Giant Sequoia National Monument
Hydrology Report

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Contents

Introduction

The hydrology report for the Giant Sequoia National Monument (Monument) is organized by Affected Environment, Environmental Effects, Management Strategy, and References. The Affected Environment provides information on beneficial uses, Stream Condition Inventory (SCI) (Frazer et al. 2005), aquatic management indicator species (MIS) site condition (Hawkins et al. 2000; EPA 2006; Rehn 2009), descriptions of riparian ecotypes (Kaplan-Henry 2000), and past and present effects.

The Affected Environment is organized in hierarchal manner using fourth- field watersheds as the largest unit. Fifth, sixth, and seventh-field watersheds are nested within the fourth-field HUC (1) for example, the Upper Tule River basin (fourth-field HUC), contains three 5th-field HUC watersheds: North Fork, South Fork, and Middle Fork of the Tule River. Fifth-field HUC watersheds are further subdivided into 6th-field HUC watersheds, which are divided further into seventh-field HUC watersheds.

This report provides a watershed analysis for the watersheds within the Monument commensurate with direction in the Sierra Nevada Plan Amendment FEIS, Volume 4, Appendix T-4. G general characteristics, special watershed basin conditions, and summary of information found in smaller watersheds are included. The fifth-field HUC watershed description details watershed characteristics and studies/surveys in the seventh-field HUC. Seventh-field HUC provides site specific detailed information to individual streams and the results of inventories and studies. Sixth-field HUC watershed is used as a planning tool for the Cumulative Watershed Effects Analysis in the Effects of Alternatives.

Affected Environment

A watershed analysis has been performed for watersheds associated with the Monument. This analysis complies with management direction in the 2001 and 2004 Sierra Nevada Forest Plan Amendments (SNFPA) and serves as landscape analysis, which will assist the forest in identification of new projects providing definition of existing conditions (USDA Forest Service 2001, 2004). Additionally, landscape analysis provides the basis for adjustment of the SNFPA Riparian Conservation Objectives (RCOs) and is commensurate with local conditions in Monument watersheds. The watershed/landscape analysis provides science-based information regarding the existing condition of watershed level ecosystems as well as the impacts of past, current, and reasonably foreseeable future management activities. The following descriptions provide characterization of the watersheds affected by the Giant Sequoia National Monument plan.

The California State Water Resources Control Board, U.S. Department of Agriculture, U.S. Environmental Protection Agency, and the U.S. Department of Agriculture, Natural Resources Conservation Service conducted a Unified Watershed Assessment (UWA) in accordance with the Federal Clean Water Action Plan (CWAP) (US Environmental Protection Agency 1998). The purpose of the UWA was to identify those

[1] Hydrologic Unit Codes (HUC) was designated by the United States Geological Service (USGS) in conjunction with other agencies. HUCs are a standardized watershed classification system.

watersheds with the most critical water quality needs and to help guide resources toward correcting identified problems. Information from this analysis has been incorporated into the Watershed Analysis for the Monument. The Unified Watershed Assessment was performed at the Basin or fourth-field HUC watershed level.

The Sierra Nevada Forest Plan Amendment Record of Decision (2001 and 2004 SNFPA ROD) provides the directive for the use of Regional Stream Condition Inventory (SCI) protocol to assess and document aquatic conditions. Additionally, SCI meets Forest requirements under the Clean Water Act to monitor the effectiveness of the Best Management Practices (BMPs) within a watershed to evaluate downstream water quality protection and meets in-channel monitoring requirements under the Region -Five Best Management Practices Effectiveness Evaluation Program (BMPEP).

SCI attributes and protocols are designed to measure stream condition characteristics at a specific time and place. SCI consists of established and proven stream assessment techniques. SCI is designed so reliable and repeatable measurements can be made to detect change. SCI is primarily designed for use on perennial streams with gradients up to about 10 percent that can be successfully waded. The Sequoia National Forest uses SCI to document stream characteristics and determine a range of natural variability for the watersheds. A summary of all the SCI sites within the Giant Sequoia National Monument can be found in Appendix D.

Meadows were surveyed and stability condition documented. Meadow conditions are defined as functioning, functioning at risk, or impaired functioning. These ratings are summarized by northern Monument and southern Monument. A summary and explanation of meadow condition can be found in Appendix E of this report.

Stream channel inventory in the vicinity of giant sequoia groves has occurred commensurate with past inventory needs. As a result, not all Potential Zones of Influence (ZOI) for all groves have been "fine tuned" based on existing riparian ecotype or channel type. Identification of the nearest stable stream channel downstream of giant sequoia groves may be desired to refine the (ZOI) associated with a specific grove. The potential for head-ward movement is the main concern associated with defining the downstream boundary of the zone of influence. The potential is highest in riparian ecotypes identified as Unstable-Sensitive-Degraded, landslide prone Naturally-Unstable ecotypes, and delicate Stable-Sensitive ecotypes (Kaplan-Henry, 2007). Therefore terminating the hydrologic zone of influence in these areas would not provide protection from head-ward erosional processes. Similarly, if the channel has not been surveyed and the stability of the stream course is unknown it is difficult to define an area of potential influence. It is assumed that Naturally-Stable channels have a very low potential for head-ward movement upstream. Based on these assumptions two conditions were identified in North et.al, (2002) and recommendations for assigning the lower ZOI boundary are as follows:

1) When riparian ecotype is unknown, the zone is terminated at the nearest confluence with the next major stream or at the first Naturally-Stable ecotype below the grove location depending on whichever is closer.
2) When riparian ecotype is known, the zone is terminated at the first Naturally-Stable ecotype below the grove location.

It is expected that stream channels where downstream riparian ecotype is unknown would eventually be surveyed and assigned an ecotype when it is considered necessary for management. If it is considered necessary downstream riparian ecotypes could be identified and the ZOI refined. The need to survey the downstream extent of a ZOI would be based on need and a desire to refine the lower boundary. In the absence of this information a conservative and larger ZOI is employed for grove protection. Grove watersheds are prioritized herein for inventory based on the extent of past surveys. The extent of stream stability inventory necessary to refine the downstream extent of the ZOI can be found in Appendix D of this report.

Benthic or bottom-dwelling macroinvertebrates (BMI) are the aquatic Management Indicator Species (MIS) for riverine or flowing water habitats on the Giant Sequoia National Monument. BMI are appropriate as aquatic MIS because they are sensitive to changes in water quality (Hawkins et al. 2000; EPA 2006; Rehn 2009). Aquatic factors of particular importance that determine the composition of aquatic communities are magnitude and timing of flow, substrate size and composition, water chemistry and temperature, bank stability, and riparian conditions. Since MIS standards direct the Forest Service to cooperate with State fish and wildlife agencies, standard operating procedures from the State's Surface Water Ambient Monitoring Program (Ode 2007) were employed.

Bioassessment samples were collected as part of standard Stream Condition Inventory or SCI monitoring (Frazier et al. 2005). Aquatic insects are collected as part of SCI monitoring. After collection collected samples are sent to University of Utah, Logan for identification and classification. Aquatic insect reports are used as the basis for this analysis. (Vinson, 2006a, 2006b, USDI Bureaus of Land Management, 2008, Miller, 2008, Miller and Judson 2010, 2011) The 85 aquatic MIS or macroinvertebrate samples from 1992 to 2009 utilized for this analysis are presented in the following Table 1. Map 1 shows the distribution of sites; 32 percent of the areas sampled are located in southern monument lands from Middle Fork of the Kern River watershed (5th-field HUC 1803000105) and 14 percent of the areas sampled are from Upper Poso and NFMF Tule River (5th-field HUC 1803000401 and 1803000602). Thirty-nine percent sample sites came from northern monument lands, specifically 20% Mill Flat watershed (1803001007), 9% Lower South Fork Kings River (1803001003 [2]), 4% Mill Creek Watershed (1803000801 [3]), and 5% Upper North Fork Kaweah (1803000703 [4]).

Site conditions were evaluated using the Hilsenhoff Biotic Index (HBI) which evaluates sites based on presence of organic pollution. Stream Bioassessment Surveys screened the pool of candidate metrics using a series of tests. HBI has been shown to be responsive to disturbance over a broad geographic range (i.e. the western states by Stoddard et al. 2005); it is permissible to use the HBI scores to evaluate water quality for Giant Sequoia National Monument streams (Furnish 2011, personnel communication).

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[2] Watershed notations have been changed since the 2001 SNFPA provided HUC 5 designations. Lower South Fork Kings River has a new HUC5 notation of 1803001004

[3] Watershed notations have been changed since the 2001 SNFPA provided HUC 5 designations. Mill Creek Watershed has a new HUC5 notation of 1803001201.

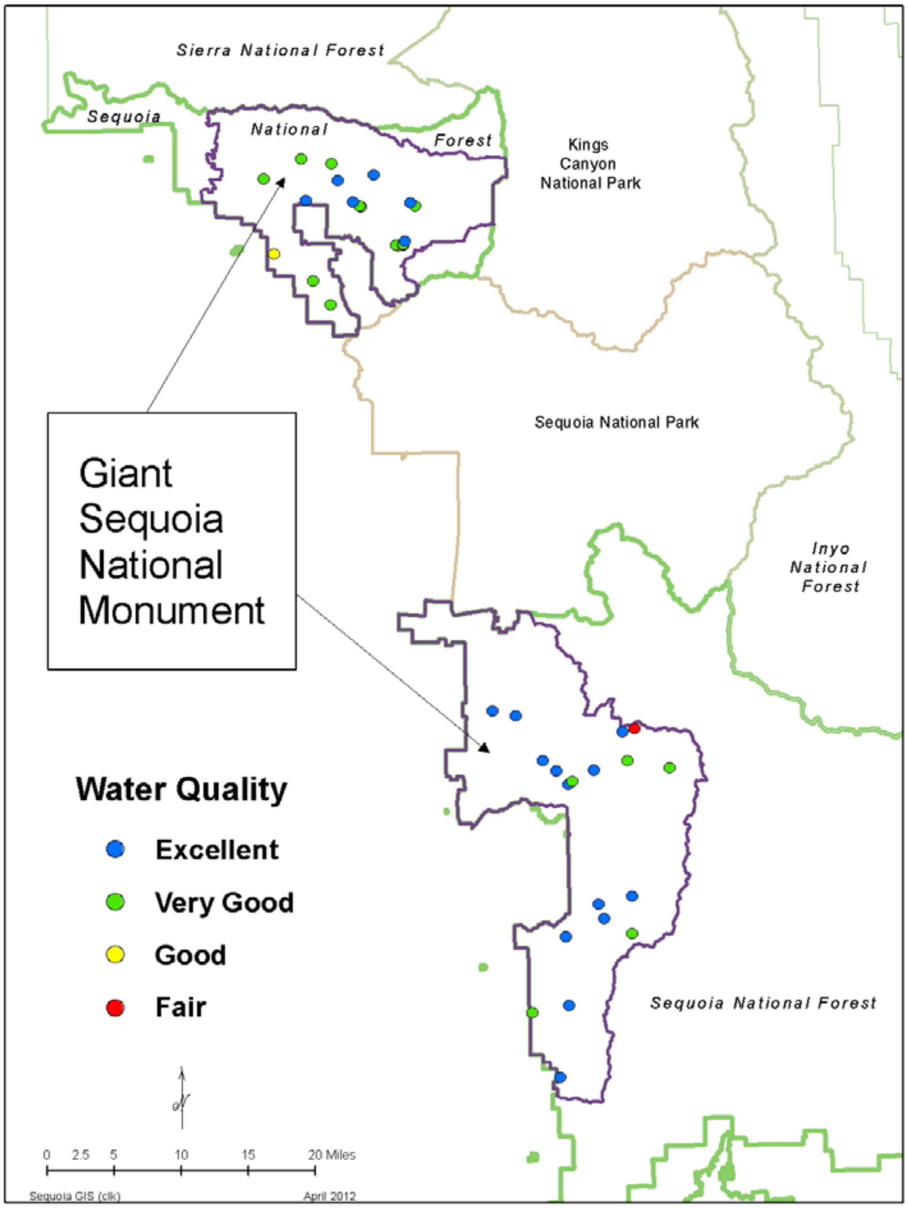
[4] Watershed notations have been changed since the 2001 SNFPA provided HUC 5 designations. Upper North Fork Kaweah River has a new HUC5 notation of 1803000703

[4] Zimmerman, M. C. 1993, The use of the biotic index as an indication of water quality, Pages 85-98, *in* Tested studies for laboratory teaching, Volume 5 (C.A. Goldman, P.L.Hauta, M.A., O'Donnell, S.E. Andrews, and R. van der Heiden, Editors), proceedings of the 5th Workshop/Conference, of the Association for Biology Laboratory Education (ABLE), 115 pages, http://www.ableweb.org/volumes/vol-5/6-zimmerman.pdf

(Table 1) Monument–wide: 46 or 54% of sites were in excellent condition, 29 or 34% were in very good condition, 7 or 8% were in good condition and 3 or 4% were in fair condition. (Figure 1) Thirty-three sites were evaluated in the Northern Monument: 15 or 45% were in excellent condition, 15 or 45% were in very good condition, 2 or 6% were in good condition and 1 or 3% were in fair condition (Figure 2). Fifty-two sites were evaluated in the Southern Monument: 31 or 60% were in excellent condition, 14 or 27% were in very good condition, 5 or 10% were in good condition and 2 or 5% were in fair condition. (Figure 3)

Table 1: Biotic Index Water Quality Degree of Organic Pollution

Biotic Index	**Water Quality**	**Degree of Organic Pollution**
0.00-3.50	Excellent	No Apparent Organic Pollution
3.51-4.50	Very Good	Possible Slight Organic Pollution
4.51-5.50	Good	Some Organic Pollution
5.51-6.50	Fair	Fairly Significant Organ Pollution
6.51-7.50	Fairly Poor	Significant Organic Pollution
7.51-8.50	Poor	Very Significant Organic Pollution
8.51-10.0	Very Poor	Severe Organic Pollution



Map 1. Distribution of 81 aquatic Management Indicator Species (MIS) sites collected in the Giant Sequoia National Monument from 1992 to 2009.

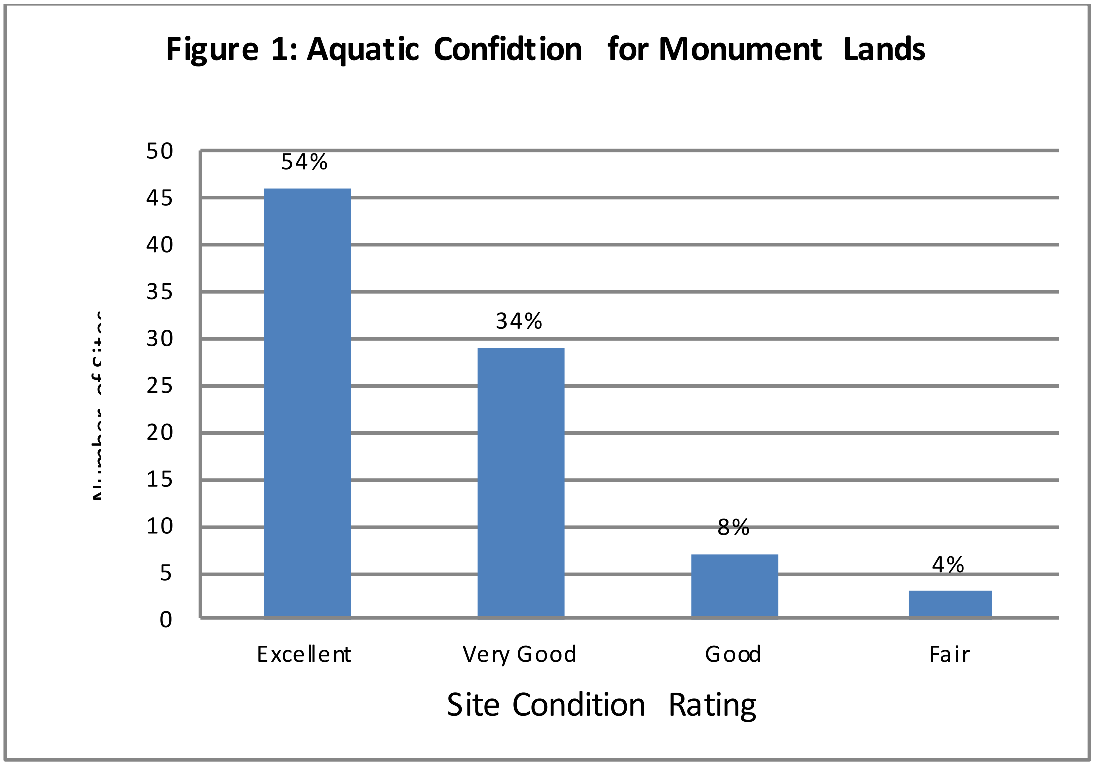


Figure 1: Distributution of site condition scores for 84 sites sampled from 1992-2009 in the Giant Sequoia National Monument.

Stream Name[5]	6th-field HUC Code[6]	Sample Date	Hilsenhoff Biotic Index	Site Condition
Abbot Creek*	180300100703	7/27/2005	1.86	Excellent
Abbot Creek*	180300100703	8/8/2009	2.72	Excellent
Bear Creek*	180300040102	6/27/2006	1.74	Excellent
Bear Creek*	180300060203	6/2/2007	3.13	Excellent
Bear creek near CCC	180300060203	7/2/2007	2.99	Excellent
Bear Creek near Coy Flat	180300060101	6/16/2008	4.06	Very Good
Bear Creek near Scion	180300060203	8/2/2006	3.36	Excellent
Bear Skin Creek*	180300100701	7/24/2003	2.9	Excellent

[5] *means site was sampled more than once in separate years

[6] Using 2010 WCATT 6th Field Notation

Bear Skin Creek*	180300100701	7/7/2004	3.67	Very Good
Big Meadow Creek, Pond 3	180300100404	9/19/2008	5.84	Fair
Big Meadows Creek, Reach B1	180300100404	7/15/2004	3.45	Excellent
Big Meadows Creek, Reach B2A	180300100404	7/18/2004	4.42	Very Good
Big Meadows Creek, Reach D	180300100404	7/11/2004	4.74	Excellent
Big Meadows Creek, Reach ESF	180300100404	7/13/2004	4.35	Very Good
Bone Creek	180300010503	7/27/2009	2.47	Excellent
Boulder Creek (Deep Meadow)	180300100404	6/2/2006	4	Very Good
Clicks Creek	180300010303	7/3/2007	2.63	Excellent
Converse Creek*	180300100702	7/18/2005	4.02	Very Good
Converse Creek*	180300100702	7/23/2007	4.22	Very Good
Deer at Deer Creek	180300050102	6/21/2010	2.73	Excellent
Deer Creek*	180300050102	7/19/2006	2.79	Excellent
Deer Creek*	180300100504	7/24/2007	3.65	Very Good
Deer Creek*	180300050201	6/7/2010	4.09	Very Good
Dry Meadow Creek	180300010503	6/30/2004	5.47	Good
Eshom Creek*	180300070304	7/22/2003	3.57	Very Good
Eshom Creek*	180300070304	7/8/2010	3.72	Very Good
Fish Creek*	180300010303	9/2/2003	3.74	Very Good
Fish Creek*	180300010303	8/1/2005	4.7	Good
Fish Creek*	180300010303	7/13/2007	4.93	Good
Freeman Creek*	180300010501	6/23/2008	3.15	Excellent
Freeman Creek*	180300010501	7/27/2009	3.75	Very Good
Holby Creek*	180300010502	10/7/1992	0.67	Very Good
Holby Creek*	180300010502	8/30/1993	0.95	Excellent
Holby Creek*	180300010502	8/30/1993	1.72	Excellent

Holby Creek*	180300010502	10/27/1994	2.63	Excellent
Holby Creek*	180300010502	10/27/1994	2.67	Excellent
Holby Creek*	180300010502	10/10/1995	4.37	Very Good
Holby Creek*	180300010502	10/10/1995	4.76	Good
Holby Creek*	180300010502	10/15/1996	5.17	Good
Holby Creek*	180300010502	10/15/1996	5.58	Excellent
Little Boulder Creek*	180300100404	8/6/2003	3.49	Excellent
Little Boulder Creek*	180300100404	7/7/2004	4.01	Very Good
Little Poso Creek*	180300040101	8/26/2003	1.67	Excellent
Little Poso Creek*	180300040101	7/5/2005	3.03	Excellent
Little Poso Creek*	180300040101	6/19/2006	3.26	Excellent
Little Poso Creek*	180300040101	7/18/2008	3.77	Very Good
Little Poso Creek*	180300040101	8/3/2010	3.97	Very Good
Loggy Meadow	180300010303	6/25/2007	6	Fair
Long Meadow Creek*	180300100701	7/6/2004	2.66	Excellent
Long Meadow Creek*	180300010503	8/3/2009	2.88	Excellent
Lower Spears	180300040101	7/6/2006	3.39	Excellent
Mill Creek*	180300120101	8/3/2004	3.07	Excellent
Mill Creek*	180300120101	5/25/2006	3.32	Excellent
Mill Creek*	180300120101	8/6/2008	5.02	Good
Mill Flat Creek*	180300100703	7/15/2003	3.47	Excellent
Mill Flat Creek*	180300100703	7/19/2005	3.5	Excellent
Mill Flat Creek*	180300100703	7/25/2007	3.86	Very Good
Moorehouse Creek*	180300060101	8/30/2005	0.9	Excellent
Moorehouse Creek*	180300060101	6/10/2009	0.92	Excellent
Nobe Young Creek	180300010503	6/14/2010	3.03	Excellent

North Fork of Middle Fork of Camp Wilson	180300060102	7/18/2006	3.38	Excellent
Parker Meadow Creek	180300010504	8/7/2003	3.08	Excellent
Peppermint Creek*	180300010502	10/7/1992	1.04	Excellent
Peppermint Creek*	180300010502	10/7/1992	1.92	Excellent
Peppermint Creek*	180300010502	8/30/1993	2.15	Excellent
Peppermint Creek*	180300010502	9/3/1993	2.24	Excellent
Peppermint Creek*	180300010502	9/3/1993	2.98	Excellent
Peppermint Creek*	180300010502	11/4/1994	3.83	Very Good
Peppermint Creek*	180300010502	11/4/1994	3.87	Very Good
Peppermint Creek*	180300010502	10/15/1996	4.25	Very Good
Peppermint Creek*	180300010502	10/15/1996	4.37	Very Good
Pierce Creek*	180300070302	6/5/2008	3.75	Very Good
Pierce Creek*	180300070304	6/23/2010	4.23	Very Good
Portugese Meadow Creek	180300040102	6/21/2004	2.79	Excellent
Princess Creek	180300100701	5/9/2008	4.19	Very Good
Sampson Creek*	180300100703	7/28/2003	2.18	Excellent
Sampson Creek*	180300100703	7/15/2010	2.2	Excellent
South Creek	180300010504	6/24/2008	4.19	Very Good
Ten Mile Creek*	180300100701	7/13/2005	3.62	Very Good
Ten Mile Creek*	180300100701	7/24/2007	4.05	Very Good
Ten Mile Creek*	180300100701	7/21/2009	4.4	Very Good
Tornado Creek	180300100701	7/23/2009	3.41	Excellent
Tule River at Belknap Campground	180300030101	7/17/2006	2.95	Excellent
Unknown tributary to Woodward Creek	180300010503	7/18/2005	3.24	Excellent
Wilson Creek	180300060101	7/31/2006	2.28	Excellent

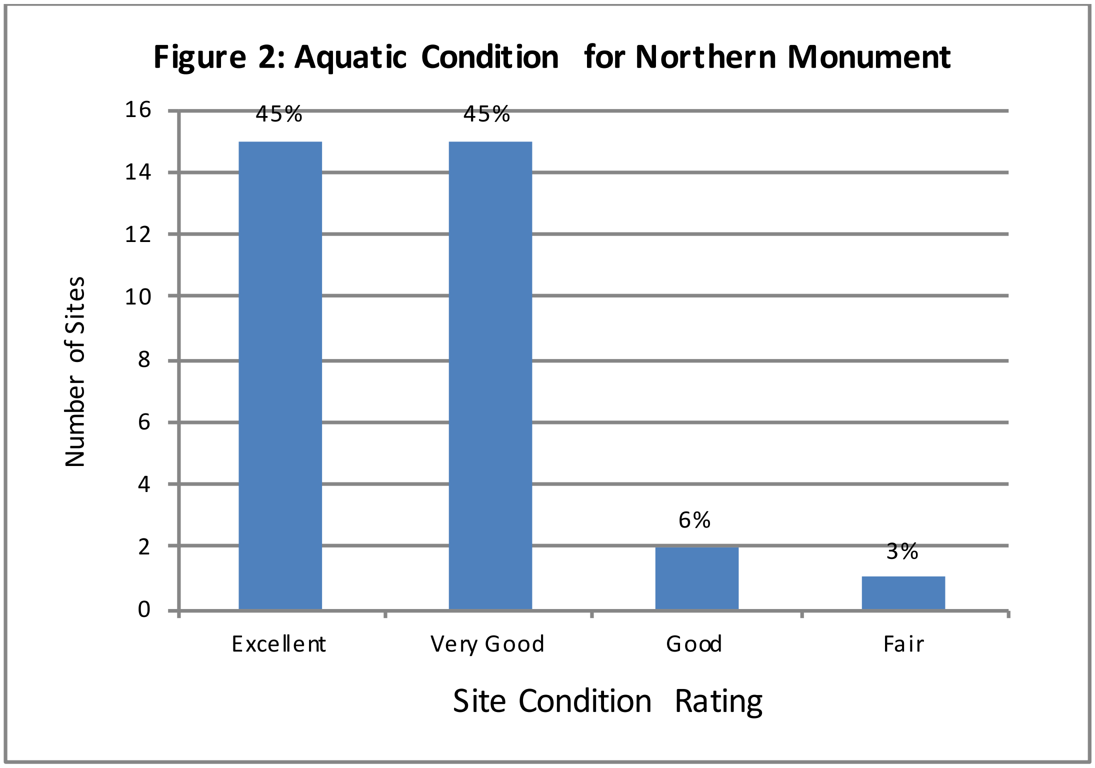


Figure 2: Distributution of site condition scores for 31 sites sampled from 1992-2009 in the Northern Giant Sequoia National Monument.

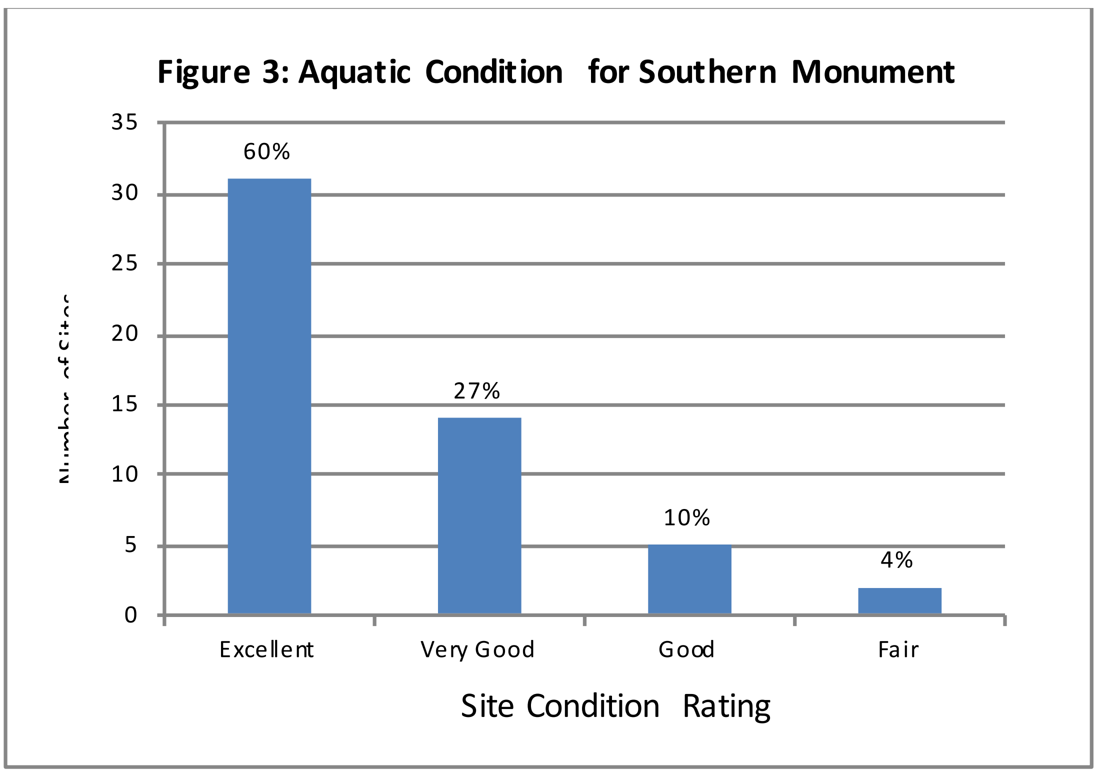


Figure 3: Distributution of site condition scores for 53 sites sampled from 1992-2009 in the Southern Giant Sequoia National Monument.

Characterization of Monument Watersheds

Waters from Monument lands flow into the Tulare lakebed. The Tulare lakebed is located in the southern San Joaquin Valley about equidistant from the cities of Fresno and Bakersfield. Historically, the Tulare lakebed received runoff from the Tule, Kaweah, Kern, and Kings Rivers, as well as other tributaries in these basins. The lakebed was comprised of the Tulare and Buena Vista Lakes and made up the largest inland body of water west of the Mississippi River (Atwater et al. 1986). Because the lakebed lacked an outlet to the sea, it acted as a sink in most years. In 1862 and 1868, the wettest years on record, Tulare Lake encompassed 790 square miles (ECORPS Consulting Inc. 2007). During those wet periods of large-scale flooding, floodwaters reached the outlet to the Sacramento-San Joaquin River Delta.

Mark Reisner (1993) writes about the Tulare lakebed and the politics associated with reclamation in his book Cadillac Desert. He describes the lake as a phantom that appears and disappears every year; filling during wet winters and evaporating quickly under the glaring summer sun. According to this author the lake was huge and often grew larger than Lake Tahoe with a shoreline that could grow or shrink by miles. The lake was a stopover for millions of migrating ducks, geese and sandhill cranes.

In the late 1800s and early 1900s, reclamation districts were formed to prevent flooding in the lakebed allowing agricultural production to begin. Tulare lakebed as currently defined encompasses from 200,000 to 250,000 acres. The lakebed is extensively farmed in crops such as cotton, barley, wheat, safflower, and alfalfa seed, as well as others. Flooding is controlled by dams and diversions upstream on the Tule, Kaweah, Kern, and Kings Rivers, and by flood control features such as detention basins, levees, and pumps within the lakebed (U.S. Army Corps of Engineers 1999).

There are 14 watersheds that are at least partially within the Monument. The Lower South Fork Kings River and Mill Flat Creek watersheds contain the Kings River Special Management area and are shared by the Sequoia and Sierra National Forests. The Mill Flat Creek, the Upper North Fork Kaweah River, and the Upper Dry Creek watersheds are shared with Sequoia and Kings Canyon National Parks. The South Fork Tule River watershed is shared with the Tule River Indian Reservation. The North Fork Tule River and the Middle Fork Tule River watersheds are shared with Mountain Home State Forest. The Middle Fork Tule River is the only watershed that is completely located within the Monument. Table 2 displays basins and watersheds associated with the Monument.

Table 2- River Basins and Watersheds Associated with the Monument

River Basin	Watershed	Ranger District[7]	HUC8[(5)]	Acres within the Monument	SQF Watershed Acres
Upper Kings	Lower South Fork Kings River	HL	1803001003	35,470	57,890
	Mill Flat Creek	HL	1803001005	64,795	73,175
Upper Kaweah	Upper North Fork Kaweah River	HL	1803000704	16,175	19,195

[7] HL = Hume Lake, WD = Western Divide, and KR = Kern River

[8] HUC6 = 6th field hydrologic unit code or watershed as defined in SNFPA 2001.

	South Fork Kaweah River9	WD	1803000705	3,115	3,115
	Lower Kaweah2	HL	1803000706	5,190	5,215
Mill	Mill Creek	HL	1803000801	8,015	12,160
Upper Kern	Middle Kern River	WD	1803000105	73,395	200,895
	Little Kern River	WD	1803000104	4,500	81,244
Upper Tule	Middle Fork Tule River	WD	1803000601	66,255	67,120
	North Fork Tule River	WD	1803000602	30,475	30,500
	South Fork Tule River	WD	1803000603	8,920	10,400
Upper Deer-Upper White	Upper White River	WD	1803000501	6,435	6,450
	Upper Deer Creek	WD	1803000502	25,935	25,965
Upper Poso	Upper Poso	WD/KR	1803000401	7,935	38,130

Table 3 displays beneficial uses existing within watersheds of the Monument. Beneficial uses are documented in the State Water Quality Control Tulare Lake Basin Plan and consist of designated uses to be protected, water quality objectives to protect uses, and a program of implementation needed for achieving the objectives. Beneficial uses, together with water quality objectives and the anti-degradation policy, meet federal regulatory criteria for water quality standards. Therefore, the protection of beneficial uses of water constitutes compliance with state water quality standards. According to the Water Quality Control Plan for the Tulare Lake Basin (California Regional Water Quality Control Board 2004), all water-related problems can be stated in terms of whether there is water of sufficient quantity and quality to protect or enhance beneficial uses.

Table 3 - Beneficial Uses Associated with Monument Watersheds

Watershed	**HUC 5#**[1]	**Beneficial Uses**												
		Mun	**Agr**	**Pow**	**Rec 1**	**Rec 2**	**Wrm**	**Cold**	**Wild**	**Rare**	**Spwn**	**Grnd**	**Ind**	**Fresh**
Lower South Fork Kings River	1803001003	X			X	X		X	X	X[(2)]	X		X	X
Mill Flat Creek	1803001005	X	X		X	X	X	X	X	X[(3)]	X			X
Upper North Fork Kaweah River	1803000704	X		X	X	X		X	X	X[(4)]	X			X
South Fork Kaweah River	1803000705	X		X	X	X		X	X	X[(4)]	X			X
Upper Dry Creek	1803000706	X		X	X	X		X	X	X[(4)]	X			X
Mill Creek	1803000801		X		X	X		X	X		X	X		X
Middle Kern River	1803000105	X			X	X		X	X	X[(5)]	X		X	X
Little Kern River	1803000104	X			X	X		X	X	X[(6)]	X			X
Middle Fork Tule River	1803000601	X	X		X	X	X	X	X	X[(7)]	X			X
North Fork Tule River	1803000602	X	X	X	X	X	X	X	X	X[(7)]	X			X
South Fork Tule River	1803000603	X	X		X	X	X	X	X	X[(7)]	X			X

[9] These watersheds are less than 10 percent national forest system lands or are less than 10,000 acres. These watersheds were excluded from analysis under the Framework. Those watersheds less than 20,000 acres may have been included with a larger neighboring watershed for analysis.

Upper White River	1803000501	X	X		X	X		X	X	X[7]	X	X		
Upper Deer Creek	1803000502	X	X		X	X		X	X	X[7]	X	X		
Upper Poso	1803000401	X	X		X	X		X	X	X[7]	X	X	X	X

Agr – Agriculture
Cold – Coldwater Fishery
Warm – Warmwater Fishery
Rec 1 – Contact Water Recreation
Rare – Rare, Threatened or Endangered Species
Mun – Municipal
Grnd – Groundwater Recharge
Fresh – Fresh water
Rec 2 – Non-contact Water Recreation
Spwn – Fish Spawning
Wild – Wildlife
Ind – Industrial
Pow – Hydropower Generation

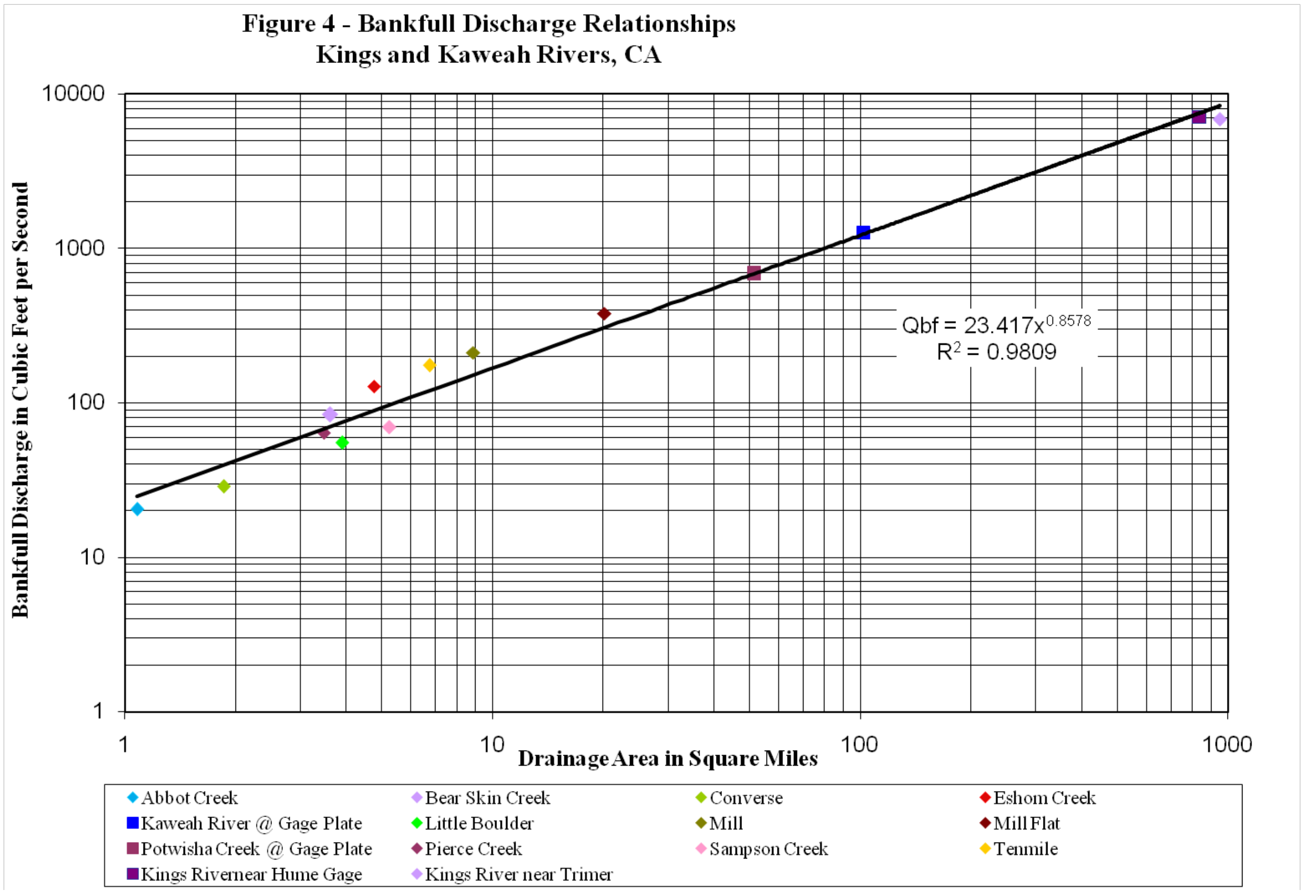
1. HUC5 = 5th field hydrologic unit code or watershed as defined in SNFPA 2001.
2. Western pond turtle, mountain yellow-legged frogs, and willow flycatcher
3. Hardhead minnow, western pond turtle, foothill and mountain yellow-legged frogs, California red-legged frogs, western pond turtles, and willow flycatchers
4. Western pond turtle, foothill and mountain yellow-legged frogs, California red-legged frogs, western pond turtles, and willow flycatchers
5. Kern Canyon slender salamander, mountain and foothill yellow-legged frog, western pond turtle, willow flycatcher, and Kern River rainbow trout
6. Little Kern Golden Trout, mountain and foothill yellow-legged frog, and relictual slender salamander
7. Western pond turtle, mountain and foothill yellow-legged frog, relictual slender salamander, and legless lizard

The Monument contains California State appropriative water rights. These are a combination of riparian and federal reserved rights. Primary use is for domestic purposes; other uses include agricultural, mining, fire protection, dust control, and frost protection. The Monument would not affect existing water rights which will be maintained to state and federal laws and regulations (a list of current water rights and uses are available upon request.)

Climate

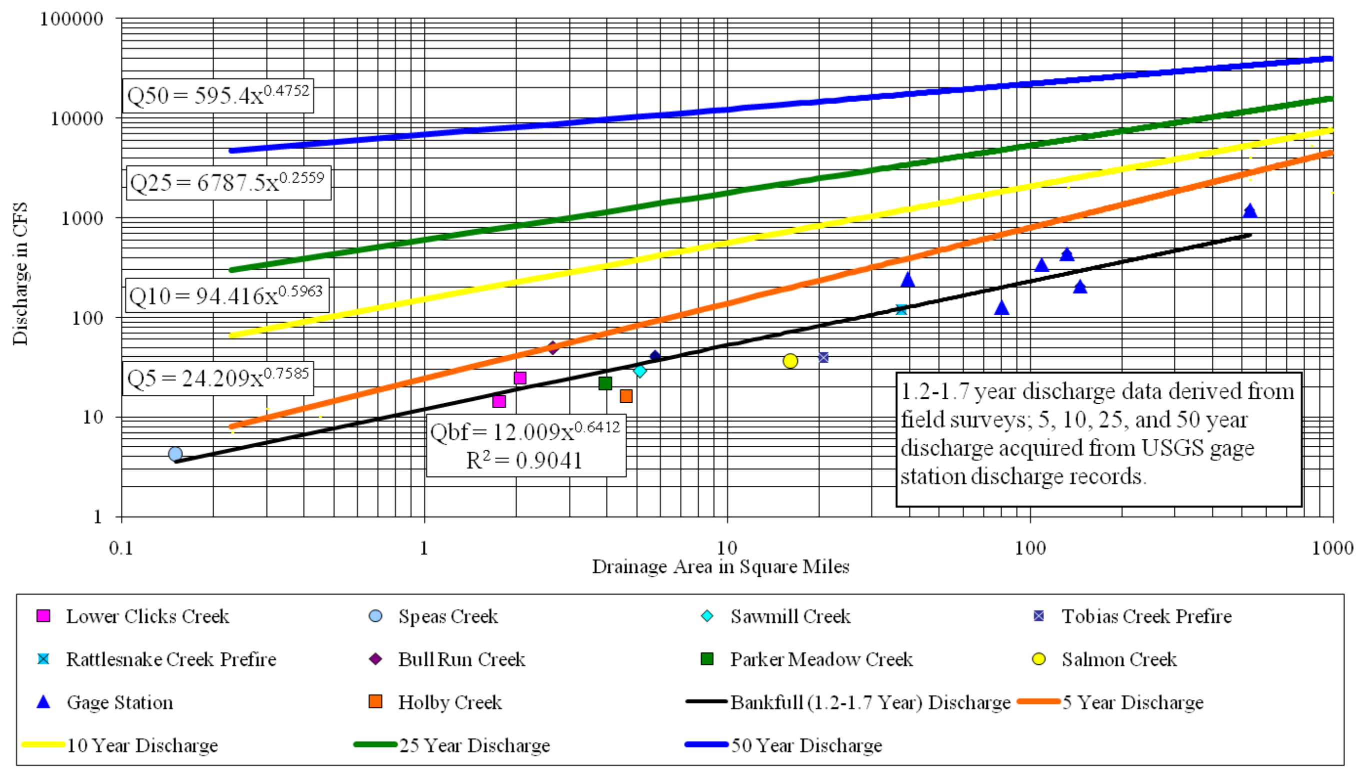
The climate is fairly typical Mediterranean with distinct wet and dry seasons. Tree ring studies of sequoias have shown that the last century is one of the wettest on record. Long-term climatic change studies are ongoing through the University of Arizona Tree Ring Lab. Precipitation seems to be the controlling factor in terms of meteorology; though heating and winds play a role in characterizing this area. The intensity, duration and timing of precipitation have the most substantial effect on the area. Annual precipitation ranges from 25 to 50 inches with most accumulation as snow in December through March. Snow accumulation averages 100 to 300 inches dependent in part on elevation. Snow accumulates from approximately 4,000 feet in elevation and above; then it will fall and stick at lower elevations for one to several days. Substantial rain-on-snow events occur approximately at 10-20 year intervals in the south to 20-30 year intervals in the north. Late summer thunderstorms with intense rainfall for short duration often cause heavy erosion on potentially hydrophobic soils, due, in part, to dry conditions. In addition, summer thunderstorms associated with lightning, are a major source of wildfire ignition. Rainfall at lower elevations is less than at higher elevations due to adiabatic effect. Lower elevations are subject to thick fog layers from November through January affecting air quality at lower elevations more so than at higher elevations due to inversion.

The most recent event in the Kings River watershed occurred on January 1, 1997 with 6,247 acre-feet/day flowing into Pine Flat Reservoir, and by January 2, 1997 the maximum was 32,821 acre-feet/day (a rise of 525 %). Air temperature ranges from winter highs of 20-40 oF (-6.6 to 4.4 ºC) to summer highs of 88 to 96 oF (31 to 35.5 ºC) as recorded by the Remote Access Weather Stations (RAWS) on Park Ridge and Cedar Grove. Afternoon canyon winds range from 2 to 10 mph. Heat and wind increase the evaporation rates, which results in relative humidity down to 15-25 percent in late summer. Regional physiographic relationships have been evaluated from 2001 to present. Discharge relationships for the Kings and Kaweah Rivers (Wright 2008) are provided in Figure 4. These discharge relationships are updated as new data become available.



Annual precipitation in the Upper Kern River watershed over the last five years ranged from 15 to 45 inches. Most occurs in the form of rain from January-March, and results in an annual average snow pack of approximately three feet at higher elevations of the watershed. Peak flows for the North Fork Kern River occur in April, May, and June with historic flows being highest in May. Monthly stream flow ranges from 17 to 600 cfs with a mean annual flow of 329 cfs. Recorded peak flows ranged from 22,000 cfs in 1963 to 60,000 cfs in 1969, substantial rain-on-snow events occur roughly on a10-20 year cycle. Major floods occurred in 1951, 1956, 1963, 1967, 1969, 1980, 1982, and 1996. Ambient summer temperatures recorded at District weather stations range from 60-90 oF (15.5 to 32.2 oC) and winter temperatures from 35-70 oF (1.6 to 21.1 oC). Regional physiographic relationships have been evaluated from 2001 to present. Discharge relationships for the Kern River (Kaplan Henry 2004) are provided in Figure 5. These discharge relationships are updated as new data become available.

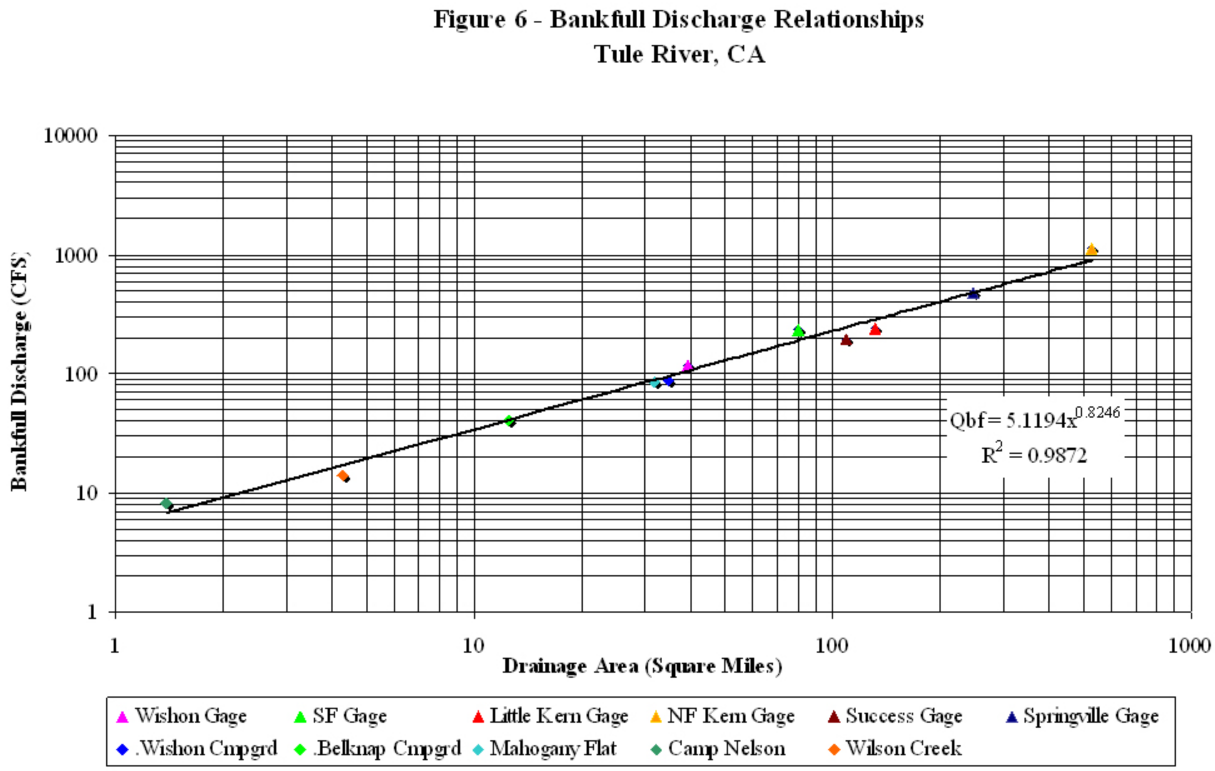
Figure 5 - Local Kern River Hydrologic Physiographic Discharge Relationships
Bankfull, 5-Year, 10-Year, 25-Year and 50-Year Recurrence Interval



Poso Creek, White River and Upper Deer Creek all have similar climate. Monthly stream flow ranges from 0.86 to 33 cfs with a mean annual flow of 6.85 cfs. Peak flow for Deer Creek occurs in March, April and May with historic flows being highest in April. Rain-on-snow events are cyclic that may have short-term impacts depending on severity. Ambient summer temperatures recorded at District weather stations range from 50-102 degrees F and winter temperatures from 35-60 degrees F.

The North, Middle, and South Forks of the Tule River have similar meteorology with annual precipitation from 21 to 61 inches. The highest runoff period for Middle Fork Tule River occurs in March, April and May. For the period of record 1978-1993, average daily flows during October-May period, recorded at a gage station adjacent to Lower Coffee Camp, has ranged from 16 cfs (October) to 217 cfs (May). Average daily flow during the June-September period has ranged from 17 cfs (September) to 148 cfs (June). Maximum flows are as high as 6,120 cfs. Peak flows for the North Fork Tule River occur in March, April and May, historic flows being highest in April. Peak flows for South Fork Tule River occur in February, March and April historic flows are highest in March. Substantial rain-on-snow events occur on a 15-20 year cycle. Major floods occurred in 1950, 1955, 1966, 1969, 1980, 1982, and 1996 and have had substantial short-term impacts on the watershed, resulting in incidences of mass wasting, and loss of riparian vegetation. Ambient summer temperatures recorded at RAWS stations range from 60-90+ ºF (15.5 to 32.2 ºC), with winter temperatures ranging from 35-70 ºF (1.6 to 21.1 ºC). Regional physiographic relationships have been evaluated from 2001 to present. Discharge relationships for the

Tule River (Stewart 2006) are provided in Figure 6. These discharge relationships are updated as new data become available.



Changes in the Modern Climate Regime

Changes in climate affect intensity and duration of storm events, snow and rain patterns, evapotranspiration, flooding, and annual runoff (Goudie 2006). The Sequoia National Forest including the Monument has experienced periods of higher than usual snow, rain-on-snow, flooding, and drought during the period of record documented at stream gage and weather stations and during the 3,000+ year time frame of the giant sequoias.

Historical reports of climatic changes on hydrologic resources have been observed from past erosion and deposition events. These events have been documented by observing stratagraphic evidence within river systems. Evidence suggests cycles of erosion and deposition occurring in both wet and dry climatic conditions for hundreds to thousands of years (Dunne and Leopold 1978). More recently, within the last 130 years, a widespread erosional event, occurring in the late 19th century, has been associated with a combination of climatic factors, specifically intense summer thunder storms. This led to widespread widening of channels documented from Montana to Mexico (Leopold 1951). The mid 20th century shows deposition in these widened eroded channels indicating a shift toward cooler and wetter conditions (Dunne and Leopold 1978). Dunne and Leopold (1978) describe visual evidence of barren channel bottoms void of vegetation in the 1940s that became green and lush in the 1970s suggesting shifting climatic conditions. Climate cycles have been ongoing for thousands of years and hydrologic systems have and will continue to adjust to accommodate climatic changes.

The effect of global climate change on hydrologic resources can be documented in storm return intervals and associated peak flow discharge records. Changes in peak flow discharge and frequency would result in changes in the bankfull discharge and channel geometry relationships in Monument lands. Bankfull discharge is synonymous with affected discharge and maintenance flow. This flow is responsible for existing channel conditions relative to riparian vegetation, channel morphology and sediment discharge. Rosgen (1996) states, "The bankfull stage and its attendant discharge serve as consistent morphological index[s] which can be related to the formation, maintenance, and dimension of the channel as it exist under the modern climatic regime." Currently, the baseline measurements for Monument hydrologic information relative to stream systems are made relative to the bankfull stage. Substantial changes in climate and resultant storm peak flows could affect the viability of existing relationships. However, changes in the modern climatic regime would be difficult to detect in the short term as a hydrologic period of record of a minimum of 10 years would be necessary before changes could be inferred. Additionally the timing of climate change is important since forest relationships documented in the past ten years may have begun to capture changes in the modern climatic regime.

Recent modeling by Young et al. (2009) on Sierra Nevada watersheds demonstrate possible effects of increased global temperatures on runoff. Their model was applied to several watersheds extending from the Feather River to the Kern River watershed. Temperature increases of 35.6, 39.2, or 42.8 ºF (2, 4, or 6 ºC) were modeled resulting in a shift in runoff of 2 to 6 weeks earlier in the year. Specific conclusions were drawn about the response of the Kern River to global climate change based on this study. The Kern River was shown to have a higher resistance to snow melt due to its calibrated soil water storage capacity. The study concludes shifts in runoff were non-uniformly distributed and varied from watershed to watershed.

Existing studies, models, and records suggest climate change is not continuous nor does it occur uniformly over the landscape in the Sierra Nevada. Climate change does have the potential to result in changes in the volume of storm runoff, peak discharge, erosion and sedimentation rates all of which are factors critical to channel stability and channel changes. For more discussion on climate change, see the air resources section in chapter 4 of the draft EIS.

Kings River Basin

Upper Kings River Basin

The Kings River basin is located in the southeastern part of the San Joaquin Valley; bounded on the north by the San Joaquin River and on the south by the Kaweah River. The Kings River originates high in the Sierra Nevada and flows in a southwesterly direction as it leaves the foothills and enters the San Joaquin Valley. Below Pine Flat Dam, it divides into numerous channels, which converge into a single channel, and then separates again into Kings River North and Kings River South. Kings River North flows into the San Joaquin River and Kings River South flows into Tulare Lake. The Upper Kings River contains Lower South Fork Kings and Mill Flat HUC 5 watersheds. Mill Flat is the only watershed containing a Critical Aquatic Refuge (CAR).

CARs provide habitat for native fish, amphibian and aquatic invertebrate populations. They are subwatersheds, generally ranging between 10,000 to 40,000 acres, with some as small 500 acres and some as large as 100,000 acres, that contain either: known locations of threatened, endangered, or sensitive species, highly vulnerable populations of native plant or animal species, or localized populations of rare native aquatic- or riparian-dependent plant or animal species. The desired condition and purpose of a CAR is to maintain and/or restore remnant plant and animal populations in aquatic communities while meeting State water quality stream standards.

Pine Flat Dam, completed by the Corps of Engineers in 1954 and situated about 25 miles east of Fresno, impounds Kings River flows for flood control, water conservation, recreation, and hydroelectric power generation. Pine Flat Lake has a capacity of about one million acre-feet at gross pool. Downstream of Pine Flat Dam, the Army Corps of Engineers constructed levees, channel improvements, and weirs to control flood flows (Federal Register, April 5, 1996).

The Upper Kings River Basin is rated as a Category II in the Unified Watershed Assessment. A Category II rating describes watersheds with good water quality that through regular program activities can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems.

Stream Condition Inventory sites provide information on water quality parameters for nine reaches in the Upper Kings River basin. These sites included two reaches in the Upper Kings River watershed at Big Meadows and Little Boulder Creek; and seven reaches in the Mill Flat watershed at Samson, Mill Flat, Abbott, Converse, Tenmile, Long Meadow, and Bearskin creeks. Ranges for large woody debris, shading, water temperature, and alkalinity are provided in Table 4. These values are ranges found in the basin. Additional detailed information is provided at the smaller watershed scale and provides information useful for management and monitoring direction and constraints.

Table 4 - Upper Kings River Basin	
Large Woody Debris (m^3/m)	0.005-0.91
% Shading	0-95.9
Temperature (Celsius)	12-22
pH (ppm)	6.0 – 7.4
Alkalinity ($CaCO_3$)	40-132
Mean Particle Size in mm (D50)	0.03-426.3
Width-to-depth Ratio	5.5-254
Hilsenhoff Biotic Index - Rating	Excellent (2.0) - Good (4.84)
Riparian Impact Rating	Low to Extreme
Rosgen Channel Type	B3, B4, B4a, B4c, C5, C6, E3b, F4, G4,

Aquatic insect data for the Upper Kings River basin indicated those waters sampled have water quality that ranges from excellent to good. Sampson Creek has site conditions that rank excellent; as is Abbott Creek; Big Meadows has excellent to good site conditions. Lower South Fork Kings River ranges from excellent to good aquatic site condition. Little Boulder Creek ranks as excellent to very good; Mill Flat Creek watershed at Bearskin Creek ranks excellent to very good; Tenmile Creek has very good site conditions; as does Converse Creek. Many aquatic insect samples are collected at the same site over a period of years. Aquatic MIS site condition based on biotic ratings for these watersheds is indicative high water quality. The majority of water quality biotic ratings are excellent.

Stream stability evaluations (Pfankuch 1975) provide information on channel physical conditions. Five of the fifteen indicators used in Pfankuch are selected to evaluate the function of riparian ecotypes. The five riparian indicators used for evaluation of stream impacts and channel functions are: vegetative bank cover, stream bank cutting, channel bottom deposition, channel bottom scour and deposition, and percent stable material. Channel types (Rosgen 1994) are used to separate channels that respond similarly. The majority of stability ratings fall in the low to moderate range.

Stream surface measurements of 0 to 20 percent are associated with stream reaches in meadow environments; remaining measurements are associated with step pool stream systems. The majority of percent stream surface shade are in the 61 to 80 percent range.

Large woody material is an important component of stream stability and aquatic habitat. Large woody material provides stream bank and stream bed stability. Measurements taken in the Upper Kings River basin show a range of large woody material from .009 to 0.80 meters3 per meter of stream evaluated. The lowest levels of woody debris were measured in Mill Flat and Sampson Creeks, and the highest levels of woody debris were measured in Little Boulder Creek. The majority of large woody material is in the 0.02 to 0.029 range.

Width-to-depth ratios provides information on the stability of channel conditions as a function of channel type. Width-to-depth ratios for stable B, C, and F channel types have width-to-depth ratios greater than 12+2; while stable E channels have width-to-depth ratios less than 12+2. G channels have width-to-depth ratios less than 12+2; however if a G channel has width-to-depth ratios greater than 12+2 it suggests recovery. Therefore this measurement provides information on stability as well as channel recovery.

Width-to-depth ratios for the Upper Kings River basin have been separated by channel type. Survey data suggests two sites on an E channel and four sites on B or C channels could be transitioning toward an unstable condition; while sites evaluated on an F channel (Sampson Creek) suggest it is moving towards stability as it is developing a floodplain. The G channel measurements were all taken at Big Meadows prior to restoration and show it as an active down cutting system at nine cross-sections and trending toward floodplain development at 13 cross-section locations. Most of the measurements taken in naturally-stable and stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements at those locations. Temperature ranges from data that was taken at a point during summer months is from 53 to 71 ºF (12 to 22 oC). The majority of temperatures range from 64.4 to 68 oF (18 to 20 oC). Stream shading is important to aquatic and riparian ecosystem health and function.

Water quality standards as defined by the Central Valley Water Quality Control Board (CVWQCB) provide a pH range of 6.5 to 8.3. Waters associated with pH values in excess of 8.3 needs to be evaluated to determine the cause associated with elevated pH ranges. Those waters with pH levels lower than 6.5 in monument lands appear to be associated with meadow ecosystems and urbanized areas. The majority of pH values range from 6.6 to 7.0 in this watershed basin.

Alkalinity is a measure of the amount of carbonate or bicarbonate in surface waters and is associated with the acid neutralizing capability of water. It is associated with rock type and other local conditions such as pH. The most common values are in the 21 to 40 ppm followed closely by the 41 to 60 ppm range. Values in the Upper Kings River basin appear to be lower than those associated with surface waters in the Tule River basin.

LOWER SOUTH FORK KINGS RIVER WATERSHED (1803001003)

The Lower South Fork of the Kings River Watershed is located on the western slope of the Sierra Nevada. This watershed drains one of three main forks of the Kings River, and is fairly typical of the rugged, partially glaciated river basins of the west side Sierra streams. The watershed is approximately 81,520 acres in size, of which about 57,890 acres are in the Sequoia National Forest. Approximately 23,800 acres are within the Monarch Wilderness, 7,000 acres are within the Jennie Lakes Wilderness, and 400 acres surrounded by National Forest System lands are under private ownership. Kings Canyon National Park makes up about 23,790 acres of this watershed. Approximately 35,470 acres of the watershed within the Sequoia National Forest is within the Monument. This area includes the 9,300-acre Agnew Roadless Area and approximately half of the Monarch Wilderness (estimated 11,900 acres).

Elevation ranges from about 4,000 to 9,000 feet. The watershed is comprised of granite bedrock, which intruded pre-existing ocean floor sediments, which now form roof pendants. Rock types are marble and meta-volcanic and sedimentary. About one-quarter of the watershed has been glaciated, and the remaining three quarters was formed from stream or fluvial processes. Just east of the confluence of the South Fork Kings River and Grizzly Creek, glacial features terminate. The South Fork of the Kings River flows in a rugged river gorge beyond this point. The drainage is characterized by steep, bedrock boulder-dominated river gorges below Grizzly Falls and the wider, flatter uplands above this confluence. Uplands are steep in sections near the watershed divide and exhibit evidence of glacial polish in the headwaters.

Riparian vegetation consists of stringers of willows and aspen along creeks or meadow edges. Vegetation has good vigor and density and meadow species are flooded for about one month each spring during snow melt. Steep bedrock and boulder channels cannot grow lush riparian vegetation along their limited floodplain. This type of riparian ecotype makes up about one-third of the watershed streams.

U.S. Geological Service (USGS) stream gages for the watershed have a 22-year period of record for the Lower South Fork of the Kings River near Hume, California between 1922 and 1957, and a 6-year period of record at Cedar Grove between 1951 and 1956. Measured peak flows from these stations range from 1042 to 2097 cfs and minimum flow from 378 to 409 cfs. Duration of minimum flow is estimated at 22 days and occurs in the month of October. The peak flow in 1952 and minimum flow in 1924 correspond to USGS stream gage readings from other rivers in the vicinity.

Historical logging in the late 1800s impacted this watershed. Much of the watershed was owned by the Hume-Bennett Lumber, Sanger Lumber, and the Kings River Lumber companies. The giant sequoias were logged heavily at this time, and overall impacts to this watershed from these activities are difficult to quantify.

This watershed is separated into six basins: South Fork Kings River, Horse Corral Creek, Upper Boulder Creek, Big Meadow Creek, Little Boulder Creek, and Lower Boulder Creek. Portions of the Big Meadow, Horse Corral, and Boulder grazing allotments lie within this watershed.

The South Fork Kings River basin drains approximately 13.25 linear miles of perennial streams and meadows. Included are: South Fork Kings River, which has not been surveyed, Lightning Creek, Lockwood Creek, Redwood Creek, Windy Gulch, several unnamed tributaries to Lightning Creek, of which one has been surveyed, an unnamed tributary to the South Fork Kings River, Summit Meadow, and Deer Meadow.

Stream Condition Inventory provides information on the range of variability for two sites inventoried in the Upper Kings River watershed, Big Meadows and Little Boulder Creek, Table 5. Extensive surveying of Big Meadows and the stream channel was conducted by Jason Olin in 2004 while producing Stream Character and Aquatic Habitat of Big Meadows Creek for his master's thesis. Jason performed the initial SCI work for Big Meadows while designing a restoration strategy for the meadow. Detailed cross-sections and elevations were surveyed the summer of 2006, which were used to design the restoration project. Big Meadows Creek was surveyed following restoration in 2008 and 2009. Surveys for Little Boulder Creek were done in 2003 and 2004.

Table 5 – Stream Condition Inventory Sites in the Lower South Fork Kings River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Lower South Fork Kings River	18030001003	Little Boulder Creek	Little Boulder Creek	Hume Lake	2003 2004	B4	Stable-sensitive	Moderate
Lower South Fork Kings River	18030001003	Boulder Creek at Big Meadows Creek	Big Meadows	Hume Lake	2004 2006 2008 2009	C6	Stable-sensitive	Low

Channel attributes associated with stream surveys are displayed in Table 6. Big Meadows' attributes are shown prior to and after the 2007 restoration. The biggest change at this site is the change in width-to-depth ratios, which prior to 2007 show results that would be associated with an unstable system while post restoration results are typical of a stable channel. Values of pH are high and may be associated with the meadow ecosystem. Additional surveys were performed in 2009 and results are pending. Pfankuch stability rating of fair in Little Boulder Creek is associated with bank cutting, vegetative bank protection, and bottom size distribution giving this reach an impact rating of moderate.

Table 6- Range in Channel Attributes, Lower South Fork Kings River Watershed

Parameter	Channel Type		
	B Channel Little Boulder Creek	Big Meadows	
		Pre Restoration 2004	Post Restoration
Large Wood Debris (m^3/m)	0.69 – 0.80	0.4	0.19
% Shading	68 – 77	0-92	0-95
Temperature (Celsius)	12 – 16	12-22	12-16
pH (ppm)	7.0 – 7.4	6.7 -6.9	6.0
Alkalinity ($CaCO_3$)	Not Collected	Not collected	50
Mean Particle Size in mm (D50)	29-32	4.0 -10.0	0.03
Width-to-depth Ratio	7.9-15.2	5.5-166	43-254

Hilsenhoff Biotic Index – Rating	3 to 4.01 – Excellent to Very Good	3.45 to 4.74 – Excellent to Good	Excellent to fair
Riparian Impact Rating	Moderate	Low	Low
Rosgen Channel Types	B4	G4 to F4	C5

Lightning Creek (2A-D)

Lightning Creek is a class III stream that encompasses approximately 3.75 linear miles which drain into the South Fork Kings River. The greatest portion of the surveyed area, approximately 72 percent, is naturally-stable with steep gradient bedrock boulder dominated channels. Approximately 19 percent of the stream is a naturally-unstable steep gradient cobble dominated channel. The remaining portion is a stable-sensitive low gradient gravel dominated channel.

Unnamed Tributary to Lightning Creek (2A-D)

The unnamed tributary to Lightning Creek is a class III stream that encompasses approximately 2.5 linear miles. Approximately 70 percent of the stream is naturally-stable with steep to moderate gradient bedrock boulder and cobble substrate channels. The uppermost portion of the stream, approximately 20 percent, is a stable-sensitive moderate to low gradient sand dominated channel. The remaining reach is a naturally-stable steep gradient cobble dominated channel.

Lockwood Creek (2F-C)

Lockwood Creek is a class III stream with no known fisheries that encompasses approximately two linear miles that drain north into the South Fork Kings River. Unstable-sensitive-degraded steep to moderate gradient cobble gravel sand silt/clay dominated channels comprise the largest portion, approximately 86 percent. Within these channels are several areas where the channel has gully characteristics and has totally abandoned its original floodplain. The remaining portion is a naturally-stable steep gradient bedrock dominated channel.

Redwood Creek (2F-B)

Redwood Creek is a class III stream with no known fisheries that encompasses approximately two linear miles, which drain into the South Fork Kings River. Naturally-stable steep to moderate gradient bedrock boulder and cobble dominated channels comprise approximately 50 percent of the drainage surveyed. Approximately 20 percent is stable-sensitive with low gradient gravel sand and silt/clay dominated channels. The remaining portion is naturally-unstable with steep gradient cobble and gravel dominated channels.

Windy Gulch (2F-D)

Windy Gulch is a class III stream with no known fisheries that encompasses approximately 2.5 linear miles, which drain into the South Fork Kings River. Steep gradient naturally-stable bedrock boulder channels comprise approximately 50 percent of the surveyed area. The uppermost 10 percent of the drainage is a naturally-unstable steep gradient cobble dominated channel. Stable-sensitive low gradient silt/clay dominated channels comprise approximately 30 percent of the surveyed area. The remaining portion is an unstable-sensitive-degraded moderate gradient gravel dominated down-cut channel. These down-cut areas have abandoned their original floodplain and have gully characteristics.

Horse Corral Creek Basin (2B)

Horse Corral Creek encompasses approximately 3,400 acres that drain approximately 7.75 linear miles of perennial streams, with headwaters located in Horse Corral Meadow, into Boulder Creek. Included are: Horse Corral Creek and several unnamed tributaries to Horse Corral Creek. The entire basin is part of the Horse Corral grazing allotment.

<u>Horse Corral Creek (2B-C, 2B)</u>

Horse Corral Creek is a class II stream associated with brook trout that encompasses approximately 3.25 linear miles. Approximately ½ of the stream is stable-sensitive with low gradient cobble gravel and sand dominated channels. Naturally-stable, steep to moderate gradient bedrock boulder dominated channel comprise the remaining ½ of the drainage.

<u>Unnamed Tributaries to Horse Corral Creek (2B-C)</u>

Several unnamed tributaries in the headwaters of Horse Corral Creek have steep gradient bedrock dominated sections that were inaccessible. Naturally-stable steep gradient bedrock boulder dominated channels comprised these unnamed tributaries. There are no known fisheries associated with these streams, which encompass approximately 4.5 linear miles that drain into Horse Corral Creek.

<u>Boulder Creek (2C-A)</u>

Upper Boulder Creek encompasses approximately 8,500 acres that drains approximately 16 linear miles of perennial streams. Approximately 1,600 acres lies within Monument boundary. Boulder Creek, an unnamed tributary to Boulder Creek, and Sunset Meadow lie within the Monument boundary. Boulder Creek is a class I stream associated with rainbow, brook, and brown trout. The entire surveyed portion of the stream is naturally-stable with steep gradient bedrock boulder dominated channels.

Big Meadows Creek Basin (2D)

Big Meadows Creek encompasses approximately 7,500 acres that drains approximately 12.3 linear miles of streams and meadows into Boulder Creek. Weaver Creek, Big Meadows Creek, several unnamed tributaries to Big Meadows Creek, Fox Meadow, Heart Meadow, and Big Meadows are included in this watershed. This area drains the Big Meadows grazing allotment.

<u>Big Meadows Creek (2D-B, E, F), S. Fork Big Meadows Creek (2D-B)</u>

Big Meadows Creek is a class I stream associated with brook trout that encompasses approximately 5.5 linear miles. Naturally-stable, steep gradient bedrock/boulder dominated channels comprise approximately 40 percent of the surveyed area. The largest reach, approximately 60 percent, of the drainage is stable-sensitive with cobble gravel sand and silt dominated channels.

The Big Meadow Improvement Project was implemented in September of 2007 to restore 6,100 feet of degraded stream and meadow habitat. "Pond and plug" techniques were used to plug the existing gully and provide ponds for saturation of the meadow. The active channel was redirected onto remnant channels on the meadow surface. This project reconnected the channel to a naturally-evolved floodplain and provided the following ecosystem benefits: reduced peak flows; increased/extended summer base flows; enhanced riparian species, aquatic and terrestrial habitat; improved water quality; and raised the groundwater table. A resurvey of Big Meadows Creek in 2008 indicates a functional low gradient C5 Rosgen channel type, which is sand dominated. Figure 7 provides a cross-section of Big Meadows following the restoration.

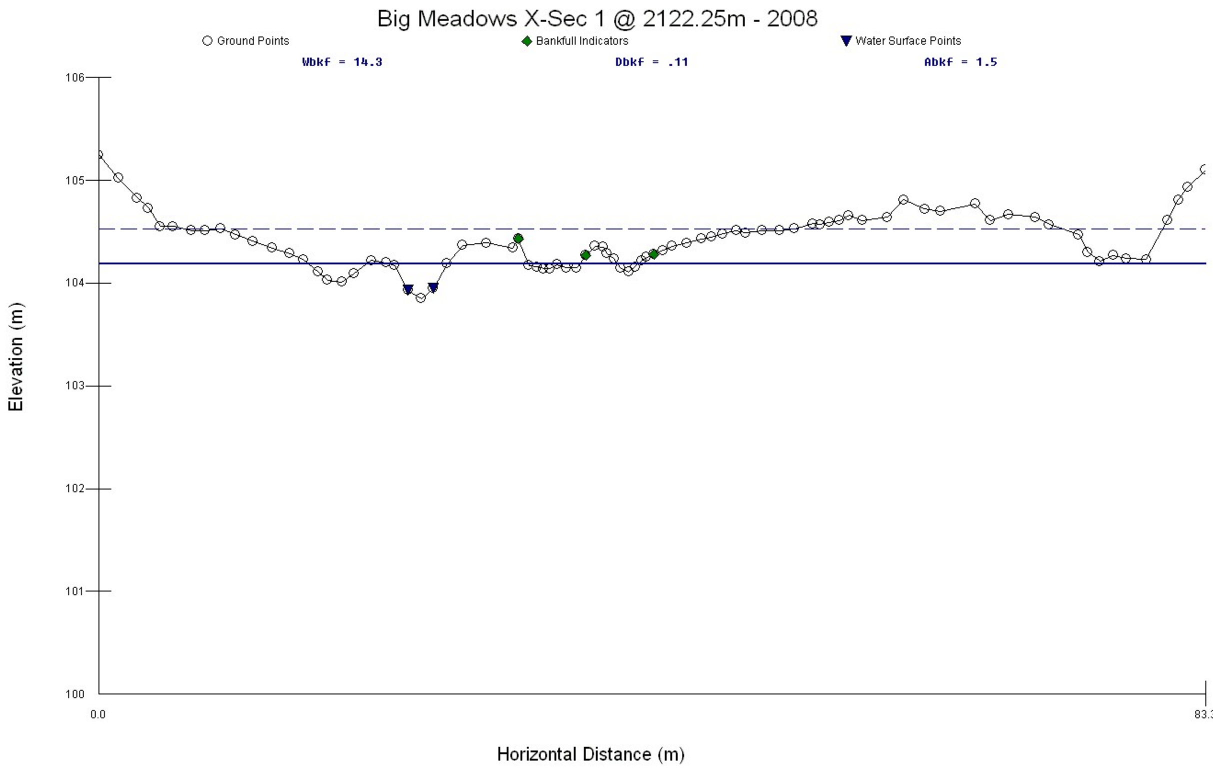


Figure 7 - Post Restoration Cross Section Big Meadows Creek - 2008

Shade cover along the stream averaged 15 percent and ranged from 0 to 94 percent in 2005 and 2008. Meadow environments generally lack shade as a result of vegetation associated with meadows except where the stream is adjacent to timber stands. Water chemistry in 2008 yielded a total alkalinity of 50 ppm CaCO3 and pH of 6.0. This value falls outside the range determined to meet water quality standards which are from 6.5 to 8.3. Acidic conditions appear to be more common in meadow ecosystems and need further evaluation. Temperatures ranges of 12 to 16 ºC were recorded in 2008; temperatures in 2004 ranged from 12 to 22 º C.

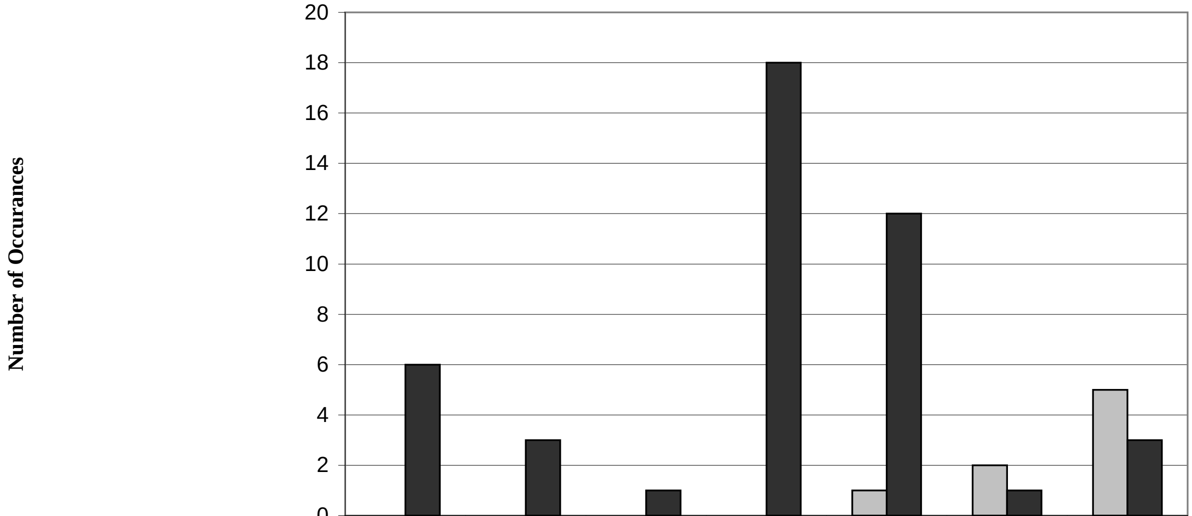
Table 7 provides results of macro-invertebrate sampling in Big Meadows collected by Jason Olin in 2004 prior to restoration and Kings River Conservation District personnel in 2008 after restoration. Four samples were submitted to the Bug Lab for processing by reach; however one site collected in 2004 and three sites collected in 2008 did not have the requisite number of individuals to support a valid rating (>100). Scores ranged from 3.45 to 8.84 which equates to Excellent to fair conditions. The change from stream to meadow habitat supports the change in site condition as meadow conditions provides poor for insects. The 2008 samples were taken using a Wildco bottom sled with net. An additional three samples are pending analysis. It is expected that conditions will improve following restoration.

Table 7 – Aquatic MIS Site Condition for Big Meadows – Pre and Post Restoration			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Big Meadows Creek, Reach B1	7/15/2004	3.45	Excellent - No apparent organic pollution
Big Meadows Creek, Reach B2A	7/18/2004	4.42	Very Good - Possible slight organic pollution
Big Meadows Creek, Reach D	7/11/2004	4.74	Good - Some organic pollution
Big Meadows Creek, Reach ESF	7/11/2004	4.35	Very Good - Possible slight organic pollution
Big Meadows Creek, Pond 3	9/19/2008	5.84	Fair, Fairly significant organic pollution

Width-to-depth ratios are the most changed after restoration of Big Meadows. Figure 8 shows the shift from width-to-depth ratios that range from less than 10 to greater than 101. Meadow ecosystems like Big Meadows (C5 stream types) typically have width-to-depth ratios greater than 12. The shift to width-to-depth post-restoration of 14-101 meets this criterion for a stable channel.

Meadow ecosystems typically are unconfined systems where water is available to the floodplain surrounding the stream and making up the meadow. Pre-restoration measurements showed many of the channels were confined with entrenchment ratios of 1.1 to 2.7 with an average of 1.5. Entrenchment is a measure of the vertical containment of a river; specifically it is a measure of the width at floodprone divided by the width at bankfull, which for meadow ecosystems should be greater than 2.2; relationships seen post-restoration indicate an unconfined system with entrenchment ratios from 2.3 to 11.4.

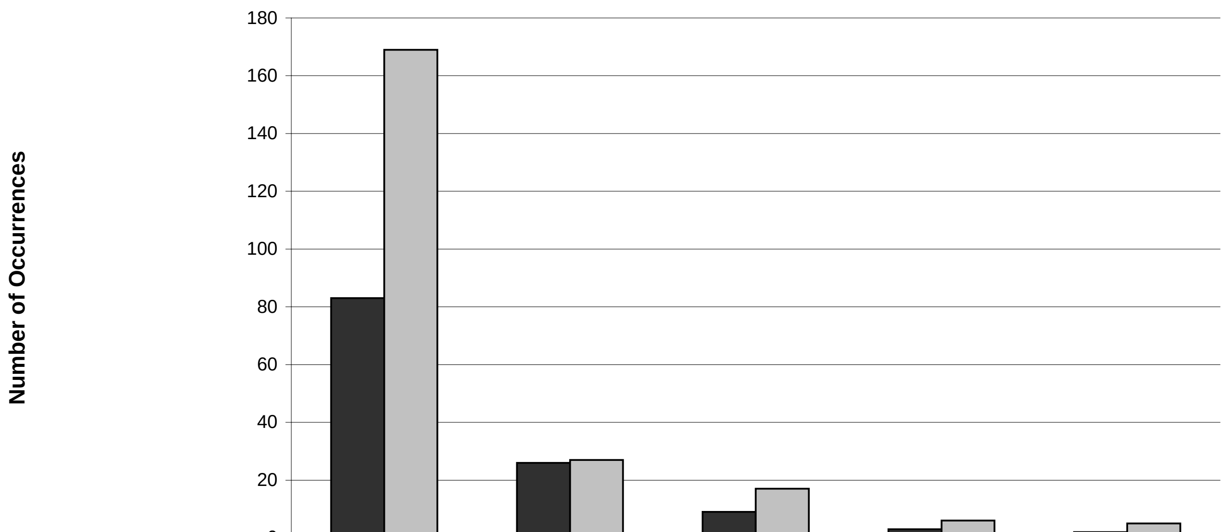
Figure 17 - Big Meadows Range of Natural Variability
Width to Depth Ratios
Pre and Post Restoration 2004 and 2008



	<10	10.1-12.0	12.1-14.0	14.1-40	41-80	81-100	>101
W/D Ratios Post Restoration	0	0	0	0	1	2	5
W/D Ratios Pre Restoration	6	3	1	18	12	1	3

Width to Depth Ratios

Figure 17 - Big Meadows Range of Natural Variability
% Stream Surface Shade
Pre and Post Restoration, 2004 and 2008



	0-20	21-40	41-60	61-80	81-100
Prerestoration 2004	83	26	9	3	2
Post Restoration 2008	169	27	17	6	5

% Shading

Changes in stream surface shade pre and post-restoration shows a slight shift to higher shading. Increases in higher shading ranges are slight and the biggest change is associated with lower shade percentages, Figure 9. High shade is not typically common to meadow environments where tall vegetation is absent and grasses and shrubs predominate.

Weaver Creek (2D-D)

Weaver Creek is a class II stream associated with rainbow trout that encompasses approximately one linear mile. Approximately ½ of the drainage is naturally-stable with steep gradient boulder dominated channels. The remaining portion is comprised of steep gradient cobble dominated naturally-unstable channels.

Unnamed Tributary to Big Meadows Creek (2D-A) North Fork Big Meadows Creek

The unnamed tributary is a class I stream associated with brown trout that encompasses approximately 1.5 linear miles that drain into Big Meadows Creek. Approximately 60 percent of the channel is a moderate gradient cobble dominated naturally-stable channel. The remaining portion is a steep gradient gravel dominated naturally-unstable channel.

Unnamed Tributary to Big Meadows Creek (2D-E), Fox Meadow Creek

This unnamed tributary is a class III stream that encompasses approximately one linear mile that drain into Big Meadows Creek. Approximately ½ of this stream is a naturally-stable moderate gradient cobble dominated channel.

Unnamed Tributary to Big Meadows Creek (2D-C), Poison Creek

The unnamed tributary is a class III stream with no known fisheries that encompasses approximately 1.5 linear miles. This portion is a naturally-stable, steep gradient bedrock channel.

Little Boulder Creek Basin (2E)

Little Boulder Creek Basin encompasses approximately 5,250 acres that drain approximately 7.5 linear miles of perennial streams into Boulder Creek. Included are: Little Boulder Creek, Buck Rock Creek, an unnamed tributary to Little Boulder Creek, an unnamed tributary to Boulder Creek (Kennedy Meadow Creek), Burton Meadow, and Kennedy Meadow. The entire area drains the Boulder grazing allotment.

Little Boulder Creek (2E-E)

Little Boulder Creek is a class II stream and contains rainbow trout. The stream flows for approximately 2.75 linear miles until it confluences downstream with Boulder Creek. The channel is a naturally-stable, steep to moderate gradient, bedrock boulder channel that comprises approximately 70 percent of the drainage. The remaining portion is a stable-sensitive low gradient cobble dominated channel.

A 39-meter long SCI reach was established in Little Boulder Creek in 2003 to document baseline conditions prior to implementation of the Boulder Timber Sale project. The site was monitored in 2004.

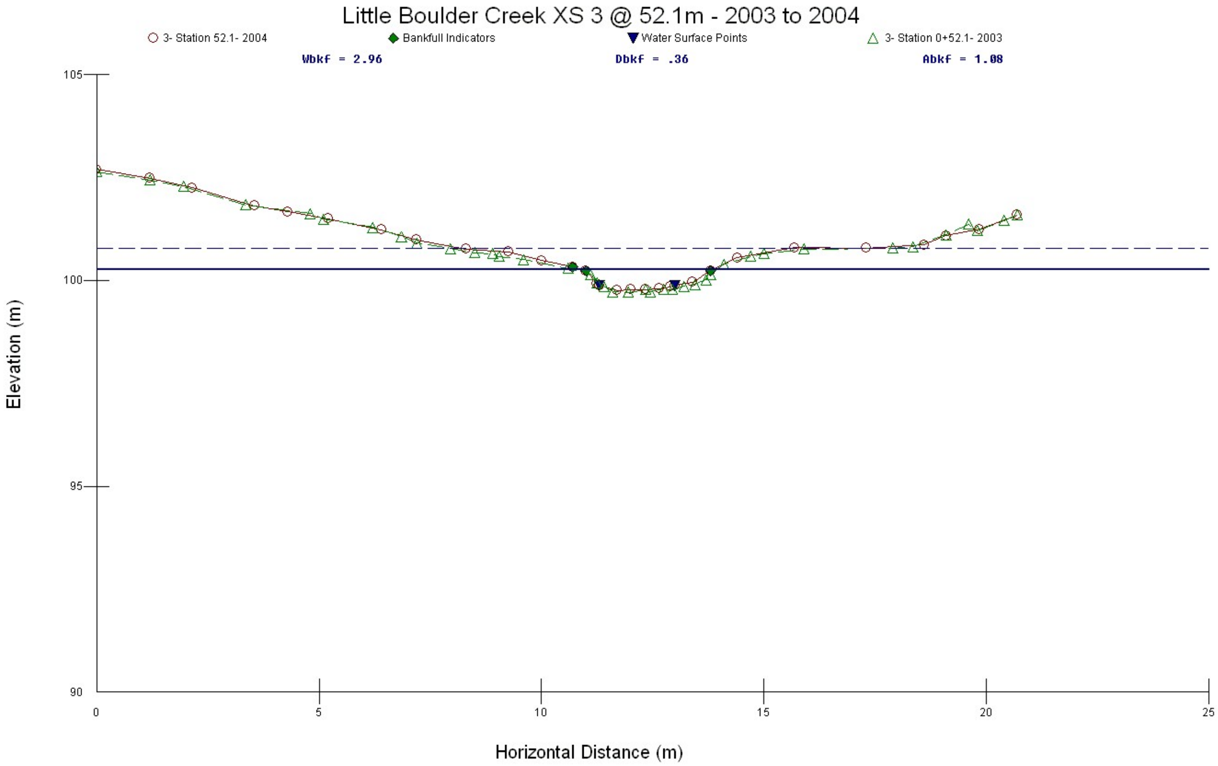


Figure 10 – Little Boulder Creek Cross Section, 2003 to 2004

There was minimal to no change detected from cross-section surveys as documented in Figure 10 and Figure 11. Average stream shading increased from 68 to 77 percent in the two years between surveys and large woody debris decreased from 0.80m3/m in 2003 to 0.00m3/m in 2004 indicating it was removed from the system through seasonal flows.

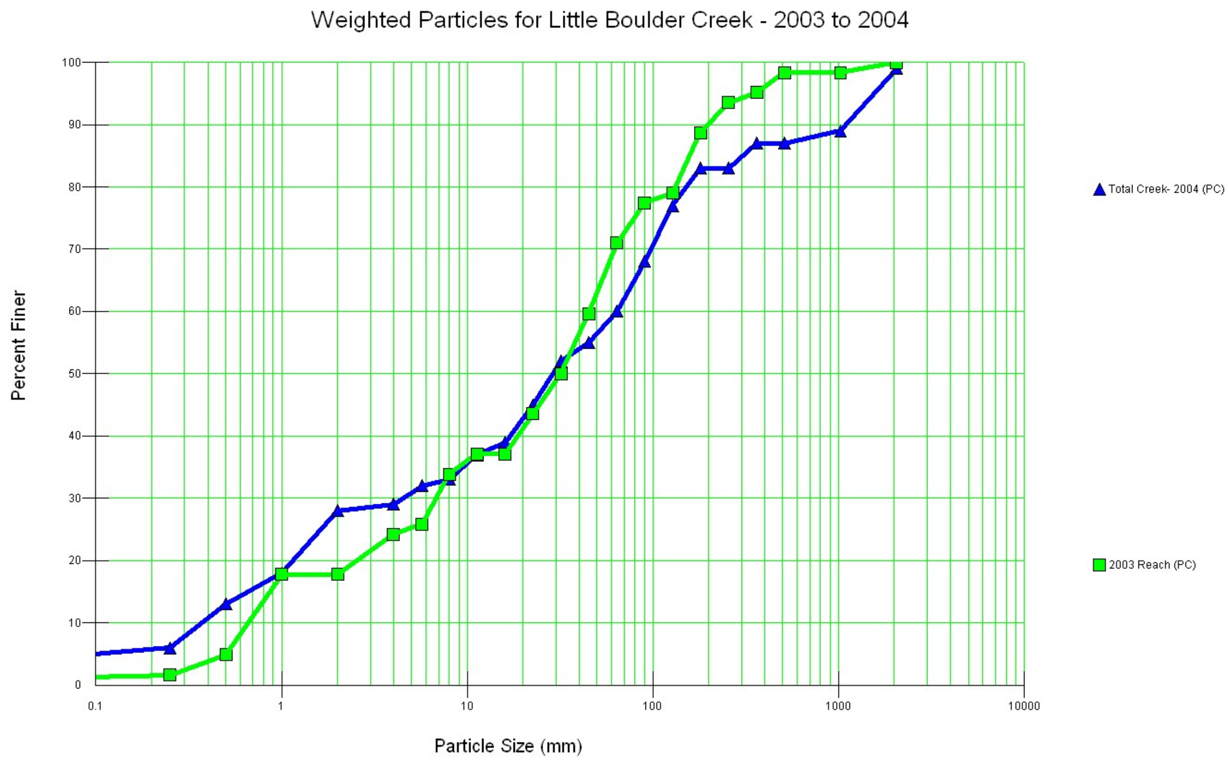


Figure 11 – Little Boulder Creek Particle Size Distribution, 2004 and 2003

Water chemistry collected in 2003 and 2004 included pH and temperature. The pH ranged from 7.0 in 2003 to 7.4 in 2004. Stream temperatures for both years measured 12 ºC. Particle size distribution or the diameter at the 50 percentile (D50) shifted from 32.0mm to 29.3mm from 2003 to 2004. This change is considered minor and within the range of natural variability for gravel systems.

Aquatic insect communities have biotic indices associated with excellent water quality suggesting no apparent organic pollution in 2003. A slight shift in water quality towards a biotic index ranking of very good occurred in 2004. However, although rating changes occurred, actual values are similar. Table 8 displays this trend.

Table 8 – Aquatic MIS Site Condition for Little Boulder Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Little Boulder Creek	8/6/2003	3	Excellent - No apparent organic pollution
Little Boulder Creek	8/6/2003	3.49	Excellent - No apparent organic pollution
Little Boulder Creek	7/7/2004	4.01	Very Good - Possible slight organic pollution

Buck Rock Creek (2E-E)

Buck Rock Creek is a class II stream associated with rainbow trout that encompasses approximately 1.25 miles that confluence with Little Boulder Creek. Approximately 90 percent of the drainage is comprised of steep gradient naturally-stable bedrock boulder channels. The remaining portion is a moderate gradient silt/clay dominated stable-sensitive channel.

Unnamed Tributary to Little Boulder Creek (2E-E)

The unnamed tributary is a class III stream with no known fisheries that encompasses approximately 1.25 linear miles with headwaters located at Burton Meadow. The lowermost 85 percent of the drainage is naturally-stable with steep to moderate gradient bedrock boulder and cobble dominated channels. The remaining portion is a naturally-unstable steep gradient gravel dominated channel.

Unnamed Tributary to Boulder Creek (2E-D) *Kennedy Meadows Creek*[10]

Kennedy Meadows Creek is a class III stream that encompasses approximately 2 linear miles with headwaters located near Kennedy Meadows. Approximately 50 percent of the stream is a steep gradient naturally-stable boulder dominated channel. A stable-sensitive moderate gradient gravel dominated channel comprises the remaining portion of the drainage.

Lower Boulder Creek Basin (2F)

Lower Boulder Creek basin encompasses approximately 5,250 acres that drains approximately 15.3 linear miles of perennial streams into the South Fork Kings River. Boulder Creek encompasses approximately 6.25 linear miles. Naturally-stable steep to moderate gradient bedrock boulder channels comprise the entire drainage area.

Grizzly Lakes, Jennie Ellis Lake, and Weaver Lake are the only large water bodies in this watershed and have been stocked with non-native fish species starting in the early 1900s. Native and introduced fish species are found in perennial streams. Introduced fish species have “naturalized” over the years and displaced golden trout in the Kings River.

Natural disturbances to water quality include wildfires and floods. Large floods were recorded in January of 1997 which was reported to have moved boulders the size of houses and eroded Highway 180 in at least six locations. Human-caused impacts include roads, residences, recreation, grazing, stock use, and vegetation management. Past disturbances have the potential to affect water quality. Watersheds of concern due to past disturbances include Big Meadow Creek and Buck Rock Creek.

MILL FLAT CREEK AND MILL CREEK WATERSHEDS (1803001005, 1803000801)

Mill Flat watershed is divided into seven basins that drain: Upper Tenmile Creek, Lower Tenmile Creek, Cabin Creek, Converse Creek, Verplank Creek, Mill Flat Creek, and Davis Creek. Approximately 1/3 of the Davis Creek basin lies outside the Monument.

Converse, Mill Flat, and Mill Creeks are the main tributaries to the Kings River on the western slope of the Sierra Nevada and flow south into the Kings River at or above Pine Flat Reservoir. Included with this discussion is the portion of the Mill Creek watershed that falls within the Monument. While this watershed occupies a watershed distinct from the Mill Flat it is small in comparison and was included

[10] Names in italics represent fictitious names (not USGS) used in database files to represent these streams.

here because of proximity. The uppermost portion of Mill Creek encompasses approximately 4,000 acres that drain approximately 3.5 linear miles of perennial streams west into the Kings River below Pine Flat Reservoir.

Mill Flat Creek watershed consists of approximately 101,480 acres, of which about 73,170 acres are within the Sequoia National Forest. Within the national forest, about 9,360 acres are under private ownership, approximately 64,800 acres are within the Monument, and about 22,450 acres are in the Kings River Special Management Area. Some of these areas overlap with 9,500 acres of sequoia groves and the 26,690-acre Mill Flat Creek Critical Aquatic Refuge. The remaining 28,310 acres of the Mill Flat Creek watershed are shared. Approximately 3,840 acres are within Kings Canyon National Park near Wilsonia, and 24,470 acres are in the Sierra National Forest.

Historical logging in the late 1800s impacted this watershed. Much of the watershed was owned by the Hume-Bennett Lumber, Sanger Lumber, and the Kings River Lumber companies. The giant sequoias were logged heavily at this time, and overall impacts to this watershed from these activities are difficult to quantify.

Elevation ranges from about 900 to 8,000 feet and is predominantly granite bedrock. Approximately 50 percent of area is steep, bedrock boulder-dominated river gorges draining into the main stem of the Kings River. Headwater drainages are generally bedrock boulder-dominated. The Kings River gorge is a narrow, steep, boulder bedrock-dominated channel with little vegetation. In the upland basin there are wide riparian areas, forming meadows with willow clumps along the streams, and substrates ranging from boulder to sand and silt. Several of the meadows have standing water in early spring with high sinuosity and low gradient channels.

Flows from the watershed are extremely variable. It was reported on January 1, 1997, that a low of 6,247 acre-feet per day flowed into the Pine Flat Reservoir, and on January 2, 1997, a maximum of 32,821 acre-feet per day was reported. Although these extreme flows occur rarely, variations in flows can and do change rapidly in the watershed. In the Oat Mountain area, it is estimated that an average of 4,000 acre-feet per day flows into the Pine Flat Reservoir (USDA Forest Service, Sequoia National Forest, 1988, Land and Resource Management Plan Final Environmental Impact Statement, Appendix C, page C13).

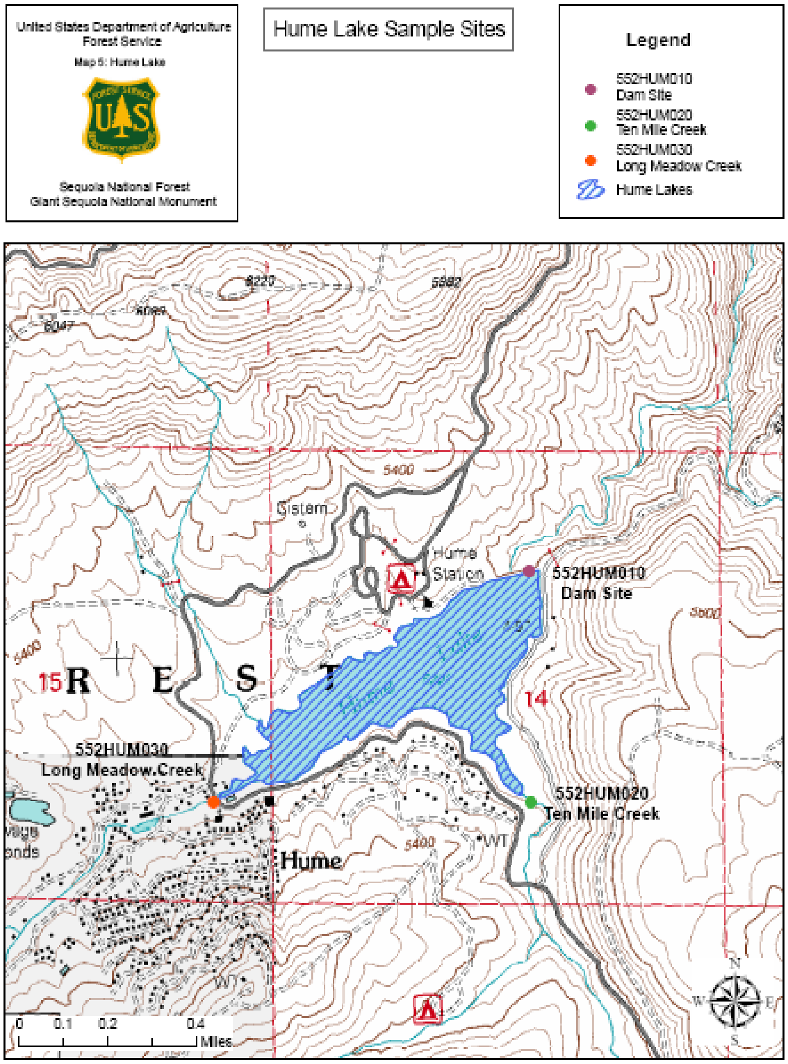
Riparian vegetation consists of stringers of willows and aspen, usually along creeks or meadow edges. This vegetation has good vigor and densities except for the aspen stands along upper Tenmile Creek which are dominated by mature and decadent trees lacking adequate regeneration and are experiencing conifer encroachment which threatens these stands. Meadow forbs and grasses are in standing water approximately one month each spring. There is minimal riparian vegetation in channels with a predominant bedrock/boulder substrate. Bedrock/boulder drainages comprise about ¼ of the drainages in the watershed.

Natural disturbances to water quality include floods and wildfires. Large scale flooding in January of 1997 damaged flood facilities at Hume Lake Christian Camp. The areas burned by the Robinson, Converse, McGee (1955), and Highway (2001) fires cover approximately 50 percent of this watershed. Human-caused impacts include those from roads, recreation residences, private camps and houses, recreation, Hume Lake Dam, grazing, and vegetation management activities. These disturbances currently affect the watersheds located in the Sampson Creek, Mill Creek, Upper Abbott Creek, and Mill Flat Creek drainages.

Hume Lake was listed as a potential 303(d) impaired water body by the Central Valley Water Quality Control Board (CVWQCB) in June of 2009. This water segment, as identified by the Board, appears to include Hume Lake to Hume Dam. Lake elevations were estimated to be approximately 5,200 feet above sea level. Sampling that placed Hume Lake for consideration to the 303(d) lists are at four sites along the lake. The location of these sites are Hume Dam, Ten Mile Creek, Long Meadow Creek, and at the Pier below Long Meadow and Ten Mile Creeks. Sampling occurred from 2002 to 2004. Findings of the sampling indicate Dissolved Oxygen (DO) values ranged from 5.47 to 14.3 mg/L. Acceptable DO values are 7 mg/L and above. Because of the location and extent of this reach, the Forest Service has documented an opposition to the listing of Hume Lake on National Forest System lands. The Forest Service has requested Hume Lake be designated as a warm water fisheries since it was historically a millpond associated with logging. Information regarding the Forest Service opposition is available upon request.

Figure 12 provides a map and sampling data from this study. The source of the DO is stated as unknown. Beneficial use for Hume Lake is stated as Cold Freshwater Habitat in Appendix F, Supporting Information, Draft 2008 California 303(d)/305(b) Integrated Report, Hume Lake, Decision ID 15948, DO sections.

Figure 12 -Map of Hume Lake CVWQCB Water Quality Sampling Sites and Data 2002-2004



Hume Lake Sampling Sites/Station Code	Sampling Date	Data Range DO (mg/L)
Hume Lake – Dam Site 552HUM010	4/26/2002	9.04
	6/13/2002	6.72
	9/25/2002	8.12
	12/5/2002	8.71
	3/13/2003	7.4
	11/13/2003	8.75
	5/26/2004	6.24
	10/5/2004	8.5
Hume Lake – Ten Mile Creek 552HUM020	4/26/2002	9.97
	6/13/2002	6.83
	9/25/2002	7.45
	12/5/2002	14.3
	3/13/2003	8.55
	11/13/2003	8.15
	5/26/2004	6.25
	10/5/2004	6.98
Hume Lake – Long Meadow Creek 552HUM030	4/26/2002	7.78
	6/13/2002	6.51
	9/25/2002	6.58
	12/5/2002	12.3
	3/13/2003	8.09
	11/13/2003	8.02
	5/26/2004	5.75
	10/5/2004	5.47
Pier b/w 020 and 030 552HUM040	10/5/2004	8.4

Landscape analysis is ongoing in the Mill Flat watershed. Mill Flat watershed is divided into seven basins: Upper Tenmile Creek, Lower Tenmile Creek, Cabin Creek, Converse Creek, Verplank Creek, Mill Flat Creek, and Davis Creek. Eight permanent SCI sites have been established on Mill Flat Creek watershed since 2003; Sampson and Abbott Creeks were surveyed in 2009.Stream Condition Inventory surveys have been on-going in Mill Flat Creek watershed since 2003. Sampson and Abbott Creeks were surveyed in 2009. Table 9 provides a list of streams surveyed in this watershed. Ranges in stream parameters from these surveys are displayed in Table 10. Figures 13 through 18 provide graphical distributions of the ranges found for most of the parameters in Table 10.

Table 9 - Streams Surveyed in the Mill Flat Watershed								
Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Mill Flat	18030001005	Long Meadow Creek	Above Hume Lake	Hume Lake	2002, 2004	B3	Naturally-stable	Low
Mill Flat	18030001005	Tenmile Creek	At Tenmile Campground	Hume Lake	2002, 2007	B4c	Stable-sensitive	Moderate-High
Mill Flat	18030001005	Mill Flat Creek	Near Goodmill	Hume Lake	2003, 2004, 2005, 2007	B3	Naturally-stable	Low
Mill Flat	18030001005	Bear Skin Creek	Near Diabetic Camp	Hume Lake	2003, 2004	C4	Stable-sensitive	Moderate
Mill Flat	18030001005	Sampson Creek	Sampson Flat	Hume Lake	2003, 2004, 2005	F4	Unstable-sensitive Degraded	Extreme
Mill Flat	18030001005	Converse Creek	Converse Creek	Hume Lake	2004, 2007	E3b	Stable-sensitive	Low
Mill Flat	18030001005	Abbott Creek	Above Mill Flat Creek	Hume Lake	2005	B2/1	Stable-sensitive	Moderate

Table 10 – Range in Channel Attributes, Mill Flat Creek Watershed 2003 to 2007				
Parameter	Channel Type			
	A and B Channels	C Channels	E Channels	F and G Channels
Large Wood Debris (m^3/m)	0.002-0.24	0.24 – 0.3	0.22- 0.5	0.005-0.3
% Shading (averaged for reach)	53 – 79	49.2 – 65.6	66.9 – 72.4	89.4 – 95.9
Temperature (Celsius)	11 – 20	14 – 19	15 -20	16-20
pH (ppm)	6.3 – 7.1	7.0	6.4 – 7.2	6.5-7.0
Alkalinity ($CaCO_3$)	40 -60	40	68 – 75	120-132
Mean Particle Size in mm	7.6 – 426.3	1.3 – 4.0	45 – 71.1	1.9 – 40.1
Width-to-depth Ratio	7.6 – 27	13 – 26.8	8.2 – 16.7	13.3 – 17.6
Hilsenhoff Biotic Index – Rating	2.66 – 4.35 Excellent-Very	2.90 – 4.0 Excellent to Very Good	3.41 – 4.22 Excellent to Very Fair-	2.0 – 4.84 Excellent – Good

Riparian Impact Rating	Low – Moderate High	Moderate	Low	Extreme
Rosgen Channel Type	B3, B2/1, B4c,	C5	E3b	F4

Davis Creek Basin (1B)

Davis Creek Basin encompasses approximately 17,600 acres that drains approximately 14.4 linear miles of perennial streams north into the Kings River. Included in this basin are: Davis Creek, Samson Creek, several unnamed tributaries to Davis and Samson Creeks, and the lower portion of Mill Flat Creek. Approximately 1/3 of this basin lies outside the Monument boundary. That portion of the basin that lies within the Monument and has been surveyed includes Mill Flat Creek and Samson Creek. This basin is predominantly naturally-stable steep bedrock boulder channels. The entire basin lies within the Samson grazing allotment. That portion of the basin that lies within the Monument is part of the Kings River Special Management Area.

Mill Flat Creek (1B-A, E)

Mill Flat Creek is a class II stream associated with rainbow trout that encompasses approximately 5 linear miles that confluence with the Kings River. The entire portion of this stream that lies within this basin is naturally-stable. Channels are comprised of steep bedrock boulder substrates.

Sampson Creek (1B-E, I)

Sampson Creek is a class III stream associated with rainbow trout that encompasses approximately 2.5 linear miles that drains into Mill Flat Creek. The entire portion of the stream that lies within the Monument has been surveyed. Naturally-stable bedrock boulder and cobble channels with moderate to steep gradients comprise the surveyed area.

The Stream Condition Inventory site on Sampson Creek is 92.9 meters long and is located at Sampson Flat. This site was established in 2003 to provide baseline conditions for the Highway Fire Rehabilitation and Delilah Dave Shredding projects. The site was resurveyed in 2003, 2004, 2005 and 2010 to monitor these projects and evaluate changes to Sampson Creek. Table 11 summarizes the SCI results.

Table 11 - Sampson Creek Ranges in Channel Attributes	
Large Wood Debris (m^3/m)	0.005-0.3
% Shading (averaged for reach)	89.4 - 95.9
Temperature (Celsius)	16-20
pH (ppm)	6.5-7.0
Alkalinity ($CaCO_3$)	120-132
Mean Particle Size in mm (D50)	1.9 - 40.1
Width-to-depth Ratio	13.3 - 17.6

Hilsenhoff Biotic Index - Rating	2.0 – 4.84
Riparian Impact Rating	Extreme
Rosgen Channel Type	F4

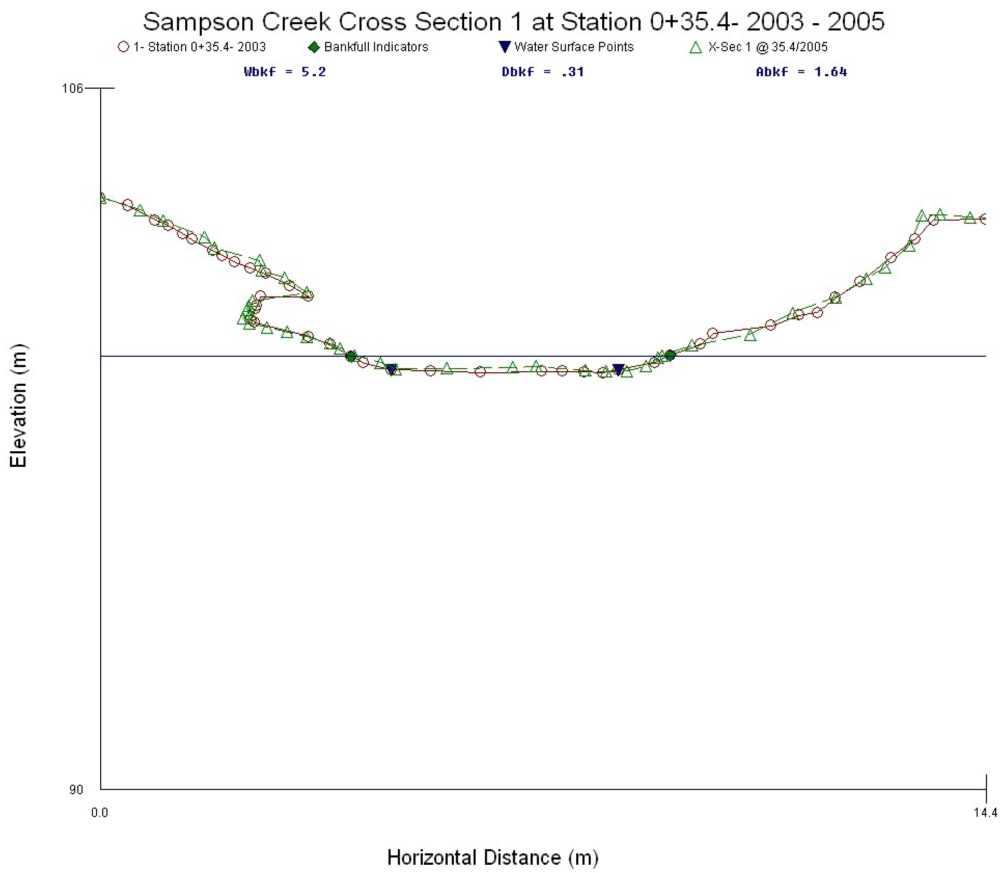


Figure 13 – Sampson Creek Cross section 2003 to 2005

The initial survey determined Sampson Creek as gravel dominated, low gradient F4 channel with an extremely impacted unstable-sensitive-degraded riparian ecotype (Figure 13). Following surveys in 2004 and 2005 show a shift in particle size from gravel to sand in the 2005 survey. Particle size distribution shows an increase in fine material in the 10 to 60 percentile, Figure 14. Larger materials remain somewhat the same from 2003 to 2005. High amounts of bank erosion are associated with F channel types; however, it is possible that increased runoff associated with the 2001 Highway fire and subsequent rehabilitation was responsible for triggering increases in erosion. Deposition into the stream channel would create a lower dominant particle size distribution.

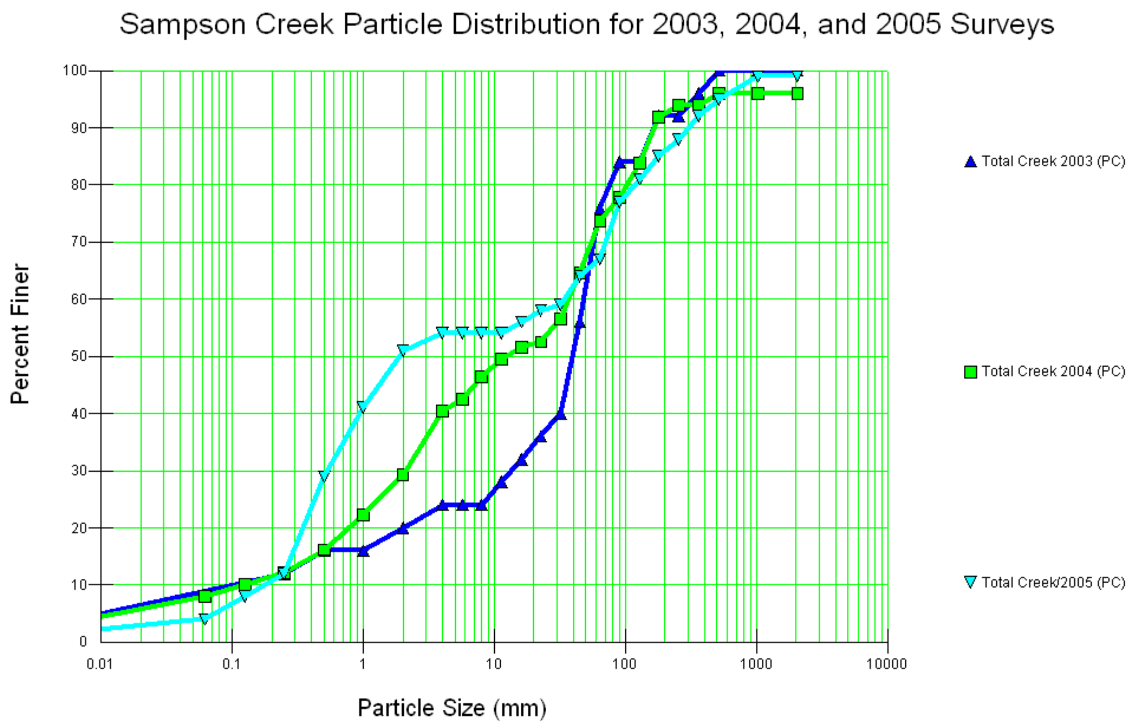


Figure 14 – Sampson Creek Particle Size Distribution 2003, 2004, and 2005 Surveys

Average stream shading increased from 90 percent in 2003 to 95 percent in 2005. An overall increase in large woody debris occurred during this time period from 0.005 m3/m to 0.30 m3/m. Total alkalinity varied from 132 ppm in 2004 to 120 ppm $CaCO_3$ in 2005. These values are the highest in the Mill Flat Watershed. Values for pH ranged from 7.0 in 2003, 6.5 in 2004, and 6.8 in 2005. Aquatic MIS site condition for Sampson Creek in 2003 and 2010 range from 2 to 2.18 and represent excellent condition. Sampling yielded inconclusive results in 2004 and 2005 as less than 100 individuals were present in the collected sample, Table 12. Aquatic Insect sampling is displayed in Table 12 and suggests excellent site.

Table 12 - Aquatic MIS Site Condition for Sampson Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Sampson Creek	7/28/2003	2 & 2.18	Excellent - No apparent organic pollution
Sampson Creek	7/8/2004	n/a	inconclusive
Sampson Creek	7/12/2005	n/a	inconclusive
Sampson Creek	7/15/2010	2.18	Excellent - No apparent organic pollution

Mill Flat Creek (1C)

Mill Flat Creek encompasses approximately 12,509 acres that drains approximately 20 linear miles of perennial streams north to its confluence with the Kings River. Included in this watershed are: Mill Flat Creek, Abbott Creek, Sequoia Creek, and several unnamed tributaries to Mill Flat Creek. Portions of Mill Flat Creek, Abbott Creek, and Unnamed Tributary to Mill Flat Creek have been surveyed. Naturally-stable steep bedrock boulder channels characterize the basin. The uppermost portion of the basin is part of the Converse-Hoist grazing allotment and the lower portion lies within the Kings River Special Management Area.

Mill Flat Creek (1C-A, C, J, K)

Mill Flat Creek is a class II stream associated with rainbow trout that encompasses approximately 7 linear miles with headwaters located at Sequoia Lake. Approximately 10 percent of the stream is naturally-unstable with steep cobble and gravel channels. Stable-sensitive moderate gradient cobble and gravel channels comprise approximately 10 percent of the stream. The remaining portions are naturally-stable bedrock boulder channels.

Mill Flat Creek was surveyed in 2003 to establish baseline conditions to monitor the Grant Grove Omnibus Burn and Delilah Davis Shredding projects. The 110.1-meter survey identified a gravel dominated, moderate gradient B4 channel with a moderately impacted stable-sensitive riparian ecotype. Repeat surveys were performed in 2003, 2003, 2005, 2007 and 2009. Table 13 provides ranges in channel attributes evaluated during these surveys.

Table 13 – Mill Flat Creek Ranges in Channel Attributes	
Large Wood Debris (m^3/m)	0.002 - 0.05
% Shading (averaged for reach)	53 - 65.5
Temperature (Celsius)	18-20
pH (ppm)	6.8 – 7.1
Alkalinity ($CaCO_3$)	40 - 60
Mean Particle Size in mm (D50)	51.4 – 358
Width-to-depth Ratio	18.75 – 37.8
Hilsenhoff Biotic Index - Rating	2.98 - 3.86 (Excellent – Very Good)
Riparian Impact Rating	Good
Rosgen Channel Type	B2/1 to B3/1

The channel shifted in particle size distribution from cobble associated with bedrock to gravel associated with bedrock from 2005 to 2007. No change occurred between 2004 and 2005. In 2007 an increase in impact rating from moderate to low impact was noted. Channel morphology could be transitioning from a slightly entrenched system to an entrenched system or from a B channel to an F channel; however, survey results currently show entrenchment within the range associated with a B channel type (Figure 15).

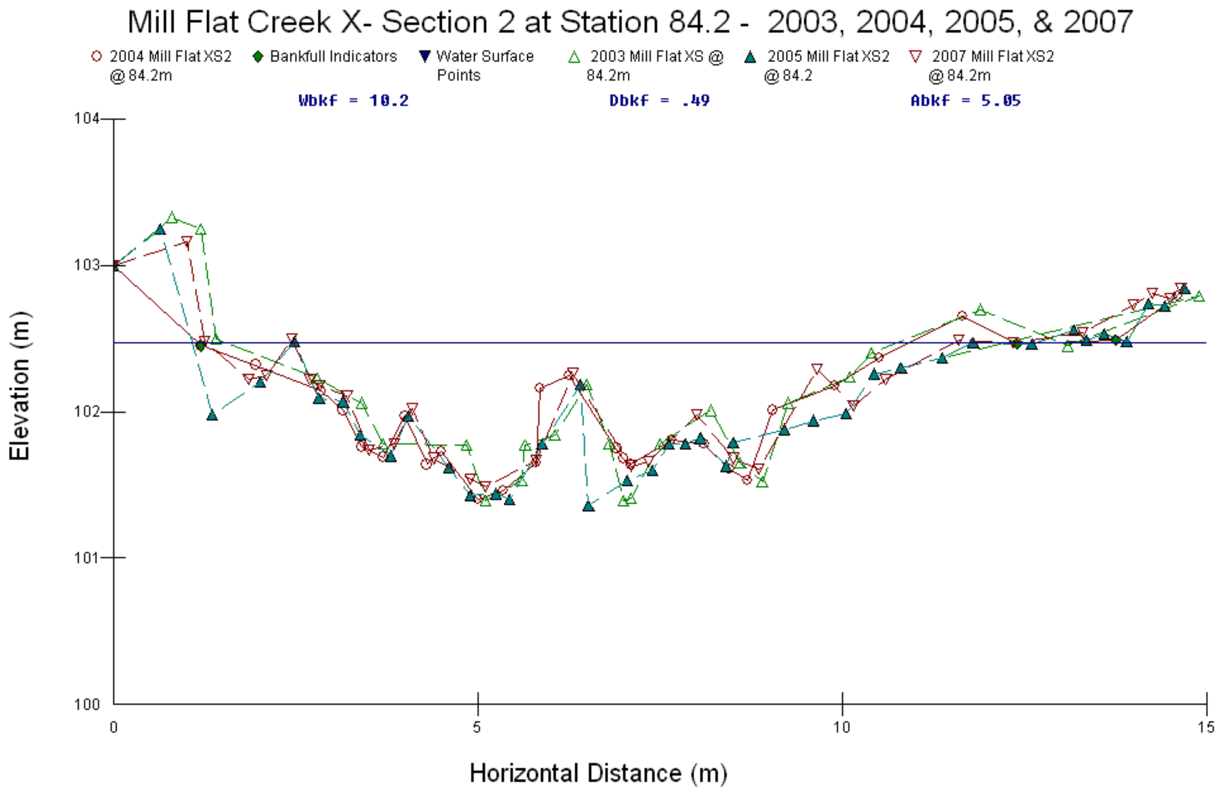


Figure 15 – Cross section of Mill Flat – 2003 to 2007

Particle size distribution fluctuated from 2003 to 2007. The channel was gravel dominated (51.4 mm) in 2003 year of the initial survey and changed to a boulder dominated system 351.3 and 358.18 mm, 2004 and 2005, respectively (Figure 16), suggesting a disturbance prior to the collection of initial baseline conditions. Thus it appears the system is able to transport finer particles. Survey of 2007 documents a transition back to a cobble dominated system (178.40 mm) suggesting a possible disturbance upstream.

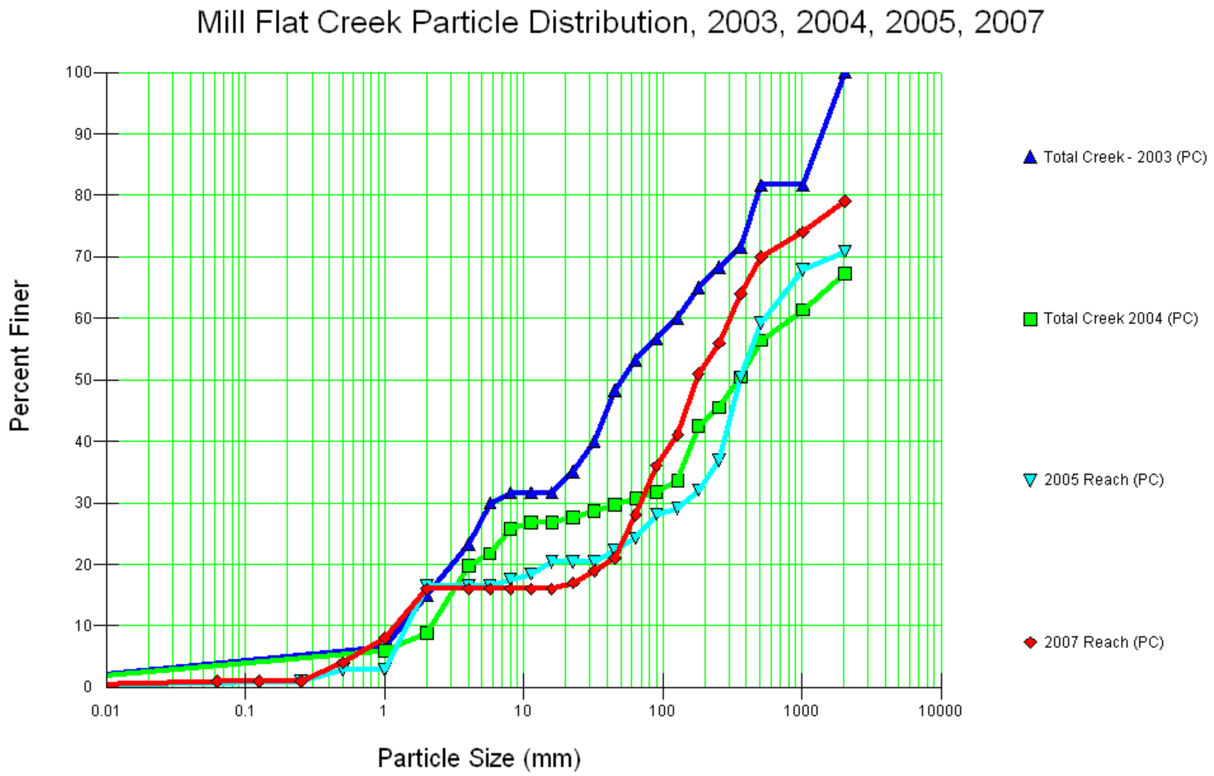


Figure 16 - Mill Creek Particle Size Distribution for years 2003, 2004, 2005, 2007

Recorded pH for Mill Flat has ranged from 7.1 in 2003; 7.0 in 2004; 6.8 in 2005; and 7.0 in 2007. Total ranged from 16 ppm $CaCO_3$ in 2004, which is considered a misreading as values this low have never been recorded on the forest, to a more typical value of 60 ppm in 2005, and 40 ppm in 2007. Temperature for the surveyed day ranged from 18 degrees C in 2003, 20 ºC in 2004, 18 ºC in 2005, and 17 ºC in 2007. Stream surface shading decreased 70 percent in 2003 to 62 percent in 2007 along with a decrease in woody debris 0.05 to 0.002 m^3/m from 2003 to 2007.

Aquatic MIS site condition for Mill Flat Creek ranges from Excellent to Very Good based on repeated sampling over a five year period from 2003 to 2009. Sampling results in 2004 and 2009 yielded inconclusive results as the number of requisite individuals (i.e. 100) were not present in the sample collected. Table 14 displays the results.

Table 14 – Aquatic MIS Site Condition for Mill Flat Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Mill Flat Creek	7/15/2003	3 & 3.47	Excellent - No apparent organic pollution
Mill Flat Creek	7/7/2004	n/a	inconclusive
Mill Flat Creek	7/19/2005	3.50	Excellent - No apparent organic pollution
Mill Flat Creek	7/25/2007	3.86	Very Good – Possible slight organic pollution
Mill Flat Creek	7/29/2009	n/a	inconclusive

Unnamed Tributary to Mill Flat Creek (1C-D, E)

The unnamed tributary to Mill Flat Creek is a class III stream that has no known fisheries that encompasses approximately 3.25 linear miles, which drains into Mill Flat Creek. Approximately ½ mile of the stream is a steep naturally-unstable cobble and gravel dominated channel. A small portion, approximately 10 percent, of the stream is a stable-sensitive moderate gradient gravel channel. The remaining portion is a naturally-stable moderately steep gradient boulder channel.

Abbott Creek (1C-F, G)

Abbott Creek is a class III stream associated with rainbow trout that encompasses approximately 4.25 linear miles with headwaters located in Kings Canyon National Park. The entire portion of this creek that lies with the Monument boundary has been surveyed and is naturally-stable. Moderately steep and steep bedrock boulder substrate channels comprise the drainage.

Abbott Creek SCI site, located north of General Grant Grove, was established to monitor the Grant Grove Omnibus Burn project in 2005 and once again in 2009. The reach length is 86.3 meters. Table 15 provides the ranges in channel attributes evaluated during surveys.

Table 15 - Stream Attributes for Abbott Creek	
Large Wood Debris (m^3/m)	0.4
% Shading (averaged for reach)	77.3
Temperature (Celsius)	16
pH (ppm)	7.5
Alkalinity ($CaCO_3$)	150
Mean Particle Size in mm (D50)	90
Width-to-depth Ratio	11.6
Hilsenhoff Biotic Index – Rating	1.86-2.72 - Excellent
Riparian Impact Rating	Moderate
Rosgen Channel Type	B4a

The survey results determined the stream channel was a high gradient, gravel dominated, stable-sensitive, moderately impacted B4a channel type. Figure 17 displays a cross-section recorded within the reach. Figure 18 is a graph of the particle size distribution throughout the reach.

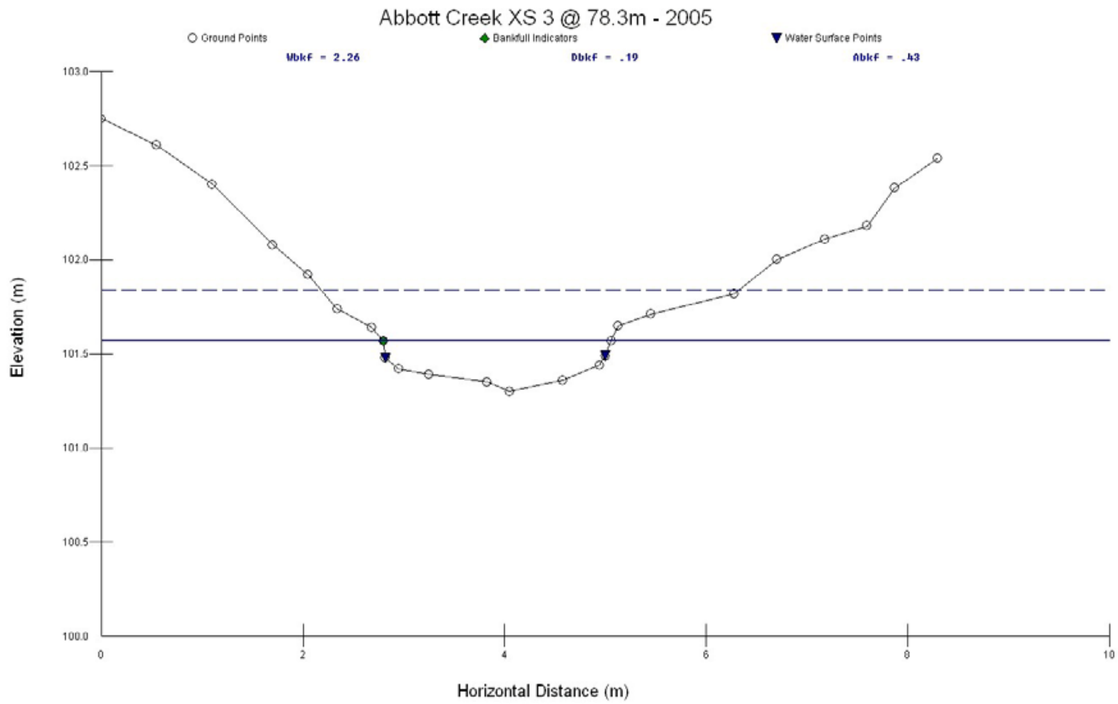


Figure 17 - Abbott Creek Cross Section, 2005

Figure 18 - Abbot Creek Particle Size Distribution, 2005

Average shading along the reach is approximately 75 percent. Water chemistry was not recorded for total alkalinity. However, the pH recorded was slightly acidic at 6.5. Temperature for that day was 11 ºC. Average amount of large woody debris throughout the reach was 0.39 m3/m. Aquatic MIS data for Abbott Creek in 2005 and 2009 indicates excellent site condition. Table 16 summarizes these findings.

Table 16 - Aquatic MIS Site Condition for Abbott Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Abbot Creek	7/27/2005	2.72	Excellent - No apparent organic pollution
Abbot Creek	8/8/2009	1.86	Excellent - No apparent organic pollution

Verplank Creek Basin (1D)

Verplank Creek (1D-A)

Verplank Creek basin encompasses approximately 4,395 acres that drains approximately 6.4 miles of perennial stream into the Kings River. Verplank Creek and several unnamed tributaries to Verplank Creek comprise the basin. Approximately one linear mile of the uppermost portion of Verplank Creek has been surveyed. The uppermost portion, that portion surveyed, of the basin is part of the Converse-Hoist grazing allotment and lies outside the Kings River Special Management Area.

Verplank Creek is a class III stream with no known fisheries. Of the portion surveyed, approximately 90 percent is comprised of stable-sensitive moderate gradient, gravel dominated channels. The remaining portion is a naturally-stable, steep gradient, boulder-dominated channel.

Converse Creek Basin (1E)

Converse Creek (1E-C, D)

Converse Creek basin encompasses approximately 6,340 acres, which drains approximately 10.4 linear miles of perennial streams into the Kings River. Converse Creek and its tributaries make up the entire basin. The headwaters of Converse Creek and those tributaries found in the upper ¼ of the basin have been surveyed. The uppermost portion of the basin is part of the Converse-Hoist grazing allotment and lies outside the Kings River Special Management Area.

Converse Creek is a class II stream associated with rainbow trout. Approximately 3 linear miles of streams in the uppermost ¼ were surveyed. Approximately 25 percent of the stream is naturally-stable with steep bedrock boulder channels. Moderate and low gradient cobble and gravel stable-sensitive channels comprise approximately 70 percent of the surveyed streams. The remaining portion is an unstable-sensitive-degraded moderate gradient cobble channel that is down cut and disconnected from its floodplain.

The Converse Creek SCI site, located in Converse Mountain Grove, established baseline conditions to monitor the Highway Fire Rehabilitation and Delilah Dave Shredding projects in 2004. Repeat surveys were completed in 2005, 2007 and 2009. The reach is 86.3 meters long. Table 17 displays a summary from the years surveyed.

Table 17 – Stream Channel Attributes Associated with Converse Creek	
Large Wood Debris (m^3/m)	0.22- 0.5
% Shading (averaged for reach)	66.9 – 72.4
Temperature (Celsius)	15 -20
pH (ppm)	6.4 – 7.2
Alkalinity ($CaCO_3$)	68 - 75
Mean Particle Size in mm (D50)	45 – 71.1
Width-to-depth Ratio	8.2 – 16.7
Hilsenhoff Biotic Index - Rating	3.41 – 4.22 Excellent to Very Good
Riparian Impact Rating	Low
Rosgen Channel Type	E3b

Surveys in 2004 and 2005 identified Converse Creek as a moderate gradient, stable-sensitive, gravel dominated, moderately impacted E4b channel. A shift in particle size and impact rating occurred in 2007. The 2007 and 2009 surveys defined the channel as a moderate gradient, stable-sensitive, cobble dominated, low impact E3b channel type due to a shift in particle size distribution. Figure 19 displays a cross-section along Converse Creek.

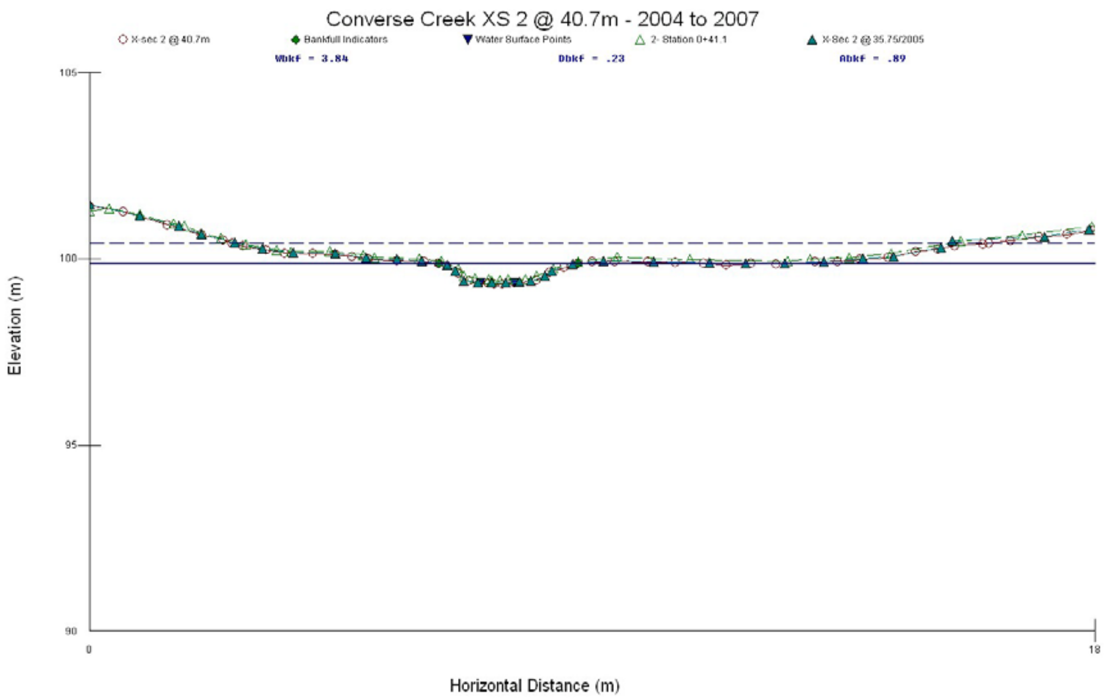


Figure 19 – Converse Creek Cross Section, 2004, 2005, 2007

Particle size distribution fluctuated from 2005 to 2007. The channel was gravel dominated (48.8 mm) in 2005 and changed to a cobble dominated system (71.09 mm) in 2007 respectively (Figure 20). The shift does not suggest a disturbance prior to the collection of initial baseline conditions. It suggests the system is able to transport finer particles.

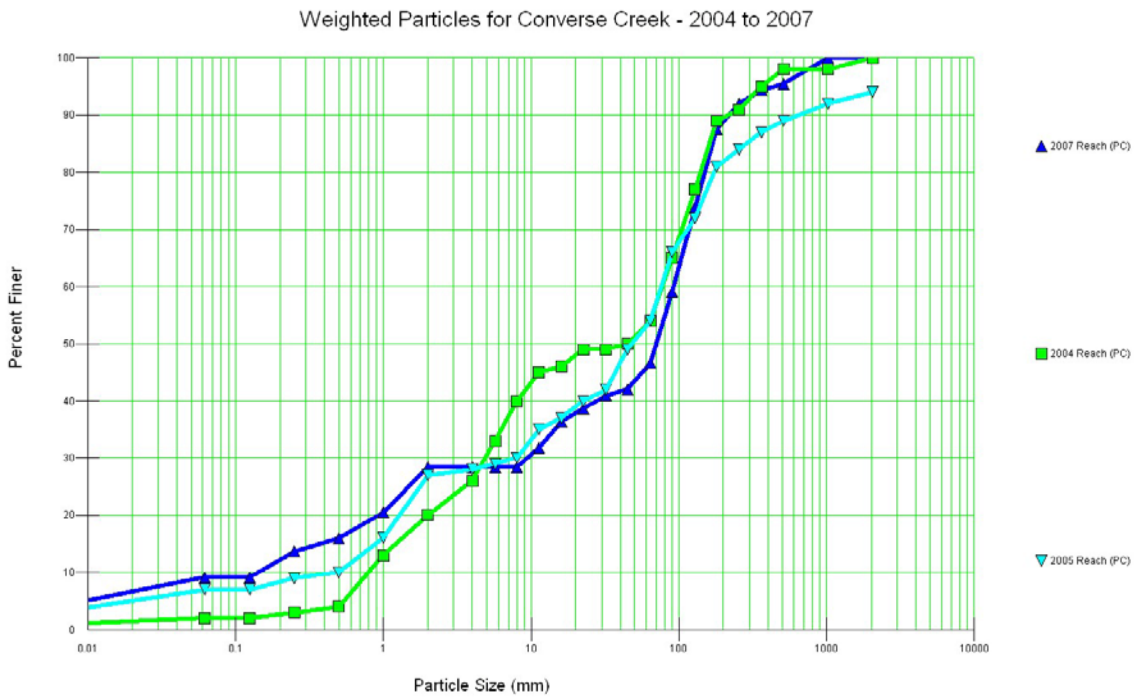


Figure 20 – Converse Creek Particle Size Distribution 2004, 2005, 2007

Recorded pH for Converse Creek ranged from 6.5 in 2005 to 6.8 in 2007. Temperature for the surveyed day ranged from 16 ºC in 2005 to 20 ºC in 2007. Total alkalinity ranged from 75 ppm in 2005 to 68 ppm in 2007. Stream shading increased from 71 percent in 2004 to 72 percent in 2007 occurred. Large woody debris increased from 0.13 m3/m to 0.16 m3/m.

Aquatic MIS site condition for Converse Creek is Very Good based on samples collected in 2005 and 2007, scores range from 4.14 – 4.22. Samples collected in 2004 and 2009 yielded inclusive results based on lack of requisite individuals (i.e. 100), Table 18.

Table 18 - Aquatic MIS Site Condition for Converse Creek			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Converse Creek	7/8/2004	3.41	inconclusive
Converse Creek	7/18/2005	4.17	Very Good - Possible slight organic pollution
Converse Creek	7/23/2007	4.22	Very Good - Possible slight organic pollution
Converse Creek	7/22/2009	n/a	Inconclusive

Cabin Creek Basin (1F)

Cabin Creek (1F-A)

Cabin Creek Basin encompasses approximately 5,960 acres that drains about 7.8 linear miles of perennial streams into the Kings River. Cabin Creek and several unnamed tributaries to the Kings River are included in this basin. Approximately one linear mile of Cabin Creek has been surveyed in the uppermost portion of the drainage. The uppermost portion, that portion surveyed, of the basin is part of the Converse-Hoist grazing allotment. The entire basin lies within the Kings River Special Management Area.

Cabin Creek is a class III stream with no known fisheries that encompasses approximately 2.5 linear miles. Approximately 40 percent of the area surveyed is stable-sensitive with moderate gradient gravel dominated channels. Another 40 percent is an unstable-sensitive-degraded low gradient sand dominated channel. The remaining portion is naturally-stable with steep gradient, bedrock dominated channels.

Tenmile Creek Basin (1G)

Tenmile Creek Basin encompasses approximately 24,600 acres that drains approximately 33.35 miles of perennial streams and meadows into the Kings River. Included are: Tenmile Creek, Bearskin Creek, Landslide Creek, Long Meadow Creek, Tornado Creek, Indian Creek, and several unnamed tributaries to Tenmile Creek, Long Meadow, Log Corral Meadow, Bacon Meadow, and Bearskin Meadow. The upper portion of this basin, above Hume Lake, is part of the Tenmile grazing allotment. A lower portion below Indian Creek lies within the Kings River Special Management Area.

Tenmile Creek (1G-F, 1G)

Tenmile Creek is a class I stream associated with rainbow trout and Sacramento perch that encompasses approximately 8.25 linear miles that drain into the Kings River after passing through Hume Lake. Of the 8.25 linear miles, approximately 5.25 linear miles of stream has been surveyed. The largest portion surveyed, approximately 61 percent, is naturally-stable with steep gradient bedrock boulder channels. Approximately 22 percent are stable-sensitive moderate gradient cobble, gravel, and sand dominated channels. The remaining portion of the surveyed stream is naturally-unstable with steep gradient cobble and gravel dominated channels. The surveyed portions of this stream lie within the Tenmile grazing allotment.

Tenmile Creek SCI site located near Tenmile Campground was established in 2002 to monitor the Reforestation Tornado Forest Health project. A survey was completed in 2005 following implementation of the project. The Burton Thinning Project created a need to survey Tenmile again in 2007 and 2008. This reach is 174 meters long. Table 19 shows ranges from the SCI surveys.

Table 19 - Stream Channel Attributes for Tenmile Creek	
Large Wood Debris (m^3/m)	0.09 – 0.24
% Shading (averaged for reach)	58 - 59
Temperature (Celsius)	16

pH (ppm)	6.3 – 6.8
Alkalinity ($CaCO_3$)	40 -60
Mean Particle Size in mm (D50)	7.6 – 23.4
Width-to-depth Ratio	13.2 – 26.4
Hilsenhoff Biotic Index – Rating	4.35 – 4.04 Very Good
Riparian Impact Rating	Moderately High
Rosgen Channel Type	B4c

Initial 2002 survey data defined the stream as a low gradient, stable-sensitive, sand dominated, and highly impacted B5c channel. The 2005 and 2007 surveys determined the channel was a low gradient, stable-sensitive, gravel dominated, moderately-high impact B4c channel (Figure 21). Recreation use occurs around the SCI location and is likely contributing to the differing impact ratings.

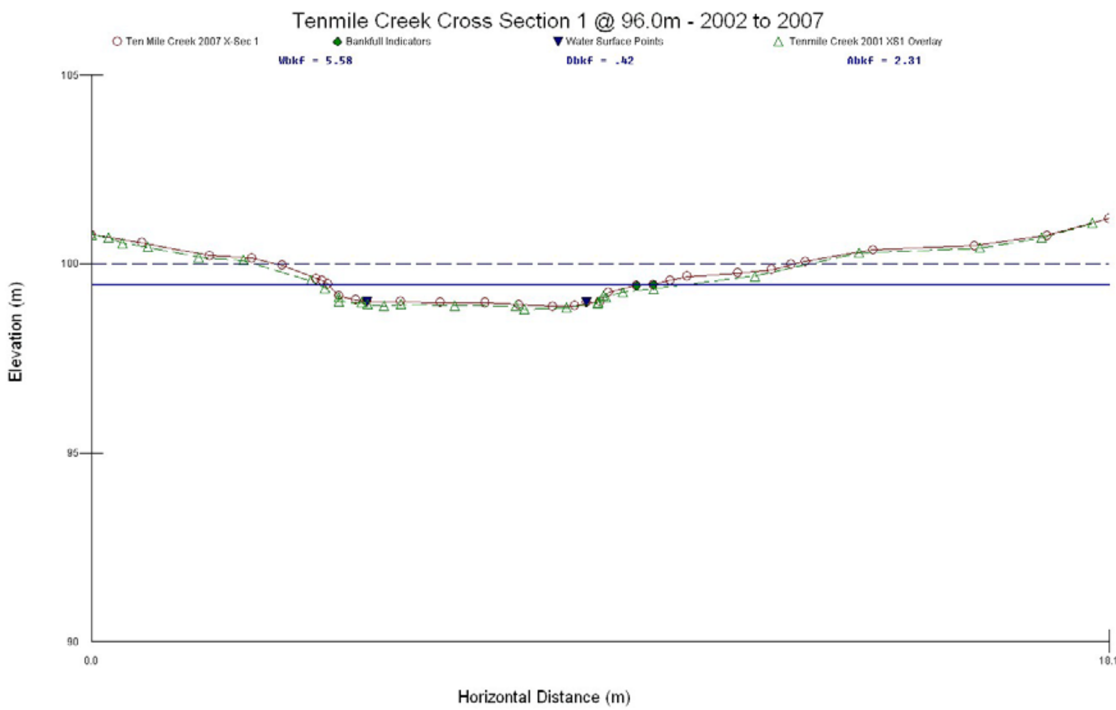


Figure 21 - Tenmile Creek Cross Section, 2002, 2005, 2007

Over the course of five years, surveys indicate particle size distribution had shifted. The shift occurred between 2002 and 2005 from 0.38 mm to 7.62 mm (Figure 22). Two years later the particle size distribution further shifted towards coarser material at 23.38 mm. The finer particles from the initial survey indicate a disturbance had occurred prior to the project. Post-project survey in 2005 discovered slightly coarser materials were dominating the system. The coarser material observed in 2007 suggests the streams particle size distribution is recovering from a previous disturbance as it is becoming coarser.

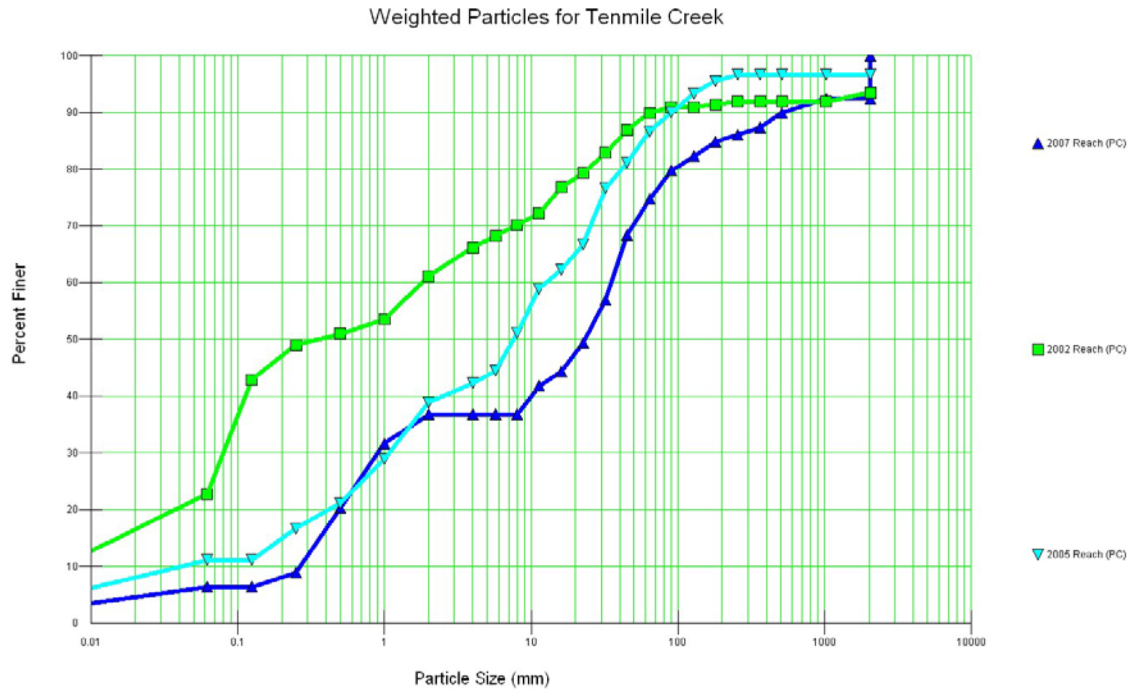


Figure 22 – Tenmile Creek Particle Size Distribution 2002, 2005, 2007

Stream shading decreased from 2002 at 66 percent to 58 percent in 2007. Large woody debris decreased from 2002's 0.24 m^3/m to 0.09 m^3/m in 2007. Human use along the reach due to the campground could be a reason for the decreased shading and large woody debris.

Chemistry data was collected in 2005 and 2007. Total alkalinity increased between 2005 and 2007 from 40 ppm to 60 ppm $CaCO_3$. The pH remained slightly acidic at 6.3 for both surveys. The only recorded temperature was in 2007 at 16 ºC. Aquatic MIS data for Tenmile Creek was collected in 2005, 2007 and 2008. Site conditions are very good (based on scores of 4.35 and 4.04, respectively). Sample collected in 2008 yielded inconclusive results based on not collecting the number of requisite individuals (>100), Table 20 displays the results.

Table 20 - Aquatic Insect Sampling for Tenmile Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Tenmile Creek	7/13/2005	4.35	Very good -Possible slight organic pollution
Tenmile Creek	7/24/2007	4.04	Very good -Possible slight organic pollution
Tenmile Creek	6/03/2008	n/a	Inconclusive

Indian Creek (1G-A)

Indian Creek is a class III stream associated with brown trout that encompasses approximately 4.5 linear miles, which drain into Tenmile Creek. The entire length of this stream has been surveyed. Approximately 72 percent of the drainage is naturally-stable, with channels gradients ranging from low to steep, comprised of bedrock, boulder, and cobble dominated channels. The remaining portion is stable-sensitive with moderate gradient gravel, sand, and silt/clay dominated channels. Approximately 20 percent of the uppermost portion of this drainage lies within the Tenmile grazing allotment.

Long Meadow Creek (1G-B)

Long Meadow Creek is a class III stream that has not been surveyed for fisheries, which encompasses approximately 2.75 linear miles that drains into Hume Lake. Greater than 95 percent of this stream has been surveyed. Approximately 63 percent of the surveyed area is naturally-stable with bedrock boulder dominated steep gradient channels. Stable-sensitive moderate gradient gravel and sand dominated channels comprise approximately 18 percent of the drainage. The remaining portion is naturally-unstable with steep gradient gravel dominated channels. This drainage is lies within the Tenmile grazing allotment.

Long Meadow Creek SCI site is located upstream from Hume Lake Christian Camp. The site was established for monitoring the Reforestation Tornado Forest Health project in 2002. The final survey was completed in 2009; Table 21 briefly summaries the SCI data from 2002 to 2009.

Table 21 - Long Meadow Creek	
Large Wood Debris (m^3/m)	0.05 – 0.10
% Shading	79
Temperature (Celsius)	15
pH (ppm)	6.5
Alkalinity ($CaCO_3$)	40
Mean Particle Size in mm (D50)	8.8 - 84
Width-to-depth Ratio	7.6 – 11.1
Hilsenhoff Biotic Index – Rating	2.66-2.88- Excellent
Riparian Impact Rating	Low
Rosgen Channel Type	B3

The stream was identified in 2002 as a moderate gradient, stable-sensitive, gravel dominated, and moderately impacted B4 system. The channel shifted by impact rating and particle size distribution to a moderate gradient, naturally-stable, cobble dominated, low impact B3 channel in 2004. Changes in morphology were minimal to insignificant and are displayed in Figure 23.

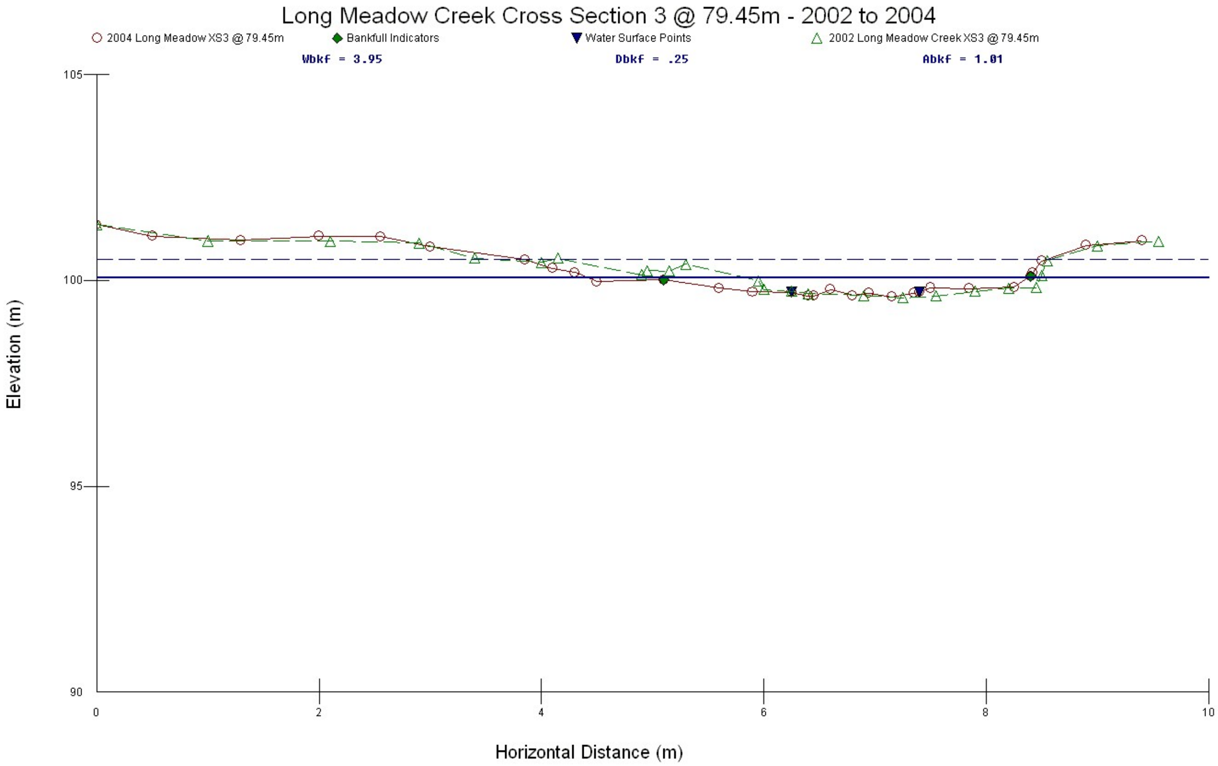


Figure 23 – Cross section of Long Meadow Creek – 2002 to 2004

The 2002 survey defined the reach as gravel dominated system with an average particle size distribution of 6.27 mm. By 2004, the particle size distribution had increased to 83.50 mm shifting the definition of the channel to a cobble dominated system. The finer particle size distribution prior to project initiation indicated a disturbance had occurred upstream of the site. After the project was complete, as the 2004 data indicate, particle size distribution became coarser moving the system into a naturally-stable riparian ecotype. Figure 24 displays a graph of the particle size distribution change from 2002 to 2004.

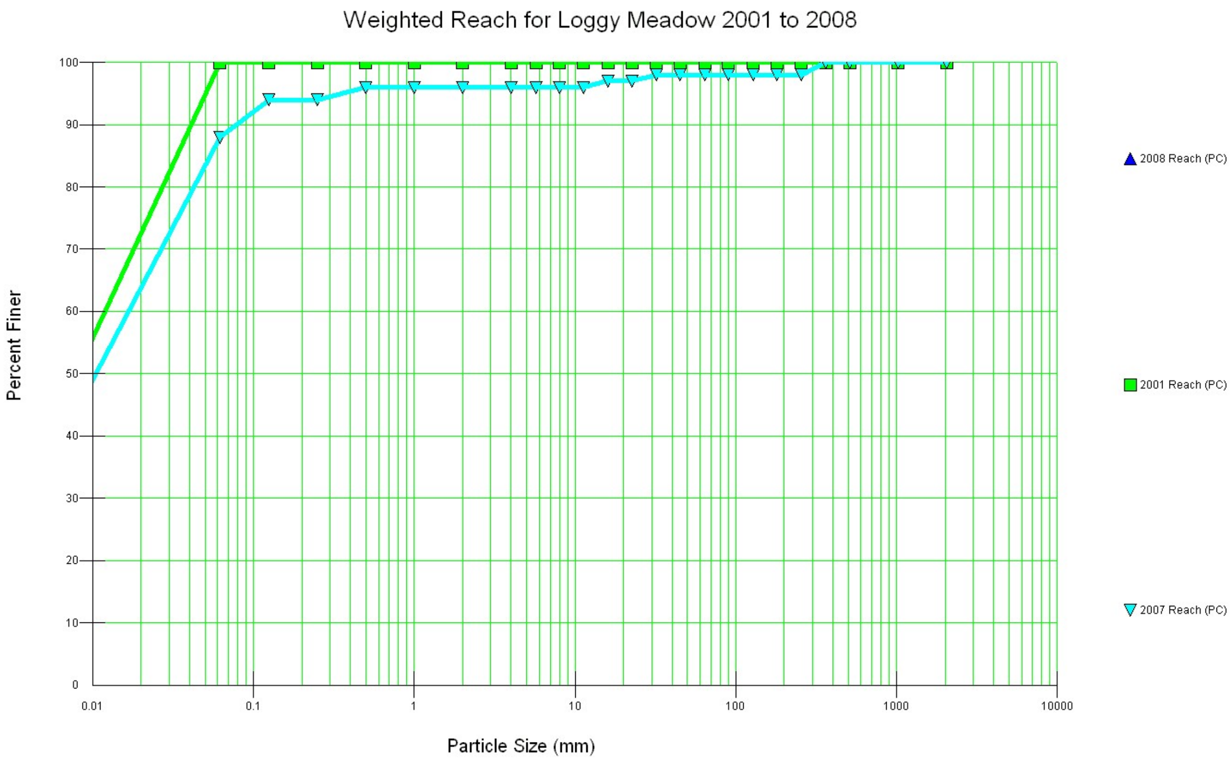


Figure 24 –Long Meadow Creek Particle Size Distribution – 2002 to 2004

Average stream shading decreased between 2002 and 2004 from 88 percent to 75 percent. However, large woody debris increased during this same period from 0.05 m^3/m in 2002 to 0.10 m^3/m in 2004. Water chemistry collected in 2004 includes total alkalinity, pH, and temperature. Total alkalinity was 40 ppm $CaCO_3$ while the pH was slightly acidic at 6.5. Temperature for that day measured 15 ºC. Aquatic MIS data for Long Meadow Creek in 2004 indicated site conditions were excellent in 2004 and 2009, Table 22.

Table 22 - Aquatic MIS Site Condition for Long Meadow Creek			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Long Meadow Creek	7/6/2004	2.66	Excellent – No apparent organic pollution
Long Meadow Creek	8/3/2009	2.88	Excellent – No apparent organic pollution

Unnamed Tributary to Tenmile Creek (1G-C)

The unnamed tributary to Tenmile Creek is a class IV stream with no known fisheries that encompasses approximately one linear mile that drain into Tenmile Creek. Approximately ½ of the stream is naturally-stable with steep gradient bedrock boulder dominated channels. Ten percent of the stream is unstable-sensitive-degraded with sand substrate and gully like characteristics. The remaining portion is stable-sensitive with low gradient sand and silt/clay dominated channels. This drainage is lies within the Tenmile grazing allotment.

Hume, Sequoia, and Pine Flat lakes are the only bodies of water other than the stream courses in this watershed; all three are water impoundments with dams. Sequoia Lake, owned and operated by the YMCA camp, is an earthen dam with a valve and spillway. All of these lakes have been stocked with non-native fish species since the early 1900s. The California Department of Fish and Game stocks these lakes as well as several streams.

Bearskin Creek (1G-D)

Bearskin Creek west of Tenmile Campground contains an SCI site. The site was established in 2003 to monitor the Hume Vegetation Mechanical Thinning project. The final survey was in 2004. Table 23 contains a summary of the SCI sites data.

Table 23 - Bearskin Creek	
Large Wood Debris (m^3/m)	0.24 – 0.3
% Shading	49.2 – 65.6
Temperature (Celsius)	14 - 19
pH (ppm)	7
Alkalinity ($CaCO_3$)	40
Mean Particle Size in mm (D50)	1.3 – 4.0
Width-to-depth Ratio	13 – 26.8
Hilsenhoff Biotic Index - Rating	3.67-2.9 Excellent
Riparian Impact Rating	Moderate
Rosgen Channel Type	C3

Channel morphology surveys along the 108 meter long reach defined it as a low gradient, stable-sensitive, sand dominated, and moderately impacted C4 channel. The channel classification remained the same except for a particle size shift to gravel dominated. Minimal to insignificant changes occurred within the channel morphology. Figure 25 displays a cross-section within Bearskin Creek.

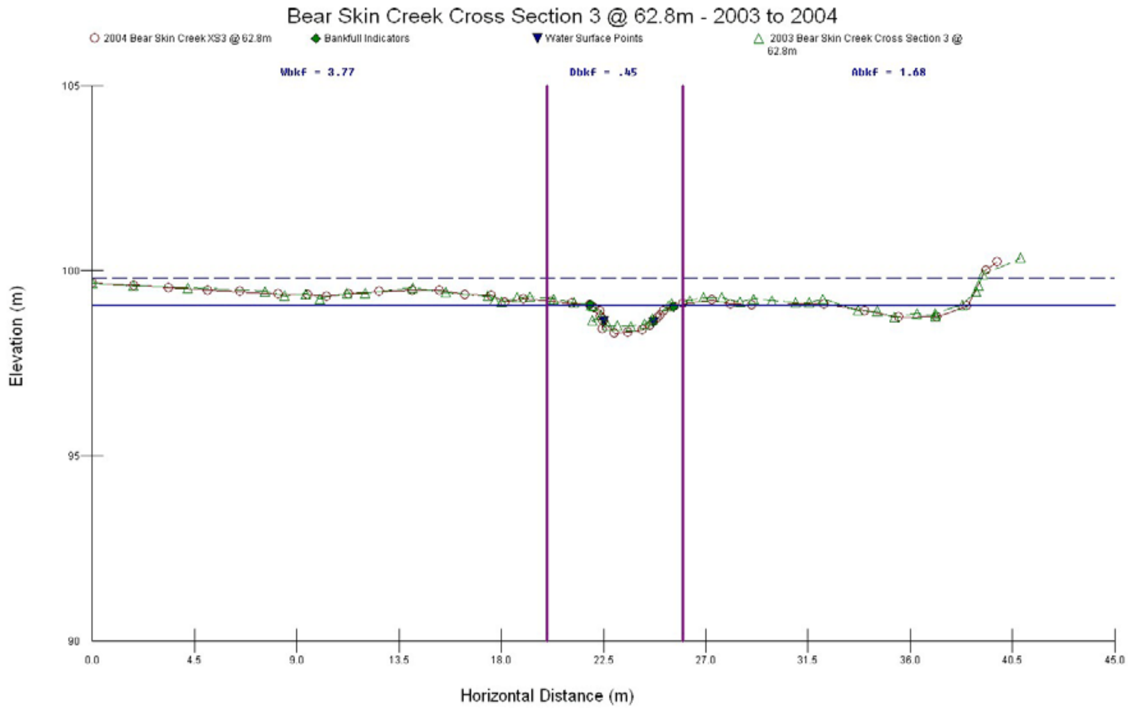


Figure 25 – Bear Skin Creek Cross Section – 2003 to 2004

Both the 2003 and 2004 surveys discovered a shift in particle size distribution. Changes in particle size from 2003 to 2004 were 1.33 mm to 4.0 mm. Even though part of the classification changed from sand dominated to gravel dominated system (C3), the change is minor and considered within the range of natural variability for this type of system. Figure 26 displays the particle size distribution.

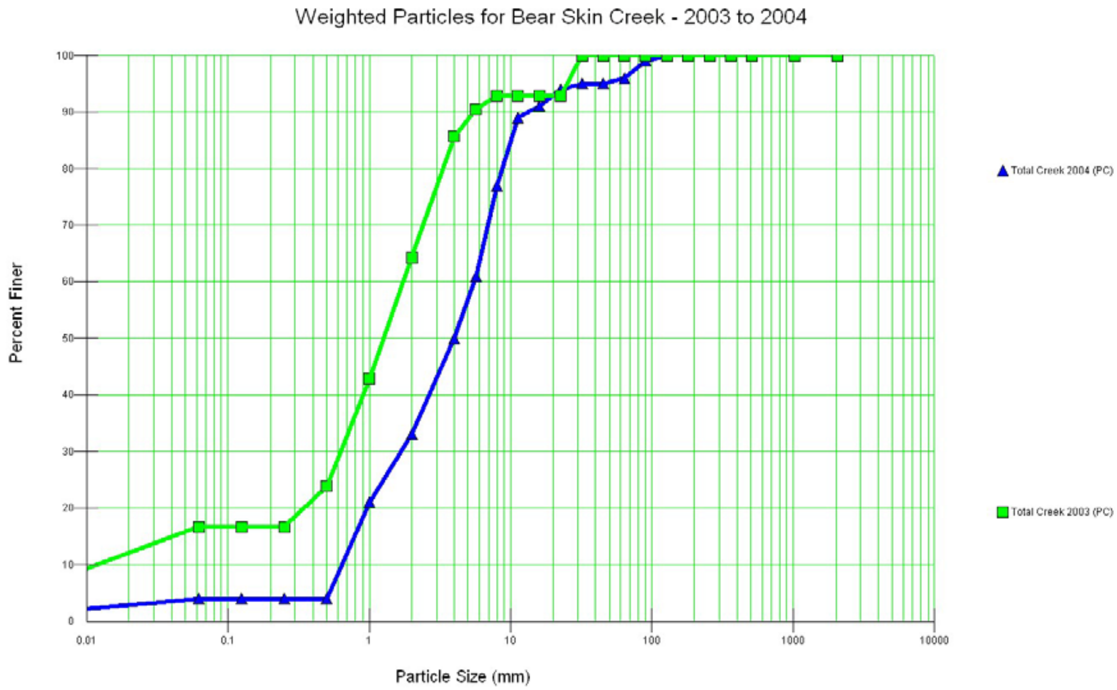


Figure 26 – Bear Skin Creek Particle Size Distribution – 2003 to 2004

Average stream shading increased from 54 percent to 65 percent cover. Large woody debris increased from 0.23 m^3/m in 2003 to 0.42 m^3/m in 2004. Water chemistry data was only collected in 2004 for total alkalinity, pH, and temperature. Total alkalinity was 40 ppm $CaCO_3$ while the pH was neutral at 7.0. Temperature for that day was recorded at 14 degrees C. Aquatic MIS data for Bearskin Creek has excellent to very good site condition (based on scores of 3.67 and 2.90), Table 24.

Table 24 - Aquatic MIS Site Condition for Bearskin Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Bear Skin Creek	7/24/2003	3.67	Very Good - Possible slight organic pollution
Bear Skin Creek	7/7/2004	2.90	Excellent – No apparent organic pollution

Mill Creek Watershed (1803000801)

Mill Creek Basin (19A)

Stream Condition Inventory surveys have been ongoing in Mill Creek Watershed since 2004. Mill Creek was surveyed in 2004 and 2008. Table 25 provides a list of streams surveyed in this watershed.

Table 25 – SCI sites located within Mill Creek Watershed								
Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Mill Creek	18030000108	Mill Creek	Below Cedarbrook	Hume Lake	2004, 2008	B4a	Stable-sensitive	Moderate

Mill Creek (19A-A)

Mill Creek is a class II stream associated with rainbow trout that encompasses approximately 3 linear miles of perennial streams within the Monument boundary. Approximately 2.5 miles of this stream have been surveyed. Some 70 percent of this stream is naturally-unstable with steep cobble dominated channels. The remaining portions are naturally-stable steep bedrock dominated channels. This stream is not associated with cattle grazing.

The Mill Creek SCI site was established for monitoring the Cedarbrook project in 2004. A final survey was conducted post-project in 2008. Table 26 displays a summary of the SCI data.

Table 26 - Mill Creek SCI Summary	
Large Wood Debris (m^3/m)	1.3
% Shading	77.3
Temperature (Celsius)	16
pH (ppm)	7.5
Alkalinity ($CaCO_3$)	150
Mean Particle Size in mm (D50)	90
Width-to-depth Ratio	11.6
Hilsenhoff Biotic Index – Rating	3.07 to 5.02 Good to Excellent
Riparian Impact Rating	Low
Channel Type	B4a

Mill Creek SCI reach is 39 meters long. Surveys determined the reach to be high gradient, naturally-stable, gravel dominated, moderately impacted B3a channel in the 2004 survey and remained so in the 2008 survey. Figure 27 displays cross-section data of Mill Creek for these years.

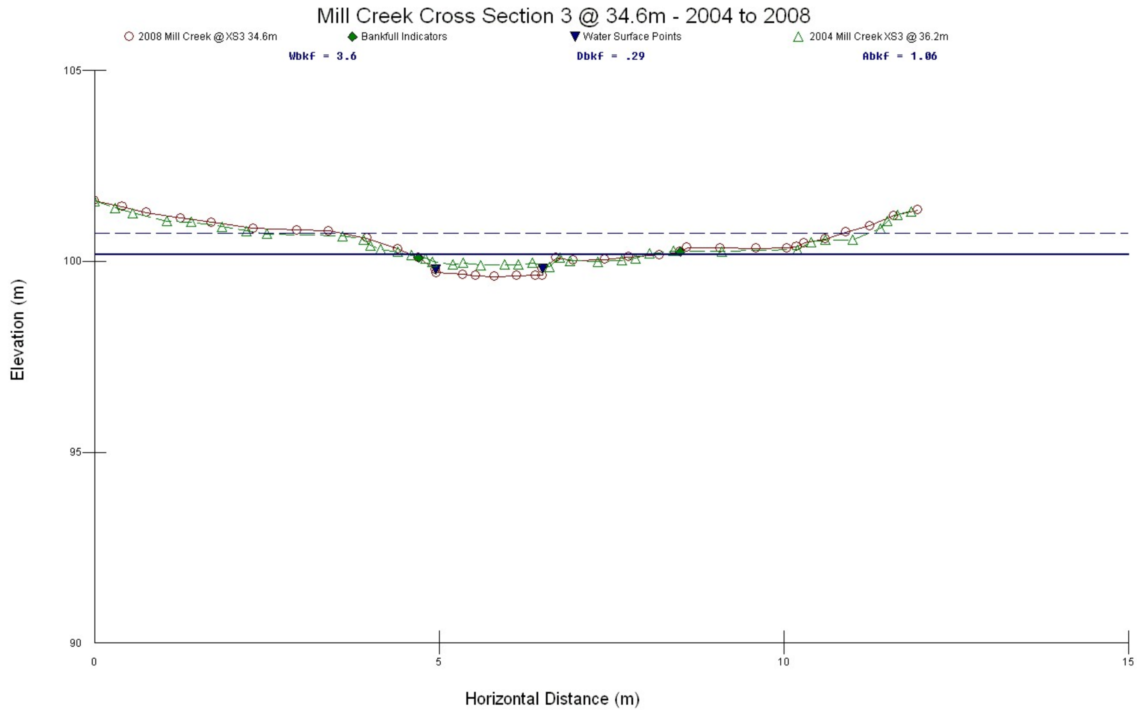


Figure 27 – Mill Creek Cross Section – 2004 to 2008

Changes in particle size distribution occurred between 2004 and 2008. The change is minor as the particles sizes shifted from 1.33 mm to 4.0 mm. Although it changes the classification from sand to gravel, the change is minor and considered within the systems range of natural variability (Figure 28).

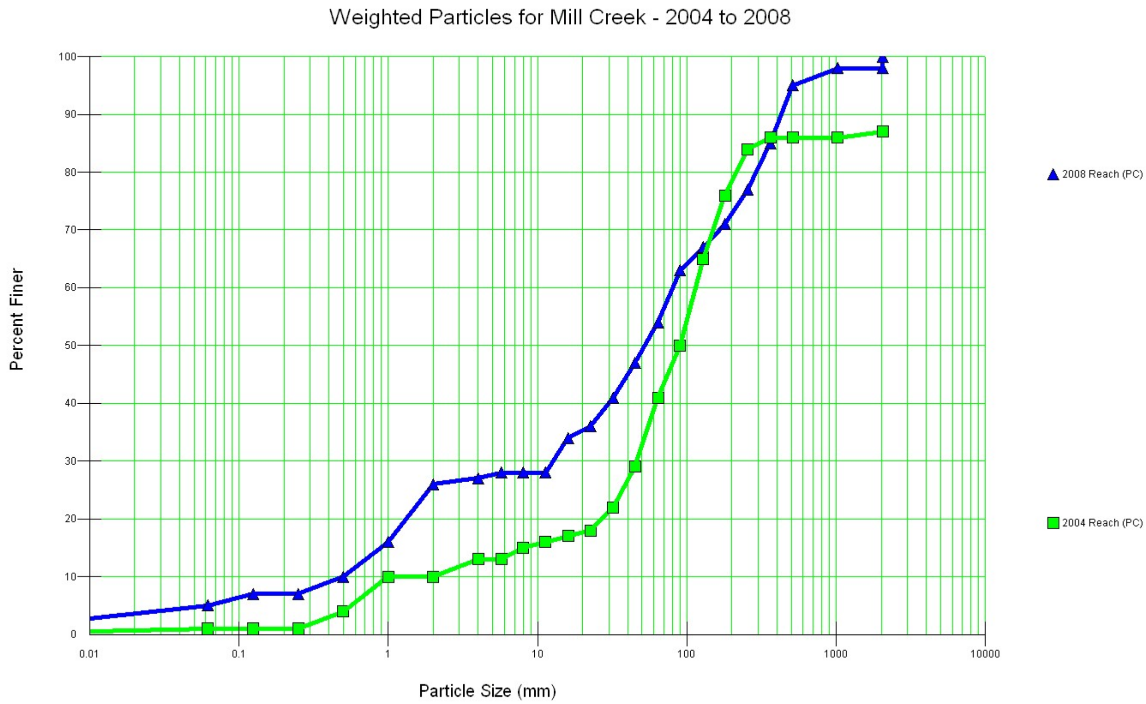


Figure 28 – Particle Size Distribution for Mill Creek – 2004 to 2008

Average shading for 2004 was 77 percent. In 2008 the average shading slightly decreased to 72 percent. Large wood debris average in 2004 was 1.25 m^3/m. Large woody debris average in 2008 had decreased to 0.47 m^3/m.

Water chemistry was collected in 2004 and 2008. Total alkalinity was 150 ppm $CaCO_3$ in 2004 and no alkalinity was recorded for 2008. The pH is basic at 7.5 in 2004 and became slightly acidic at 6.8. A recorded temperature for that day in 2004 was 16 ºC and in 2008 it was 11 ºC.

Aquatic MIS data for Mill Creek has good to excellent site conditions in 2004, 2006 and 2008 (based on scores of 3.07, 3.32 and 5.02, respectively). Sampling performed in 2006 indicated excellent site condition and received a score of 3.32, Table 27.

Table 27 – Aquatic MIS Site Condition for Mill Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Mill Creek	8/3/2004	3.07	Excellent – No organic pollution
Mill Creek	5/25/2006	3.32	Excellent – No organic pollution
Mill Creek	6/4/2008	5.02	Good – Some organic pollution

Kaweah River Basin

Upper Kaweah Basin

The following passage describing the Kaweah Basin was taken from the San Joaquin District, Department of Water Resources, Division of Planning and Local Assistance, Kaweah Ground Water Basin Preliminary Report, and the 1996 Kaweah River Basin Investigation Draft Environmental Impact Statement/Report, U.S. Army Corps of Engineers:

The Kaweah Basin lies between the Kings Basin on the north, the Tule Basin on the south, the Sierra Nevada foothills on the east, and the Kings River Conservation District on the west. Major rivers and streams in the basin include the Kaweah and St. Johns Rivers. The Kaweah River is the primary source of recharge to the area.

The Kaweah River Basin ranges in elevation from 175 feet in the Tulare lakebed to 12,600 feet in the Sierra Nevada. Along the western foothill front, granitic and basic intrusive rock outcrops form outliers of low to irregular hills rising from the valley floor. The topography above Terminus Dam is steep, mountainous terrain with deeply incised canyons. Mountain peaks and ridges characterize the area above 10,000 feet. Below the dam the foothills slope gently to the Tulare lakebed.

The Kaweah River originates from a group of glacial lakes near Triple Divide Peak on the Great Western Divide, a secondary ridge parallel to the main crest of the Sierra Nevada. The Kaweah River is comprised of the North, Middle, and Marble Forks above the town of Three Rivers. Below Three Rivers, the South Fork of the Kaweah confluences into the main drainage at the head of Lake Kaweah. These forks have an overall slope of 350 feet per mile and are fed by numerous short, steep streams with slopes ranging from 400 feet per mile to almost 1,000 feet per mile.

More than one-half of the basin tributary to Lake Kaweah lies within the boundaries of Sequoia National Park. The 561 square-mile watershed above Terminus Dam drains to the west and reaches the flattened slopes of the San Joaquin Valley floor about 2 miles below the dam. As the Kaweah River flows toward the valley floor, many distributaries branch from the main river creating the effect of a delta. A few of the Kaweah River's distributaries eventually reach the Tulare lakebed.

Flood basin deposits consist of poorly permeable silt, clay, and fine sand. Groundwater in the flood-basin deposits is often of poor quality. Lacustrine and marsh deposits consist of blue, green, or gray silty clay and fine sand and underlie the flood-basin deposits. Clay beds of the lacustrine and marsh deposits form aquitards that control the vertical and lateral movement of groundwater. The most prominent clay bed is the Corcoran clay, which underlies the western half of the Kaweah basin at depths ranging from about 200 to 500 feet. In the eastern portion of the basin, groundwater occurs under unconfined and semi-confined conditions. In the western half of the basin, where the Corcoran clay is present, groundwater is confined below the clay (San Joaquin District, Department of Water Resources, Division of Planning and Local Assistance, 1995, Kaweah Ground Water Basin Preliminary Report).

Stream Condition Inventory sites provide information on the range of variability for four reaches inventoried in the Upper Kaweah River basin. These sites included Pierce Creek, Stony Creek, a tributary to Woodward Creek, and Eshom Creek. Parameters for these sites were collected at various times between 2002 through 2008. These values in Table 28 are ranges found in the basin. Additional information is provided at the smaller watershed scale.

Table 28 – Upper Kaweah River Basin	
Large Wood Debris (m^3/m)	0.06 – 3.2
% Shading	60 - 96
Temperature (Celsius)	15 - 17
pH (ppm)	6.1 – 7.0
Alkalinity ($CaCO_3$)	40 – 170
Mean Particle Size in mm	3.1 - 474
Width-to-depth Ratio	14.5 – 24.6
Hilsenhoff Biotic Index –	Excellent (2.86) - Very Good
Riparian Impact Rating	Low to Moderate

The Kaweah basin was rated as a category II in the Unified Watershed Assessment. A category II rating describes watersheds with good water quality that through regular program activities can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems.

Aquatic insect data for the Upper Kaweah River basin indicated those waters sampled have water quality that ranges from excellent aquatic MIS site conditions using the Hilsenhoff biotic ratings. Many of the samples evaluated are taken from the same site. Water quality based on biotic ratings for these watersheds is very close in value and is suggestive of high water quality. Riparian ecotype impact ratings fall in the low riparian impact range.

Stream surface shade ranges between 6 to 96 percent. Large woody material is an important component of stream stability and aquatic habitat. Measurements taken in the Upper Kaweah River basin show a range of large woody material from 0.06 to 3.20 $meters^3$ per meter of stream evaluated. The lowest levels of woody debris were measured in Stony Creek, and the highest levels of woody debris were measured in an unnamed tributary to Woodward Creek.

Values for the Upper Kaweah River basin for width-to-depth ratios have been separated by channel type. Survey data discovered one site on a C channel and four sites on B channels. Measurements taken in these naturally-stable or stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements at those locations.

The majority of pH values range from 6.1 to 7.0 in this watershed basin. Temperature ranges from data that was taken at a point during summer months is from 59 to 63 ºF (15 to 17 ºC). Alkalinity values range from 40 to 170 ppm.

Upper North Fork Kaweah River, South Fork Kaweah River, and Lower Kaweah Watersheds (1803000704, 1803000705, 1803000706)

The upper north fork Kaweah River drainage is on the western slope of the Sierra Nevada. Stony, Woodward, and Eshom creeks flow into the Kaweah River above Kaweah Lake. Dry Creek flows into the Kaweah just below the reservoir. The North Fork of the Kaweah is one of three main forks of the Kaweah River and is fairly typical of the rugged, partially-glaciated river basins of the west side Sierra streams. Floods rarely occur in the upper portion of the Kaweah on the Sequoia National Forest. U.S. Geological Survey stream gauge stations are located on the North Fork of the Kaweah River.

These watersheds are approximately 232,240 acres in total, of which approximately 27,525 are within the Sequoia National Forest and 24,480 are in the Monument. Within these boundaries, there are approximately 1,270 acres in private ownership, and approximately 310 acres are in the U.C. Berkeley-managed Whitaker Forest. Approximately 62,120 acres of the Upper Kaweah drainage are within Kings Canyon and Sequoia National Parks; the remaining 22,900 acres are privately owned. The remaining 112,550 acres are outside the Sequoia National Forest and outside of the Monument.

Elevation in the Upper Kaweah drainage ranges from about 4,000 to 8,500 feet. The basin is comprised predominantly of granite bedrock. Approximately 30 percent of the area is in steep, bedrock boulder-dominated river channels draining into the upper Kaweah River. Approximately 35 percent is in basins and other areas of alluvial deposition, with the remaining 35 percent in the steeper headwater drainages leading to the watershed boundaries.

The wetlands and riparian areas are characterized by narrow steep boulder bedrock-dominated channels, with little riparian vegetation in the Stony and Woodward creek drainages and in the lower Eshom drainage outside national forest lands. Dry and Eshom creeks have more pronounced riparian areas at higher elevations where gentler stream gradients favor meadow and willows associated with boulder to sand and silt substrates. Several of the meadows, such as Pierce Meadow, have standing water in early spring with low gradient meandering channels.

Stream Condition Inventory (SCI) sites provide information on water quality parameters for four reaches in the Upper North Fork Kaweah River basin (Table 29). Ranges for large woody debris, shading, water temperature, alkalinity and other parameters are provided in Table 30. These values are ranges found in the basin. Additional detailed information is provided at the smaller watershed scale.

Table 29 – SCI sites located within Upper North Fork Kaweah River Watershed								
Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Upper North Fork Kaweah River	1803000704	Pierce Creek	Pierce Valley Upper Watershed	Hume Lake	2002, 2006, 2008	B3	Naturally-stable	Low
Upper North Fork Kaweah River	18030000704	Eshom Creek	Above Heartland	Hume Lake	2003, 2005	C4	Stable-sensitive	Moderate

Upper North Fork Kaweah River	18030000704	Stony Creek	Below Stony Creek Store and Campground	Hume Lake	2004	B3	Naturally-stable	Low
Upper North Fork Kaweah River	18030000704	Trib to Woodward Creek	Above Stony Creek near Montecito Sequoia	Hume Lake	2005	B2/1	Stable-sensitive	Low

Table 30 - Range in Channel Attributes, Upper North Fork Kaweah River Watershed

Parameter	Channel Type	
	A and B Channels	C Channels
Large Wood Debris (m^3/m)	0.06-3.2	0.23
% Shading (Range)	59.7-87.2	68-94
Temperature (Celsius)	17	15
pH (ppm)	6.1-6.5	7.0
Alkalinity ($CaCO_3$)	40-170	40
Mean Particle Size in mm (D50)	84.8-474	3.1
Width-to-depth Ratio	14.5-24.6	16.7-24
Hilsenhoff Biotic Index – Rating	2.86-3.24, Excellent	2.90 – 4.0 Excellent-Very Good
Riparian Impact Rating	Low	Moderate
Rosgen Channel Type	B3, B2/1	C4

The South Fork Kaweah, Lower Kaweah, and North Fork Kaweah watersheds encompass approximately 27,250 acres that drains approximately 36 linear miles of perennial streams within the forest and Monument boundaries into the Kaweah River. The greatest portions of these watersheds lie outside the forest and Monument boundaries within the national park. The North Fork Kaweah and Lower Kaweah watershed flow southwest into the Kaweah River. The South Fork Kaweah watershed flows northwest into the Kaweah River adjacent to Terminus Reservoir near the community of Three Rivers.

These watersheds are comprised of six basins that lie within the Monument boundary. Included are: Dry Creek, Eshom Creek, Pierce Creek, Stony Creek, Woodward Creek, and Grouse Creek basins. Stream surveys have not been conducted in the Grouse Creek Basin and are not considered further in this report.

Dry Creek Basin (3A)

Dry Creek (3A-A, B)

Dry Creek Basin encompasses approximately 5,140 acres that drain approximately 4.4 linear miles of perennial streams, which lie in the Monument boundary, south into the Kaweah River. The entire basin is part of the Eshom grazing allotment.

Dry Creek is the only stream within this basin that has been surveyed. Dry Creek is a class III stream associated with rainbow trout. Approximately 3.75 linear miles has been surveyed within the Monument boundary. Naturally-stable moderate to steep gradient bedrock boulder and cobble channels comprise approximately 65 percent of the surveyed stream. Naturally-unstable steep gradient cobble channels comprise approximately 21 percent. The remaining portion is unstable-sensitive-degraded with steep gradient cobble and gravel dominated channels that have abandoned their floodplain and have gully characteristics.

Eshom Creek Basin (3B)

Eshom Creek (3B-A, B)

Eshom Creek basin encompasses approximately 3,900 acres that drain approximately 7.13 linear miles of perennial streams within the Monument boundary into the Kaweah River. This basin is part of the Eshom grazing allotment.

Eshom Creek is the only perennial stream within the basin and approximately 5 linear miles of the stream has been surveyed. Eshom Creek is a class III stream associated with rainbow trout. Approximately 40 percent of the surveyed stream is naturally-stable with bedrock boulder steep gradient channels. Naturally-unstable steep gradient cobble dominated channels comprise approximately 15 percent of the drainage. The remaining portion is stable-sensitive moderate gradient, cobble, gravel, sand, and silt/clay dominated channels.

Northeast of Hartland a SCI site on Eshom Creek was established to monitor the Mechanical Fuels, Dry Eshom Timber Sale, and Disking Fuel Breaks projects in 2003. A post-project survey was completed in 2005. Table 31 below summarizes the collected data for 2003 and 2005.

Table 31 - Eshom Creek	
Large Wood Debris (m^3/m)	0.23
% Shading	68-94
Temperature (Celsius)	15
pH (ppm)	6.5
Alkalinity ($CaCO_3$)	40
Mean Particle Size in mm (D50)	3.1
Width-to-depth Ratio	16.7-24
Hilsenhoff Biotic Index – Rating	2.90 – 4.0 Excellent to Very Good
Riparian Impact Rating	Moderate
Rosgen Channel Type	C4

The 174.5 meter long SCI reach surveyed in 2003 defined the stream channel as a low gradient, stable-sensitive, gravel dominated, moderately impacted C4 channel. No significant changes occurred in 2005

to change these channel characteristics. Figure 29 below displays overlaid cross-sections for Eshom Creek.

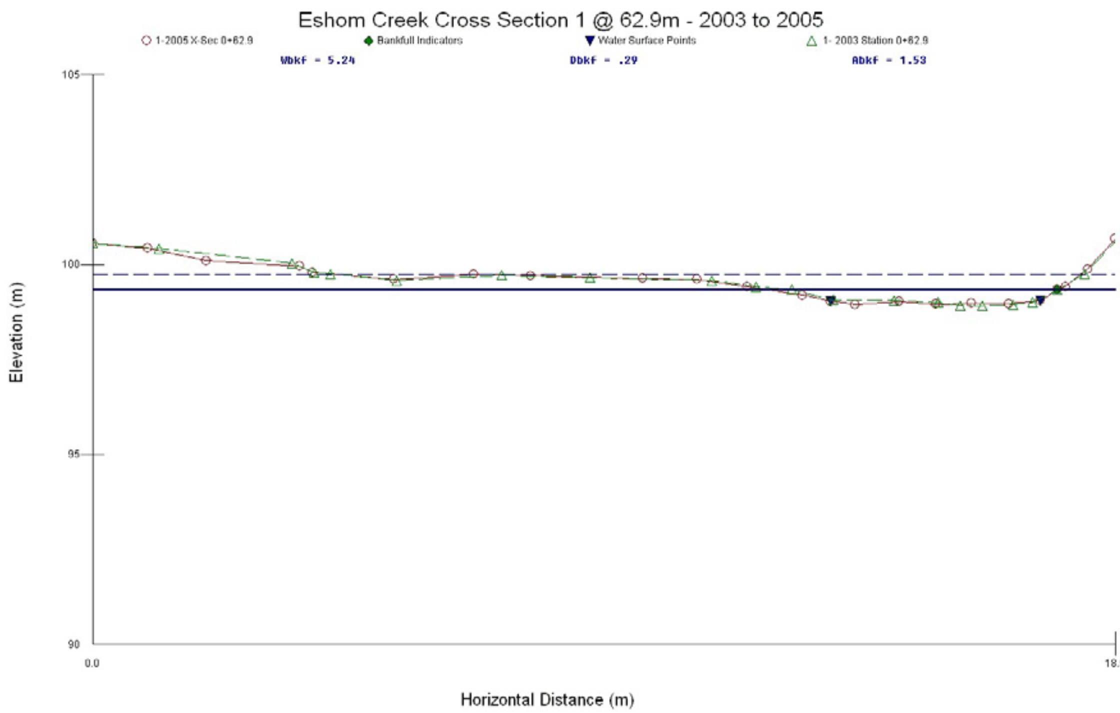


Figure 29 – Cross section of Eshom Creek – 2003 to 2005

Both 2003 and 2005 surveys of particle size distribution determined the channel was a gravel dominated system. Even though it is gravel dominated, a shift occurred to finer sized particles. Changes in particle size from 2003 to 2005 were 13.65 mm to 4.0 mm. The change is minor and considered within the range of natural variability for this type of system. Figure 30 displays the particle size distribution.

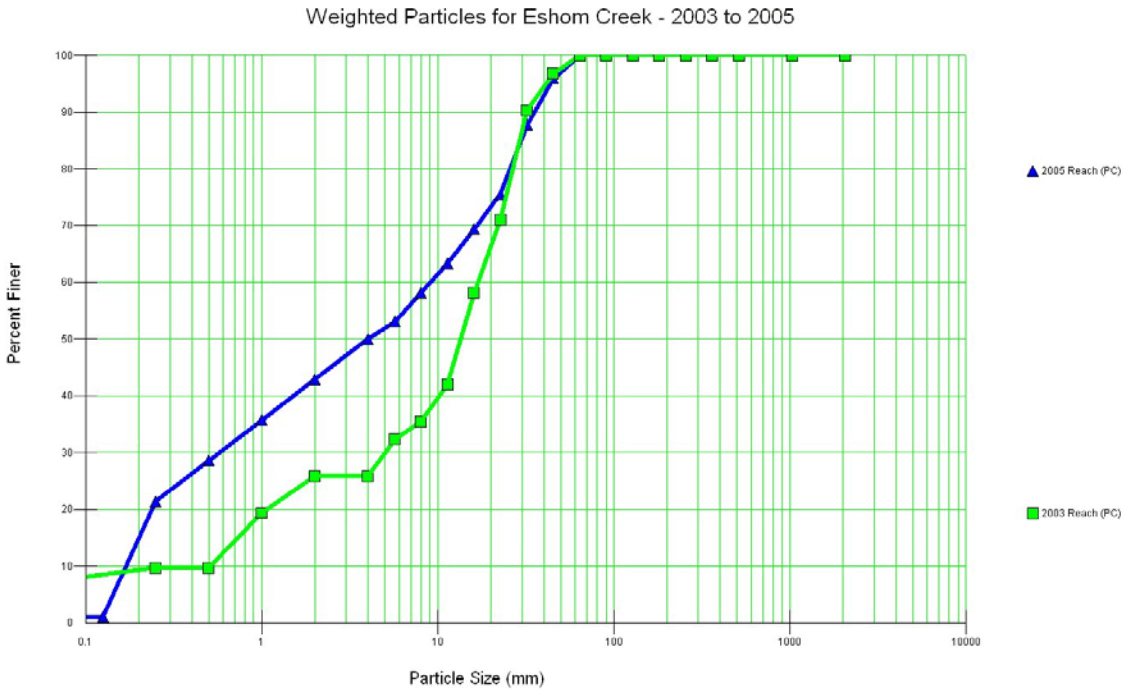


Figure 30 – Particle Size Distribution for Eshom Creek – 2003 to 2005

Stream shading and lard woody debris was collected in 2003. Average stream shading provides 82 percent cover along the reach. Average amount of large woody debris was documented at 0.54 m^3/m.

Aquatic insect communities have biotic indices associated with possible slight organic pollution for 2003. A second sample site was taken in 2003 and indicated excellent condition. Aquatic MIS site condition in 2010 taken at a new location upstream from the old site yielded a rating of very good, Table 32.

Table 32 – Aquatic MIS Site Condition for Eshom Creek			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Eshom Creek	7/22/2003	4	Very Good - Possible slight organic pollution
Eshom Creek	7/22/2003	3.57	Excellent – No apparent organic pollution
Eshom Creek (new)	7/8/10	3.72	Very Good - Possible slight organic pollution

Pierce Creek Basin (3C)

Pierce Creek (3C-A)

Pierce Creek Basin encompasses approximately 4,700 acres that drain approximately 5.3 linear miles of perennial streams within the Monument boundary into the Kaweah River. This basin is part of the Eshom grazing allotment.

Pierce Creek is the only perennial stream in this basin. Approximately 4.5 linear miles of this stream has been surveyed. Pierce Creek is a class III stream associated with small mouth bass and catfish. The largest portion of the surveyed area, approximately 56 percent, is naturally-stable with steep gradient bedrock boulder dominated channels. Approximately 6 percent is a naturally-unstable steep gradient cobble dominated channel. The remaining portion is stable-sensitive low gradient cobble and silt/clay dominated channels.

The SCI site on Pierce Creek is located southeast of Pierce Valley and was established in 2002 to monitor the Mechanical Fuels Project, Dry/ Eshom Timber Sale, and Disking Fuel Breaks projects. The site was surveyed again in 2006 and 2008. The reach is 91 meters long. Table 33 summarizes the SCI data.

Table 33 - Pierce Creek	
Large Wood Debris (m^3/m)	1.0 – 2.4
% Shading	83-88
Temperature (Celsius)	Not taken
pH (ppm)	6.5
Alkalinity ($CaCO_3$)	130
Mean Particle Size in mm (D50)	85
Width-to-depth Ratio	14.5 – 15.8
Hilsenhoff Biotic Index - Rating	2.86 Excellent
Pfankuch Stability Rating	Fair
Rosgen Channel Type	B3

Results of the initial survey of 2002 defined the stream as a moderate gradient, stable-sensitive, gravel dominated, moderately-high impacted B4 channel. There was no change from 2002 to 2006. However, the 2008 survey showed the channel had changed slightly to a moderate gradient, naturally-stable, cobble dominated, moderately impacted B3 channel type. The morphology remained as a B channel, particle size distribution shifted from gravel to cobble. Figure 31 displays cross sections from the surveys.

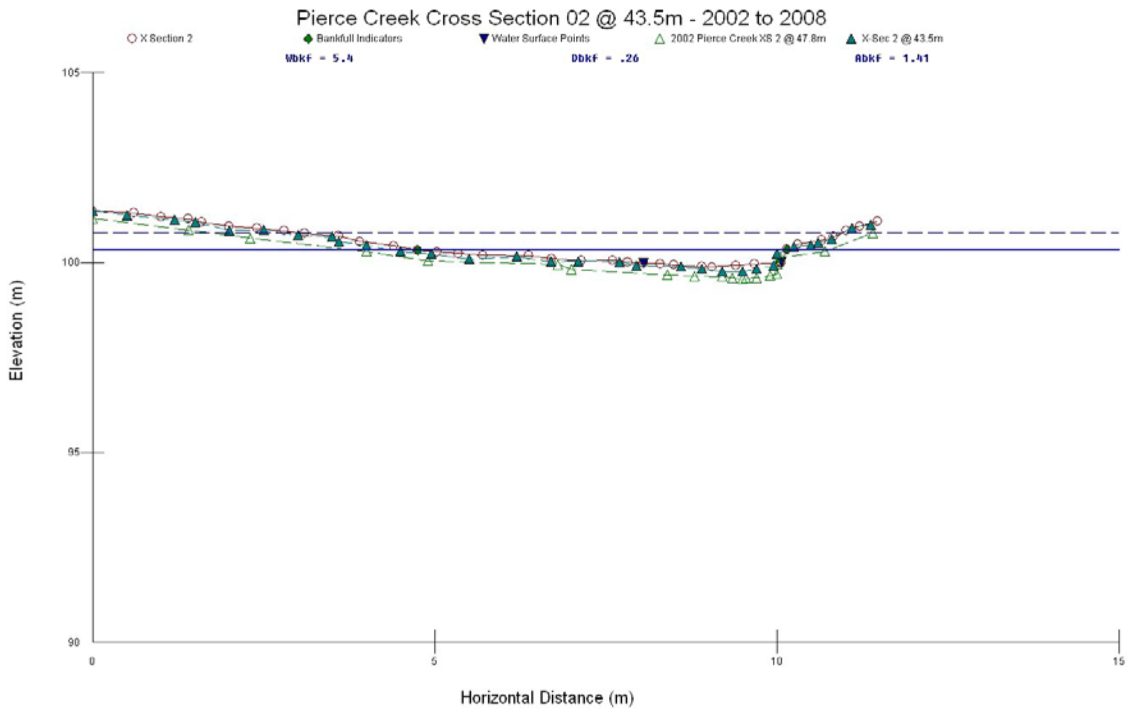


Figure 31 – Cross section of Pierce Creek – 2002 to 2008

Pierce Creek remained a gravel dominated system from 2002 to 2006. However, in 2008 a shift occurred changing the dominant particle size from gravel to cobble. The change in particle size was from 54.5 mm to 84.8 mm from 2002 to 2008. The finer particles from the initial survey indicate a disturbance had occurred prior to the project. These materials were eventually transported out of the reach and allowed the stream to return to its naturally-stable riparian ecotype. Figure 32 displays the particle size distribution for Pierce Creek.

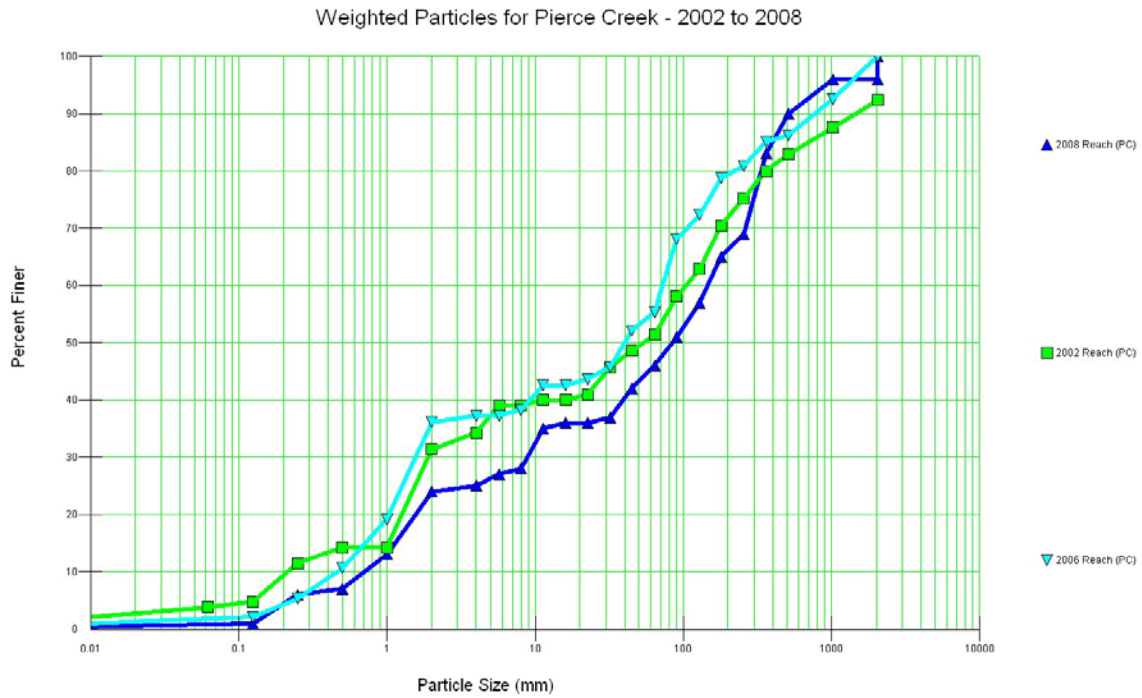


Figure 32 – Particle Size Distribution for Pierce Creek – 2002 to 2008

Average stream shading decreased slightly from 87 percent in 2002 to 83 percent in 2008. Large woody debris decreased from 2.15 m^3/m in 2002 to 0.82 m^3/m in 2008.

Water chemistry data was collected in 2006 and 2008 for total alkalinity, pH, and temperature. Total alkalinity showed an overall increase from 75 ppm in 2006 to 130 ppm $CaCO_3$ in 2008. The pH remained the same, slightly acidic at 6.5 for both years. The only recorded temperature was during the 2006 survey which was 14 ºC.

Aquatic MIS site condition is very good based on sampling in too8 and 2010. Sampling was performed in 2006 however the requisite numbers of individuals was not collected therefore the sample is inconclusive, Table 34.

Table 34 – Aquatic MIS Site Condition for Pierce Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Pierce Creek	7/13/2006	na	inconclusive
Pierce Creek	6/23/2008	3.75	Very Good - Possible slight organic pollution
Pierce Creek	6/23/2010	4.23	Very Good - Possible slight organic pollution

Stony Creek Basin (3E)

Stony Creek (3E-C)

Stony Creek basin encompasses approximately 4,900 acres that drain approximately 8.5 linear miles of perennial streams. The greatest portion of this basin lies within Jennie Lakes Wilderness and is not within the Monument boundary. Approximately 1.5 linear miles of Stony Creek, of which approximately 0.75 linear miles below Stony Creek Campground has been surveyed, lies within the Monument. This basin is part of the Big Meadows grazing allotment.

Stony Creek is a class I stream associated with rainbow trout. The entire surveyed portion of the stream is naturally-stable with moderate to steep gradient bedrock and boulder dominated channels. Stony Creek below the Stony Creek Campground contains a SCI site. The site was established in 2004. Table 35 displays a summary of the SCI data.

Table 35 - Stony Creek SCI Data Summary	
Large Wood Debris (m^3/m)	0.06
% Shading	58
Temperature (Celsius)	Not Collected
pH (ppm)	6.5
Alkalinity ($CaCO_3$)	170
Mean Particle Size in mm (D50)	161
Width-to-depth Ratio	17.5-24.6
Hilsenhoff Biotic Index - Rating	Not available
Riparian Impact Rating	Low
Rosgen Channel Type	B3

Surveys define the channel as a moderate gradient, cobble dominated, naturally-stable, low impact B3 channel type. The surveyed reach length is 115 meters. Figure 33 below displays a cross-section of Stony Creek. Figure 34 displays a graph of the particle size distribution throughout the reach.

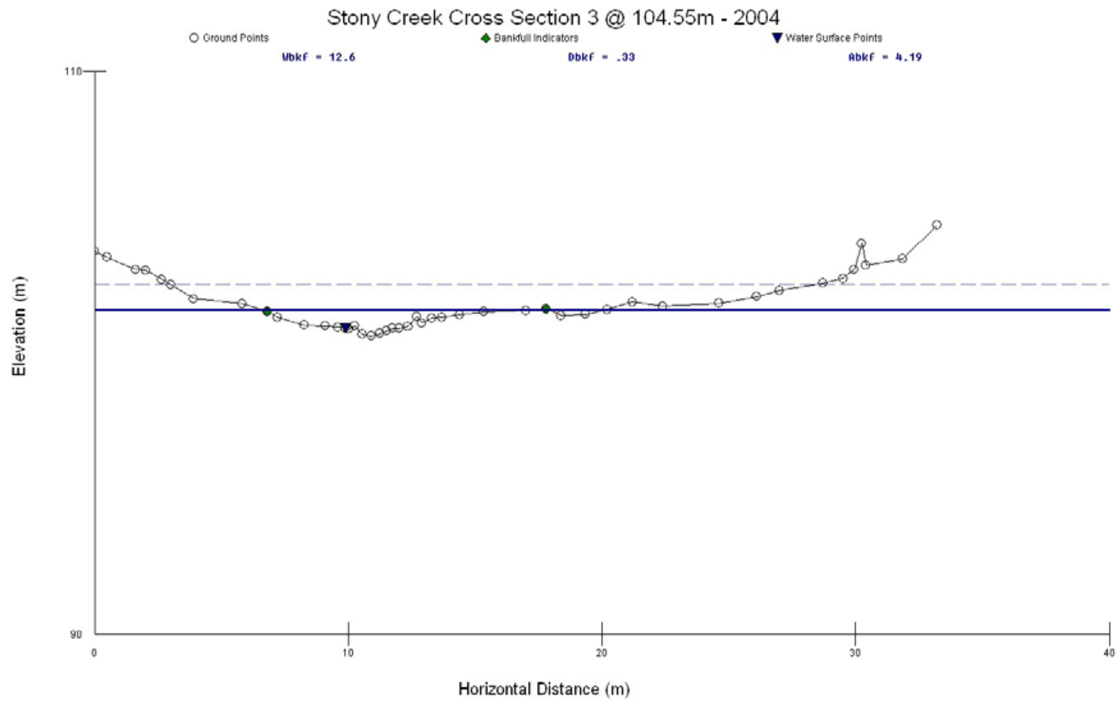


Figure 33 – Cross section of Stony Creek – 2004

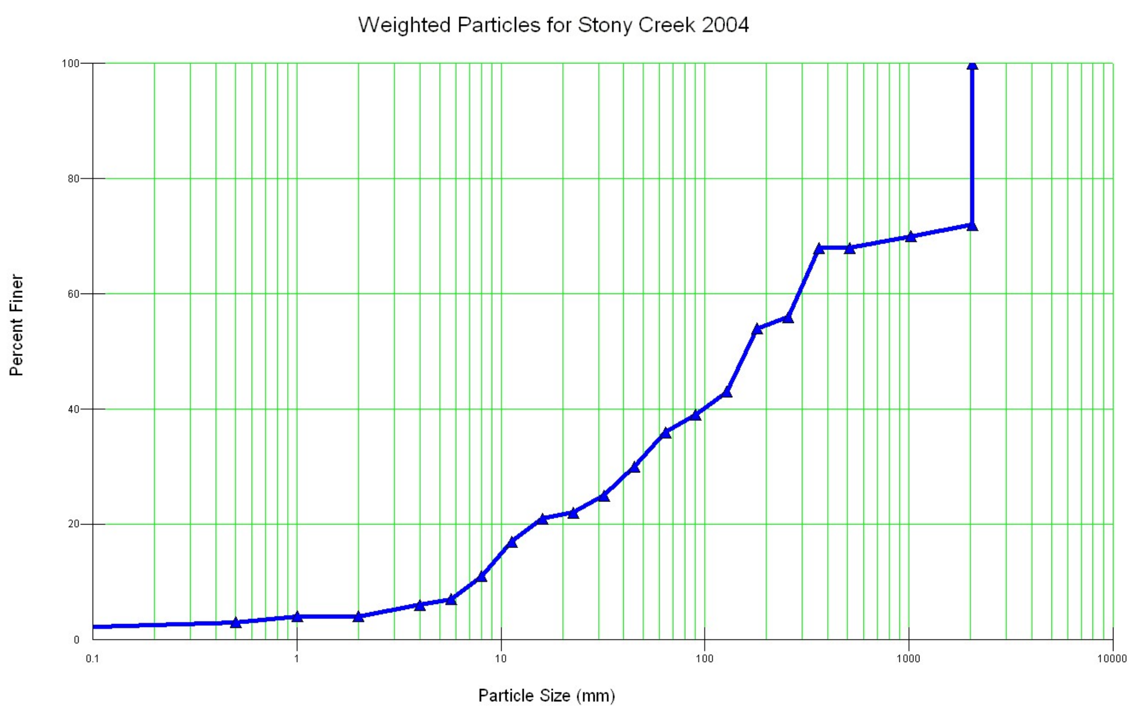


Figure 34 – Particle Size Distribution for Stony Creek – 2004

Average stream shading along the stream provides approximately 59 percent shade cover. Average large woody debris recorded throughout the reach was 0.06 m^3/m. Water chemistry recorded data for total alkalinity and pH. Temperature was not recorded. Total alkalinity was 170 ppm $CaCO_3$ while the pH was slightly acidic at 6.5.

Woodward Creek Basin (3F)

Woodward Creek Basin encompasses approximately 4,500 acres that drain approximately 6.4 linear miles of perennial streams into Stony Creek. Woodward Creek and several unnamed tributaries to Woodward Creek comprise the drainage. This basin is part of the Big Meadows grazing allotment.

Woodward Creek (3F-B, D)

Woodward Creek is a class I stream associated with rainbow trout that encompasses approximately 4.75 linear miles of which all but the uppermost ¼ mile has been surveyed. The greatest portion of this stream, approximately 70 percent, is naturally-stable with steep gradient bedrock boulder dominated channels. Approximately 5 percent is a naturally-unstable steep gradient gravel dominated channel. The remaining portion of the stream is stable-sensitive with moderate gradient cobble and silt/clay dominated channels.

Unnamed Tributary to Woodward Creek (3F-A)

The unnamed tributary to Woodward Creek is a class II stream associated with rainbow trout that encompasses approximately one linear mile. The entire length of this stream has been surveyed and is a naturally-stable steep gradient bedrock dominated channel.

An unnamed tributary to Woodward Creek (Kellogg) near Montecito Lake Resort established an SCI site in 2005 to monitor the Woodward Pre-commercial Thin project. The total reach length for the established site is 112.2 meters. Table 36 displays a summary of the SCI data.

Table 36 - Trib to Woodward Creek (Kellogg) SCI Data	
Large Wood Debris (m^3/m)	3.2
% Shading	69
Temperature (Celsius)	17
pH (ppm)	6.1
Alkalinity ($CaCO_3$)	40
Mean Particle Size in mm (D50)	474
Width-to-depth Ratio	14.7-41
Hilsenhoff Biotic Index - Rating	3.24 Excellent
Riparian Impact Rating	Low
Rosgen Channel Type	B2/1

Surveyed results along the unnamed tributary to Woodward Creek define the stream channel as a moderate gradient, boulder dominated, naturally-stable, low impact B2 channel type. Figure 35 displays a cross-section from the survey. Figure 36 displays a graph of the particle size distribution throughout the reach.

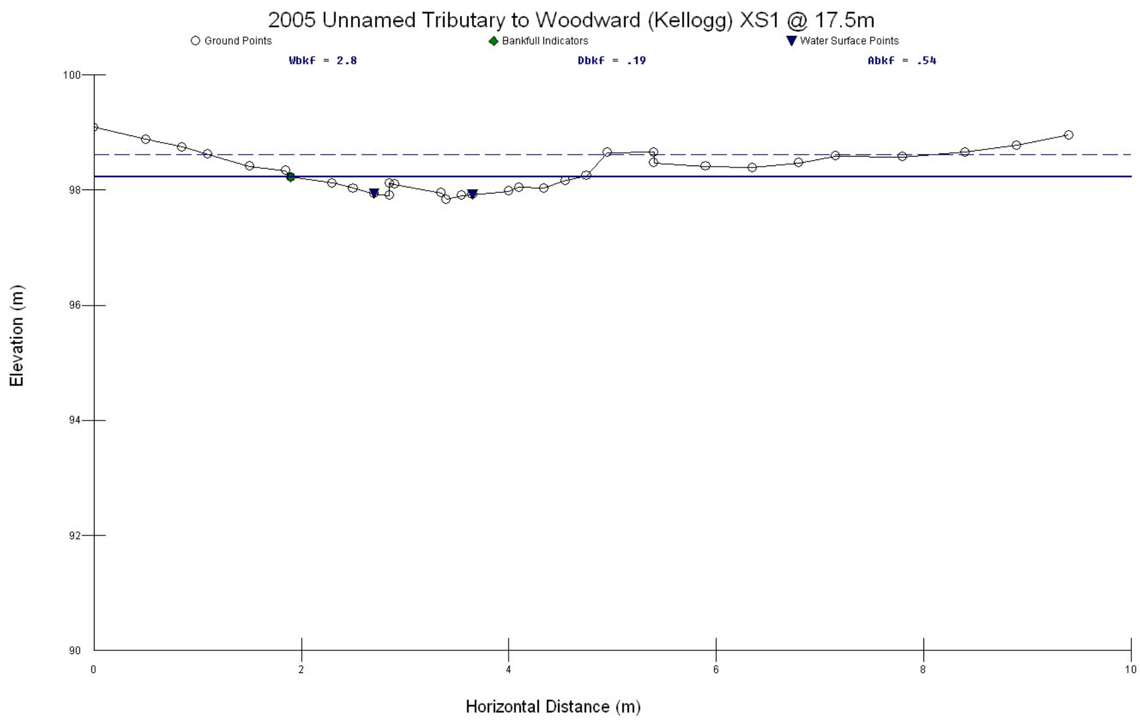


Figure 35 – Cross section of Unnamed Tributary to Woodward Creek - 2005

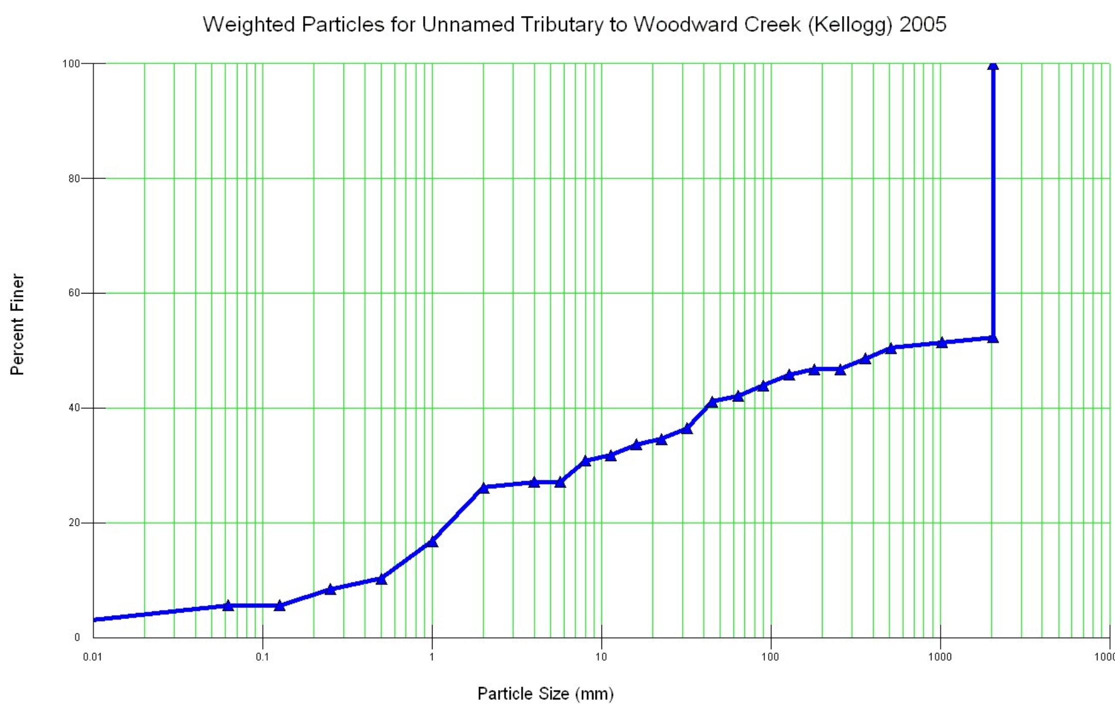


Figure 36 – Particle Size Distribution for Unnamed Tributary to Woodward Creek - 2005

Average stream shading provides approximately 77 percent cover throughout the reach. Average amounts of large woody debris recorded were 3.89 m3/m. Recorded water chemistry data included total alkalinity, pH, and temperature. Total alkalinity measurements discovered 40 ppm $CaCO_3$ while the pH was acidic at 6.1. A recorded temperature for that day was 17 ºC. Aquatic MIS site condition is excellent based on 2005 data. Table 37 contains the measured data.

Table 37 – Aquatic MIS Site Condition for Unnamed Tributary to Woodward Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Unknown tributary to Woodward Creek	7/18/2005	3.24	Excellent - No apparent organic pollution

Grouse Creek Basin (3G)

Grouse Creek basin encompasses approximately 3,250 acres that drain approximately 2.3 linear miles of perennial streams that drain north into the Kaweah River. No stream surveys have been conducted within this basin. It is estimated that basin is in medium good condition. The entire Monument portion of the basin is part of three grazing allotments: North Grouse, South Grouse, and Grouse.

Kern River Basin

UPPER KERN RIVER BASIN

The Upper Kern River basin drains a 2,300-square-mile watershed above Bakersfield, California. The North Fork of the Kern River begins at over 10,000 feet in elevation along the Kings-Kern Divide, Junction Peak, and Triple Divide Peak, which separate the south-flowing North Fork of the Kern from the headwaters of the Kings River and the west-flowing Kaweah River. The North Fork Kern tributary system flows over 400 miles from its headwaters to Lake Isabella. The South Fork of the Kern River begins at over 10,000 feet in elevation in alpine meadows on the Kern Plateau. The South Fork and its tributary streams total over 200 miles and flow from near Mount Whitney to Lake Isabella. The Kern basin is unique because five of California's six major bioregions merge in the valley: the Great Basin Desert, the Mojave Desert, the Coastal Chaparral, the Sierra Nevada, and the Great Valley Grassland. This area includes the largest remaining contiguous riparian forest in California.

Geologic forces uplifted the mountains of the Kern Plateau, which then experienced the down cutting of the Kern River, erosion, volcanic activity, and glaciations over the past 1.5 million years. The combination of these forces left "hanging valleys," or basins with high waterfalls, which are a natural barrier to fish migration. The fish that survived in these cutoff high-elevation streams slowly evolved during the next 100,000 years into unique subspecies of rainbow trout.

The Kern River flows out of the Sierra Nevada Mountains across the Kern River fault. The river undergoes a dramatic change in slope as it spreads out from the confines of the Kern River Canyon onto the grasslands of the southern San Joaquin Valley. This water is used for crop irrigation, domestic water, and allowed to seep into the alluvial river bottom to recharge the aquifers in the old Tulare lakebed.

The upper reaches of the North Fork of the Kern River, from its confluence with the Little Kern River upstream to its confluence with Tyndall Creek, was designated a Heritage Trout Stream in 1999. This stream is within the Golden Trout Wilderness in the Sequoia National Forest and Sequoia National Park. The southeastern edge of the Little Kern River Critical Aquatic Refuge overlaps the Monument boundary. Because the Monument affects so little of this watershed it has been included in the discussion of the Kern River basin.

Over 151 miles of the North and South Forks of the Kern River above Lake Isabella were designated part of the National Wild and Scenic River system in 1987. The upper reaches of the North Fork are remote and accessed only by hiking and horseback. The four-mile section of the North Fork upstream of Johnsondale Bridge, which is about 20 miles north of Kernville, is a catch-and-release wild trout fishery managed under special angling regulations. Deep pools and fast runs characterize this part of the river, which has good trail access.

Stream Condition Inventory sites provide information on water quality parameters for fourteen reaches in the Kern River basin. Ranges for large woody debris, shading, water temperature, alkalinity, and other parameters are provided in Table 38. These values are ranges found in the basin. Additional detailed information is provided at the smaller watershed scale.

Table 38 - Upper Kern River Basin	
Large Wood Debris (m^3/m)	0.00 – 1.10
% Shading	3 - 100
Temperature (Celsius)	6 - 19
pH (ppm)	6.0 – 9.0
Alkalinity ($CaCO_3$)	16 – 140
Mean Particle Size in mm (D50)	0.03 – 87.11
Width-to-depth Ratio	10.34 – 35
Hilsenhoff Biotic Index - Rating	0.67 – 6.00
Riparian Impact Rating	Low – Moderate
Rosgen Channel Type	B, C, and E

Aquatic insect data for the Upper Kern River basin indicates Aquatic MIS site ranges from excellent fair using the Hilsenhoff biotic ratings. Riparian ecotype impact ratings fall in the low riparian impact range. Stream surface shade at non-meadow and meadow environments ranges between 3 to 100 percent.

Large woody material taken in the Upper Kern River basin range from 0.00 to 1.10 $meters^3$ per meter of stream evaluated. The lowest levels of woody debris were measured in Fish Creek, and the highest levels of woody debris were measured in an additional creek outside the Monument, but within the watershed.

Values for the Upper Kern River basin for width-to-depth ratios have been separated by channel type. Survey data discovered one site on a C channel, one site on an E channel, and five sites on B channels. Measurements taken in these naturally-stable or stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements at those locations.

Water chemistry has pH values from 6.0 to 9.0 in this watershed basin. Temperature ranges from data that was taken at a point during summer months from 6 to 19 ºC. Alkalinity values range from 16 to 140 ppm.

The Upper Kern basin was rated as a category II in the Unified Watershed Assessment. A category II rating describes watersheds with good water quality that through regular program activities can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems.

Little Kern Watershed (1803000104)

A small portion, approximately 4,500 acres, of the Little Kern River watershed, lies within the Monument boundary. The watershed comprises the uppermost sections of Fish Creek, Clicks Creek, and North Fork Clicks Creek. The watershed includes Loggy Meadow, Log Cabin Meadow, Junction Meadow, and White Meadow. Of these areas, only Clicks Creek (Lower), and Fish Creek at Loggy Meadow have been surveyed (Table 39). These streams and meadows drain in an easterly direction into the Little Kern River that then drains into the North Fork Kern River. This portion of the watershed is part of the Jordan grazing allotment. Cattle use in this area is concentrated in the meadows.

Natural ranges of variability were developed from the SCI sites over six years of data collection within the Little Kern Watershed. The Monument does not include all of the watersheds within the Little Kern River Watershed. However, to develop a more accurate range of variability, five of the seven SCI sites are located in the Golden Trout Wilderness. These surveys are from Fish Creek, Grey Meadow (South), Tamarack, Willow Creek, and Soda Springs Creek. Table 40 summaries the data ranges by channel type.

Table 39 – SCI sites located within Little Kern Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Little Kern River	1803000104	Lower Clicks Creek	Above Junction Meadow	Western Divide	2002, 2007	E5	Stable-sensitive	Low
Little Kern River	1803000104	Fish Creek	Loggy Meadow	Western Divide	2007, 2008	C6	Stable-sensitive	Low

Table 40 - Range in Channel Attributes, Little Kern River Watershed

Parameter	Channel Type		
	A and B Channels	C Channels	E Channels
Large Wood Debris (m^3/m)	0.00 – 0.19	0.00	0.05
% Shading	13 – 97	20 - 100	3 - 91
Temperature (Celsius)	12 – 16	13	13 – 18
pH (ppm)	6.5 – 7.5	6.0	6.0 - 6.2

Alkalinity ($CaCO_3$)	70 - 88	80 - 84	45 – 80
Mean Particle Size in mm (D50)	22.6 - 82.7	0.03 – 0.04	1.02 – 10.66
Width-to-depth Ratio	10.96 – 33.75	12.96	3.5 - 11.62
Hilsenhoff Biotic Index - Rating	Not analyzed	6.00	2.63
Riparian Impact Rating	Low - Moderate	Low	Low

Clicks Creek (7C-B)

Clicks Creek is a class I stream associated with Little Kern golden trout that encompasses approximately 1.5 linear miles. The headwaters of Clicks Creek are located in Junction Meadow. The portion of the surveyed area within the Monument boundary is of low gradient stable-sensitive gravel and sand dominated channel.

An SCI site was established in 2007 along Clicks Creek (Lower) to monitor grazing activities for the Little Kern Grazing allotment. The surveyed reach length is 216.3 meters. Table 41 summarizes the SCI data.

Table 41 - Clicks Creek (Lower) SCI Data	
Large Wood Debris (m^3/m)	0.05
% Shading	38 - 91
Temperature (Celsius)	13
pH (ppm)	6.2
Alkalinity ($CaCO_3$)	45
Mean Particle Size in mm (D50)	1.02
Width-to-depth Ratio	11.62
Hilsenhoff Biotic Index - Rating	2.63 Excellent
Riparian Impact Rating	Low
Rosgen Channel Type	E5

Surveys determined the stream channel to be a low gradient, sand dominated, stable-sensitive, low impact E5 channel type. Figure 37 displays a cross-section taken along Clicks Creek (Lower). Figure 38 graphs the particle size distribution throughout the reach.

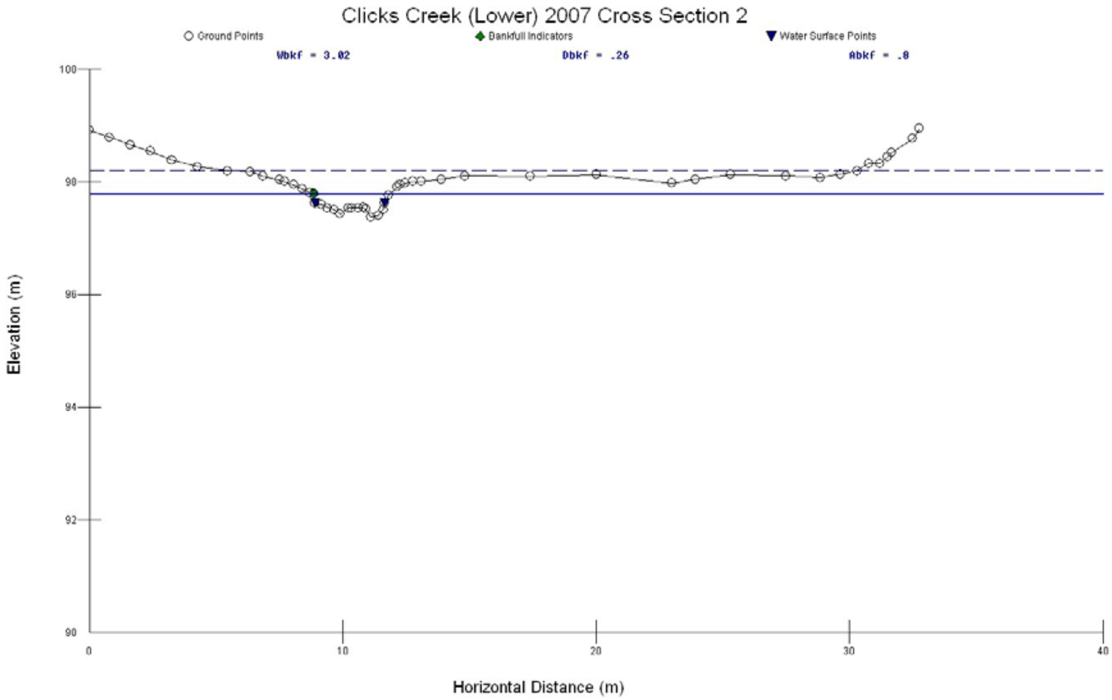


Figure 37 – Cross section of Clicks Creek (Lower) 2007

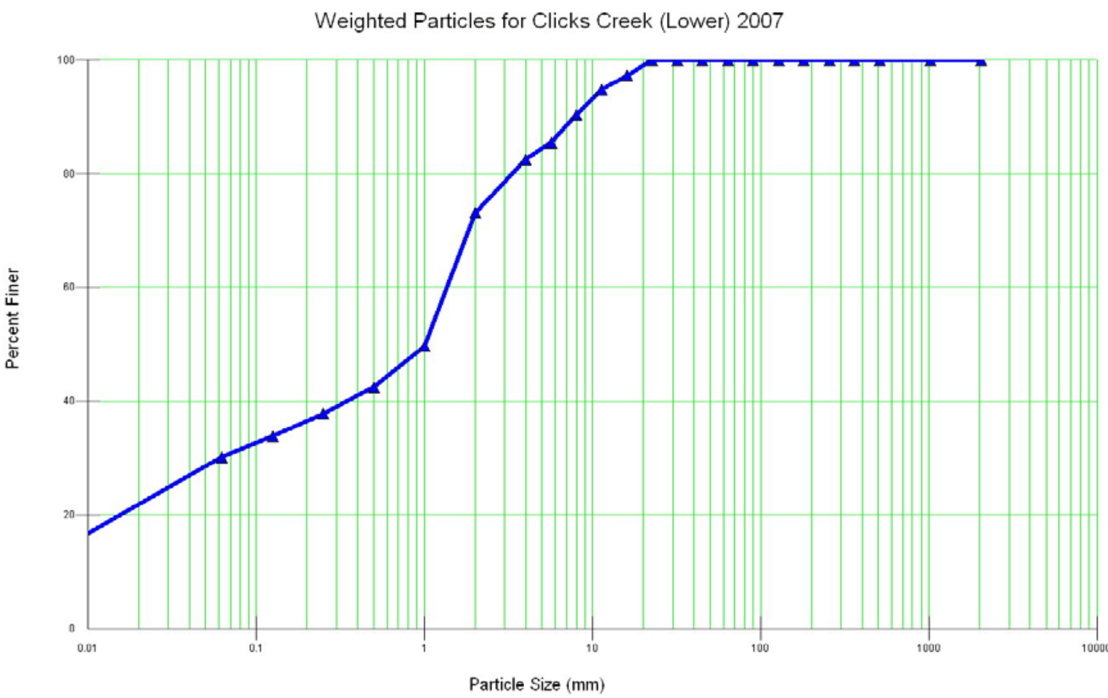


Figure 38 – Particle Size Distribution for Clicks Creek (Lower) 2007

Average stream shade provided approximately 55 percent cover throughout the reach. Average amounts of large woody debris discovered was 0.05 m^3/m. Water chemistry data included total alkalinity, pH, and temperature. Recorded total alkalinity was 45 ppm $CaCO_3$ while pH was acidic at 6.2.

Temperature for that day was 13 degrees C. Aquatic MIS site condition is excellent based on samples collected in 2007, Table 42.

Table 42 – Aquatic MIS Site Condition for Clicks Creek (Lower)			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Clicks Creek	7/3/2007	2.63	Excellent - No apparent organic pollution

Fish Creek (7B-J)

Fish Creek is a class I stream associated with Little Kern golden trout that encompasses approximately 1.75 linear miles. Headwaters of Fish Creek are located in Loggy Meadow. The portion of this drainage that falls within the Monument boundary is a low gradient stable-sensitive cobble, gravel, and sand dominated channel.

Loggy Meadow along Fish Creek contains a SCI site and was surveyed in 2007 and 2008. The site was established to monitor the Loggy Meadow Restoration Project. The total length of the SCI reach is 226.40 meters. Table 43 summarizes the SCI data.

Table 43 - Loggy Meadow along Fish Creek SCI Data	
Large Wood Debris (m^3/m)	0.00
% Shading	20 - 25
Temperature (Celsius)	13
pH (ppm)	6.0
Alkalinity ($CaCO_3$)	80 - 84
Mean Particle Size in mm (D50)	0.03 – 0.04
Width-to-depth Ratio	12.96
Hilsenhoff Biotic Index - Rating	6.00
Riparian Impact Rating	Low
Rosgen Channel Type	C6

Pre-restoration surveys were completed in 2001. These surveys included various components of the SCI survey, but not all of them were needed for restoration purposes. The meadow restoration project was completed in September 2006 to restore the streams access to the floodplain and restore groundwater levels throughout the meadow. As a result of the meadow restoration, the 2001 channel morphology has changed dramatically with the modification of the stream channel.

The stream channel is no longer a declining system. Post-project restoration surveys defined the channel as a low gradient, sand dominated, low impact, stable-sensitive C5 channel type. Surveys in 2008 showed no change in channel morphology, but a slight shift in particle size distribution was noted. Figure 39 displays overlaid cross-sections for Loggy Meadow.

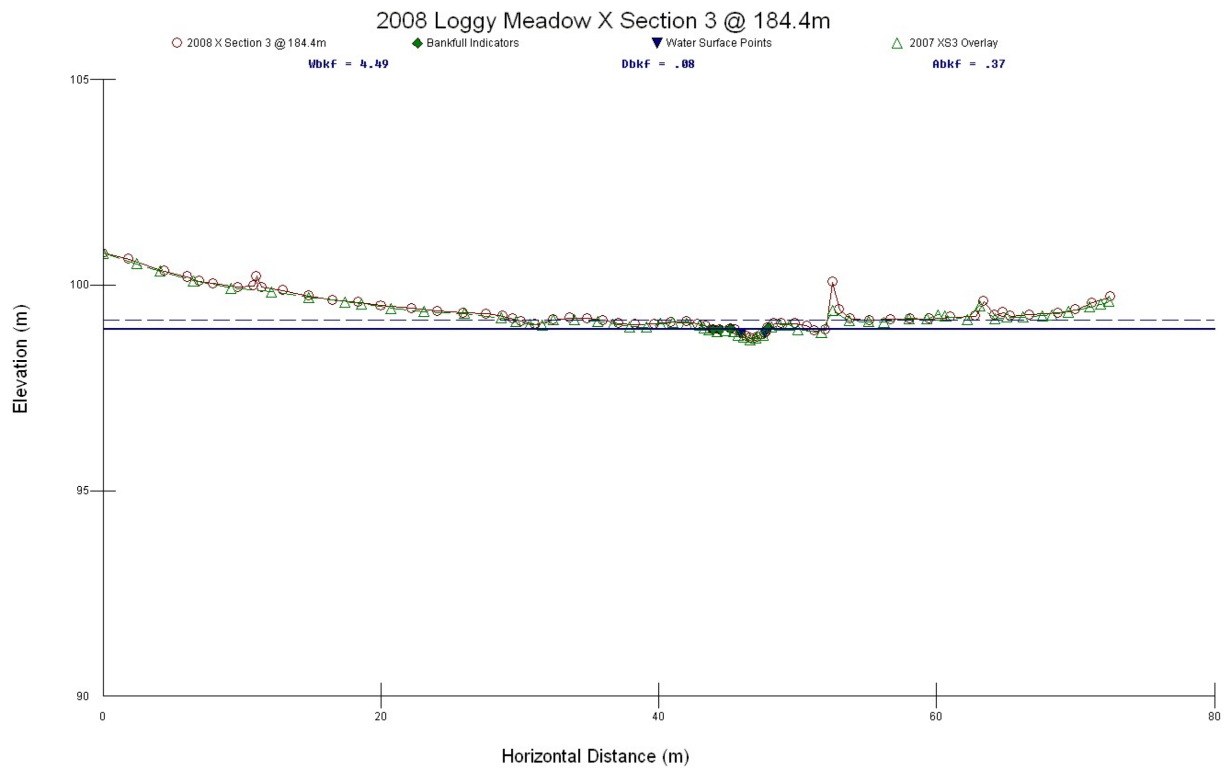


Figure 39 – Cross section of Loggy Meadow – 2001 to 2008

Prior to implementing the Loggy Meadow Restoration Project, the dominant particle size was silt. One year after the restoration took place, 2007, the particle size distribution shifted to a sand dominated system. In 2008, the particle size distribution returned back to a silt dominated system. This suggests a temporary disturbance created by the restoration project. However, the channel quickly returned back to a silt dominated system. Figure 40 displays a graph of the particle size distribution.

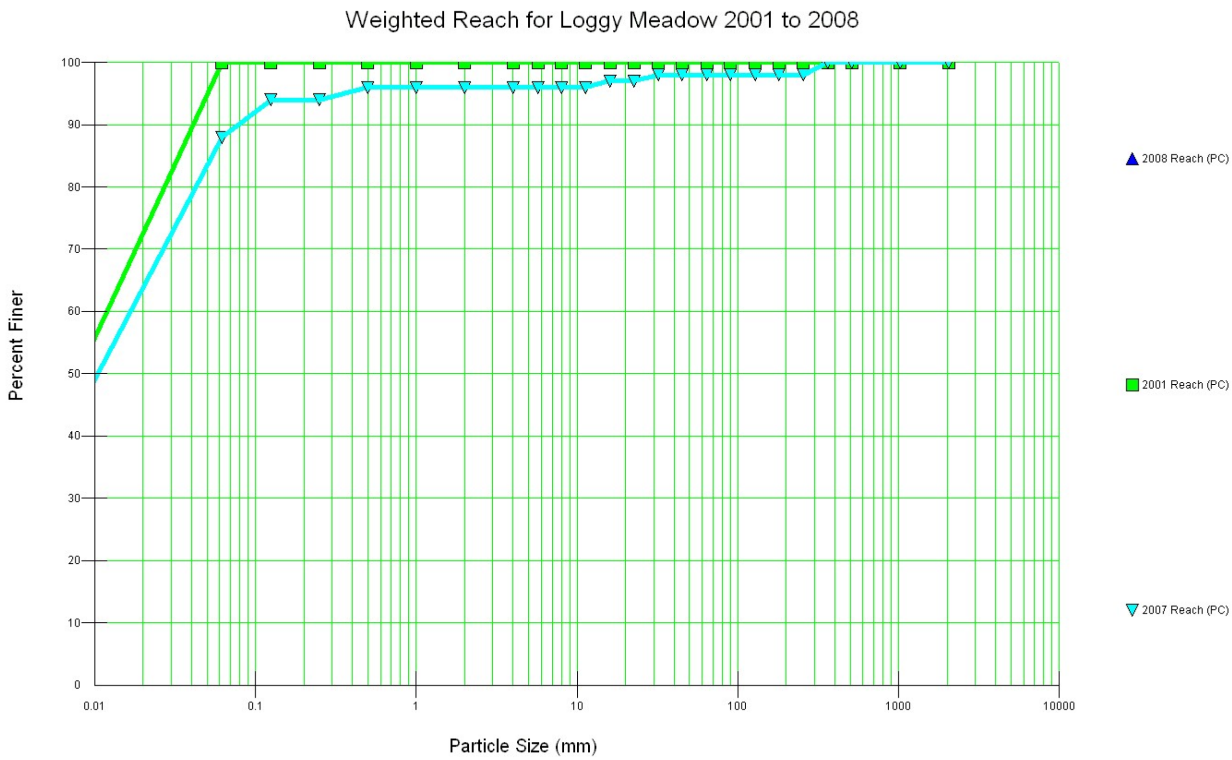


Figure 40 – Particle Size Distribution for Loggy Meadow 2001 to 2008

Average stream shade increased slightly. In 2007 the average stream shading was 20 percent. In 2008 there was an increase to an average of 25 percent cover. There was no change in the average amounts of large woody debris as both years surveyed resulted in 0.00 m^3/m.

Water chemistry was collected in 2007 and 2008 for total alkalinity, pH, and stream temperature. Total alkalinity for Loggy Meadow in 2007 was 84 ppm $CaCO_3$ and in 2008 declined to 80 ppm $CaCO_3$. The pH was acidic at 6.0 during 2007 and 2008. Temperature recorded during the last survey was 13 ºC. Aquatic MIS site condition for Loggy Meadow is fair based on samples collected in 2007 the site was re-sampled in 2008 and yielded inconclusive results based requisite number of individuals(>100), Table 44.

Table 44 – Aquatic MIS Site Condition for Loggy Meadow

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Loggy Meadow	6/25/2007	6.00	Fair, Fairly significant organic pollution
Loggy Meadow	6/25/2008	n/a	inconclusive

Middle Kern River Watershed (1803000105)

This watershed encompasses approximately 204,180 acres. About 200,900 acres are National Forest System lands, of which approximately 73,400 acres lie within the Monument and about 2,120 acres are private land. Less than two acres lie outside the forest boundary.

The Middle Kern River watershed is subdivided by the Kern River and borders the southern edge of the Golden Trout Wilderness. The Monument encompasses this entire watershed west of the Kern River. The watershed extends south to the community of Fairview. The morphology of the drainage basin is U-shaped along the Kern River, suggesting glacial influences. The terrain changes to more moderate slopes as elevation decreases towards the Kern River.

Elevations range from approximately 4,000 feet along the Kern River to a high of 8,270 feet at Needles Lookout. Streams exhibit a dendritic drainage pattern. Dominant channel types in the watershed are steep and moderate gradient, confined, boulder and bedrock channels with deep pools. High flows are associated with the Kern River and occur in the spring. Meadow environments occur most frequently at higher elevations.

There are 58.84 miles of trails in the watershed. There are 1.07 miles of roads per square mile in this watershed (USDA Forest Service 2001). Roads in this watershed are closed from approximately November 15 to late April annually. Ponderosa and R-Ranch are the most developed parcels of private land in the watershed. The majority of the use of these areas is during the summer months, with a small percentage of year-round residents on site.

Human-caused impacts include roads, residences, recreation, grazing, stock use, and vegetation management. Past disturbances have the potential to affect water quality. The main watershed of concern in the Middle Kern watershed is the Holby Creek drainage. This is predominantly due to the effects of urbanization on water quality.

There is a concrete dam at Camp Whitsett and at the base of Long Meadow. An earthen dam exists on private land at R-Ranch. The R-Ranch millpond is now used for recreation; however, this was built originally as part of a logging mill site.

Wells exist at the three organizational camps; horizontal wells exist at Lower Peppermint, Redwood Meadow, and Holey Meadow campgrounds and Jerky Trailhead. The Johnsondale administrative site has a well and water system, and there are wells and community water systems on private lands at Ponderosa and R-Ranch. There are several minor springs and seeps that occur within the watershed.

The Kern Canyon was formed by numerous episodes of uplift, deformation, deposition, and intrusion of igneous rocks. The canyon has steep rock walls, cluttered with bedrock outcrops and large boulders. Alluvial fans have formed along the base of the canyon walls. Soils consisting of fine, well-sorted sandy loams have developed from the alluvial fans. Coarse sandy loams have developed from the weathering of the bedrock, boulders, and steep canyon walls. The steep rock walls and bedrock outcroppings are a result of the watershed having rapid runoff rates combined with concentrated flows.

The basins on the western half of the Middle Kern watershed, within the Monument, form both a physical and ecological boundary. This watershed contains ten subwatersheds including Lloyd Meadow Creek, Nobe Young Creek, Mill Creek, Peppermint Creek, Freeman Creek, Dry Meadow Creek, Needle Rock Creek, Parker Meadow Creek, and sections of the Kern River. These sub-basins have a southern or eastern aspect, drain in a south or southeasterly direction, and feed the Middle Kern River, a wild and scenic river. Drainages outside the Monument within the Middle Kern watershed have a western aspect and flow in a southwest direction into the Kern River. These sub-basins include Durwood Creek, Brush Creek, and sections of the Kern River.

Natural ranges in variability were developed from eight years of data collection within the Middle Kern River Watershed (see Table 45). The ranges were created from the eleven SCI sites. Ranges were developed from eight years of data and the ranges of natural variability displayed in Table 46. The Monument does not include all of the subwatersheds within the Middle Kern River Watershed. However, to develop a more accurate range of variability four of the eleven SCI sites are outside the Monument, but within the watershed. These surveys include Brush Creek, Poison Meadow Creek, Salmon Creek, and Cow Creek.

Table 45 – SCI sites located within Middle Kern River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Middle Kern River	1803000105	Holby Creek	Near Holby Meadow	Western Divide	2002, 2006	B4c/1	Stable-sensitive	Low
Middle Kern River	1803000105	Parker Meadow Creek	At Parker Meadow	Western Divide	2003, 2008	B4c	Stable-sensitive	Moderate
Middle Kern River	1803000105	Bone Creek	Below Last Chance Meadow	Western Divide	2008	B4a	Stable-sensitive	Moderate
Middle Kern River	1803000105	Freeman Creek	Downstream of North Road Crossing	Western Divide	2008	B4c	Stable-sensitive	Moderate
Middle Kern River	1803000105	South Creek	SW of Johnsondale	Western Divide	2008	C4b	Stable-sensitive	Moderate
Middle Kern River	1803000105	Tobias Creek	Near Fairview	Kern River	2002, 2003, 2004, 2005	B3	Naturally-stable	Low
Middle Kern River	1803000105	Dry Meadow Creek	Off Lloyd Meadow Rd below Horse Canyon	Western Divide	2004	B3c	Naturally-stable	Low

Table 46 - Range in Channel Attributes, Middle Kern River Watershed

Parameter	Channel Type	
	A and B Channels	C Channels
Large Wood Debris (m^3/m)	0.00 – 1.1	0.01
% Shading (Ranges)	22 – 100	61 – 100
Temperature (Celsius)	6 – 19	17
pH (ppm)	6.5 – 9.0	6.5
Alkalinity ($CaCO_3$)	16 – 140	120
Mean Particle Size in mm (D50)	4.85 – 87.11	18.64
Width-to-depth Ratio	10.34 - 35	11.05 – 17.97
Hilsenhoff Biotic Index - Rating	0.67 – 5.58	Not Analyzed
Riparian Impact Rating	Low – Moderate	Moderate

Freeman Creek Basin (8A)

Freeman Creek is the northern most drainage in the Middle Kern watershed. Freeman Creek drains approximately 21.6 linear miles and 14,300 acres of streams and meadows. Included are: Freeman Creek and its unnamed tributaries, Lloyd Meadow Creek and its unnamed tributaries, Lloyd Meadow, Jerky Meadow, and Coffee Mill Meadow. Channel condition in the watershed ranges from minimal to moderate high in the naturally-stable and sensitive stable reaches and from minimal to extreme in the naturally-unstable reaches. High gradient bedrock, boulder and cobble channels at its headwaters that comprise approximately 55 percent of the surveyed area characterize the basin. The remaining portion of the basin is comprised of gravel and sand substrate type channels. This basin has high recreation use at Pyles Camp, day use areas, and some dispersed camping.

Freeman Creek (8A-A, B, E)

Freeman Creek, with headwaters found in Coffee Mill Meadow, and its unnamed tributaries range from class I, II, and III type streams associated with rainbow trout, and class IV streams that are not associated with rainbow trout, that encompass approximately 4.5 linear miles that drain into the Kern River. Naturally-stable high gradient bedrock and boulder channels and moderate gradient cobble channels comprise the greatest portion, approximately 65 percent, of the stream. Naturally-unstable steep and fine-grained substrate channels make up approximately 10 percent. The remaining portion is stable-sensitive with stringer meadow like channels. Fisheries habitat component surveys were completed in 1989. High use is concentrated in the Pyles Camp area.

Freeman Creek baseline monitoring was established in 2008 to monitor livestock grazing activities that occur in the area. The reach is 112.5 meters long. Table 47 displays a summary of the SCI findings.

Table 47 - Freeman Creek	
Large Wood Debris (m^3/m)	0.01
% Shading	22 – 100
Temperature (Celsius)	16
pH (ppm)	6.7
Alkalinity ($CaCO_3$)	135
Mean Particle Size in mm (D50)	16
Width-to-depth Ratio	10.34 – 23.88
Hilsenhoff Biotic Index - Rating	3.15-375 Very Good to Excellent
Riparian Impact Rating	Moderate
Rosgen Channel Type	B4c

Surveys discovered the stream channel as a low gradient, gravel dominated, moderately impacted, stable-sensitive B4c channel type. Figure 41 shows a cross-section along Freeman Creek. Figure 42 displays the particle size distribution throughout the reach.

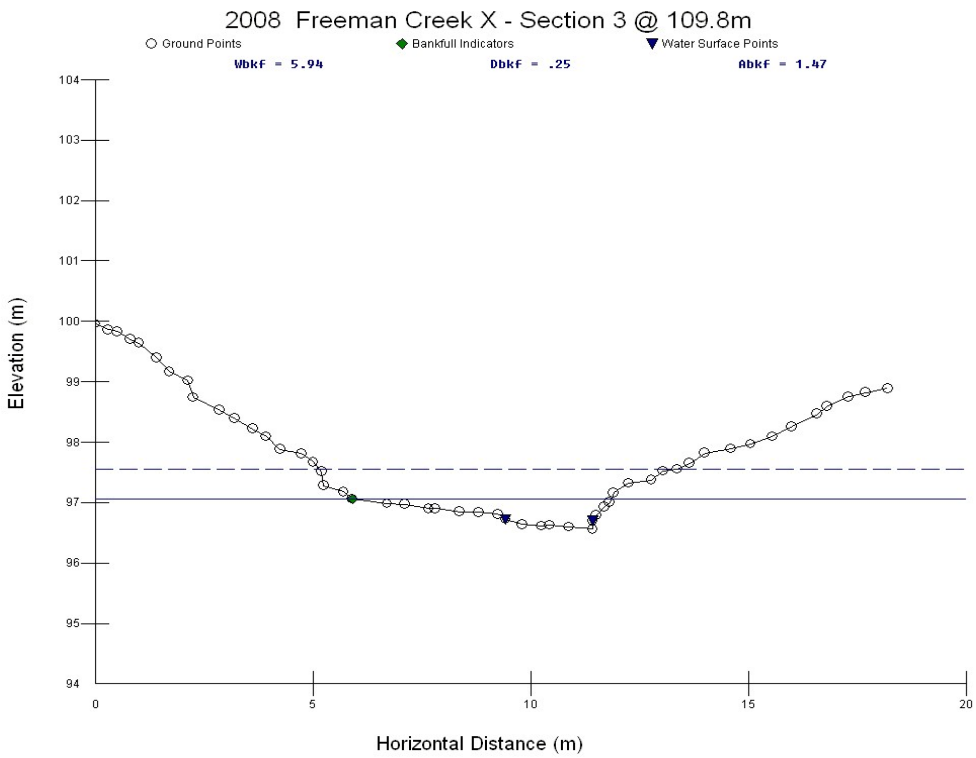


Figure 41 – Cross section of Freeman Creek

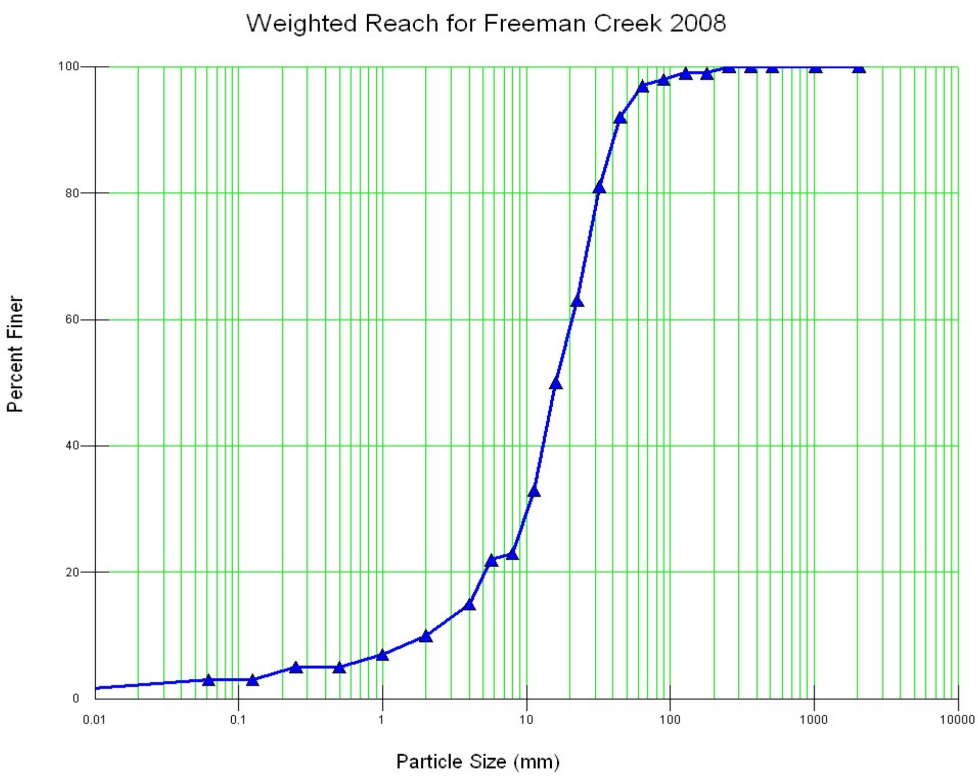


Figure 42 – Particle Size Distribution of Freeman Creek

Average stream shading along the reach provides approximately 58 percent cover. An average amount of large woody debris found throughout the reach was 0.01 m^3/m. Water chemistry was recorded for total alkalinity, pH, and stream temperature. Results revealed total alkalinity at 135 ppm $CaCO_3$. The pH is slightly acidic at 6.7. The temperature for that day was 16 º C. Lloyd Meadow Creek (8A-C). Aquatic MIS site condition for Freeman Creek is Very good to Excellent based on samples collected in 2008 and 2009, Table 48.

Table 48 – Aquatic MIS Site Condition for Freeman Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Freeman Creek	6/23/2008	3.15	Excellent - No apparent organic pollution
Freeman Creek	7/27/2009	3.75	Very Good - Possible slight organic pollution

Lloyd Meadow Creek (8A-C)

Lloyd Meadow Creek is a class III stream associated with rainbow trout that encompasses approximately 3.5 linear miles that drains into Freeman Creek. A section of this creek was surveyed from its confluence with Freeman Creek upstream through Lloyd Meadow approximately two miles. It was determined to be a stable-sensitive moderate gradient channel with gravel substrate that is in moderate condition. High use areas are concentrated at Jerky and Forks of the Kern trailheads. Access to these areas may be adding sediment load to the channel from road surface runoff.

Needlerock Creek Basin (8B)

Needlerock Creek Basin drains approximately 4.1 linear miles and 4,330 acres of streams into the Kern River. There are no meadows associated with this drainage. Needlerock Creek is the main drainage in this watershed and is the only drainage that has been surveyed in the Needlerock sub-basin. There are two unnamed tributaries to the Kern that form drainages in the Needlerock basin. This basin is characterized by steep rugged terrain with narrow bedrock, boulder, cobble and gravel channels. There are no known disturbances associated with this watershed except access roads.

Needlerock Creek (8B-A)

Needlerock Creek is a class III stream with no known fisheries that encompasses approximately 3.25 linear miles that drains into the Kern River. Naturally-unstable extremely steep debris slide dominated channels makeup approximately 60 percent of the surveyed area. The remaining portion is naturally-stable steep bedrock and boulder dominated channels. The drainage is heavily wooded with cedar, fir, pine, alder and oak creating dense canopy. Aquatic vegetation is commonly comprised of mosses, algae, watercress, and mints. There are no high use areas in the area. Dispersed camping near roads and the stream is common.

Peppermint Creek Basin (8C)

Peppermint Creek basin drains approximately 16 linear miles and 9,200 acres of streams and meadows.

Included are: Peppermint Creek, Holby Creek, Peppermint Meadow, Kramer Meadow, and Holby Meadow into the Middle Kern River. Only those streams and meadows upstream of Upper Peppermint Campground have been surveyed. Bedrock, boulder, cobble, and gravel channels characterize the watershed. The residential community of Ponderosa, Upper Peppermint Campground, and Lower Peppermint Campground are areas of high use within this watershed. This basin is not part of a grazing allotment. An administrative study was performed on Holby and Peppermint drainages as part of the forest Cumulative Watershed Effects (CWE) validation. This study occurred from 1992 to 1997 and evaluated macro-invertebrates, fish habitat, channel typing, channel condition, and water chemistry (MULC Report 1999).

Holby Creek (8C-A)

Holby Creek is a class II stream associated with rainbow trout, with headwaters found in Holby Meadow, which encompasses approximately 2.25 linear miles and 2,947 acres that drains into Peppermint Creek. Approximately 28 percent of the stream surveyed was found to be naturally-stable with steep, moderate, and gentle gradient bedrock and boulder channels, in minimal to moderate condition. Approximately 8 percent is naturally-unstable debris slide dominated drainage in extreme condition. The remaining portion is stable-sensitive with meadow channels in minimal to moderate-high condition. High deposition throughout the surveyed reaches was common. Holby Creek flows adjacent to the community of Ponderosa. This is likely contributing to sediment loads present in the channel produced from the roads and residences within the community.

An SCI site was established on Holby Creek near the confluence of Peppermint Creek to monitor the Ponderosa Fuels Reduction Project. It was surveyed initially in 2002 and again in 2006. A previous study on Holby Creek was conducted during 1992 to 1997 regarding water quality. All the data is summarized in Table 49 below.

Table 49 – Holby Creek Water Quality and SCI Survey Data

Holby Creek	1992-1997 Study	2002 – 2006 SCI Surveys
Large Wood Debris (m^3/m)	Not collected	0.00 – 0.10
% Shading	Not collected	51 – 92
Temperature (Celsius)	8-12	14
pH (ppm)	6-8	6.5
Alkalinity ($CaCO_3$)	28-56	35 - 72
Electrical Conductivity (EC)	22.8-46.5	Not collected
Dissolved Oxygen (DO)	6.5-9.4	Not collected
Turbidity (NTU)	0.4-3.15	Not collected
Mean Particle Size in mm (D50)	Not collected	0.17 – 20.4
Width-to-depth Ratio	Not collected	16.71 – 35.00
Hilsenhoff Biotic Index - Rating	0.95-5.58	Not Available
Riparian Impact Rating	Not collected	Low
Rosgen Channel Type	Not collected	B5c/1 to B4c/1

Minor changes have occurred within the reach's channel morphology. The cross-section in Figure 43 illustrates some geomorphologic changes due to the removal and addition of sediment. In 2002, the stream was a low gradient, stable-sensitive, sand dominated channel with bedrock control, identified as a B5/1c channel. Figure 43 displays the cross-sections. An increase of 0.03 square meters of sediment was observed in 2006 accounting for the only change in channel morphology. It remained a B channel with bedrock control (B4/1c). However, the particle size distribution shifted from sand to gravel.

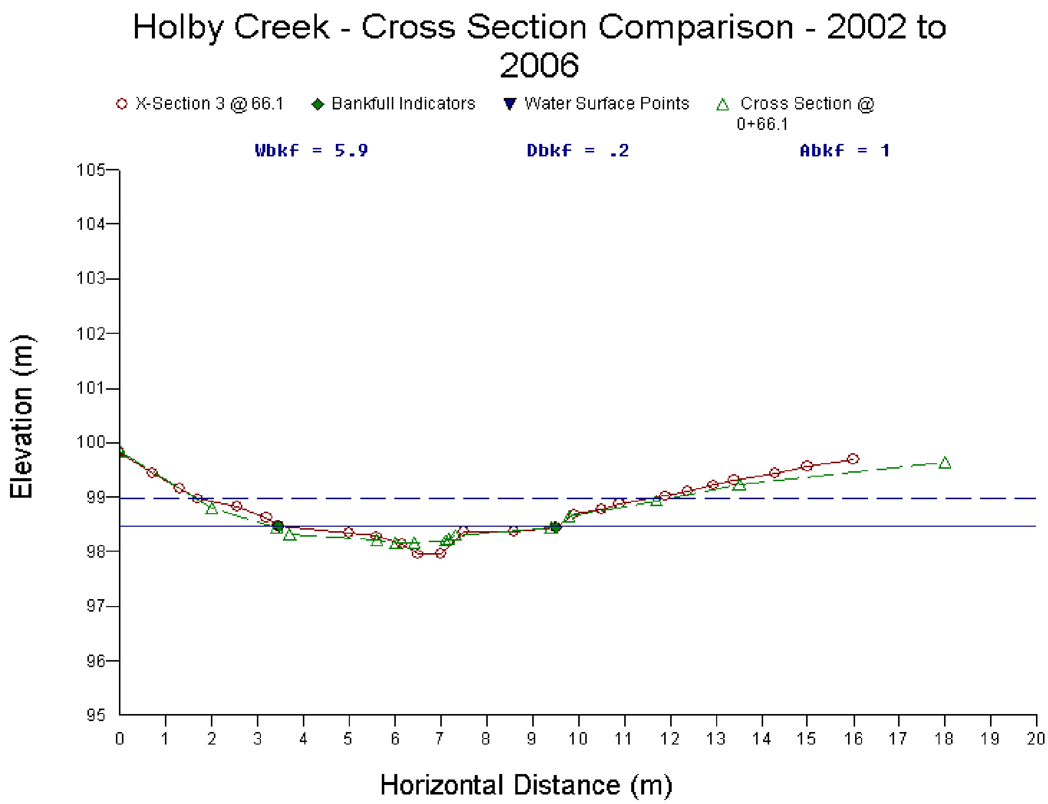


Figure 43 – Cross section of Holby Creek – 2002 to 2006

The shift in particle size distribution from 2002 to 2006 resulted in a gravel dominated system from a sand dominated system (see Figure 44). The linear appearance along the 2006 graph line below interprets as an even amount of material being deposited within the stream, where as in 2002 the particle size distribution is not as linear resulting in finer materials such as sands and silts. The change in particle size distribution from 2002 to 2006 is considered favorable as the channel is able to transport and deposit sediment onto the floodplain during high flows.

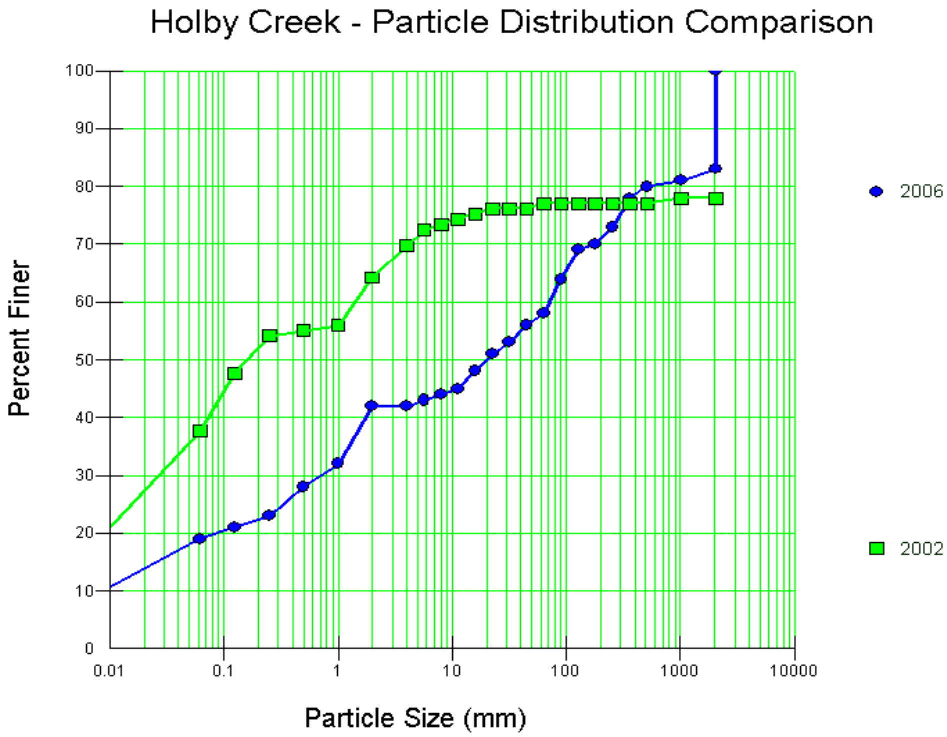


Figure 44 – Particle Size Distribution for Holby Creek – 2002 to 2006

Stream shading increased from 72 percent in 2002 to 75 percent in 2006. Large woody debris averages increased from 2002 at 0.00 m^3/m to 0.1 m^3/m in 2006. Water chemistry was collected in 2006. Total alkalinity for Holby Creek is 72 ppm $CaCO_3$. The pH is slightly acidic at 6.5. A recorded temperature for that day was 14 ºC.

Holby Creek was surveyed prior to SCI implementation from 1992 to 1996. Aquatic MIS site condition was used to represent biological conditions as part of a Cumulative Watershed Effects Study (USDA 2000). Holby Creek was paired with Peppermint Creek and represented the more managed watershed. The study concluded that biological conditions were most like affected by the Ponderosa community upstream of the channel. The site was surveyed again in 2009 as part of the forest monitoring program, Table 50. Aquatic MIS site conditions for this area range from excellent to good and show a decrease in condition over time. The most recent sample in 2009 and one site from 1992 was inconclusive based on the number of required individuals (>100).

Table 50 – Aquatic MIS Site Condition for Holby Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Holby Creek	10/7/1992	na	inconclusive
Holby Creek	10/7/1992	1.72	Excellent – No apparent organic pollution
Holby Creek	8/30/1993	0.95	Excellent – No apparent organic pollution
Holby Creek	8/30/1993	2.67	Excellent – No apparent organic pollution
Holby Creek	10/27/1994	2.63	Excellent – No apparent organic pollution
Holby Creek	10/27/1994	0.67	Excellent – No apparent organic pollution
Holby Creek	10/10/1995	5.58	Fair – Fairly significant organic pollution

Holby Creek	10/10/1995	4.37	Very Good – Possible slight organic pollution
Holby Creek	10/15/1996	5.15	Good – Some organic pollution
Holby Creek	10/15/1996	4.73	Good – Some organic pollution
Holby Creek	6/29/2009	na	inconclusive

Peppermint Creek (8C-B)

Peppermint Creek is a class I stream associated with rainbow trout that encompasses approximately 7.5 linear miles that drains into the Kern River. That section above Peppermint Campground, which has been surveyed, encompasses approximately 3.25 linear miles and 2,702 acres. Approximately 90 percent of the surveyed channel is naturally-stable with steep and moderate gradient bedrock, boulder and cobble dominated channels in minimal to moderate condition. The remaining 10 percent is stable-sensitive with a moderate gradient gravel dominated channel.

Fisheries habitat condition surveys were conducted in 1989. Canopy cover is dense consisting of cedar, fir, pine and aspen. Common aquatic vegetation consisting of mosses, algae, and mint are present. Riparian vegetation is common with many willows and perennial grasses and forbs.

Water quality studies were conducted between 1992 and 1996 along Peppermint Creek. Data collection included temperature, pH, alkalinity, electrical conductivity, dissolved oxygen, and turbidity. Table 51 summarizes water quality using the Hilsenhoff biotic index, while Table 52 summarizes the water chemistry.

Peppermint Creek was surveyed prior to SCI implementation from 1992 to 1996. Aquatic MIS site condition was used to represent biological conditions as part of a Cumulative Watershed Effects Study (USDA 2000). Peppermint Creek (above the western divide highway) was paired with Holby Creek and represented the less managed watershed. This watershed is not grazed and has not been harvested since the early 1970's. The study concluded biological conditions in Peppermint were unaffected by past management activity that took place in the 70's. Aquatic MIS site conditions for Peppermint Creek range from excellent to good. Site condition was inconclusive based on a number of replicate samples in all years the number of required individuals (>100) see Table 51.

Table 51 – Aquatic MIS Site Condition for Peppermint Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Peppermint Creek	10/7/1992	2.15	Excellent – No apparent organic pollution
Peppermint Creek	10/7/1992	1.92	Excellent – No apparent organic pollution
Peppermint Creek	10/7/1992	na	inconclusive
Peppermint Creek	10/7/1992	na	inconclusive
Peppermint Creek	8/30/1993	na	inconclusive
Peppermint Creek	8/30/1993	3.87	Very Good – Possible slight organic pollution
Peppermint Creek	9/3/1993	3.83	Very Good – Possible slight organic pollution
Peppermint Creek	9/3/1993	4.25	Very Good – Possible slight organic pollution
Peppermint Creek	11/4/1994	2.24	Excellent – No apparent organic pollution

Peppermint Creek	11/4/1994	na	inconclusive
Peppermint Creek	11/4/1994	1.04	Excellent – No apparent organic pollution
Peppermint Creek	11/4/1994	na	inconclusive
Peppermint Creek	10/10/1995	na	inconclusive
Peppermint Creek	10/10/1995	4.55	Good – Some organic pollution
Peppermint Creek	10/10/1995	na	inconclusive
Peppermint Creek	10/10/1995	na	inconclusive
Peppermint Creek	10/15/1996	3.30	Excellent – No apparent organic pollution
Peppermint Creek	10/15/1996	2.98	Excellent – No apparent organic pollution
Peppermint Creek	10/15/1996	4.37	inconclusive
Peppermint Creek	10/15/1996	na	inconclusive

Table 52 – Peppermint Water Quality Summary	
Peppermint Creek	1992-1997 Study
Large Wood Debris (m^3/m)	Not collected
% Shading	Not collected
Temperature (Celsius)	6-12
pH (ppm)	7-9
Alkalinity ($CaCO_3$)	16-56
Electrical Conductivity (EC)	19.3-40.0
Dissolved Oxygen (DO)	7.0-10.0
Turbidity (NTU)	0.1-0.9
Mean Particle Size in mm (D50)	Not collected
Width-to-depth Ratio	Not collected
Hilsenhoff Biotic Index – Rating	1.04-4.37
Riparian Impact Rating	Not collected
Rosgen Channel Type	Not collected

South Creek Basin (8I)

The South Creek watershed drains approximately 27 linear miles and 16,500 acres of streams and meadows into the Middle Kern River watershed (1803000105). Included are: South Creek, Horse Creek, Parker Creek, Doublebunk Creek, Bear Creek, Windy Creek, Packsaddle Creek, Mill Creek, Horse Meadow, Parker Meadow, Holey Meadow, Doublebunk Meadow, Powderhorn Meadow, Bear Meadow, Packsaddle Meadow, Clover Meadow and French Joe Meadow. South Creek drains the Kern River, designated a wild and scenic river. The basin has been surveyed at low flows in 1991 and 1992, field verified in 1993, and spot-checked in 1995. A detailed Ecological Unit Inventory was completed for South Creek.

Stream channel composition within the basin is comprised mostly (approximately 68 percent) of naturally-stable bedrock, boulder, and cobble channels. Stable-sensitive, naturally-unstable, and unstable-sensitive-degraded channels exist. Stream conditions range from minimal in the naturally-stable channels to extreme in the naturally-unstable channels. Holey Meadow has substantial resource damage created by active head cuts. Detailed information on stability, meadow characteristics, and fish habitat and population components can be found in the South Creek Ecosystem Analysis (USDA Forest Service 1994). Recreation activity occurs at Johnsondale, Holey Meadow Campground, Redwood Meadow Campground, Thompson Camp, and numerous other dispersed camping sites along streams and channels.

South Creek (8I-J, L, M, N)

South Creek is a class I stream associated with rainbow trout encompassing approximately 5.8 linear miles that drains into the Kern River. All of South Creek is naturally-stable and dominated by bedrock, boulder and cobble substrates lending it to low susceptibility of channel alterations. Channels are steep to moderate bedrock; boulder and cobble A1A, A1, A2, B2, and B3 channel types. Cattle use is associated with much of South Creek. In addition to grazing, roads, and dispersed camping adjacent to South Creek contribute to the sediment load. The primary contributor has been identified as those roads directly adjacent to the creek lacking appropriate energy dissipaters at over-side drains.

Fisheries habitat has been affected by sediment and high water temperatures in approximately 38 percent of the channel. These areas are primarily located where South Creek flows through and below Johnsondale and immediately below Thompson Camp, a dispersed camping area. Cover complexity is low with various types of streambank vegetation and almost non-existent in the Johnsondale area.

Mill Creek near South Creek contains an SCI site. The site was established in 2008 for monitoring the South Creek Road Restoration Project. The reach length is 77.8 meters. Table 53 summarizes data collected from the SCI survey.

Table 53 - South Creek	
Large Wood Debris (m^3/m)	0.01
% Shading	61 – 100
Temperature (Celsius)	17
pH (ppm)	6.5
Alkalinity ($CaCO_3$)	120
Mean Particle Size in mm (D50)	18.64
Width-to-depth Ratio	11.05 – 17.97
Hilsenhoff Biotic Index – Rating	4.19 Very Good
Riparian Impact Rating	Moderate
Rosgen Channel Type	C4b

Data collected defines Mill Creek near South Creek as a moderate gradient, gavel dominated, moderately impacted, stable-sensitive, C4b channel type. Figure 45 shows a cross-section of South Creek. Figure 46 displays the particle size distribution throughout the reach.

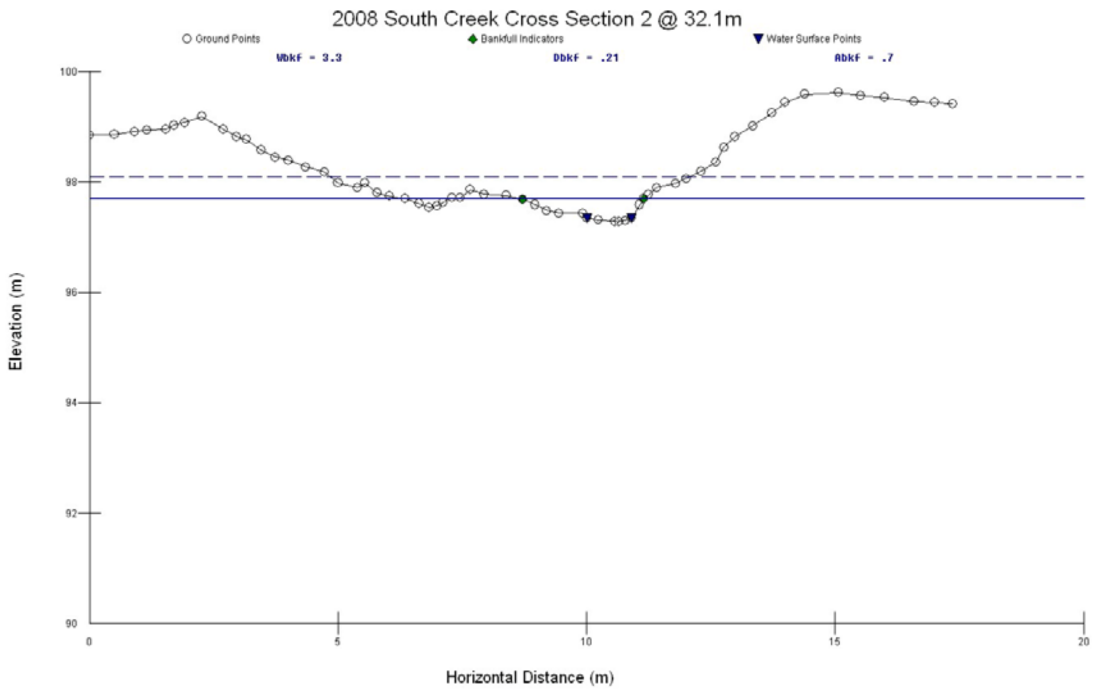


Figure 45 – Cross section of South Creek - 2008

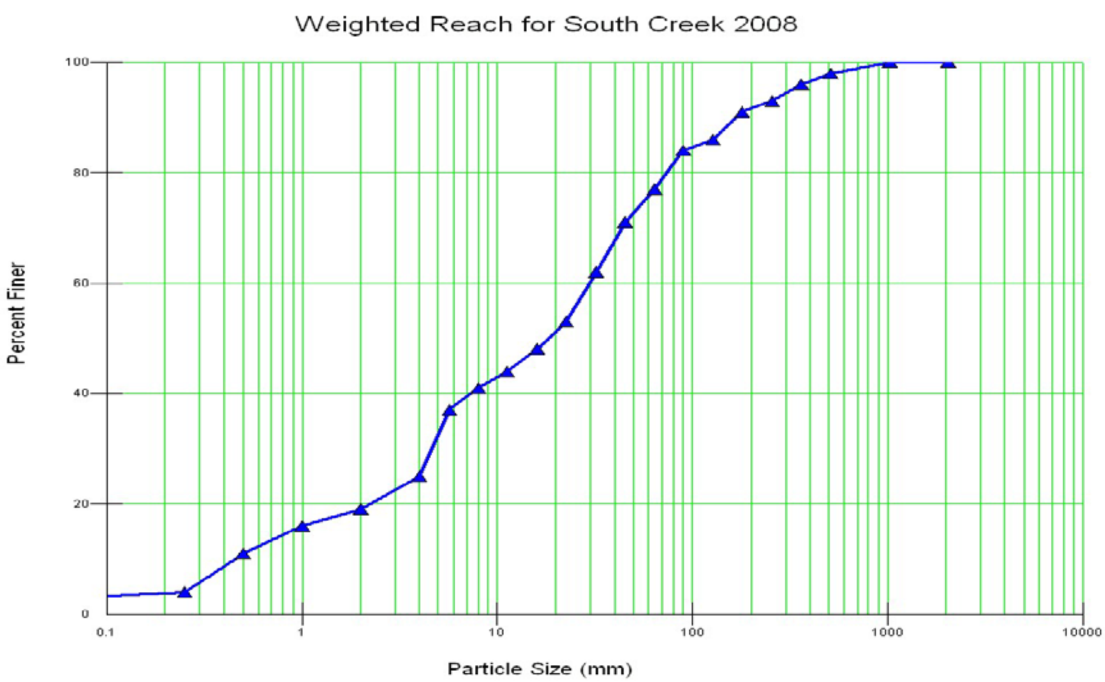


Figure 46 – Particle Size Distribution for South Creek - 2008

Average stream shade provides 87 percent cover along the stream. Average amount of large woody debris is 0.01 m^3/m. Water chemistry recorded total alkalinity, pH, and stream temperature. Observed total alkalinity for South Creek was 120 ppm $CaCO_3$. The pH is slightly acidic at 6.5. The temperature for that day was 17 ºC. Aquatic MIS site condition is very good, Table 54.

Table 54 – Aquatic MIS Site Condition for South Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
South Creek	6/24/2008	3.15	Very Good – Possible slight organic pollution

Horse Meadow Creek (8IA)

Horse Meadow Creek is a class III stream associated with rainbow trout, with headwaters located in Horse Meadow, which encompasses approximately 1.7 linear miles and that drains into Parker Meadow Creek. The largest portion of this stream is meadow dominated stable-sensitive type channels. A small portion near the headwaters is naturally-unstable being comprised of landslide terrain. The remainder of the stream is naturally-stable moderate gradient boulder cobble channel types.

Fisheries habitat is degraded in the stable-sensitive areas along the creek. Low percentages of undercut banks and high width-to-depth ratios have been identified as the primary causes. This is an indicator of unstable stream banks; however, cover complexity is moderate with stream bank vegetation.

Road 22S04 parallels the stream for the entire length of channel with drainage structures contributing sediment directly into the channel. Approximately one-half mile downstream of where road 22S22 crosses the creek restoration in 1993 was conducted to stabilize a head-cut and restore meadow character caused by a loss of bank vegetation and extensive bank cutting.

Parker Meadow Creek (8I-B, C)

Parker Meadow Creek is a class II stream associated with rainbow trout, with headwaters located in Parker Meadow, which encompasses approximately 7.6 linear miles that drains into South Creek. The greatest portion of this stream is naturally-stable dominated by steep to moderate gradient bedrock, boulder and cobble channel types. Approximately one-third of the channel is stable-sensitive meadow environment. The remainder of this stream is unstable-sensitive-degraded down-cut channels, which have abandoned their current floodplain.

Fisheries habitat is degraded by low percentages of undercut banks in the stable-sensitive sections. This is an indicator of unstable stream banks. Cover complexity is low in the stream with stream bank vegetation.

There is a high amount of bank disturbance, sedimentation and an absence of bank vegetation, where road 22S04 crosses Parker Meadow. This is related to road drainage and the presence of cattle grazing in the area. Lower in the drainage near Horse Meadow Creek, the stream exhibits poor riparian vegetation, extensive bank cutting, and high sedimentation in pools due mainly to high cattle use upstream of this area.

In 1993, a restoration project was conducted on an area of the stream adjacent to the Western Divide Highway that was exhibiting high percentages of fine materials and sedimentation in the creek bottom along with bank cutting and scour and deposition. Root wads were placed in the channel to reduce bank cutting, willows were planted and straw blankets were placed along the banks to improve vegetative bank protection.

Parker Meadow Creek SCI site was initially established to monitor the Saddle Helicopter Timber Sale project. Pre-project implementation was surveyed in 2003 and repeated post-project in 2008. Table 55 displays ranges from the SCI survey.

Table 55 – Parker Meadow Creek SCI Data	
Large Wood Debris (m^3/m)	0.003 – 3.24
% Shading	16 – 86
Temperature (Celsius)	19
pH (ppm)	6.8 – 7.0
Alkalinity ($CaCO_3$)	64
Mean Particle Size in mm (D50)	4.85 – 8.44
Width-to-depth Ratio	13.17 – 22.75
Hilsenhoff Biotic Index – Rating	3.00 – 3.08 Excellent
Riparian Impact Rating	Moderate
Rosgen Channel Type	B4c

Resurveying the channel in 2008 discovered all cross-section stakes were removed. The data collected remains relevant for classification of the system. Surveys for 2008 re-established cross section pins as close to the original 2003 cross-section locations as possible for comparison. Surveys from 2003 defined the channel as a low gradient, gravel dominated, stable-sensitive, B4c channel type. The 2008 survey defined the channel as a low gradient, gravel dominated, moderately impacted, stable-sensitive, B4c channel type. Figure 47 displays a cross section of Parker Meadow Creek.

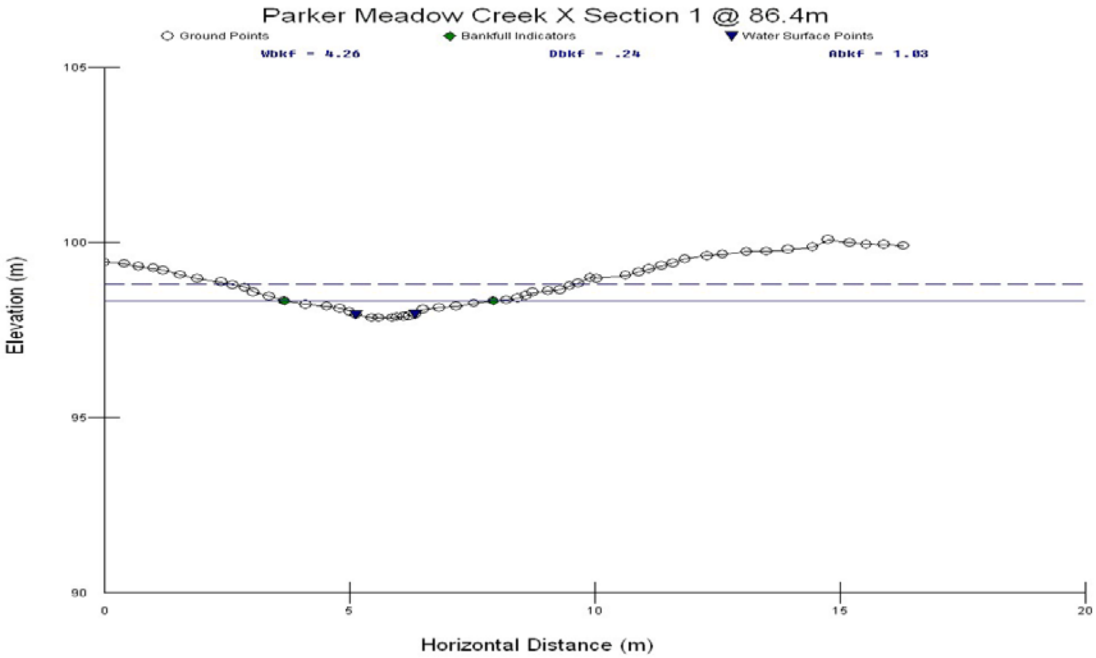


Figure 47 – Cross section of Parker Meadow

Particle size distribution became slightly coarser between 2003 and 2008. Particle sizes for 2003 were gravel dominated (4.85 mm) and remained gravel dominated (8.44 mm) in 2008. Figure 48 displays the particle size distribution for both surveys.

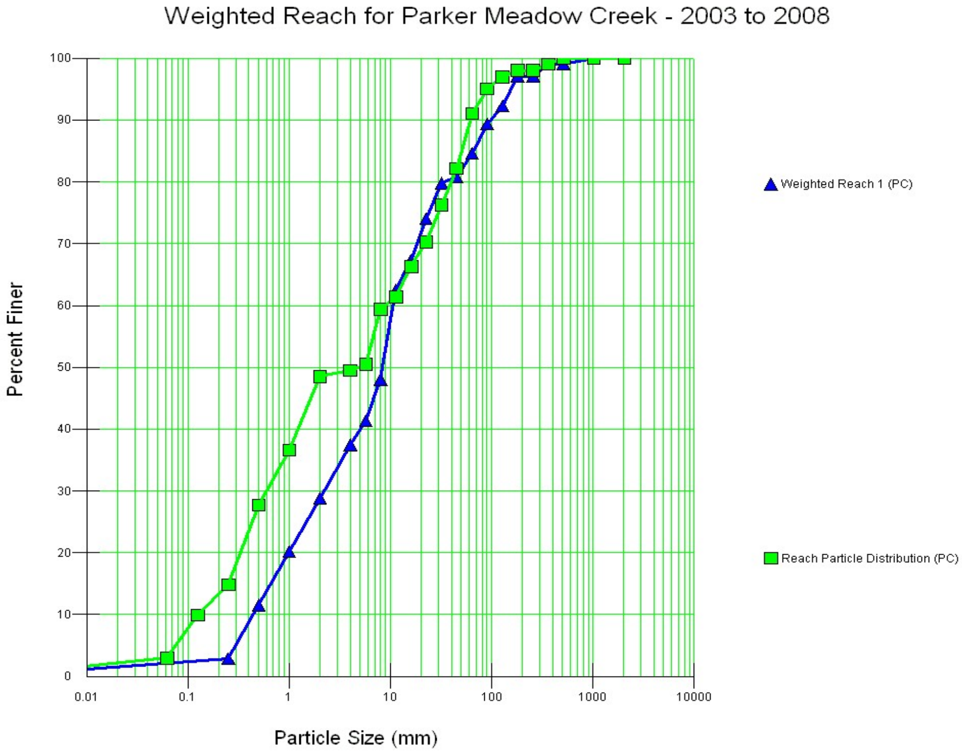


Figure 48 – Particle Size Distribution for Parker Meadow from 2003 to 2008

Average stream shading resulted in an overall increase from 2003 to 2008. Average stream shading in 2003 provided 33 percent cover and in 2008 increased to 43 percent. Large woody debris decreased from 2003 to 2008 from 3.24 m^3/m to 0.003 m^3/m. Water chemistry recorded total alkalinity, pH, and stream temperature for 2003 and 2008. Total alkalinity for Parker Meadow Creek was not recorded in 2003, but in 2008 measured 64 ppm $CaCO_3$. The pH was neutral at 7.0 in 2003 and slightly acidic at 6.8 in 2008. Stream temperature recorded in 2008 was 19 ºC. Aquatic MIS site condition for Parker Meadow Creek is excellent based on a 2003 sample. Additional sampling was performed in 2008 and 2009 however the requisite number of individuals were not collected resulting in inconclusive results, Table 56.

Table 56 – Aquatic MIS Site Condition for Parker Meadow Creek

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Parker Meadow Creek	8/7/2003	3 & 3.08	Excellent No apparent organic pollution
Parker Meadow Creek	7/9/2008	na	inconclusive
Parker Meadow Creek	8/3/2009	na	Inconclusive

Doublebunk Creek (8I-D)

Doublebunk Creek is a class II stream associated with rainbow trout, with headwaters located in Doublebunk Meadow, which encompasses approximately 2.9 linear miles that drains into Packsaddle Creek. The largest portion of this stream is naturally-stable steep to moderate bedrock/boulder/cobble dominated channel. Approximately 20 percent of the stream is unstable-sensitive-degraded down cut channel disconnected from its floodplain. The remainder of the stream is stable-sensitive meadow environment.

Fisheries habitat is degraded by low percentages of undercut banks, high stream temperatures, and high width-to-depth ratios. These are indicators of unstable stream banks and poor water quality. Cover complexity is low with some stream bank vegetation. There are very high amounts of fine grained materials in the creek, a lack of riparian vegetation on the stream banks, extensive bank cutting, and high amounts of scour and deposition in areas affected by runoff from roads and cattle use.

Bear Creek (8I-E, H)

Bear Creek is a class II stream associated with rainbow trout, with headwaters found in Powderhorn Meadow, which encompasses approximately 2.5 linear miles that drains into South Creek. Approximately one-half of the stream is naturally-stable dominated by steep bedrock and boulder with moderate gradient cobble inclusions. Approximately 30 percent is unstable-sensitive-degraded down cut channel that has a lowered water table and disconnected floodplain. Stable-sensitive portions of the stream are comprised of meadow channels, while the remaining 6 percent of the stream is naturally-unstable channels associated with landslides.

Thompson Camp, Powderhorn Meadow, and the area adjacent to Powderhorn Meadow are areas of high cattle use. Dispersed recreation and roads crossing and running adjacent to the stream on both the north and south sides have caused high sedimentation in pools and behind logs in the naturally-stable and naturally-unstable areas of the stream. The unstable-sensitive-degraded areas of the stream exhibit low amounts of riparian vegetation on the stream banks, high bank cutting, high deposition, and high amounts of scour and deposition. Fisheries habitat is limited by moderate width-to-depth ratios, and cover complexity is low with moderate stream bank vegetation.

Packsaddle Creek (8I-F)

Packsaddle Creek is a class II stream associated with rainbow trout, with headwaters found in Packsaddle Meadow that encompasses approximately two linear miles which drains into Bear Creek. Approximately 37 percent of this stream is naturally-stable dominated by steep bedrock channel with moderate gradient boulder/cobble inclusions. Another 36 percent is stable-sensitive with moderate to low gradient channels and meadow characteristics. The remaining portion of the stream is naturally-unstable channels associated with landslides.

The reach identified as a gullied channel near the uppermost extent of the stream within Packsaddle Meadow exhibits bank cutting, high sedimentation, and active scour and deposition. Riparian vegetation is sparse in this area. The lowermost extent of the stream, near Clover Meadow, is a high cattle use area.

Fisheries habitat is affected by a lack of undercut banks, high width-to-depth ratios, and high temperatures. These are indicators of poor bank stability and poor water quality. Cover complexity is low with moderate stream bank vegetation.

Windy Creek (8I-F)

Windy Creek is a class II stream with no known fishery that encompasses approximately 2 linear miles which drains into Packsaddle Creek. Approximately 70 percent of the stream is naturally-stable dominated by steep bedrock channels with moderate gradient boulder/cobble inclusions. Stable-sensitive moderate to low gradient channels and meadow characteristics make up approximately 20 percent of the stream. The remaining portion is a naturally-unstable channel associated with landslides. This stream has not been extensively surveyed for fish habitat components.

Unnamed Tributary to Packsaddle Creek (8I-G)

The unnamed tributary to Packsaddle Creek is a class IV stream associated with channels known to contain fisheries that encompasses approximately 1.5 linear miles and 32 acres, which flows into Packsaddle Creek. The greatest portion of this stream, all but the uppermost extent, is naturally-stable consisting of steep and low gradient bedrock channels with moderate gradient boulder/cobble inclusions. The uppermost portion is naturally-unstable consisting of debris slide terrain. Fisheries habitat is limited by a high amount of sedimentation. Cover complexity and stream bank vegetation is moderate.

Mill Creek (8I-I)

Mill Creek is a class III stream associated with rainbow trout that encompasses approximately 2.7 linear miles, which drains into South Creek. Approximately 60 percent of the stream is naturally-stable dominated by steep and moderate gradient bedrock/boulder channels. The headwaters of the stream are naturally-unstable with channels in landslide terrain that make up approximately 35 percent of the stream. The remaining portion of the stream is unstable-sensitive-degraded downcut channels.

High cattle use is associated with the lower most portion of the stream near Clover Meadow. High sediment loads associated with the landslide terrain are present within the landslide area and that section of the stream directly below the slide area. This stream has not been extensively surveyed for fisheries habitat components.

Nobe Young Basin (8H)

The Nobe Young watershed drains approximately 15 miles and 12,600 acres of stream and meadows, which comprises part of the Middle Kern River watershed (180300105), into Dry Meadow Creek that eventually drains into the Kern River, a wild and scenic river. Included in the watershed are: Nobe Young Creek, Bone Creek, Long Meadow Creek, Nobe Young Meadow, Long Meadow, Bone Meadow, Mule Meadow, Crane Meadow, Last Chance Meadow, and Redwood Meadow.

The Nobe Young basin was surveyed in 1995. Channels within this watershed are comprised of approximately 25 percent naturally-stable bedrock, boulder, and cobble channels, 20 percent stable-sensitive meadow type channels, 20 percent unstable-sensitive-degraded channels, and 35 percent has not been classified. Stream reaches are impacted at minimal to moderate levels.

This basin is part of the Summit grazing allotment along with the South Creek basin. High cattle use areas are concentrated in the lowermost portions of the basin from approximately road 22S82 to the confluence with Dry Meadow Creek, above the Western Divide Highway around Nobe Young Creek, Last Chance Meadow, Bone Meadow, the lowermost portion of Crane Meadow, and approximately from one-quarter to three-quarters of a mile below the Western Divide Highway in Nobe Young and Bone creeks. Long Meadow and Last Chance Meadow have substantial resource damage created by active head cuts. Recreation activities occur at Camp Whitsett, Redwood Meadow Campground, Long Meadow Campground, Trail of 100 Giants, and dispersed camping in and along stream channels and meadows.

Nobe Young Creek (8H-A, F, G)

Nobe Young Creek is a class I stream associated with rainbow trout that encompasses approximately 7.2 linear miles, which drains into Dry Meadow Creek. Naturally-stable channels comprise approximately 26 percent of the stream dominated by moderate gradient cobble channels, approximately 13 percent are stable-sensitive channels comprised of moderate to low gradient sand channels, and the remaining portion of the stream has not been surveyed and classified. Fisheries habitat is limited by large width-to-depth ratios and some sedimentation. An extensive survey for fisheries habitat components has not been completed.

Bone Creek (8H-B,C, E)

Bone Creek is a class II stream associated with rainbow trout, with headwaters found in Bone Meadow, which encompasses approximately six linear miles that flows through Last Chance Meadow, which drains into Nobe Young Creek. Approximately 20 percent of the stream is naturally-stable bedrock/boulder/cobble moderate to high gradient channels, 37 percent is stable-sensitive meadows, 29 percent is unstable-sensitive-degraded gullied channels, and the remaining portions have not been surveyed and classified. Last Chance Meadow is the site of ongoing restoration work. The entire meadow has been surveyed for restoration design and headcut restoration in the lower portion of the meadow. Extensive fisheries habitat component surveys have not been completed.

Bone Creek SCI site was established in 2008 below Last Chance Meadow. The site was established to monitor a possible restoration project within Last Chance Meadow. Table 57 summarizes the SCI data.

Table 57 - Bone Creek SCI Data	
Large Wood Debris (m^3/m)	0.04
% Shading	38 – 91
Temperature (Celsius)	12
pH (ppm)	7.1
Alkalinity ($CaCO_3$)	140
Mean Particle Size in mm (D50)	32
Width-to-depth Ratio	11.67 – 12.68
Hilsenhoff Biotic Index - Rating	2.47 Excellent

Riparian Impact Rating	Moderate
Rosgen Channel Type	B4a

Surveys determined the stream channel to be a high gradient, gravel dominated, stable-sensitive, moderately impacted B4a channel type. The reach length is 75.2 meters. Figure 49 displays a cross-section along Bone Creek. Figure 50 displays the particle size distribution throughout the reach.

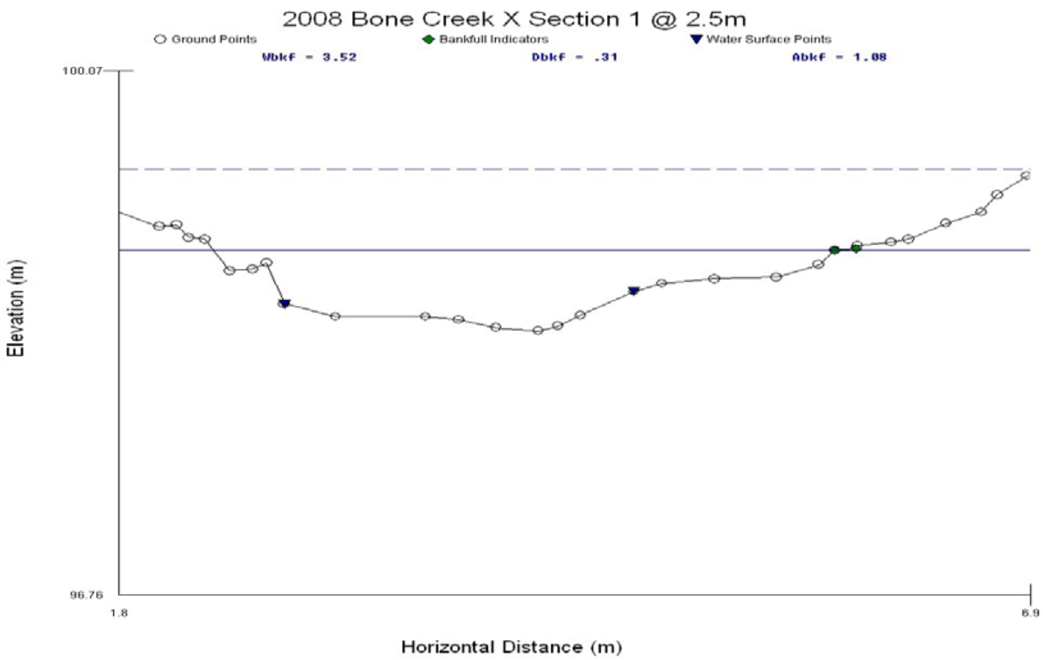


Figure 49 – Cross section of Bone Creek - 2008

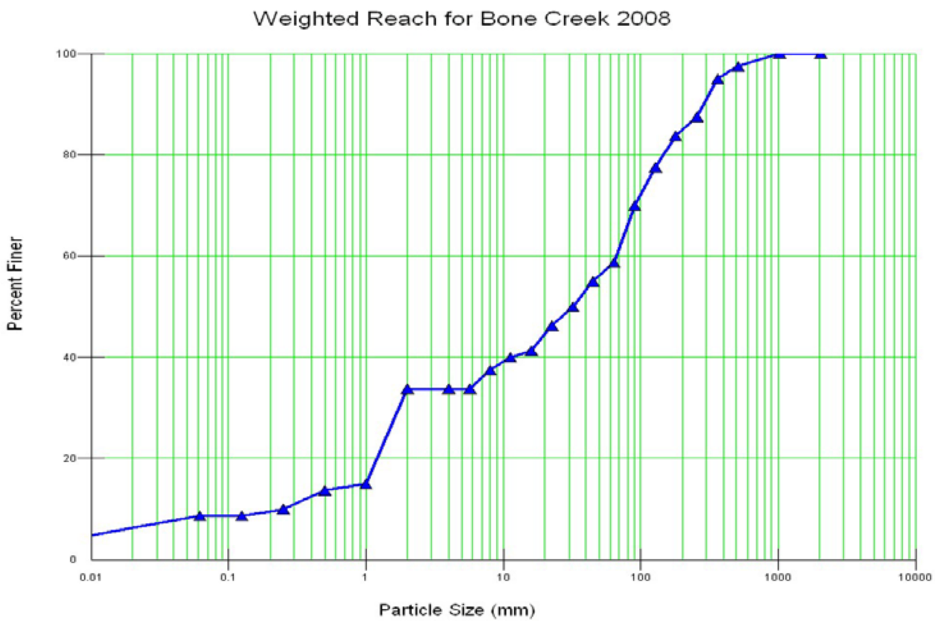


Figure 50 – Particle Size Distribution of Bone Creek - 2008

Average stream shading along the reach provided approximately 78 percent cover. Water chemistry measured total alkalinity, pH, and stream temperature. Recorded total alkalinity measured 140 ppm $CaCO_3$. The pH is slightly basic at 7.1. Recorded temperature for that day was 12 ºC. Average amount of large woody debris found throughout the reach was 0.04 m^3/m. Aquatic MIS site condition for Bone Creek is Excellent based on a 2008 sample. The site was sampled again in 2009, however the requisite number of individuals were not collected (>100) yielding inconclusive results, Table 58.

Table 58– Aquatic MIS Site Condition for Bone Creek			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Bone Creek	7/23/2008	na	Inconclusive
Bone Creek	7/27/2009	2.47	Excellent No apparent organic pollution

Long Meadow Creek (8H-D)

Long Meadow Creek is a class II stream associated with rainbow trout with headwaters found in Redwood Meadow, which encompasses approximately 3.5 linear miles, which drains into Bone Creek. Naturally-stable channels comprise approximately 15 percent of the stream with confined moderate gradient boulder/bedrock type channels. Stable-sensitive channels comprise approximately 35 percent of the streams flow through meadows. Long Meadow has some very large headcuts. This entire meadow complex was extensively surveyed for restoration design in 2001. The remaining portion of the stream has not been surveyed and classified. Fish habitat is limited due to high width-to-depth ratios in the Long Meadow area of the stream.

Dry Meadow Creek (8G-G)

The lower portion of Dry Meadow Creek, near the confluence of Nobe Young Creek upstream to near the end of road 22S56, had been surveyed until the establishment of an SCI site in 2004. Dry Meadow Creek is a class I stream associated with rainbow trout that encompasses approximately 1.8 linear miles that drains into the Kern River. Sensitive stable meadow-like environments comprise the extent of the surveyed stream. Stream stability surveys performed in 1988 rate this drainage in medium fair condition. High use areas are concentrated in Dry Meadow Creek between the elevations of 3,800 and 4,400 feet and between 5,000 and 5,400 feet. Dry Meadow Creek is within the Dry Meadow grazing allotment. Extensive fisheries habitat component surveys have not been completed. Dry Meadow Creek SCI site was established in 2004 to monitor a proposed salvage sale following the McNally Fire of 2002. The reach length is 132 meters. Table 59 summarizes channel characteristics.

Table 59 - Dry Meadow Creek	
Large Wood Debris (m^3/m)	0.02
% Shading	13.5 – 48.5
Temperature (Celsius)	Not Collected
pH (ppm)	Not Collected
Alkalinity ($CaCO_3$)	Not Collected
Mean Particle Size in mm (D50)	87.11
Width-to-depth Ratio	21 – 28
Hilsenhoff Biotic Index – Rating	5.47 Good
Riparian Impact Rating	Low
Rosgen Channel Type	B3c

Surveys define the stream channel as a low gradient, cobble dominated, naturally-stable, low impact B3c channel type. Figure 51 below shows a cross-section of Dry Meadow Creek. Figure 52 displays particle size distribution throughout the reach.

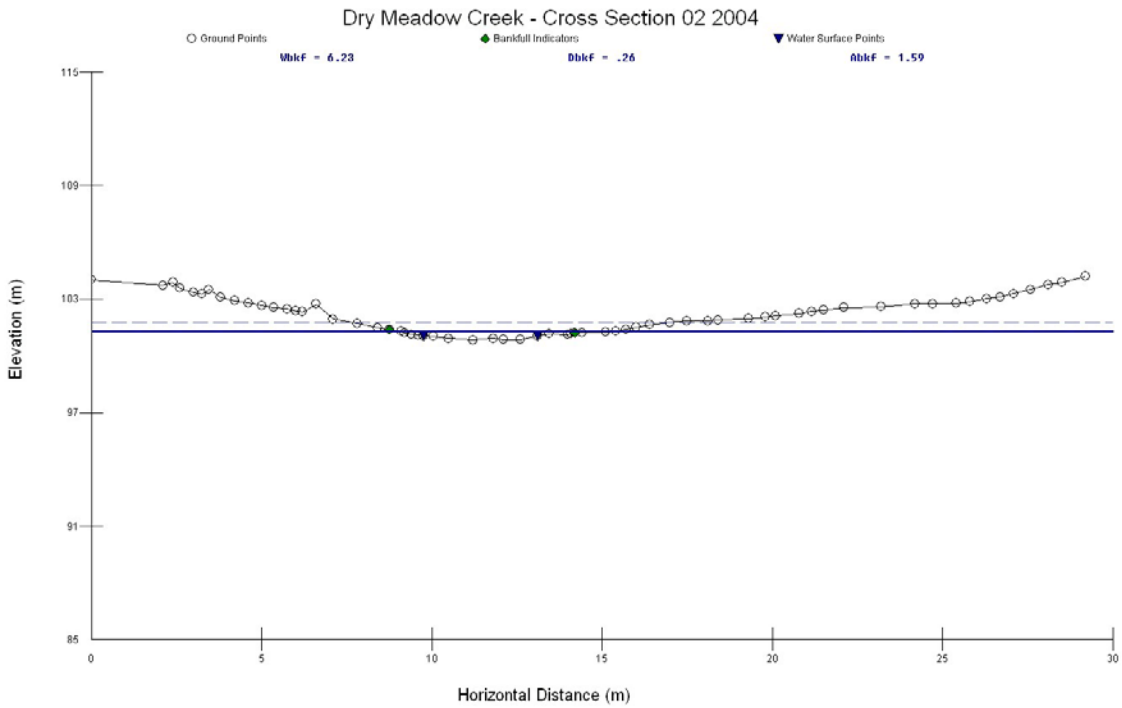


Figure 51 – Cross section of Dry Meadow Creek 2004

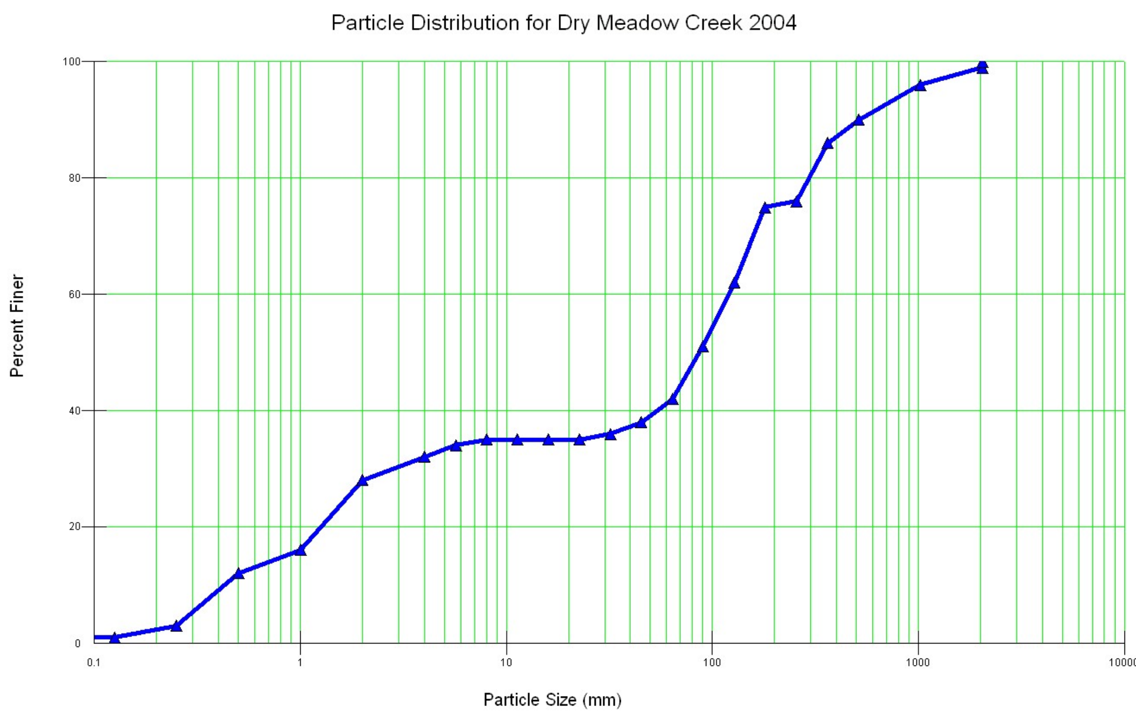


Figure 52 – Particle Size Distribution for Dry Meadow Creek 2004

Average stream shading provides approximately 39 percent cover throughout the reach. Large woody debris averaged throughout the reach was 0.02 m^3/m. No water chemistry data was recorded during the survey.

Aquatic MIS site condition is good for Dry Meadow Creek based on a 2004 sample. The same site was sampled in 2009 and yielded inconclusive results based on the presence of required individuals (>100), Table 60.

Table 60 – Aquatic MIS Site Condition for Dry Meadow Creek			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Dry Meadow Creek	6/30/2004	5.47	Good – Some organic pollution
Dry Meadow Creek	8/6/2009	na	inconclusive

Upper Tule River Basin

The Tule River basin is located in Tulare and Kings Counties, in the southeast portion of the San Joaquin Valley, and the Tule River flows from the Sierra Nevada westward toward the Tulare lakebed. Hydrologically, the basin is a closed system with the river terminating in the lakebed. Lake Success is located on the main branch of the Tule River about six miles east of Porterville. The river is located within Tulare County, bounded on the north by the Kaweah basin and on the south by the White River-Deer Creek Basin. Success Dam, with construction completed in 1961 by the U.S. Army Corps of Engineers, provides flood protection and storage for irrigation water. The earth-fill dam is 156 feet high, 3,490 feet long, and has a crest elevation of 652.5 feet. Currently, the dam and its reservoir provide 82,300 acre-feet of water storage capacity.

The Tule River basin is a fan-shaped area of about 393 square miles above Success Dam on the western slope of the Sierra Nevada. Three main forks form the Tule River basin, the North, Middle, and South Forks, which are fed by numerous small tributaries.

As the Tule River leaves the foothills, it enters the flat expanse of the San Joaquin Valley. The river passes along the southern edge of the city of Porterville, continues across the valley floor, converges with Elk Bayou (a distributary of the Kaweah River), and continues towards the Tulare lakebed. A few miles upstream of Porterville is a natural distributary called Porter Slough that is used to convey irrigation water. In addition to Porter Slough, there are numerous irrigation diversions along the river. Water that is not diverted terminates in the Tulare lakebed.

Elevations range from about 175 feet at the lowest point in the lakebed, to 450 feet in Porterville, to 650 feet at the dam, to a maximum of 10,000 feet in the upper watershed. The higher elevation areas are steep and mountainous, but transition to gentle slopes on the valley floor. Slopes range from 400 to 1,000 feet per mile. Soil cover below 9,000 feet is moderate to deep.

Two small hydroelectric power plants are located in the upper reaches of the Tule River. One plant is owned by the Pacific Gas and Electric Company (PG&E) and located on the North Fork of the Middle Fork

Tule River. The other is owned by Southern California Edison (SCE) and located on the Middle Fork Tule River. These plants operate on the unregulated flow of the Middle Fork Tule River.

The PG&E plant on the North Fork of the Middle Fork Tule River, FERC Project No. 1333, pumps water from Doyle Springs into the Tule River conduit. The Tule River conduit connects to the powerhouse. Regular intake from the river is approximately 5 cubic feet per second (cfs); during drier season's intake decreases to 2 cfs.

The Southern California Edison plant, FERC Project No. 372, is a run-of-the-river project. Water is diverted from the North and South Forks of the Middle Fork of the Tule River and Middle Fork of the Tule River. Between October and May 4.7 cfs is diverted from the river and 9.7 cfs between June and September. The 4.7 cfs release is made year-round from the South Fork diversion.

Natural ranges of variability were developed from data collected on nine sites within the Upper Tule River basin. The ranges were created from the SCI sites located within the basin's watersheds. Similarities were discovered when analyzing all the SCI data. These similarities create the ranges of natural variability displayed in the Table 61. The information provides as a summary of conditions not segregated by local conditions and channel types. Additional detailed information is provided at the smaller watershed scale, 7th field HUCs, and provides information useful for management and monitoring direction and constraints.

Table 61 - Upper Tule River Basin	
Large Wood Debris (m^3/m)	0.00 – 1.17
% Shading	0 – 100
Temperature (Celsius)	11 - 16
pH (ppm)	6.5 – 7.5
Alkalinity ($CaCO_3$)	30 – 180
Mean Particle Size in mm (D50)	0.05 - 222.22
Width-to-depth Ratio	11.03 – 293.71
Hilsenhoff Biotic Index - Rating	0.90 – 4.00
Riparian Impact Rating	Minimal – Moderate
Rosgen Channel Type	B and C

Aquatic insect data for the Upper Tule River Basin indicated those waters sampled have aquatic MIS site condition that range from excellent to Very Good using the Hilsenhoff biotic rating. Riparian ecotype impact ratings fall in the low riparian impact range.

Stream surface shade measurements were taken both in non-meadow and meadow environments. The percent stream surface shade ranges from 0 to 100 percent. Large woody material show a range from 0.00 to 1.40 meters^3 per meter of stream evaluated. The lowest levels of woody debris were measured in Boulder Creek, and the highest levels of woody debris were measured in Tule River at Belknap.

Values for the Upper Tule River basin for width-to-depth ratios have been separated by channel type. Measurements taken in these naturally-stable or stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements.

Water chemistry measurements for pH values range from 6.5 to 7.5 in this watershed basin.

Temperature ranges from data that was taken at a point during summer months is from 11 to 16 ºC. Alkalinity values range from 30 to 180 ppm.

Flooding on the Tule River has occurred from winter and spring rains and spring/early summer snowmelt. Sharp peaks characterize the winter floods with most of the flood volume occurring within a few days. The spring flood events are usually not as sharp as the winter events. Winter floods generally occur between November and April. Snowmelt floods, on the other hand, have a greater volume, but the runoff occurs over a number of months. The time frame for snowmelt flooding is April through June.

Tule River waters can be classified as rich in calcium carbonate. Salinity concentrations are low; electrical conductivity ranges from 112 to 365 micro-ohms per centimeter. Occasionally, inflow levels of iron, lead, and zinc have exceeded EPA standards for freshwater aquatic life. At the South Fork inflow, total and dissolved iron levels exceeded the federal drinking water standards in the summers of 1995 and 1996. Total iron values exceeded the drinking water standard at the North Fork inflow in the spring of 1995. Additionally, in the spring of 1995, copper exceeded the aquatic life criteria at the North Fork Tule River inflow, and mercury exceeded the standard at the South Fork inflow. Both copper and mercury have exceeded federal standards in past years. However, mineral and nutrient concentrations in the inflow to Lake Success do not pose a threat to water quality within the lake or downstream of the dam.

The Upper Tule River basin was rated as a priority category I in the Unified Watershed Assessment. A category I rating describes watersheds that are candidates for increased restoration activities due to impaired water quality or other impaired natural resource goals (emphasis on aquatic systems). Category I watersheds have flows that have been modified through the existence of dams, channels, canals, ponds, water transfers, and additional criteria listed in the process for development of the final unified watershed assessment (California Unified Watershed Assessment Fact Sheet, Index of Indicators). Most of the activities leading to the classification occur in the lower reaches of the watershed. Roads, water diversions and hydroelectric power generation, private residence tracts, recreation, vegetation management, grazing, natural and prescribed fires, slope stability, and floods influence water quality in the watershed.

MIDDLE FORK TULE RIVER WATERSHED (1803000601)

The Middle Fork Tule River is one of three large tributaries that feed the main stem of the Tule River. The total acreage within the watershed is 70,480 acres and drains approximately 99 linear miles of perennial streams. National Forest System lands occupy approximately 67,120 acres. Private property and state lands within the Monument encompass 4,160 acres and 2,450 acres, respectively. Approximately 3,270 acres of private lands occur at lower elevations west of the forest. The basin is concave in nature with a dendritic drainage pattern. Headwaters of the watershed are dominated by steep rugged granitic slopes and rock outcrops, which gradually shift to rolling hills at lower elevations. The watershed drains west through Springville into Lake Success.

Elevation ranges 1,070 feet at Springville to nearly 9,300 feet at Slate Mountain. Dominant channel types include steep and moderately steep bedrock and boulder channels with deep pools. Sedimentation levels tend to increase near channel confluences. Meadow environments occur in headwater areas. Most channels have standing water in the springs within meadow environments.

A portion of the Moses Roadless Area (approximately 2,500 acres) and all of the Black Mountain Roadless Area (2,116 acres) occur within the watershed. Five giant sequoia groves occur within this watershed. Collectively these features provide important habitat for many forest interior species such as the fisher, marten, spotted owl, and goshawk.

The Middle Fork Tule River watershed contains relatively low road density with approximately 1.01 mi/sq mile of road (USDA Forest Service 2001). Of this, approximately 0.35 mi/sq mi occur within 300 feet of streams, 0.16 mi/sq mi occur on steep slopes, and 0.60 mi/sq mi occur in the lower 1/3 slope (USDA Forest Service 2001). Watershed characteristics are affected by dense urbanization in the lower reaches of the watershed clustering around main drainages, such as the North Fork of the Middle Fork of the Tule River. Highway 190 parallels the stream for the entire length of the basin. There are 62.18 miles of trails in the watershed.

Natural ranges in variability were developed from eight years of data within the Middle Fork Tule River watershed (see Table 62). These ranges were created from the seven SCI sites within the watershed. Table 63 contains a summary of these ranges by channel type.

Table 62 - SCI Locations and Information within the Middle Fork Tule River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Middle Fork Tule River	1803000601	SFMF Tule River	Belknap Campground	Western Divide	2001, 2006	B3a	Naturally-stable	Minimal
Middle Fork Tule River	1803000601	Boulder Creek	Deep Meadow	Western Divide	2001, 2006	C6	Stable-sensitive	Moderate
Middle Fork Tule River	1803000601	NFMF Tule River	Camp Wishon	Western Divide	2001, 2006	B3a	Naturally-stable	Minimal
Middle Fork Tule River	1803000601	Moorehouse Creek	Above Old Fish Hatchery, at Mahogany flat	Western Divide	2005	B4a	Stable-sensitive	Moderate
Middle Fork Tule River	1803000601	Tributary to SFMF Tule River	Camp Nelson	Western Divide	2005	B3	Naturally-stable	Low
Middle Fork Tule River	1803000601	Bear Creek	Near tributary to Coy Creek	Western Divide	2008	B3a	Naturally-stable	Low
Middle Fork Tule River	180300601	SFMF Tule River	Southeast of Mahogany Flat	Western Divide	2001	B3c	Naturally-stable	Minimal
Middle Fork Tule River	1803000601	Wilson Creek	Below Black Mtn Grove	Western Divide	2006	B3a	Naturally-stable	Low

Table 63- Range in Channel Attributes, Middle Fork Tule River Watershed		
Parameter	Channel Type	
	A and B Channels	C Channels
Large Wood Debris (m^3/m)	0.01 – 1.40	0.01 – 1.17
% Shading	26 - 100	0 – 39
Temperature (Celsius)	11 - 14	14
pH (ppm)	6.5 – 7.5	6.5
Alkalinity ($CaCO_3$)	30 – 180	30
Mean Particle Size in mm (D50)	5.39 – 222.22	0.05 – 0.12
Width-to-depth Ratio	12 - 26	11.43 – 293.71
Hilsenhoff Biotic Index - Rating	0.90 – 2.95 Excellent	4.00 Very Good
Riparian Impact Rating	Low - Moderate	Moderate

There are numerous wells, spring developments and diversions in this watershed on forest land. Camp Nelson Water Company has a diversion from Belknap Creek, Alpine Village has a community spring box development, Cedar Slope community has a diversion from Marshall Creek, Slate Mountain Homeowners have a well and filter basin, and there are 11 spring developments or diversions to individual cabins. Quaker Meadow Camp has a well, and there are wells supplying water to Quaking Aspen, Belknap, and Coy Flat campgrounds, Upper Coffee Camp, and Boulder Camp administrative area. There is a spring development and well providing water to Wishon Campground. On private land there are two known community water systems, one serving the Pierpoint area and one at Cedar Slope. Water chemistry, specifically water pH, is natural and is the result of soda springs throughout the watershed.

Both hydroelectric power plants are located in this watershed. One plant is owned by the Pacific Gas and Electric Company (PG&E) and located on the North Fork of the Middle Fork Tule River. The other is owned by Southern California Edison (SCE) and located on the Middle Fork Tule River. Both PG&E and SCE divert waters from the channel to produce electricity. PG&E diverts water near Wishon Campground by lift pump, while SCE diverts water near the powerhouse at Highway 190. These plants operate on unregulated flow of the Middle Fork Tule River. Both of these projects are "run-of-the-river" and return all water for downstream uses.

There are two lakes at Quaker Meadow Camp on National Forest System land and two small ponds in the Sequoia Crest and Alpine Village areas on private land. These are not natural features and were constructed prior to designation of the Monument.

Camping, hiking, hunting, mountain biking, equestrian use, cross-country skiing, and snowmobile activities are popular in this watershed. Mountain Home State Forest has 2,451 acres in this watershed including two campgrounds with a total of 29 campsites and one group campsite.

Two day use areas, Upper and Lower Coffee Camps, lie in this basin. Upper and Lower Coffee Camp day use areas are heavily used in the summer months. Upper and lower stream banks in these areas are heavily affected by recreational use. Stream bank vegetation is sparse, and sedimentation is present in pools. Human refuse and graffiti are associated with these areas and a source of pollution to the waterway. A parking and access area, the Stairs, is located near the upper extent of the drainage and receives similar damage from recreational use.

The Black Mountain, Cow Mountain and Middle Tule grazing allotments and approximately 20 percent of the Little Kern allotment are found in the watershed. Impacts to riparian vegetation occur, but are isolated. There is an abandoned copper mine in this watershed. There are earthen type dams on the four lakes/ponds within the national forest boundary of this watershed.

Lower Middle Fork Tule River 4C-, A, B, C, D, E

Approximately 80 percent of the Lower Middle Fork Tule River watershed lies within the Monument boundary. These watersheds consist primarily of intermittent and ephemeral channels. The only perennial channel is Long Canyon, 4C-B and 4C-D. These channels have not been surveyed due to steep terrain, dense vegetation, and limited access. However, based on topography, aerial photos, and other channels in the area, these channels are expected to be either naturally-stable or naturally-unstable A and B channel types. These watersheds are characterized by waterfalls and step pools and large areas of bedrock control.

Stevenson Gulch (4D-A)

Stevenson gulch contains two roads 21S12 and 21S12B. Both are located in the headwaters and are the only roads within the watershed. No campgrounds, recreation trails, or private property exist. Due to very steep topography and dense vegetation, field surveys of the stream channel could not be completed. Ocular observations from the headwaters and confluence with the Tule River (South Fork Middle Fork) and aerial photos suggest the tributaries in the headwaters begin as a very high gradient Aa+ channel type. Half-way down the watershed and including a small tributary to the west the channel is a series of step pools and small waterfalls. It is a high to very high gradient, bedrock controlled, naturally-stable, A and Aa+ stream type.

Deadman Creek (4D-B)

Deadman Creek headwaters begin at Solo Peak. The headwaters contain roads 21S25, 21S25A, 21S25C, 21S25D, 21S12, 21S12A. No campgrounds or recreation trails exist. Private property is located at the base of the watershed near the Tule River (South Fork Middle Fork). No surveys have been completed in this watershed. However, based on topography, aerial photos, and other channels in the area, these channels are expected to be either naturally-stable or naturally-unstable A and B channel types.

Unnamed Creek (4D-C)

An unnamed creek flows into the lower portion of the Wilson Creek watershed. The headwaters contain roads 21S12 and 21S58. Private property resides within the headwaters. No recreation trails or campgrounds exist. The west side of Bateman Ridge is within the watershed. No surveys have been completed in this watershed. However, based on topography and aerial photos the channels are expected to either be naturally-stable or naturally-unstable A and B channel types.

Wilson Creek (4D-D)

An SCI site was established in 2006 on Wilson Creek for monitoring the Tule River Reservation Protection Project. The project has not been implemented and pre-project data have been collected. Table 64 summarizes the SCI data collected.

Table 64 - Wilson Creek	
Large Wood Debris (m^3/m)	0.68
% Shading	59 – 93
Temperature (Celsius)	14
pH (ppm)	6.5
Alkalinity ($CaCO_3$)	80
Mean Particle Size in mm (D50)	146.91
Width-to-depth Ratio	13.62 – 18.23
Hilsenhoff Biotic Index - Rating	2.28 Excellent
Riparian Impact Rating	Low
Rosgen Channel Type	B

Surveys determined the stream channel to be a high gradient, cobble dominated, naturally-stable, low impact B3a channel type. The reach length is 45.90 meters. Figure 53 displays a cross-section along Wilson Creek. Figure 54 displays the particle size distribution throughout the reach.

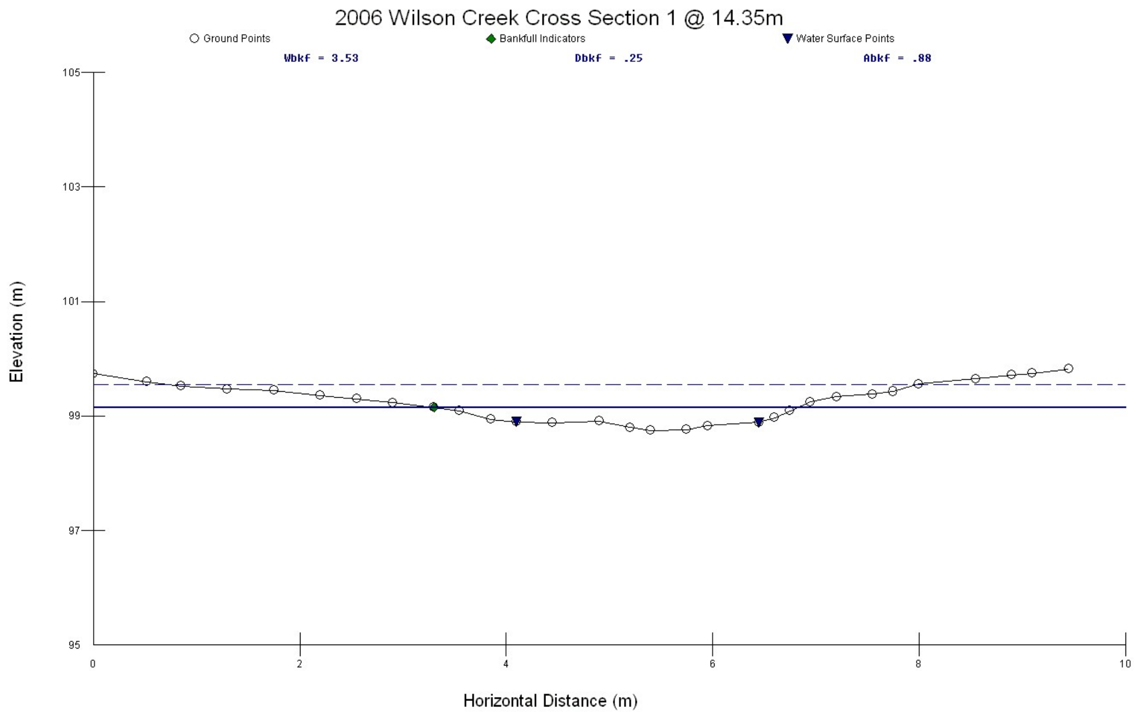


Figure 53 – Cross section of Wilson Creek 2006

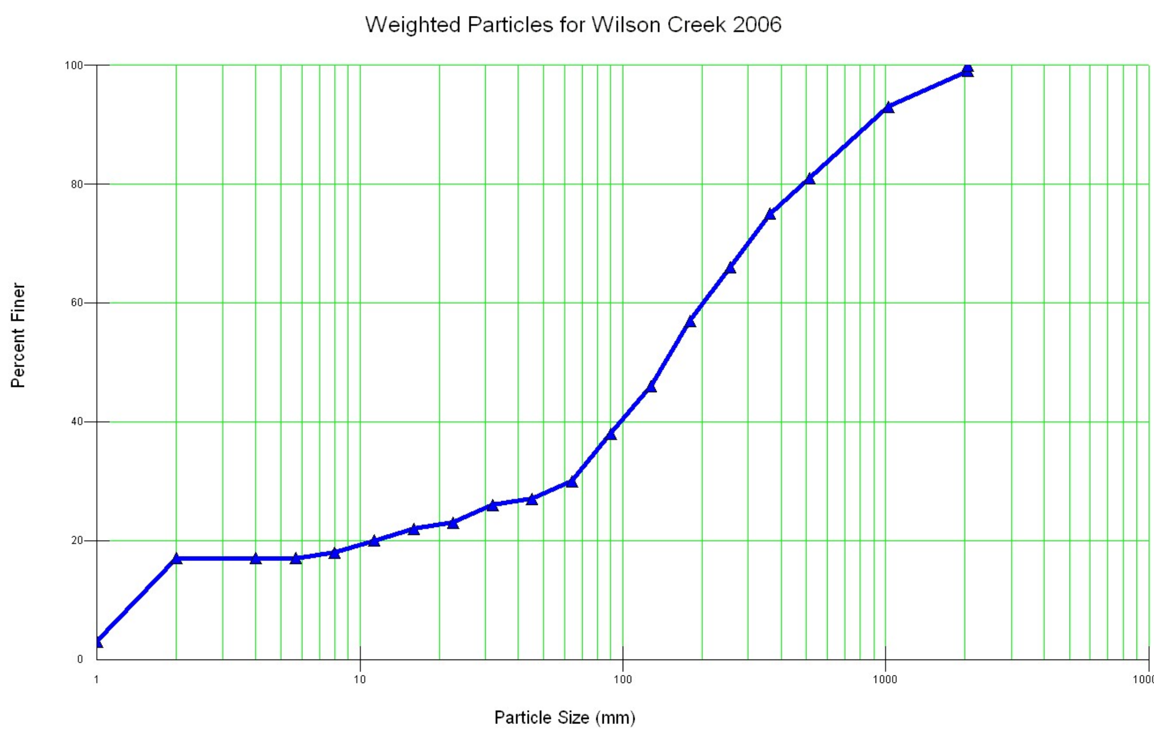


Figure 54 – Particle Size Distribution for Wilson Creek 2006

Average stream shading along the reach provides approximately 82 percent cover. Water chemistry measured total alkalinity, pH, and stream temperature. Total alkalinity results discovered 80 ppm $CaCO_3$ while the pH was slightly acidic at 6.5. Recorded stream temperature for that day was 14 ºC. Average amounts of large woody debris were 0.68 m^3/m. Aquatic MIS site condition for Wilson Creek is Excellent based on a sample obtained in 2006,Table 65.

Table 65 - Aquatic MIS Site Condition for Wilson Creek			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Wilson Creek	7/31/2006	2.28	Excellent No apparent organic pollution

Coy Creek (4D-E)

Coy Creek watershed includes Coy Creek and several unnamed tributaries. The headwaters and tributaries begin and alternate between a naturally-stable, high to moderate gradient, A and B channel type to naturally-unstable, high to moderate gradient, A and B channel type throughout the watershed. Road 21S94, Coy Flat Campground, and the private residences at Rogers Camp lie partially or wholly within the watershed and can influence water quality. In addition, landslide activity has occurred in the past southwest of Coy Flat Campground immediately adjacent to and flowing into the stream channel.

Bear Creek (4D-F)

The Bear Creek watershed contains two perennial streams. One is Bear Creek, and the other is unnamed. There are residential homes located in the bottom portion of the drainage just before the confluence with the South Fork Middle Fork Tule River. The terrain is very steep as the creeks begin at the top of Slate Mountain. Starting at the top of the watershed, Bear Creek changes from a naturally-stable, very high to high gradient, A channel type to a naturally-stable, moderate gradient, B channel type at the end of the watershed.

An SCI site at Bear Creek near Coy Flat was established in 2008. The purpose was to monitor the proposed Coy Flat Land Exchange, which has been completed. Table 66 summarizes the SCI data.

Table 66 - Bear Creek Watershed near Coy Flat	
Large Wood Debris (m^3/m)	0.12
% Shading	83 – 96
Temperature (Celsius)	12
pH (ppm)	7
Alkalinity ($CaCO_3$)	180
Mean Particle Size in mm (D50)	201.71
Width-to-depth Ratio	11.8
Hilsenhoff Biotic Index - Rating	4.06-Very Good
Riparian Impact Rating	Low
Rosgen Channel Type	B3a

Surveys define the stream channel as a high gradient, cobble dominated, naturally-stable, low impact B3a channel type. The reach length is 56 meters in length. Figure 55 displays a cross-section of Bear Creek near Coy Flat. Figure 56 displays the particle size distribution throughout the reach.

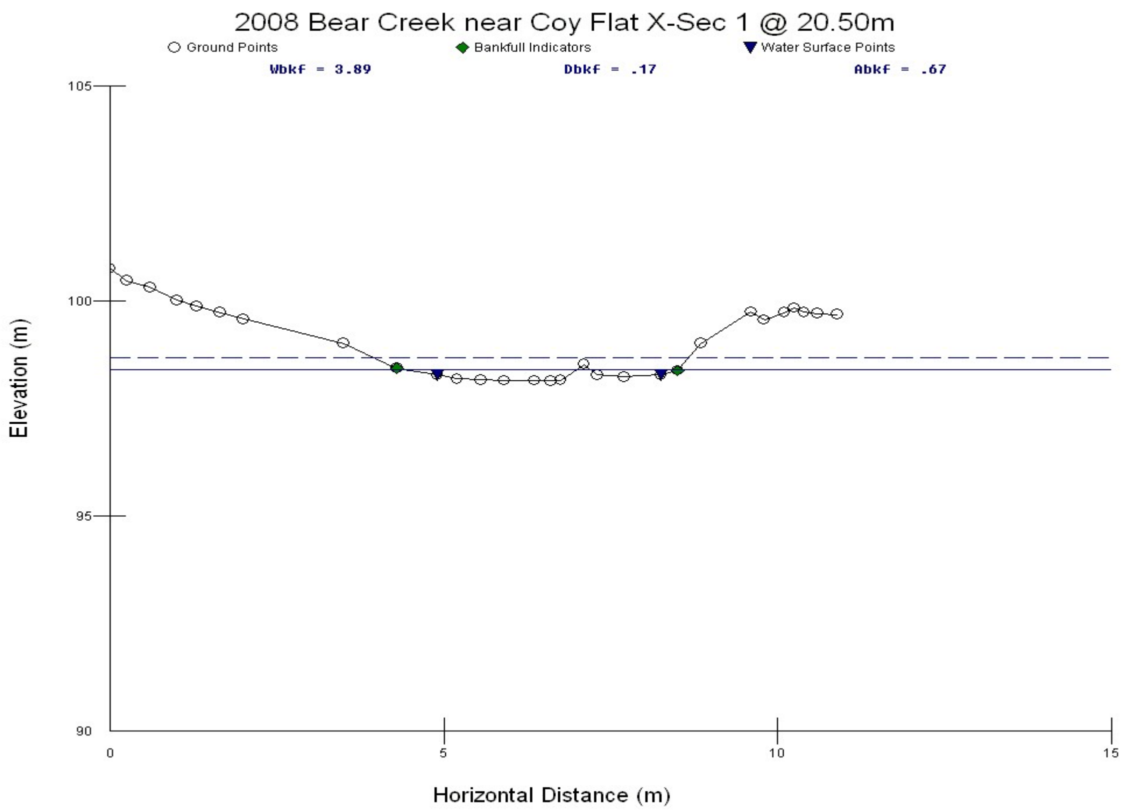


Figure 55 – Cross section of Bear Creek Near Coy Flat - 2008

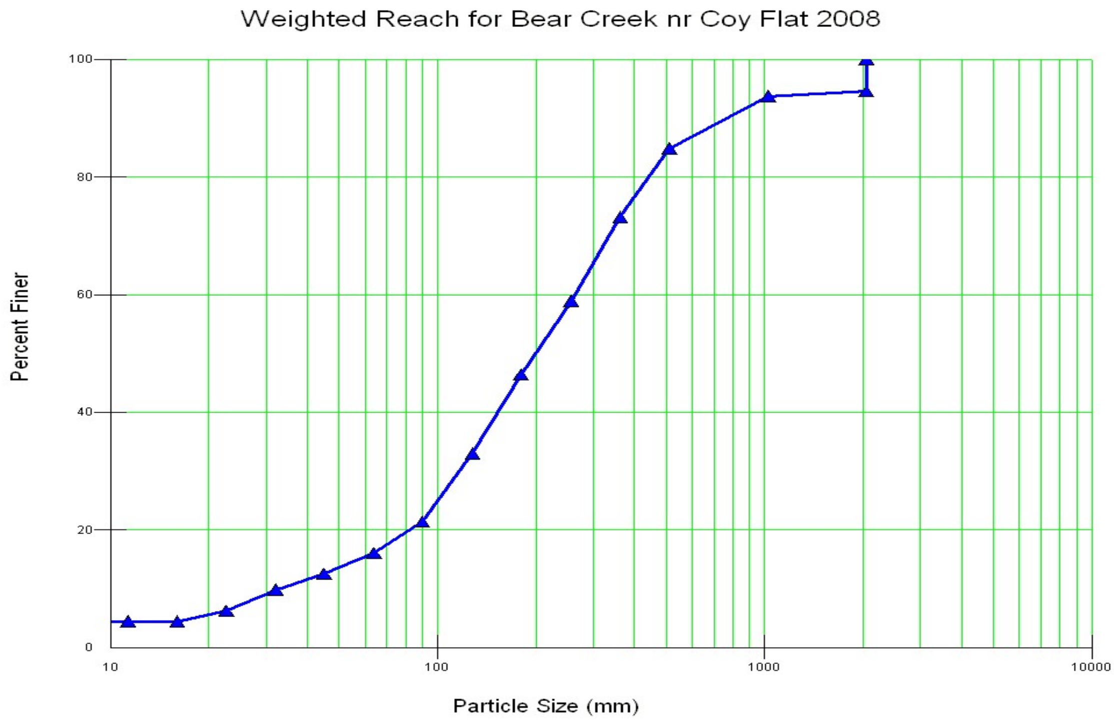


Figure 56 – Particle Size Distribution of Bear Creek Near Coy Flat - 2008

Average stream shading provides approximately 91 percent cover throughout the reach. Average amounts of large woody debris were 0.12 m^3/m. Water chemistry measured total alkalinity, pH, and stream temperature. Recorded total alkalinity was 180ppm $CaCO_3$. The pH was neutral at 7.0. Recorded temperature for that day was 12 ºC. Aquatic MIS site condition is very good based on a sample taken in 6/16/2008

South Fork Middle Fork Tule River (4D-G, Q, P)

South Fork Middle Fork Tule River is a class I stream associated with rainbow, brown, and brook trout that encompass approximately 13 linear miles that drain into the Middle Fork Tule River. Brook trout are found in and near the headwaters of the stream located in Quaking Aspen Meadow and Quaker Meadow. The entire portion surveyed, including the headwaters, is naturally-stable. The channel consists primarily of bedrock boulder substrate in steep rugged terrain except for the headwaters that are primarily low gradient gravel and sand substrate.

The headwater areas of this stream have year-round recreation activities. The communities of Camp Nelson, Pierpoint, Mahogany Flat, and the recreation residences at Belknap lie adjacent to the stream. There are no cattle grazing allotments associated with this stream.

Tule River above Mahogany Flat contains an SCI site. Established in 2001, the site was to monitor a possible future project that was later incorporated into the Camp Nelson Urban Interface project. Table 67 summarizes the SCI data.

Table 67 - Tule River at Mahogany Flat	
Large Wood Debris (m^3/m)	0.45
% Shading	58 – 99
Temperature (Celsius)	Not Recorded
pH (ppm)	Not Recorded
Alkalinity ($CaCO_3$)	Not Recorded
Mean Particle Size in mm (D50)	145.36 – 222.22
Width-to-depth Ratio	19 – 22
Hilsenhoff Biotic Index - Rating	Not Recorded
Riparian Impact Rating	Minimal
Rosgen Channel Type	B

Surveyed results defined the stream channel as a low gradient, cobble dominated, naturally-stable, minimally impacted, B3c channel type. The reach length is 269.9 meters. Figure 57 displays a cross-section along the Tule River at Mahogany Flat. Figure 58 displays the reach-wide particle size distribution.

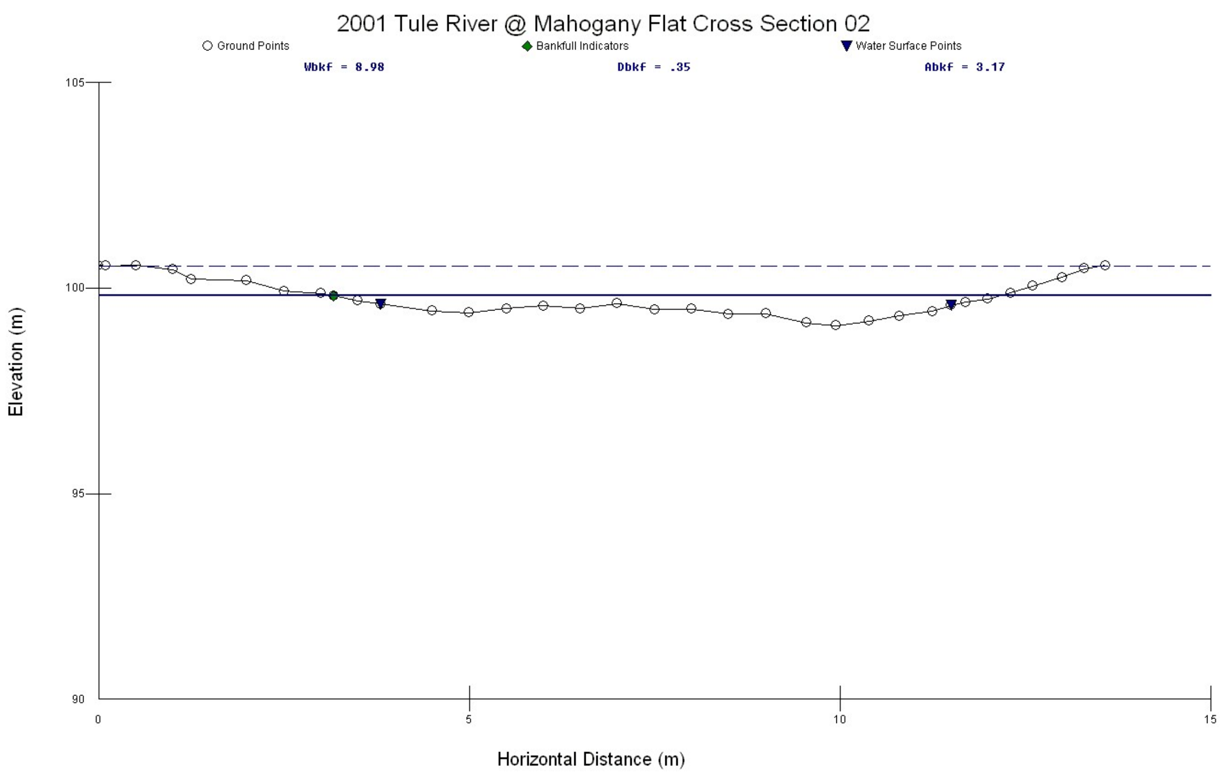


Figure 57 – Cross section of Tule River at Mahogany Flat - 2001

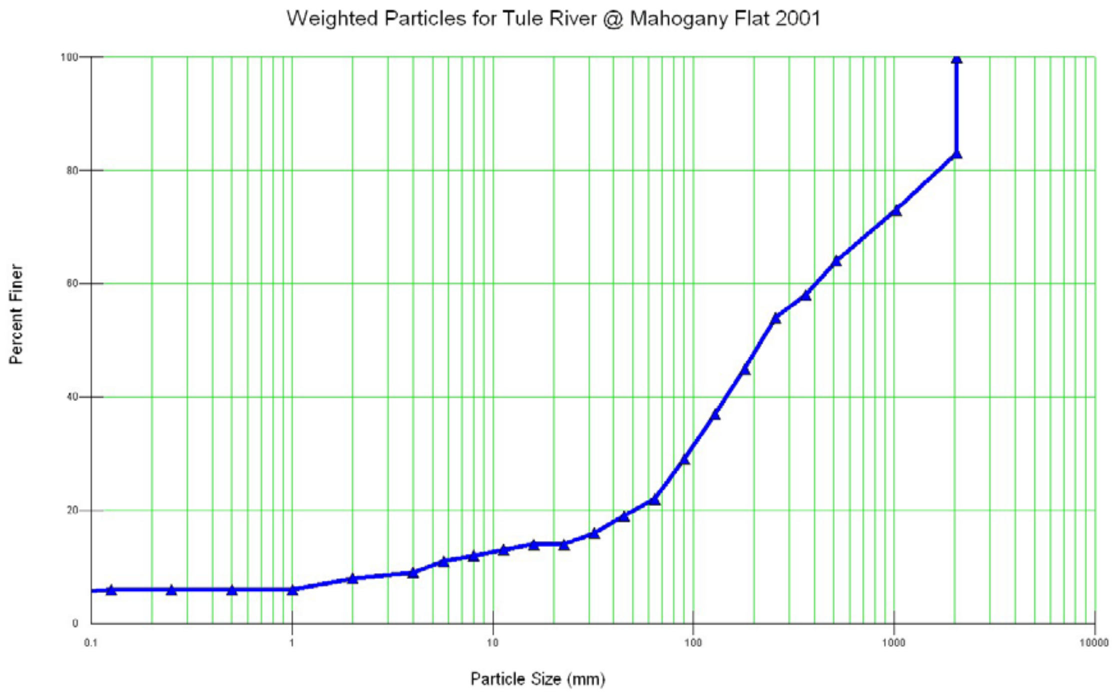


Figure 58 – Particle Size Distribution for Tule River at Mahogany Flat - 2001

Average stream shading provides approximately 85 percent cover. The average amount of large woody debris recorded throughout the reach was 0.45m^3/m.

The Tule River above Belknap Campground contains an SCI site. The site was implemented to monitor fuels reduction projects in the upper portion of the watershed. It was initially surveyed in 2001 and again in 2006. Cross-sections were extended in 2006 to better capture stream morphology characteristics. The reach is 82.6 meters. Table 68 summarizes the SCI data.

Table 68 - Tule River at Belknap Campground	
Large Wood Debris (m^3/m)	**Large Wood**
% Shading	**% Shading**
Temperature (Celsius)	**Temperature**
pH (ppm)	**pH (ppm)**
Alkalinity ($CaCO_3$)	**Alkalinity**
Mean Particle Size in mm (D50)	**Mean Particle**
Width-to-depth Ratio	**Width-to-**
Hilsenhoff Biotic Index - Rating	**2.95 Excellent**
Riparian Impact Rating	**Riparian**
Rosgen Channel Type	**Rosgen**

Surveys define the stream as a high gradient, naturally-stable, cobble dominated, minimally impacted B3a channel for both 2001 and 2006. Changes have occurred within the channel morphology since the initial survey was conducted. However, the changes are minimal and did not affect the classification or impact ratings associated with the reach. Figure 61 displays the extended cross-section.

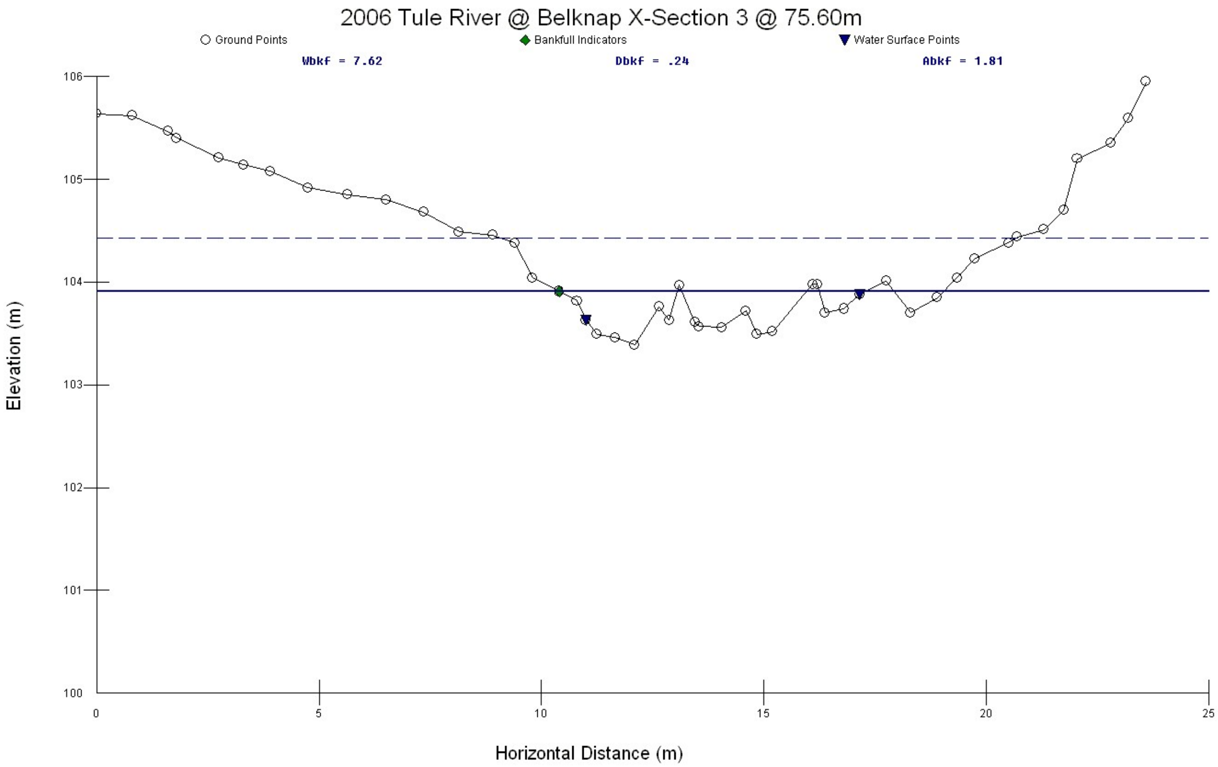


Figure 61 – Cross section of Tule River at Belknap Campground

Change in particle size from 2001 to 2006 was 70.49 mm to 128 mm. This change in particle size distribution is considered within the range of natural variability. Figure 62 displays both surveyed particle size distributions for the reach.

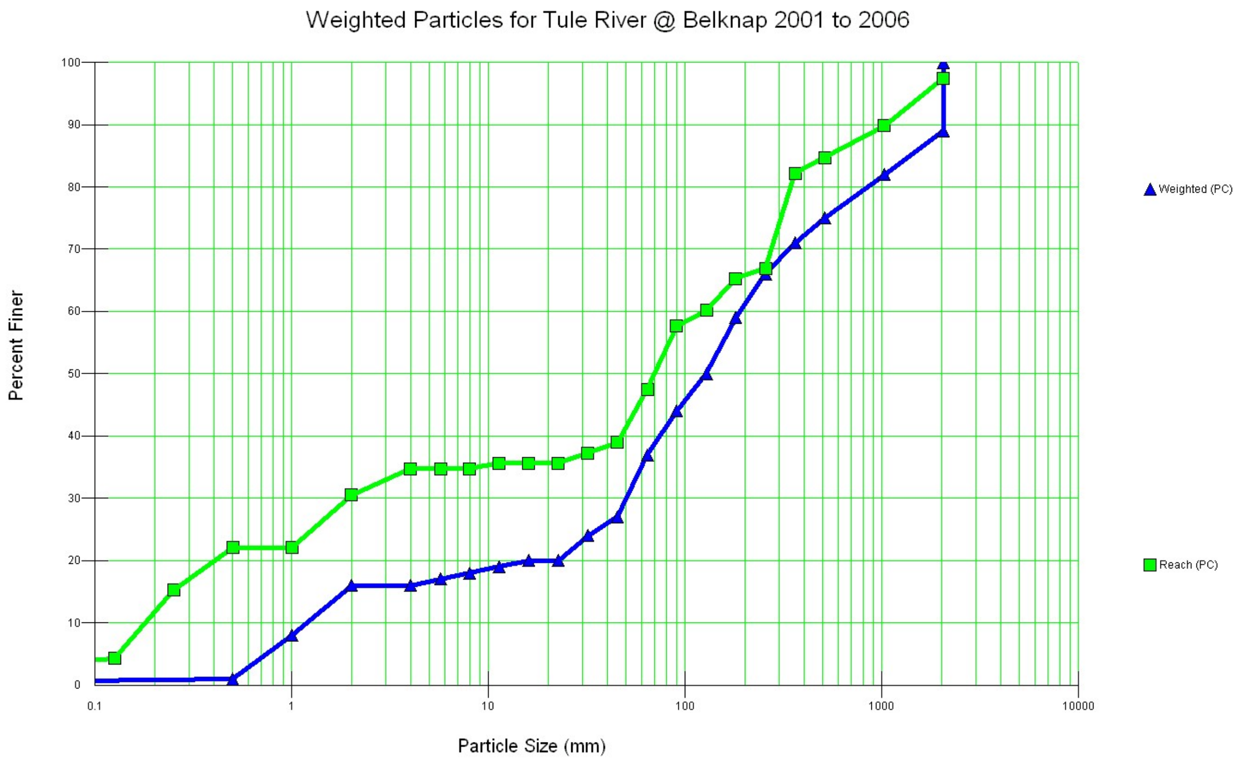


Figure 62 – Particle Size Distribution for Tule River at Belknap Campground

Average stream shading increased in 2001 to 2006 from 80 percent to 99 percent. Large woody debris increased during this time from 0.09m^3/m in 2001 to 1.40m^3/m in 2006. Water chemistry measured total alkalinity, pH, and stream temperature in 2006. Total alkalinity was recorded at 80 ppm CaCO3 while the pH was slightly acidic at 6.5. Temperature for that day was 14 degrees C. Aquatic MIS site condition is excellent based on sample collected in 2006, Table 69.

Table 69 – Aquatic MIS Site Condition for Tule River at Belknap Campground

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Tule River at Belknap Campground	7/17/2006	2.95	Excellent No apparent organic pollution

North Fork Middle Fork Tule River (4B-L, 4B)

North Fork Middle Fork Tule River is a class I stream associated with rainbow and brown trout encompasses approximately 15 linear miles. Naturally-stable bedrock boulder channels comprise approximately 97 percent of the surveyed area. An unstable-sensitive-degraded channel with downcut characteristics and moderate gradient gravel channel comprise the reaches of the channel.

Portions of the Middle Tule grazing allotment, adjacent to the lowermost portion of North Fork Middle Fork Tule River, and Mountain Home State Forest lie in the drainage area. Various campgrounds and dispersed camping areas are associated with this drainage. Impacts from cattle use are low due to the rugged brushy terrain. The Doyle Springs summer home community, adjacent to North Fork Middle Fork Tule River, is a development in the area.

The North Fork of the Middle Fork of the Tule River at Wishon Campground contains an SCI site. The site was established in 2001 to monitor a project called Tule River Urban Interface project. However, this project has not been implemented. Table 70 summarizes the SCI data.

Table 70 - Tule River at Wishon Campground SCI Data	
Large Wood Debris (m^3/m)	0.04
% Shading	65 - 91
Temperature (Celsius)	Not Recorded
pH (ppm)	Not Recorded
Alkalinity ($CaCO_3$)	Not Recorded
Mean Particle Size in mm (D50)	145.36
Width-to-depth Ratio	12 – 27
Hilsenhoff Biotic Index - Rating	3.38 Excellent
Riparian Impact Rating	Minimal
Rosgen Channel Type	B3a

Surveys defined the stream channel to be a high gradient, cobble dominated, naturally-stable, minimally impacted B3a channel type. The reach length is 95 meters. Figure 61 displays a cross-section at the SCI site. Figure 62 displays particle size distribution throughout the reach.

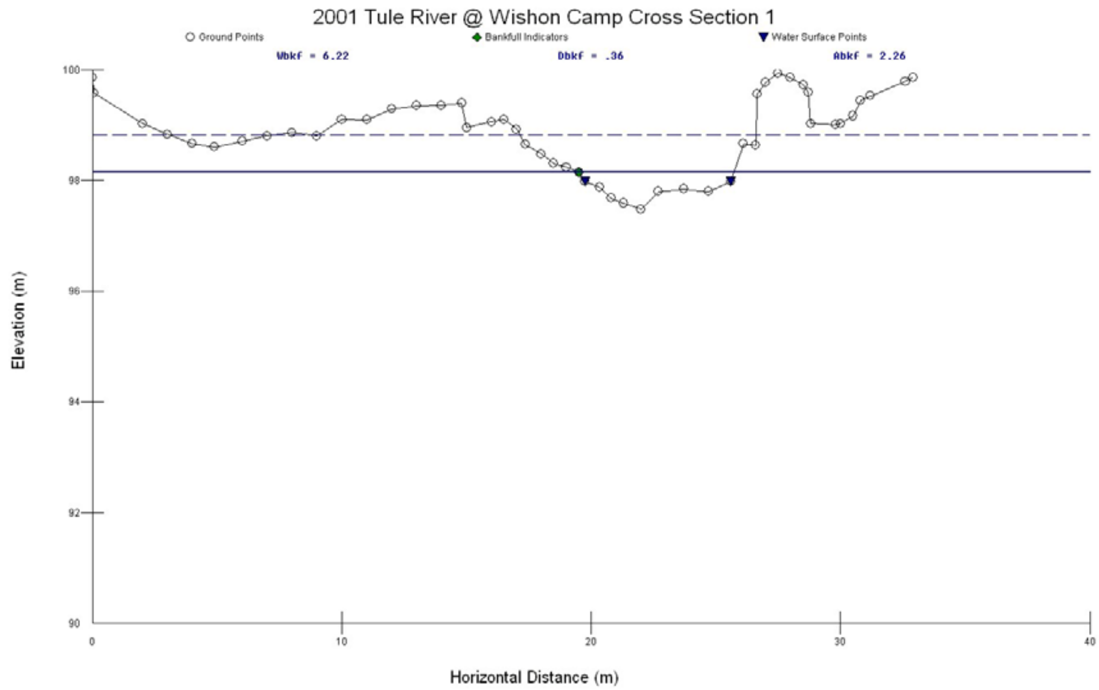


Figure 61 – Cross section of Tule River at Wishon Campground 2001

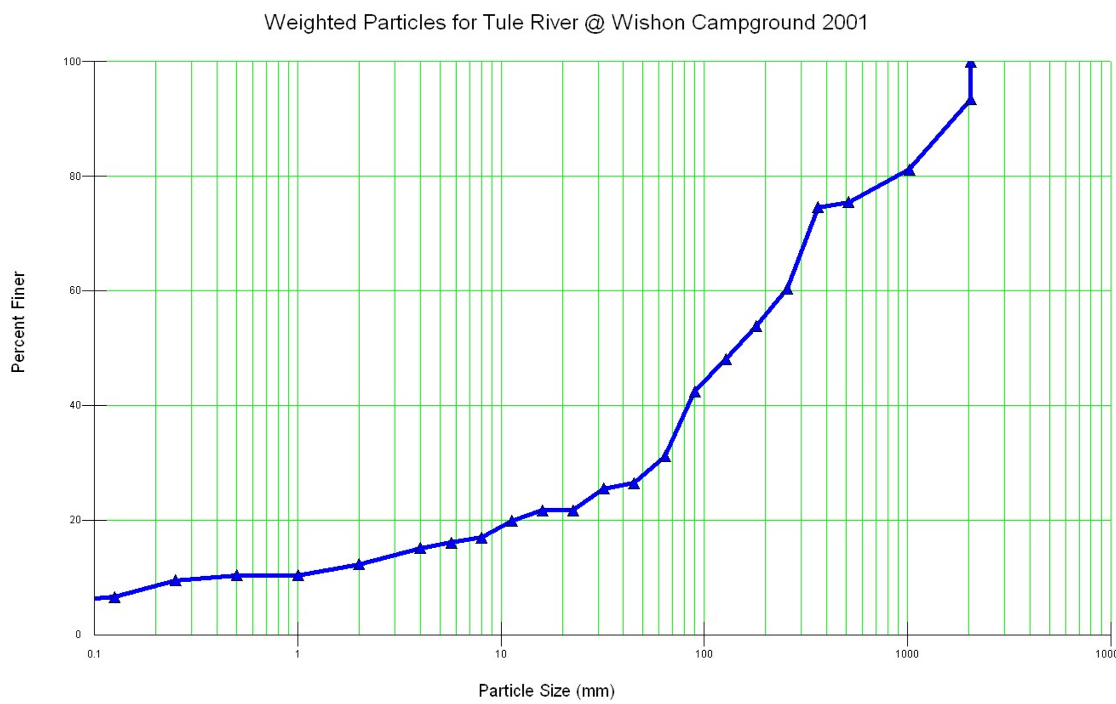


Figure 62 – Particle Size Distribution for Tule River at Wishon Campground 2001

Average stream shading along the reach provides approximately 79 percent cover. Average amount of large woody debris throughout the reach was $0.04m^3/m$. No water chemistry was recorded. Aquatic MIS site condition is excellent based on a 2006 sample, Table 71.

Table 71 – Aquatic MIS Site Condition for Tule River at Wishon Campground

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Tule River at Wishon Campground	7/18/2006	3.38	Excellent - No apparent organic pollution

Galena Creek (4B-E)

Galena Creek is a class II stream associated with rainbow trout that encompasses approximately 2.25 linear miles that drains into the North Fork Middle Fork (NFMF) Tule River. The entire surveyed portion is naturally-stable bedrock dominated channel. A portion of an unnamed tributary to Galena Creek, approximately 2000 feet of an estimated 1.25 linear miles, was surveyed and found to be a stable-sensitive predominantly low gradient meandering gravel channel. The only known development in this drainage is trail 30E14 that crosses the stream near its confluence with NFMF Tule River.

Burro Creek (4B-G)

Burro Creek is a class II stream associated with brown trout that encompasses approximately 2.5 linear miles that drains into the NFMF Tule River. The entire surveyed portion of the stream was a naturally-stable steep bedrock boulder channel. Trail 30E14, the only known development, crosses the stream near its confluence with NFMF Tule River.

Silver Creek (4B-F)

Silver Creek is a class II stream associated with brown trout that encompasses approximately 2.5 linear miles that drains into the North Fork Middle Fork Tule River. The entire surveyed portion of the stream was a naturally-stable steep bedrock boulder channel. The only known development in this drainage is trail 30E14 that crosses the stream near its confluence with North Fork Middle Fork Tule River.

North Alder Creek (4B-H)

North Alder Creek is a class I stream associated with rainbow trout that encompasses approximately three linear miles that drains into South Alder Creek. The entire surveyed portion of the stream was a naturally-stable steep bedrock boulder channel. There are no known disturbances in the drainage.

South Alder Creek (4B-I)

South Alder Creek is a class I stream associated with rainbow trout that encompasses approximately 3.5 linear miles that drains into North Fork Middle Fork Tule River about ¼ mile upstream of the community of Doyle Springs. A portion of this stream flows through private lands at Sequoia Crest. The entire surveyed portion of the stream is a naturally-stable steep bedrock boulder channel. The community of Sequoia Crest and road 20S03 from Wishon Campground to Sequoia Crest are the only known developments in the drainage.

Unnamed Tributaries to North Fork Middle Fork Tule (4B-K, L)

The three unnamed tributaries to NFMF Tule River lie in Mountain Home State Forest. These streams encompass approximately 2.75 linear miles. These tributaries have not been surveyed for fisheries, although these channels were surveyed and typed in 2001. Of the estimated 2.75 miles of stream, approximately 1.3 miles were found to be naturally-stable moderate gradient cobble dominated channels in minimal to low condition. The remaining channels are stable-sensitive low gradient gravel dominated channels in minimal to low condition.

Boulder Creek (4D-H)

Boulder Creek is a class I stream associated with rainbow, brown and brook trout, which encompass approximately 2.75 linear miles. Headwaters are located in Deep Meadow and drain into the South Fork Middle Fork (SFMF) Tule River near the community of Cedar Slope. Naturally-stable steep bedrock boulder channels dominate the drainage. A small portion, approximately 35 percent of the surveyed area, is stable-sensitive low gradient gravel and sand dominated channels.

The upper portion of this drainage contains a portion of the Jordan unit of the Little Kern grazing allotment, and cattle concentration occurs in the meadow areas. Trail 31E14 and road 22S75 cross the stream below Deep Meadow. OHV/OSV use on roads and dispersed camping are recreation uses in the area. The lower portion of the drainage, near its confluence with SFMF Tule River, has recreational fishing activities associated with the area. The middle portion of the stream is steep and rugged; Highway 190 crosses it.

Boulder Creek within Deep Meadow contains a SCI site. The site was established to monitor livestock grazing. An initial survey was completed in 2001 and then surveyed again in 2006. Cross-sections were extended in the 2006 survey to better capture the channel's morphology. Table 72 displays ranges from both surveys.

Table 72 - Boulder Creek at Deep Meadow	
Large Wood Debris (m^3/m)	0.01 – 1.17
% Shading	0 – 39
Temperature (Celsius)	14
pH (ppm)	6.5
Alkalinity ($CaCO_3$)	30
Mean Particle Size in mm (D50)	0.05 – 0.12
Width-to-depth Ratio	11.43 – 293.71
Hilsenhoff Biotic Index - Rating	4.00 Very Good
Riparian Impact Rating	Moderate
Rosgen Channel Type	C

Survey results for 2001 defined the channel as a low gradient, sand dominated, low impact, stable-sensitive, C5 channel. In 2006 the survey defined the channel as a low gradient, silt dominated, moderate impact, stable-sensitive C6 channel type. Channel morphology has not changed. Figure 63 displays overlaid cross-sections for Boulder Creek in Deep Meadow.

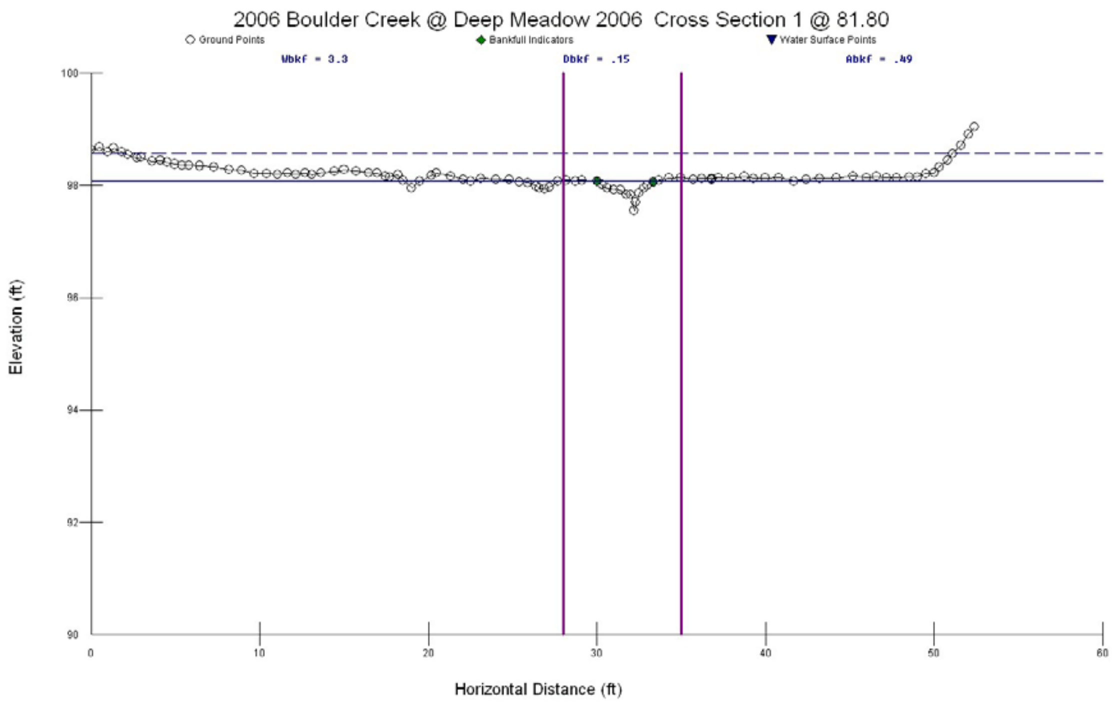


Figure 63 – Cross section of Boulder Creek at Deep Meadow – 2001 to 2006

Change in particle size distribution from 2001 to 2006 was minimal with the dominant measured particle size in 2001 at 0.12 mm and in 2006 at 0.05 mm. There is only a 0.07 mm difference in particle size suggesting this slight change is part of the channel's natural variability. Figure 64 displays the particle size distribution for both surveys.

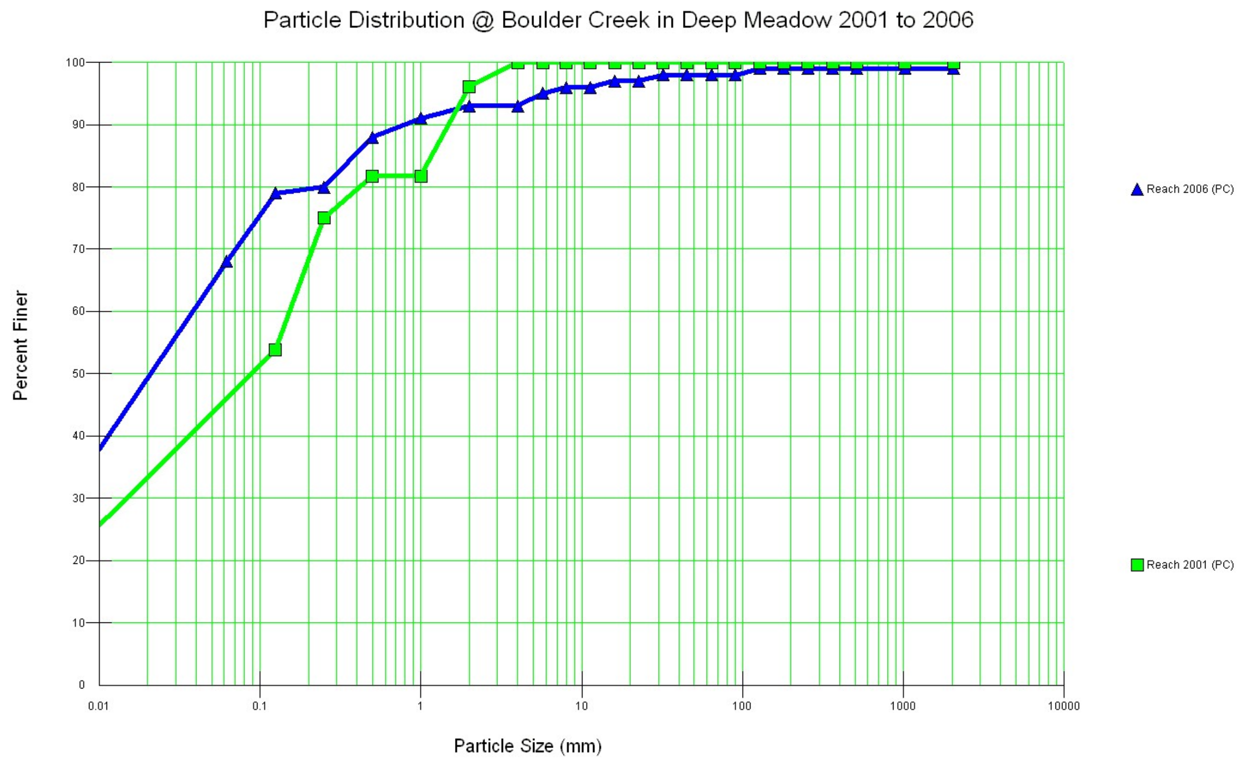


Figure 64 – Particle Size Distribution for Boulder Creek at Deep Meadow – 2001 to 2006

Increases in average stream shade and large woody debris were recorded. Average stream shade increased in 2001 to 2006 from 11 percent to 20 percent. Average large woody debris increased from 2001 to 2006 from $0.01m^3/m$ to $1.17m^3/m$.

Water chemistry measured total alkalinity, pH, and stream temperature for 2006. Total alkalinity for Boulder Creek was recorded at 30ppm $CaCO_3$ while pH was slightly acidic at 6.5. Temperature for that day was 14 degrees C. Aquatic MIS site condition is very good based on sample collected in 2006, Table 73.

Table 73 – Boulder Creek at Deep Meadow			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Boulder Creek (Deep Meadow)	6/2/2006	4.00	Very good Possible slight organic pollution

Belknap Creek (4D-I)

Belknap Creek is a class I stream associated with rainbow trout that encompasses approximately two linear miles that drains into the SFMF Tule River at Belknap Campground. The surveyed portion of this stream is naturally-stable with bedrock boulder and cobble dominated channels. Road 20S54 and Highway 190 cross the stream above Belknap Campground. These are the only known development in the drainage.

Nelson Creek (4D-J)

Nelson Creek is a class III stream with no known fisheries that encompasses approximately two linear miles that drains into SFMF Tule River at the community of Camp Nelson. The entire length of the stream has been surveyed and is a naturally-stable, moderate to steep gradient, bedrock boulder and cobble channel.

The community of Camp Nelson and surrounding private holdings encompass approximately 40 percent of the drainage area. Highway 190 and Redwood Drive cross the stream above Camp Nelson. The stream passes through approximately ¼ mile of private land near its headwaters. The headwaters area of this drainage is dominated by landslide terrain. There are no cattle grazing associated with this drainage.

An SCI site was established on an unnamed tributary to the Tule River near Camp Nelson in 2005. The site was established to monitor the Camp Nelson Urban Interface Project. The reach length is 77.8 meters. Table 74 summarizes the SCI data.

Table 74 - Tributary to Tule River at Camp Nelson	
Large Wood Debris (m^3/m)	0.31
% Shading	80 - 100
Temperature (Celsius)	Not Recorded
pH (ppm)	Not Recorded
Alkalinity ($CaCO_3$)	Not Recorded
Mean Particle Size in mm (D50)	114.43
Width-to-depth Ratio	16 – 29
Hilsenhoff Biotic Index - Rating	Not Recorded
Riparian Impact Rating	Low
Rosgen Channel Type	B3a

Surveys define the tributary as a high gradient, cobble dominated, low impact, stable-sensitive B3a type channel. Figure 65 displays a cross-section for the unnamed tributary near Camp Nelson. Figure 66 displays the particle size distribution for the reach.

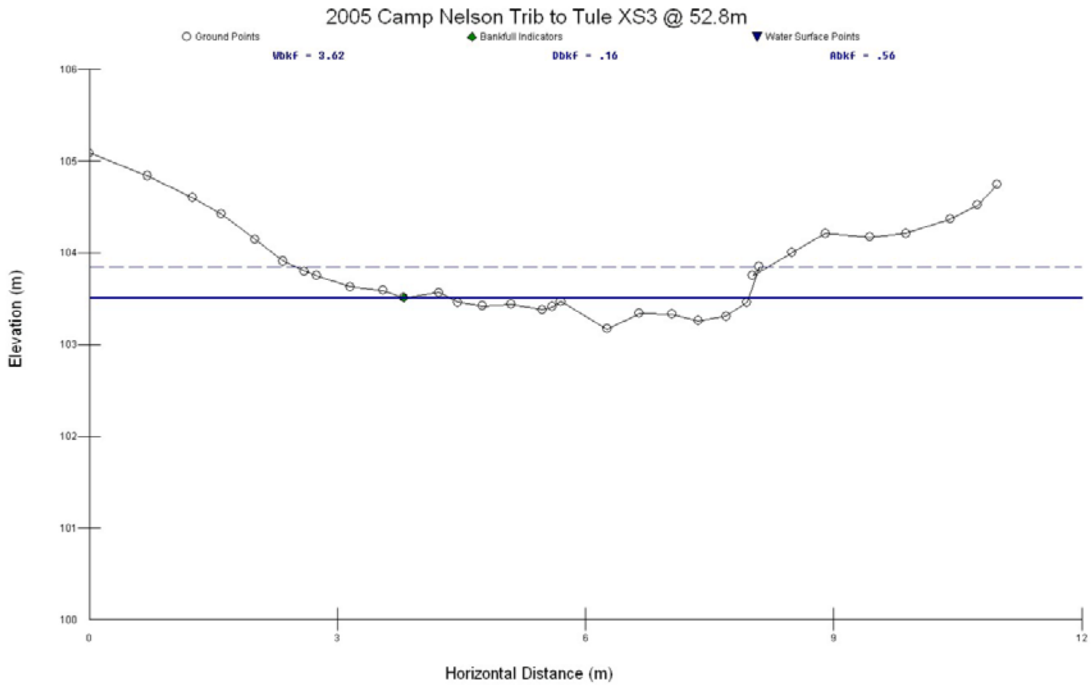


Figure 65 – Cross section of Camp Nelson Trib to Tule

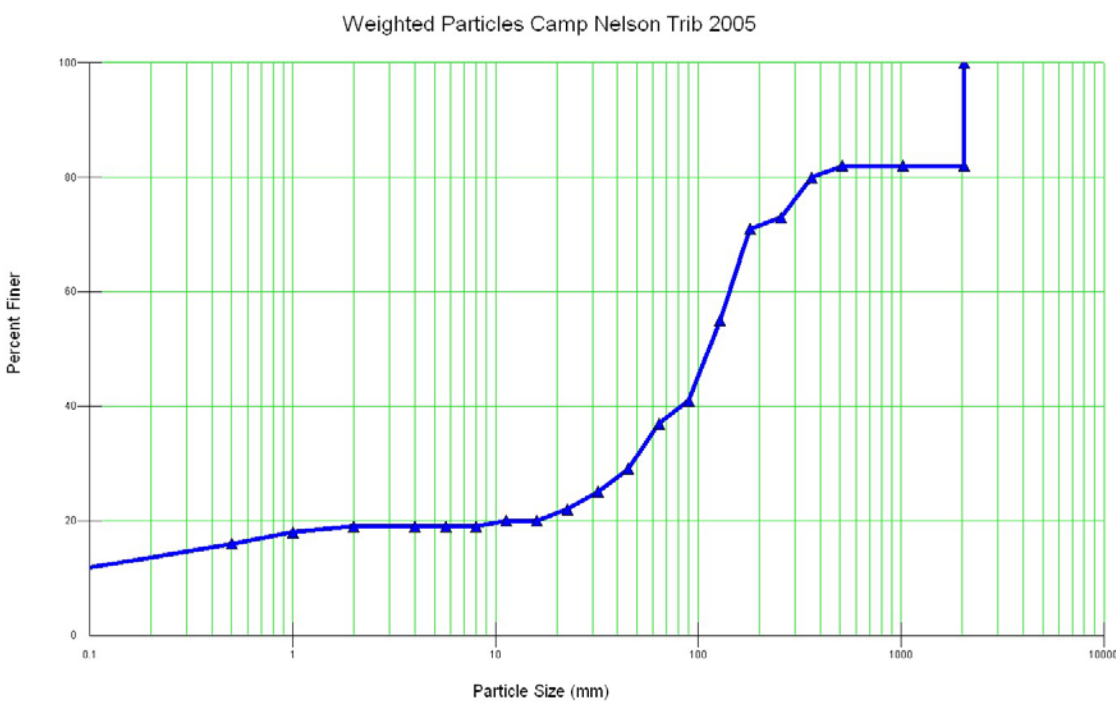


Figure 66 – Particle Size Distribution for Camp Nelson Tributary to Tule River

Average stream shading along the reach provided 92 percent cover. Average amounts of large woody debris found throughout the reach was 0.31 m3/m. Water chemistry was not recorded due to lack of water at the time of sampling.

Moorehouse Creek (4D-L)

Moorehouse Creek is a class III stream associated with no known fisheries that encompasses approximately 4.5 miles of stream that drains into the SFMF Tule River. Highway 190 crosses through the lower portion of the watershed, which is private property. Approximately 0.60 square miles of the total approximate 1.90 square miles of watershed is private property. The upper portion contains Forest Service road 20S04A and a small portion of Redwood Drive.

The Moorehouse Creek SCI site is located north of the confluence of the South Fork Middle Fork of the Tule River. The site was established to monitor the Camp Nelson Urban Interface project. Table 75 summarizes the SCI data.

Table 75 - Moorehouse Creek SCI Data	
Large Wood Debris (m^3/m)	1.27
% Shading	92 – 100
Temperature (Celsius)	12 – 15
pH (ppm)	6.5 – 7.2
Alkalinity ($CaCO_3$)	Not Recorded
Mean Particle Size in mm (D50)	5.39 – 14.66
Width-to-depth Ratio	11.28 – 20.77
Hilsenhoff Biotic Index - Rating	0.90 Excellent
Stream Impact Rating	Moderate
Rosgen Channel Type	B

Surveys were completed in 2005 that defined the stream channel as a high gradient, gravel dominated, stable-sensitive, moderately impacted B4a channel type. The reach length is 26.6 meters. Figure 67 displays a cross-section along Moorehouse Creek. Figure 68 displays particle size distribution throughout the reach.

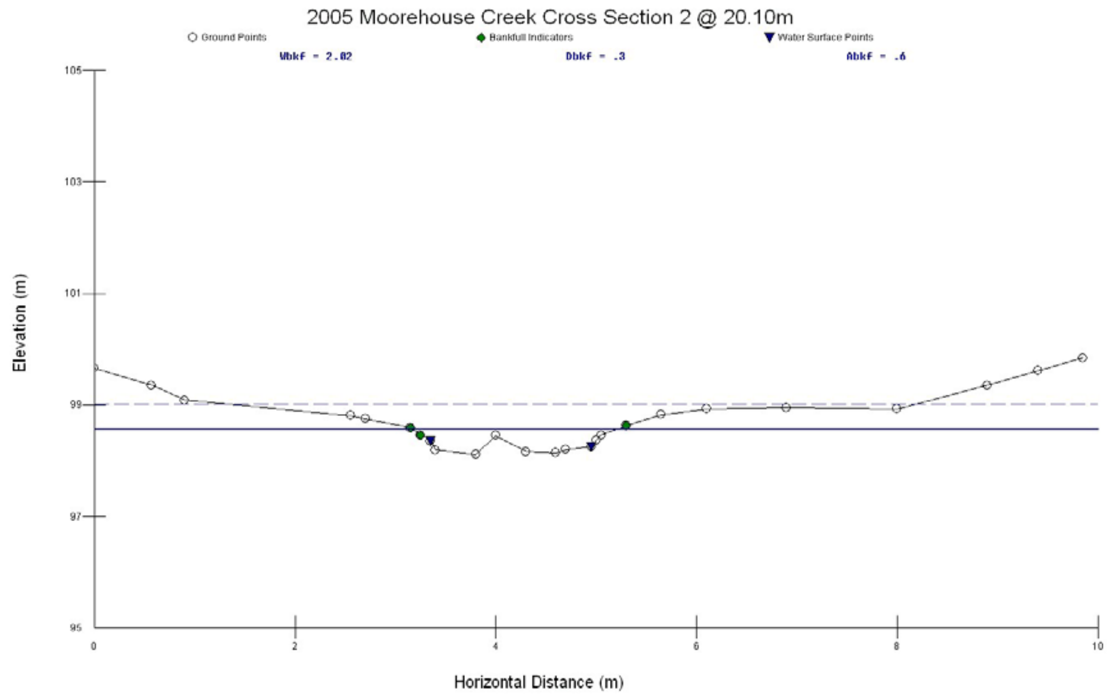


Figure 67 – Cross section of Moorehouse Creek – 2005

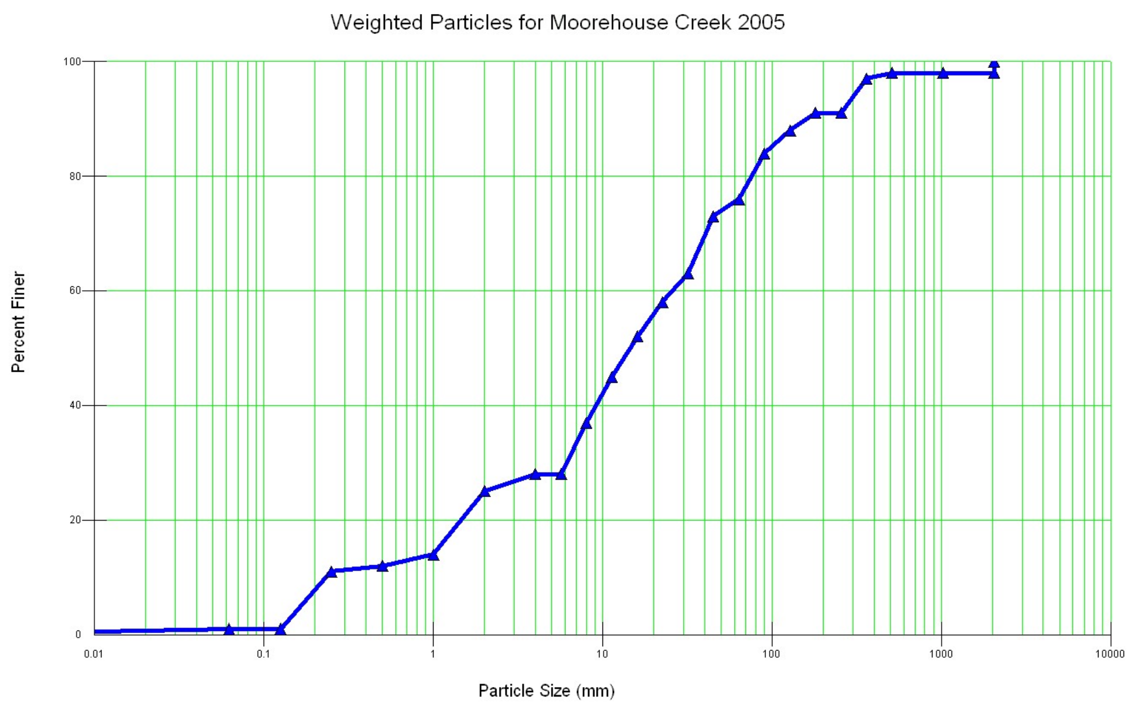


Figure 68 – Particle Size Distribution for Moorehouse Creek – 2005

Average stream shading along the reach was approximately 75 percent. Average amount of large woody debris was 1.27 m^3/m. Water chemistry was not recorded for total alkalinity, but did measure pH and stream temperature. The pH was slightly acidic at 6.5. Temperature for that day was 11 ºC. Aquatic MIS site condition for Moorehouse Creek is excellent based on samples collected in 2005 and 2009, Table 76.

Table 76 – Aquatic MIS Site Condition for Moorehouse Creek			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Moorehouse Creek	8/30/2005	0.90	Excellent No apparent organic pollution
Moorehouse Creek	6/10/2009	0.92	Excellent No apparent organic pollution

Soda Creek (4D-M)

Soda Creek is a class IV stream associated with no known fisheries that encompasses approximately 3.3 miles of stream that drains into the SFMF Tule River. Highway 190 crosses through private property. Approximately 0.10 square miles of private property resides within the lower portion of the subwatershed.

The terrain, dense vegetation, and limited access do not allow for surveys. However, based on aerial photography, topography, and nearby watersheds, Soda Creek is expected to be within a range of naturally-stable or naturally-unstable, moderate to very high gradient, A and B channel types.

McIntyre Creek (4D-N)

McIntyre Creek is a class I stream associated with rainbow and brook trout that encompasses approximately 2.25 linear miles that drains into the SFMF Tule River. Naturally-unstable steep debris slide dominated cobble channels comprise approximately 50 percent of the drainage. The lower portion of the stream is a naturally-stable steep boulder channel.

The headwaters of this stream are located less than ¼ mile south of road 20S81. Cattle grazing and dispersed camping occur in the headwaters area. Highway 190 crosses the stream near Cedar Slope.

Marshall Creek (4D-O)

Marshall Creek is a class I stream with no known fisheries. The channel encompasses approximately 1.25 linear miles and drains into the SFMF Tule River below Cedar Slope. Approximately 50 percent of the stream, the upper half, is a naturally-unstable steep cobble gravel debris slide dominated channel. The remaining portion is a naturally-stable steep boulder channel.

Cattle use is not associated with this drainage. Highway 190 crosses the stream at Cedar Slope. The stream passes through a portion of the private land associated with Cedar Slope. Trail 31E30, the Camp Nelson trail, crosses the stream near its confluence with SFMF Tule River and is used seasonally by the public.

North fork tule river watershed (1803000602)

The watershed encompasses approximately 62,360 acres. Of these, about 30,475 acres are National Forest System lands that fall within the Monument, approximately 4,370 acres are private land, 2,380 acres are state lands, and 32,120 acres lie outside the Monument. Approximately 6,000 acres of the watershed comprise the Mountain Home State Forest.

This watershed drains approximately 39 linear miles of perennial streams. It is separated into two basins, North Fork Tule River and Bear Creek. The streams that comprise these two basins are the North Fork Tule River, Bear Creek, Rancheria Creek, Dillon Creek, Pine Creek, South Bear Creek, Backbone Creek, Kramer Creek, an unnamed tributary to Rancheria Creek, and Jenny Creek.

Natural ranges of variability were developed from seven years of data collection within the North Fork Tule River Watershed. The ranges were created from two SCI sites (see Table 77). Table 78 displays the natural range of variability for the North Fork Tule River Watershed.

Table 77 – SCI Location and Information for the North Fork Tule River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
North Fork Tule River	1803000602	Bear Creek	Bear Creek at SCICON	Western Divide	2001, 2006	B4c	Stable-sensitive	Moderate
North Fork Tule River	1803000602	Bear Creek	Bear Creek by CCC camp	Western Divide	2007	B5a	Stable-sensitive	Moderate

Table 78 - Range in Channel Attributes, North Fork Tule River Watershed

Parameter	Channel Type
	A and B Channels
Large Wood Debris (m^3/m)	0.00 – 0.03
% Shading	58 - 78
Temperature (Celsius)	12 - 16
pH (ppm)	7.1 - 7.5
Alkalinity ($CaCO_3$)	72 - 140
Mean Particle Size in mm (D50)	2.00 – 163.45
Width-to-depth Ratio	11.03 – 25.98
Hilsenhoff Biotic Index - Rating	2.99 – 3.39 Excellent
Riparian Impact Rating	Moderate

The elevation ranges from approximately 2,200 to 9,300 feet. Approximately 60 percent of the watershed within the Monument is in steep terrain with high gradient bedrock and boulder channels. The remaining 40 percent of the watershed is composed of moderate gradient boulder and cobble channels.

Human-caused impacts include roads, residences, recreation, grazing, and vegetation management. Past disturbances have the potential to affect water quality. No watersheds cause concern from any of these past disturbances.

Bear Creek (4A-A, 4A)

Bear Creek is a class I stream associated with rainbow trout and encompasses approximately 11.5 linear miles. Private property is located in various portions of the watershed. Buckhorn Ranch is in the center, followed to the east is the Mountain Home Conservation Camp. Mountain Home State Forest headquarters is within the headwaters. SCICON is located in the southwest below the confluence of Bear and Rancheria creeks. Other private property areas are located in the northern and western portions. Mountain Road 296, locally known as Balch Park Road, is the main road through the watershed. Forest Service roads are located in the southeastern portion.

Portions of the South Grouse, Rancheria, East Bear Creek, and West Bear Creek grazing allotments lie in the drainage area. Impacts from livestock use are low due to steep terrain. Concentrated use areas by livestock have minimal impact on adjacent and/or nearby stream corridors.

The western most unnamed tributary, in sections 16 and 9, starts off as a gravel dominated, high gradient, minimally impacted, naturally-unstable A4 channel. Downstream about 0.25 miles the channel becomes a bedrock dominated, very high gradient, minimally impacted, naturally-stable, A1a+ channel type. The A1a+ channel type continues down to the confluence of Bear Creek.

An unnamed tributary in the middle of the area, section 10, begins as a catch pond. The stream channels above the catch pond are all ephemeral channels. The outlet of the pond flows down towards Mountain Road 220 and is dominated by bedrock and/or boulders. The channel was not surveyed, but is assumed to be a naturally-stable system with a high gradient, dominated by bedrock and/or boulders.

The easternmost unnamed tributary, in the northwest corner of section 11, is a naturally-stable, bedrock dominated, moderate gradient, minimally impacted, B1 channel type. Approximately 25 percent of the channel is ephemeral. The ephemeral portion is located near the headwaters and becomes intermittent below road 20S93.

Surveys were conducted in 2001 on portions of Rancheria Creek, an unnamed tributary to Rancheria Creek, and Bear Creek within the Bear Creek drainage, as well as the North Fork Tule River in the North Fork Tule River drainage. Naturally-stable bedrock, boulder, and cobble type channels dominate the watershed. However, areas of naturally-unstable landslide-dominated channels and meadow-dominated stable-sensitive channels exist in the headwaters of Rancheria Creek and the unnamed tributary to Rancheria Creek.

The Bear Creek SCI site, below the confluence of Bear Creek and Rancheria Creek near SCICON, was established in 2001. The site was implemented to monitor the Coffee Camp Broadcast Burn project. The project has not occurred, and the site was then used for the Tule River West Grazing project. An initial survey was completed in 2001 and then resurveyed in 2006 after implementation. Cross-section surveys were extended in 2006 to better capture the channels morphology. Table 79 summarizes the SCI data collected.

Table 79 - Bear Creek at SCICON SCI Data	
Large Wood Debris (m^3/m)	0.00 – 0.01
% Shading	26 – 97
Temperature (Celsius)	16
pH (ppm)	7.5
Alkalinity ($CaCO_3$)	72
Mean Particle Size in mm (D50)	2 – 4
Width-to-depth Ratio	11.88 – 25.98
Hilsenhoff Biotic Index - Rating	3.36 Excellent
Riparian Impact Rating	Moderate
Rosgen Channel Type	B4c

Initial surveys in 2001 recorded Bear Creek as a low gradient, sand dominated, low impacted, stable-sensitive B5c channel. There was no change in channel morphology between both surveys. However, there was a change is particle size distribution and impact ratings. Changes in 2006 defined the channel as a low gradient, gravel dominated, moderately impacted, stable-sensitive, B4c channel type. Figure 67 displays an extended cross-section in Bear Creek.

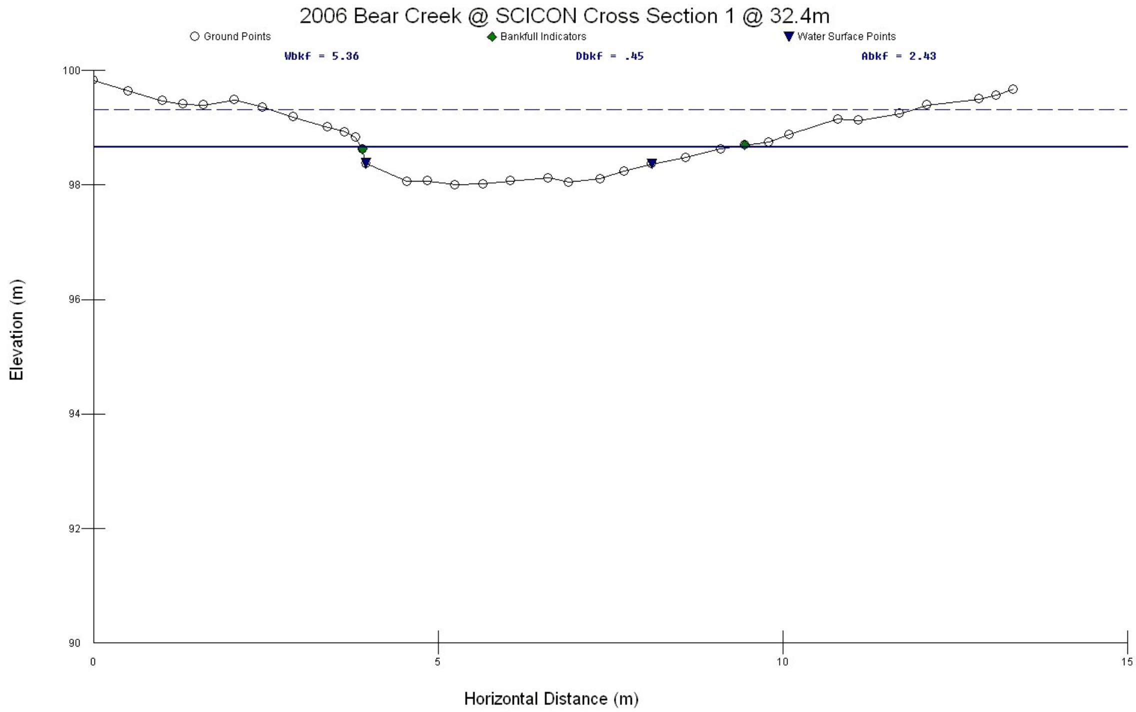


Figure 67 – Cross section of Bear Creek At SCICON

Change in particle size distribution from 2001 to 2006 was minimal. The dominant measured particle size in 2001 was 2 mm and in 2006 it was 4 mm. There is only a 2 mm size difference and suggests the slight change is part of the channels natural variability. Figure 68 displays the particle size distribution for both surveys for the entire reach.

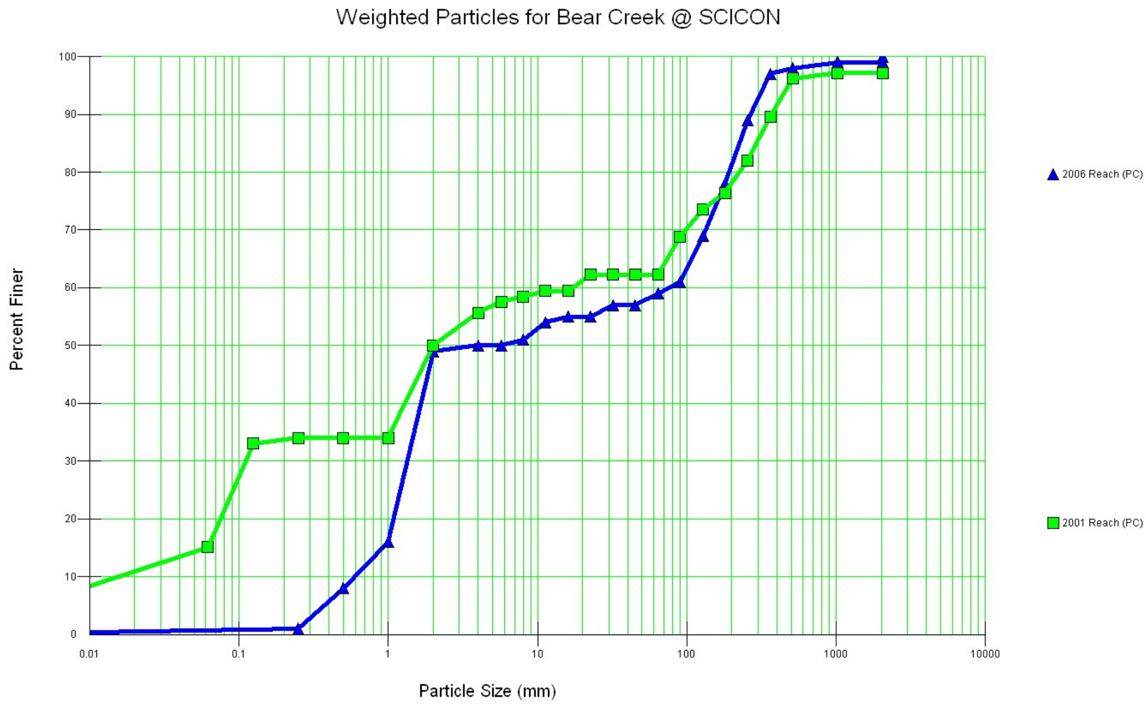


Figure 68 – Particle Size Distribution for Bear Creek at SCICON

The higher impact rating recorded in 2006 was caused from the steep, sand and silt dominant, naturally-unstable channels upstream in the watershed. These streams are contributing sediment down Rancheria Creek and Bear Creek from private property and/or non-national forest lands. Localized impacts directly adjacent to and above the SCI site are recreation trail use from SCICON. Livestock had access to the channel creating potential impacts. Tule West Grazing project installed a fence approximately ½ mile in length above the SCI site on Rancheria Creek to exclude livestock and recreational access to the channel. It is expected the impact rating will remain the same or decrease in the future as a result of these improvements and watershed conditions.

Average stream shading for the reach in 2001 provided approximately 61 percent cover. In 2006 average shading for the reach was 58 percent. The change in shade cover is considered minimal to insignificant. Large woody debris across the reach decreased during the period of 2001 to 2006 from $0.01m^3/m$ to $0.00m^3/m$.

Water chemistry collected total alkalinity, pH, and stream temperature in 2006 for Bear Creek. Total alkalinity was recorded at 72 ppm $CaCO_3$. The pH was slightly basic at 7.5. Temperature for that day was 16 ºC. Aquatic MIS site condition for this site is excellent based on a 2006 sample, Table 80.

Table 80 – Aquatic MIS Site Condition for Bear Creek at SCICON			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Bear Creek near SCICON	8/2/2006	3.36	Excellent - No apparent organic pollution

An SCI site on Bear Creek at the California Department of Corrections (CDC) facility was established in 2008 for monitoring a potential project called the Buckhorn Fuels Reduction Project. The project has not been implemented, so only pre-project data was collected. Table 81 summaries the SCI data.

Table 81 - Bear Creek near CDC (Mountain Home California Division of Corrections)	
Large Wood Debris (m^3/m)	0.188
% Shading	56 – 98
Temperature (Celsius)	Not Recorded
pH (ppm)	7.0
Alkalinity ($CaCO_3$)	77
Mean Particle Size in mm (D50)	163.45
Width-to-depth Ratio	11.03 – 25.55
Hilsenhoff Biotic Index - Rating	2.99 Excellent
Riparian Impact Rating	Moderate
Rosgen Channel Type	B

Surveys define the stream channel as high gradient, sand dominated, stable-sensitive, moderately impacted B5a channel type. The reach length is 95.5 meters. Figure 69 displays a cross-section along Bear Creek at CDC. Figure 70 displays particle size distribution throughout the reach.

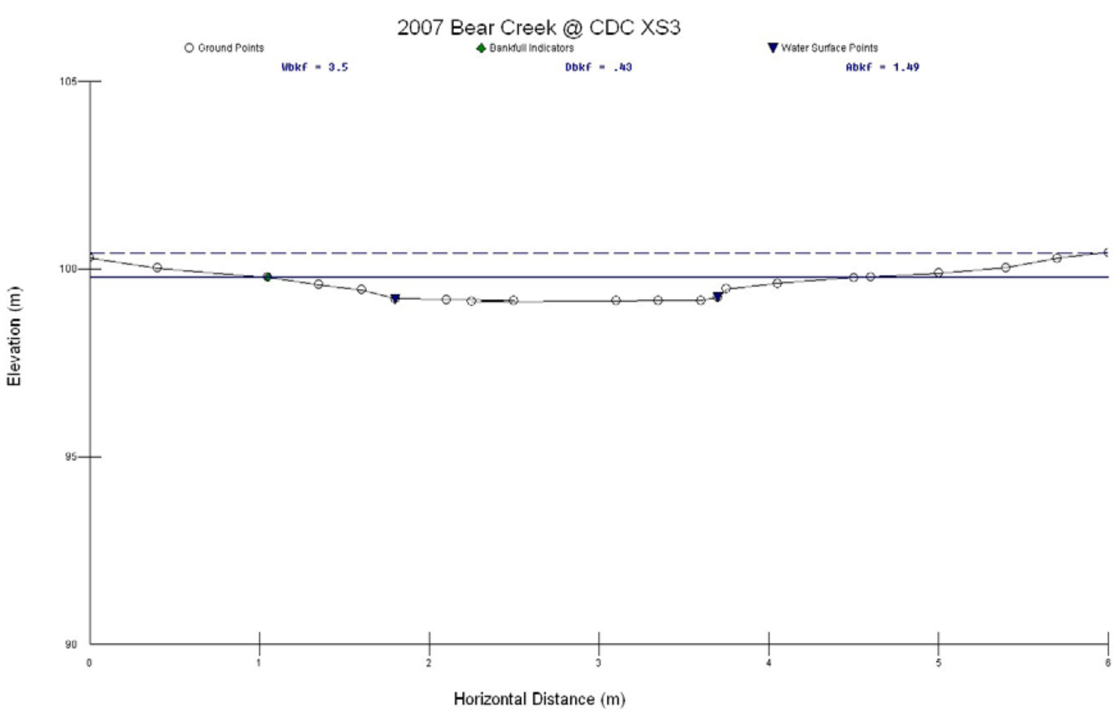


Figure 69 – Cross section of Bear Creek at CDC - 2007

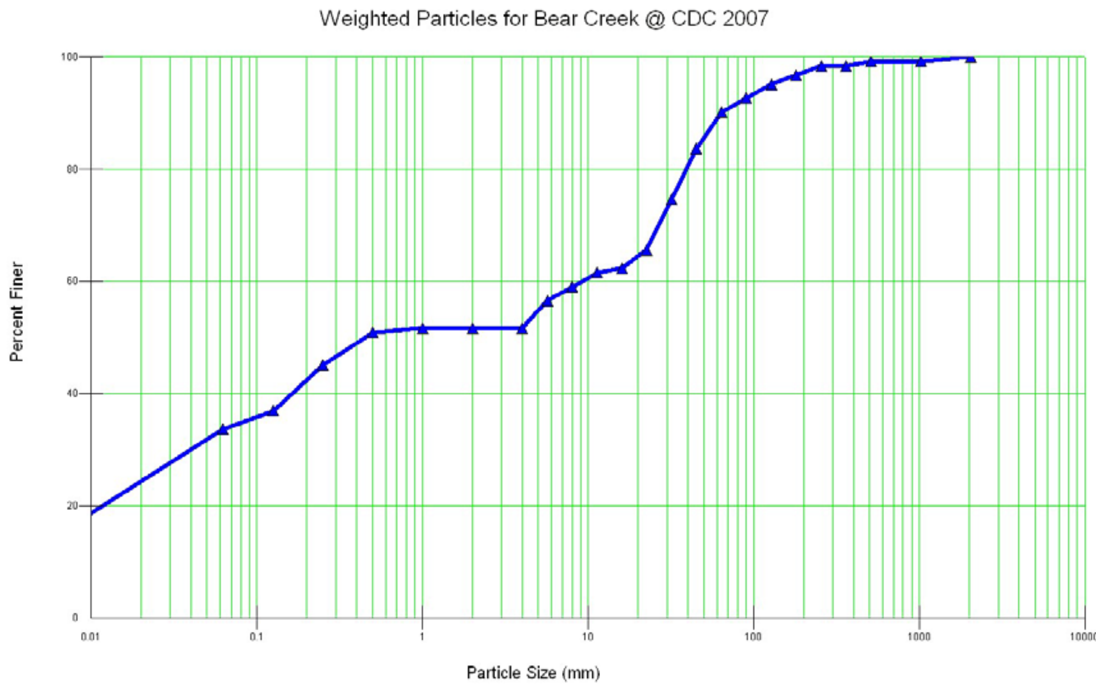


Figure 70 – Particle Size Distribution for Bear Creek at CDC - 2007

Average stream shading along the reach provides approximately 78 percent cover. Average amount of large woody debris throughout the reach was 0.18m^3/m for both 2007. Water chemistry collected data regarding total alkalinity, pH, and stream temperature. Measured total alkalinity was 140 ppm $CaCO^3$ while the pH was slightly basic at 7.1. Recorded temperature for that day was 12 degrees C. Aquatic MIS site condition at this location is excellent; Table 82.

Table 82 –Bear Creek at CDC			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Bear Creek near CDC	7/2/2007	2.99	Excellent No apparent organic pollution

SOUTH FORK TULE RIVER WATERSHED
(1803000603)

The South Fork Tule River and its tributaries, which include Cedar Creek, Kessing Creek, Windy Creek, and Crawford Creek, drain west through the Tule River Indian Reservation into Lake Success and eventually into the Tulare lakebed. The watershed encompasses approximately 64,576 acres. Of these, about 10,524 acres are National Forest System lands within the Monument, and approximately 160 acres are private land. The remaining 53,892 is the Tule River Indian Reservation. Elevation ranges from approximately 5,000 at the Monument boundary to 9,000 feet at Slate Mountain.

Human-caused impacts within National Forest System lands include roads, residences, recreation, grazing, and vegetation management. Past disturbances have the potential to affect water quality. No watersheds cause concern from any of these past disturbances.

Upper Deer, White, and Poso River Basins

UPPER DEER-UPPER WHITE RIVER BASIN

Most of the Upper Deer-Upper White River basin is located outside of National Forest System lands. Headwaters begin along the Greenhorn Summit, which separates these two east-flowing watersheds from the south-flowing North Fork of the Kern River. Tobias and Bull Run Peaks are high points along this divide. Deer Creek basin is roughly 90 square miles and terminates 10 miles east of Terra Bella. The White River basin is roughly 100 square miles and ends about 20 miles east of Delano on the Tulare/Kern County line. Deer Creek and White River become intermittent drainages once they hit the valley floor. Historically, these drainages flowed directly into the old Tulare lakebed. Both drainages have had no flow for several months in most years; however, high flows have reached 2,720 cubic feet per second and 5,330 cubic feet per second for White River and Deer Creek, respectively.

Natural ranges in variability were developed from data on five sites within the Upper Deer-Upper White River Basin. Similarities were discovered when analyzing all the SCI data. These similarities create the ranges of natural variability displayed in the following table. The ranges are shown for large woody debris, stream shading, water temperature, alkalinity and other parameters displayed in Table 83. Information provided is a summary of conditions that have not been segregated by local conditions and channel types. Additional detailed information is provided at the smaller watershed scale (7th field HUC) and provides information useful for management and monitoring direction and constraints.

Table 83 - Upper Deer-Upper White River Basin	
Large Wood Debris (m^3/m)	0.04 – 0.58
% Shading	37 - 97
Temperature (Celsius)	15 - 18
pH (ppm)	7.0 – 7.5
Alkalinity ($CaCO_3$)	65 – 175
Mean Particle Size in mm	1.28 – 87.11
Width-to-depth Ratio	13.22 - 35
Hilsenhoff Biotic Index – Rating	2.97 -3.57 Excellent to Very Good
Riparian Impact Rating	Low - Moderate
Rosgen Channel Type	B

Aquatic insect data for the Upper Deer-Upper White River basin aquatic MIS site condition ranges from excellent to very good using Hilsenhoff biotic rating. Riparian ecotype impact ratings fall in the low riparian impact range. Stream surface shade may be associated with stream temperatures. Surveys were taken along sites in non-meadow environments. The percent stream surface shade ranges from 37 to 97 percent.

Large woody material is an important component of stream stability and aquatic habitat. Measurements taken in the Upper Deer-Upper White River basin show a range of large woody material from 0.04 to 0.58 meters^3 per meter of stream evaluated. The lowest levels of woody debris were measured in Capinero Creek, and the highest levels of woody debris were measured in White River.

Values for the Upper Deer-White River basin for width-to-depth ratios have been separated by channel type. Survey data discovered one site on a C channel and nine sites on B channels. Measurements taken in these naturally-stable or stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements at those locations.

Water chemistry measurements for pH values range from 7.0 to 7.5 in this watershed basin. Temperature ranges from data that was taken at a point during summer months is from 15 to 18 ºC. Alkalinity values range from 65 to 175 ppm.

These basins were both rated as category II in the Unified Watershed Assessment. A category II rating describes watersheds with good water quality that, through regular program activities, can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems. Roads, private residence tracts, recreation, vegetation management, grazing, natural and prescribed fires, slope stability, and floods influence water quality in the watershed.

UPPER WHITE RIVER WATERSHED
(1803000501)

The White River and its tributaries are located on the west slope of the Sierra Nevada and drain in a westerly direction into the central valley south of Ducor. The morphology of the drainage basin ranges from deep V-shaped canyons with steep rugged terrain to moderate slopes at lower elevations. The White River basin comprises the entire Upper White River watershed that lies within the Monument boundary.

The watershed encompasses approximately 57,490 acres. Of these, approximately 6,540 acres are National Forest System lands that fall within the Monument, about 350 acres are private land, and 50,600 acres lie outside the national forest. Elevations range from 4,000 feet at Twin Springs to 8,025 feet at Bull Run Peak. Dominant channel types include moderate to steep bedrock/boulder/cobble channels, and there are several minor springs and seeps that occur within the watershed. No giant sequoia groves are located in this watershed, and there are no known dams within the Monument in this watershed. Natural ranges in variability were developed from six years of data collection within the Upper White River Watershed (see Table 81).

Table 81 – SCI Location and Information for Upper White River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating

Upper White River	1803000501	White River	Near Betty Waller Mdw	Western Divide	2001, 2006	B3	Naturally-stable	Low

White River (18E-B, D, E)

White River is a class I stream associated with rainbow trout with headwaters in Bull Run Meadow. The watershed encompasses approximately 5.5 linear miles within the forest boundary that drains west into the Tulare Lake basin. Steep to moderate gradient bedrock/boulder/cobble naturally-stable channels comprise approximately 85 percent of the reaches. Approximately 12 percent of the reaches are naturally-unstable fine grained steep landslide dominated channels. The remaining reaches are meadow dominated stable-sensitive channels. Stream channel stability surveys after Pfankuch rate this channel to be in low good condition (Pfankuch 1975).

White River contains the lower portion of the Capinero grazing allotment and in its headwaters, a portion of the Dunlap grazing allotment. Some areas of hoof shear are visible on hillsides within the watershed. High use areas are concentrated around the White River summer home tract, White River Campground, and O'Quinn Meadow. Roads and these areas of recreation use have been identified as the main contributors to the sediment load present in the drainage.

Stream stability of White River have been locally affected by recreation, roads, and livestock uses. The channel above and below White River Campground contains very high amounts of sedimentation in pools and high percentages of fine material. This reach has at least three locations where sediment is entering the creek from over-side drains off of Capinero Road (23S05) and from culverts off of 24S06. Localized compaction of stream banks is evident in some areas frequented by people.

There are several small foothill communities on private land in this watershed, totaling 351 acres. There is a well serving White River Campground and spring developments providing water to the 22 cabins in the White River recreation residence tract within the national forest portion of this watershed. There are no known dams in this watershed within the NF boundary.

White River SCI site is located below White River Campground. It was established to monitor livestock grazing in several active allotments. It was initially surveyed in 2001 and again in 2006. Cross-sections were extended in 2006 to better capture stream morphology characteristics. The reach is 190.5 meters. Table 82 summarizes the SCI data.

Table 82 - White River SCI Data	
Large Wood Debris (m^3/m)	0.19 – 0.58
% Shading	75 - 82
Temperature (Celsius)	15
pH (ppm)	7.0
Alkalinity ($CaCO_3$)	65
Mean Particle Size in mm (D50)	1.56 – 87.11
Width-to-depth Ratio	13.22 – 22.8

Hilsenhoff Biotic Index – Rating	inconclusive
Riparian Impact Rating	Low
Rosgen Channel Type	B5

Minor changes were noticed between 2001 and 2006 and did not affect channel type or riparian impact ratings. Surveys defined the stream channel as a moderate gradient, stable-sensitive, sand dominated, moderately-high impact B5 channel in 2001. In 2006, the channel changed to a moderate gradient, naturally-stable, cobble dominated, moderately impacted B3 channel. Figure 71 displays a cross-section along White River.

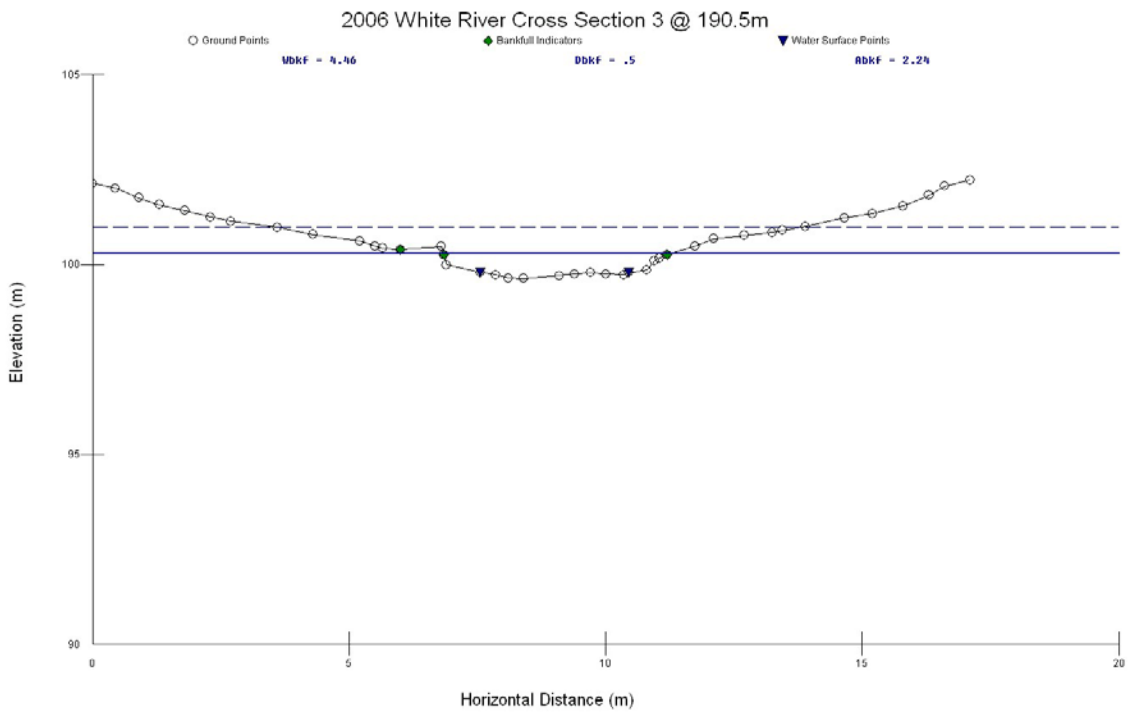


Figure 71 – Cross section of White River – 2001 to 2006

Particle size distribution in the 2001 classified the channel as a sand dominated system. The 2006 survey displayed a shift to a cobble dominated system. The change in particle size distribution from 2001 to 2006 was 1.56 mm to 87.11 mm. A disturbance may have occurred higher up in the watershed and deposited finer particles into the stream prior to 2001. However, the 2006 survey results suggest the disturbance has passed through the system and the channel is returning back to a naturally-stable, cobble dominated system. Figure 72 displays a graph of the particle size distribution for both surveys.

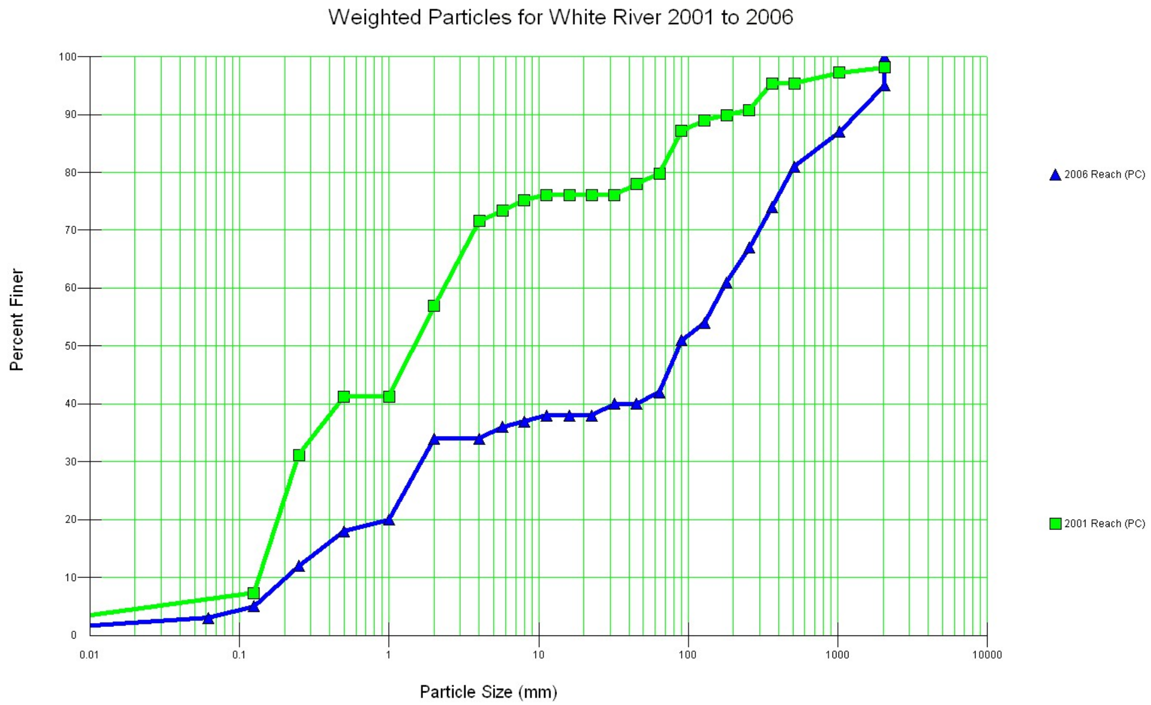


Figure 72 – Particle Size Distribution for White River – 2001 to 2006

Average stream shading decreased from 2001 at 82 percent to 75 percent in 2006. Large woody debris increased from 0.19m^3/m in 2001 to 0.58m^3/m in 2006. Water chemistry measurements collected total alkalinity, pH, and stream temperature in 2006. Total alkalinity measured 65 ppm $CaCO_3$ while the pH was neutral at 7.0. The recorded temperature for that day was 15 ºC. Aquatic MIS site condition was inconclusive based on requisite individuals (>100), Table 83.

Table 83 – White River			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
White River	7/11/2006	na	inconclusive

UPPER DEER CREEK WATERSHED (1803000502)

Deer Creek and its tributaries are located on the western slope of the Sierra Nevada and drain west into the central valley between Terra Bella and Porterville. The morphology of the drainage basin ranges from deep V-shaped canyons with steep rugged terrain to moderate slopes at lower elevations. The watershed encompasses approximately 65,340 acres. Of these, about 25,970 acres are National Forest System lands that fall within the Monument, approximately 2,366 acres are private land, and 37,004 acres lie outside the Monument boundary.

Elevations range from approximately 3,600 to 8,285 feet at Tobias Peak. Dominant channel types include high gradient bedrock boulder or landslide-dominated channels in steeper terrain within the watershed and moderate gradient cobble channels in the more moderate terrain. Two meadows occur in the upper portions of the watershed. They include Pup Meadow and Dead Horse Meadow. The Upper Deer Creek watershed is comprised of four watershed basins: Gordon Creek, Rube Creek, Tyler Creek, and Deer Creek. There are several minor springs and seeps that occur within the watershed.

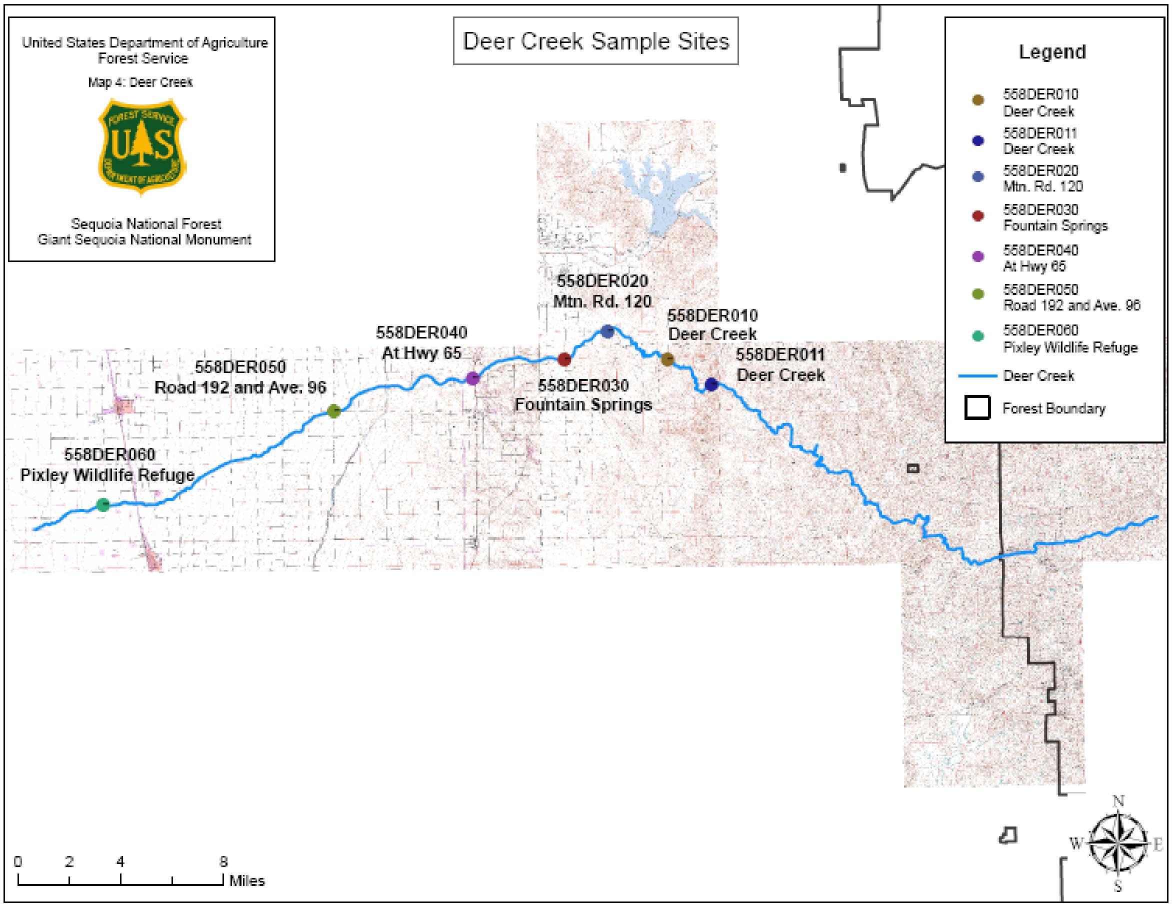
Upper Deer Creek watershed was rated as a category II in the Unified Watershed Assessment. A category II rating describes watersheds with good water quality that through regular program activities can be sustained and improved. Category 2 watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems.

California Hot Springs Water Company has a water bottling plant on private land within this watershed. Pine Flat Water Company has a water system, and cabin owners get their water supply from National Forest System land. There is well providing water to the Uhl administrative site and providing water to the Deer Creek administrative site and Leavis Flat Campground. This watershed contains the foothill communities of California Hot Springs and Pine Flat.

Human-caused impacts include roads, residences, recreation, grazing, and vegetation management. Past disturbances have the potential to affect water quality such as natural and prescribed fires, slope stability, and floods. Watersheds of concern resulting from past disturbances include the tributaries to Rube Creek, Merry Creek, Alder Creek, the headwaters of Deer Creek, and Capinero Creek.

Deer Creek is listed as a potential 303(d) impaired water body by the Central Valley Water Quality Control Board (CVWQCB) in June of 2009. This water segment, as identified by the board, started somewhere around Pixley, California and proceeded to the headwaters on the Sequoia National Forest. Sampling that placed Deer Creek for consideration on the 303(d) lists are at seven sites along the reach. None of these sites are on National Forest System lands, and the nearest sample site is 17 miles downstream of the forest boundary. Deer Creek is crossed by Highway 65, Highway 99, and Highway 43 and flows through agricultural lands, range lands, and communities once it leaves the forest. Deer Creek sample sites tables below provides a map and sampling data provided by the regional water board (Figure 73).

Figure 73 - RWQCB Water Quality Sampling Sites and Data, Deer Creek, 2003-2006



Deer Creek Sampling Sites/Station Code	Sampling Date	Data Range (p
Deer Creek 558DER011	6/24/2003	8.2
	5/19/2004	8
	6/16/2004	7.37
Deer Creek 558DER010	2/3/2005	7.37
	5/10/2005	7.84
	6/28/2005	8.28
	7/26/2005	7.83
	8/30/2005	7.6
	10/19/2005	7.57
	1/3/2006	7.96
	2/14/2006	8.51
	3/13/2006	8.72
	4/25/2006	8.2
	6/26/2006	7.82
	7/24/2006	7.56
	8/21/2006	7.72
	10/23/2006	8.15
Deer Creek – Mtn Rd 120 558DER020	6/24/2003	8.4
	5/19/2004	8.3
Deer Creek –	6/24/2003	8.6

Deer Creek Sampling Sites/Station Code	Sampling Date	Data Range (pl
Deer Creek 558DER011	6/24/2003	8.2
	5/19/2004	8
	6/16/2004	7.37
Deer Creek 558DER010	2/3/2005	7.37
	5/10/2005	7.84
	6/28/2005	8.28
	7/26/2005	7.83
	8/30/2005	7.6
	10/19/2005	7.57
	1/3/2006	7.96
	2/14/2006	8.51
	3/13/2006	8.72
	4/25/2006	8.2
	6/26/2006	7.82
	7/24/2006	7.56
	8/21/2006	7.72
	10/23/2006	8.15
Deer Creek – Mtn Rd 120 558DER020	6/24/2003	8.4
	5/19/2004	8.3
Deer Creek –	6/24/2003	8.6

Deer Creek Sampling Sites/Station Code	Sampling Date	Data Range (pH)
Deer Creek 558DER011	6/24/2003	8.2
	5/19/2004	8
	6/16/2004	7.37
Deer Creek 558DER010	2/3/2005	7.37
	5/10/2005	7.84
	6/28/2005	8.28
	7/26/2005	7.83
	8/30/2005	7.6
	10/19/2005	7.57
	1/3/2006	7.96
	2/14/2006	8.51
	3/13/2006	8.72
	4/25/2006	8.2
	6/26/2006	7.82
	7/24/2006	7.56
	8/21/2006	7.72
	10/23/2006	8.15
Deer Creek – Mtn Rd 120 558DER020	6/24/2003	8.4
	5/19/2004	8.3

Fountain Springs 558DER030		
Deer Creek at Hwy 65 558DER040	2/3/2005	8.14
	5/10/2005	7.76
	6/28/2005	8.26
	1/3/2006	8.2
	2/14/2006	8.71
	3/13/2006	8.55
	4/25/2006	8.15
Deer Creek; Road 192 and Ave. 96 558DER050	6/28/2005	8.19
	7/26/2005	7.48
	8/30/2005	8.08
	2/14/2006	8.36
	3/13/2006	8.79
	4/25/2006	8.35
	6/26/2006	7.92
	7/24/2006	7.2
	8/21/2006	7.66
Deer Creek at Pixley Wildlife Refuge 558DER060	6/28/2005	8.79
	7/26/2005	6.85
	8/30/2005	8.05
	2/14/2006	8.06
	3/13/2006	8.53
	4/25/2006	8.35
	6/26/2006	8.2
	7/24/2006	7.6
	8/21/2006	7.71

Fountain Springs 558DER030		
Deer Creek at Hwy 65 558DER040	2/3/2005	8.14
	5/10/2005	7.76
	6/28/2005	8.26
	1/3/2006	8.2
	2/14/2006	8.71
	3/13/2006	8.55
	4/25/2006	8.15
Deer Creek; Road 192 and Ave. 96 558DER050	6/28/2005	8.19
	7/26/2005	7.48
	8/30/2005	8.08
	2/14/2006	8.36
	3/13/2006	8.79
	4/25/2006	8.35
	6/26/2006	7.92
	7/24/2006	7.2
	8/21/2006	7.66
Deer Creek at Pixley Wildlife Refuge 558DER060	6/28/2005	8.79
	7/26/2005	6.85
	8/30/2005	8.05
	2/14/2006	8.06
	3/13/2006	8.53
	4/25/2006	8.35
	6/26/2006	8.2
	7/24/2006	7.6
	8/21/2006	7.71

Deer Creek – Fountain Springs 558DER030	6/24/2003	8.6
Deer Creek at Hwy 65 558DER040	2/3/2005	8.14
	5/10/2005	7.76
	6/28/2005	8.26
	1/3/2006	8.2
	2/14/2006	8.71
	3/13/2006	8.55
	4/25/2006	8.15
Deer Creek; Road 192 and Ave. 96 558DER050	6/28/2005	8.19
	7/26/2005	7.48
	8/30/2005	8.08
	2/14/2006	8.36
	3/13/2006	8.79
	4/25/2006	8.35
	6/26/2006	7.92
	7/24/2006	7.2
	8/21/2006	7.66
Deer Creek at Pixley Wildlife Refuge 558DER060	6/28/2005	8.79
	7/26/2005	6.85
	8/30/2005	8.05
	2/14/2006	8.06
	3/13/2006	8.53
	4/25/2006	8.35
	6/26/2006	8.2
	7/24/2006	7.6
	8/21/2006	7.71

The source of the pH is stated as unknown. Findings of the sampling indicate pH values range from 6.85 to 8.79. Toxicity data was not included in the documents provided for public review. The source of the toxicity is stated as unknown. The forest has gone on record and documented that the sampling stations are so far downstream of the Sequoia National Forest boundary and conditions are so different that information provided in the state's data set is not applicable to the forest. The location of the nearest site is 17 miles downstream from the forest boundary and has pH values of 7.37-8.2 which are within the range set for water quality standards. Acceptable pH ranges are 6.5 to 8.3. Beneficial use for Deer Creek is stated as warm freshwater habitat in Appendix F, Supporting Information, Draft 2008 California 303(d)/305(b) Integrated Report, Deer Creek, Decision ID 13090, Unknown Toxicity and ID 13088, pH.

The forest has been monitoring water quality on national forest lands for years. The forest has fisheries inventories and channel stability data that go back to the early 1970s. Policy directs the forest to investigate macro-invertebrate and stream condition inventories prior to any ground disturbing activity (USDA Forest Service 2001, 2004). Roughly 33 miles of stream tributary to and including Deer Creek have been surveyed for fisheries habitat and stream stability since 1971. Stream surveys for Deer Creek drainage follow Stream Condition Inventory protocol. These surveys provide chemical, physical, and biological data. Evaluation of pH provides a value of 7.5 in 2006 and 7.3 in 2007. Aquatic insect data collected in 2006 indicate that there is no apparent organic pollution. Table 84 provides a summary of data collected at Leavis Flat Campground located on Deer Creek.

Table 84 - Summary of SCI Data from Deer Creek, Tulare County, California					
Name	Location	pH	Hilsenhoff Aquatic Insects	Date Collected	UTM
Deer Creek	Levis Flat Camp Ground	7.5	3.49 No apparent organic pollution	7/19/2006	11S 0348884 3971701
Deer Creek	Levis Flat Camp Ground	7.3	None collected	12/03/07	11S 0348884 3971701

The most recent investigation of Deer Creek was on November 6-7, 2007 for renewal of recreation residence authorizations. During field investigations the following water chemistry measurements were taken in Deer Creek, SFMF Tule River, and White River. All the sampled rivers are within state water quality standards. Table 85 displays results of that water quality sampling.

Table 85 - Water Quality Sampling for Recreation Residence Relicensing, 2007			
Water Quality Sample	**Deer Creek**	**Tule River (SFMF)**	**White River**
Alkalinity	64 ppm of CaCO3	62 ppm of CaC03	40 ppm of CaCO3
Dissolved Oxygen	9.1 ppm	10 ppm	9.2 ppm
pH	7.3	7.5	7.3
Nitrates	0 ppm	0 ppm	0 ppm
Nitrites	0 ppm	0 ppm	0 ppm

Based on forest fisheries data, Deer Creek is a Class I stream that supports a population of rainbow trout and thus would be considered a cold water fishery. Final determinations as to the listing of Deer Creek as an impaired water body would be evaluated in 2010 by the California State Water Quality Control Board. Currently, this waterbody remains unlisted.

Natural ranges in variability were developed from six years of data collection within the Upper Deer Creek Watershed (see table 86). The ranges were created from four SCI sites. Table 87 contains the ranges of natural variability derived from the SCI sites within Upper Deer Creek watershed.

Table 86 – SCI Locations and Information for Upper Deer Creek Watershed								
Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Upper Deer Creek	1803000502	Capinero Creek	Near Capinero Campground	Western Divide	2001, 2006	B5c	Stable-sensitive	Moderate
Upper Deer Creek	1803000502	Deer Creek	Near Leavis Flat	Western Divide	2001, 2006	B4	Stable-sensitive	Minimal

Upper Deer Creek	1803000502	Starvation Creek	Section 21 on Starvation Creek	Western Divide	2001, 2006	B5c	Stable-sensitive	Minimal
Upper Deer Creek	1803000502	Merry Creek	Tributary to Tyler Creek	Western Divide	2006	B4a/1	Stable-sensitive	Low

Table 87 - Range in Channel Attributes, Upper Deer Creek Watershed	
Parameter	Channel Type
	A and B Channels
Large Wood Debris (m^3/m)	0.04 – 0.38
% Shading	37 - 95
Temperature (Celsius)	18
pH (ppm)	7.5
Alkalinity ($CaCO_3$)	64 - 175
Mean Particle Size in mm (D50)	1.28 – 22.6
Width-to-depth Ratio	14 - 35
Hilsenhoff Biotic Index - Rating	2.93-4.09 Excellent to Very Good
Riparian Impact Rating	Low – Moderate

Gordon Creek Basin (18A)

Gordon Creek is a very small watershed in the northern most portion of the Upper Deer Creek watershed and encompasses approximately 625 acres of drainage area.

Gordon Creek (18A-A)

Gordon Creek (18A-A) has not been surveyed for habitat or channel stability. Gordon Creek is estimated to be in a low/good condition with no known fisheries. Gordon Creek flows into Deer Creek approximately four miles downstream of the forest/Monument boundary. The watershed contains one grazing allotment, Rube. The watershed contains less than one mile of road.

Rube Creek Basin (18B)

Rube Creek is a small watershed in the northern most portion of the Upper Deer Creek watershed that encompasses approximately 5,200 acres of drainage area. Rube Creek and Cold Springs Creek make up the watershed and drain into Deer Creek approximately five miles below the forest/Monument boundary. Naturally-stable steep bedrock and cobble channels comprise the surveyed reaches. Stream condition has been rated from low to high good after Pfankuch. Rube Creek contains the majority of the Rube grazing allotment. There are no known high use cattle areas identified within the watershed. There are no known fisheries in the watershed.

Tyler Creek Basin (18C)

Tyler Creek drains Merry Creek, Alder Creek, Starvation Creek, and Tyler Creek into Deer Creek approximately 1.5 miles below the forest/Monument boundary. This basin encompasses approximately 11 linear miles of streams and 8,600 acres of drainage area. Most of Merry Creek and the upper one-half of Tyler Creek have not been surveyed due to the inaccessible nature of these drainages. The headwaters of these drainages are naturally-stable bedrock channels with swift flowing waters, vertical drops and slick surfaces. Tyler Creek occupies a portion of the Summit grazing allotment. High use areas in this basin are concentrated in Starvation and Tyler creeks between 3,000 and 4,000 feet in elevation.

Merry Creek SCI site was established in 2006 to monitor the Rube and Powder Magazine Grazing project. Total reach length is 77.8 meters. Table 88 summarizes the SCI data.

Table 88 - Merry Creek	
Large Wood Debris (m^3/m)	0.31
% Shading (Range)	40 – 91
Temperature (Celsius)	Not Collected
pH (ppm)	Not Collected
Alkalinity ($CaCO_3$)	Not Collected
Mean Particle Size in mm (D50)	4.57
Width-to-depth Ratio	13 – 14
Hilsenhoff Biotic Index - Rating	Not Collected
Riparian Impact Rating	Low
Rosgen Channel Type	B4a/1

Survey data defined the channel as a stable-sensitive, low impact, gravel dominated, high gradient, B4/1a type channel with some bedrock control scattered throughout the reach. Figure 74 displays a cross-section of Merry Creek. Figure 75 displays the particle size distribution throughout the reach.

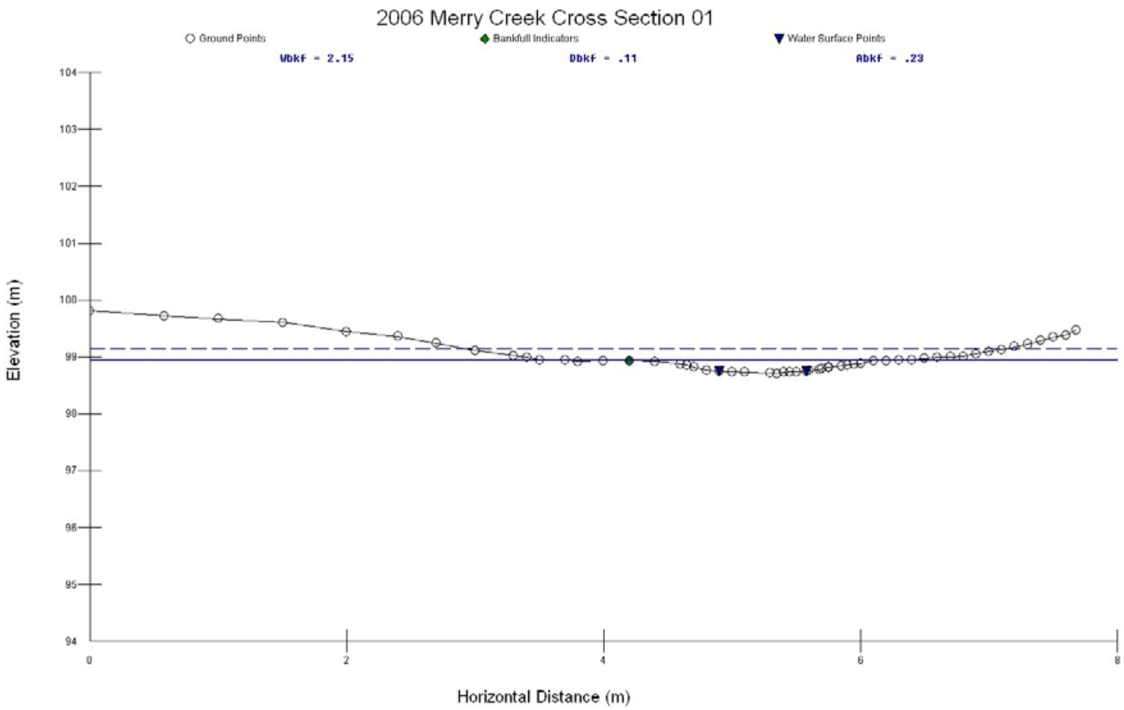


Figure 74 – Cross section of Merry Creek

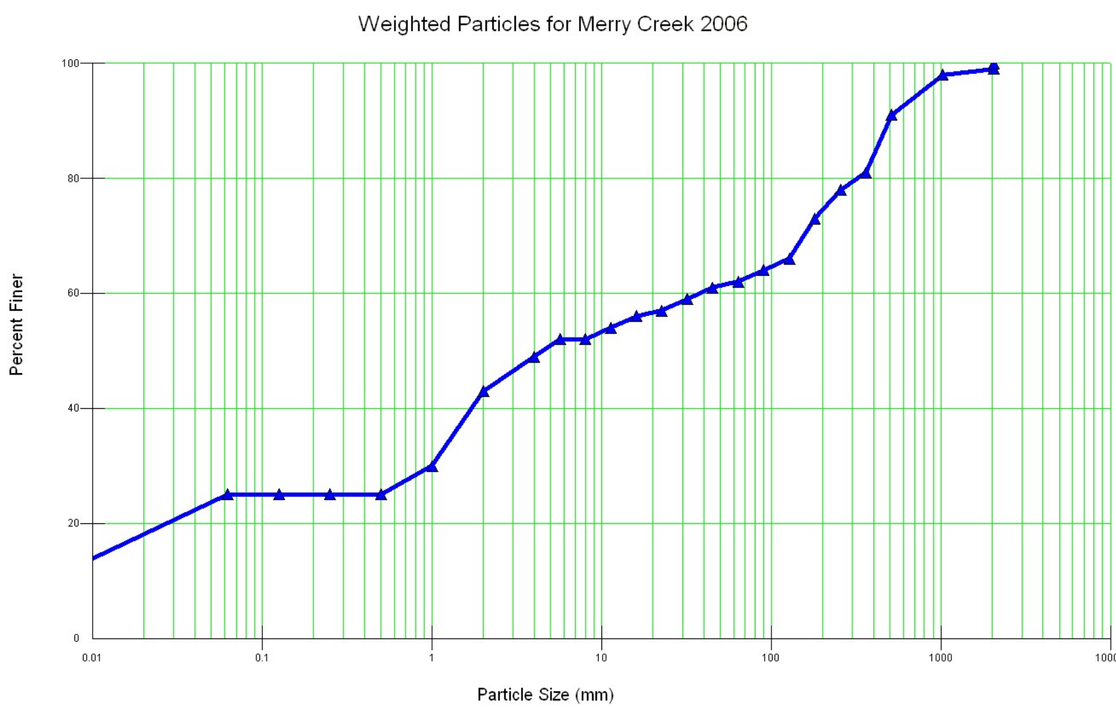


Figure 75 – Particle Size Distribution for Merry Creek

Average stream shading provided at 72 percent cover. Average amount of large woody debris found throughout the reach is 0.31 m^3/m. Water chemistry and aquatic site condition was not recorded.

Alder Creek (18C-D)

Alder Creek is a class IV stream with no known fisheries that encompasses approximately 1.5 linear miles that drains into Tyler Creek. The entire length of the stream is naturally-stable steep bedrock boulder channel.

Starvation Creek (18C-E)

Starvation Creek is a class II stream associated with rainbow trout that encompasses approximately 3.75 linear miles that drains onto Tyler Creek. Approximately 64 percent of the stream is naturally-stable steep and very steep bedrock and boulder channels. The remaining portion is a naturally-unstable steep landform slope susceptible to natural debris slides.

High cattle use is common in the low gradient areas below road 23S65A. These areas are located immediately below a steep naturally-unstable landslide dominated section of the stream. This area shows sedimentation in pools dominated by sands and fine materials that is attributed to roads 23S68, 23S29, and a temporary road above 23S29. There is no evidence of decreased vegetation along the stream channel.

Starvation Creek contains an SCI site established in 2001 to monitor the Hotel Hazard Reduction project. Table 89 summarizes the SCI Data.

Table 89 - Starvation Creek	
Large Wood Debris (m^3/m)	0.38
% Shading (Range)	52 – 95
Temperature (Celsius)	Not Collected
pH (ppm)	Not Collected
Alkalinity ($CaCO_3$)	Not Collected
Mean Particle Size in mm (D50)	2.1
Width-to-depth Ratio	Not Collected
Hilsenhoff Biotic Index - Rating	Not Collected
Riparian Imapct Rating	Minimal
Rosgen Channel Type	B5c

Surveys define the stream channel as a low gradient, sand dominated, minimally impacted, stable-sensitive B5c channel type. Figure 76 displays a cross-section along Starvation Creek. Figure 77 displays a graph of the particle size distribution along the reach.

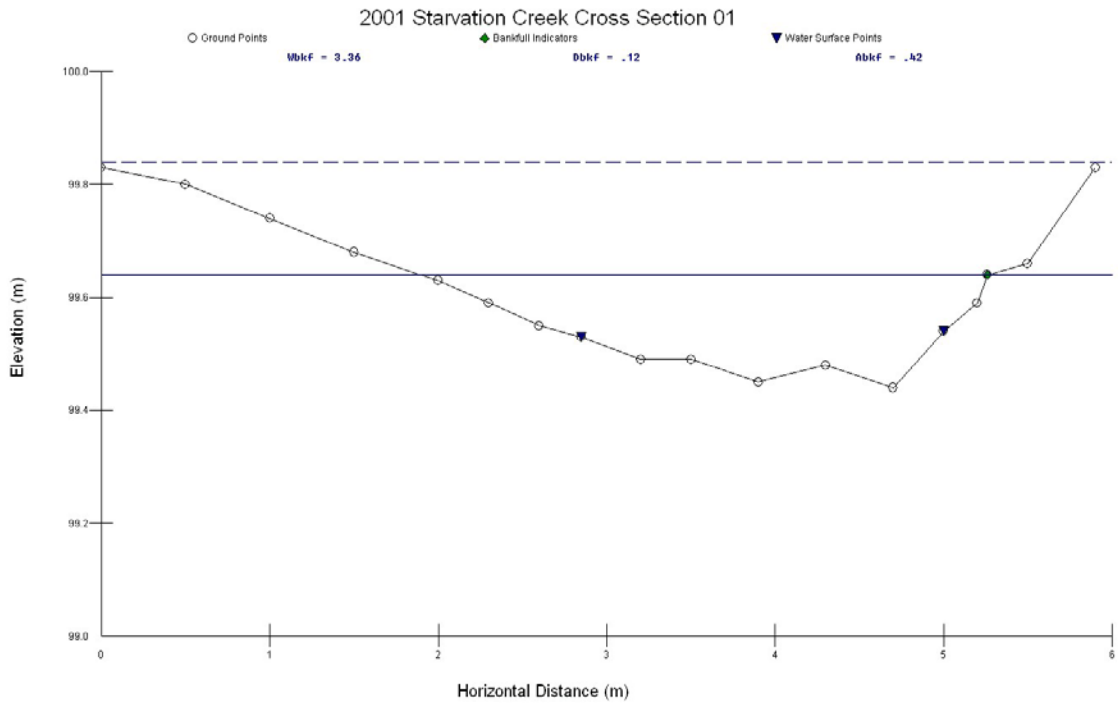


Figure 76 – Cross section of Starvation Creek - 2001

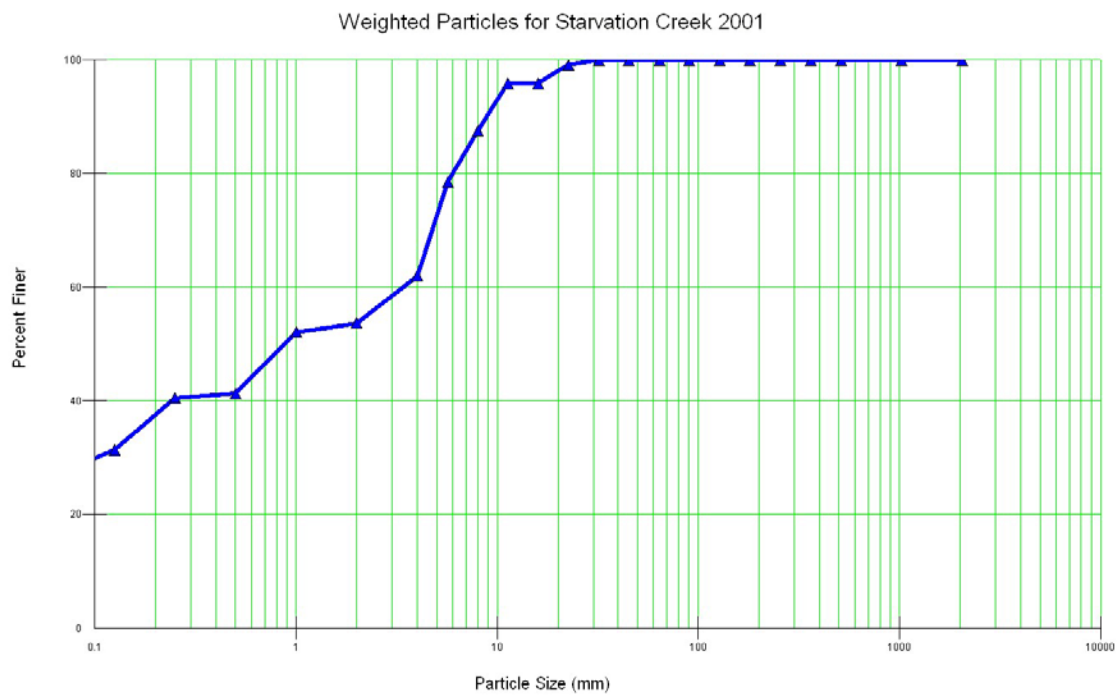


Figure 77 – Particle Size Distribution for Starvation Creek - 2001

Average stream shading provided 75 percent cover. Average amount of large woody debris throughout the reach was approximately 0.38 m^3/m. Water chemistry data was not recorded neither were aquatic insects sampled.

Tyler Creek (18C-G)

Tyler Creek is a class I stream associated with rainbow trout that encompasses approximately six linear miles within the forest boundary. Tyler Creek drains into Deer Creek. The surveyed reaches consist of a steep bedrock boulder naturally-stable channel.

Deer Creek Basin (18D)

The Deer Creek basin encompasses approximately 14 linear miles of streams and meadows. Total drainage area is 10,745 acres. Headwaters of Deer Creek (watersheds 18D-F and 18D-G) have not been completely surveyed. Portions of the Summit, Powder Magazine, and Capinero grazing allotments lie within this watershed. Stream channel stability evaluations in this basin rate the drainages from high good to medium fair (Pfankuch 1975).

Capinero Creek (18D-D,I, J)

Capinero Creek is a class III stream associated with rainbow trout, which encompasses approximately 5 linear miles with headwaters originating in Dead Horse Meadow. Capinero Creek is a tributary to Deer Creek and confluences approximately 1.25 miles above the forest/Monument boundary. The entire drainage has been surveyed. These surveys suggest that the greatest portion of this drainage, 75 percent, is a steep to moderately steep boulder/bedrock/cobble dominated naturally-stable channel. The remaining portion is naturally-unstable as it is associated with landslide terrain.

Capinero Creek SCI site near the Capinero dispersed camping area was established in 2001. The site was implemented to monitor potential future grazing projects. Table 90 summarizes the SCI data.

Table 90 - Capinero Creek	
Large Wood Debris (m^3/m)	0.04
% Shading (Ranges)	36 – 97
Temperature (Celsius)	Not Collected
pH (ppm)	Not Collected
Alkalinity ($CaCO_3$)	Not Collected
Mean Particle Size in mm (D50)	1.28
Width-to-depth Ratio	13.9 - 36
Hilsenhoff Biotic Index - Rating	Not Collected
Riparian Impact Rating	Moderate
Rosgen Channel Type	B5c

Surveys determined the stream channel to be a low gradient, sand dominated, stable-sensitive, moderate impact B5c channel type. The reach length is 93.6 meters. Figure 78 displays a cross-section along Capinero Creek. Figure 79 displays the particle size distribution throughout the reach.

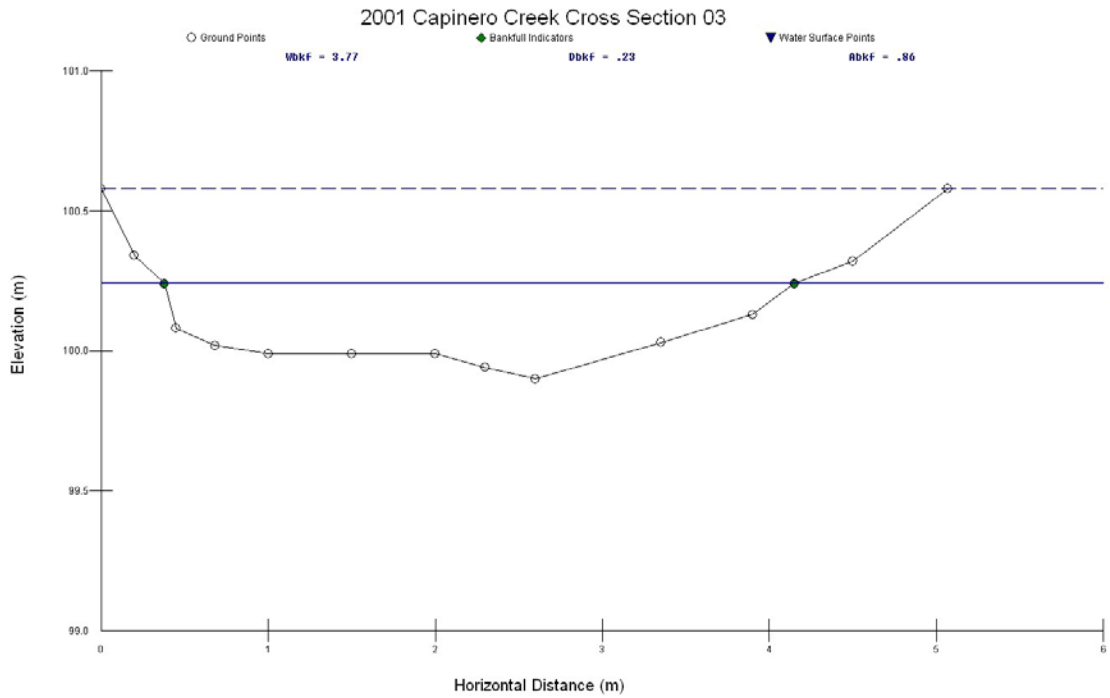


Figure 78 – Cross section of Capinero Creek - 2001

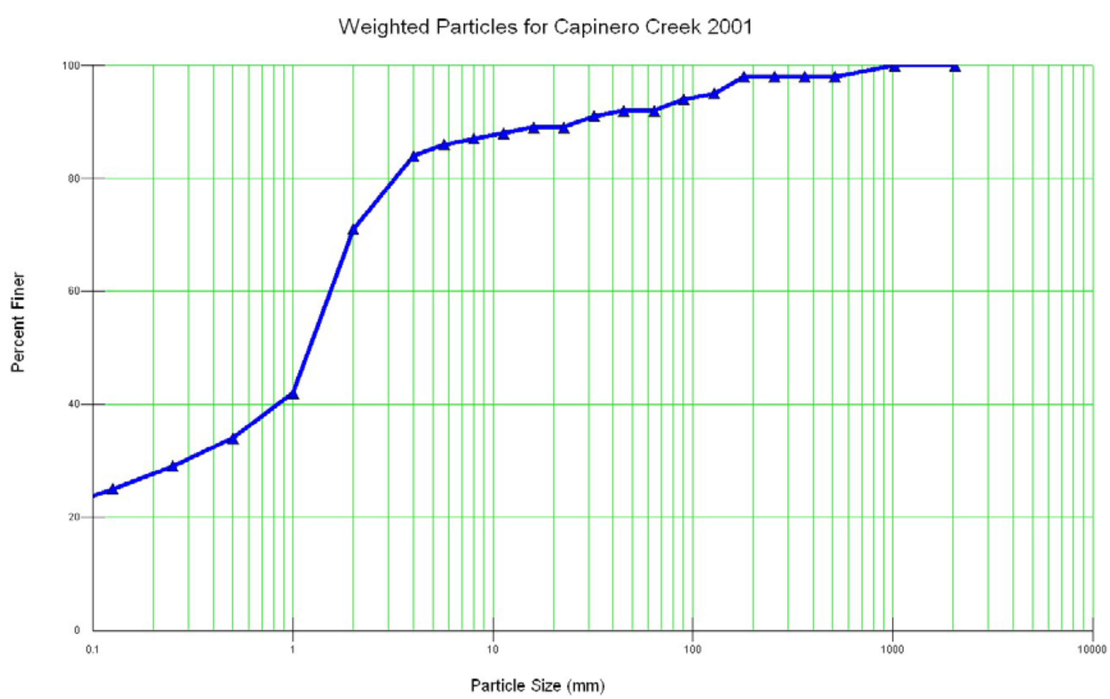


Figure 79 – Particle Size Distribution for Capinero Creek - 2001

Average shading along the reach was approximately 74 percent. Average amounts of large woody debris throughout the reach were 0.04 m^3/m. No water chemistry or water quality was recorded at the time.

Deer Creek (18D-B, E, F, H, G)

Deer Creek is a class I stream associated with rainbow trout, which encompasses seven linear miles within the forest/Monument boundary. Headwaters originate in Pup Meadow and drain west to the Tulare Lake basin. The channel is predominantly (83 percent) a steep bedrock boulder dominated naturally-stable channel. The remaining portion of the stream is a landslide dominated naturally-unstable channel. The headwaters of Deer Creek contain a high percentage of deposited fine material. Deposition is associated with the landslide terrain and runoff from roads.

Creek at Leavis Flat Campground contains an SCI site. The site was initially established in 2001 and resurveyed in 2006 to monitor future grazing projects. Cross-sections were extended in the 2006 survey to better capture the channel morphology. Table 91 summarizes the SCI data.

Table 91 - Deer Creek at Levis Flat Campground	
Large Wood Debris (m^3/m)	0.11
% Shading (Range)	60 - 100
Temperature (Celsius)	18
pH (ppm)	7.5
Alkalinity ($CaCO_3$)	175
Mean Particle Size in mm (D50)	12.48
Width-to-depth Ratio	16 – 30
Hilsenhoff Biotic Index - Rating	2.97-4.09 Excellent to Very Good
Riparian Impact Rating	Minimal
Rosgen Channel Type	B4

Surveys in 2001 and 2006 described the channel as a moderate gradient, gravel dominated, minimally impacted, stable-sensitive B4 channel. Channel morphology has not changed to warrant concern. Figure 80 displays a cross-section along Deer Creek at Leavis Flat Campground.

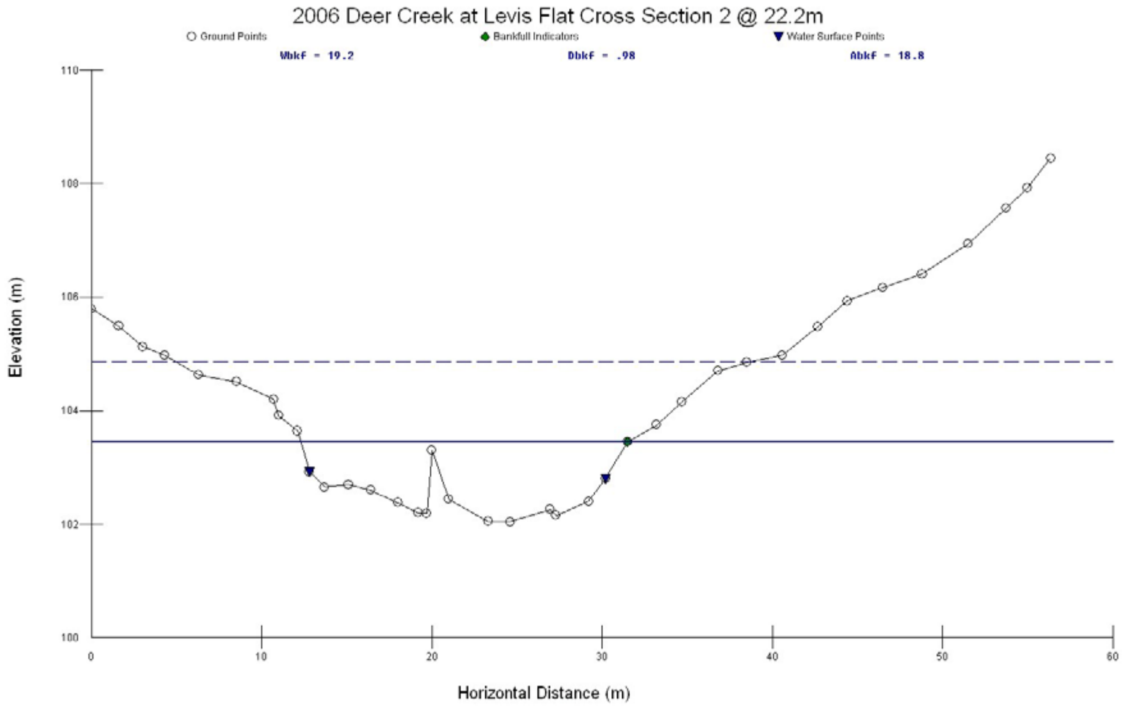


Figure 80 – Cross section of Deer Creek at Levis Flat – 2001 to 2006

Change in particle size distribution occurred from 2001 to 2006 but was minimal. The dominant measured particle size in 2001 was 17.65 mm and 22.6 mm in 2006. There is approximately a 5.0 mm size difference. This slight change is considered part of the channels natural variability. Figure 81 displays the particle size distribution for both surveys.

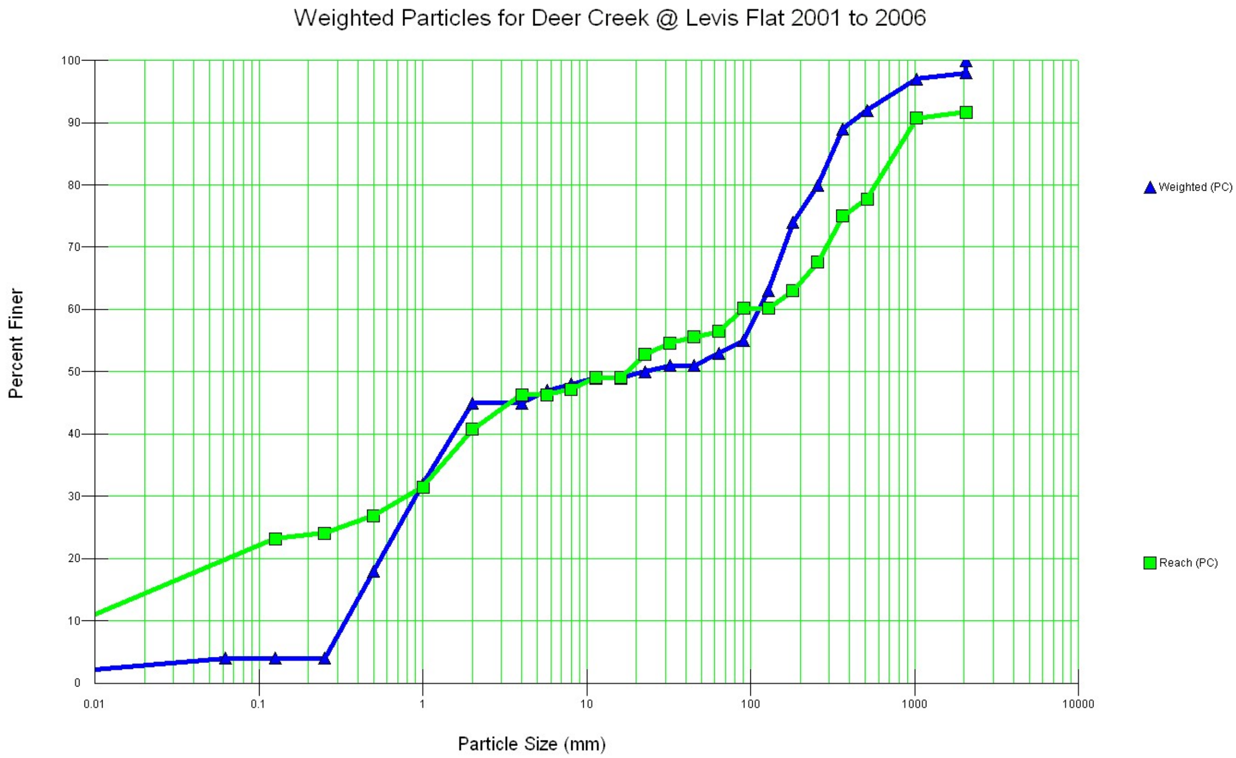


Figure 81 – Particle Size Distribution for Deer Creek at Levis Flat – 2001 to 2006

Both Large woody debris and average stream shading increased from 2001 to 2006. Average shading for the reach in 2001 was approximately 86 percent then increased to 93 percent in 2006. Large woody debris averaged 0.04 m^3/m in 2001 and increase to 0.11 m^3/m in 2006.

Water chemistry measurements collected in 2006 for Deer Creek were total alkalinity, pH, and stream temperature. Total alkalinity measured 175 ppm $CaCO_3$ while the pH was slightly basic at 7.5. A recorded temperature for that day was 18 degrees C. Aquatic MIS site condition for Deer Creek is Very Good to Excellent based on sampling from 2006 to 2010, Table 92.

Table 92 – Aquatic MIS Site Condition for Deer Creek at Levis Flat

Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Deer Creek at Levis Flat	7/19/2006	2.97	Excellent - No apparent organic pollution
Deer Creek at Levis Flat	7/24/2007	4.09	Very good Possible slight organic pollution
Deer Creek at Levis Flat	6/7/2010	3.65	Very good Possible slight organic pollution

Upper Poso River Basin

Rivers forming the headwaters of the Upper Poso River basin drain southwest into the central valley near Famoso in Kern County and then run north toward the old Tulare lakebed. The basin covers more than 250,000 acres. Precipitation ranges from six to 30 inches. The morphology ranges from deep v-shaped canyons with steep rugged terrain to moderate slopes at lower elevations. Poso Creek drains into the Kern National Wildlife Refuge, which is located just south of the historic Tulare Lake in the San Joaquin Valley. Poso Creek is an intermittent stream, which spills floodwaters onto the Kern National Wildlife Refuge only during wet years. The region was a vast wetland prior to the 1900s. Starting in the 1850s and ending in the early 1950s, most of the wetlands were drained and reclaimed for agriculture.

Natural ranges of variability were developed from data collected on six sites within the Upper Poso River basin. The ranges were created from the SCI sites located within the basin's watersheds. Table 93 summarizes the ranges of natural variability for the Upper Poso River basin. Information provided is a summary of conditions that have not been segregated by local conditions and channel types. Additional detailed information is provided at the smaller watershed scale and provides information useful for management and monitoring direction and constraints.

Table 93 - Upper Poso River Basin	
Large Wood Debris (m^3/m)	0.03 – 1.32
% Shading	48 - 93
Temperature (Celsius)	8 - 18
pH (ppm)	6.5 – 7.5
Alkalinity ($CaCO_3$)	65 – 175
Mean Particle Size in mm (D50)	0.2 – 299.65
Width-to-depth Ratio	12.17 – 30.26
Hilsenhoff Biotic Index – Rating	3.39
Riparian Impact Rating	Low – Moderate-High

Aquatic insect data for the Upper Poso River basin indicate aquatic MIS site conditions range from excellent to very good after Hilsenhoff. Riparian ecotype impact ratings fall in the moderate impact range. Stream surface shade may be associated with stream temperatures. Surveys were taken along sites in non-meadow environments. The percent stream surface shade ranges within the 48 to 93 percent range.

Large woody material is an important component of stream stability and aquatic habitat. Measurements taken in the Upper Poso River basin show a range of large woody material from 0.03 to 1.32 $meters^3$ per meter of stream evaluated. The lowest levels of woody debris were measured in Little Poso Creek, and the highest levels of woody debris were measured in Spear Creek (Lower).

Values for the Upper Poso River basin for width-to-depth ratios have been separated by channel type. Survey data discovered six sites on B channels. Measurements taken in these naturally-stable or stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements at those locations.

Water chemistry measurements for pH values range from 6.5 to 7.5 in this watershed basin.

Temperature ranges from data that was taken at a point during summer months from 8 to 18 ºC. Alkalinity values range from 65 to 175 ppm.

The Poso Creek basin was rated as a category II in the Unified Watershed Assessment. A category II rating describes watersheds with good water quality that through regular program activities can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems.

UPPER POSO CREEK WATERSHED
(1803000401)

The Poso Creek watershed encompasses approximately 136,090 acres. Of these, approximately 37,170 acres are National Forest System lands, and approximately 7,785 of those acres are within the Monument. The remaining acres consist of approximately 2,430 acres are private land, and 96,490 acres lie outside the Monument boundary.

Elevations range from about 4,000 feet at Poso Cabin to 8,295 feet at Sunday Peak. Tributaries include Von Hellum Creek, Peel Mill Creek, and Spear Creek. Dominant channel types include steep to moderate gradient cobble/boulder/bedrock channels. Meadow habitats are limited and restricted to the upper portions of the watershed (Marshall Meadow). Upper Poso Creek watershed contains the watersheds of Poso Creek, Fulton Creek, Cedar Creek, Lumreau Creek, and Little Poso Creek. Only a portion of the Poso Creek drainage is within the Monument.

Natural ranges in variability were developed from six years of data collection within the Upper Poso Creek watershed (see Table 94). The ranges were created from six SCI sites. The Monument does not include all of the watersheds within the Upper Poso Creek watershed. However, to develop a more accurate range of variability four additional SCI sites were included bringing the total to six. These surveys are from Cedar Creek at Cedar Creek Campground, Cedar Creek at Alder Creek Campground, Little Poso Creek, and Bear Creek on the Kern River District. Table 95 summarizes the SCI data by channel type for Upper Poso Creek watershed.

Table 94 – SCI Location and Information for Upper Poso Creek Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Upper Poso Creek	1803000401	Lower Spears Creek	Spear Creek below Poso Park	Western Divide	2002, 2006	B4	Stable-sensitive	Moderate-High
Upper Poso Creek	1803000401	Upper Spears Creek	Spear Creek above Poso Park	Western Divide	2002, 2006	B4	Stable-sensitive	Moderate-High

Table 95 - Range in Channel Attributes, Upper Poso Creek Watershed	
Parameter	Channel Type
	A and B Channels
Large Wood Debris (m^3/m)	0.03 – 1.32
% Shading	48 - 93
Temperature (Celsius)	8 - 18
pH (ppm)	6.5 – 7.5
Alkalinity ($CaCO_3$)	65 – 175
Mean Particle Size in mm (D50)	0.2 – 299.65
Width-to-depth Ratio	12.17 – 30.26
Hilsenhoff Biotic Index - Rating	3.39
Riparian Impact Rating	Low – Moderate-High

Poso Creek Basin (5A)

Poso Creek drains Spear Creek, Von Hellum Creek, Peel Mill Creek and Sandy Creek; these streams confluence with Poso Creek outside the forest boundary. Sandy Creek lies outside the Monument. The Dunlap grazing allotment is located within this watershed. High use areas within this allotment are located along low gradient reaches of Von Hellum Creek where roads and trails make access easy and along sections of Spear Creek. The communities of Panorama Heights, Spear Creek Summer Home Tract, and Poso Park, along with Camp KEEP, represent development within the Poso Creek basin.

Spear Creek (5A-C)

Spear Creek is a class I stream with rainbow trout that drains into Poso Creek about one-half mile west of the forest/Monument boundary. Naturally-stable steep boulder and cobble channel types comprise the greatest portion of the stream. The remaining portion, approximately 16 percent, is naturally-unstable with debris slide characteristics. Spear Creek rates in a low good condition for channel stability.

Very high sediment loads below the community of Poso Park can be attributed to County Road M3, a non-system fire road uphill of road M3, Camp KEEP, and the community of Poso Park. The county road drains water and transported sediment for approximately 600 feet before directly depositing it into the channel at the bridge crossing of Spear Creek. The location of this deposition causes sand bar formation and bank cutting. Width-to-depth ratios and sediment affect aquatic habitat conditions and are associated with unstable stream banks and poor water quality. Cover complexity is moderate with low to moderate amounts of streamside vegetation.

Spear Creek (Upper) above the community of Poso Park contains a SCI site. The site was for monitoring the Panorama Heights Fire Safe Council and Peel Mill Fuel Break and the PCT Telephone Sale Area projects. It was initially surveyed in 2002 and again in 2006. Table 96 summarizes the SCI data.

Table 96 - Spear Creek (Upper) SCI Data	
Large Wood Debris (m^3/m)	0.10 – 0.19
% Shading (Range)	85 – 100
Temperature (Celsius)	14
pH (ppm)	7.0
Alkalinity ($CaCO_3$)	68
Mean Particle Size in mm (D50)	7.42 – 8.00
Width-to-depth Ratio	12.39 – 27.6
Hilsenhoff Biotic Index – Rating	inconclusive
Ripairan Impact Rating	Moderate-high - High
Rosgen Channel Type	B4

Minor changes in channel morphology have occurred between the initial 2002 survey and the 2006 survey. The 2002 survey defined the channel as a moderate gradient, stable-sensitive, gravel dominated, highly impacted B4 channel. When comparing 2002 to 2006, the channel remained a B4 channel type, but the impact to the riparian ecotype was reduced from highly impacted to moderately-high. Figure 82 displays overlaid cross-sections for Spear Creek (Upper).

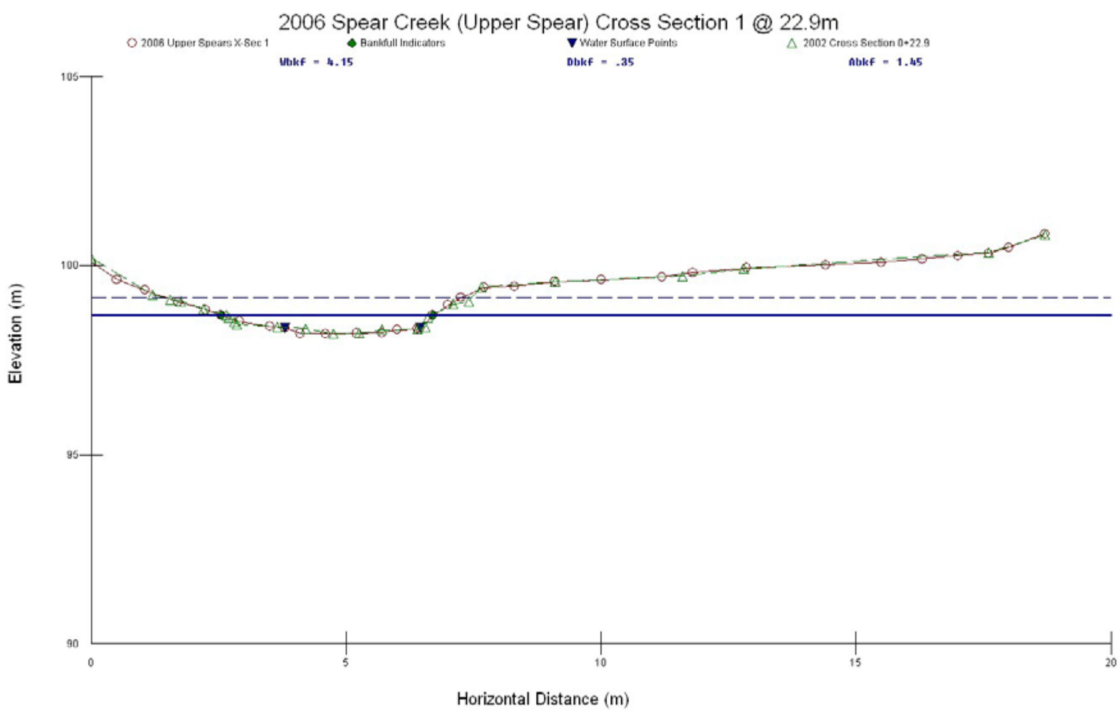


Figure 82 – Cross section of Spear Creek (Upper)

Minimal changes in particle size distribution occurred between 2002 and 2006. Measured changes in particle size were 7.42 mm to 8 mm. This change did not warrant concern, nor is it considered outside the natural variability of this type of channel. Figure 83 displays the particle size distribution for both surveys.

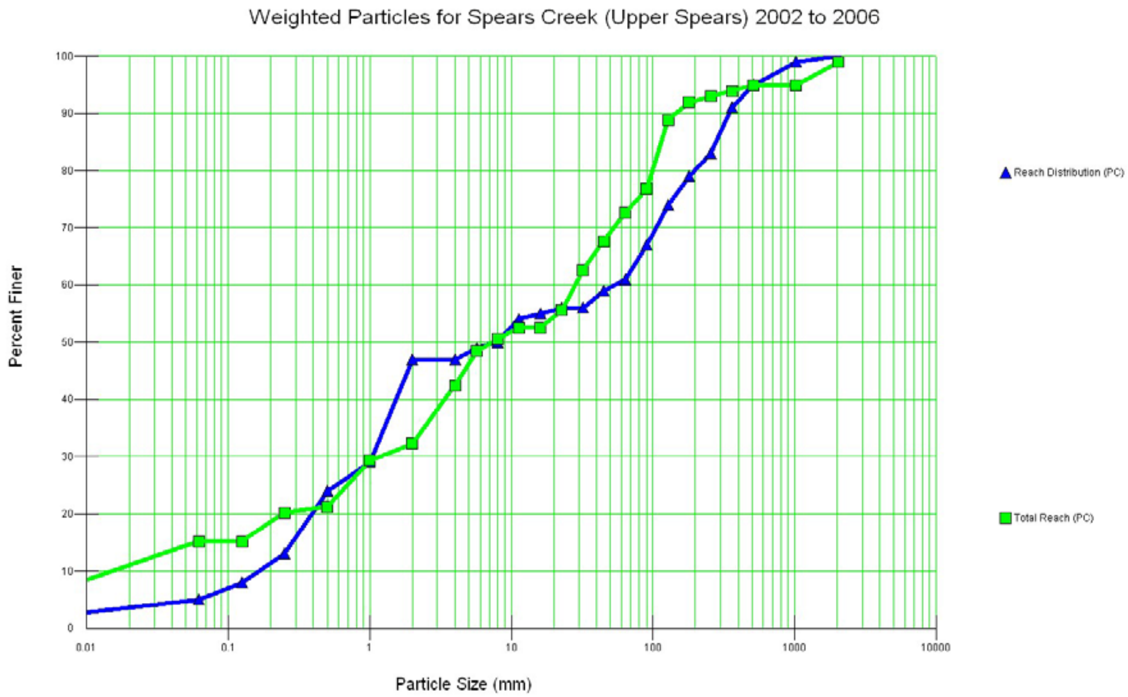


Figure 83 – Particle Size Distribution for Spear Creek (Upper)

Average stream shading increased from 80 percent in 2002 to 93 percent in 2006. A decrease in large woody debris was recorded during these surveys from 0.19 m^3/m in 2002 to 0.10 m^3/m in 2006. Water chemistry was collected in 2006 for total alkalinity, pH, and stream temperature. Total alkalinity measured at 175 ppm $CaCO_3$ while the pH was slightly basic at 7.5. Recorded temperature for that day was 18 º C. Aquatic MIS site condition is inconclusive due to requisite individuals (>100), Table 97.

Table 97 – Aquatic MIS Site Condition for Spear Creek (Upper)			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Spears Creek (Upper)	7/12/2006	na	inconclusive

Spear Creek (Lower) SCI site was established to monitor the Panorama Heights Fire Safe Council and Peel Mill Fuel Break and PCT Telephone Sale Area in 2002. The final survey was completed in 2006. The 87.85-meter reach is located below the community of Poso Park. Table 98 summarizes the SCI data.

Table 98 - Spear Creek (Lower)	
Large Wood Debris (m^3/m)	1.05 – 1.32
% Shading (Range)	2 – 98
Temperature (Celsius)	13
pH (ppm)	7

Alkalinity ($CaCO_3$)	65
Mean Particle Size in mm (D50)	1.67 – 2.67
Width-to-depth Ratio	11.7 – 20.3
Hilsenhoff Biotic Index - Rating	3.39 Excellent
Riparian Impact Rating	Moderately-High
Rosgen Channel Type	B4

Surveys in 2002 and 2006 define the stream as a moderate gradient, stable-sensitive, gravel dominated, moderately-high impacted B4 channel. Particle size distribution shifted toward finer materials in the 2006 survey. Figure 84 displays overlaid cross-sections for both survey years.

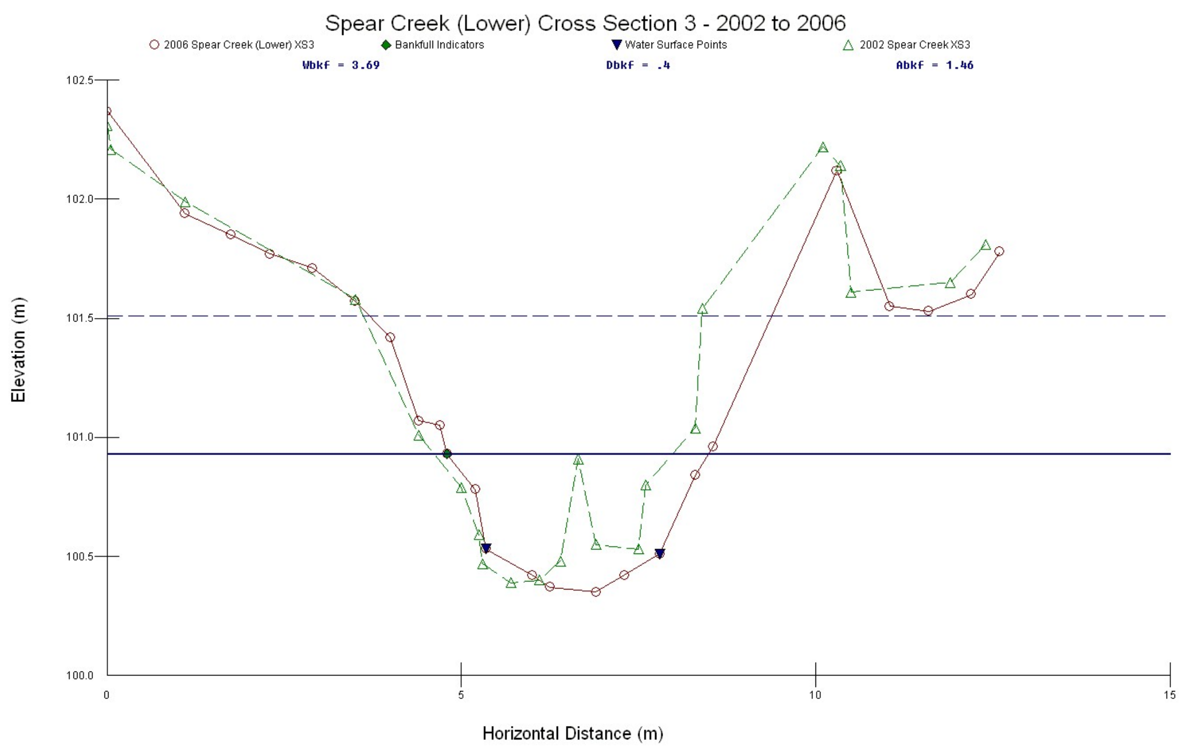


Figure 84 – Cross section of Spear Creek (Lower) – 2002 to 2006

A shift in particle size occurred from 2.67 mm in 2002 to 1.67 mm in 2006. The shift is considered within the range of natural variability for a B type channel. Figure 85 displays the particle size distribution throughout the reach.

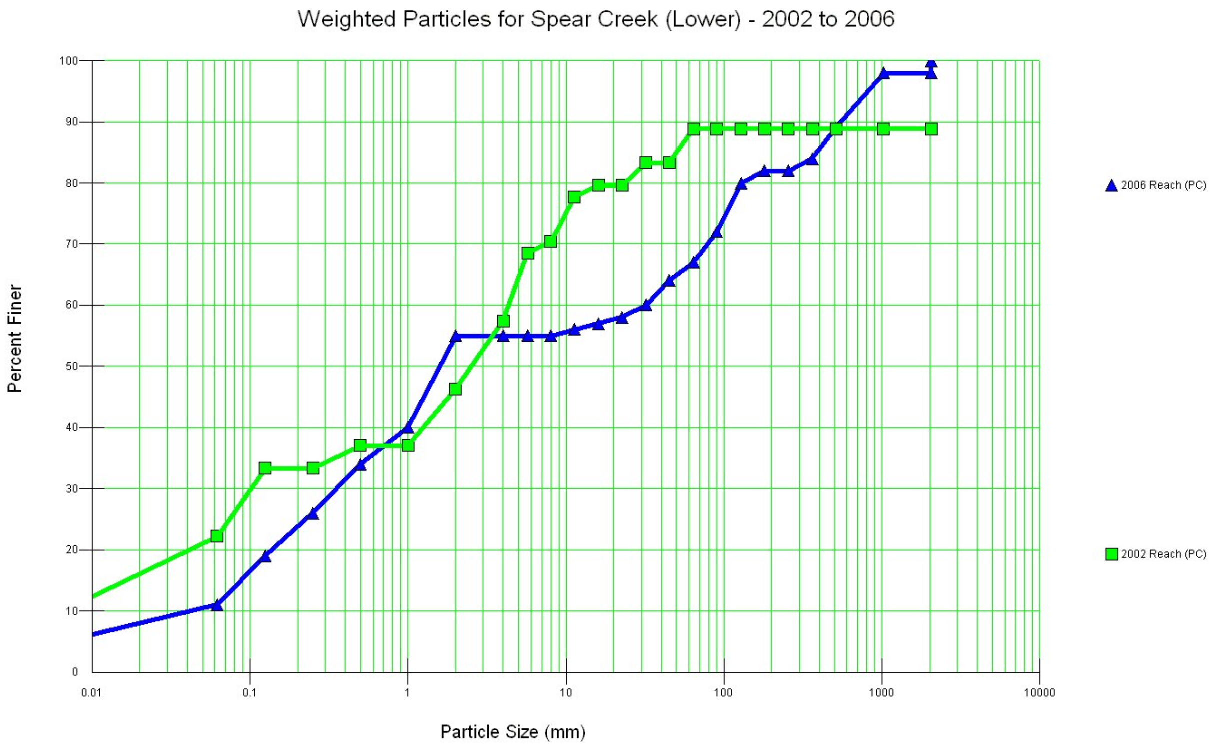


Figure 85 – Particle Size Distribution for Spear Creek (Lower) – 2002 to 2006

Average stream shading decreased from 81 percent in 2002 to 77 percent in 2006. Large woody debris decreased in this same time period from 1.32 m^3/m to 1.05 m^3/m.

Water chemistry measurements collected in 2006 contain total alkalinity, pH, and stream temperature. Total alkalinity measured 65 ppm $CaCO_3$ while the pH was neutral at 7.0. Temperature for that day was recorded at 13 ºC. Aquatic MIS site condition is excellent based on a 2006 sample, Table 99.

Table 99 –Spear Creek (Lower)			
Stream Name	Sample Date	Hilsenhoff Biotic Index	Hilsenhoff Biotic Rating
Spears Creek (Lower)	7/6/2006	3.39	Excellent No apparent organic pollution

Von Hellum Creek (5A-D)

Von Hellum Creek is a class III stream with no known fisheries that drains into Poso Creek approximately one-quarter of a mile west of the forest boundary. The predominant portion of the stream, approximately 66 percent, is a naturally-unstable cobble channel with a very steep gradient. The remaining portion of the stream is naturally-stable moderate gradient cobble channel.

Stream banks appear stable except at localized areas of cattle concentration areas and at stream crossings. The riparian vegetation consists mainly of cedar and oak canopy. This stream is not associated with fisheries, but does exhibit high width-to-depth ratios and stream temperatures. There are very high quantities of fines present.

Peel Mill Creek (5A-E)

Peel Mill Creek is a class III stream with no known fisheries that drains into Poso Creek about two miles west of the forest/Monument boundary. The channel is comprised of approximately 75 percent naturally-stable steep to moderate bedrock/boulder/cobble channels and is healthy with minimal impacts. The remaining channel type is a naturally-unstable steep cobble dominated channel that has high sedimentation in pools and behind large woody debris. Extensive fisheries habitat component surveys have not been completed. Cover complexity is moderate with moderate amounts of streamside vegetation.

Desired Conditions for Hydrological Resources

SNFPA 2004 ROD (pg. 10) provides the desired conditions of aquatic, riparian and meadow ecosystems. Elements of the AMS strategy, as defined on page A6 of SNFPA 2001 ROD includes four elements, three of which are applicable to the Sequoia National Forest. The fourth element is appropriate only to the Lassen National Forest. Applicable elements are Aquatic Management Strategy Goals; Riparian Conservation Areas (RCAs) and Critical Aquatic Refuges (CARs); and Riparian Conservation Objectives (RCOs).

"Proper management of rivers and their watersheds involves balancing a host of resource uses of the river and the ability to predict the response of the river to imposed change. Reliable predictions necessitate a clear understanding about the functions of the river and the physical variables which influence the river behavior."Rosgen 1996

Desired condition for hydrology resources, rivers, streams, meadows seasonally or perennially wet areas and their associated riparian vegetation is defined by the ability of this resource to adjust and recover from natural and human caused events. Riparian and wetland areas are dynamic systems that change in response to climatic events. Riparian areas are in dynamic equilibrium with respect to erosion/deposition, and sediment supply, and have the potential to affect discharge, pattern, profile and dimension. These areas provide habitat for a number of aquatic and terrestrial species. Rosgen, 1996, defines river stability or equilibrium as, "the rivers ability, in the present climate, to transport the stream flows and sediment of its watershed over time in such a manner that the channel maintains its dimension, pattern, and profile without either aggrading or degrading."

Channel types on the Sequoia National Forest and Monument lands have been grouped into four riparian ecotypes based on response to natural events (floods and fire) and land management activities (grazing, roads, fuels management, recreation, etc.) relative to similarities in their physical conditions (Kaplan-Henry, 2007). Channels are grouped to: 1) Identify key ecosystem elements that represent riparian ecosystem function and health and 2) describe riparian ecosystem existing conditions in terms of environmental indicators that are sensitive to change. Riparian ecotypes are of four types, Naturally-Stable, Naturally-Unstable, Stable-Sensitive, and Unstable-Sensitive-Degraded and are defined as follows:

Naturally-Stable – Bed Rock Boulder Channels

This ecotype is inherently stable and comprised of bedrock, boulder and cobble controlled channels. It is not significantly influenced by land management activities. Sediment build-up can be of concern in locally impacted areas.

Stable-sensitive –Meadow Environments

This ecotype is inherently stable dominated by cobble, gravel, sand, and finer material. It is located in relatively flat riparian areas that are easily influenced by land management activities. This ecotype is comprised of streams typically associated with meadows with or without defined channels. This ecotype is stable and very susceptible to disturbances and changes in the flow, timing, and quality of water.

Unstable-Sensitive-Degraded[11]-Gullies and Downcut Areas

This ecotype has been destroyed and represents severe alteration of another riparian ecotype. In most cases, this ecotype represents the destroyed form of Stable-Sensitive ecotypes that were formerly meadows. These ecotypes are comprised of down cut meadows with lowered water tables and abandoned floodplains. Meadow functions are not operating and vegetation is comprised of species that represent dry sites; accelerated erosion is common. A less common form of this ecotype is the altered form of the Naturally-Stable ecotype resulting from extensive accelerated sediment deposition on a course substrate i.e., compromised pool function in a bedrock-boulder-controlled system. These areas exhibit braided characteristics the source of which is usually associated with upstream sites and/or deposition from off-site sources of sediment (roads, trails, campgrounds etc.) that has been transmitted to the site.

Naturally-Unstable- Landslide Prone Areas

This ecotype is typically eroded, steep, and unstable due to natural processes. It has a very high sediment load and is usually associated with debris avalanche or landslide terrain. These environments are sensitive to disturbance.

Desired Condition of Riparian Ecotypes

The four riparian ecotypes defined above all have unique characteristics and elements associated with stability and dynamic equilibrium. Desired condition for each riparian ecotype is described below.

Naturally-Stable – Bed Rock Boulder Channels

Naturally-Stable ecotypes are as defined extremely stable; however, sedimentation can substantially alter water quality and aquatic habitat through the filling of pools, spawning gravels, and pour spaces affecting aquatic insect habitat. While gravel is not a major component of this ecotype it does occur in the system and provides opportunity for spawning in localized areas. Different fish species occupy

[11] The term degraded to describe riparian ecotypes was used prior to its use in the publication discussing ecological restoration. Degraded as used for disturbance of this ecotype would equate to Damaged or Destroyed in USDA, 2006, Ecosystem Restoration: A Framework for Restoring and Maintaining the National Forests and Grasslands.

different locations within pools. Sedimentation in pools has the potential to displace fish species and affect aquatic organism habitat. Therefore desired condition focuses on the effects of sedimentation to this ecotype and maintenance of aquatic habitat.

The presence of sediment deposition and sediment movement in this ecotype is an indication of transport from upstream or off-site sources such as roads and other compacted sites. The accumulation of sediment could be related to cumulative watershed affects (CWE) or could be from localizes sources. Desired conditions for Naturally-Stable ecotypes (channels associated with Naturally-Stable ecotypes) focus on the following criteria:

- Low frequency of mid-channel bars;
- Pool-to-riffle ratio greater than 10 for B and F channel types and less than 14 for A channel types;
- Slight size distribution shift between 50-80% stable material;
- Mean particle size should not show a shift toward fine material to the extent that a change in channel type occurs;
- Maintenance of Woody material in and adjacent to stream courses; Maintenance of average existing stream surface shade at >60%;
- Maintenance of stream water temperature at a no more than a daily average of 20 °C; and
- Riparian vegetation is sparse with the exception of those channels with a predominately cobble substrate; here it has a moderate role in providing stability.

Stable-Sensitive –Meadow Environments

Stable-Sensitive ecotypes encompass the most sensitive and heavily used riparian areas within the Forest and Monument. This ecotype defines meadows of all sizes including stringer meadows along streamcourses. Desired conditions in Stable-Sensitive ecotypes focus on the degree of channel bottom sediment deposition, streambank cutting or erosion, and vegetative bank protection. Once the boundary conditions or threshold for sediment deposition is exceeded these ecotypes will trend toward the Unstable-Sensitive-Degraded riparian ecotypes and a change in channel type. Changes in width-to-depth ratios are associated with streambank erosion and sediment deposition. Stream bank stability due to the loss of aquatic vegetation by high stream flows, bank cutting and sediment deposition are inter-related. Desired conditions for Stable-Sensitive ecotypes (channels associated with Stable-Sensitive ecotypes) focus on the following criteria:

- Vegetative condition would be expected to have 80-90% ground cover with stable continuous root mass;
- Little or no sand bar development with less than 5% of the bottom affected by deposition of sand and gravel bars;
- Streambanks exposed by erosion or streambank erosion greater than 1foot high affecting less than 20% of the stream reach; and
- Maintenance of width-to-depth ratios for E channel types of values less than 14 and C channel types of values greater than 10.

While erosion, cutting, and deposition help to define the stability of Stable-Sensitive riparian ecotypes hydrologic connectivity needs to be considered to fully address hydrologic function in meadow environments. Entrenchment defines the ability of flood flows to access the active floodplain. Therefore the following criteria are necessary to fully define desired conditions for this ecotype:

- Entrenchment ratios for stringer meadows along B channel types would range between a value of 1.4-2.2; and
- Entrenchment ratios for meadows containing C and E channel types would be greater than 2.2 would extend across the meadow and include meadow terraces developed during early historic times".

Unstable-Sensitive-Degraded -Gullies and Downcut Areas

Unstable-Sensitive Degraded ecotypes are typically sites of gully erosion or heavy deposition. Desired condition for these ecotypes is to stop the processes causing degradation and begin stabilization or a return to equilibrium for these sites. Reduction in erosion, development of a floodplain and associated riparian vegetation are components of the desired condition for these sites. Desired conditions for Unstable-Sensitive Degraded ecotypes (channels associated with Unstable-Sensitive-Degraded ecotypes) focus on the following criteria:

- Trend toward width-to-depth ratio values greater than 12 for G channel types, gullies;
- Maintenance of width-to-depth ratios for F channel types of values greater than 10; Trend toward vegetative bank protection greater than or equal to 70 % ground cover with stable continuous root mass;
- Trend toward less than or equal to one foot of exposed bank cuts affecting less than or equal to 30% of the channel;
- Trend toward stabilizing water table; and
- Trend in vegetation change from facultative upland plants to obligate wetland plants.

Naturally-Unstable - Landslide Prone Areas

Naturally-Unstable ecotypes are unstable because they drain unstable landforms. Landform features associated with these sites include deeply entrenched streams, vertical steps and high sediment sources. Desired conditions associated with this ecotype focus on maintenance of naturally occurring conditions. Desired conditions for Naturally-Unstable ecotypes (channels associated with Naturally-Unstable ecotypes) focus on the following criteria:

- Maintenance of width-to-depth ratios of less than a value of 12; and
- Maintenance of entrenchment ratios of less than a value of 1.4.

Environmental Effects

Comparison of Alternatives

Alternatives A, B, D and F are alternatives that closely follow Aquatic Management Strategy (AMS) direction as outlined in the SNFPA 2001 or 2004. Based on these findings, these alternatives would not be expected to have detrimental effects on water quality and riparian dependent resources. It is therefore inferred that alternatives that adopt the SNFPA AMS direction and propose similar levels of treatment in each watershed would all have similar effects at the programmatic level relative to aquatic resources. And, as expected in the SNFPA, analysis of site-specific treatments at the landscape level would be necessary to identify any potential impacts to water quality and riparian dependent resources at the project level.

These alternatives would not affect existing water rights. All current water rights and uses will be maintained in accordance to State and Federal laws and regulations. (A list of current water rights and statement of water use is available upon request.)

Alternatives A, B, C, D, and F are similar in the adoption of standards and guidelines following AMS direction and objectives. A more in depth discussion of these alternatives follows.

Alternative A

Alternative A would embrace the Aquatic Management Strategy and the Ecosystem Management Strategy of the 2001 and 2004 Sierra Nevada Forest Plan Amendment in conjunction with the 1990 Riparian and Wetland Standards and Guidelines, documented in Exhibit D of the Mediated Settlement Agreement (MSA).

Objectives for hydrologic resources under the No Action Alternative include:

- Preserve, enhance, and restore habitat for riparian and aquatic dependent species;
- Ensure that water quality is maintained or restored;
- Enhance habitat conservation for species associated with the transition zone between upslope and riparian areas; and
- Provide greater connectivity within the watershed.

<u>Aquatic Management Strategy (AMS)</u>

"The fundamental principle of the AMS is to retain, restore, and protect the processes and landforms that provide habitat for aquatic and riparian-dependent organisms, and produce and deliver high-quality waters for which the National Forests were established" (USDA Forest Service 2001, Record of Decision, Appendix A, page A-5). The AMS includes the designation of riparian conservation areas (RCAs) along streams and around water bodies and critical aquatic refuges (CARs). RCAs focus on preserving, enhancing, and restoring habitat for riparian and aquatic-dependent species, ensuring that water quality is maintained or restored, enhancing habitat conservation for species associated with the transition zone between upslope and riparian areas, and providing greater connectivity within watersheds.

The AMS has four core elements including the adaptive management strategy for aquatic and riparian ecosystems. Three core elements are applicable to Monument lands. The following summary of the AMS is incorporated into this statement by reference. The fourth strategy is direction for the Lassen National Forest pertaining to anadromous fish and does not apply to the Sequoia National Monument.

1. Aquatic Management Strategy Goals

AMS goals focus on "end points" which provide a broad framework for establishing desired future conditions for ecosystem analysis at other scales. These goals are consistent with existing mandates such as the National Forest Management Act, the Endangered Species Act, the Organic Act, the Clean Water Act, etc. These acts and mandates include direction on Best Management Practice implementation and monitoring for reduction of non-point source pollution, soil and water quality standards, plant and animal diversity, special habitats, and other specific goals documented in the Framework.

2. Riparian Conservation Areas (RCAs) and Critical Aquatic Refuges (CARs)

CARs have been designated in small watersheds that contain known locations of threatened, endangered, or sensitive species; highly vulnerable populations of native plant or animal species; or localized populations of rare native aquatic or riparian-dependent plant or animal species. CARs provide habitat for native fish, amphibian, and aquatic invertebrate populations. Streams in meadows, lower elevation grasslands, and hardwood ecosystems have vegetation and channel bank conditions that approach historic potential (USDA Forest Service 2001).

There are two CARs in the Monument. The southeastern edge of the Little Kern River CAR on the Western Divide Ranger District overlaps the Monument boundary. The Little Kern River CAR was designated for management of a native population of Little Kern golden trout and is located within the Golden Trout Wilderness. The other CAR is located in Mill Flat Creek drainage on the Hume Lake Ranger District. This CAR was designated for management of western pond turtle and a stable native fish population that may be threatened by introduced, non-native members of the sunfish family.

The designation of RCAs follows guidelines provided in the SNFPA. Modeling of all treatments and effects follow the direction in the standards and guidelines for RCAs in Appendix A of the Framework Record of Decision (ROD). RCAs are land allocations that are managed to maintain or restore the structure and function of streams and wetlands. The widths are measured from the bankfull edge of the stream (SNFP 2001, Record of Decision, Appendix A-52; SNFP2004, Record of Decision, pg. 42). The following widths are listed below.

Stream Type	**Width of Conservation Area**
Perennial Streams	300 feet on each side
Seasonally Flowing Streams	150 feet on each side
Meadows or Streams with Special Features	300 feet on each side
Other Topographic Depressions	Determined at the project level

As defined in the AMS strategy the location and size of CARs and RCAs is to remain as defined until such time that a landscape analysis provides additional information. A watershed analysis has been performed for watersheds associated with the Monument. This analysis complies with management direction in the 2001 and 2004 Sierra Nevada Forest Plan Amendments (SNFPA) and serves as landscape analysis, which will assist the forest in identification of new projects providing definition of existing conditions (USDA Forest Service 2001, 2004). Details of these analyses may be found in the previous section, Affected Environment, of this document.

3. Riparian Conservation Objectives (RCOs)

Riparian Conservation Objectives provide a checklist for evaluating consistency of proposed activity with desired conditions described by the AMS goals. There are six RCOs with associated standards and guidelines discussed in 2001 and 2004 Sierra Nevada Forest Plan Amendment RODs that apply to Monument lands in addition to the Riparian and Wetland Standards and Guidelines associated with the Sequoia National Forest Mediated Settlement Agreement of 1990.

2001/2004 Sierra Nevada Forest Plan Amendment RCOs

Riparian Conservation Areas and Critical Aquatic Refuges

Conduct a site specific project area analysis to determine the appropriate level of management within RCAs or CARs. Determine the type and level of allowable management activities by assessing how proposed activities measure against the riparian conservation objectives and their associated standards and guidelines.

Standards and Guidelines Associated with RCAs and CARs:

1. *Designate riparian conservation area (RCA) widths as described in Part B of the SNFP ROD appendix A. The RCA widths displayed in Part B may be adjusted at the project level if a landscape analysis has been completed and a site-specific RCO analysis demonstrates a need for different widths.*

2. *Evaluate new proposed management activities within CAR's and RCA's during environmental analysis to determine consistency with the riparian conservation objectives at the project level and the AMS goals for the landscape. Ensure that appropriate mitigation measures are enacted to (1) minimize the risk of activity-related sediment entering aquatic systems and (2) minimize impacts to habitat for aquatic- or riparian-dependent plant and animal species.*

3. *Identify existing uses and activities in CAR's and RCA's during landscape analysis. At the time of permit re-issuance, evaluate and consider actions needed for consistency with RCO's.*

4. *As part of project-level analysis, conduct peer reviews for projects that propose ground-disturbing activities in more than 25 percent of the RCA or more than 15 percent of a CAR.*

5. *Determine which critical aquatic refuges or areas within critical aquatic refuges are suitable for mineral withdrawal. Propose these areas for withdrawal from location and entry under U.S. mining laws, subject to valid existing rights, for a term of 20 years.*

6. *Approve mining-related plans of operation if measures are implemented that contribute toward the attainment or maintenance of aquatic management strategy goals.*

Riparian Conservation Objective #1

Ensure that identified beneficial uses for the water body are adequately protected. Identify the specific beneficial uses for the project area, water quality goals from the Regional Basin Plan, and the manner in which the standards and guidelines will protect the beneficial uses.

Standards and Guidelines Associated with RCO #1:

1. *For waters designated as "Water Quality Limited" (Clean Water Act Section 303(d)), implement appropriate State mandates for the water body, such as Total Maximum Daily Load (TMDL) protocols*. (Hume Lake and Deer Creek water bodies are currently pending State evaluation, 2010.)

2. *Limit pesticide applications to cases where project level analysis indicates that pesticide applications are consistent with riparian conservation objectives. Prohibit application of pesticides to livestock in RCAs and CARs.*

3. *Within 500 feet of known occupied sites for the California red-legged frog, foothill yellow-legged frog and mountain yellow-legged frog, design pesticide applications to avoid adverse effects to individuals and their habitats.*

4. *Prohibit storage of fuels and other toxic materials within RCAs and CARs except at designated administrative sites. Prohibit refueling within RCAs and CARs unless there are no other alternatives. Ensure that spill plans are reviewed and up-to-date.*

Riparian Conservation Objective #2

Maintain or restore: (1) The geomorphic and biological characteristics of special aquatic features, including lakes, meadows, bogs, fens, wetlands, vernal pools, springs; (2) streams, including in stream flows; and (3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.

Standards and Guidelines Associated with RCO #2:

1. *Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity.*

2. *Ensure that culverts or other stream crossings do not create barriers to upstream or downstream passage for aquatic-dependent species. Locate water-drafting sites to avoid adverse effects to in stream flows and depletion of pool habitat. Where possible, maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features.*

3. *Prior to activities that could adversely affect streams, determine if relevant stream characteristics are within the range of natural variability. If characteristics are outside the range of natural variability, implement mitigation measures and short-term restoration actions needed to prevent further declines or cause an upward trend in conditions. Evaluate required long-term restoration actions and implement them according to their status among other restoration needs.*

4. *Prevent disturbance to streambanks and natural lake and pond shorelines caused by resource activities (for example, livestock, off-highway vehicles, and dispersed recreation) from exceeding 20 percent of stream reach or 20 percent of natural lake and pond shorelines. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots. This standard does not apply to developed recreation sites and sites authorized under Special Use Permits.*

5. *In stream reaches occupied by, or identified as "essential habitat" in the conservation assessment for Little Kern golden trout, limit streambank disturbance from livestock to 10 percent of the occupied or "essential habitat" stream reach. (Conservation assessments are described in the record of decision.) Cooperate with State and Federal agencies to develop streambank disturbance standards for threatened, endangered, and sensitive species. Use the regional streambank assessment protocol. Implement corrective action where disturbance limits have been exceeded.*

6. *At either the landscape or project-scale, determine if the age class, structural diversity, composition, and cover of riparian vegetation are within the range of natural variability for the vegetative community. If conditions are outside the range of natural variability, consider implementing mitigation and/or restoration actions that will result in an upward trend. Actions could include restoration of aspen or other riparian vegetation where conifer encroachment is identified as a problem.*

7. *Cooperate with Federal, Tribal, State and local governments to secure in stream flows needed to maintain, recover, and restore riparian resources, channel conditions, and aquatic habitat. Maintain in stream flows to protect aquatic systems to which species are uniquely adapted. Minimize the effects of stream diversions or other flow modifications from hydroelectric projects on threatened, endangered, and sensitive species.*

8. *For exempt hydroelectric facilities on national forest lands, ensure that special use permit language provides adequate in stream flow requirements to maintain, restore, or recover favorable ecological conditions for local riparian- and aquatic-dependent species.*

Riparian Conservation Objective #3:

Ensure a renewable supply of large down logs that: (1) Can reach the stream channel and (2) provide suitable habitat within and adjacent to the RCA.

Standards and Guidelines Associated with RCO #3:

1. *Determine if the level of coarse large woody debris (CWD) is within the range of natural variability in terms of frequency and distribution and is sufficient to sustain stream channel physical complexity and stability. Ensure proposed management activities move conditions toward the range of natural variability.*

Riparian Conservation Objective #4:

Ensure that management activities, including fuels reduction actions, within RCAs and CARs enhance or maintain physical and biological characteristics associated with aquatic- and riparian-dependent species.

Standards and Guidelines Associated with RCO #4:

1. *Within CARs, in occupied habitat or "essential habitat" as identified in conservation assessments for threatened, endangered, or sensitive species, evaluate the appropriate role, timing, and extent of prescribed fire. Avoid direct lighting within riparian vegetation; prescribed fires may back into riparian vegetation areas. Develop mitigation measures to avoid impacts to these species whenever ground disturbing equipment is used.*

2. *Use screening devices for water drafting pumps. (Fire suppression activities are exempt). Use pumps with low entry velocity to minimize removal of aquatic species, including juvenile fish, amphibian egg masses and tadpoles, from aquatic habitats.*

3. *Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation in RCAs. In burn plans for project areas that include, or are adjacent to RCAs, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining which mitigation*

measures to adopt, weigh the potential harm of mitigation measures, for example fire lines, against the risks and benefits of prescribed fire entering riparian vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could be damaging to habitat or long-term function of the riparian community.

4. *Post-wildfire management activities in RCAs and CARs should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, minimizing adverse effects from the existing road network, and carrying out activities identified in landscape analyses. Post-wildfire operations shall minimize the exposure of bare soil.*

5. *Allow hazard tree removal within RCA's or CAR's. Allow mechanical ground disturbing fuels treatments, salvage harvest, or commercial fuelwood cutting within RCA's or CAR's when the activity is consistent with RCO's. Utilize low ground pressure equipment, helicopters, over the snow logging, or other non-ground disturbing actions to operate off of existing roads when needed to achieve RCO's. Ensure that existing roads, landings, and skid trails meet Best Management Practices. Minimize the construction of new skid trails or roads for access into RCA's for fuel treatments, salvage harvest, commercial fuelwood cutting, or hazard tree removal.*

6. *As appropriate, assess and document aquatic conditions following the Regional Stream Condition Inventory protocol prior to implementing ground disturbing activities within suitable habitat for California red-legged frog and foothill and mountain yellow-legged frogs.*

7. During fire suppression activities, consider impacts to aquatic- and riparian-dependent resources. Where possible, locate incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities outside of RCAs or CARs. During presuppression planning, determine guidelines for suppression activities, including avoidance of potential adverse effects to aquatic- and riparian-dependent species as a goal.

8. *Identify roads, OHV trails and staging areas, trails, developed recreation sites, dispersed campgrounds, special use permits, grazing permits, and day use sites during landscape analysis. Identify conditions that degrade water quality or habitat for aquatic and riparian-dependent species. At the project level, evaluate and consider actions to ensure consistency with standards and guidelines or desired conditions.*

Riparian Conservation Objective #5:

Preserve, restore, or enhance special aquatic features, such as meadows, lakes, ponds, bogs, fens, and wetlands to provide the ecological conditions and processes needed to recover or enhance the viability of species that rely on these areas.

Standards and Guidelines Associated with RCO #5:

1. *Assess the hydrologic function of meadow habitats and other special aquatic features during range management analysis. Ensure that characteristics of special features are, at a minimum, at Proper Functioning Condition, as defined in the appropriate Technical Reports (or their successor publications): (1) "Process for Assessing PFC" TR 1737-9 (1993), "PFC for Lotic Areas" USDI TR 1737-15 (1998) or (2) "PFC for Lentic Riparian-Wetland Areas" USDI TR 1737-11 (1994).*

2. *Prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems. During project analysis, survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock, pack stock, humans, and wheeled vehicles. Criteria for defining bogs and fens include, but are not limited to, presence of: (1) sphagnum moss (Spagnum spp.), (2) mosses belonging to the genus Meessia, and (3) sundew (Drosera spp.) Complete initial plant inventories of bogs and fens within active grazing allotments prior to re-issuing permits.*

3. *Locate new facilities for gathering livestock and pack stock outside of meadows and riparian conservation areas. During project-level planning, evaluate and consider relocating existing livestock facilities outside of meadows and riparian areas. Prior to re-issuing grazing permits, assess the compatibility of livestock management facilities located in riparian conservation areas with riparian conservation objectives.*

4. *Under season-long grazing: For meadows in early seral status: limit livestock utilization of grass and grass-like plants to 30 percent (or minimum 6-inch stubble height). For meadows in late seral status: limit livestock utilization of grass and grass-like plants to a maximum of 40 percent (or minimum 4-inch stubble height; Determine ecological status on all key areas monitored for grazing utilization prior to establishing utilization levels. Use Regional ecological scorecards and range plant list in regional range handbooks to determine ecological status. Analyze meadow ecological status every 3 to 5 years. If meadow ecological status is determined to be moving in a downward trend, modify or suspend grazing. Include ecological status data in a spatially explicit Geographical Information System database; intensive grazing systems (such as rest-rotation and deferred rotation) where meadows are receiving a period of rest, utilization levels can be higher than the levels described above if the meadow is maintained in late seral status and meadow-associated species are not being impacted. Degraded meadows (such as those in early seral status with greater than 10 percent of the meadow area in bare soil and active erosion) require total rest from grazing until they have recovered and have moved to mid- or late seral status.*

5. *Limit browsing to no more than 20 percent of the annual leader growth of mature riparian shrubs and no more than 20 percent of individual seedlings. Remove livestock from any area of an allotment when browsing indicates a change in livestock preference from grazing herbaceous vegetation to browsing woody riparian vegetation.*

Riparian Conservation Objective #6:

Identify and implement restoration actions to maintain, restore, or enhance water quality and maintain, restore, or enhance habitat for riparian and aquatic species.

Standards and Guidelines Associated with RCO #6:

1. *Recommend restoration practices in: (1) areas with compaction in excess of soil quality standards, (2) areas with lowered water tables, or (3) areas that are either actively down cutting or that have historic gullies. Identify other management practices, for example, road building, recreational use, grazing, and timber harvests, which may be contributing to the observed degradation.*

Ecosystem Analysis

Ecosystem analysis provides a context for managing the entire ecosystem. These analyses are conducted to better understand situations and how watersheds and landscapes function before projects are planned.

The ecosystem analysis strategy, as stated in the 2001 Sierra Nevada Forest Plan Amendment, "Establishes a consistent, landscape-wide approach and context for maintaining or restoring ecological conditions that provide the desired levels of resources, such as clean water, clean air, plant and animal community diversity, and species viability, consistent with regulatory requirements and ongoing policies" (USDA Forest Service 2001, Appendix T, page T-1).

The ecosystem analysis strategy provides opportunities to perform assessments that are tailored to local conditions, capabilities, and restoration needs. The information assembled during landscape analysis would provide the basis for the identification of opportunities at the project level to move the landscape towards desired condition. Ecosystem analysis is a prerequisite for determining which processes, and parts of the landscape, would most affect fish and riparian habitats and would be essential for defining watershed-specific boundaries for RCAs, CARs, and riparian management objectives. Ecosystem analysis would form the basis for evaluating cumulative watershed effects, defining watershed restoration needs, goals, and objectives; implementing restoration strategies; and monitoring the effectiveness of watershed protection measures. Site-specific analysis would be done at the project level to address resource needs and potential effects of individual project alternatives on riparian health, soil, and water resources.

Alternative B - Proposed Action

Alternative B would embrace the Aquatic Management Strategy (AMS) and the Ecosystem Management Strategy of the 2001 and 2004 Sierra Nevada Forest Plan Amendment in conjunction with the 1990 Riparian and Wetland Standards and Guidelines documented in Exhibit D of the MSA. Aquatic Management Strategy (AMS) The AMS, in the 2004 SNFPA, retains CARs, RCAs, and the goals of the AMS established in the SNFPA 2001 ROD. "The goals of protecting and restoring desired conditions of aquatic, riparian and meadow ecosystems and providing for the viability of species associated with those ecosystems remain unchanged" (USDA Forest Service 2004, Record of Decision, page 10). The standards and guidelines associated with the AMS RCOs have been streamlined to remove redundancy and duplication with existing laws, executive orders, and direction.

The desired condition is for sustainable hydrological function. Management actions would maintain, improve, and restore hydrologic function in order to promote properly functioning riparian and wetland areas and aquatic ecosystems while providing water for communities and habitats outside the Monument. Objectives for hydrologic resources under the proposed action, Alternative B, include:

1. During the life of the Monument Plan, inventory 10 percent of the perennial streams in 6th-field watersheds to determine existing condition.
2. During the life of the Monument Plan, assess meadows for hydrologic function and prioritize ecological restoration needs.
3. During the life of the Monument Plan, based on assessment, restore hydrologic function in priority meadows to enhance riparian habitat.

Riparian Conservation Objectives (RCOs) - remain unchanged from those of the 2001 SNFPA and documented in Alternative A. The standards and guidelines have been streamlined for the 2004 SNFPA AMS. A comparison of 2001 and 2004 SNFPA RCOs have been provided in Appendix A of this document. Direction inconsistent to the Monument proclamation (Clinton 2000), such as management of species that do not occur in the area, minerals management, and OHV activities, has been eliminated from the standards and guides. Additionally, standards and guides specific to Monument lands have been added to document local conditions. Standards and guides specific to Monument lands were developed based on watershed specific ranges of natural variability collected during landscape level analysis as directed in the 2001/2004 SNFPA AMS. Monument specific data which is used to refine standards and guidelines based on local condition. While monument specific standards and guides may be appropriate for multiple SNFPA standards they are described in detail once; a application and discussion of the data and studies associated with Monument specific standards and guidelines may be found in Appendix B of this report.

Standards and Guidelines for Riparian Conservation Areas and Critical Aquatic Refuges

91. Designate riparian conservation area (RCA) widths as described in Part B 2004 ROD Appendix A. The RCA widths displayed in Part B, 2004 ROD Appendix A, may be adjusted at the project level if a landscape analysis has been completed and a site-specific RCO analysis demonstrates a need for different widths.

Monument specific:

91a. Streamside Management Zone (SMZ) widths would be determined for the first 100+ feet perpendicular to Class I and II perennial streams; Class III intermittent streams with side slopes greater than 30 percent; and <50 percent to 75 feet of a Class IV ephemeral stream, dependent on slope. SMZ direction provides the following widths in feet. (The values provided in Table 100 are used as a guide.)

Stream Class	**Table 100 - SMZ Width by % Slope**					**Stream Order**
	<30%	>30%	>40%	>50%	>70%	
Meadows	100	Na	Na	Na	Na	-
Seeps Springs Bogs	100	Na	Na	Na	Na	-
I	100	150	200	250	1.5 times distance to slope break	4+
II	100	100	150	200		3-4
III	50	100	100	150		2-3
IV	≤50	≤50	75	100		1-2
IV	≤50	≤50	≤50	≤50		1-0

Field conditions, including stream type and project objectives, should dictate the streamside management zone width at the project level.

Treatments in this zone would be dependent on project objectives. Objectives for SMZs are maintenance or improvement of riparian areas to provide unobstructed passage of storm flows, to control sediment, and other pollutants entering the stream course, and to restore the natural course of any stream, as soon as practicable, when diversion of the stream has resulted from management activities.

92. Evaluate new proposed management activities within CARs and RCAs during environmental analysis to determine consistency with the RCOs at the project level and the AMS goals for the landscape. Ensure that appropriate mitigation measures are enacted to (1) minimize the risk of activity-related sediment entering aquatic systems and (2) minimize impacts to habitat for aquatic- or riparian-dependent plant and animal species.

93. Identify existing uses and activities in CARs and RCAs during landscape analysis. At the time of permit re-issuance, evaluate and consider actions needed for consistency with RCOs.

94. As part of project-level analysis, conduct peer reviews for projects that propose ground-disturbing activities in more than 25 percent of the RCA, or more than 15 percent of a CAR. 2004 SNFPA ROD page 71 defines ground disturbing activities as: "Activities that result in detrimental soil compaction or loss of organic matter beyond the thresholds identified by soil quality standards".

Standards and Guidelines Associated with RCO #1

95. For waters designated as "Water Quality Limited" (Clean Water Act Section 303(d)), participate in the development of Total Maximum Daily Loads (TMDLs) and TMDL Implementation Plans. Execute applicable elements of completed TMDL Implementation Plans.

96. Ensure that management activities do not adversely affect water temperatures necessary for local aquatic and riparian-dependent species assemblages.

Monument specific:

96a. Maintain temperature at a no more than a daily average of 20 degrees C for streams affected by management activity. Stream courses with special circumstances such as those affected by hot springs or other geologic and geochemical features would be evaluated on a site by site basis at the project level.

96b Maintain average stream surface shade at >60 percent on streams affected by management activity. Meadow environments and other streams with limited overhead vegetation would be assessed on a site by site basis at the project level.

96c. Ensure that management activities do not adversely affect pH values necessary for local aquatic and riparian-dependent species assemblages as defined by the Central Valley Water Quality Board Basin Plan.

pH values between 6.5 and 8.5 on streams affected by management activity. Water bodies that exhibit special conditions would be evaluated at the project level. Special circumstances could include waters affected by hot springs in the presence of CO_2 springs or other geologic and geochemical features. Such areas would be expected to yield pH values outside the range of state standards.

96d. Ensure that management activities do not adversely affect alkalinity values, which have a potential to affect pH values, necessary for local aquatic and riparian-dependent species assemblages as defined by the Central Valley Water Quality Board Basin Plan.

Maintain alkalinity values of no less than 10 mg/L. Site specific differences could occur based on local geology and water chemistry. Values outside these ranges would be evaluated at the project level.

97. Limit pesticide applications to cases where project level analysis indicates that pesticide applications are consistent with riparian conservation objectives.

Monument specific:

97a. Use local channel geometry discharge relationships as published in this document or updated at a future time to determine location of floodprone area. Pesticide application, including gopher baiting, would not take place within the floodprone area of perennial or intermittent stream course. In the event that project objectives include treatment of riparian areas, conditions would be evaluated on a site by site basis at the project level.

98. Within 500 feet of known occupied sites for the California red-legged frog, foothill yellow-legged frog, mountain yellow-legged frog, design pesticide applications to avoid adverse effects to individuals and their habitats.

99. Prohibit storage of fuels and other toxic materials within RCAs and CARs except at designated administrative sites and sites covered by a Special Use Authorization. Prohibit refueling within RCAs and CARs unless there are no other alternatives. Ensure that spill plans are reviewed and up-to-date.

Standards and Guidelines Associated with RCO #2

100. Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity.

101. Ensure that culverts or other stream crossings do not create barriers to upstream or downstream passage for aquatic-dependent species. Locate water drafting sites to avoid adverse effects to in stream flows and depletion of pool habitat. Where possible, maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features.

102. Prior to activities that could adversely affect streams, determine if relevant stream characteristics are within the range of natural variability. If characteristics are outside the range of natural variability, implement mitigation measures and short-term restoration actions needed to prevent further declines or cause an upward trend in conditions. Evaluate required long-term restoration actions and implement them according to their status among other restoration needs.

Monument specific:

102a. Maintain width-to-depth ratios for A and E channels of values less than 14 on streams affected by management activity. Maintain width-to-depth ratios for B, C, and F channels of values greater than 10 on stream channels affected by Management Activity. Encourage G and F channels to trend towards width-to-depths greater than 12.

102b. Mean particle size distribution should not show a shift toward fine material in stable channel types (A, B, C, and E) to the extent that a change in channel type occurs in streams affected by management activity. Mean particle size distribution would be expected to change in impaired systems or following restoration activities. Stream courses with special circumstances would be evaluated on site by site basis at the project level.

102c. Manage for specific components of Stream Reach Inventory and Channel Stability Evaluation (Pfankuch, 1975) affected by management activity. Special conditions would be evaluated at the project level:

Environmental Indicator from Pfankuch Channel Condition and Stability Evaluation **Riparian Ecotype** → ↓	**Vegetative Bank Protection**	**Bank Cutting**	**Bottom Deposition and Scour& Deposition**	**Bottom Size Distribution and % Stable Material**
Naturally Stable **Rosgen Channel Type: A1, A2, B1, B2, B3, C1, C2, F1, F2, G1, G2** *Restoration Not Required*	NA	NA	Low frequency of mid-channel bars and good pool to riffle ratio	NA
Stable Sensitive **Rosgen Channel Type: B4, B5, B6, C3, C4, C5, C6, E3, E4, E5, E6** *Recover with Passive Restoration*	80 to 90 % ground cover with stable continuous root mass	Less than or equal to 1 foot of exposed bank cuts affecting less than or equal to 20% of the channel	Little or no sand bar development with 0 to 5% of the bottom affected by bar deposition	NA
Unstable-Sensitive Degraded **Rosgen Channel Type: G2, G3, G4, G5, G6, F3, F4, F5, F6, and those D3, D4, D5, D6 in unexpected geomorphic settings.** *Recover with Active Restoration*	Greater than or equal to 70 % ground cover with stable continuous root mass	Less than or equal to 1 foot of exposed bank cuts affecting less than or equal to 30% of the channel	Low frequency of mid channel bar development, Improved pool to riffle ratio, with 5 to 30% deposition behind obstructions	Slight size distribution shift between 50-80% stable material
Naturally Unstable **Rosgen Channel Type: A3, A4, A5, A6 (Landslide and Debris slide Terrain)** *Impractical to Restore*	NA	NA	NA	NA

102d. For stable streams (A, B, C, E), maintain or improve the channel as necessary based on Reach Inventory and Channel Stability Evaluation (Pfankuch, 1975). Actions should be taken to maintain or improve stream sites based on successional stage shifts away from stable conditions. For impaired stream reaches (G, F, and D[12]), successional stage shifts from the impaired stream reach

[12] D channels are considered unimpaired where they exist under stable conditions, at deltas and at the base of alluvial fans

would show a trend toward an unimpaired condition.

103. Prevent disturbance to stream banks and natural lake and pond shorelines caused by resource activities (for example, livestock, and dispersed recreation) from exceeding 20 percent of stream reach or 20 percent of natural lake and pond shorelines. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots. This standard does not apply to developed recreation sites; sites authorized under special use permits, and roads.

104. In stream reaches occupied by, or identified as "essential habitat" in the conservation assessment for, Little Kern golden trout, limit stream bank disturbance from livestock to 10 percent of the occupied or "essential habitat" stream reach. (Conservation assessments are described in the record of decision.) Cooperate with state and federal agencies to develop stream bank disturbance standards for threatened, endangered, and sensitive species. Use the regional stream bank assessment protocol. Implement corrective action where disturbance limits have been exceeded.

105. At either the landscape or project-scale, determine if the age class, structural diversity, composition, and cover of riparian vegetation are within the range of natural variability for the vegetative community. If conditions are outside the range of natural variability, consider implementing mitigation and/or restoration actions that will result in an upward trend. Actions could include restoration of aspen or other riparian vegetation where conifer encroachment is identified as a problem.

106. Cooperate with federal, tribal, state, and local governments to secure in stream flows needed to maintain, recover, and restore riparian resources, channel conditions, and aquatic habitat. Maintain in-stream flows to protect aquatic systems to which species are uniquely adapted. Minimize the effects of stream diversions or other flow modifications from hydroelectric projects on threatened, endangered, and sensitive species.

107. For exempt hydroelectric facilities on national forest lands, ensure that special use permit language provides adequate in-stream flow requirements to maintain, restore, or recover favorable ecological conditions for local riparian- and aquatic-dependent species.

Standard and Guideline Associated with RCO #3

108. Determine if the level of coarse large woody debris (CWD) is within the range of natural variability in terms of frequency and distribution and is sufficient to sustain stream channel physical complexity and stability. Ensure proposed management activities move conditions toward the range of natural variability.

Monument specific:

108a. Woody material (CWD) needs to be maintained in and adjacent to stream courses. Where fire is responsible for removal of CWD, replacement would occur at levels associated with pre-fire conditions if possible. Amounts of wood necessary for maintenance of stream stability, sediment reduction and aquatic species habitat needs would be evaluated at the project level.

Standards and Guidelines Associated with RCO #4

109. Within CARs, in occupied habitat or "essential habitat" as identified in conservation assessments for threatened, endangered, or sensitive species, evaluate the appropriate role, timing, and extent of prescribed fire. Avoid direct lighting within riparian vegetation; prescribed fires may back into riparian vegetation areas. Develop mitigation measures to avoid impacts to these species whenever ground-disturbing equipment is used.

<u>Monument specific:</u>

109a. Streamside Management Zones (SMZ) widths would be determined for the first 100+ feet perpendicular to Class I and II perennial stream; Class III intermittent streams, with side slopes greater than 30 percent; and <50 to 75 feet of a Class IV ephemeral stream, dependent on slope. SMZ direction provides the following widths in slope distance in feet. (The values provided in Table 101 are used as a guide.)

Stream Class	Table 101 - SMZ Width by % Slope					Stream Order
	<30%	>30%	>40%	>50%	>70%	
Meadows	100	Na	Na	Na	Na	-
Seeps Springs Bogs	100	Na	Na	Na	Na	-
I	100	150	200	250	1.5 times distance to slope break	4+
II	100	100	150	200		3-4
III	50	100	100	150		2-3
IV	≤50	≤50	75	100		1-2
IV	≤50	≤50	≤50	≤50		1-0

Field conditions including stream type and project objectives would define width of SMZ. Treatments in this zone would be dependent on treatment objectives. Objectives for SMZs are maintenance or improvement of riparian values, to provide unobstructed passage of storm flows, to control sediment and other pollutants entering the stream course, and to restore the natural course of any stream as soon as practicable when diversion of the stream has resulted from management activities.

110. Use screening devices for water drafting pumps. (Fire suppression activities are exempt during initial attack.) Use pumps with low entry velocity to minimize removal of aquatic species, including juvenile fish, amphibian egg masses, and tadpoles from aquatic habitats.

111. Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation in RCAs. In burn plans for project areas that include, or are adjacent to RCAs, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining which mitigation measures to adopt, weigh the potential harm of mitigation measures, for example fire lines, against the risks and benefits of prescribed fire entering riparian vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could be damaging to habitat or long-term function of the riparian community.

112. Post-wildfire management activities in RCAs and CARs should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, minimizing adverse effects from the existing road network, and carrying out activities identified in landscape analysis. Post-wildfire operations shall minimize the exposure of bare soil.

113. Allow hazard tree removal within RCAs or CARs. Allow mechanical ground disturbing fuels treatments, salvage harvest, or commercial fuelwood cutting within RCAs or CARs when the activity is consistent with RCOs. Utilize low ground pressure equipment, helicopters, over the snow logging, or other non-ground disturbing actions to operate off of existing roads when needed to achieve RCOs. Ensure that existing roads, landings, and skid trails meet Best Management Practices. Minimize the construction of new skid trails or roads for access into RCAs for fuel treatments, salvage harvest, commercial fuelwood cutting, or hazard tree removal.

114. As appropriate, assess and document aquatic conditions following the regional Stream Condition Inventory protocol prior to implementing ground disturbing activities within suitable habitat for California red-legged frog, foothill yellow-legged frog, and mountain yellow-legged frogs.

Monument specific:

114d. Maintain 85 percent of water bodies affected by management activity at no less than very good water quality based on aquatic MIS site condition. Water bodies outside this range would be evaluated for site specific impacts. Aquatic MIS site condition would be in reference condition, good or better site condition. Water bodies outside this range would be evaluated on a site by site basis at the project level.

115. During fire suppression activities, consider impacts to aquatic- and riparian-dependent resources. Where possible, locate incident bases, camps, helicopter-bases, staging areas, helicopter-spots, and other centers for incident activities outside of RCAs or CARs. During pre-suppression planning, determine guidelines for suppression activities including avoidance of potential adverse effects to aquatic- and riparian-dependent species as a goal.

116. Identify roads, trails, developed recreation sites, dispersed campgrounds, special use permits, grazing permits, and day use sites during landscape analysis. Identify conditions that degrade water quality or habitat for aquatic- and riparian-dependent species. At the project level, evaluate and consider actions to ensure consistency with standards and guidelines or desired conditions.

Standards and Guidelines Associated with RCO #5

117. Assess the hydrologic function of meadow habitats and other special aquatic features during range management analysis. Ensure that characteristics of special features are, at a minimum, at Proper Functioning Condition (PFC), as defined in the appropriate Technical Reports (or their successor publications): (1) “Process for Assessing PFC” TR 1737-9 (1993), “PFC for Lotic Areas” USDI TR 1737-15 (1998) or (2) “PFC for Lentic Riparian-Wetland Areas” USDI TR 1737-11 (1994).

118. Prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems. During project analysis, survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock,

pack stock, humans, and wheeled vehicles. Criteria for defining bogs and fens include, but are not limited to, presence of: (1) sphagnum moss (Spagnum spp.), (2) mosses belonging to the genus Meessia, and (3) sundew (Drosera spp.). Complete initial plant inventories of bogs and fens within active grazing allotments prior to re-issuing permits.

Monument specific:

118a. Maintain temperature at a no more than a daily average of 20 degrees C on streams affected by management activity. Stream courses with special circumstances such as those affected by hot springs, geologic, or geochemical conditions would be evaluated on site by site basis at the project level.

119. Locate new facilities for gathering livestock and pack stock outside of meadows and riparian conservation areas. During project-level planning, evaluate and consider relocating existing livestock facilities outside of meadows and riparian areas. Prior to re-issuing grazing permits, assess the compatibility of livestock management facilities located in riparian conservation areas with riparian conservation objectives.

120. Under season-long grazing:

- For meadows in early seral status: limit livestock utilization of grass and grass-like plants to 30 percent (or minimum 6-inch stubble height).
- For meadows in late seral status: limit livestock utilization of grass and grass-like plants to a maximum of 40 percent (or minimum 4-inch stubble height).

Determine ecological status on all key areas monitored for grazing utilization prior to establishing utilization levels. Use regional ecological score cards and range plant list in regional range handbooks to determine ecological status. Analyze meadow ecological status every 3 to 5 years. If meadow ecological status is determined to be moving in a downward trend, modify or suspend grazing. Include ecological status data in a spatially explicit geographical information system database.

Under intensive grazing systems (such as rest-rotation and deferred rotation) where meadows are receiving a period of rest, utilization levels can be higher than the levels described above if the meadow is maintained in late seral status and meadow-associated species are not being impacted. Degraded meadows (such as those in early seral status with greater than 10 percent of the meadow area in bare soil and active erosion), require total rest from grazing until they have recovered and have moved to mid- or late seral status.

121. Limit browsing to no more than 20 percent of the annual leader growth of mature riparian shrubs and no more than 20 percent of individual seedlings. Remove livestock from any area of an allotment when browsing indicates a change in livestock preference from grazing herbaceous vegetation to browsing woody riparian vegetation.

Standard and Guideline Associated with RCO #6

122. Recommend restoration practices in: (1) areas with compaction in excess of soil quality standards, (2) areas with lowered water tables, or (3) areas that are either actively down cutting or that have historic gullies. Identify other management practices, for example, road building, recreational use, grazing, and timber harvests that may be contributing to the observed degradation.

Alternative C

Alternative C would protect "Objects of Interest" as identified in the proclamation (Clinton 2000) and manage Monument lands in a fashion similar to Sequoia and Kings Canyon National Parks. Lessons learned from the National Park would be incorporated into management direction and would be expected to result in resilient ecosystems adaptable to climate change. This alternative focuses on managing the Monument for ecosystem resiliency, adaptability to climate change, and heterogeneity. Objectives for hydrologic resources under the Alternative C include:

1. During the life of the Monument Plan, inventory 10 percent of the perennial streams in 6th-field watersheds to determine existing condition.
2. During the life of the Monument Plan, assess meadows for hydrologic function and prioritize ecological restoration needs.
3. During the life of the Monument Plan, based on assessment, restore hydrologic function in priority meadows to enhance riparian habitat.

Alternative C includes standards and guidelines from Alternative B with the exception of Standards and Guidelines for Riparian Conservation Areas and Critical Aquatic Refuges. The following guidelines are <u>not</u> included in Alternative C:

<u>Riparian Conservation Areas (RCAs) and Critical Aquatic Refuges (CARs)</u>

91. Designate riparian conservation area (RCA) widths as described in Part B 2004 ROD Appendix A. The RCA widths displayed in Part B 2004 ROD, Appendix A may be adjusted at the project level if a landscape analysis has been completed and a site-specific RCO analysis demonstrates a need for different widths.

92. Evaluate new proposed management activities within CARs and RCAs during environmental analysis to determine consistency with the riparian conservation objectives at the project level and the AMS goals for the landscape. Ensure that appropriate mitigation measures are enacted to (1) minimize the risk of activity-related sediment entering aquatic systems and (2) minimize impacts to habitat for aquatic- or riparian-dependent plant and animal species.

93. Identify existing uses and activities in CARs and RCAs during landscape analysis. At the time of permit reissuance, evaluate and consider actions needed for consistency with RCOs.

94. As part of project-level analysis, conduct peer reviews for projects that propose ground-disturbing activities in more than 25 percent of the RCA or more than 15 percent of a CAR.

<u>Riparian Conservation Objective #1</u>

99. Prohibit storage of fuels and other toxic materials within RCAs and CARs except at designated

administrative sites and sites covered by a special use authorization. Prohibit refueling within RCAs and CARs unless there is no other alternative. Ensure that spill plans are reviewed and up-to-date.

Riparian Conservation Objective #4

109. Within CARs, in occupied habitat or "essential habitat" as identified in conservation assessments for threatened, endangered, or sensitive species, evaluate the appropriate role, timing, and extent of prescribed fire. Avoid direct lighting within riparian vegetation; prescribed fires may back into riparian vegetation areas. Develop mitigation measures to avoid impacts to these species whenever ground-disturbing equipment is used.

111. Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation in RCAs. In burn plans for project areas that include or are adjacent to RCAs, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining mitigation measures, weigh the potential harm of mitigation measures (e.g.,fire lines) against the risks and benefits of prescribed fire entering riparian vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances when fire suppression or fuel management actions could be damaging to habitat or the long-term function of a riparian community.

112. Post-wildfire management activities in RCAs and CARs should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, minimizing adverse effects from the existing road network, and carrying out activities identified in landscape analyses. Post-wildfire operations shall minimize the exposure of bare soil.

113. Allow hazard tree removal within RCAs or CARs. Allow mechanical ground disturbing fuels treatments, salvage harvest, or commercial fuelwood cutting within RCAs or CARs when the activity is consistent with RCOs. Utilize low ground pressure equipment, helicopters, over the snow logging, or other non-ground disturbing actions to operate off of existing roads when needed to achieve RCOs. Ensure that existing roads, landings, and skid trails meet Best Management Practices. Minimize the construction of new skid trails or roads for access into RCAs for fuel treatments, salvage harvest, commercial fuelwood cutting, or hazard tree removal.

115. During fire suppression activities, consider impacts to aquatic- and riparian-dependent resources. Where possible, locate incident bases, camps, heli-bases, staging areas, heli-spots, and other centers for incident activities outside of RCAs or CARs. During pre-suppression planning, determine guidelines for suppression activities, including avoidance of potential adverse effects to aquatic- and riparian-dependent species as a goal.

Riparian Conservation Objective 5

119. Locate new facilities for gathering livestock and pack stock outside of meadows and RCAs. During project-level planning, evaluate and consider relocating existing livestock facilities outside of meadows and riparian areas. Prior to re-issuing grazing permits, assess the compatibility of livestock management facilities located in RCAs with RCOs.

Alternative D

Alternative D would permit naturally-occurring fire and other processes to occur to protect the objects of interest and promote giant sequoia regeneration. This alternative was derived from public comments suggesting the Monument should be managed in a manner that mimics natural processes. Objectives for hydrologic resources under Alternative D include:

1. During the life of the Monument Plan, inventory 10 percent of the perennial streams in 6th-field watersheds to determine existing condition.
2. During the life of the Monument Plan, assess meadows for hydrologic function and prioritize ecological restoration needs.
3. During the life of the Monument Plan, based on assessment, restore hydrologic function in priority meadows to enhance riparian habitat.

Alternative D would contain all standards and guidelines from Alternative B.

Alternative E

Alternative E directs management to follow the 1988 Land and Resource Management Plan (LRMP) and the 1990 Mediated Settlement Agreement (MSA). Standards and guidelines are those associated with the LRMP and MSA. Objectives for hydrologic resources under this alternative include:

1. During the life of the Monument Plan, inventory 10 percent of the perennial streams in 6th-field watersheds to determine existing condition.
2. During the life of the Monument Plan, assess meadows for hydrologic function and prioritize ecological restoration needs.
3. During the life of the Monument Plan, based on assessment, restore hydrologic function in priority meadows to enhance riparian habitat.

The following specific riparian and wetland standards and guides are applicable to Alternative E:

<u>Riparian and Wetland Standards and Guidelines from the 1990 MSA and 1988 LRMP</u>

- Identify areas of watershed damage and abandoned roads. These areas will be added to watershed improvement needs (WIN) program for rehabilitation. Water quality improvement will receive first priority, followed by priorities established by management prescriptions. (LRMP p. 4-35)
- Secure water rights annually for existing and foreseeable future forest consumptive uses following appropriate federal and state filing procedures. (LRMP p. 4-35)
- Utilize administrative studies on small watersheds to evaluate water yield improvement in cooperation with other agencies. (LRMP p. 4-35)
- Manage riparian areas under the principles of multiple use and sustained yields, while emphasizing protection and improvement of soil, water, vegetation, and fish and wildlife resources. Give preferential consideration to riparian dependent resources when conflicts among land use activities occur. [FSM 2526.03-2] (MSA Exhibit D, Standard #1, p. 2)
- Give special attention to land and vegetation for approximately 100 feet from the edges of all perennial streams, lakes, and other bodies of water. This distance shall correspond to at least the recognizable area dominated by the riparian vegetation [36 CFR 219.27e; FSM 2526.03-5]. (MSA Exhibit D, Standard #3, p. 2)
- Provide protection where resource management activities are likely to seriously and adversely affect water conditions or fish habitat. [NMFA, P L 94-588] (MSA Exhibit D, Standard #4, p. 2)

- Facilitate the determination of sound vegetation manipulation practices based on watershed conditions and land capability, rather than decisions based solely on silvicultural characteristics and the public demand for goods. [NFMA P.L. 94-588] (MSA Exhibit D, Standard #5, p. 2)
- Delineate and evaluate riparian areas prior to implementing any project activity. [FSM 2526.03-3] (MSA Exhibit D, Standard #2, p. 2)
- Beneficial Uses of Water: The beneficial uses that are most sensitive to watershed disturbance are fish habitat and domestic supply. The forest shall manage any watershed in which it has identified one of these as a beneficial use to protect such use, as per RWQCB Basin Plans, using developed criteria. The forest shall identify and protect sensitive reach(es) (weakest links) in the watershed. In all cases, the forest shall protect soil productivity.
- Avoid long- and short-term adverse impacts associated with modification of floodplains and wetlands. Minimize, to the extent practicable, destruction, loss, or degradation of wetlands (E.O. 11988 Floodplain Management and E.O. 11990 Protection of Wetlands). (BMP 1.18)
- Give priority to watershed improvement projects which enhance recreation opportunities. (LRMP pp. 4-55, 4-58, and 4-60)
- Give priority to watershed improvement projects which enhance and improve range productivity (LRMP pp. 4-78, 4-80, 4-82, and 4-87)
- Give priority to watershed improvement projects which protect plantations. (LRMP p. 4-89)

Streamside Management Zone Designation

- Streamside Management Zones will be established and maintained for all "stream courses and wetlands affected by management activities. Project plans will be designed to include site-specific prescriptions for the prevention of sedimentation, stream damage, and the protection of riparian dependent species.
- Follow appropriate Management Requirements and Constraints with respect to stream type and Class. (MSA Exhibit D, Guideline #5, pp. 5-6)
- Landings and non-system roads that have been decommissioned that are located within streamside management zones, and that would be inconsistent with these Riparian Standards and Guidelines, will not be reopened and reused unless the Sequoia National Forest makes a specific finding, based on a project environmental document, that using such roads or landings would cause less harm to riparian resources than building new roads and/or landings. (MSA Exhibit D, Guideline #5, pp. 5-6)
- Conduct monitoring of individual management practices to determine how well objectives have been met, and how closely management standards and guidelines have been applied (NFMA, NEPA, FSM 1922.7, 36 CFR 219.12k). (MSA Exhibit D, Standard #8, p. 3)

Streambank Stability

- Identify all stream reaches with undercut or raw streambanks. Lay out management activities to protect and maintain vegetation and streambank integrity within 50 feet of unstable stream banks. Designated stream crossings are an exception and should be determined with the aid of appropriate personnel, which will be determined by the complexity of the situation. Stream crossings on Class I and II streams should be done in consultation with California Department of Fish and Game.
- Improvements such as development of water troughs, watershed improvement projects, rerouting of trails, stream crossing structures, and construction of barriers to protect unstable and/or sensitive stream banks will be designed to minimize impacts on the streambank. (MSA Exhibit D, Guideline #1, p. 4).

Vegetative Cover

- Establish a management zone that is a minimum 100 feet horizontal distance on both sides of perennial streams and Class II and III intermittent streams, and around meadows; 100 feet horizontal distance on both sides of Class III intermittent streams where necessary for fish spawning, rearing, or migration; 50 feet on both sides of other intermittent streams, seeps, springs, and bogs; and maintain riparian vegetation on ephemeral streams. Vegetative cover within these zones is to be managed for the protection or enhancement of riparian dependent resources. Vegetation manipulation may occur within this zone with the intent of improving riparian dependent resources. Projects must meet concurrence with earth scientist, wildlife, and fisheries biologists. Timber harvesting will not be scheduled within the vegetative cover zone. Timber could be removed in this zone for wildlife or fisheries improvement projects.
- Designated cable corridors and road crossings are exceptions and are to be determined by the appropriate specialist. Cable corridors will be minimized and will not exceed twenty feet in width. Proposed new crossings of Class I and II streams will be identified in environmental documents. Consultation should occur with outside agencies when crossing Class 1 or Class 2streams. Road and trail crossings will be designed to cross drainages as "quickly as possible" to minimize construction parallel to stream courses within SMZs. (MSA Exhibit D, Guideline #2, pp. 4-5)

Stream Surface Shade

- Where management activity for enhancement of riparian dependent species is proposed within 50 feet of perennial or intermittent streams affecting fisheries, baseline data will be established by use of a device designed to measure the average total solar radiation. The goal of this guideline will be to maintain an average minimum of 65 percent blockage of available July/August solar radiation within the affected project site. Designated cable corridors and road crossings are exceptions and are to be determined with appropriate personnel input. Monitoring will require a similar set of readings to determine the effects of management activities on stream shading. (MSA Exhibit D, Guideline #3, p. 5)

Interception of Sediment

- Maintain a protective ground cover of duff, litter, plants, downed woody debris, and slash within a filter strip.
- Where percentage of ground cover resulting from management activity is below 50 percent, an interdisciplinary analysis is required to develop appropriate mitigation to negate environmental consequences. Designated stream crossings are an exception to this direction.
- Ground cover percentages in filter strips affected by management activities can be estimated by the use of photo guides. Treatments designed to increase the efficiency of this filter strip may include the establishment of living plants, introduction of litter, slash, or other treatments as identified. (MSA Exhibit D, Guideline #4, pp. 5-6)
- Correct existing, and prevent potential water quality problems through the implementation of Best Management Practices (BMPs) as contained in Water Quality Management for the National Forest System lands in California; a State of California Water Resources Control Board (SWRCB)/USDA Forest Service Cooperative Agreement. [Clean Water Act, P.L. 92-500, Section 208] This agreement contains the following provisions from NFMA P.L. 94.588:
- Protection of stream courses from detrimental changes in temperature. (BMP 1.8) Protection of

stream courses from blockage. (BMP 1.19)

- Protection of stream courses from detrimental deposits of sediment. (BMP 1.19) (MSA Exhibit D, Standard #6, p. 3)

Meadow Hydrology

- Activities that take place on or within 250 feet of a meadow require site specific investigation during project planning to describe the risk of altering the hydrologic characteristics. Proposed management activities need to consider direct and indirect effects on the meadows hydrologic character. Activities will be evaluated through an ID team process including consulting with cooperating agencies, individuals and permittees. (MSA Exhibit D, Guideline #6, p. 9)
- Effects from offsite activities will be evaluated by tracking past management activities and assessing stream channel stability. Use the Sequoia NF Cumulative Watershed Effects Working Guide, 1987 (FSH 2509.22 Sequoia Supplement #1) and Pfankuch Stream Reach and Channel Stability Inventory rating system (BMP 7.8). (MSA Exhibit D, Guideline #6, p. 9)
- Consider meadows smaller than two acres as part of the riparian areas. (LRMP p. 4-30)

Forage Utilization

- Livestock will not be permitted to graze in meadows until Kentucky bluegrass heads begin to emerge; and/or Nebraska sedge flowers are almost open. (BMP 8.2)
- Allowable use factors will be established for each key meadow to assure maintenance of vegetative stability and site productivity.
- Cattle will be distributed in a manner consistent with moderate forage utilization within meadows. Plant height/weight ratios will be used to monitor the results. (BMP 8.3)
- Grazing will cease in time to permit re-growth sufficient to store carbohydrates for initial spring growth (as specified in individual allotment plans). (MSA Exhibit D, Guideline #7, p. 10)

Woody and Herbaceous Vegetation in Riparian and Wetland Ecosystems

- Determine the distribution, vegetative structure, condition and trend of riparian areas and wetlands by developing a Forest Riparian Wetland Inventory. Identify riparian and wetland areas impacted from past forest management activities in Allotment Management Plans and Watershed Improvement Needs Inventory (WINI) (FSH 2509.15 form FS 2500-7, BMP 7.1). Plans will be developed to maintain or re-establish riparian and wetland ecosystems. Effectiveness monitoring of projects will occur.
- Allotment management plans will identify management strategies needed to maintain or re-establish vegetative structure conditions that maintain and/or re-establish fish and wildlife habitat in key areas. These areas will be identified in the Forest Riparian Wetland Inventory. Develop demonstration areas for habitat re-establishment in concert with California Department of Fish and Game. (MSA Exhibit D, Guideline #8, p. 11)

Cumulative Watershed Effects Analysis

- Utilize the Sequoia National Forest's cumulative watershed effects (CWE) methodology for application within the forest to assess each project for potential to incur Cumulative Effects.
- The forest shall determine the proper size of the watershed unit to be subject to CWE analysis based on the identified beneficial use(s). The unit size will generally range from 250 to 2,000 acres.
- Each project NEPA document shall identify the beneficial uses of water and the most sensitive stream reach(es) as part of the CWE analysis (p. 110).

- Identification and Evaluation of Processes Within the Watershed (CWE Analysis). The Sequoia National Forest staff will determine the controlling processes of concern (as required by FSM 2509.22, 7/88, Amendment 1) in order to assess disturbance coefficients and mitigation opportunities.
- Where, according to established criteria, soil erosion and sediment supply are determined to be controlling processes, CWE shall analyze change in soil erosion and sediment supply as processes independent of change in annual peak flow run-off.
- In assessing sediment impacts, relative changes in erosion and sediment delivery rather than only the amount of compaction shall be assessed.
- CWE analysis shall identify the most crucial elements in the watershed, ie. specific processes that are controlling processes of concern for the system (e.g., rain on snow events and surface erosion).
- When sedimentation is identified as the controlling process, the Sequoia National Forest shall modify its disturbance coefficients to include evaluation of sediment yield and transport. Where sedimentation is identified as a dominant earth-forming process by established criteria, the forest will identify erosional processes affecting sites as mentioned above. The forest will identify soil condition class and evaluate it together with erodability potential to give information on site conditions that address sediment yield.
- In determining ERAS for any given project, the forest shall state the assumptions that formed the basis for its calculation, including any modifications of standard ERA values that might have been made because of site-specific observations, and shall distinguish between existing and residual ERAS.
- Until such time as there is sufficient data to establish the recovery rate in a given watershed, the forest shall utilize a linear thirty-year recovery rate. However, the forest may use an exponential recovery rate instead of a linear recovery rate if the forest determines surface erosion to be the predominant hydrological process impacting the streams and can provide either references or on-site inventories to support these recovery rates.
- If a proposed project would increase ERAS to within 20 percent of the threshold of concern in a watershed, the forest will perform an on-site review to determine the actual recovery rates and to evaluate the effects of the proposed project: a) where field verification is impossible, the forest may assume a thirty-year recovery rate. b) where field verification is undertaken, the recovery rate should be based on a time trend in the ERA for management units. The ERA at any point in time is determined based on an on-site inspection of site conditions (percent cover, stand development, measure of soil disturbance, and compaction, development of erosion pavements, etc.), and a professional assessment of how these factors influence on-site generation of parameters of concern (peak flows, sediment, etc.). Factors used to judge the ERA for a site will be explicitly recorded and data sheets of site conditions (percent cover, etc.) will be maintained by the forest to allow for future changes in assessment relationships.

Alternative F

Alternative F would eliminate diameter limit constraints associated with vegetation management. Desired conditions would focus on resilient ecosystems adaptable to climate change. This alternative focuses on managing the Monument for ecosystem resiliency, adaptability to climate change, and heterogeneity. Objectives for hydrologic resources under Alternative F include:

1. During the life of the Monument Plan, inventory 10 percent of the perennial streams in 6th-field watersheds to determine existing condition.

2. During the life of the Monument Plan, assess meadows for hydrologic function and prioritize ecological restoration needs.
3. During the life of the Monument Plan, based on assessment, restore hydrologic function in priority meadows to enhance riparian habitat.

Alternative F would contain standards and guidelines from Alternative B.

Legal and Regulatory Compliance

Applicable to All Alternatives

The following executive orders and public laws apply to all alternatives listed within the Monument.

Clean Water Act of 1948 (as amended in 1972 and 1987) establishes as federal policy the control of point and non-point pollution and assigns the states the primary responsibility for control of water pollution. Compliance with the Clean Water Act by national forests in California is achieved under state law.

Non-point source pollution on National Forests is managed through the Regional Water Quality Management Plan (USDA Forest Service 2000), which relies on implementation of prescribed Best Management Practices.

The California Water Code consists of a comprehensive body of law that incorporates all State laws related to water, including water rights, water developments, and water quality. The laws related to water quality (Sections 13000 to 13485) apply to waters on the National Forests and are directed at protecting the beneficial uses of water.

The Porter-Cologne Water Quality Act, as amended in 2006, is included in the California Water Code. This act provides for the protection of water quality by the State Water Resources Control Board and the Regional Water Quality Control Boards, which are authorized by the U.S. Environmental Protection Agency to enforce the Clean Water Act in California.

National Soil Management Handbook: FSM 2500 Watershed and Air Management Chapter 2550, Soil Management, 11/23/2010. Manuel direction defining soil productivity and components of soil productivity, establishes guidance for measuring soil productivity, and establishes thresholds to assist in Forest planning.

Executive Orders 11988 and 11990 (Flood Plains and Wetlands) require federal agencies to avoid, to the extent possible, short- and long-term effects resulting from the occupancy and modification of flood plains, and the modification or destruction of wetlands. Standards and guidelines are provided for soil, water, wetlands, and riparian areas to minimize effects to flood plains and wetlands. They incorporate the Best Management Practices of the Soil and Water Conservation Handbook. The standards and guidelines apply to all floodplains and wetlands where less restrictive management might otherwise occur.

Organic Administration Act of 1897: "No national forest shall be established, except to improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States…"

Assumptions and Methodology

Ecological Restoration

Ecological Restoration is the process of assisting the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed. Restoration focuses on establishing the composition, structure, pattern, and ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and healthy under current and future conditions, USDA, 2010[13].

Degraded pertains to subtle or gradual changes that reduce ecological integrity and health. ***Damaged*** refers to acute and obvious changes in an ecosystem. An ecosystem is ***destroyed*** when severe degradation or damage removes all macroscopic life and drastically alters the physical environment as well, USDA, 2006[14].

Ecological Restoration for Riparian Ecotypes varies by ecotype, the degree of departure from stability/equilibrium, and amount of restoration necessary to regain proper hydrologic function. The following discussion provides a definition of what constitutes degradation, damage, or destruction for each ecotype; what hydrologic function is compromised and what level of restoration would be necessary to regain sustainable ecologic restoration by riparian ecotype.

Naturally-Stable

Naturally-Stable Ecotypes are inherently stable as they are predominately bedrock controlled. *These ecotypes are not directly influenced by land management activities, but can be affected by cumulative watershed impacts; therefore, ecological restoration is dependent on elimination of upstream sediment sources, off-site sediment sources, and non-point-source pollution reduction as long as the ecotype has not been destroyed.* Roads, trails, and other compacted sites such as campgrounds, administrative sites, and urbanized areas are associated with increases in runoff and sediment transport to adjacent stream systems. Proper drainage control, road maintenance, surface stabilization and treatment, controlling in-channel excavation, timely erosion control, and the implementation of soil and water conservations measures all reduce off-site sedimentation.

[13] USDA, 2010, FSM 2000, National Forest Resource Management Ch. 2020-Ecological Restoration and Resilience.

[14] USDA, 2006, Ecosystem Restoration: A Framework for Restoring and Maintaining the National Forests and Grasslands, Restoration Frame work Team: Day, Ken, Berg, Joy, Brown, Hutch, Crow, Tom, Morrison, Jim, Nowacki, Greg, Puckett, Greg, Sallee, Rod, Schenck, Ted, Wood, Bonnie, January 6, 2005, 24p.

Off-site and upstream sedimentation can result in degradation of the channel through its affect on aquatic habitats, specifically increases of fine material resulting in the clogging of pour spaces for aquatic insects and clogging of spawning gravels. Additional sedimentation can result in damage of the ecotype through physical channel changes affecting dissipation of stream energy and the streams ability to transport sediment. Without the ability of the stream to transport sediment the channel can no longer maintain channel characteristics and the main channel will begin to branch and develop mid-channel bars and islands, aquatic habitat is diminished along with a reduction in the ability of the channel to provide habitat for aquatic organisms. Compromised functions associated with destruction of the ecotype include: clogged spawning gravel, filling of pore spaces, filling of pools, reduction of pool depth, and changes in water chemistry. Continued sediment accumulation can result destruction all physical characteristic associated with a Naturally-Stable riparian ecotype causing a transition to a non functional Unstable-Sensitive-Degraded ecotype. The destruction of the ecotype results in a braided channel characterized by high sediment loads, excessive deposition, decreased gradient, high velocity and flashy flows with high flooding potential. These systems are incapable of supporting aquatic species and may require active on-site restoration to restore the ecosystem. The following summarizes features, compromised function, and level of restoration associated with varying levels of damage for Naturally-Stable ecotypes (Table 102).

Table 102 - Features, Function and Level of Restoration associated by Damage to Naturally-Stable Ecotypes

Level of Damage	Features associated with Disturbance	Compromised Function	Level of Restoration
Degraded	• Increased fine material in substrate. • Bimodal distribution of bed material	• Ability to provide habitat for aquatic organism	• Off-site reduction of sediment associated with roads, trails, campgrounds, dispersed recreational sites and other facilities
Damaged	• Clogging of spawning gravels • Clogging of pore spaces in substrate • Filling of pools and reduction of pool depth • Increases in stream temperature • Decrease in Dissolved Oxygen • Main channel branching with the formation of numerous mid-channel bar and islands	• Ability to provide habitat for aquatic organism • Dissipation of stream energy • Sediment transport • Maintenance of channel characteristics	• Off-site reduction of sediment associated with roads, trails, campgrounds, dispersed recreational sites and other facilities
Destroyed	• Change in stream channel pattern, profile and dimension	• Ability to provide habitat for aquatic organism	• Off-site reduction of sediment associated with

	from pool riffle system to braided channel[15] • Change from Naturally-Stable to Unstable-Sensitive-Degraded ecotype • Increases in stream temperature • Decrease in dissolved oxygen	• Dissipation of stream energy • Sediment transport • Maintenance of channel characteristics • Floodplain development	roads, trails, campgrounds, dispersed recreational sites and other facilities. Active on-site restoration may be required to restore pre damaged conditions.

Stable-Sensitive

Stable-Sensitive ecotypes are inherently stable dominated by moderately fine to fine streambed material and represent meadow environments. This ecotype is easily influenced by land management activity and very susceptible to disturbance. *Ecological restoration is dependent on re-establishing critical elements associated with ecosystem stability and function. Critical elements associated with ecosystem stability and function in Stable-Sensitive ecotypes includes sediment transport, vegetative bank protection, and streambank stability. Ecological restoration for Stable-Sensitive ecotypes focuses on the removal of the cause of disturbance. Because the nature of this ecotype is so sensitive as long as the channel in this ecotype remains in contact with its floodplain restoration most likely can be addressed by a change in management activity or offsite restoration to restore ecosystem function and stability.* The need for restoration may be associated with on-site and/or off-site disturbances and could include reduction in runoff and sediment discharge from roads and other compacted surfaces; change in grazing practices; or control of dispersed recreation sites. The level of damage is associated with the amount and level of disturbance required to restore the ecotype.

Stable-Sensitive ecotypes are dependent on good sediment transport, bank stability and vegetative bank protection. These three elements are inter-related and the failure of one element could lead to failure of the others resulting in a degraded system. However if the ecosystem is still functional and flood flows are able to access the floodplain, then restoration is usually simple and a change in management could restore the system.

Damage to the system may occur if all three of the elements are affected. Once channel banks lose vegetation, begin to erode, and add sediment to the system the channel begins to laterally erode this may ultimately lead to evolution of the channel[16] which is associated with a vertically eroded system that is partially to completely entrenched. While stream flood flows are able to connect with a portion or all of the floodplain the system would be considered damaged. Restoration requires identification and elimination of the cause of initial degradation in addition to restoration of the resultant damage which may require more than a change in management activity or reduction in sediment.

[15] A/B boulder/bedrock-controlled channels are environments where pool function could be compromised, and braiding may be unlikely. B/C channels with finer substrates represent environments are more susceptible to a change in pattern, profile, and dimension.

[16] Stream channel evolution is a change associated with meander shoot cut off, vertical erosion, decreased stream length, increased velocity and increased erosion.

Once the system has evolved from a meandering low gradient Stable-Sensitive ecotype to a gully in a meadow at the bottom of which is a channel that can no longer access its floodplain the ecotype is destroyed. The ecotype has transitioned to an Unstable-Sensitive-Degraded ecotype which will not naturally recover until lateral erosion has developed a floodplain at a lower elevation and of sufficient width to allow development of meanders, point bars, and floodplains. The meadow habitat will be abandoned, water table drained, and habitat and species destroyed. Restoration of the destroyed ecotype would include reestablishment of the original floodplain and ecological stream function requiring ground disturbing activity. The following summarizes features, compromised function, and level of restoration associated with varying levels of damage for Stable-Sensitive ecotypes (Table 103).

Table 103 - Features, Function and Level of Restoration associated by Damage to Stable-Sensitive Ecotypes			
Level of Damage	Features associated with Disturbance	Compromised Function	Level of Restoration
Degraded	• Development of mid-channel bars, or • Stream bank erosion, or • Decrease in stream bank vegetation	• Ability to provide habitat for aquatic organism • Dissipation of stream energy • Sediment filtering and transport • Stabilization of streambanks	• Change in management activity to restore function
Damaged	• Development of mid-channel bars, and • Stream bank erosion, and • Decrease in stream bank vegetation • Reduction in sinuosity • Down cutting of channel • Partial entrenchment of channel	• Ability to provide habitat for aquatic organism • Dissipation of stream energy • Sediment filtering and transport • Stabilization of streambanks	• Change in management activity to restore function and active restoration to stabilize and maintain ecologic function.
Destroyed	• Extensive vertical erosion • Extensive entrenchment of stream channel • Disconnection of stream flows onto floodplain • Change in stream pattern, profile, and dimension from Stable-Sensitive ecotype to Unstable-Sensitive-Degraded. • Change in wetland vegetation to dry upland species • Extensive erosion and high stress in the near-bank region	• Ability to provide habitat for aquatic organism • Dissipation of stream energy • Sediment filtering and transport • Stabilization of streambanks • Maintenance of channel characteristics • Ground water recharge • Floodplain development • Loss of riparian habitat and riparian vegetative buffer	• Change in management activity to restore function in addition to active restoration to restore characteristics associated with meadow function. Floodplain active reconstruction associated with restoration of abandoned floodplain and ecological stream function.

Unstable-Sensitive-Degraded[17]

Unstable-Sensitive-Degraded ecotypes represent the destroyed form of Stable-Sensitive ecotypes (gullies in meadows) or destroyed form of Naturally-Stable ecotypes (accelerated sediment deposition creating a braided stream). *Ecological restoration of these ecotypes includes identification of the initial problem responsible for the degradation/damage of the ecotype and restoration of hydrologic function through restoration of habitat, pattern, dimension, and profile of the stable form of the destroyed ecotype.* As this ecotype occurs as a result of a destroyed system there is no damaged or degraded level of damage. Description of the destroyed ecotype has been previously discussed. The following summarizes features, compromised function, and level of restoration associated with varying levels of damage for Unstable-Stable-Degraded ecotypes (Table 104).

Table 104 - Features, Function and Level of Restoration associated by Damage to Unstable-Sensitive-Degraded Ecotypes

Level of Damage	Features associated with Disturbance	Compromised Function	Level of Restoration
Degraded	NA	NA	NA
Damaged	NA	NA	NA
Destroyed	• Continued downward trend: • Extensive vertical erosion • Extensive entrenchment of stream channel • Extensive erosion and high shear stress in the near-bank region • High sediment loads • Excessive deposition	• Ability to provide habitat for aquatic organism • Dissipation of stream energy • Sediment transport • Stabilization of streambanks • Maintenance of channel characteristics • Floodplain development	• Active restoration to restore characteristics associated with meadow function. Floodplain active reconstruction associated with restoration of abandoned floodplain and ecological stream function. • Reduction in offsite sedimentation through drainage improvements and reduction of compacted surfaces.

Naturally-Unstable

The Naturally-Unstable ecotype is typically eroded, steep, and unstable and is associated with debris avalanche or landslide terrain. These environments are extremely sensitive to disturbance. *Ecological restoration of this ecotype is impossible due to their steep nature, very poor recovery potential, very high sediment supply, and negligible influence of vegetation for erosion control. The best restoration of these ecotypes is to avoid or minimize disturbance.*

Use of Science

[17] The term degraded to describe riparian ecotypes was used prior to its use in the publication discussing ecological restoration. Degraded as used for disturbance of this ecotype would equate to Damaged or Destroyed in USDA, 2006, Ecosystem Restoration: A Framework for Restoring and Maintaining the National Forests and Grasslands.

Science Advisory Board (SAB) stated the watershed analysis could be improved by expanding the analysis to include recreation (Scientific Advisory Board, 2003). The cumulative watershed effects (CWE) analysis includes recreation impacts as part of the analysis process for a watershed. The same analysis would be used for site specific project level NEPA to determine if a project would put a watershed over threshold. Detailed information on the CWE process can be read in the Cumulative Effects section of the hydrologic resources report or summarized in volume 1, Chapter 4, of the FEIS.

Stream Condition Inventory (SCI) was used to collect intensive and repeatable data from stream reaches to document existing stream condition and make reliable comparisons over time within or between stream reaches. SCI is therefore an inventory and monitoring program. It is designed to assess effectiveness of management actions on streams in managed watersheds (non-reference streams), as well as to document stream conditions over time in watersheds with little or no past management or that have recovered from historic management effects (Frazier, et al., 2005). SCI was used to develop additional[18] standard and guidelines[19] for the Monument as well as determine ranges in natural variability per watershed. Chapter 3, Affected Environment, Volume 1 of the FEIS summarizes the ranges in natural variability per watershed. More detailed information can be read in the Affected Environment section of the hydrologic resources specialist report.

Science Considered

The most current and applicable science was considered and used in the hydrologic resources sections of the Giant Sequoia National Monument FEIS. Examples include Bergs and Azuma, 2008, Fraizer et. al, 2005, Goudie, 2006, and Kaplan-Henry, 2007. A full list of the sciences used can be read in the literature cited section of the FEIS and/or reference section in the hydrologic resources specialist report.

Assumptions for All Alternatives

The Giant Sequoia National Monument management plan would continue to follow currents laws, regulations, and agreements regarding hydrologic resources. Proposed future management activity associated with fuels management and ecological restorationwould be recognize threshold of concerns at the project level. Management actions and decisions would be made to balance need for treatment to maintain ecological condition, Protection of Objects of Interest in addition to aquatic habitat and water quality.

Each alternative contains objectives for the Monument plan. It is assumed the objectives for hydrologic resources would be obtained if adequate time, finances, and resources are available during the extent of the Monument plan. Determination of where ecological restoration is needed will be based on site-specific analysis. Natural and land management disturbances would be analyzed using Sequoia National Forest Cumulative Watershed Effects Analysis Guide (Kaplan-Henry and Machado 1991) during project level analysis. Current watershed conditions are further discussed in the Cumulative Effects Analysis for this document.

Forest Service regulations and agreements would be followed, mitigations would be implemented, and monitoring would be performed to minimize potential effects from land management activities. Land

[18] Including and adding to the Sierra Nevada Forest Plan Amendment 2004 standard and guidelines.
[19] Monument specific standards and guidelines can be found in alternatives B, C, E, and F.

management activities include, but are not limited to, fuels reduction, vegetation management, grazing, maintenance of infrastructure, and recreation use.

Assumptions for Alternative A

The No Action Alternative, Alternative A, follows existing management direction from the sources described in Chapter 2 of this FEIS. Specific to hydrologic resources are the:

- Riparian and Wetland Standard and Guidelines from the 1990 MSA,
- Aquatic Management Strategy Goals (AMS) from 2001/2004 SNFPA which include:
    - Riparian Conservations Areas (RCAs),
    - Critical Aquatic Refuges (CARs), and
    - Riparian Conservations Objectives (RCOs).

Assumptions for Alternative B

- Alternative B follows the 2001/2004 SNFPA strategies, objectives, and standards and guidelines for the Riparian Conservation Objectives (RCOs), including Monument-specific standards and guidelines.
- Zones of Influence (ZOIs) established around the giant sequoia groves are included to ensure that key ecological processes, structures, and functions are considered and evaluated during project planning.

Assumptions for Alternative C

- Alternative C manages the Monument similar to Sequoia and Kings Canyon National Parks (SEKI). It makes use of the 2001/2004 SNFPA strategies, objectives, and standards and guidelines for the Riparian Conservation Objectives (RCOs), as well as Monument-specific standards and guidelines..
- Streamside management zones (SMZs) would be used to protect riparian areas, rather than the critical aquatic refuges (CARs), riparian conservation areas (RCAs), and the associated riparian conservation objectives (RCOs).
- Management activities would be restricted to recreation sites, administrative sites, and wildland urban intermix (WUI) zones.

Assumptions for Alternative D

- Under Alternative D management of hydrological resources would be limited to WUI defense zones.
- The remainder of the Monument would be managed to let natural processes occur with little to no intervention.
- Restoration efforts would not occur, as natural processes are expected to return resource to a stable condition.

Assumptions for Alternative E

- Alternative E follows management direction in the 1988 Forest Plan and the 1990 MSA.
- The MSA's Riparian and Wetland Standards and Guidelines are used to maintain and protect

hydrologic resources in terms of streambank stability, vegetative cover, stream surface shade, interception of sediment, streamside management zone designation, meadow hydrology, forage utilization, and woody and herbaceous vegetation in riparian and wetland ecosystems.

Assumptions for Alternative F

- Alternative F follows the 2004 SNFPA strategies, objectives, and standards and guidelines for the Riparian Conservation Objectives (RCOs), as well as Monument-specific standards and guidelines.
- Zones of Influence (ZOIs) established around the giant sequoia groves are included to ensure that key ecological processes, structures, and functions are evaluated during land management planning.

Methodology

Pacific Southwest Region Stream Condition Inventory

The purpose of the Pacific Southwest Region Stream Condition Inventory (SCI) is to collect intensive and repeatable data from stream reaches to document existing stream condition and make reliable comparisons over time within or between stream reaches. SCI is therefore an inventory and monitoring program. It is designed to assess effectiveness of management actions on streams in managed watersheds (non-reference streams), as well as to document stream conditions over time in watersheds with little or no past management or that have recovered from historic management effects (Frazier, et al., 2005).

Stream Condition Inventory (SCI) plots have been established at various sites within the monument. SCI plots monitor chemical, physical and biological stream features, or attributes, that are useful in classifying channels, evaluating the condition of stream morphology and aquatic habitat, and making inferences about water quality (Frazier et. al., 2005). SCI data provides a basis for evaluation of pre and post project conditions. These ranges were included into Standards and Guidelines for certain alternatives to further protect aquatic resources (i.e. alternatives B, C, D, and F).

Rating Alternatives

The alternative that best protects hydrologic resources was determined by evaluating the management and direction proposed in an alternative. For example, Alternative B was better at protecting hydrologic resources than Alternative C due elimination of RCA and CAR land allocations in Alternative Cwhich would reduce the effectiveness of the AMS strategy to protect identified species.

Cumulative Watershed Effects Analysis

The Council on Environmental Quality issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." The cumulative effects analysis in this EIS is consistent with the National Environmental Policy Act (NEPA) Regulations (36 CFR 220.4 (f)) (July 24, 2008), which state, in part:

CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalog or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making (40 CFR 1508.7). Cumulative watershed effects analysis has attempted to include all past present and reasonably foreseeable activities at the seventh field HUC in 2009 and combine this information with remaining treatment ERAs to provide a multi-scale analysis to be evaluated as a “budget” of available treatment acres and ERAs at the sixth field HUC. Current watershed conditions are discussed in the Cumulative Watershed Effects Analysis section below.

Riparian Ecotypes

Channels in the monument have been grouped into riparian ecotypes and assigned an impact level following a protocol established by Kaplan-Henry in 2007. Determination of riparian ecotype is based on how a stream type responds to natural events and land management activity. Level of impact is assigned to riparian ecotypes based on the number of environmental indicators (associated with that ecotype) not considered to meet criteria for good to excellent stream stability conditions as defined by Pfankuch, 1995. Key indicators used to rank impact level include 1) vegetative bank protection, 2) streambank cutting, 3) channel bottom deposition, 4) scour and deposition, and 5) bottom size distribution and percent stable material.

Indirect Effects

All Alternatives

Alternative A through F vary in the type of management activities and land uses allowed within the Monument. Land management activities or land uses such as, grazing, prescribed fire, vegetation management, and/or stream restoration would have a positive and/or negative effect on the watersheds within the Monument. How much of an effect depends on the location, duration, and timing of the management activity or land use in a watershed. Watershed responds differently due to their geology, vegetation, topography, soil, and local climate.

Alternatives that adopt the Aquatic Management Strategy (AMS) direction as outlined in both the 2001 and 2004 SNFPA, propose similar levels of treatment in each watershed, are not expected to have any effects on aquatic resources at the programmatic level. Analysis of site-specific treatments at the project level would be necessary to identify potential effects to water quality and riparian-dependent resources. Adopting the AMS is expected to:

- Maintain and restore water quality to meet the goals of the Clean Water Act and the Safe Drinking Water Act, providing water that is fishable, swimmable, and suitable for drinking after normal treatment.
- Maintain and restore habitat to support viable populations of native and desired non-native plant, invertebrate and vertebrate riparian-dependent species.
- Maintain and restore the species composition and structural diversity of plant and animal communities in riparian areas, wetlands, and meadows to provide desired habitats and ecological functions.
- Maintain and restore the distribution and health of biotic communities in special aquatic habitats (such as springs, seeps, vernal pools, fens, bogs, and marshes) to perpetuate their unique functions and biological diversity (USDA Forest Service 2004f, pp. 32-33).

All alternatives are not expected to affect existing water rights. All current water rights and uses would be maintained in accordance with state and federal laws and regulations.

Alternative A

Alternative A provides less protection for hydrologic resources than Alternatives B and F and more protection than Alternatives C, E, and D. Alternatives A adopts standards and guidelines from the 2001/2004 Sierra Nevada Forest Plan Amendment (SNFPA) and would implement the 2001 and 2004 SNFPA AMS direction which includes RCA and CAR land allocations, Riparian Conservation Objectives (RCOs) and associated standards and guidelines. Alternative A does not include refined standards and guidelines (S&Gs) developed specifically in response to conditions on Monument watersheds. Examples are ranges in natural variability for riparian conditions, water quality, and meadow restoration strategies. Elimination of S&G's developed to specific conditions associated with monument watersheds reduces the effectiveness of this alternatibe to provide protection for water quality, riparian habitat, and species, and ability to acheieve desired conditions.

Alternative B

Alternative B provides the best protection for hydrologic resources. This alternative is similar to Alternative A in that it recognizes the AMS defined in both the 2001 and 2004 SNFPA including RCOs, associated standards and guidelines tailor suited to monument watersheds and CAR and RCA land allocations. Alternative B provides the best protection of water quality, riparian habitat conditions, and the highest potential to meet desired conditions.

Alternative C

Alternative C provides less protection to hydrologic resources than Alternative A and more protection than Alternatives E and D. While this alternative includes a portion of the SNFP AMS it eliminates allocations associated with Critical Aquatic Refuges (CARs) and Riparian Conservation Areas (RCAs) and as such fails to meet desired conditions associated with providing habitat conditions that support riparian and aquatic dependent species. While SMZs are still included as a soil and water protection measure the objective of these zones are not intended to do more than exclude equipment from riparian areas and act as a filter strip to trap sediment and keep it from reaching the streamcourse. RCOs and CARs provide and opportunity to development a management this for water quality, riparian habitat and aquatic dependent species. Furthermore the opportunity to develop standards and guidelines commensurate with local watershed conditions is not included in this alternative.

Alternative D

Alternative D provides the least protection to hydrologic resources. This alternative does not contain AMS defined in both the 2001 and 2004 SNFPA including RCOs, associated standards and RCO/CAR land allocations for riparian and aquatic dependent resources nor would it meet desired conditions associated with the AMS. Alternative D would be unable to treat the landscape with the objective of control ling wildfires in riparian and wetland areas. Much of the landscape monument watersheds has conditions outside the natural range of variability for fire return intervals. Inability to control wildfires in watersheds could lead to increases in sediment; impacts to riparian dependent species; detrimental impacts to water quality; inability to protect soil and water resources and large woody material; inability to maintain shade and water temperatures; resulting in an inability to protect water quality, riparian habitat and aquatic species.

Alternative E

Alternative E provides more protection to hydrologic resources than D and less than Alternatives A, B, C, and F. This alternative adopts the standards and guidelines under the 1988 Land Management Plan (LRMP) and 1990 Mediated Settlement Agreement (MSA). While these documents were scientifically valid at the time, they lack the value of monitoring and current knowledge associated with SNFPA and subsequent monitoring over the last twenty one years. The lack of current knowledge and value for monitoring reduces for the effectiveness of this alternative in achieving desired conditions.

Alternative F

Alternative F provides the best protection for hydrologic resources as does Alternative B. Alternative F deviates from other alternatives based on diameter limits, which have no effect on the ability to manage vegetation in a manner consistent with RCOs and would not compromise water quality or riparian dependent species.

Alternative Outcomes for Hydrologic Resources

The following table summarizes what alternative provides the best protection for aquatic systems while moving towards desired conditions (Table 104). Rankings were based on a hydrology perspective and rationale is in the previous paragraphs.

Table 104 Alternatives and Hydrologic Resource Protection Rankings

Alternative	Protection of aquatic habitat and riparian dependent species.	Achieving Desired Conditions
B and F	High	Best
A	Moderate-High	Better
C	Moderate	Good
E	Low	Fair
D	Minimal	Poor

Cumulative Effects

Treatments identified in this document have the potential to affect multiple watersheds, which support numerous beneficial uses. “A watershed is a natural management unit for evaluating the physical and social consequences of management decisions” (Scientific Advisory Board 2003). Because this document proposes numerous projects at differing scales from basin-wide fuel treatments to installation of recreational facilities that have a localized affect, the scale of the action under consideration would define the watershed scale of analysis.

The forest's Cumulative Watershed Effects (CWE) methodology quantifies the effects of past, present, and reasonably foreseeable future management activities. The threshold of concern (TOC) is defined as an indicator of the potential for management activities to affect water quality and or watershed stability and ultimately affect beneficial uses. The TOC is a level based on an individual subwatersheds ability to resist change. When the TOC is exceeded, the potential to affect water quality, stream stability, riparian habitat, and beneficial uses increases. TOC would vary by watershed scale and prescribed treatment. Thus the TOC provides a quantification of the potential of a watersheds tolerance for disturbance. Once this level is approached, a more rigorous, field-based, analysis is required prior to management activity.

The CWE analysis is the primary element of determining the effect of management activities on watersheds. This takes place at the project level, as the location of the activity is site specific to the affected watershed. The CWE model focuses on the impacts of ground disturbing activities. It includes quantification of fuel treatment methods including prescribed fire and wildfire. Because prescribed fire treatments take place at the HUC 6th-field watershed scale, the effects of this action should be evaluated at the same scale.

The CWE methodology will be used as a basis for predicting the effects of all activities, including recreation, on watersheds. This would occur during project level analysis. The current CWE analysis considers sediment transport, which is the process of concern relative to ground disturbing activities including fuels and fire management. Chemical water quality in association with recreation development has the potential for CWE. As long as water quality is considered in the development of recreation facilities and Best Management Practices are implemented and effective, the potential for CWE would be low. Mitigation would focus on maintaining potential pollutants on-site and monitoring would evaluate effectiveness of treatment. “Restoration of existing water quality impairment from recreation facilities would be considered in conjunction with management plans for expanded recreational use during project level analysis” (Scientific Advisory Board 2003).

Urbanized areas currently have had the highest potential to affect water quality resources and beneficial uses as a result of the high density of compacted areas including roads. Additionally, these areas pose the greatest threat from wildfires, as there is the greatest potential for loss of life, property, and resources. Therefore, these areas are the highest priority for fuels reduction treatments. Urbanized areas typically have the greatest effect on watersheds placing them closest to or exceeding the threshold of concern.

Management activities in the Monument would likely lead to further exceedance of TOC for HUC 7 field watersheds close to or currently over TOC. Of particular concern for fuels treatment, are the urban interface zones, where HUC 7 field watersheds currently at or near the TOC would be the focus of greater fuels management. Of concern for recreation, is increased use and development of already developed areas, where HUC 7 field watersheds are already at or near the TOC(Scientific Advisory Board 2003).

HUC 7 field watersheds over 80 percent TOC as a result of the high density of compacted sites such as roads, recreation and facilities are included in the following table.

Proposed Treatment Acres in HUC 7 field watersheds with % TOC Used greater than 80%.

HUC 7 Watershed	Existing %TOC Used	Watershed Acres
Spear Creek (5A-C)	84.6	1469
Pup Meadow (18DG)	90.4	897

Von Hellum Creek watershed (5A-D) uses over 80 percent of the TOC. The Panorama Heights community resides within the watershed and is contributing most of the disturbance. Homes, roads, and roads crossing streams are the sources. CWE analysis discovered past projects only account for approximately 4 percent of the TOC used.

Pup Meadow watershed (18DG) uses over 90 percent of the TOC. CWE analysis discovered past projects from the late 1980s to late 1990s are the result. Any possible future projects within the watershed will be analyzed to determine the extent of impact to the watershed.

These watersheds have a higher potential for cumulative watershed effects and need to be closely managed during project level implementation. Mitigation measures specific to projects and affected watersheds would be developed during project level environmental analysis. Additionally, these watersheds and any other watershed of special concern would need to be closely monitored for effects.

Cumulative Watershed Effects (CWE) analysis is spatial and temporal. Actual treatment at the project level would focus on potential effects in watersheds affected by specific projects; scale, intensity, timing, and extent of past management activities including vegetation management, campgrounds, facilities, and roads have the potential to effect riparian health, soil and water quality. Actual locations of treatments cannot be provided at the programmatic level. Cumulative watershed effects would be evaluated at the appropriate watershed scale during project level analysis. The hierarchical framework of ecosystem analysis would facilitate cumulative effects analysis by providing information across multiple scales.

Detailed Cumulative Watershed Effects (CWE) analysis would be performed at the project level. Therefore the CWE analysis for the Monument Plan provides a multi-scale CWE review at the HUC 7 and HUC 6 watershed scale. The Monument occupies a small percentage of affected HUC 5 watersheds;

therefore, CWE analysis has not been provided at this scale. HUC 7 watersheds range in size from roughly 200 to 3,500 acres with an average size of 1,500 acres. HUC 6 watersheds are larger than HUC 7 watersheds and range in size from 10,000 to 34,000 acres with an average of 21,000 acres. Threshold levels are based on watershed size and the sensitivity of the watershed.

Sensitivity is ranked high, moderate, and low and is a function of six physical characteristics of the watershed that include soil, topography, climate, geology, vegetation, and channel condition (Kaplan-Henry and Machado 1991). High, moderate, and low sensitivity designations for watersheds yield estimated roaded acres (ERAs) available for management of 3 percent, 4 percent, and 5 percent of the watershed acreage based on the watershed conditions. The following table displays ERAs available for management in addition to existing condition or percent of TOC used from past and present activity at the HUC 7 watershed scale.

Table 105 Cumulative Watershed Effects Analysis for HUC 7 Watersheds Showing 2009 Existing Condition

1803001003 Lower South Fork Kings River						
7th Field Watershed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
SFK KINGS RIVER	2A-B	1820.0	0.0	54.6	54.6	0.0
UNNAMED	2A-C	1421.0	9.4	56.8	47.4	16.6
UNNAMED	2A-D	2333.0	12.9	93.3	80.4	13.8
UNNAMED	2A-E	1022.0	0.0	30.7	30.7	0.0
UNNAMED	2B-A	602.0	2.2	24.1	21.9	9.1
UNNAMED	2B-B	729.0	6.9	29.2	22.3	23.7
UNNAMED	2B-C	1202.0	11.9	48.1	36.2	24.8
BOULDER CREEK	2C-A	1999.0	12.1	80.0	67.9	15.1
N.FORK BIG MDWS	2D-A	610.0	0.0	18.3	18.3	0.0
S.FORK BIG MDWS	2D-B	810.0	6.9	24.3	17.4	28.5
POISON CREEK	2D-C	523.0	5.9	20.9	15.0	28.3
WEAVER CREEK	2D-D	1037.0	4.7	41.5	36.8	11.3
FOX MEADOW CK	2D-E	3210.0	27.1	96.3	69.3	28.1
BIG MEADOWS	2D-F	873.0	14.3	26.2	11.9	54.6
EVANS CREEK	2E-A	965.0	0.0	38.6	38.6	0.0
RATTLESNAKE CREEK	2E-B	304.0	0.0	12.2	12.2	0.0
FOOTMAN CANYON	2E-C	1440.0	0.0	57.6	57.6	0.0
KENNEDY MEADOW	2E-D	1154.0	5.3	46.2	41.0	11.4
BUCK ROCK CREEK	2E-E	2904.0	62.9	116.2	53.3	54.1
UNNAMED	2E-F	840.0	23.1	33.6	10.5	68.8
BOULDER CREEK	2E-G	1058.0	15.0	42.3	27.3	35.4
REDWOOD CREEK	2F-B	1675.0	0.0	50.3	50.3	0.0
LOCKWOOD CREEK	2F-C	635.0	0.0	19.1	19.1	0.0

WINDY GULCH	2F-D	879.0	0.0	26.4	26.4	0.0
UNNAMED	2F-E	231.0	0.0	6.9	6.9	0.0
UNNAMED	2G-F	654.0	0.0	19.6	19.6	0.0

1803001005 Converse-Mill flat Creek

7th Field Sub-shed		Acres	Existing Condition	TOC	ERA's Available	%TOC used
INDIAN CREEK	1G-A	3767.0	34.5	150.7	116.2	22.9
LONG MEADOW	1G-B	3653.0	31.2	146.1	114.9	21.4
UNNAMED	1G-C	639.0	4.4	25.6	21.1	17.3
BEARSKIN	1G-D	2332.0	12.2	116.6	104.4	10.4
TEN MILE TRIBUT	1G-E	767.0	4.7	30.7	26.0	15.4
TEN MILE CREEK	1G-F	3683.0	40.5	184.1	143.6	22.0
LANDSLIDE CREEK	1G-G	2768.0	18.3	110.7	92.4	16.5
TORNADO CREEK	1G-H	2312.0	22.7	42.5	19.8	53.3
BARTONS RESORT	1G-I	1268.0	2.4	38.0	35.7	6.2
CABIN CREEK	1F-A	746.0	0.0	22.4	22.4	0.0
UNNAMED	1F-B	1557.0	0.0	62.3	62.3	0.0
UNNAMED	1F-C	576.0	0.0	17.3	17.3	0.0
UNNAMED	1E-A	862.0	0.0	25.9	25.9	0.0
UNNAMED	1E-B	697.0	0.0	27.9	27.9	0.0
CONVERSE CREEK	1E-C	1362.0	0.0	68.1	68.1	0.0
CONVERSE CREEK	1E-D	1299.0	0.0	39.0	39.0	0.0
UNNAMED	1E-E	815.0	0.0	24.5	24.5	0.0
CONVERSE CREEK	1E-F	1473.0	0.0	58.9	58.9	0.0
VERPLANK CREEK	1D-A	2748.0	0.0	82.4	82.4	0.0
UNNAMED	1D-B	711.0	0.0	21.3	21.3	0.0
UNNAMED	1D-C	462.0	0.0	13.9	13.9	0.0
MILL FLAT CREEK	1C-A	2989.0	13.4	119.6	106.2	11.2
UNNAMED	1C-B	1003.0	0.0	40.1	40.1	0.0
MILL FLAT CREEK	1C-C	879.0	11.5	35.2	23.7	32.6
UNNAMED	1C-D	1259.0	0.0	37.8	37.8	0.0
UNNAMED	1C-E	882.0	0.0	35.3	35.3	0.0
UPPER ABBOTT	1C-F	1283.0	17.8	64.2	46.4	27.7
ABBOTT CREEK	1C-G	1433.0	9.5	43.0	33.5	22.2
UNNAMED	1C-H	1022.0	14.7	30.7	16.0	47.8
SEQUOIA CREEK	1C-I	1836.0	0.0	91.8	91.8	0.0
MILL FLAT CREEK	1C-J	1388.0	16.0	55.5	39.5	28.8
MILL FLAT CREEK	1C-K	1042.0	30.2	41.7	11.5	72.3
UNNAMED	1C-L	897.0	0.0	35.9	35.9	0.0
DAVIS CREEK	1B-A	705.0	0.0	21.2	21.2	0.0
UNNAMED	1B-C	1192.0	8.9	59.6	50.7	14.9
UNNAMED	1B-D	3250.0	20.1	130.0	109.9	15.5
DAVIS CREEK	1B-E	3430.0	0.0	102.9	102.9	0.0
MILL FLAT CREEK	1B-F	658.0	0.0	19.7	19.7	0.0
UNNAMED	1B-G	1481.0	13.6	74.0	60.4	18.4
UNNAMED	1B-I	3672.0	9.5	146.9	137.5	6.4
UNNAMED	1B-H	525.0	0.0	15.7	15.7	0.0

1803000105 Middle Kern River

7th Field Sub-shed		Acres	Existing Condition	TOC	ERA's Available	%TOC used
FREEMAN CREEK	8AA	1782.0	4.1	71.3	67.2	5.8
TRIB TO FREEMAN	8AB	1271.0	0.6	50.8	50.2	1.2
LLOYD MDW CK	8AC	3823.0	25.0	152.9	127.9	16.3
TRIB TO FREEMAN	8AD	1546.0	1.7	61.8	60.1	2.8
UNNAMED TRIB	8AF	813.0	0.9	32.5	31.6	2.9
UNNAMED	8AG	364.0	0.3	14.6	14.3	1.8
NEEDLE ROCK CK	8BA	2093.0	17.8	83.7	65.9	21.2
TRIB TO KERN	8BB	870.0	2.1	34.8	32.7	6.1
TRIB TO KERN	8BC	628.0	4.0	25.1	21.1	16.0
HOLBY CREEK	8CA	2957.0	87.8	118.3	30.5	74.2
UP PEPPERMINT CR	8CB	2698.0	3.8	107.9	104.1	3.5
PEPPERMINT MDW	8CC	1870.0	11.9	56.1	44.3	21.1
LOWER PEPPERMINT	8CD	1723.0	10.5	51.7	41.2	20.3
MDL PEPPERMINT	8CE	1070.0	0.0	32.1	32.1	0.0
HORSE CANYON	8GA	1245.0	29.1	49.8	20.8	58.3
DOME CREEK	8GB	781.0	15.8	31.2	15.4	50.6
UPPPER ALDER CK	8GD	1039.0	7.8	41.6	33.8	18.7
LOWER ALDER CK	8GE	1308.0	26.0	52.3	26.3	49.7
UP DRY MEADOW	8GF	1016.0	0.8	30.5	29.7	2.7
MDL DRY MEADOW	8GG	2737.0	5.4	82.1	76.7	6.6
UNNAMED	8GH	711.0	0.0	21.5	21.5	0.0
UNNAMED	8GI	781.0	0.7	23.4	22.8	2.8
UNNAMED	8GJ	207.0	0.0	6.2	6.2	0.0
LOWER DRY MDW	8GK	577.0	2.9	17.3	14.4	16.8
UNNAMED	8GL	774.0	0.0	23.2	23.2	0.0
UPPER NOBE YOUN	8HA	2682.0	30.0	107.3	77.3	28.0
LAST CHANCE MDW	8HB	1203.0	14.3	48.1	33.9	29.6
UPPER BONE CK	8HC	2086.0	32.2	83.4	51.2	38.6
LONG MEADOW CK	8HD	2419.0	26.8	96.8	70.0	27.7
MIDDLE NOBE YON	8HF	1505.0	20.8	45.2	24.4	46.0
LOWER NOBE YOUG	8HG	1933.0	10.5	77.3	66.8	13.6
HORSE MEADOW CK	8IA	1108.0	1.1	44.3	43.3	2.4
PARKER MEADOW C	8IB	803.0	2.6	32.1	29.5	8.1
PARKER MDW CK	8IC	3157.0	9.7	126.3	116.6	7.7
DOUBLEBUNK CK	8ID	1151.0	13.1	46.0	33.0	28.4
BEAR CREEK	8IE	549.0	0.2	22.0	21.7	1.1
PACKSADDLE CK	8IF	830.0	0.3	33.2	32.9	1.0
UNNAMED	8IG	1244.0	0.2	49.8	49.5	0.5
MIDDLE BEAR CK	8IH	1055.0	6.1	42.2	36.1	14.4
MILL CREEK	8II	1433.0	20.2	43.0	22.8	46.9
UPPER SOUTH CK	8IJ	614.0	3.1	18.4	15.3	17.0
MIDDLE SOUTH CK	8IL	1015.0	6.5	40.6	34.1	16.0
UNNAMED	8IM	573.0	0.0	22.9	22.9	0.0
LOWER SOUTH CK	8IN	1221.0	22.4	36.6	14.2	61.3
N. FORK CLICKS	7CA	1850.0	2.1	55.5	53.4	3.7
HEADWATERS CLIC	7CB	2847.0	11.6	113.9	102.2	10.2
UPPER FISH CK	7BJ	1492.0	1.4	74.6	73.2	1.9

1803000401 Upper Poso						
7th Field Sub-shed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
UNNAMED	5AA	1204.0	17.6	48.2	30.6	36.6
UNNAMED	5AB	450.0	7.0	18.0	11.1	38.6
SPEAR CREEK	5AC	3161.0	69.4	126.4	57.1	54.8
VON HELLUM	5AD	1469.0	49.7	58.8	9.0	84.6
PEEL MILL CREEK	5AE	2407.0	14.1	96.3	82.2	14.6
1803000501 Upper White River						
7th Field Sub-shed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
COVE CANYON	18EA	1075.0	3.2	43.0	39.8	7.3
LOWER WHITE RVR	18EB	2378.0	11.3	95.1	83.8	11.9
DARK CANYON	18EC	392.0	10.6	15.7	5.1	67.5
MIDDLE WHITE RI	18ED	1132.0	32.1	45.3	13.2	70.9
UP WHITE RIVER	18EE	2199.0	44.2	88.0	43.8	50.2
1803000502 ***Upper Deer Creek***						
7th Field Sub-shed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
SO FORK GORDON	18AA	1413.0	3.0	42.4	39.4	7.1
TRIB TO RUBE	18BA	902.0	0.0	27.1	27.1	0.0
COLD SPRINGS	18BB	1669.0	36.5	50.1	13.6	72.9
RUBE CREEK	18BC	1747.0	7.8	52.4	44.7	14.8
HEAD WATERS RUBE	18BD	1380.0	1.8	41.4	39.7	4.2
TRIB TO NR CK	18BE	1159.0	21.4	34.8	13.4	61.6
LOWER TYLER CK	18CA	1984.0	2.1	79.4	77.3	2.6
MERRY CREEK	18CB	757.0	9.0	30.3	21.3	29.7
MIDDLE TYLER CK	18CC	1417.0	10.8	42.5	31.7	25.5
ALDER CREEK	18CD	652.0	9.3	19.6	10.3	47.5
STARVATION CK	18CE	2607.0	42.3	78.2	35.9	54.0
TRIB TO TYLER	18CF	809.0	5.2	32.4	27.2	16.1
HEADWATERS TYLER	18CG	2417.0	27.9	72.5	44.7	38.4
UPER DEER CREEK	18DB	1985.0	20.0	79.4	59.4	25.2
L CAPINERO	18DD	2728.0	37.2	81.8	44.6	45.5
DEER CK @ UHL	18DE	1328.0	13.6	53.1	39.5	25.6
UP DEER CREEK	18DF	1780.0	12.7	71.2	58.5	17.9
PUP MEADOW	18DG	897.0	24.3	26.9	2.6	90.4
TRIB TO CAPINER	18DH	928.0	9.9	37.1	27.2	26.8
DEAD HORSE MDW	18DI	631.0	14.6	18.9	4.3	77.1
UP CAPINERO CK	18DJ	1124.0	16.6	45.0	28.4	36.8
1803000601 ***Middle Fork Tule River***						
7th Field Sub-shed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
MILK CYN	4BA	889.0	0.0	26.5	26.5	0.0
UNNAMED	4BB	1057.0	0.0	31.7	31.7	0.0
MEADOW CK	4BC	602.0	0.0	18.1	18.1	0.0

GALENA CK	4BE	1286.0	0.0	38.6	38.6	0.0
SILVERCREEK	4BF	1040.0	0.0	31.2	31.2	0.0
BURRO CK	4BG	2889.0	0.0	86.7	86.7	0.0
N. ALDER CK	4BH	1650.0	0.0	49.5	49.5	0.0
SO. ALDER CK	4BI	2208.0	1.6	66.2	64.7	2.4
HOSSACK CK	4BJ	1575.0	2.6	63.2	60.6	4.1
UNNAMED	4BK	1096.0	3.0	32.9	29.9	9.0
NFKMFK TULE RIV	4BL	4913.0	2.8	147.4	144.6	1.9
DEEP CYN	4CA	1234.0	1.8	37.0	35.2	4.9
LONG CANYON	4CB	2608.0	0.6	78.2	77.6	0.8
COFFEE CYN	4CC	1521.0	0.1	45.6	45.5	0.3
HDW LONG CYN	4CD	1760.0	4.4	52.8	48.4	8.3
SIPHON CANYON	4CE	1203.0	0.0	48.1	48.1	0.0
STEVENSON GULCH	4DA	1042.0	2.7	31.3	28.5	8.8
DEADMAN	4DB	1843.0	6.0	55.3	49.3	10.9
UNNAMED	4DC	1261.0	3.9	37.8	33.9	10.4
WILSON CK	4DD	1162.0	0.3	34.9	34.6	0.9
COY CREEK	4DE	1914.0	28.0	57.4	29.5	48.7
BEAR CREEK	4DF	1478.0	11.9	44.3	32.5	26.7
LOWER HD WTR	4DG	1402.0	6.8	42.1	35.2	16.2
BOULDER CREEK	4DH	2297.0	13.9	91.9	78.0	15.1
BELKNAP	4DI	1412.0	14.0	42.4	28.3	33.1
NELSON	4DJ	1374.0	19.1	55.0	35.9	34.8
UNNAMED	4DK	714.0	6.5	21.4	14.8	30.5
MOORHOUSE CK	4DL	1228.0	8.9	36.8	27.8	24.3
SODA CREEK	4DM	961.0	0.2	28.8	28.7	0.6
MCINTYRE	4DN	1431.0	4.9	57.2	52.3	8.6
MARSHALL	4DO	441.0	2.1	17.6	15.6	11.8
QUAKING ASPEN	4DP	1528.0	0.0	45.8	45.8	0.0
QUAKER MEADOW	4DQ	1051.0	3.4	52.6	49.1	6.5
1803000602 ***North Fork Tule River***						
7th Field Sub-shed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
BEAR CRK	4AA	3899.0	63.4	117.0	53.5	54.2
UNNAMED	4AB	406.0	1.1	12.2	11.0	9.4
BEAR CREEK	4AC	2291.0	4.6	91.6	87.0	5.0
RANCHERIA	4AD	3178.0	1.6	95.3	93.8	1.6
SO. BEAR CK	4AE	1589.0	27.8	47.7	19.9	58.3
UNNAMED	4AF	1118.0	11.1	33.5	22.5	33.1
KRAMER CK	4GA	2933.0	23.1	88.0	64.9	26.2
UNNAMED	4GB	741.0	0.2	22.2	22.1	0.8
JENNY CK	4GC	1458.0	0.0	43.7	43.7	0.0

DILLON CK	4GD	1703.0	0.0	68.1	68.1	0.0
NF,TR HEAD	4GE	2840.0	0.0	113.6	113.6	0.0
UNNAMED	4GF	901.0	0.0	27.0	27.0	0.0
PINE CREEK	4GG	3022.0	12.0	90.7	78.6	13.3
BACKBONE	4GH	2600.0	8.6	104.0	95.4	8.3
1803000603 South Fork Tule River						
7th Field Sub-shed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
CRAWFORD CK	4EA	750.0	17.7	30.0	12.3	59.1
WINDY CR UPPER	4EC	1785.0	19.5	71.4	51.9	27.4
UNNAMED	4ED	687.0	6.5	27.5	21.0	23.5
CEDAR CR	4EE	1942.0	45.2	77.7	32.5	58.1
KESSING CR	4EF	1914.0	31.7	76.6	44.8	41.4
HD WTR SFK TULE R	4EG	2065.0	10.9	82.6	71.7	13.2
UNNAMED	4EH	410.0	5.0	16.4	11.4	30.6
UNNAMED	4EI	903.0	13.1	36.1	23.0	36.3
MINERS CK	4EJ	954.0	0.0	47.7	47.7	0.0
1803000704 Upper North Fork Kaweah River						
7th Field Sub-shed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
UNNAMED TRIB	3D-G	995.0	0.0	39.8	39.8	0.0
STONY CREEK	3E-C	1503.0	15.3	75.2	59.9	20.3
N.FORK WOODWARD	3F-A	978.0	10.4	29.3	18.9	35.5
WOODWARD CREEK	3F-B	1770.0	23.1	53.1	30.0	43.5
UNNAMED	3F-C	526.0	10.8	21.0	10.2	51.5
S.FORK WOODWARD	3F-D	873.0	1.0	43.7	42.6	2.3
REDWOOD CREEK	3D-A	1402.0	0.2	70.1	69.9	0.3
E. FRK. RDWD CR	3D-B.	1410.0	0.0	42.3	42.3	0.0
UNNAMED TRIB	3D-C	1503.0	0.0	45.1	45.1	0.0
UNNAMED	3D-D	770.0	0.0	38.5	38.5	0.0
UNNAMED	3D-F	844.0	0.0	42.2	42.2	0.0
ESHOM CREEK	3B-A/ 3B-B	4372.0	0.0	174.9	174.9	0.0
PIERCE CREEK	3C-A	4843.0	85.8	193.7	107.9	44.3
1803000705 South Fork Kaweah River						
7th Field Sub-shed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
UPPER GROUSE	3GA	2559.0	3.4	102.4	99.0	3.3
EFK DEVILS CNYN	3GB	1622.0	0.0	81.2	81.2	0.0
UNNAMED	3GC	1543.0	1.6	77.1	75.5	2.1
1803000706 *Lower Kaweah*						
7th Field Sub-shed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
DRY CREEK	3A-A/ 3A-B	2886.0	0.0	115.4	115.4	0.0
UNNAMED	3A-C	968.0	29.8	38.7	8.9	77.1
UNNAMED	3A-D	1052.0	14.4	42.1	27.7	34.2

18030801 *Mill Creek*						
7th Field Sub-shed		**Acres**	**Existing Condition**	**TOC**	**ERA's Available**	**%TOC used**
MILL CREEK	19A-A	2966.0	2.8	118.6	115.8	2.3
UNNAMED	19A-B	820.0	0.0	32.8	32.8	0.0

Table 106 provides CWE analysis for HUC 6 field watersheds. The CWE analysis for the HUC 6 watersheds would be applied based on watershed sensitivity. TOC for high, moderate, and low sensitivity have been provided and would be determined at the project level during landscape level analysis. While the information in the watershed working papers provides details at the HUC 7 scale, this information would be aggregated to the HUC 6 scale during environmental analysis at the project level.

Table 106 HUC 6 Watershed Acres and ERAs as a Function of Watershed Sensitivity				
HUC 6 Watershed	Watershed Acres	HUC 6 Watershed TOC		
		3% ERAs	4% ERAs	5% ERA's
		High Sensitivity	Moderate Sensitivity	Low Sensitivity
South Fork Kings River/Lightning Creek	6596	198	264	330
Upper Boulder Creek	12749	382	510	637
South Fork Kings River/Lower Boulder Creek	17607	528	704	880
Tenmile Creek	24825	745	993	1,241
Kings River/Rough Creek	12573	377	503	629
Kings River/Verplank Creek	5550	167	222	278
Mill Flat Creek	30862	926	1,234	1,543
Kern River/Freeman Creek	14133	424	565	707
Kern River/Peppermint Creek	13909	417	556	695
Dry Meadow Creek	23004	690	920	1,150
South Creek	14753	443	590	738
Lower Little Kern River	6189	186	248	309
Upper Poso Creek	12387	372	495	619
Headwaters White River	7176	215	287	359
Deer Creek/Gordon Creek	8270	248	331	414
Tyler Creek	10643	319	426	532
Headwaters Deer Creek	11401	342	456	570
North Fork Middle Fork Tule River	24687	741	987	1,234
Lower Middle Fork Tule River	8326	250	333	416
South Fork Middle Fork Tule River	22539	676	902	1,127
Bear Creek	16349	490	654	817
Upper North Fork Tule River	19788	594	792	989
Upper South Fork Tule River	11410	342	456	571
Upper North Fork Kaweah River	6645	199	266	332
North Fork Kaweah River/Eshom Creek	15144	454	606	757
South Fork Kaweah River/Grouse Creek	19028	571	761	951
Upper Dry Creek	4906	147	196	245
Mill Creek	3786	114	151	189

Total Acers	385,235	11,557	15,409	19,262

Fuels management treatments can affect large areas. These areas would be evaluated at the HUC 6 field watershed scale. Threshold of concern and ERAs for HUC 6 watersheds are provided in Table 107. ERAs have been converted to "acreage available for fuels management activity" using disturbances from past fires, average fire conditions, and desired conditions for fuels management. Table 108 provides acreage available for fuels management treatments at the HUC 6 watershed scale.

Table 107 HUC 6 Watershed Acres and Acres Available for Fuels Management by Watershed Sensitivity

HUC 6 Watershed	Watershed Acres	Acres Available for Fuels Management		
		3% acres	4% acres	5% acres
		High Sensitivity	Moderate Sensitivity	Low Sensitivity
South Fork Kings River/Lightning Creek	6596	1,282	1,710	2,137
Upper Boulder Creek	12749	2,478	3,305	4,131
South Fork Kings River/Lower Boulder Creek	17607	3,423	4,564	5,705
Tenmile Creek	24825	4,826	6,435	8,043
Kings River/Rough Creek	12573	2,444	3,259	4,074
Kings River/Verplank Creek	5550	1,079	1,439	1,798
Mill Flat Creek	30862	6,000	7,999	9,999
Kern River/Freeman Creek	14133	2,747	3,663	4,579
Kern River/Peppermint Creek	13909	2,704	3,605	4,507
Dry Meadow Creek	23004	4,472	5,963	7,453
South Creek	14753	2,868	3,824	4,780
Lower Little Kern River	6189	1,203	1,604	2,005
Upper Poso Creek	12387	2,408	3,211	4,013
Headwaters White River	7176	1,395	1,860	2,325
Deer Creek/Gordon Creek	8270	1,608	2,144	2,679
Tyler Creek	10643	2,069	2,759	3,448
Headwaters Deer Creek	11401	2,216	2,955	3,694
North Fork Middle Fork Tule River	24687	4,799	6,399	7,999
Lower Middle Fork Tule River	8326	1,619	2,158	2,698
South Fork Middle Fork Tule River	22539	4,382	5,842	7,303
Bear Creek	16349	3,178	4,238	5,297
Upper North Fork Tule River	19788	3,847	5,129	6,411
Upper South Fork Tule River	11410	2,218	2,957	3,697
Upper North Fork Kaweah River	6645	1,292	1,722	2,153
North Fork Kaweah River/Eshom Creek	15144	2,944	3,925	4,907
South Fork Kaweah River/Grouse Creek	19028	3,699	4,932	6,165
Upper Dry Creek	4906	954	1,272	1,590
Mill Creek	3786	736	981	1,227
Total Acers	385,235	74,890	99,853	124,817

Percent of Total Acres		19%	26%	32%
Average Acres Available per Watershed		2,675	3,566	4,458

Past fires provided information on levels of soil burn severity that occurred as a result of the fire. Information from Burn Area Emergency Rehabilitation (BAER) documents from the McNally, Deep, Choke, and Highway fires were used to provide information on soil burn severity. Acres of high, moderate, and low soil burn severity were documented from these fires and converted to percentages. The highest acreages by burn severity determined the overall severity of the fire. As can be seen in Table 109, McNally and Highway are considered as moderate severity fire, Deep high severity, and Choke low. ERAs per acre were determined based on the average of wildfire conditions from 1997 to present using these four fires. Based on evaluations of fire disturbance coefficients for average fire conditions associated with basic erosion rates of 11 for high, 5 for moderate, and 2 for low, fire severity weighted by average resulted in ERA/acre values that range from 0.64 to 0.22 with an average value of 0.27. This information was developed to provide a comparison for development of ERA/acre relationships for burn prescriptions.

Table 109 Information from Past Wildfires from BAER Analysis

Fires	Total Acres	% Soil Burn Severity			Acres by Soil Burn Severity		
		High	Moderate	Low	High	Moderate	Low
McNally- Moderate Severity	74,888	9%	45%	29%	6,936	33,972	21,677
Deep- High Severity	3,143	87%	3%	10%	2,747	87	309
Choke-1997- Low Low Severity	4,100	12%	11%	78%	477	444	3,179
Highway- Moderate Severity	4,152	26%	57%	3%	1,087	2,373	134

Desired conditions provided for burn prescriptions based on past treatment indicates high soil burn severity would be around 5 percent total burn, moderate soil burn severity around 10 percent, low soil burn severity around 65 percent, and unburned areas within the total burn area would equal roughly 20 percent (Table 110). A basic erosion rate for prescribed burning was calculated at 2.4. This value was multiplied by the average estimated disturbance factor of 0.0643 to yield a value of 0.15 ERA/acre. Watershed acres multiplied by 3 percent, 4 percent, or 5 percent, based on sensitivity, yield available ERAs. Available ERAs divided by ERA/acre values for prescribed burned prescriptions associated with desired conditions described above yield acres in a watershed available for fuels treatments. These values were calculated for each HUC 6 watershed and are displayed in Table 105 at the beginning of this section.

Table 110 Desired Condition Prescribed Burn Prescription By Soil Burn Severity

High	Moderate	Low	Unburned
5%	10%	65%	20%

Temporal relationship of fire on the landscape has been studied by Burg and Azuma (2008). These authors studied post fire recovery/erosion relationships at over 600 sites on the Sequoia National Forest from 2004 to 2006. Berg and Azuma found that in areas affected by high, moderate, or low soil burn severity, soil rilling is seldom evident after more than four years post-fire. Percent bare soil at unburned reference sites provided no significant difference to percent bare soil at wildfire plots greater than six years post fire. A number of fuel treatment techniques were evaluated including burning at machine and hand piled fuel sites, thinning, mastication, and crushing sites. These sites provided similar results with little difference from reference conditions. "These findings suggest that the study locations 'recovered' from wildfire-induced surface erosion within a few years and that fuels treatments, particularly those incorporating little or no burning, exhibit no substantive evidence of post-treatment surface erosion" (Berg and Azuma 2008).

Based on the Berg and Azuma (2008) study, it would be safe to assume cumulative effects of wildfire and prescribed fire related activities would recover after four years. To provide for a more conservative approach it would be reasonable to assume the potential for CWE would be low after five years, and a five-year fire recovery could be used to assess CWE from fire related events.

In conclusion this analysis provides a multi-scale CWE approach that may be used to plan projects in the future. It is expected that roughly 19 to 32 percent of a HUC 6 watersheds, dependent on watershed sensitivity, could be treated on a five-year cycle. This would provide for fuels treatment that would not cause large scale adverse effects to water quality and riparian dependent species. Riparian standards would be followed to ensure that riparian areas are maintained and treated in a manner that provides protection of riparian dependent resources commensurate with the need for fuels management both inside and outside riparian areas.

Standards and Guidelines and Monitoring

Effects on hydrological resources affect aquatic habitats, water quality, and ecosystems within and surrounding giant sequoia groves, including the following objects of interest identified in the proclamation (Clinton 2000):

- The naturally-occurring giant sequoia groves and their associated ecosystems, individual giant trees, rare and endemic plant species, such as the Springville clarkia, and other species listed as threatened or endangered by the Endangered Species Act, or sensitive by the Forest Service.
- The ecosystems and outstanding landscapes that surround the giant sequoia groves.

The standards and guidelines for hydrological resources displayed in Appendix A of the FEIS are designed to protect those objects of interest associated with aquatic ecosystems both inside and outside groves. These standards and guidelines follow the Aquatic Management Strategy (AMS) developed in the 2004 SNFPA. The AMS was developed to retain, restore, and protect processes and landforms that provide habitat for aquatic and riparian-dependent species. The AMS provides an approach based on maintaining and restoring watershed processes that form and maintain habitats and yield high quality water. The Riparian Conservation Objectives (RCOs) provide standards and guidelines to meet hydrological resource objectives described for each alternative.

The monitoring plan developed for the Monument, as described in Part 3, Design Criteria, of the Monument Plan, contains implementation, effectiveness, validation, and status and trend monitoring for ecosystem analysis and aquatic resources. Plan monitoring is conducted to evaluate plan implementation and its effectiveness in meeting management strategies and objectives, in particular protecting the objects of interest and restoring ecosystems. Data collected and analyzed inform specialists and managers of any additional effects from management activities and the need for hydrological restoration to further protect a portion of the groves' ecosystems. For example, following project completion, resurveying aquatic resources and habitat conditions determines if there were any impacts to those resources and if those impacts cause concern for an ecosystem (e.g., change in stream stability, change in riparian ecotype, headcutting in meadows).

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Appendix A: Standard and Guideline Consistency Analysis

Riparian Conservation Objective Analysis-2004 (Alternatives, B, C, F)	Riparian Conservation Objective Analysis-2001 (Alternative A)	Justification for use of 2004 RCO S&G's
Standards and Guidelines for Riparian Conservation Areas and Critical Aquatic Refuges (Not included in Alternative C)		*Comments*
91. Designate riparian conservation area (RCA) widths as described in Part B of the SNFP ROD appendix A. The RCA widths displayed in Part B may be adjusted at the project level if a landscape analysis has been completed and a site-specific RCO analysis demonstrates a need for different widths.	Designate riparian conservation area (RCA) widths as listed in Table II.C.1 below. RCA widths shown in Table II.C.1may be adjusted at the project level if a landscape analysis has been completed and a site specific RCO analysis demonstrates a need for different widths.	Identical no change
92. Evaluate new proposed management activities within CAR's and RCA's during environmental analysis to determine consistency with the riparian conservation objectives at the project level and the AMS goals for the landscape. Ensure that appropriate mitigation measures are enacted to (1) minimize the risk of activity-related sediment entering aquatic systems and (2) minimize impacts to habitat for aquatic- or riparian-dependent plant and animal species.	Evaluate new proposed management activities within CARs and RCAs during environmental analysis to determine consistency with the riparian conservation objectives at the project level and the AMS goals for the landscape. Ensure that appropriate mitigation measures are implemented to (1) minimize the risk of activity-related sediment entering aquatic systems, and (2) minimize impacts to habitat for aquatic- or riparian-dependent plant and animal species.	Identical no change
93. Identify existing uses and activities in CAR's and RCA's during landscape analysis. At the time of permit re-issuance, evaluate and consider actions needed for consistency with RCO's.	Identify existing uses and activities in CAR's and RCA's during landscape analysis. Evaluate existing management activities to determine consistency with RCO's during project level analysis. Develop and implement actions needed for consistency with RCO's.	**2004 provides time frame for evaluation of existing condition…"at time of permit re-issuance, other than this detail there is *no change in direction*.**
94. As part of project-level analysis, conduct peer reviews for projects that propose ground-disturbing activities in more than 25 percent of the RCA or more than 15 percent of a CAR.	Use peer review process for vegetation treatments or other activities proposed within CAR's and RCA's that are likely to significantly affect aquatic resources. Conduct peer review for projects that propose ground-disturbing activities in more than 25 percent of the RCA or more than 15 percent of a CAR	**2004 provides peer review timing…"as part of project-level analysis". *Other than wording the intent of this S&G remains the same.***
Riparian Conservation Objective #1: ***Ensure that identified beneficial uses for the water body are adequately protected. Identify the specific beneficial uses for the project area, water quality goals from the Regional Basin Plan, and the manner in which the standards and guidelines will protect the beneficial uses.***		

Standards and Guidelines Associated with RCO #1		***Comments***
Not in 2004 S&G's	Implement project appropriate Best Management Practices and monitor their effectiveness following protocols outlined in "Investigating Water Quality in the Pacific Southwest Region: Best Management Practices Evaluation Program" (USDA-FS, PSW Region 1992).	*The need to do BMP monitoring is required by other authority:* Agreement with RWQCB, Sections 208 and 319 of the Federal Clean Water Act (PL92-500), US EPA guidance to the Costal Zone Act Reauthorization Amendment, State Water Quality Control Board Basin Plans, *FSH 2509.22*, and 1981 State Water Quality Management Plan with Forest Service. *The direction in 2001 S&G's is redundant.*
	Implement soil quality standards for soil loss, detrimental soil compaction, and organic matter retention to minimize the risk of sediment delivery to aquatic systems from management activities. Ensure that management-related activities, including roads, skid trails, landings, trails, or other activities, do not result in detrimental soil compaction on more than 5 percent of the RCA or 10 percent of the area in CAR's.	*The need to follow Soil Quality Standards is required by other authority:* FSM2550-2010-1, Watershed and Air Management Chapter 2550, Soil Management
	Conduct project-specific cumulative watershed effects analysis following Regional procedures or other appropriate scientific methodology to meet NEPA requirements.	*The need to do CWE is required by other authority:* FSH 2509.22 Chapter 20, R-5 as well as NEPA, 40 CFR, Sec. 1508.7 & 1508.25; Federal Water Pollution Control Act, 1977, Sec. 208(2)(F)a. *The direction in 2001 S&G's is redundant*
95. For waters designated as "Water Quality Limited" (Clean Water Act Section 303(d)), implement appropriate State mandates for the water body, such as Total Maximum Daily Load (TMDL) protocols.	For waters designated as "Water Quality Limited" (Clean Water Act Section 303(d)), implement appropriate State mandates for the water body, such as Total Maximum Daily Load (TMDL) protocols.	**Identical no change**
96. Ensure that management activities do not adversely affect water temperatures necessary for local aquatic and riparian-dependent species assemblages.	Ensure that management activities do not adversely affect water temperatures necessary for local aquatic- and riparian-dependent species assemblages.	**Identical no change**

97. Limit pesticide applications to cases where project level analysis indicates that pesticide applications are consistent with riparian conservation objectives.	Limit pesticide applications to cases where project level analysis indicates that pesticide applications are consistent with riparian conservation objectives. Prohibit application of pesticides to livestock in RCAs and CARs.	The intent of this S&G remains the same. The addition of prohibiting application of pesticides to livestock in RCA's and CAR's is prohibitive and without necessity as the application would need to be consistent with RCO's
98. Within 500 feet of known occupied sites for the California red-legged frog, Cascade frog, Yosemite toad, foothill yellow-legged frog, mountain yellow-legged frog, and northern leopard frog, design pesticide applications to avoid adverse effects to individuals and their habitats.	Avoid pesticide applications within 500 feet of known occupied sites for the California red-legged frog, Cascade frog, Yosemite toad, foothill yellow-legged frog, mountain yellow-legged frog, and northern leopard frog unless environmental analysis documents that pesticides are needed to restore or enhance habitat for these amphibian species.	**The intent of this S&G remains the same.**
99. Prohibit storage of fuels and other toxic materials within RCA's and CAR's except at designated administrative sites. Prohibit refueling within RCA's and CAR's unless there are no other alternatives. Ensure that spill plans are reviewed and up-to-date.	Prohibit storage of fuels and other toxic materials within RCAs and CARs except at designated administrative sites. Prohibit refueling within RCAs and CARs unless there are no other alternatives. Ensure that spill plans are reviewed and up-to-date	**Identical no change**
<u>Riparian Conservation Objective #2:</u> ***Maintain or restore: (1) The geomorphic and biological characteristics of special aquatic features, including lakes, meadows, bogs, fens, wetlands, vernal pools, springs; (2) streams, including in stream flows; and (3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.***		
Standards and Guidelines Associated with RCO #2		*Comments*
Not in 2004 S&G's	During re-licensing of Federal Energy Regulatory Commission (FERC) hydroelectric projects, evaluate modifications by the project to the natural hydrograph. Determine and recommend in stream flow requirements and habitat conditions that maintain, enhance, or restore all life stages of native aquatic species, and that maintain or restore riparian resources, channel integrity, and fish passage. Provide written and timely license conditions to FERC. Coordinate re-licensing projects with the appropriate State and Federal agencies.	***The need to provide hydrologic analysis during re-licensing is redundant as it is required by other authority and is covered in S&G 106***
100. Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying	Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by	***<u>Identical no change</u>***

roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity.	identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity.	
101. Ensure that culverts or other stream crossings do not create barriers to upstream or downstream passage for aquatic-dependent species. Locate water-drafting sites to avoid adverse effects to in stream flows and depletion of pool habitat. Where possible, maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features.	Ensure that culverts or other stream crossings do not create barriers to upstream or downstream passage for aquatic-dependent species. Locate water drafting sites to avoid adverse effects to in stream flows and depletion of pool habitat. Where possible, maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features.	***Identical no change***
102. Prior to activities that could adversely affect streams, determine if relevant stream characteristics are within the range of natural variability. If characteristics are outside the range of natural variability, implement mitigation measures and short-term restoration actions needed to prevent further declines or cause an upward trend in conditions. Evaluate required long-term restoration actions and implement them according to their status among other restoration needs.	Prior to activities that could affect streams, determine if relevant geomorphic characteristics, including bank angle, channel bank stability, bank full width-to-depth ratio, embeddedness, channel-floodplain connectivity, residual pool depth, or channel substrate, are within the range of natural variability for the reference stream type as described in the Pacific Southwest Region Stream Condition Inventory protocol. If properties are outside the range of natural variability, implement restoration actions that will result in an upward trend.	*The intent of this S&G remains the same*. **The 2001 direction references the use of the Pacific Southwest Region Stream Condition Inventory (SCI) Protocol, while the 2004 references the components of the SCI protocol.**
103. Prevent disturbance to streambanks and natural lake and pond shorelines caused by resource activities (for example, livestock, off-highway vehicles, and dispersed recreation) from exceeding 20 percent of stream reach or 20 percent of natural lake and pond shorelines. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots. This standard does not apply to developed recreation sites; sites authorized under Special Use Permits and designated off-highway vehicle routes.	Prevent disturbance to meadow-associated streambanks and natural lake and pond shorelines caused by resource activities (for example, livestock, off-highway vehicles, and dispersed recreation) from exceeding 20 percent of stream reach or 20 percent of natural lake and pond shorelines. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plantroots. This standard does not apply to developed recreation sites and designated off-highway vehicle routes.	***The intent of this S&G remains the same.***

104. In stream reaches occupied by, or identified as "essential habitat" in the conservation assessment for, the Lahontan and Paiute cutthroat trout and the Little Kern golden trout, limit streambank disturbance from livestock to 10 percent of the occupied or "essential habitat" stream reach. (Conservation assessments are described in the record of decision.) Cooperate with State and Federal agencies to develop streambank disturbance standards for threatened, endangered, and sensitive species. Use the regional streambank assessment protocol. Implement corrective action where disturbance limits have been exceeded.	In stream reaches occupied by, or identified as "essential habitat" in the conservation assessment for, the Lahonton and Paiute cutthroat trout and the Little Kern golden trout, limit streambank disturbance from livestock to 10 percent of the occupied or "essential habitat" stream reach. (Conservation assessments are described in the record of decision.) Cooperate with State and Federal agencies to develop streambank disturbance standards for threatened, endangered, and sensitive species. Use the regional streambank assessment protocol. Implement corrective action where disturbance limits have been exceeded.	***Identical no change***
105. At either the landscape or project-scale, determine if the age class, structural diversity, composition, and cover of riparian vegetation are within the range of natural variability for the vegetative community. If conditions are outside the range of natural variability, consider implementing mitigation and/or restoration actions that will result in an upward trend. Actions could include restoration of aspen or other riparian vegetation where conifer encroachment is identified as a problem.	Determine if the age class, structural diversity, composition, and cover of riparian vegetation are within the range of natural variability for the vegetative community. If outside the range of natural variability, implement restoration actions that will result in an upward trend. Actions could include restoration of aspen or other riparian vegetation where conifer encroachment is identified as a problem	***The intent of this S&G remains the same.*** The 2004 direction indicates this inventory/determination may be done "at either the landscape or project-scale."
106. Cooperate with Federal, Tribal, State and local governments to secure in stream flows needed to maintain, recover, and restore riparian resources, channel conditions, and aquatic habitat. Maintain in stream flows to protect aquatic systems to which species are uniquely adapted. Minimize the effects of stream diversions or other flow modifications from hydroelectric projects on threatened, endangered, and sensitive species.	Cooperate with Federal, Tribal, State and local governments to secure in stream flows needed to maintain, recover, and restore riparian resources, channel conditions, and aquatic habitat. Maintain in stream flows to protect aquatic systems to which species are uniquely adapted. Minimize the effects of stream diversions or other flow modifications from hydroelectric projects on threatened, endangered, and sensitive species and essential habitat as identified in conservation assessments. (Conservation assessments are described in the record of decision.)	***The intent of this S&G remains the same.*** According to the 2001 ROD Conservation assessments for the foothill and mountain yellow legged frogs; Cascades frog, Yosemite toad, northern leopard frog, and willow flycatcher were to have been done by 2002. Assessments are still on going and are discussed in section 2004 ROD, page 10.

107. For exempt hydroelectric facilities on national forest lands, ensure that special use permit language provides adequate in stream flow requirements to maintain, restore, or recover favorable ecological conditions for local riparian- and aquatic-dependent species.	For exempt hydroelectric facilities on national forest lands, ensure that special use permit language provides adequate in stream flow requirements to maintain, restore, or recover favorable ecological conditions for local riparian- and aquatic-dependent species	Identical no change
Riparian Conservation Objective #3: ***Ensure a renewable supply of large down logs that: (1) Can reach the stream channel and (2) provide suitable habitat within and adjacent to the RCA.***		
Standards and Guidelines Associated with RCO #3:		***Comments***
Not in 2004 S&G's	In plantations within RCAs or CAR**s**, determine if the plantation will be able to provide a sufficient supply of standing trees suitable for large wood recruitment. If there is not sufficient wood for recruitment, develop a restoration program that will provide standing trees of the appropriate size in the RCA or CAR. In developing the restoration program, ensure that proposed activities are consistent with the riparian conservation objectives.	***The S&G specific to plantations is redundant***. Large woody material is required in all areas jot just in plantations. 2004 document discusses this in S&G 108 and the corresponding S&G from 2001.
108. Determine if the level of coarse large woody debris (CWD) is within the range of natural variability in terms of frequency and distribution and is sufficient to sustain stream channel physical complexity and stability. Ensure proposed management activities move conditions toward the range of natural variability.	Determine if the level of coarse large woody debris (CWD) is within the range of natural conditions in terms of frequency and distribution and is sufficient to sustain stream channel physical complexity and stability. If CWD levels are deficient, ensure proposed management activities, when appropriate, contribute to the recruitment of CWD. Burning prescriptions should be designed to retain CWD; however short-term reductions below either the soil quality standards or standards in species management plans may result from prescribed burning within strategically placed treatment areas or the urban wildland intermix zone.	*The intent of this S&G remains the same.* **2004 is less prescriptive.**
RCO#4: Ensure that management activities, including fuels reduction actins, within RCA's and CAR's enhance or maintain physical and biological characteristics associated with aquatic- and riparian-dependent species.		
Standards and Guidelines Associated with RCO #4:		***Comments***
109. Within CAR's, in occupied habitat or "essential habitat" as identified in conservation assessments for threatened, endangered, or sensitive species, evaluate the appropriate role, timing, and extent of prescribed fire. Avoid direct lighting within riparian vegetation; prescribed fires	Within CARs, in occupied habitat or "essential habitat" as identified in conservation assessments for threatened, endangered, or sensitive species, evaluate the appropriate role, timing, and extent of prescribed fire. Avoid direct lighting within riparian	***Identical no change***

may back into riparian vegetation areas. Develop mitigation measures to avoid impacts to these species whenever ground-disturbing equipment is used.	vegetation; prescribed fires may back into riparian vegetation areas. Develop mitigation measures to avoid impacts to these species whenever ground-disturbing equipment is used.	
110. Use screening devices for water drafting pumps. (Fire suppression activities are exempt). Use pumps with low entry velocity to minimize removal of aquatic species, including juvenile fish, amphibian egg masses and tadpoles, from aquatic habitats.	Use screening devices for water drafting pumps. (Fire suppression activities are exempt). Use pumps with low entry velocity to minimize removal of aquatic species, including juvenile fish, amphibian egg masses and tadpoles, from aquatic habitats.	***Identical no change***
111. Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation in RCA's. In burn plans for project areas that include, or are adjacent to RCA's, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining which mitigation measures to adopt, weigh the potential harm of mitigation measures, for example fire lines, against the risks and benefits of prescribed fire entering riparian vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could be damaging to habitat or long-term function of the riparian community.	Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation in RCAs. In burn plans for project areas that include, or are adjacent to RCAs, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining which mitigation measures to adopt, weigh the potential harm of mitigation measures, for example fire lines, against the risks and benefits of prescribed fire entering riparian vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could be damaging to habitat or long-term function of the riparian community.	***Identical no change***
112. Post-wildfire management activities in RCA's and CAR's should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, minimizing adverse effects from the existing road network, and carrying out activities identified in landscape analyses. Post-wildfire operations shall minimize the exposure of bare soil.	Post-wildfire management activities in RCAs and CARs should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, minimizing adverse effects from the existing road network, and carrying out activities identified in landscape analyses. Post-wildfire operations shall minimize the exposure of bare soil.	***Identical no change***
113. Allow hazard tree removal within RCA's or CAR's. Allow mechanical ground disturbing fuels treatments, salvage harvest, or commercial fuelwood cutting within RCA's or CAR's when the activity is consistent with RCO's. Utilize low	Allow mechanical ground disturbing fuels treatments, hazard tree removal, salvage harvest, or commercial fuelwood cutting within RCAs or CARs when the activity is consistent with RCOs. Projects providing for	***The intent of this S&G remains the same.*** Instead of describing hazards associated with the need for public safety

ground pressure equipment, helicopters, over the snow logging, or other non-ground disturbing actions to operate off of existing roads when needed to achieve RCO's. Ensure that existing roads, landings, and skid trails meet Best Management Practices. Minimize the construction of new skid trails or roads for access into RCA's for fuel treatments, salvage harvest, commercial fuelwood cutting, or hazard tree removal	public health and safety, such as the felling of hazard trees or fuel reduction activities within the defense zone of the urban wildland intermix zones, are permitted. Utilize low ground pressure equipment, helicopters, over the snow logging, or other non-ground disturbing actions to operate off of existing roads when needed to achieve RCOs. Prior to removing trees within RCAs or CARs, determine if existing down wood is sufficient to sustain the stream channel physical complexity and stability required to maintain or enhance the aquatic- and riparian-dependent community. Ensure that existing roads, landings, and skid trails meet Best Management Practices. Minimize the construction of new skid trails or roads for access into RCAs for fuel treatments, salvage harvest, commercial fuelwood cutting, or hazard tree removal.	and allowing for felling of trees these are simply referred to as hazard tree removal in the 2004 document. The 2001 goes on to discuss the need for down wood which is already covered in RCO #3, S&G 108.
114. As appropriate, assess and document aquatic conditions following the Regional Stream Condition Inventory protocol prior to implementing ground disturbing activities within suitable habitat for California red-legged frog, Cascades frog, Yosemite toad, foothill and mountain yellow-legged frogs, and northern leopard frog.	Prior to implementing ground disturbing activities within suitable habitat for the California red-legged frog, Cascade frog, Yosemite toad, foothill yellow-legged frog, mountain yellow-legged frog, and northern leopard frog: *assess and document aquatic conditions using the Pacific Southwest Region Stream Condition Inventory protocol, and *develop mitigation measures (such as timing of activities, limited operating seasons, avoidance) to avoid impacting these species.	***The intent of this S&G remains the same.*** 2004 indicates to assess and document as appropriate, which is not included in 2001. 2001 requires the development of mitigation measures for the noted species. The direction for mitigation would be redundant to management practices already in place for dealing with these special species.
115. During fire suppression activities, consider impacts to aquatic- and riparian-dependent resources. Where possible, locate incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities outside of RCA's or CAR's. During pre-suppression planning, determine guidelines for suppression activities, including avoidance of potential adverse effects to aquatic- and riparian-dependent species as a goal.	During fire suppression activities, consider impacts to aquatic- and riparian-dependent resources. Where possible, locate incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities outside of RCAs or CARs. During pre-suppression planning, determine guidelines for suppression activities, including avoidance of potential adverse effects to aquatic- and riparian-dependent species as a goal.	***Identical no change***

116. Identify roads, trails, OHV trails and staging areas, developed recreation sites, dispersed campgrounds, special use permits, grazing permits, and day use sites during landscape analysis. Identify conditions that degrade water quality or habitat for aquatic and riparian-dependent species. At the project level, evaluate and consider actions to ensure consistency with standards and guidelines or desired conditions.	Access roads, trails, OHV trails and staging areas, developed recreation sites, dispersed campgrounds, special use permits, grazing permits, and day use sites during landscape analysis. Identify conditions that degrade water quality or habitat for aquatic- and riparian-dependent species. At the project level, determine if use is consistent with other standards and guidelines or desired conditions. If inconsistent, modify the use through redesign, rehabilitation, relocation, closure, or re-directing the use to a more suitable location.	***The intent of this S&G remains the same.***
Riparian Conservation Objective #5: **Preserve, restore, or enhance special aquatic features, such as meadows, lakes, ponds, bogs, fens, and wetlands to provide the ecological conditions and processes needed to recover or enhance the viability of species that rely on these areas.**		
Standards and Guidelines Associated with RCO #5		***Comments***
117. Assess the hydrologic function of meadow habitats and other special aquatic features during range management analysis. Ensure that characteristics of special features are, at a minimum, at Proper Functioning Condition, as defined in the appropriate Technical Reports (or their successor publications): (1) "Process for Assessing PFC" TR 1737-9 (1993), "PFC for Lotic Areas" USDI TR 1737-15 (1998) or (2) "PFC for Lentic Riparian-Wetland Areas" USDI TR 1737-11 (1994).	Assess the hydrologic function of meadow habitats and other special aquatic features during range management analysis. Ensure that characteristics of special features are, at a minimum, at Proper Functioning Condition, as defined in the appropriate Technical Reports: (1) "Process for Assessing PFC" TR 1737-9 (1993), "PFC for Lotic Areas" USDI TR 1737-15 (1998) or (2) "PFC for Lentic Riparian-Wetland Areas" USDI TR 1737-11 (1994).	***Identical no change***
118. Prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems. During project analysis, survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock, pack stock, humans, and wheeled vehicles. Criteria for defining bogs and fens include, but are not limited to, presence of: (1) sphagnum moss (Spagnum spp.), (2) mosses	Prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems. During project analysis, survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock, pack stock, humans, and wheeled vehicles. Criteria for defining bogs and fens include, but are not limited to, presence of: (1) sphagnum	***Identical no change***

belonging to the genus Meessia, and (3) sundew (Drosera spp.) Complete initial plant inventories of bogs and fens within active grazing allotments prior to re-issuing permits	moss *(Spagnum sp*p.), (2) mosses belonging to the genus *Meessi*a, and (3) sundew *(Drosera sp*p.) Complete initial plant inventories of bogs and fens within active grazing allotments prior to re-issuing permits.	
119. Locate new facilities for gathering livestock and pack stock outside of meadows and riparian conservation areas. During project-level planning, evaluate and consider relocating existing livestock facilities outside of meadows and riparian areas. Prior to re-issuing grazing permits, assess the compatibility of livestock management facilities located in riparian conservation areas with riparian conservation objectives.	Locate new facilities for gathering livestock and pack stock outside of meadows and riparian conservation areas. During landscape analysis, evaluate and consider relocating existing livestock facilities outside of meadows and riparian areas. Prior to re-issuing grazing permits, assess the compatibility of livestock management facilities located in riparian conservation areas with riparian conservation objectives	***The intent of this S&G remains the same.*** 2004 requires this action to apply at the project-planning level where the 2001 gives the direction at the larger landscape analysis.
120. Under season-long grazing: For meadows in early seral status: limit livestock utilization of grass and grass-like plants to 30 percent (or minimum 6-inch stubble height). For meadows in late seral status: limit livestock utilization of grass and grass-like plants to a maximum of 40 percent (or minimum 4-inch stubble height; Determine ecological status on all key areas monitored for grazing utilization prior to establishing utilization levels. Use Regional ecological scorecards and range plant list in regional range handbooks to determine ecological status. Analyze meadow ecological status every 3 to 5 years. If meadow ecological status is determined to be moving in a downward trend, modify or suspend grazing. Include ecological status data in a spatially explicit Geographical Information System database; intensive grazing systems (such as rest-rotation and deferred rotation) where meadows are receiving a period of rest, utilization levels can be higher than the levels described above if the meadow is maintained in late seral status and meadow-associated species are not being impacted. Degraded meadows (such as those in early seral status with greater than 10 percent of	Under season-long grazing: For meadows in early seral status: limit livestock utilization of grass and grass-like plants to 30 percent (or minimum 6-inch stubble height). For meadows in late seral status: limit livestock utilization of grass and grass-like plants to a maximum of 40 percent (or minimum 4-inch stubble height). Determine ecological status on all key areas monitored for grazing utilization prior to establishing utilization levels. Use Regional ecological scorecards and range plant list in regional range handbooks to determine ecological status. Analyze meadow ecological status every 3 to 5 years. If meadow status is determined to be moving in a downward trend, modify or suspend grazing. Include ecological status data in a spatially explicit	***<u>Identical no change</u>***

the meadow area in bare soil and active erosion) require total rest from grazing until they have recovered and have moved to mid- or late seral status.	Geographical Information System database. Under intensive grazing systems (such as rest-rotation and deferred rotation) where meadows are receiving a period of rest, utilization levels can be higher than the levels described above if the meadow is maintained in late seral status and meadow-associated species are not being impacted. Degraded meadows (such as those in early seral status with greater than 10 percent of the meadow area in bare soil and active erosion) require total rest from grazing until they have recovered and have moved to mid- or late seral status.	
121. Limit browsing to no more than 20 percent of the annual leader growth of mature riparian shrubs and no more than 20 percent of individual seedlings. Remove livestock from any area of an allotment when browsing indicates a change in livestock preference from grazing herbaceous vegetation to browsing woody riparian vegetation.	Limit browsing to no more than 20 percent of the annual leader growth of mature riparian shrubs (including willow and aspen) and no more than 20 percent of individual seedlings. Remove livestock from any area of an allotment when browsing indicates a change in livestock preference from grazing herbaceous vegetation to browsing woody riparian vegetation. Herd sheep away from woody riparian vegetation at all times.	***The intent of this S&G remains the same.*** Regardless of the presence of sheep the S&G would still be required and has no bearing the implementation of the standard.
Riparian Conservation Objective #6: ***Identify and implement restoration actions to maintain, restore, or enhance water quality and maintain, restore, or enhance habitat for riparian and aquatic species.***		
Standards and Guidelines Associated with RCO #6		***Comments***
Not in 2004 S&G's	Reclaim abandoned mine sites that are degrading aquatic riparian and meadow ecosystems. First priority is to reclaim sites with hazardous or toxic substances located within CARs and RCAs.	***The need for mine reclamation is required by other authority:*** Surface Mining and Reclamation Act and Associated Regulations, 1975; Superfund Amendments and Reauthorization Act (SARA), 1986; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),

		1980; 42 USC 9604A, National Contingency Act; Executive Order 12580, Superfund Implementation, 1987.
122. Recommend restoration practices in: (1) areas with compaction in excess of soil quality standards, (2) areas with lowered water tables, or (3) areas that are either actively down cutting or that have historic gullies. Identify other management practices, for example, road building, recreational use, grazing, and timber harvests, which may be contributing to the observed degradation.	Recommend and establish priorities for restoration practices in: (1) areas with compaction in excess of soil quality standards, (2) areas with lowered water tables, or (3) areas that are either actively down cutting or that have historic gullies. Identify other management practices, for example, road building, recreational use, grazing, and timber harvests, which may be contributing to the observed degradation.	***Identical no change***
Standards and Guidelines Associated with Critical Aquatic Refuges (Only section not in Alternative C)		***Comments***
123. Determine which critical aquatic refuges or areas within critical aquatic refuges are suitable for mineral withdrawal. Propose these areas for withdrawal from location and entry under U.S. mining laws, subject to valid existing rights, for a term of 20 years.	Determine which critical aquatic refuges or areas within critical aquatic refuges are suitable for mineral withdrawal. Propose these areas for withdrawal from location and entry under U.S. mining laws, subject to valid existing rights, for a term of 20 years.	***Identical no change***
124. Approve mining-related plans of operation if measures are implemented that contribute toward the attainment or maintenance of aquatic management strategy goals.	Approve mining-related plans of operation if measures are implemented that contribute toward the attainment or maintenance of aquatic management strategy goals.	***Identical no change***

SNFPA 2004 ROD (pg. 10) provides the desired conditions of aquatic, riparian and meadow ecosystems as follows: "The SNFPA goal of protecting and restoring desired conditions of aquatic, riparian and meadow ecosystems and providing for the viability of species associated with those ecosystems remains unchanged. With this decision, I am retaining the Critical Aquatic Refuges, the Riparian Conservation Areas, and the goals of the Aquatic Management Strategy (AMS) established in the SNFPA 2001 ROD." Therefore the direction contained in the 2001 AMS is by direction is retained and brought forward into the 2004 SNFPA.

Alternative E

Alternative E would employ Riparian and Wetland Standards and Guidelines contained the 1988 Forest Plan and MSA 1990 amendments.

Appendix B: Standards and Guidelines for RCAs and CARs

<table>
<tr><th>Riparian Conservation Objective Analysis – 2004
(Alternatives A, B, C, and F)</th><th>Monument Specific S&G
(Alternatives B, C, D, and F)</th><th>Discussion and additional information which may be needed to define/describe S&G</th></tr>
<tr><td colspan="3">*Standards and Guidelines for Riparian Conservation Areas and Critical Aquatic Refuges*</td></tr>
<tr><td colspan="2">***Standards and Guidelines Associated with RCA's and CAR's***
(Not included in Alternative C)</td><td>*Discussion*</td></tr>
<tr><td>91. Designate riparian conservation area (RCA) widths as described in Part B of the SNFPA ROD appendix A. The RCA widths displayed in Part B may be adjusted at the project level if a landscape analysis has been completed and a site-specific RCO analysis demonstrates a need for different widths.</td><td>SMZ widths would be determined for the first 100± feet perpendicular to Class I and II perennial stream; Class III intermittent stream with side slopes greater than 30%; and ≤50 to 75 feet of a Class IV ephemeral stream, dependent on slope. SMZ direction provided the following widths in slope distance in feet. The values provided in Table 1 are used as a guide.
<table>
<tr><th rowspan="2">Stream Class</th><th colspan="5">Table 1 - SMZ Width by % Slope</th><th rowspan="2">Stream Order</th></tr>
<tr><th><30 %</th><th>>30 %</th><th>>40 %</th><th>>50 %</th><th>>70%</th></tr>
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Field conditions including stream type and project objectives should dictate the streamside management</td><td>Stream Side Management Zones are required under Region 5 Water Quality Management for Forest System Lands in California, Best Management Practices. The authority for Water Quality Protection Measures or Best Management Practices (BMP's) is section 208 and 319 of the Clean Water Act (CWA) as amended. The Sierra Nevada Forest Plan Amendment directs us to meet the goals of the CWA. This requires following all applicable BMP's. The following BMP's are appropriate for SMZ development, filtering, and water quality protection:
Development of SMZ's, BMP 1.8;
Stream course protection, BMP 1.19,
Meadow protection, BMP 1.18
Streamside protection during pesticide/herbicide applications, BMP 5.12

SMZ's are nested inside RCA's if this land allocation is part of the selected alternative. Most often SMZ's define an equipment exclusion zone immediately adjacent to the streamside for the purpose of creating a filter strip to trap potential sediment.</td></tr>
</table>

<table>
<tr>
<td></td>
<td>zone widths.

Treatments in this zone would be dependent on treatment objectives. Objectives for SMZ's are maintenance or improvement of riparian values, to provide unobstructed passage of storm flows, to control sediment and other pollutants entering the stream course, and to restore the natural course of any stream as soon as practicable when diversion of the stream has resulted from management activities.</td>
<td>Framework direction does not change previous legal requirements it encompasses it and adds direction under the Riparian Conservation Strategy. This strategy provides Riparian Conservation Areas (RCA's) which are considered a zone of closely managed activity for riparian dependent resources that include SMZ's which may be a zone of equipment exclusion.</td>
</tr>
<tr>
<td>92. Evaluate new proposed management activities within CAR's and RCA's during environmental analysis to determine consistency with the riparian conservation objectives at the project level and the AMS goals for the landscape. Ensure that appropriate mitigation measures are enacted to (1) minimize the risk of activity-related sediment entering aquatic systems and (2) minimize impacts to habitat for aquatic- or riparian-dependent plant and animal species.</td>
<td>SMZ widths would be determined for the first 100± feet perpendicular to Class I and II perennial stream; Class III intermittent stream with side slopes greater than 30%; and ≤50 to 75 feet of a Class IV ephemeral stream, dependent on slope. The values provided in Table 1 are used as a guide.
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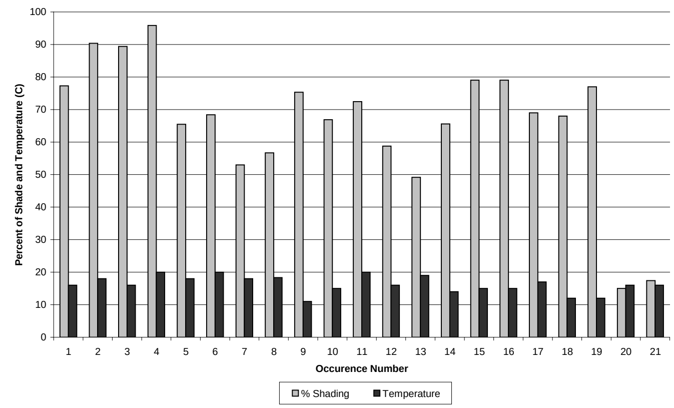
	provide unobstructed passage of storm flows, to control sediment and other pollutants entering the stream course, and to restore the natural course of any stream as soon as practicable when diversion of the stream has resulted from management activities.	
93. Identify existing uses and activities in CAR's and RCA's during landscape analysis. At the time of permit re-issuance, evaluate and consider actions needed for consistency with RCO's.		
94. As part of project-level analysis, conduct peer reviews for projects that propose ground-disturbing activities in more than 25 percent of the RCA or more than 15 percent of a CAR.		
<u>Riparian Conservation Objective #1:</u> ***Ensure that identified beneficial uses for the water body are adequately protected. Identify the specific beneficial uses for the project area, water quality goals from the Regional Basin Plan, and the manner in which the standards and guidelines will protect the beneficial uses.***		
Standards and Guidelines Associated with RCO #1		*Discussion*
95. For waters designated as "Water Quality Limited" (Clean Water Act Section 303(d)), implement appropriate State mandates for the water body, such as Total Maximum Daily Load (TMDL) protocols.	.	***Sequoia National Monument contains two water bodies proposed for States 303(D) list. These include Deer Creek and Hume Lake.***
96. Ensure that management activities do not adversely affect water temperatures necessary for local aquatic and riparian-dependent species assemblages.	*96a*. Maintain Temperature at a no more than a daily average of 20^{o}C on streams affected by Management Activity. Stream courses with special circumstances such as those affected by hot springs or other geologic and geochemical features would be evaluated on site by site bases at the project level.	Review of Literature on Rainbow Trout Temperature Requirements by California Edison FERC Re-licensing project in 2007 support the findings of forest temperature data. An indication of Monument temperature data for the Northern Monument lands may be seen in Figure 13. This information indicates that temperatures collected in the northern portion of the

		Monument rarely exceed 20^{o}C. This Figure provides information relative to stream surface shade as discussed above. Findings from Edison's document are as follows: "Daily mean temperature criteria were developed to assess whether temperatures would be suitable for fish growth and daily maximum temperature criteria were developed to assess conditions that would stress fish. Preferred temperatures are often considered a reasonable estimator of beneficial/optimal temperatures. Fish can withstand short-term exposure to water temperatures higher than those needed for longer-term growth or survival without significant negative effects. Based upon the best available information for regional streams, the temperature evaluation criterion applied to assess conditions for suitable trout growth is a mean daily water temperature at or below 20°C. A daily maximum temperature of 24°C was applied as a criterion for short-term high temperature exposure, above which temperatures are expected to be stressful for trout." Based on this information in addition to Forest level surveys it is suggested that 20^{o}C be adopted for average maximum stream temperature.

		Figure 13 - Northern Monument Stream Surface Shade and Water Temperature Relationships  http://www.sce.com/NR/rdonlyres/0FC4BFA7-EAF6-4F45-912F-B78666C81EAE/0/APDEA_AttachmentITroutTemperatureRequirements.pdf
	96b Maintain average stream surface shade at ≥60% on streams affected by Management Activity. Meadow environments and other streams with limited overhead vegetation would be assessed on a site by site basis at the project level.	Stream shade is beneficial to these species in summer because it reduces heat input and water temperatures. The removal of shading vegetation is the major mechanism by management activity can increase summertime temperatures of small streams. Existing and target shade levels have been determined from other studies as starting at 60 percent. This value is supported by site specific stream side data from monument lands. http://fortress.wa.gov/dnr/forestpractices/lhzproject/wsasmt/kennedy_ck/riparian_function.pdf

	96c. Ensure that management activities do not adversely affect pH values necessary for local aquatic and riparian-dependent species assemblages as defined by the Central Valley Water Quality Board Basin Plan Maintain pH values between 6.5 and 8.5 on streams affected by management activity. Water bodies that exhibit special conditions would be evaluated at the project level. Special circumstances could include waters affected by hot springs in the presence of CO_2 springs or other geologic and geochemical features. Such areas would be expected to yield pH values outside the range of state standards.	Central Valley Water Quality Control Board Basin Plan, 2005 states the following: "The pH shall not be depressed below 6.5 nor raised above 8.5. Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters with designated COLD or WARM beneficial uses. In determining compliance with the water quality objective for pH, appropriate averaging periods may be applied provided that beneficial uses will be fully protected." Therefore maintenance of pH levels will be managed to meet this water quality standard set by the State of California where appropriate.
	96d. Ensure that management activities do not adversely effect alkalinity values which have a potential to affect pH values necessary for local aquatic and riparian-dependent species assemblages as defined by the Central Valley Water Quality Board Basin Plan Maintain alkalinity values of no less than 10 mg/L. Site specific differences could occur based on local geology and water chemistry. Values outside these ranges would be evaluated at the project level.	State standards are not set for Alkalinity. However based on USGS maps suggest range averages for the Southern Sierra Nevada area are from 121 to 180 milligrams/liter. Forest data suggests ranges of 40 to 180. It has been indicated that values of less than 10 mg/L lack buffering capability to maintain pH in natural systems. Http://bcn.boulder.co.us/basin/data/BACT/info/Alk.html
97. Limit pesticide applications to cases where project level analysis indicates that pesticide applications are consistent with riparian conservation objectives.	Use Local Channel Geometry Curves to determine location of floodprone area. Pesticide application including gopher baiting would not take place within the floodprone area of perennial or intermittent stream courses. In the event that project objectives include treatment of riparian areas conditions would be evaluated on site by site bases at the project level.	Floodprone width and depth information as a function of drainage area is available for Kings, Kaweah, Tule, and Kern Rivers. This information can be provided by the forest/district hydrologists in any area proposed for pesticide application to assure stream courses are protected from chemicals.

98. Within 500 feet of known occupied sites for the California red-legged frog, Cascade frog, Yosemite toad, foothill yellow-legged frog, mountain yellow-legged frog, and northern leopard frog, design pesticide applications to avoid adverse effects to individuals and their habitats.	Use Local Channel Geometry Curves to determine location of floodprone area. Pesticide application including gopher baiting would not take place within the floodprone area of perennial or intermittent stream courses. In the event that project objectives include treatment of riparian areas conditions would be evaluated on site by site bases at the project level	*See Discussion under S&G 97*
99. Prohibit storage of fuels and other toxic materials within RCA's and CAR's except at designated administrative sites. Prohibit refueling within RCA's and CAR's unless there are no other alternatives. Ensure that spill plans are reviewed and up-to-date.	Use Local Channel Geometry Curves to determine location of floodprone area. Fuel or other toxic materials storage and refueling activities would not take place within the floodprone area of perennial or intermittent stream courses.	***See Discussion under S&G 97***
<u>Riparian Conservation Objective #2:</u> ***Maintain or restore: (1) The geomorphic and biological characteristics of special aquatic features, including lakes, meadows, bogs, fens, wetlands, vernal pools, springs; (2) streams, including in stream flows; and (3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.***		
Standards and Guidelines Associated with RCO #2		*Discussion*
100. Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity.		

101. Ensure that culverts or other stream crossings do not create barriers to upstream or downstream passage for aquatic-dependent species. Locate water-drafting sites to avoid adverse effects to in stream flows and depletion of pool habitat. Where possible, maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features.		
102. Prior to activities that could adversely affect streams, determine if relevant stream characteristics are within the range of natural variability. If characteristics are outside the range of natural variability, implement mitigation measures and short-term restoration actions needed to prevent further declines or cause an upward trend in conditions. Evaluate required long-term restoration actions and implement them according to their status among other restoration needs.	*102a*. Maintain Width-to-depth ratios for A and E channels of values less than 14 on streams affected by Management Activity Maintain Width-to-depth ratios for B, C and F channels of values greater than 10 on stream channels affected by Management Activity Encourage G and F channels to trend towards width-to-depths greater than 12.	Width/depth ratio is a relative index of channel shape. Width is the total distance across the channel and depth is the mean depth of the channel. Both of these measurements are taken relative to bankfull elevation. The width/depth ratio is determined by dividing the bankfull width by the mean bankfull depth. Ratios below 12 are considered low for B, C, and F channels and could indicate a trend toward vertical erosion, an unstable state such as a G channel, and an increase in *entrenchment* which disconnects the stream from its floodplain. High ratios could indicate excessive sedimentation resulting in overheating and loss of habitat for A and E channels; for F channels high ratios suggest development of a floodplain; and for G channels would signify reduction in vertical erosion and a trend toward lateral erosion and a trend toward a more stable state. Channels with high w/d ratios tend to be shallow and wide. Channels with low w/d ratios tend to be narrow and deep. *Entrenchment* is closely associated with width-to-depth ratios and is a measure of the vertical confinement (bank height) of the stream. Entrenchment determines whether

		the flat area next to the stream, the floodplain, may be accessed by the stream.
	102b. Mean particle size should not show a shift toward fine material in stable channel types (A, B, C, E) to the extent that a change in channel type occurs in streams affected by Management Activity. Mean particle size would be expected to change in impaired systems or following restoration activity. Stream courses with special circumstances would be evaluated on site by site bases at the project level.	*See Discussion under S&G 102d*
	102c. Manage for specific components of Pfankuch Channel and Stream Stability Evaluation affected by Management Activity. Special conditions would be evaluated at the project level: **Vegetative Bank Protection** Meadow Environments (C and E streams) 80 to 90 % ground cover with stable continuous root mass Impaired stream reaches (G, F, and D*) Greater than or equal to 70 % ground cover with stable continuous root mass **Bank Cutting** Meadow Environments (C and E streams)	Pfankuch, 1978, developed a channel stability procedure to systematically measure and evaluate the resistive capacity of mountain streams. The concept of riparian ecotypes had not been developed when Pfankuch envisioned his channel condition evaluation procedure. Since this time, selection of environmental indicators appropriate for different channel types has been discussed in the literature and applied to stream surveys in the field. Five of the fifteen indicators used in Pfankuch are selected to evaluate the function of riparian ecotypes. The five indicators selected are those most affected by disturbance. These indicators are used to evaluate stream reaches that have been classified using Rosgen, 1985. Information from Rosgen, 1985; Meyers

* D channels are considered unimpaired where they exist under stable conditions, at deltas and at the base of alluvial fans.

<table>
<tr>
<td></td>
<td>Less than or equal to 1 foot of exposed bank cuts affecting less than or equal to 20% of the channel
<u>Impaired stream reaches (G, F, and D*)</u>
Less than or equal to 1 foot of exposed bank cuts affecting less than or equal to 30% of the channel
Bottom Deposition and Scour& Deposition
<u>Stable streams (A and B channels)</u>
Low frequency of mid-channel bars and good pool to riffle ratio
<u>Meadow Environments (C and E streams)</u>
Little or no sand bar development with 0 to 5% of the bottom affected by bar deposition
<u>Impaired stream reaches (G, F, and D*)</u>
Low frequency of mid channel bar development, Improved pool to riffle ratio, with 5 to 30% deposition behind obstructions
Bottom Size Distribution and % Stable Material
<u>Stable streams (A and B channels)</u>
Slight size distribution shift between 50-80% stable material</td>
<td>and Swanson, 1992; Forest stream inventory data from 1989 to present; and professional judgment has been used to determine which indicators are appropriate for each riparian ecotype.

The four riparian indicators used for evaluation of stream impacts and channel functions are: vegetative bank cover, stream bank cutting, channel bottom deposition, channel bottom scour and deposition, and percent stable material. The total sum of the indicators as described in Pfankuch is not employed in this system; rather the indicators are evaluated independently and then together to define a combination of processes responsible for changes in channel function.
<table>
<tr><th>Environmental Indicator from Pfankuch Channel Condition and Stability Evaluation
Riparian Ecotype</th><th>Vegetative Bank Protection</th><th>Bank Cutting</th><th>Bottom Deposition and Scour& Deposition</th><th>Bottom Size Distribution and % Stable Material</th></tr>
<tr><td>Naturally-stable
Rosgen Channel Type:
A1, A2, B1, B2, B3, C1, C2, F1, F2, G1, G2
Restoration Not Required</td><td>NA</td><td>NA</td><td>Low frequency of mid-channel bars and good pool to riffle ratio</td><td>NA</td></tr>
<tr><td>Stable-sensitive
Rosgen Channel Type:
B4, B5, B6, C3, C4, C5, C6, E3, E4, E5, E6
Recover with Passive Restoration</td><td>80 to 90 % ground cover with stable continuous root mass</td><td>Less than or equal to 1 foot of exposed bank cuts affecting less than or</td><td>Little or no sand bar development with 0 to 5% of the bottom affected by bar deposition</td><td>NA</td></tr>
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				equal to 20% of the channel		
		Unstable-Sensitive Degraded **Rosgen Channel Type:** **G2, G3, G4, G5, G6, F3, F4, F5, F6, and those D3, D4, D5, D6 in unexpected geomorphic settings.** *Recover with Active Restoration*	Greater than or equal to 70 % ground cover with stable continuous root mass	Less than or equal to 1 foot of exposed bank cuts affecting less than or equal to 30% of the channel	Low frequency of mid channel bar development, Improved pool to riffle ratio, with 5 to 30% deposition behind obstructions	Slight size distribution shift between 50-80% stable material
		Naturally-unstable **Rosgen Channel Type:** **A3, A4, A5, A6 (Landslide and Debris slide Terrain)** *Impractical to Restore*	NA	NA	NA	NA

	102d. For stable streams (A, B, C, E) maintain or improve channel as necessary based on stability indices. Actions should be taken to maintain or improve stream sites based on successional stage shifts away from stable conditions. For impaired stream reaches (G, F, and D*) successional stage shift from the impaired stream reach would show a trend toward an unimpaired condition.	Stream succession scenario suggests that A, B, and C streams (streams depicted in the first and last frames of Figure 9) are morphologically stable. The forest would maintain streams in morphological stable conditions. A number of factors provide indication of stream stability and provide information on maintenance of stability. Stability indices include: Meander Patterns, Debris and Channel Blockage, Streambank Cutting, Vegetative Bank Stability, Depositional Features (deposition and scour and deposition). Most of theses indices may be found in Pfankuch and are collected during Stability Evaluations. Streamflow changes, sediment budget changes, and many other causes lead to channel change that result in stability shifts. These shifts and adjustments lead to stream channel morphological changes culminating in a stream type change. Stream channel instability induced by management activites or natural events can be described and quantified through an evolution of stream types. Rosgen (2001, 2009) has observed at least 12 separate evolutionary scenarios involving stream type succession progression scenarios; nine of which are displayed in Figure 9 from Rosgen 2001. Stream succession scenarios suggest that streams depicted in the first and last frames of Figure 9 are morphologically stable. As long as streams are trending toward morphological stable systems riparian conditions would are considered to be in an upward trend. Rosgen, D.L. 2001. A practical for computing streambank erosion rate. Proceedings 7th Interagency Sedimentation Conference, March 25-29, 2002, Reno, NV.

* D channels are considered unimpaired where they exist under stable conditions, at deltas and at the base of alluvial fans.

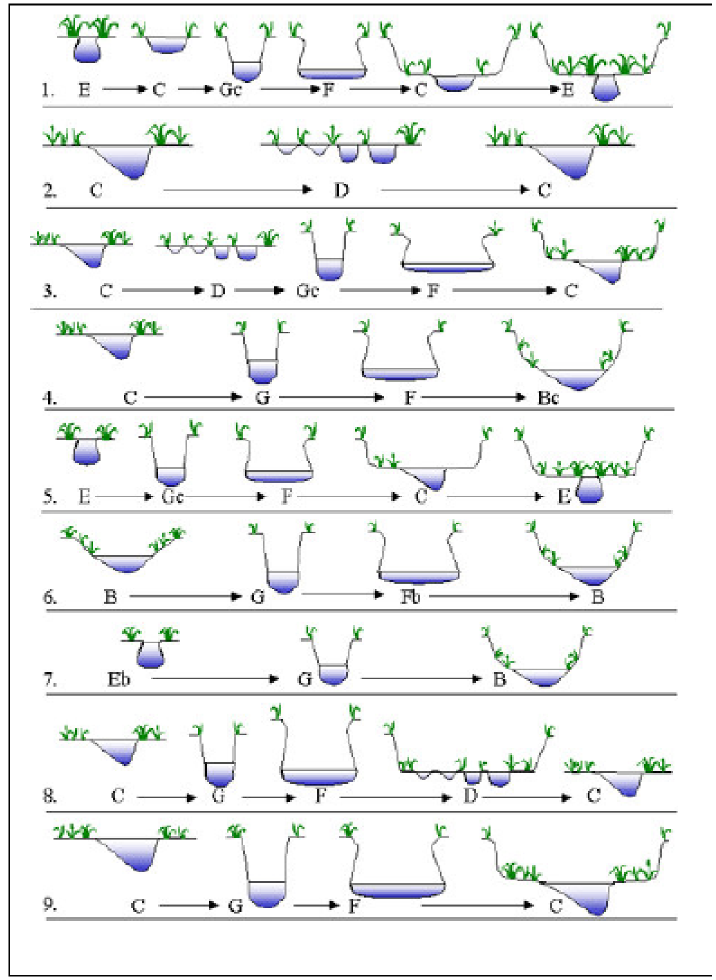

Figure 9: Various stream type succession scenarios (after Rosgen 2001).

103. Prevent disturbance to streambanks and natural lake and pond shorelines caused by resource activities (for example, livestock, and dispersed recreation) from exceeding 20 percent of stream reach or 20 percent of natural lake and pond shorelines. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots. This standard does not apply to developed recreation sites; sites authorized under Special Use Permits and designated off-highway vehicle routes.		
104. In stream reaches occupied by, or identified as "essential habitat" in the conservation assessment for, the Lahontan and Paiute cutthroat trout and the Little Kern golden trout, limit streambank disturbance from livestock to 10 percent of the occupied or "essential habitat" stream reach. (Conservation assessments are described in the record of decision.) Cooperate with State and Federal agencies to develop streambank disturbance standards for threatened, endangered, and sensitive species. Use the regional streambank assessment protocol. Implement corrective action where disturbance limits have been exceeded.	Maintain Width-to-depth ratios for A and E channels of values less than 14 on streams affected by Management Activity Maintain Width-to-depth ratios for B, C and F channels of values greater than 10 on stream channels affected by Management Activity Encourage G and F channels to trend towards width-to-depths greater than 12.	*See Discussion S&G 102a*

105. At either the landscape or project-scale, determine if the age class, structural diversity, composition, and cover of riparian vegetation are within the range of natural variability for the vegetative community. If conditions are outside the range of natural variability, consider implementing mitigation and/or restoration actions that will result in an upward trend. Actions could include restoration of aspen or other riparian vegetation where conifer encroachment is identified as a problem.		
106. Cooperate with Federal, Tribal, State and local governments to secure instream flows needed to maintain, recover, and restore riparian resources, channel conditions, and aquatic habitat. Maintain in stream flows to protect aquatic systems to which species are uniquely adapted. Minimize the effects of stream diversions or other flow modifications from hydroelectric projects on threatened, endangered, and sensitive species.		
107. For exempt hydroelectric facilities on national forest lands, ensure that special use permit language provides adequate in stream flow requirements to maintain, restore, or recover favorable ecological conditions for local riparian- and aquatic-dependent species.		
<u>Riparian Conservation Objective #3:</u> ***Ensure a renewable supply of large down logs that: (1) Can reach the stream channel and (2) provide suitable habitat within and adjacent to the RCA.***		

Standards and Guidelines Associated with RCO #3:		*Discussion*
108. Determine if the level of coarse large woody debris (CWD) is within the range of natural variability in terms of frequency and distribution and is sufficient to sustain stream channel physical complexity and stability. Ensure proposed management activities move conditions toward the range of natural variability.	Woody material needs to be maintained in and adjacent to stream courses. Where fire is responsible for removal of wood, replacement would occur at levels associated with pre-fire conditions. Amount of wood necessary for maintenance of stream stability, sediment reduction and aquatic species habitat needs to be evaluated at the project level.	Large wood can store and/or sort sediment, reduce erosion, increase connectivity of the stream channel with the floodplain, and create habitat suitable for a variety of fish and other aquatic and terrestrial species.
RCO#4: Ensure that management activities, including fuels reduction actins, within RCA's and CAR's enhance or maintain physical and biological characteristics associated with aquatic- and riparian-dependent species.		
Standards and Guidelines Associated with RCO #4:		*Discussion*
109. Within CAR's, in occupied habitat or "essential habitat" as identified in conservation assessments for threatened, endangered, or sensitive species, evaluate the appropriate role, timing, and extent of prescribed fire. Avoid direct lighting within riparian vegetation; prescribed fires may back into riparian vegetation areas. Develop mitigation measures to avoid impacts to these species whenever ground-disturbing equipment is used.	SMZ widths would be determined for the first 100± feet perpendicular to Class I and II perennial stream; Class III intermittent stream with side slopes greater than 30%; and ≤50 to 75 feet of a Class IV ephemeral stream, dependent on slope. The values provided in Table 1 are used as a guide.	*See Discussion under S&G 91*

Stream Class	Table 1 - SMZ Width by % Slope					Stream Order
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						-

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III	50	100	100	150		2-3
IV	≤50	≤50	75	100		1-2

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Field conditions including stream type and project objectives should dictate the streamside management zone widths.

Treatments in this zone would be dependent on treatment objectives. Objectives for SMZ's are maintenance or improvement of riparian values, to provide unobstructed passage of storm flows, to control sediment and other pollutants entering the stream course, and to restore the natural course of any stream as soon as practicable when diversion of the stream has resulted from management activities.
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<td>110. Use screening devices for water drafting pumps. (Fire suppression activities are exempt). Use pumps with low entry velocity to minimize removal of aquatic species, including juvenile fish, amphibian egg masses and tadpoles, from aquatic habitats.</td>
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<tr>
<td>111. Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation in RCA's. In burn plans for project areas that include, or are adjacent to RCA's, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining which mitigation measures to adopt, weigh the potential harm of mitigation measures, for example fire lines, against the risks and benefits of prescribed fire entering riparian vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire</td>
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suppression or fuel management actions could be damaging to habitat or long-term function of the riparian community.										
		I	100	15 0	20 0	25 0	1.5 times distan	4+		
		II	100	10	15	20		3-4		

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<td>112. Post-wildfire management activities in RCA's and CAR's should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, minimizing adverse effects from the existing road network, and carrying out activities identified in landscape analyses. Post-wildfire operations shall minimize the exposure of bare soil.</td>
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<tr>
<td>113. Allow hazard tree removal within RCA's or CAR's. Allow mechanical ground disturbing fuels treatments, salvage harvest, or commercial fuelwood cutting within RCA's or CAR's when the activity is consistent with RCO's. Utilize low ground pressure equipment, helicopters, over the</td>
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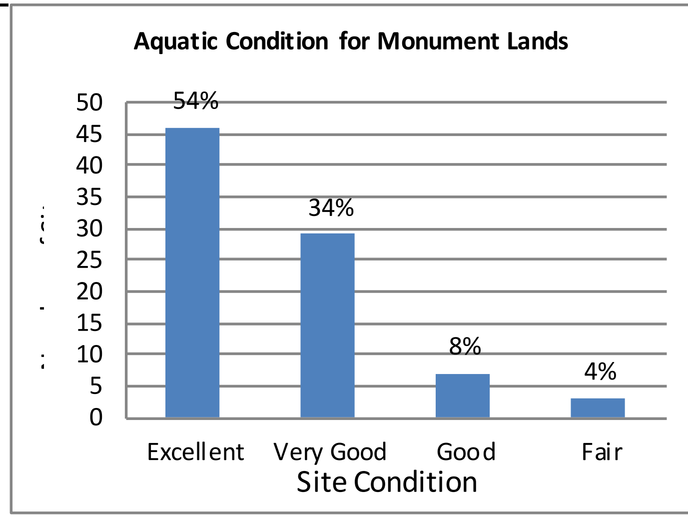
snow logging, or other non-ground disturbing actions to operate off of existing roads when needed to achieve RCO's. Ensure that existing roads, landings, and skid trails meet Best Management Practices. Minimize the construction of new skid trails or roads for access into RCA's for fuel treatments, salvage harvest, commercial fuelwood cutting, or hazard tree removal		
114. As appropriate, assess and document aquatic conditions following the Regional Stream Condition Inventory protocol prior to implementing ground disturbing activities within suitable habitat for California red-legged frog, Cascades frog, Yosemite toad, foothill and mountain yellow-legged frogs, and northern leopard frog.	*114a*. Maintain average stream surface shade at $\geq$60% on streams affected by Management Activity. Meadow environments and other streams with limited overhead vegetation would be assessed on a site by site basis at the project level.	*See Discussion S&G 102b*
	114b. Maintain Width-to-depth ratios for A and E channels of values less than 14 on streams affected by Management Activity Maintain Width-to-depth ratios for B, C and F channels of values greater than 10 on stream channels affected by Management Activity Encourage G and F channels to trend towards width-to-depths greater than 12.	*See Discussion S&G 102a*
	114c. Mean particle size should not show a shift toward fine material in stable channel types (A, B, C, E) to the extent that a change in channel type occurs in streams affected by Management Activity. Mean particle size would be expected to change in impaired systems or following restoration activity. Stream courses with special circumstances would be evaluated on site by site bases at the project level.	*See Discussion S&G 102b*

114d. Maintain 85 percent of water bodies affected by management activity at no less than very good water quality based on aquatic site condition. Water bodies outside this range would be evaluated for site specific impacts. Aquatic site condition would be in reference condition, good or better site condition. Water bodies outside this range would be evaluated on a site by site basis at the project level. Currently the Forest uses Hilsenhoff Biotic Index to determine aquatic MIS site condition. There are other biologic indices that may be utilized to determine site condition.



Based on forest water quality data as indicated by aquatic insects 54% of Monument streams have a biotic index of Excellent; 34% have an index of Very Good; 8% have an index of Good and 4% of Fair. Aquatic Insects in addition to habitat conditions are currently considered management indicators for biologic species.

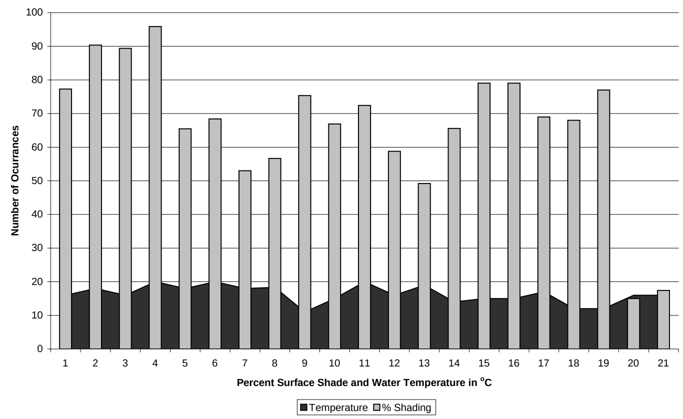
Table 1- Hilsenhoff Biotic Index Aquatic MIS Site Condition

0.00–3.50	Excellent	No apparent organic pollution
3.51–4.50	Very good	Possible slight organic pollution
4.51–5.50	Good	Some organic pollution
5.51–6.50	Fair	Fairly significant organic pollution
6.51–7.50	Fairly poor	Significant organic pollution
7.51–8.50	Poor	Very significant organic pollution
8.51–10.0	Very poor	Severe organic pollution

	114e. Manage for specific components of Pfankuch Channel and Stream Stability Evaluation affected by Management Activity. Special conditions would be evaluated at the project level: **Vegetative Bank Protection** <u>Meadow Environments (C and E streams)</u> 80 to 90 % ground cover with stable continuous root mass <u>Impaired stream reaches (G, F, and D)</u> Greater than or equal to 70 % ground cover with stable continuous root mass **Bank Cutting** <u>Meadow Environments (C and E streams)</u> Less than or equal to 1 foot of exposed bank cuts affecting less than or equal to 20% of the channel <u>Impaired stream reaches (G, F, and D)</u> Less than or equal to 1 foot of exposed bank cuts affecting less than or equal to 30% of the channel **Bottom Deposition and Scour& Deposition** <u>Stable streams (A and B channels)</u> Low frequency of mid-channel bars and good pool to riffle ratio <u>Meadow Environments (C and E streams)</u> Little or no sand bar development with 0 to 5% of the bottom affected by bar deposition <u>Impaired stream reaches (G, F, and D)</u> Low frequency of mid channel bar development, Improved pool to riffle ratio, with 5 to 30% deposition behind obstructions **Bottom Size Distribution and % Stable Material** <u>Stable streams (A and B channels)</u> Slight size distribution shift between 50-80% stable material	*See Discussion under S&G 102c*

	For stable streams (A, B, C, E) maintain or improve channel as necessary based on stability indices. Actions should be taken to maintain or improve stream sites based on successional stage shifts away from stable conditions. For impaired stream reaches (G, F, and D) successional stage shift from the impaired stream reach would show a trend toward an unimpaired condition.	*See Discussion under S&G 102d*
115. During fire suppression activities, consider impacts to aquatic- and riparian-dependent resources. Where possible, locate incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities outside of RCA's or CAR's. During pre-suppression planning, determine guidelines for suppression activities, including avoidance of potential adverse effects to aquatic- and riparian-dependent species as a goal.		
116. Identify roads, trails, developed recreation sites, dispersed campgrounds, special use permits, grazing permits, and day use sites during landscape analysis. Identify conditions that degrade water quality or habitat for aquatic and riparian-dependent species. At the project level, evaluate and consider actions to ensure consistency with standards and guidelines or desired conditions.		
<u>Riparian Conservation Objective #5:</u> ***Preserve, restore, or enhance special aquatic features, such as meadows, lakes, ponds, bogs, fens, and wetlands to provide the ecological conditions and processes needed to recover or enhance the viability of species that rely on these areas.***		
Standards and Guidelines Associated with RCO #5		*Discussion*

117. Assess the hydrologic function of meadow habitats and other special aquatic features during range management analysis. Ensure that characteristics of special features are, at a minimum, at Proper Functioning Condition, as defined in the appropriate Technical Reports (or their successor publications): (1) "Process for Assessing PFC" TR 1737-9 (1993), "PFC for Lotic Areas" USDI TR 1737-15 (1998) or (2) "PFC for Lentic Riparian-Wetland Areas" USDI TR 1737-11 (1994).	Perform Stream Condition Inventory (SCI) to validate PFC in drainages affected by range management. Not all drainages need to be evaluated however at least one site in the allotment should have a permanent SCI monitoring site. This would only apply to permits where streams meet criteria suitable for monitoring as described in SCI protoco	
118. Prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems. During project analysis, survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock, pack stock, humans, and wheeled vehicles. Criteria for defining bogs and fens include, but are not limited to, presence of: (1) sphagnum moss (Spagnum spp.), (2) mosses belonging to the genus Meessia, and (3) sundew (Drosera spp.) Complete initial plant inventories of bogs and fens within active grazing allotments prior to re-issuing permits	Maintain Temperature at a no more than a daily average of 20^{o}C on streams affected by Management Activity. Stream courses with special circumstances such as those affected by hot springs, or conditions would be evaluated on site by site bases at the project level.	Review of Literature on Rainbow Trout Temperature Requirements by California Edison FERC Re-licensing project in 2007 support the findings of forest temperature data. An indication of Monument temperature data for the Northern Monument lands may be seen in Figure 13. This information indicates that temperatures collected in the northern portion of the Monument rarely exceed 20^{o}C. This Figure provides information relative to stream surface shade as discussed above. Findings from Edison's document are as follows: "Daily mean temperature criteria were developed to assess whether temperatures would be suitable for fish growth and daily maximum temperature criteria were developed to assess conditions that would stress fish. Preferred temperatures are often considered a reasonable estimator of beneficial/optimal temperatures. Fish can withstand short-term exposure to water temperatures higher than those needed for longer-term growth or survival without significant negative effects. Based upon the best available information for regional streams, the temperature evaluation criterion applied to assess conditions for suitable trout growth is a mean daily

		water temperature at or below 20°C. A daily maximum temperature of 24°C was applied as a criterion for short-term high temperature exposure, above which temperatures are expected to be stressful for trout." Based on this information in addition to Forest level surveys it is suggested that 20°C be adopted for average maximum stream temperature. Figure 13 - Northern Monument Stream Surface Shade and Water Temperature Relationships  http://www.sce.com/NR/rdonlyres/0FC4BFA7-EAF6-4F45-912F-B78666C81EAE/0/APDEA_AttachmentITroutTemperatureRequirements.pdf
119. Locate new facilities for gathering livestock and pack stock outside of meadows and riparian conservation areas. During project-level planning, evaluate and consider relocating existing livestock facilities outside of meadows and riparian areas. Prior to re-issuing grazing permits, assess the compatibility of livestock management facilities located in riparian		

conservation areas with riparian conservation objectives.		
120. Under season-long grazing: For meadows in early seral status: limit livestock utilization of grass and grass-like plants to 30 percent (or minimum 6-inch stubble height). For meadows in late seral status: limit livestock utilization of grass and grass-like plants to a maximum of 40 percent (or minimum 4-inch stubble height; Determine ecological status on all key areas monitored for grazing utilization prior to establishing utilization levels. Use Regional ecological scorecards and range plant list in regional range handbooks to determine ecological status. Analyze meadow ecological status every 3 to 5 years. If meadow ecological status is determined to be moving in a downward trend, modify or suspend grazing. Include ecological status data in a spatially explicit Geographical Information System database; intensive grazing systems (such as rest-rotation and deferred rotation) where meadows are receiving a period of rest, utilization levels can be higher than the levels described above if the meadow is maintained in late seral status and meadow-associated species are not being impacted. Degraded		

meadows (such as those in early seral status with greater than 10 percent of the meadow area in bare soil and active erosion) require total rest from grazing until they have recovered and have moved to mid- or late seral status.		
121. Limit browsing to no more than 20 percent of the annual leader growth of mature riparian shrubs and no more than 20 percent of individual seedlings. Remove livestock from any area of an allotment when browsing indicates a change in livestock preference from grazing herbaceous vegetation to browsing woody riparian vegetation.		
<u>Riparian Conservation Objective #6:</u> ***Identify and implement restoration actions to maintain, restore, or enhance water quality and maintain, restore, or enhance habitat for riparian and aquatic species.***		
Standards and Guidelines Associated with RCO #6		*Discussion*
122. Recommend restoration practices in: (1) areas with compaction in excess of soil quality standards, (2) areas with lowered water tables, or (3) areas that are either actively down cutting or that have historic gullies. Identify other management practices, for example, road building, recreational use, grazing, and timber harvests, which may be contributing to the observed degradation.	Maintain Width-to-depth ratios for A and E channels of values less than 14 on streams affected by Management Activity Maintain Width-to-depth ratios for B, C and F channels of values greater than 10 on stream channels affected by Management Activity Encourage G channels to trend towards width-to-depths greater than 12.	*See Discussion under S&G 102a.*

	For stable streams (A, B, C, E) maintain or improve channel as necessary based on stability indices. Actions should be taken to maintain or improve stream sites based on successional stage shifts away from stable conditions. For impaired stream reaches (G, F, and D) successional stage shift from the impaired stream reach would show a trend toward an unimpaired condition. <u>Aquic Soil Moisture Regime</u> Maintain soil structure and porosity. Use water dependent vegetation as a surrogate to evaluate riparian soil moisture condition.	*See Discussion under S&G 102d* Areas with aquic soil moisture regime include wet meadows, fens, and riparian soils next to perennial channels where soil moisture levels remain high throughout most of the year. Loss of the aquic soil moisture regime is the result of lowering of the water table due to downcutting from a variety of possible causes. **Functioning Properly** *Water dependent species composition comprises the majority (70-90%) of plant species present. A variety of species and age class are represented. Growth is vigorous and ground continuous. Deep dense root mat is inferred, (Pfankuch 1978)* **Functioning at Risk:** *Water dependent plant species cover ranges from 50-70%; lack of vigor is evident in some individuals and or species. Seedling reproduction is nil. (Pfankuch 1978)* Where feasible restore soil moisture through re-establishment of water table elevation. Use water dependent vegetation as a surrogate to evaluate riparian soil moisture condition. Water dependent species show increase in plant species composition, vigor and density percentages from post project condition. Ecological

		condition is for riparian areas function at risk is degraded. Features associated with Degraded Ecological riparian sites include: • Stream bank erosion, or • Decrease in stream bank vegetation **Impaired Function:** *Less than 50% of the ground is covered root mass is discontinuous and shallow. Water dependent species are diminished in presence (Pfankuch 1978).* Soil Moisture regime may be relict depending on the potential for ecological restoration. Determination if site is damaged or destroyed relative to riparian function. Damaged riparian condition associated with riparian sites has the potential for restoration of soil moisture regime. Restoration treatments could focus on changes in management activity depending on the extent of damage. Indicators of Damaged Ecological riparian sites include: • Decrease in stream bank vegetation • Down cutting of channel • Partial entrenchment of channel Riparian areas in Destroyed Ecological condition associated with riparian sites have no or limited soil moisture to support aquatic soil moisture regime. Riparian dependent species are absent. These areas need to be actively restored.

		Indicators of Destroyed Ecological riparian sites include: • Extensive vertical erosion • Extensive entrenchment of stream channel • Disconnection of stream flows onto floodplain • Change in wetland vegetation to dry upland species

Appendix C: Stream Condition Inventory (SCI)

Long Term Monitoring within the Giant Sequoia National Monument Watersheds

The purpose of the Pacific Southwest Region Stream Condition Inventory (SCI) is to collect intensive and repeatable data from stream reaches to document existing stream condition and make reliable comparisons over time within or between stream reaches. SCI is therefore an inventory and monitoring program. It is designed to assess effectiveness of management actions on streams in managed watersheds (non-reference streams), as well as to document stream conditions over time in watersheds with little or no past management or that have recovered from historic management effects (Frazier, et al., 2005).

Several SCI sites have been implemented throughout Sequoia National Forest. The table below lists all the SCI sites, locations, and years surveyed within the Giant Sequoia National Monument. Any future projects within the Giant Sequoia National Monument will use existing sites and/or implement new monitoring sites depending on the timing, location and scope of the proposed project.

Table 1 -Stream Condition Inventory sites associated with Watersheds of the Giant Sequoia National Monument

Watershed (HUC 5)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Mill Flat	18030001005	Long Meadow Creek	Above Hume Lake	Hume Lake	2002, 2004	B3	Naturally-stable	Low
Mill Flat	18030001005	Tenmile Creek	At Tenmile Campground	Hume Lake	2002, 2007	B4c	Stable-sensitive	Moderate-High
Mill Flat	18030001005	Mill Flat Creek	Near Goodmill	Hume Lake	2003, 2004, 2005, 2007	B3	Naturally-stable	Low
Mill Flat	18030001005	Bear Skin Creek	Near Diabetic Camp	Hume Lake	2003, 2004	C5	Stable-sensitive	Moderate
Mill Flat	18030001005	Sampson Creek	Sampson Flat	Hume Lake	2003, 2004, 2005	F4	Unstable-sensitive Degraded	Extreme

Watershed (HUC 5)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Mill Flat	18030001005	Converse Creek	Converse Creek	Hume Lake	2004, 2007	E3b	Stable-sensitive	Low
Mill Flat	18030001005	Abott Creek	Above Mill Flat Creek	Hume Lake	2005	B4a	Stable-sensitive	Moderate
Middle Kern River	1803000105	Holby Creek	Near Holby Mdw	Western Divide	2002, 2006	B4c/1	Stable-sensitive	Low
Middle Kern River	1803000105	Parker Meadow Creek	At Parker Meadow	Western Divide	2003, 2008	B4c	Stable-sensitive	Moderate
Middle Kern River	1803000105	Bone Creek	Below Last Chance Meadow	Western Divide	2008	B4a	Stable-sensitive	Moderate
Middle Kern River	1803000105	Freeman Creek	Downstream of North Road Crossing	Western Divide	2008	B4c	Stable-sensitive	Moderate
Middle Kern River	1803000105	South Creek	SW of Johnsondale	Western Divide	2008	C4b	Stable-sensitive	Moderate
Middle Kern River	1803000105	Tobias Creek	Near Fairview	Kern River	2002, 2003, 2004, 2005	B3	Naturally-stable	Low
Middle Kern River	1803000105	Dry Meadow Creek	Off Lloyd Mdw Rd below Horse Canyon	Western Divide	2004	B3c	Naturally-stable	Low
Little Kern River	1803000104	Lower Clicks Creek	Above Junction Meadow	Western Divide	2002, 2007	E5	Stable-sensitive	Low
Little Kern River	1803000104	Fish Creek	Loggy Meadow	Western Divide	2007, 2008	C6	Stable-sensitive	Low

Watershed (HUC 5)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Middle Fork Tule River	1803000601	SFMF Tule River	Belknap Campground	Western Divide	2001, 2006	B3a	Naturally-stable	Minimal
Middle Fork Tule River	1803000601	Boulder Creek	Deep Mdw	Western Divide	2001, 2006	C6	Stable-sensitive	Moderate
Middle Fork Tule River	1803000601	NFMF Tule River	Camp Wishon	Western Divide	2001, 2006	B3a	Naturally-stable	Minimal
Middle Fork Tule River	1803000601	Moorehouse Creek	Above Old Fish Hatchery, at Mahogany flat	Western Divide	2005	B4a	Stable-sensitive	Moderate
Middle Fork Tule River	1803000601	Trib to SFMF Tule River	Camp Nelson	Western Divide	2005	B3	Naturally-stable	Low
Middle Fork Tule River	1803000601	Bear Creek	Near trib to Coy Creek	Western Divide	2008	B3a	Naturally-stable	Low
Middle Fork Tule River	180300601	SFMF Tule River	Southeast of Mahogany Flat	Western Divide	2001	B3c	Naturally-stable	Minimal
Middle Fork Tule River	1803000601	Wilson Creek	Below Black Mtn Grove	Western Divide	2006	B3a	Naturally-stable	Low
Mill Creek	18030000108	Mill Creek	Below Cedarbrook	Hume Lake	2004, 2008	B4a	Stable-sensitive	Moderate
Upper North Fork Kaweah River	1803000704	Pierce Creek	Pierce Valley Upper Watershed	Hume Lake	2002, 2006, 2008	B3	Naturally-stable	Low

Watershed (HUC 5)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Upper North Fork Kaweah River	18030000704	Eshom Creek	Above Heartland	Hume Lake	2003, 2005	C4	Stable-sensitive	Moderate
Upper North Fork Kaweah River	18030000704	Stony Creek	Below Stony Creek Store and Campground	Hume Lake	2004	B3	Naturally-stable	Low
Upper North Fork Kaweah River	18030000704	Trib to Woodward Creek	Above Stony Creek near Montecito Sequoia	Hume Lake	2005	B5	Stable-sensitive	Low
North Fork Tule River	1803000602	Bear Creek	Bear Creek at SCICON	Western Divide	2001, 2006	B4c	Stable-sensitive	Moderate
North Fork Tule River	1803000602	Bear Creek	Bear Creek by CCC camp	Western Divide	2007	B5a	Stable-sensitive	Moderate
Upper Poso Creek	1803000401	Lower Spears Creek	Spear Creek below Poso Park	Western Divide	2002, 2006	B4	Stable-sensitive	Moderate-High
Upper Poso Creek	1803000401	Upper Spears Creek	Spear Creek above Poso Park	Western Divide	2002, 2006	B4	Stable-sensitive	Moderate-High
Lower South Fork Kings River	18030001003	Little Boulder Creek	Little Boulder Creek	Hume Lake	2003, 2004	B4	Stable-sensitive	Moderate
Lower South Fork Kings River	18030001003	Boulder Creek at Big Meadows Creek	Big Meadows	Hume Lake	2004, 2008	C6	Stable-sensitive	Low
Upper Deer Creek	1803000502	Capinero Creek	Near Capinero Campground	Western Divide	2001, 2006	B5c	Stable-sensitive	Moderate

Watershed (HUC 5)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Upper Deer Creek	1803000502	Deer Creek	Near Leavis Flat	Western Divide	2001, 2006	B4	Stable-sensitive	Minimal
Upper Deer Creek	1803000502	Starvation Creek	Section 21 on Starvation Creek	Western Divide	2001, 2006	B5c	Stable-sensitive	Minimal
Upper Deer Creek	1803000502	Merry Creek	Trib to Tyler Creek	Western Divide	2006	B4a/1	Stable-sensitive	Low
Upper White River	1803000501	White River	Near Betty Waller Mdw	Western Divide	2001, 2006	B3	Naturally-stable	Low

Appendix D: Zone of Influence for Giant Sequoia Groves

Inventory Priorities for Giant Sequoia Groves

Potential Zone of Influence for Giant Sequoia Groves

In 1999 a team of scientists and resource professionals were assembled by Forest Supervisor Gaffrey. The objective of the team was to define a zone, based on the best available science, within which key ecological processes, structures, and functions should be evaluated during land management planning activities to help ensure that giant sequoia groves on national forest lands are preserved, protected, and restored. In other words, develop a map and supporting documentation that shows the zone within which a land manager must ask the question "What are the potential effects to giant sequoia ecology if I implement this project?" The purpose of this zone is to ensure that ecological processes, composition, and structure are adequately considered in land management planning (North et.al. 2002).

This team defined the boundaries of "Potential Zones of Influence" for Giant Sequoia Groves or ZOIs. ZOI boundaries were established by the following process:

1. Plotting the tree line boundaries of the groves. The tree line was used as the starting point for the ecological boundary of the giant sequoia groves rather than the administratively-defined 500 foot buffer established under the MSA.
2. Identifying a 400 meter buffer beyond the tree line to reflect the need to consider potential effects on terrestrial considerations (Chapter IV in North et.al, 2002).
3. Plotting the results of steps 1 and 2 and overlaying these with watershed boundaries developed in association with surface water drainage of the groves. These subwatersheds provided the uppermost boundaries for the zones of potential influence and ensured that any potential effects, both direct and indirect, on subsurface and/or surface flow would be considered.
4. Identifying the stream stability ratings for the portions of the streams that flow through and out of the groves.
5. Identifying the nearest stable stream channel below the grove, which was used as the downstream (lower) boundary of the subwatershed boundary.
6. Refining the subwatershed boundaries to ensure that the stream channels identified in Step 5 were included

Stream Channel Stability Inventory Prioritization

Step five associated with the identification Potential Zone of Influence (ZOI) for groves as described above involves identification of the nearest stable stream channel below the grove. The potential for head-ward movement is the main concern associated with defining the downstream boundary of the zone of influence. The potential is highest in riparian ecotypes identified as Unstable-Sensitive-

Degraded, landslide prone Naturally-Unstable ecotypes, and delicate Stable-Sensitive ecotypes (Kaplan-Henry, 2007). Therefore terminating the hydrologic zone of influence in these areas would not provide protection from head-ward erosional processes. Similarly, if the channel has not been surveyed and the stability of the stream course is unknown it is difficult to define an area of potential influence. It is assumed that Naturally-Stable channels have a very low potential for head-ward movement upstream. Based on these assumptions two conditions were identified in North et.al, (2002) and recommendations for assigning the lower ZOI boundary are as follows:

a. When riparian ecotype is unknown, the zone is terminated at the nearest confluence with the next major stream or at the first Naturally-Stable ecotype below the grove location depending on whichever is closer.
b. When riparian ecotype is known, the zone is terminated at the first Naturally-Stable ecotype below the grove location.

It is expected that stream channels where downstream riparian ecotype is unknown would eventually be surveyed and assigned an ecotype. Once riparian ecotypes are identified, the ZOI could be refined based on this new information. The need to survey the downstream extent of a ZOI would be based on need and a desire to refine the lower boundary.

Therefore the purpose of stream stability inventory is to define the downstream extent of the ZOI for sequoia groves. Stream channel inventory in the vicinity of giant sequoia groves has occurred commensurate with past inventory needs and as a result not all ZOI's for all groves have been "fine tuned" based on existing riparian ecotype or channel type. In the absence of this information a conservative and larger ZOI was employed for grove protection. Grove watersheds are prioritized herein for inventory based on the extent of past surveys. Priorities are defined as high, moderate or low. Table 1 defines inventory priority.

Table 1 – Inventory Priority

Inventory Priority Rating	**Definition of Inventory Priority Rating**
High	Stream stability inventories not complete. ZOI's are defined at the nearest confluence with the next major stream or at the first Naturally-Stable ecotype below the grove location depending on whichever is closer.
Moderate	Partial stream stability inventories completed. ZOI defined based on either condition as defined above or where known ZOI is well defined.
Low	Minimal need for inventory. Well defined ZOI's with complete stream stability inventory

Inventory Priority for Northern Portion of Giant Sequoia National Monument

The northern portion of the Giant Sequoia National Monument (GSNM) is located on the Hume Lake Ranger District (HLRD) and contains 13 giant sequoia groves. Table 2 summarizes the groves and inventory priority of the hydrologic Zone of Influence (ZOI) watersheds by sequoia grove. Thirteen percent of the ZOI are well defined and are low priority for stability inventory, 38% are of moderate priority having a partial inventory and 49% are high priority with no inventory. It is these ZOIs that are terminated at the nearest confluence with the next major stream or at the first Naturally-Stable ecotype below the grove location depending on whichever is closer.

Table 2 - Inventory Priority Rating for each subwatershed within Northern Portion of the Monument

Sequoia Grove Name	Number of Subwatersheds	Inventory Priority		
		High	Mod	Low
Abbot Creek	2		1	1
Agnew	1	1		
Bearskin	2		1	1
Big Stump	5		5	
Cherry Gap	4	2	2	
Converse Basin	13	11	2	
Deer Meadow	1	1		
Evans Complex	10	6		4
Grant	2		2	
Indian Basin	1		1	
Landslide	1		1	
Monarch	1	1		
Redwood Mountain	4	1	3	

Abbott Creek Grove and Grant Grove are located in the same watershed. Unnamed tributary to Abbott Creek flows directly through Abbott Creek grove and is partially inventoried. Unnamed tributary to Abbott Creek is inventoried and the downstream extent of the ZOI defined based on stream stability inventory.

Agnew is within Rattlesnake Creek watershed (2EB), Deer Meadow is within Footman Canyon watershed (2EC), and Monarch is within an unnamed subwatershed (2GF). The ZOI for these watersheds have the potential to be refined through stream inventory surveys.

Bearskin Grove occupies two watersheds. The western watershed drains Bear Skin Creek and has a well defined ZOI. The ZOI in the eastern watershed is partially inventoried and drained by unnamed tributary to Tenmile Creek

Big Stump grove is drained by five subwatersheds flowing into Mill Creek. The grove is located west of the Forest Service-Park Service boundary. Watersheds associated with this grove are partially inventoried.

Cherry Gap Grove is located within the headwaters of Abbott Creek. There are four unnamed tributaries within the watershed. Half of the watersheds are not inventoried while the remainders are partially inventoried.

Converse Basin Grove is drained by 14 watersheds. Eleven of these watersheds are not inventoried. The un-inventoried watersheds are located along the grove boundary. The remaining two watersheds, drain Converse Creek within the center of the grove, are partially inventoried.

Evans Complex consists of 6 groves; Evans, Boulder, Little Boulder, Lockwood, Kennedy, and Horseshoe Bend. Ten watersheds drain the Evans Complex. The northernmost six watersheds are not inventoried. Watershed associated with Buckrock and Little Boulder Creek have well defined ZOI's.

Grant Grove and Abbott Creek Grove are drained by an unnamed tributary to Mill Flat Creek. This watershed is partially inventoried.

Indian Basin Grove is drained by Indian Creek and an unnamed creek. The unnamed tributary to Indian Creek is partially inventoried.

Landslide Grove is drained by Landslide Creek watershed. This watershed is partially inventoried.

Redwood Mountain Grove is drained by four watersheds, which confluence with Eshom or Pierce Creek Watersheds. These watersheds are partially inventoried.

Inventory Priority for Southern Portion of Giant Sequoia National Monument

The Southern portion of the Giant Sequoia National Monument (GSNM) includes portions of the Western Divide Ranger District (WDRD). The WDRD contains 20 Sequoia Groves. Table 3 summarizes the stream stability inventory priority by sequoia grove. Twenty-nine percent of the ZOI watersheds are well defined based on channel type, 51% are of moderate priority, having partial inventory and 20% are high priority with no inventory. It is these ZOIs that are terminated at the nearest confluence with the next major stream or at the first Naturally-Stable ecotype below the grove location depending on whichever is closer.

Table 3 - Inventory Priority Rating for each subwatershed within Southern Portion of the Monument

Sequoia Grove Name	Number of Subwatersheds	Inventory Priority		
		High	Mod	Low
Alder Creek	2		2	
Belknap Complex	9	1	1	7
Black Mountain	4	4		
Burro Creek	1		1	
Cunningham	1		1	
Deer Creek	1		1	
Dillonwood	1		1	
Freeman Creek	6		6	
Long Meadow	2		1	1
Maggie Mountain	1		1	
Middle Tule	1			1
Mountain Home	8	4	4	
Packsaddle	2		2	
Peyrone	3			3
Red hill	2		2	
Silver Creek	1		1	

South Peyrone	1		1	
Starvation Creek	1			1
Upper Tule	1	1		
Wishon	1			1

Alder Creek Grove is drained by South Alder Creek and Hossack Creek which are both partially inventoried.

Belknap Complex includes four groves, Belknap, Wheel Meadow, McIntyre, and Carr Wilson that drain into the South Fork Middle Fork (SFMF) Tule River. ZOI associated with groves on the north side of the SFMF Tule River are well defined the remainder are not inventoried with the exception of Bear Creek which is partially inventoried.

Black Mountain Grove is drained by three watersheds. The western watershed drains the headwaters of Long Canyon, Deadman Creek, and Wilson Creek are not inventoried.

Burro Creek Grove is located in a portion of Mountain Home State Park Headwaters of Burro Creek are partially inventoried.

Cunningham Grove is drained by tributary to Parker Meadow Creek, this watershed is partially inventoried.

Deer Creek Grove is drained by an unnamed tributary to Deer Creek which is partially inventoried.

Dillonwood Grove is drained by the headwaters of the North Fork Tule River which is partially inventoried.

Freeman Creek Grove is drained by Freeman Creek which is partially inventoried.

Long Meadow Grove is drained by Long Meadow Creek and Parker Meadow Creek. Parker Meadow Creek has a well defined ZOI and Long Meadow Creek is partially surveyed.

Maggie Mountain Grove is drained by headwaters of Galena Creek. This watershed is partially surveyed.

Middle Tule Grove is shared between Mountain Home State Forest and the Sequoia National Forest’s portion of the Golden Trout Wilderness. The North Fork Middle Fork (NFMF) Tule River is inventoried and has a well defined ZOI.

Mountain Home Grove drains into two watersheds; North Fork Middle Fork Tule River and the North Fork of the Tule River. These watersheds are partially inventoried.

Packsaddle Grove contains Packsaddle Creek (8IF) and Unnamed (8IG) watersheds. Within the subwatershed there are three streams. From west to east, the names are Windy Creek, Packsaddle Creek, and an unnamed tributary to Packsaddle Creek. The grove resides in the middle of the three streams on packsaddle Creek. The subwatersheds are partially inventoried.

Peyrone Grove contains 3 subwatersheds. The northern watershed, (4EC), contains Cedar Creek and has an inventory priority rating of a 3. The southern watershed, (4ED), contains an unnamed tributary to Cedar Creek. The ZOI for this grove is well defined.

Red Hill Grove is drained by the headwaters of the South Fork Tule River and an unnamed tributary to South Fork Tule River. Both watersheds are partially inventoried.

Silver Grove is drained by Silver Creek. The lower portion of the watershed is within the Sequoia National Forest, the middle Mountain Home State Forest, and the upper portion the Sequoia National Forest's Golden Trout Wilderness. The portion of Silver Grove in the GTW is not located within the Monument. This watershed is partially inventoried.

Peyrone Grove is drained by Windy Creek and tributary to Windy Creek. Windy Creek is surveyed defining the ZOI; tributary to Windy Creek is partially surveyed.

Starvation Complex is drained by Starvation Creek. Starvation Complex has a well defined ZOI.

Upper Tule Grove resides within the North Fork Middle Fork Tule River subwatershed (4BL). Wishon Grove is drained by the North Fork Middle Fork (NFMF) Tule River and has a well defined ZOI.

Wishon Grove is drained by the North Fork Middle Fork (NFMF) Tule River and has a well defined ZOI.

Appendix E: Meadow Condition

Meadow Conditions for the Giant Sequoia National Monument

Meadow Condition Classification

Meadow conditions for the Giant Sequoia National Monument were developed based on survey information. Meadows have been grouped into three condition classes. Not all meadows have been surveyed. Meadow condition class is defined as Functioning, Functioning-at-Risk, and Impaired Functioning. Details of each condition class are listed below.

<u>Functioning</u>: Functioning meadows are able to adjust and recover from natural and/or human caused disturbances. Meadows in this condition class often do not have a defined channel however if a channel is present stream bank erosion is minimal, deposition of mid channel bars is minimal or lacking, and stream bank protection from vegetation is good or excellent. Adequate bank vegetation provides protection and stability throughout the meadow. Meadow vegetation composition consists of obligate wetland species. Conifer encroachment is minimal to non-existent. Past restoration structures and treatment, if present, add to meadow function and are not responsible for negative impacts to stability Meadows with stream channels are able to effectively and efficiently transport sediment. Bankfull flows or flood waters access the floodplain.

<u>Functioning-at-Risk</u>: Functioning-at-risk meadows represent meadow conditions that are degraded. Degraded meadows have subtle or gradual changes that reduce the integrity and health of the system. Meadows of this condition class generally have a defined channel that exhibits stream bank erosion with some intermittent erosion at out curves and constrictions, raw stream banks may be up to a foot high. Bank vegetation is at 70 to 90% density with fewer species or less vigor suggesting a less dense root mass. Sediment transport is becoming inefficient and in channel deposition is present as new mid channel bars comprised mostly from coarse material. Flood waters may only access a portion of the floodplain.

<u>Impaired Functioning</u>: Meadows with impaired function represent damaged meadow conditions that are damaged and trending toward destroyed. A damaged meadow shows acute and obvious changes. Destroyed meadows show severe degradation or damage that ultimately affects habitat conditions for all macroscopic life and drastically alters the physical environments. Ultimately these meadows no longer function as meadows. Stream bank erosion is significant with cuts greater than a foot and continuous with root mat overhangs and sloughing evident. Root mat overhangs show evidence of failure. Bank vegetation is at less than 50% density with lower vigor and fewer species indicating a poor and discontinuous and shallow root mass. Meadow vegetation composition is shifting to dryer species, suggesting lowering of local water table. Sediment transport is efficient and moderate of deposition of new gravel and course sand on old and some new mid channel bars is evident. Channel is access floodplain is discontinuous.

Meadow condition in the Monument is 36 percent functioning, 59 percent functioning at risk, and five percent impaired functioning. Table 7 provides a detailed summary of meadow condition within the Giant Sequoia National Monument.

Table 7 Existing condition of Meadows in Monument Lands

Watershed	Meadow Name	Year Surveyed	Condition at year of Survey	Erosion Features Present	District
1CF	Polly Meadow	1994	Functioning at Risk	Unknown	HL
1G	Horseshoe Meadow	1992	Functioning at Risk	Yes	HL
1GB	Long Meadow	1998	Functioning at Risk	Yes	HL
1GD	Bacon Meadow	1990	Functioning at Risk	Yes	HL
1GD	Bearskin Meadow	2004	Functioning at Risk	Yes	HL
1GD	Log Corral Meadow	1998	Functioning at Risk	No	HL
1GF	Weston Meadow	1997	Impaired Functioning	Yes	HL
1GH	Tornado Meadow	1990	Functioning at Risk	No	HL
2D	Big Meadows	2008	Functioning	No	HL
2DB	Summit Rabbit Meadow	1989	Functioning	No	HL
2DB	Unnamed Stringer E	1997	Functioning	No	HL
2DE	Unnamed Stringer D	1997	Functioning	No	HL
2EE	Unnamed Stringer B	1997	Functioning	No	HL
2EE	Unnamed Stringer C	1997	Functioning	No	HL
2FB	Redwood Creek	1995	Functioning	Unknown	HL
2FD	Windy Gulch	1995	Functioning	Unknown	HL
3BB	Meadow Flat	1989	Functioning at Risk	No	HL
3CA	Pierce Meadow	1994	Functioning at Risk	Unknown	HL
18ED	O'Quinn Meadow	1993	Functioning	Yes	WD
18EE	Bull Run Meadow	1993	Functioning at Risk	Yes	WD
1CI	Hitchcock Meadow	1991	Functioning at Risk	Yes	WD
2BC	Horse Corral	1994	Impaired Functioning	Yes	WD
3BB	Evans Meadow	1991	Functioning at Risk	Yes	WD
4DA	Smith and Failing	1991	Functioning at Risk	No	WD
4DC	Boulder Meadow	1995	Functioning at Risk	Yes	WD
4DH	Deep Meadow	2006	Functioning at Risk	Yes	WD
4DO	Quaker Meadow	1990	Functioning	Unknown	WD
5AD	Marshall Meadow	1990	Functioning	No	WD
7BJ	Loggy Meadow	2009	Functioning	No	WD
7CB	Clicks Creek Meadow	2007	Functioning at Risk	Yes	WD
7CB	Upper Clicks Creek Meadow	2009	Functioning at Risk	Yes	WD
7CB	White Meadow	1996	Functioning at Risk	Yes	WD
8AA	Freeman Meadow	1992	Functioning at Risk	Yes	WD
8AA	Freeman Meadow Trib	1991	Functioning at Risk	Yes	WD
8AC	Lloyd Meadow	1994	Functioning at Risk	Yes	WD

8CA	Holby Meadow	2009	Functioning at Risk	No	WD
8CA	Kramer Meadow	1994	Functioning at Risk	Yes	WD
8CC	Peppermint Meadow	1988	Impaired Functioning	Yes	WD
8GG	Dry Meadow at Dry Meadow Creek	1994	Functioning at Risk	Yes	WD
8HA	Mule Meadow	1995	Functioning	No	WD
8HC	Bone Meadow	1995	Functioning at Risk	Yes	WD
8HC	Crane Meadow	1980	Functioning	Yes	WD
8HC	Last Chance Meadow	2009	Functioning at Risk	Yes	WD
8HD	Long Meadow	2009	Functioning at Risk	Yes	WD
8IA	Horse Meadow	1991	Functioning at Risk	Yes	WD
8IA	Soldier Meadow	1992	Functioning	No	WD
8IB	Parker Meadow	1998	Functioning at Risk	yes	WD
8IB	Upper Parker Meadow	1998	Functioning at Risk	Unknown	WD
8IC	Holey Meadow	1992	Functioning	No	WD
8ID	Double Bunk Meadow	1994	Functioning at Risk	No	WD
8IE	Bear Meadow	1991	Functioning at Risk	No	WD
8IE	Powderhorn Meadow	1991	Functioning at Risk	Yes	WD
8IF	Bear Meadow along Bear Creek	1994	Functioning	Yes	WD
8IF	Packsaddle Meadow	1995	Functioning at Risk	Yes	WD
8IG	Clover Meadow	1992	Functioning	No	WD
8IG	Speas Meadow	1992	Functioning	Yes	WD
8IH	Bear Meadow	1992	Impaired Functioning	Yes	WD
8IH	French Joe Meadow	1995	Functioning	Yes	WD
7CB	Junction Meadow	1993	Functioning	Yes	WD

Meadow Conditions - Northern Monument

The northern portion of the Monument has 53 percent meadow condition functioning at risk. The remaining 47 percent is functioning. There are no meadows classified as impaired functioning. Details about each meadow are below.

Bacon Meadow has erosion most like resulting from recreation use. Meadow condition is functioning at risk.

Bearskin Meadow is located near a diabetic camp with high use during the summer months. Numerous willows cover the banks and floodplain of the channel. Near the end of the meadow downcutting and bank erosion is documented. Upper banks are contributing sediment through mass wasting. The meadow is functioning at risk.

Horseshoe Meadow contains two headcuts. Headcuts have created gully erosion in the meadow. Erosion treatments were installed to reduce the headcut effects in the meadow. Meadow's condition is functional at risk.

Log Corral Meadow has excessive bank erosion. Vegetation covers over half the channel within the meadow. Deposition of fine sediments into the channel occurs over the majority of the stream. The meadow's condition is functioning at risk.

Long Meadow near Hume Lake Christian camp exhibits gully erosion. Water is diverted from the meadow and used as a source of drinking water. Meadow's condition is functional at risk.

Meadow flat has numerous check dams below Eshom campground resulting in lateral erosion. The meadow's condition is functioning at risk.

Pierce Meadow riparian vegetation is sparse while cutting and deposition is continuous and extensive. Bank failures are imminent and deposition of fine material is extensive. More than 50% of the channel bottom is affected by scouring and depositional processes. In 1995 a fence was constructed around the west and north sides of the meadow to keep cattle from drifting into the meadow until desired. The meadow's condition is functioning at risk.

Polly Meadow along Abbott Creek is a highly vegetated. Deposition is relatively high providing new gravel and coarse sand accumulating on old and some new mid channel bars. Scouring and deposition is at a minimal with less than 5% of the channel bottom is affected. Surveys determined the meadow's condition is functioning at risk.

Redwood Creek Meadow has moderate depositional features with good vegetation cover along the banks Minimal deposition of excess sediment is occurring (<5%). Meadow condition is functioning.

Summit Rabbit Meadow was affected by road runoff. The road was obliterated and effects associated with the road have since declined. There are no erosion features present in the meadow that would cause concern. Meadow condition is functioning.

Tornado Meadow has bank cutting and deposition. Approximately a third of the stream channel has deposition of excess sediment. The creek is entrenched within the meadow potentially causing some dewatering. Meadow condition is functioning at risk.

Unnamed Stringer Meadow B, C, D, & E do not contain erosional features. These meadows are located in the upper portions of the Big Meadows watershed. All four meadows are functioning.

Weston Meadow is located on private property and has a long history of check dam installation and failure. Failures have created bank erosion, excess deposition, and loss of aquatic habitat. Meadow condition is impaired functioning.

Windy Gulch contains a meadow with no defined channel. Banks are vegetated with little cutting/erosion. Scouring and depositional processes has only affected a minimal length of the stream; less than 5%. There are no known erosion features causing concern for the meadow. Meadow condition is functioning.

Meadow Conditions - Southern Monument

Meadows in the southern portion of the Monument are 32 percent functioning, 61 percent functioning at risk and 7 percent impaired functioning. Details about each meadow are below.

Bear Meadow along Bear Creek contains no defined channel. At time of survey no overland flow was observed. Above and below the meadow headcuts were observed. Only 25% of the meadow had ground cover. Vegetation is dominated by dryer species. A road is present through the meadow accessing dispersed campsites. Meadow condition is functioning.

Bear Meadow contains a ± 20 foot deep headcut and gullies. The water table is lowering as a result. Meadows condition is impaired functioning.

Bear Meadow vegetative cover encompasses approximately 25% of the meadow with small patches of willows. Two rock structures were placed at the end of each meadow and have breached. The channel is flowing roughly 20 feet below the meadow surface exposing bedrock. Meadow condition is functioning at risk.

Bone Meadow is developing gullies with unstable banks. Bone Meadow has a fence crossing the stream responsible for increased width immediately downstream. Banks are well vegetated with moderate cutting and no deposition. Less than 30% of the channel bottom is affected by scour/depositional processes. Meadow condition is functioning at risk.

Boulder Meadow contains a total of 9 check dams. These were installed for every one foot drop in elevation along a steep, rapidly cutting section of a small headwater stream to Boulder Creek. Two additional check dam structures were placed at the top of two small headcuts. Meadow condition is functioning at risk.

Bull Run Meadow contains several gullies. Several erosion control projects have been implemented to minimize the impacts of the gullies. Vegetation has since returned around the erosion control structures providing additional support and stability. Meadow condition is functioning at risk.

Clover meadow is dry and sandy with patches of willow on the southern end. Raw banks are along some portions of the defined stream channel. Most of the meadow does not have a defined channel. Forest Service road 32S16A is within 200 feet of the meadow to the north. Meadow condition is functioning.

Crane Meadow contained one small headcut. Willows were planted in the area around the head to slow and/or prevent further erosion. A 2-feet diameter concrete spring box is present. Meadow condition is functioning.

Deep Meadow contains armored stream banks due to a headcut eroding the meadow. Downed debris was placed above the project area to discourage livestock use on the site. Two trails run, Summit and Jordan Trail, run alongside the meadow. Summit trail runs along the west side and is contributing minimal amounts of excess sediment into the meadow. The Jordan Trail treks along the south and eastern side of the meadow. No excess erosion was observed entering the channel. Meadow condition is functioning at risk.

Double Bunk Meadow has large and abundant woody debris. Approximately six percent of the stream banks are undercut, providing little habitat for fish. Impacts from roads are occurring along Forest Highway M50 and temporary road #6 (South Creek ESM Analysis, 1995). Dispersed campsites are adjacent to the meadow along with one inside the meadow. Meadow condition is functioning at risk.

Dry Meadow has good vegetative bank protection (70-90% density). Additionally, cutting and deposition are moderate; streambank cutting is less than one foot high and several new mid channel bars are present comprised of coarse gravel. Scour and depositional processes is moderate, with less than 30% of the channel bed affected. Recreation traffic adjacent to parts of the meadow has affected this meadow. Impact rating for this stable-sensitive riparian ecotype is moderate-high. Since 1991, restoration measures have been implemented in this meadow. The last stage of the restoration work was performed in August 1997. Spillways in all the check dams were enlarged and cut down. Enlarging the spillways allowed the stream to reduce its width/depth to that of a reference reach directly upstream of the project. One check dam still needs work and fencing would be installed to designate reduce grazing impacts. Meadow condition is functioning at risk.

Evans Meadow has past erosion control structures in the form of check dams. Meadow condition is functioning at risk.

Freeman Meadow Tributary contains a headcut. Erosion control structures were installed using rocks and logs. Stream banks were armored with rock and logs. Coconut mat was used for soil stabilization and to promote re-vegetation of the site. Numerous check dams were placed upstream of the original headcut to prevent additional headcuts from beginning. Meadow condition is functioning at risk.

Freeman Meadow was impacted by livestock grazing in the past. Check dams were placed upstream of the original headcut to prevent additional headcuts. Meadow condition is functioning at risk.

French Joe Meadow vegetative community is dominantly grasses and sedges. No well defined stream channel flows through the meadow. Meadow condition is functioning.

Hitchcock Meadow contains minor headcuts ranging from one to two inch vertical drops. No evidence of livestock or human use was observed to be causing the problems. Meadow condition is functional at risk.

Holby Meadow Creek was identified as an indistinct channel during a 1995 survey. Vegetative bank protection is fair (~70-90% density) with little to no cutting of the banks. Deposition is moderate with new bars forming while old bars are getting larger. Sour and deposition are relatively low with 5-30% of channel bottom affected. Meadow's condition is functioning at risk.

Holey Meadow has no defined stream channel. Water flows subsurface at certain times of the year. No major erosion problems causing concern. The meadow condition is functioning.

Horse Corral Tributary meadow contains a semi-braided channel. Vegetative bank protection is poor (50%< density), cutting is significant (1-2 ft high), and moderate deposition as new channel bars are forming. About 50% of the channel bottom is affected by scour/deposition processes. Meadow condition is impaired functioning.

Horse Meadow has a history of erosion structure installation since the 1940's. Currently the meadow contains several check dam structures and headcut treatment structures. Excess erosion and bank erosion is present in spots. Vegetation provides a 100% cover throughout the meadow except where previously noted erosion is occurring. Forest Service road 22S04 parallels the meadow to the west. Scour and deposition is affecting 50% of the stream channel. Meadow condition is functioning at risk.

Kramer Meadow has substantial cutting and deposition. The meadow is dry in some spots while others have stagnant pools. A 1991 project installed gully plugs and log structures to reduce the cutting and excess deposition. Rocks were used to armor unstable banks while willow cuttings were planted to promote stabilization. Scour and deposition were relatively moderate, less than 30% of channel bottom affected. A check dam was repaired in Kramer Meadow. Loss of the check dam created a four-foot headcut. The old structures were removed and two new check dams installed. Willows were planted along the creek for bank stabilization. Meadows condition is functioning at risk.

Last Chance Meadow has had past restoration on the upper and lower parts of the meadow. A sustainable, 135 long, step-pool structure was installed at the lower end of the meadow in 1999. The lower portion is now stable. The upper portion contains a large and stable rock walled check dam reinforced with willows and steel bars. The middle portion of the meadow contains an entrenched and downcut channel approximately ten feet below the meadow surface. Meadow condition is considered functioning at risk.

Lloyd Meadow has poor riparian vegetation. Cutting and deposition at the lower banks are minimal while scour/deposition is moderate (30-50% channel affected). Upper banks are unstable with sandy soils. Two lower headcuts were restored to reduce erosion. Meadow condition is functioning at risk.

Loggy Meadow was restored in 2007. Prior to restoration erosion was affecting streambanks, lowering the water table, and allowing for lodgepole encroachment. Meadow restoration has improved condition to functioning.

Long Meadow has several large headcuts at the base of the meadow ranging from approximately two to ten feet in vertical drop. A small vegetative area in the lower portion of the meadow is shifting towards dryer species. Meadow condition is functioning at risk.

Marshall Meadow has good grass cover with corn lily on the edges and two patches of willows. There were neither existing erosion control structures nor signs of erosion. The channel is not well defined throughout the meadow. Meadow condition is functioning.

Mule Meadow bank vegetation is good (70-90% density) with some lateral bank cutting and deposition. 5-30% of the channel bottom is affected by scour/deposition processes. There are no erosional features that cause concern for the stability of the meadow. Meadow condition is functioning.

O' Quinn Meadow contains poor vegetative cover. Erosion features are present in the form of a headcut located in the northern portion of the meadow. Meadows condition is functioning.

Packsaddle Meadow has no defined channel. Where a defined channel exists, in the northeast and southern portions of the meadow, there are numerous headcuts and raw banks. Some of the check dams have failed causing increased erosion and localized instability concerns. Meadow condition is functioning at risk.

Parker Meadow has severe cutting and deposition creating exposed banks above 24" high. Scour and deposition processes were severe with more than 50% of the channel bottom being in a constant state of flux. Past livestock use exacerbated the problem. The areas where these problems are occurring have been fenced. Meadow condition is functioning at risk.

Peppermint Meadows has erosional features causing concern for stability. The meadow's channel is laterally cut (2-3 feet in some places) and has extensive deposition. The channel contains several point bars resulting from high amounts of sediment being deposited in the channel. Scour and deposition affects 50% of the channel bottom is in a constant state of flux. Conditions improve slightly upstream. Meadow condition is impaired functioning.

Powderhorn Meadow contains very little undercut banks (less than 1%). The stream channel has mid channel bars, check dams, and eroded banks below the check dams. A headcut is present at the confluence of two creeks. Two gated Forest Service roads are adjacent to the meadow; 23S11 to the east and 23S15 to the north. Meadow condition is functioning at risk.

Quaker Meadow at Quaking Aspen Campground is fairly well vegetated. Willows grow along portions of the meadow and stream channel. Bank cutting was moderate, between 1-2 feet, and there were some new bar increases (deposition). Between 30-50% of the channel bottom were affected by scour and depositional processes. Rip rap was installed for channel stability and erosion prevention. Meadow condition is functioning.

Smith and Failing Meadow stream banks were armored with rock a headcut restored using logs. Areas where cattle crossings were evident, the crossings were lined with rock to prevent erosion. Check dams were placed upstream of the original headcut to prevent additional headcuts from beginning. The summit trail crosses the upper most portion of the meadow. Excess sediment is currently entering the meadow and affecting stream channel function. Meadow condition is functioning at risk.

Soldier Meadow does not contained a well defined channel. Dispersed campsites and OHV use was observed around the meadow. However, no gullies or erosional features were observed. The southwest corner of the meadow is dry with encroaching white fur. Forest Service road 23S63 parallels the meadow on the west side. Vegetation is providing 100% ground cover on the meadow. Meadow condition is functioning.

Speas Meadow does have a well defined channel that is stable. Willows are at the top of the meadow. Some raw banks were seen in the northeastern portion. Old plantations surround the meadow. Signs of lodgepole encroachment are present. Meadow condition is functioning.

The Upper Clicks Creek Meadow contains several headcuts. Check dams and rock walls were installed to check erosion almost of these dams were ineffective and have failed. New headcuts are developing above the restoration site. Meadow condition is functioning at risk.

Upper Parker Meadow contains four rock check dams. Large willows are present in the south end of the meadow. Three Forest Service roads are adjacent to the meadow; 22S81 to the west, 22S04A to the east, and 22S04 to the south. Dispersed campsites are near the meadow and OHV damage was observed. Meadow condition is functioning at risk.

White Meadow has erosional features that cause concern. Previous attempts to stop the erosion were in the form of check dams. These structures have failed. A larger headcut is migrating up from the bottom of the meadow. Meadow condition is functioning at risk.