Table 2.4 – Road Points, Culverts, Watercourse Crossings and Mitigation Points

Refer also to **ROADS AND MITIGATION POINTS MAP** *for Map Point Locations and Master Legend*
Map polygons in-filled with fine dots are areas of High EHR. Those with vertical lines are slides.

ROAD 3

Length – 5,135′ **Elevation Change** – 0′ **Average Grade =** 0% **Width –** *Single lane with turnouts.*

Road Prism – Varies from full bench to cut & fill. Mostly drained with an inside ditch, but some areas have been outsloped.

Surface – Native material. Some portions rocked.

FPR Classification – Permanent truck road within the plan area. 1,060 feet of WLPZ road segments (four crossings with the balance being road segments parallel to the watercourse).

Notes & Comments: Existing year around primary, ranch access road. Serves as an access for two full time residences on the Miller property and one recreational cabin on the Cook property to the north. Must be maintained for year around access. Like **Road 1** and **Road 2**, this road has a high priority for maintenance and improvements. Upgrade surface over time and continue to outslope where possible and rock the WLPZ segments. Upgrade crossings to the standards recommended in **The Handbook for Forest and Ranch Roads.**

Where applicable, the site descriptions and recommendations from the geology report prepared by SHN Consulting Engineers, March 12, 2001, is included for the map point or road segment described. The complete text of SHN's report is included as an attachment in NTMP Section V.

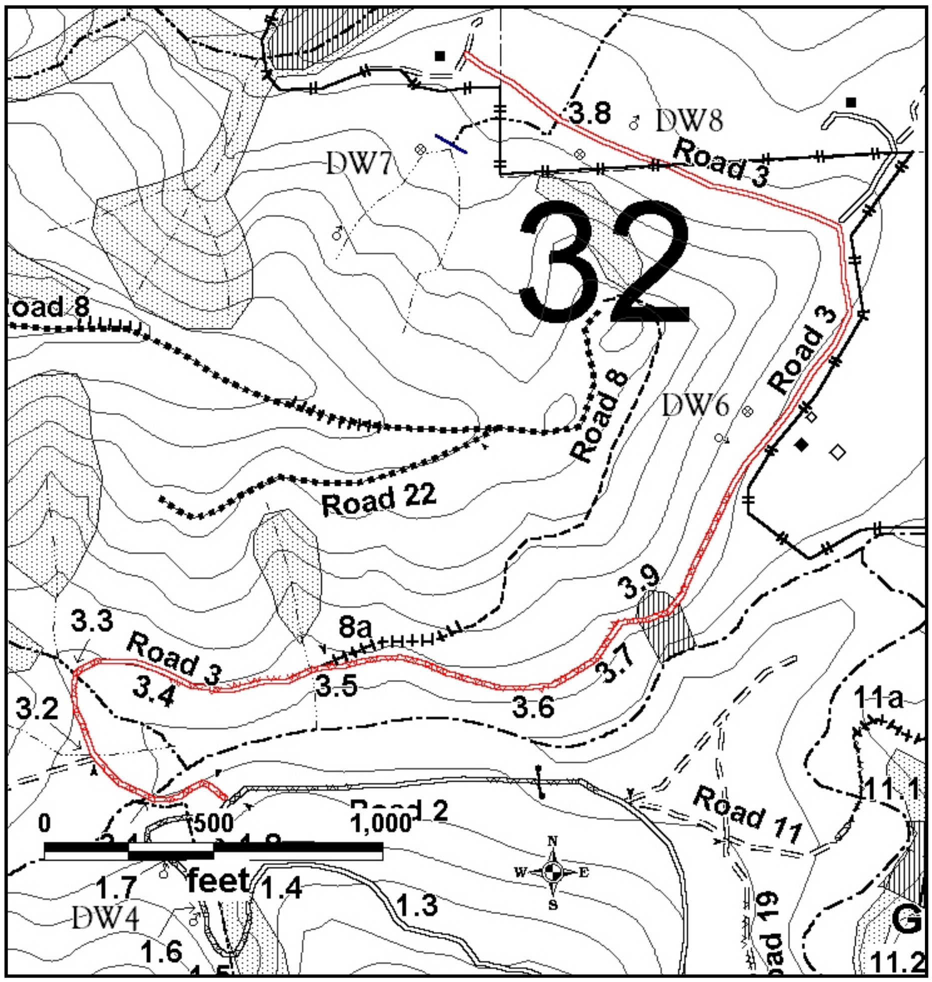


Table 2.4 – ROAD 3: Points, Culverts, Watercourse Crossings and Mitigation Points.

MAP POINT	DESCRIPTION AND MITIGATIONS
3.1	**Description:** Rocked ford at the Class I crossing of Cow Creek. May be Impassable during high water. The streambed contains a rocky substrate and is usually dry at the crossing during the summer months. Generally proposed for timber operations use as a truck road and equipment crossing only during the summer months when there is no surface flow at the crossing. Rick Macedo, DFG biologist, reviewed this crossing in a preconsultation field visit on October 6, 1999. His suggestions are incorporated below. **Treatment:** If the crossing is to be used for timber operations in the period between October 15th of one season and June 15th of the next season, or if water is present in the channel or within 18 inches below the surface of the stream bottom, install a temporary culvert. If crossing is to be used between June 15th and October 15th and no water is present in the stream channel or within 18" below the surface of the stream bottom, then the crossing can be used as a dry ford. **A DFG 1603 agreement shall be obtained before using this crossing for timber operations.**
3.2	**Description:** Existing Class III crossing within the Class I WLPZ. A 15-inch culvert is currently in place. Some sediment is deposited in the culvert. The culvert outlet is partially collapsed, but still working fairly well. The Class III watercourse crosses under the road and then runs down an outboard ditch for approximately 140 feet until it flows directly into the Class I watercourse. The ditch has a rock bottom. **Treatment:** This is the only feasible location in which to drain the Class III watercourse. Maintain the layer of rock in the ditch to dissipate energy of runoff and reduce the potential for downcutting of the ditch. The runoff patterns at this pint have been observed over several winter periods when there were high flows. The water running down the inside ditch into the Class I contained little or no discoloration from sediment.
3.3	**Description:** Class II crossing on existing permanent truck road, **Road 3**. A 24-inch culvert is currently in place. The culvert is working well. The inlet of the culvert extends beyond the fill. Some incising of the fill is occurring below the outlet. **Treatment:** Rock-armor the culvert inlet as per **The Handbook for Forest and Ranch Roads**.
3.4	**Description:** Approximately 400 feet of an inside ditch drains into a Class III watercourse. The inside ditch is downcutting slightly. **Treatment:** Install a 15-inch culvert cross drain at the point flagged by the RPF.

Table 2.4 – ROAD 3: Points, Culverts, Watercourse Crossings and Mitigation Points.

MAP POINT	DESCRIPTION AND MITIGATIONS
3.5	**Description:** Class III crossing. A 24-inch culvert is in place. The culvert is installed at too shallow of a gradient compared to the natural stream channel. The stream channel is downcutting the area below culvert outlet. **Treatment:** Install an energy dissipater at the outlet of the pipe during the initial harvest entry. When the culvert is replaced in the future, install the culvert at or near the same gradient as the natural channel.
3.6	**Description:** A 12-inch culvert cross-drain is in place at this point. The inlet of the culvert is partially collapsed. The culvert serves to drain approximately 150 feet of inside ditch. A bank seep also drains into the inside ditch upstream of the culvert intake. The inside ditch is beginning to fill with sediment near the inlet of the culvert. **Treatment:** Replace collapsed culvert with a 15-inch culvert. Install new culvert at a 30^{o} angle from the ditch line. Excavate ditch to 12 inches below road surface.
3.7	**Description:** A 6-inch plastic pipe cross-drain is in place. The pipe serves to drain 2 bank seeps located at either side of the pipe. The pipe appears to be undersized. Water has been diverted onto the road surface during periods of high flow. This has resulted in a nick in the fill at the outboard edge of the road. **Treatment:** Excavate the inside ditch for the first 65 feet north of the pipe and for the first 40 feet south of the pipe. Install a 15-inch culvert.
3.8	**DESCRIPTION:** This crossing is on the adjacent property owned by Jonathan Cook. Any roadwork on this road section will be undertaken only by joint agreement with Mr. Cook. The description and treatment provided here are advisory only and are not a requirement for this NTMP since the area is outside the NTMP boundary and ownership of the submitter on a non-appurtenant road. A Class II watercourse runs down the inside ditch of **Road 3** for approximately 100 feet, and then crosses the road at a culvert cross-drain. A 15-inch culvert is installed at a 90° angle from the ditch line. The Class II flow hits the culvert inlet and eddies at the back wall of the inlet. Some incising of the road fill is occurring. **TREATMENT:** When the culvert is replaced, install an 18-inch culvert at a 30° angle from the ditch line. Rock armor culvert inlet.

Table 2.4 – ROAD 3: Points, Culverts, Watercourse Crossings and Mitigation Points.

MAP POINT	DESCRIPTION AND MITIGATIONS
3.9	**Description:** The WLPZ road segment passes across a full bench cut within about 50 feet horizontal distance of the west transition line of the Cow Creek channel zone near an outside bend in the creek. The road surface is about 30-40 feet in elevation above the stream channel. The bank below the road is steep and unvegetated. The upper cutbank is also long and steep. Material from the cutbank occasionally sloughs off and is deposited on the road surface. The outboard edge of the road currently has an earthen berm to direct runoff down the road in either direction away from the raw surface of the bank below. There are no suitable alternate routes upslope from this road alignment. The old crossing was located just below the confluence of Cow Creek and Nason Creek and was washed out in the 1964 flood. **Treatment:** Maintain the road width as narrow as possible at one lane and no more than 12 feet of width on the running surface. Whenever loose material is deposited on the road surface, it should be feathered out along the road surface so that the road surface is ramped up and over the debris. Under no circumstance should loose material be sidecast down the bank or the toe of the cut bank further cut away. The berm at the outside edge of the road shall be maintained to divert surface drainage back down the road in either direction where it will not drain onto the surface of the raw bank below the road.
3.10	**Description:** The original channel of the Class II watercourse below the Barrel Spring likely once crossed the **Road 3** alignment at this point. The channel was apparently redirected along the inside ditch of this road segment and now drains to Cow Creek without crossing the road (refer to the description of **Map Point 1.8** on page **67**). The inside ditch and the road are currently stable. The inside ditch does not appear to be downcutting or causing sediment contribution to Cow Creek; probably owing to the low gradient of the channel and the relatively low flow at this point. **Treatment:** No treatment is proposed at this time. The treatment for the portion of the road segment near Cow Creek is described under **Map Point 3.1** on page **70**. The inside ditch and lower channel of the Class II watercourse that crossed **Road 1** at **Map Point 1.8** will be monitored by the RPF or his designee following the installation of the treatment at **Map Point 1.9** at the head of the watercourse. The monitoring will be done to ensure that the increase in water flow resulting from the return to the original watershed drainage pattern does not overwhelm, the inside ditch below **3.10.** If the new drainage pattern creates too much runoff for the inside ditch and results in increased and excessive downcutting, the watercourse may have to be returned to the original channel by adding an 18" culvert crossing at this point on **Road 3** or the inside ditch and the channel below **Map Point 1.8** may have to be rock-armored to dissipate the energy of the added flow.

Table 2.4 – Road Points, Culverts, Watercourse Crossings and Mitigation Points

Refer also to **ROADS AND MITIGATION POINTS MAP** *for Map Point Locations and Master Legend*
Map polygons in-filled with fine dots are areas of High EHR. Those with vertical lines are slides.

ROAD 8

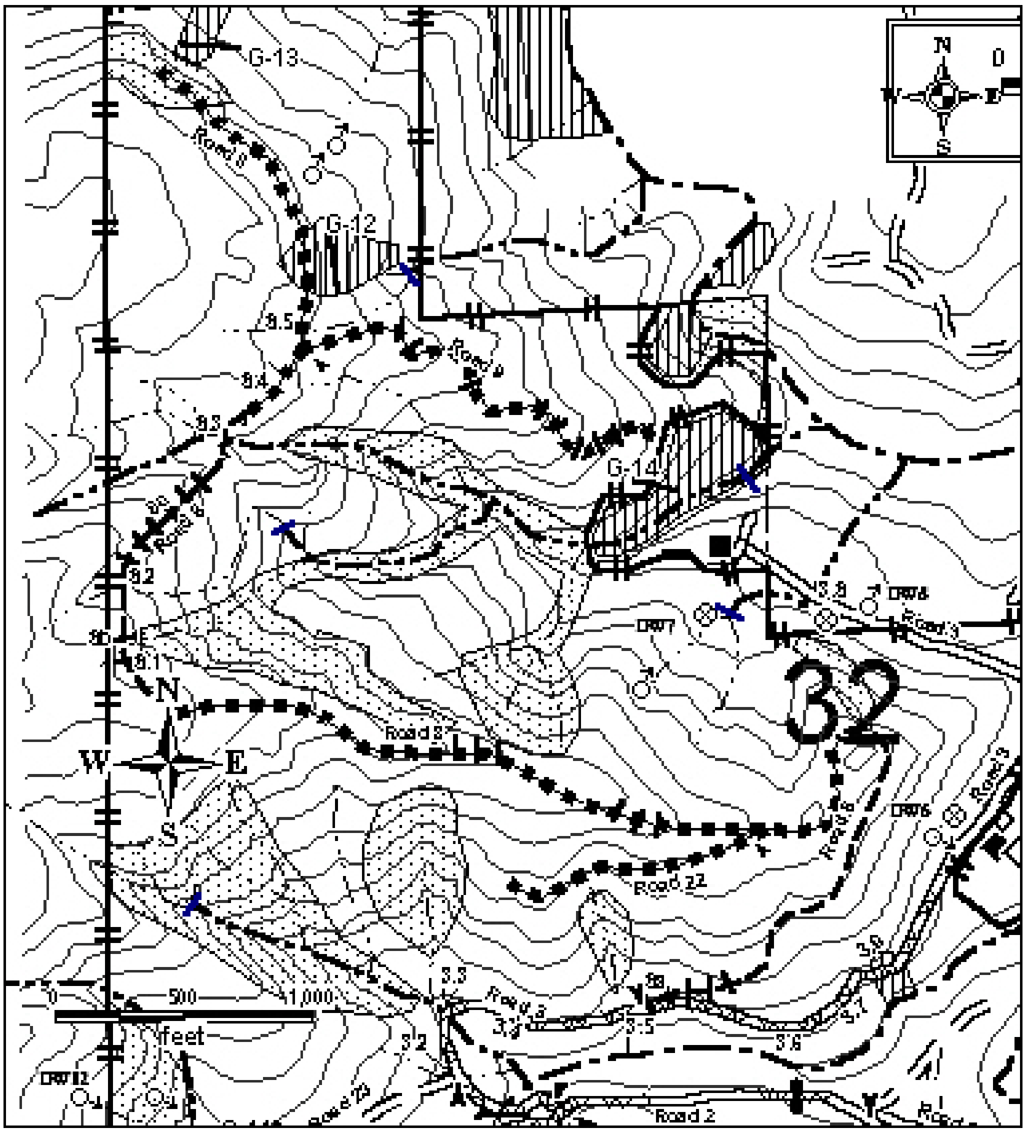
Length – 7,856 ′   **Elevation Change** – 720′   **Average Grade** ≅ 10 %   **Width –** Single lane with turnouts.

Road Prism – Varies from full bench to cut & fill. Much of it ridgetop with no fill.

Surface – Native material.

FPR Classification – Seasonal truck road within the plan area. 200 feet of WLPZ road segment (at crossing **8.3**).

Notes & Comments:



Combination of new construction and reconstruction incorporating existing stable skid trails and segments of entirely new construction. Ties **Road 3** in the valley to the northeastern areas of the ranch. Coupled with its spur roads (**Road 9** and **Road 22) Road 8** provides the only fire and administrative access to the approximately 200-acre northwest portion of the ranch. Some segments along the ridgetop have pitches of 20%, but follow an already existing and stable jeep trail. The most difficult section of Road 8 will be the segment between map point **8.1** and **8.4**. This segment will require an excavator and dump truck for full bench construction and endhaul. The spoils can be deposited on the landing on the ridge south of point **8.1** or be used for fill at the crossing at **8.3**. The segment of **Road 8** between **8.1** and **8.2** is close to the property line. The exact location of the property line needs to be verified before construction to avoid the potential of trespass issues. A property corner marker was located on the north-south section line between sections 31 and 32. The property corner is approximately 8 chains south of the ridge where **Road 8** is located. The northwest corner of Section 32 has also been located and flagged. It is below the break in slope and approximately 40 chains to the north of the point where **Road 8** leaves the ridge.

Table 2.4 – ROAD 8: Points, Culverts, Watercourse Crossings and Mitigation Points.

MAP POINT	DESCRIPTION AND MITIGATIONS
8.1	**Description:** Class III crossing on proposed seasonal road, **Road 8**. Stream channel gradient is 10% at the crossing. The potential for diversion is low. **Treatment:** Install a rock-armored ford.
8.2	**Description:** Class III crossing on proposed seasonal road R8. Stream channel gradient is 10% at the crossing. The potential for diversion is low. **Treatment:** Install a rock-armored ford.
8.3	**Description:** Class II crossing on proposed seasonal **Road 8**. Stream channel gradient is 20% at crossing. The stream channel is incised and approximately 10 feet of fill will be required to bring the road up to the proper grade. The potential for diversion is low. **Treatment:** Install a minimum 24-inch culvert with trash rack at the crossing. Rock armor the inlet and the outlet. Install critical dip in road prism over the culvert to provide a "fail soft" crossing.
8.4	**Description:** Class III crossing on existing seasonal road R8. Stream channel gradient is 10% at the crossing. The potential for diversion is low. **Treatment:** Install a rock-armored ford.
8.5	**Description:** Class III crossing on existing seasonal road R8. Stream channel gradient is 10% at the crossing. The potential for diversion is low. **Treatment**: Install a rock-armored ford.
8a, 8b, 8c	**Description: 8a** and **8c** are exception segments that are located on steep side slopes for more than 100 feet. **8a** is also located in and adjacent to a Class I WLPZ. **8b** is a segment shorter than 100 feet that is located on slopes over 65%. **Treatment**: The three road segments are to be constructed on a full bench using an excavator with the spoils endhauled to a stable location away from the watercourses.
G-12	**Description:** The proposed road alignment passes across the head of a mapped slide (**G-12**). **Treatment**: *Springs may be exposed during the construction of **Road 8** in the vicinity of **Site G-12**. If springs are exposed, construct waterbars or rolling dips below the seeps to direct surface water off of the road surface.* (Geo. Rec. #10).

<u>Anadromous Salmonid Protection Rules, 2009</u>

[Adopted September 9, 2009]

Title 14 of the California Code of Regulations (14 CCR):

<u>Amend</u>:

§ 895	Abbreviations Applicable Throughout the Chapter.
§ 895.1	Definitions.
§ 898	Feasibility Alternatives.
§ 914.8 [934.8, 954.8]	Tractor Road Watercourse Crossing.
§ 916.5 [936.5, 956.5].	Procedure for Determining Watercourse and Lake Protection Zone (WLPZ) Widths and Protective Measures
§ 916 [936, 956]	Intent of Watercourse and Lake Protection.
§ 916.2 [936.2, 956.2]	Protection of the Beneficial Uses of Water and Riparian Functions.
§ 916.9 [936.9, 956.9]	Protection and Restoration in Watersheds with Threatened or Impaired Values.
§ 916.11 [936.11, 956.11]	Effectiveness and Implementation Monitoring.
§ 916.12 [936.12, 956.12]	Section 303(d) Listed Watersheds.
§ 923.3 [943.3, 963.3]	Watercourse Crossings.
§ 923.9 [943.9, 963.9]	Roads and Landings in Watersheds with Threatened or Impaired Values.
§ 916.9.1 [936..9.1]	Protection Measure in Watersheds with Coho Salmon.
§ 923.9.1 [943.9.1]	Measures for Roads and Landings in Watersheds with Coho Salmon.

Amend 14 CCR § 895. Abbreviations Applicable Throughout Chapter.

§ 895. Abbreviations Applicable Throughout Chapter

The following abbreviations are applicable to throughout this chapter:

B & M Baseline and*****

*******cm** Centimeter(s)

CMZ Channel Migration Zone

dbh The average diameter.*****

*****ＰTHP** Program Timber Harvesting Plan

QMD Quadratic Mean Diameter

R Range:*****

*******WLPZ** Watercourse and Lake Protection Zone

WTL Watercourse Transition Line

Note: Authority cited: Sections 4551, 4551.5 and 21082, Public Resources Code. Reference: Sections 4511, 4512, 4513, 4521.3, 4522, 4522.5, 4523-4525, 4525.3, 4525.5, 4525.7, 4526, 4526.5, 4527, 4527.5, 4528, 4551, 4551.5, 4552, 4582 and 21080.5, Public Resources Code.

Amend 14 CCR § 895.1. Definitions.

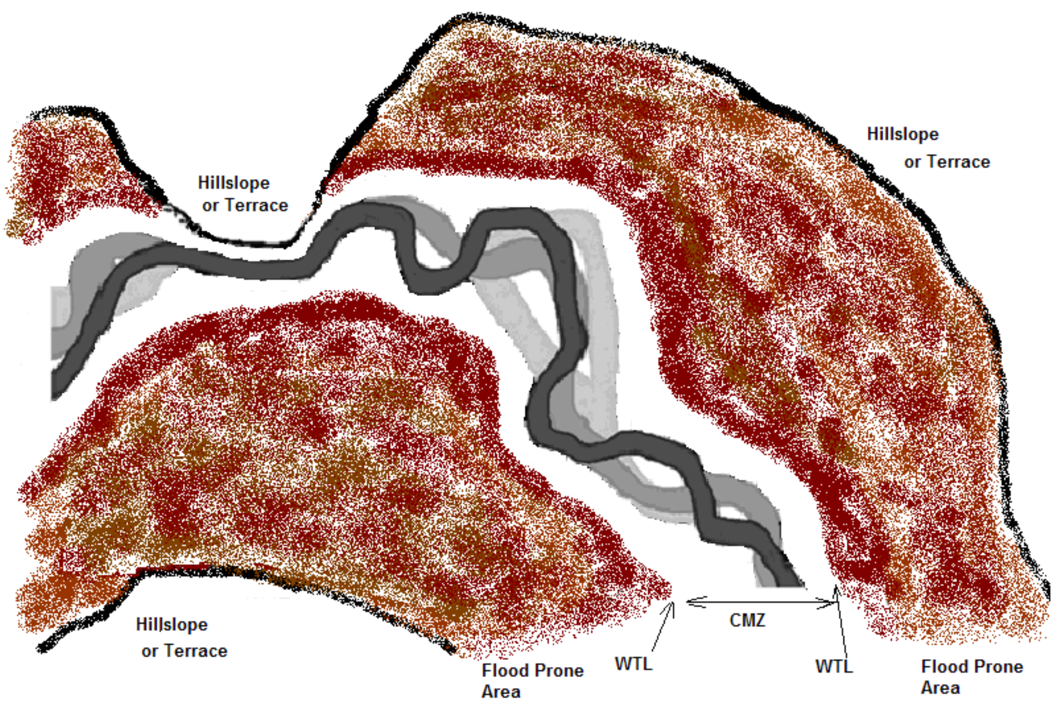
§ 895.1. Definitions.

The definitions*****

*****Canopy** means*****

<u>**Channel Migration Zone** means the area where the main channel of a watercourse can reasonably be expected to shift position on its floodplain laterally through avulsion or lateral erosion during the period of time required to grow forest trees from the surrounding area to a mature size, except as modified by a permanent levee or dike. The result may be the loss of beneficial functions of the riparian zone or riparian habitat (see Figure 1).</u>

<u>Figure 1. Plan view diagram of a simple Channel Migration Zone designation.</u>



Channel zone means that area ~~that includes a watercourse's channel at bankfull stage and a watercourse's floodplain, encompassing the area~~ located between the watercourse transition lines.

Coastal Commission Special treatment area means*****

*******Confidential Archaeological Letter** means*****

*******Confined Channel** means a watercourse with an incised channel that does not shift position on a floodplain, the channel has no contiguous flat, flood prone areas, and the width of the valley floor is less than 2 times the channel width at bankfull stage.

Countable Tree means *****

*******Feasible means*******

*****~~**Fifty-Year Flood Flow** means that magnitude of peak flow which one would expect to be equaled or exceeded, on the average, once every 50 years. This flow shall be estimated by empirical relationships between precipitation and watershed characteristics and run off and then may be modified by direct channel cross-section measurements and local experience.~~

Fill means*****

*******Fire Protection Zone** (For the Coast*****

*******Flood Flow** means that magnitude of peak flow that would, on the average, be equaled or exceeded once every specified period of years (e.g. once every 10 year, 50 years, 100 years). This flow shall be estimated by flood flow measurement records and by empirical relationships between precipitation, watershed characteristics, and runoff, and may be modified by direct channel cross-section measurements informed by local experience.

Flood Prone Area means an area contiguous to a watercourse channel zone that is periodically flooded by overbank flow. Indicators of flood prone areas may include diverse fluvial landforms, such as overflow side channels or oxbow lakes, hydric vegetation, and deposits of fine-grained sediment between duff layers or on the bark of hardwoods and conifers. The outer boundary of the flood prone area may be determined by field indicators such as the location where valley slope begins (i.e., where there is a substantial percent change in slope, including terraces, the toes of the alluvial fan, etc.), a distinct change in soil/plant characteristics, and the absence of silt lines on trees and residual evidence of floatable debris caught in brush or trees. Along laterally stable watercourses lacking a channel migration zone ~~W~~where the outer boundary of the flood prone area cannot be clearly determined using the field indicators above, it shall be determined based on the area inundated by a 20-year recurrence interval flood flow event, or the elevation equivalent to twice the distance between a thalweg riffle crest and the depth of the channel at bankfull stage. When both a channel migration zone and flood prone area are present, the boundaries established by the channel migration zone supersedes the establishment of a flood prone area.

Fluvial means the processes associated with rivers and streams and the deposits and landforms created by them.

Fuelbreak see PRC*****

*******Historic Road** means*****

Hydric means a soil that formed under conditions of saturation, flooding,or ponding long enough during the growing season to develop anaerobic conditions in the upper portions of the soil profile.

Hydrologic Disconnection means the removal of direct routes of drainage or overland flow of road runoff to a watercourse or lake by directing drainage or overland flow onto stable portions of the forest floor to dissipate energy, facilitate percolation, and resist or prevent erosion or channelization.

Inner Gorge means*****

*******Lake Tahoe region** means*****

Lake Transition Line means that line closest to the lake where mesic vegetation is permanently established.

*****Landing** means*****

*****Predominant Trees** means*****

*****Pre-existing Large Wood** means, for Class III watercourses in watersheds with listed anadromous salmonids:

(a) a log or tree segment that is (i) at least 12 inches or greater in diameter outside bark when measured at the small end, (ii) at least six feet in length, (iii) in contact with the ground, and (iv) present prior to timber operations.

(b) a root wad that is (i) at least 12 inches or greater in diameter outside bark when measured at the base of the trunk, (ii) in contact with the ground, and (iii) present prior to timber operations.

*****Prescribed Maintenance Period** means*****

*****Project** means*****

***** **Properly Functioning Salmonid Habitat** means the beneficial functions of the riparian zone are suitable for all life-history stages of listed anadromous salmonid species that would be expected to occur in specific geomorphic conditions considering spatial and temporal variability.

Public Fire Agency means*****

*****Riparian** means*****

*****Riparian-Associated Species** means those plant, invertebrate, amphibian, reptile, fish, or terrestrial wildlife species that require utilization of riparian zones ~~areas~~ during any life history stage

Rip Rap means*****

*******Saturated soil conditions** means that ~~site conditions are sufficiently wet that timber operations displace soils in yarding or mechanical site preparation areas or displace road and landing surface materials in amounts sufficient to cause a turbidity increase in drainage facilities that discharge into Class I, II, III, or IV waters, or in downstream Class I, II, III, or IV waters that is visible or would violate applicable water quality requirements.~~

~~In yarding and site preparation areas, this condition may be evidenced by: a) reduced traction by equipment as indicated by spinning or churning of wheels or tracks in excess of normal performance, b) inadequate traction without blading wet soil, c) soil displacement in amounts that cause visible increase in turbidity of the downstream waters in a receiving Class I, II, III, or IV waters, or in amounts sufficient to cause a turbidity increase in drainage facilities that discharge into Class I, II, III, or IV waters, or d) creation of ruts greater than would be normal following a light rainfall.~~

~~On logging roads and landing surfaces, this condition may be evidenced by a) reduced traction by equipment as indicated by spinning or churning of wheels or tracks in excess of normal performance, b) inadequate traction without blading wet soil, c) soil displacement inamounts that cause visible increase in turbidity of the downstream waters in receiving Class I, II, III, or IV waters, or in amounts sufficient to cause a turbidity increase in drainage facilities that discharge into Class I, II, III, or IV waters, d) pumping of road surface materials by traffic, or e) creation of ruts greater than would be created by traffic following normal road watering, which transports surface material to a drainage facility that discharges directly into a watercourse. The Soils or road and landing surfaces that are hard frozen are excluded from this definition.~~ soil and/or surface material pore spaces are filled with water to such an extent that runoff is likely to occur. Indicators of saturated soil conditions may include, but are not limited to: (1) areas of ponded water, (2) pumping of fines from the soil or road surfacing material during timber operations, (3) loss of bearing strength resulting in the deflection of soil or road surfaces under a load, such as the creation of wheel ruts, (4) spinning or churning of wheels or tracks that produces a wet slurry, or (5) inadequate traction without blading wet soil or surfacing materials.

Scattered Parcels means*****

*******Spotted Owl Resource Management Plan** means*****

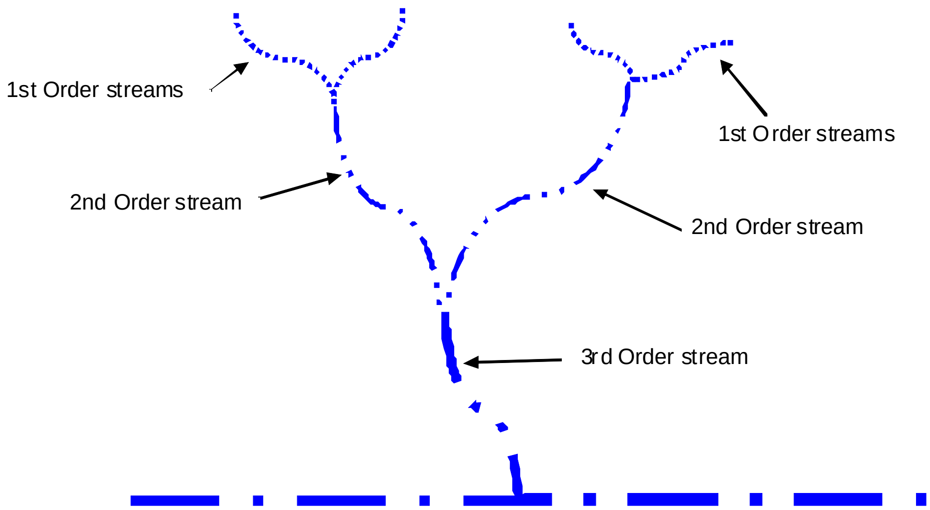
*******Stable operating surface** means t~~hat throughout the period of use, the operating surface of a logging road or landing does not either (1) generate waterborne sediment in amounts sufficient to cause a turbidity increase in downstream Class I, II, III, or IV waters, or in amounts sufficient to cause a turbidity increase in drainage facilities that discharge into Class I, II, III, or IV waters or, that is visible or would violate applicable water quality requirements; or (2) channel water for more than 50 feet that is discharged into Class I, II, III, or IV waters.~~a road or landing surface that can support vehicular traffic and has a structurally sound road base appropriate for the type, intensity and timing of intended use.

Stand Vigor is*****

*******Stream** see*****

*******Stream Order** means a classification method based on the branching pattern of watercourses in a watershed. As watercourses of equal order meet, they combine to form a watercourse of the next higher order. A first order watercourse is defined as the smallest unbranched watercourse in the headwaters of a watershed (usually an ephemeral channel). When two first order watercourse channels join, they form a second order watercourse. Similarly, when two second order watercourses join, they form a third order watercourse (See Figure 2).

Figure 2: Plan view of stream order delineation



Substantial adverse change means*****

*****Temporary Road means*****

Thalweg riffle crest means the upstream end of a riffle feature and can be identified as the area where the surface water flow changes from smooth to turbulent. The thalweg is found at the deepest part of the channel. Where the thalweg is measured in a pool, the riffle crest is a high point on a longitudinal profile and the shallowest place at the downstream end of a pool.

THP means*****

*****Watercourse Bank means*****

~~*****Watercourse or Lake Transition Line~~

~~(a) for a watercourse with an unconfined channel (a channel with a valley to width ratio at bankfull stage of 4 or greater) means that line defined by the landward margin of the most active portion of the channel zone area readily identified in the field by riverine hardwood and conifer trees at least twenty five years in age at breast height.~~

~~(b) for a watercourse with a confined channel means that line that is the outer boundary of a watercourse's 20-year return interval flood event floodplain. The outer boundary corresponds to an elevation equivalent to twice the maximum depth of the adjacent riffle at bankfull stage. The bankfull stage elevation shall be determined by field indicators and may be verified by drainage area/bankfull discharge relationships.~~

~~(c) For a lake, it is that line closest to the lake where riparian vegetation is permanently established.~~

Watercourse Transition Line

Watercourse Transition Line for a watercourse without a CMZ, means the line defined by one or more the following features: 1) a change of vegetation from bare surfaces or annual water tolerant species to perennial water tolerant or upland species at least 25 years in age at breast height, 2) physical indicators of scour such as undercut banks, moss lines on rocks, the top of exposed roots along the channels, and 3) a change in the size distribution of surface sediments from gravel to fine sand.

Figure 3. Indicators for determining a Watercourse Transition Line

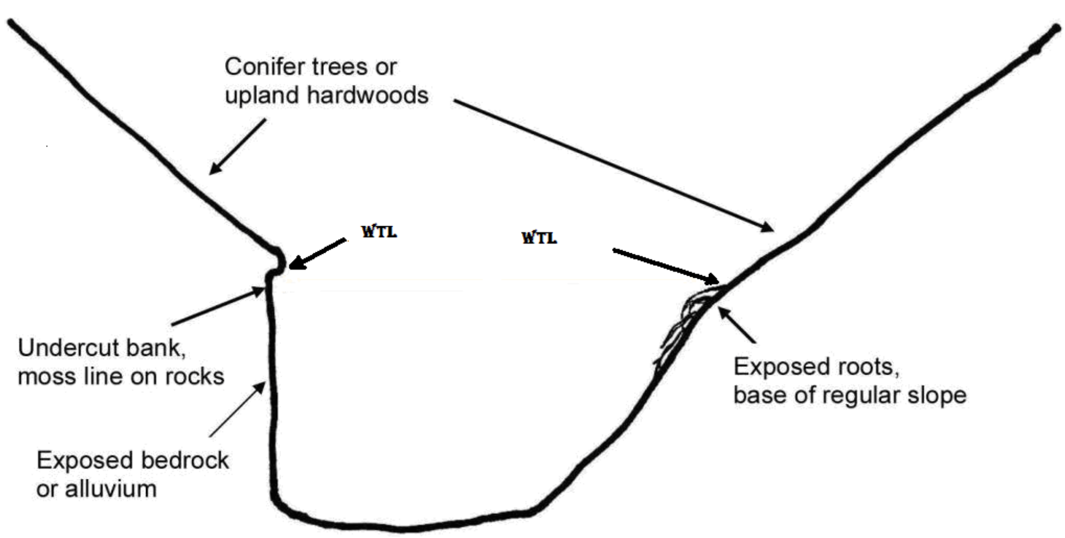


Figure 3A. Indicators for determining a Watercourse Transition Line

*****Watershed**s** in the Coastal Anadromy Zone** means any planning watershed(s) in the Central California Coast coho salmon Evolutionary Significant Units (ESU), South Central Steelhead Distinct Population Segment (DPS), Central California Coast steelhead DPS, Northern California steelhead DPS, California Coastal Chinook salmon ESU, and Southern Oregon/Northern California Coast coho salmon ESU, as defined in 70 Federal Register 37160, dated June 28, 2005, where salmonids listed as threatened, endangered, or candidate under the State or Federal Endangered Species Acts are currently present or can be restored. Official maps of ESUs and DPSs are found at http://swr.nmfs.noaa.gov/recovery/Salm_Steel.htm. as published on January 1, 2010.

Watersheds with Coho Salmon means *****

Watersheds with listed anadromous salmonids ~~threatened or impaired values~~ means any planning watershed where populations of anadromous salmonids that are listed as ~~T~~threatened, endangered, or candidate under the State or Federal Endangered Species Acts ~~with their implementing regulations~~, are currently present or can be restored.

Wet Meadow and other wet areas means*****

*****Winter Period means the period between November 15 to April 1, except as noted under special County Rules at 14 CCR, Article 13 § 925.1, 926.18, 927.1, and 965.5.

Woody debris means*****

*****~~The amendments to 14 CCR § 895.1 adopted on March 15, 2000 and April 4, 2000, which became effective July 1, 2000, shall expire on December 31, 2009.~~

Note: Authority cited: Sections 4551, 4551.5, 4553, 4561, 4561.5, 4561.6, 4562, 4562.5, 4562.7 and 4591.1, Public Resources Code. Reference: Sections 4512, 4513, 4526, 4551, 4551.5, 4561, 4561.6, 4562, 4562.5, 4562.7, 4583.2, 4591.1, 21001(f), 21080.5, 21083.2 and 21084.1, Public Resources Code; CEQA Guidelines Appendix K (printed following Section 15387 of Title 14 Cal. Code of Regulations), and Laupheimer v. State(1988) 200 Cal.App.3d 440; 246 Cal.Rptr. 82.

Amend 14 CCR § 898. Feasibility Alternatives.

After considering the rules of the Board and any mitigation measures proposed in the plan, the RPF shall indicate whether the operation would have any significant adverse impact on the environment. On TPZ lands, the harvesting per se of trees shall not be presumed to have a significant adverse impact on the environment. If the RPF indicates that significant adverse impacts will occur, the RPF shall explain in the plan why any alternatives or additional mitigation measures that would significantly reduce the impact are not feasible.

Cumulative impacts shall be assessed based upon the methodology described in Board Technical Rule Addendum Number 2, Forest Practice Cumulative Impacts Assessment Process and shall be guided by standards of practicality and reasonableness. The RPF's and plan submitter's duties under this section shall be limited to closely related past, present and reasonably foreseeable probable future projects within the same ownership and to matters of public record. The Director shall supplement the information provided by the RPF and the plan submitter when necessary to ~~i~~ensure that all relevant information is considered.

When assessing cumulative impacts of a proposed project on any portion of a waterbody that is located within or downstream of the proposed timber operation and that is listed as water quality limited under Section 303(d) of the Federal Clean Water Act, the RPF shall assess the degree to which the proposed operations would result in impacts that may combine with existing listed stressors to impair a waterbody's beneficial uses, thereby causing a significant adverse effect on the environment. The plan preparer shall provide feasible mitigation measures to reduce any such impacts from the plan to a level of insignificance, and may provide measures, insofar as feasible, to help attain water quality standards in the listed portion of the waterbody.

The Director's evaluation of such impacts and mitigation measures will be done in consultation with the appropriate RWQCB.

~~(a) The amendments to 14 CCR § 898 that became effective July 1, 2000 shall expire on December 31, 2009.~~

Note: Authority cited: Sections 4551 and 4553, Public Resources Code. Reference: Sections 4512, 4513, 4551.5 and 4582.75, Public Resources Code; and Laupheimer v.State (1988) 200 Cal.App.3d 440; 246 Cal.Rptr. 82.

Amend 14 CCR § 914.8. [934.8, 954.8] Tractor Road Watercourse Crossing.

Watercourse crossing facilities on tractor roads shall be planned, constructed, maintained, and removed according to the following standards:

(a) The number of crossings shall be kept to a minimum. Existing crossing locations shall be used wherever feasible.

(b) A prepared watercourse crossing using a structure such as a bridge, culvert, or temporary log culvert shall be used to protect the watercourse from siltation where tractor roads cross a watercourse in which water may be present during the life of the crossing.

(c) Crossing facilities on watercourses that support fish shall allow for unrestricted passage of all life stages of fish that may be present, and for unrestricted passage of water. Such crossing facilities shall be fully described in sufficient clarity and detail to allow evaluation by the review team and the public, provide direction to the LTO for implementation, and provide enforceable standards for the inspector.

(d) Watercourse crossing facilities not constructed to permanent crossing standards on tractor roads shall be removed before the beginning of the winter period. If a watercourse crossing is to be removed, it shall be removed in accordance with 14 CCR § 923.3 [943.3, 963.3], subsection (d) ~~[943.3(d), 963.3(d)]~~.

(e) If the watercourse crossing involves a culvert, the minimum diameter shall be stated in the THP and the culvert shall be of a sufficient length to extend beyond the fill material.

(f) Consistent with the protection of water quality, exceptions may be provided through the Fish and Game Code and shall be indicated in the plan.

~~**(g)** The amendments to 14 CCR § 914.8 [934.8, 954.8] that became effective July 1, 2000 shall expire on December 31, 2009.~~

Note: Authority cited: Sections 4551, 4551.5 and 4553, Public Resources Code. Reference: Sections 4512, 4513, 4527, 4562.5, 4562.7 and 4582, Public Resources Code.

Amend 14 CCR § 916. [936, 956] Intent of Watercourse and Lake Protection.

The purpose of this article is to ensure that timber operations do not potentially cause significant adverse site-specific and cumulative impacts to the beneficial uses of water, native aquatic and riparian-associated species, and the beneficial functions of riparian zones; or result in an unauthorized take of listed aquatic species; ~~are protected from potentially significant adverse site-specific and cumulative impacts associated with timber operations~~ , or threaten to cause violation of any applicable legal requirements. This article also provides protection measures for application in watersheds with listed anadromous salmonids and watersheds listed as water quality limited under Section 303(d) of the Federal Clean Water Act.

It is the intent of the Board to restore, enhance, and maintain the productivity of timberlands while providing ~~equal~~ appropriate levels of consideration for the quality and beneficial uses of water relative to that productivity. Further, it is the intent of the Board to clarify and assign responsibility for recognition of potential and existing impacts of timber operations on watercourses and lakes, native aquatic and riparian-associated species, and the beneficial functions of riparian zones and to ensure ~~adoption of~~ all plans, exemptions and emergency notices employ feasible measures to effectively achieve compliance with this article.

Further, it is the intent of the Board that the evaluations that are made, and the measures that are taken or prescribed, be documented in a manner that clearly and accurately represents those existing conditions and those measures. "Evaluations made" pertain to the assessment of the conditions of the physical form, water quality, and biological characteristics of watercourses and lakes, including cumulative impacts affecting the beneficial uses of water on both the area of planned logging operations and in the Watershed Assessment Area (WAA). "Measures taken" pertain to the procedures used or prescribed for the restoration, enhancement, and maintenance of the beneficial uses of water.

All provisions of this article shall be applied in a manner, which complies with the following:

(a) During and following timber operations, the beneficial uses of water, native aquatic and riparian-associated species, and the beneficial functions of riparian zones shall be maintained where they are in good condition~~,~~ and protected where they are threatened~~,~~. ~~and i~~Insofar as feasible, native aquatic and riparian-associated species and the beneficial functions of riparian zones shall be restored where they are impaired.

(b) Maintenance, p~~P~~rotection, and contribution towards restoration of the quality and beneficial uses of water during the planning, review, and conduct of timber operations shall comply with all applicable legal requirements including those set forth in any applicable water quality control plan adopted or approved by the State Water Resources Control Board. At a minimum, the LTO shall not ~~At a minimum, the LTO shall not do either of the following during timber operations:~~

~~**(1)** Place, discharge, or dispose of or deposit in such a manner as to permit to pass into the waters of the state, any substances or materials, including, but not limited to, soil, silt, bark, slash, sawdust, or petroleum, in quantities deleterious to fish, wildlife, beneficial functions of riparian zones, or the quality and beneficial uses of water;~~

~~**(2)**~~ remove water, trees or large woody debris from a watercourse or lake, the adjacent riparian area, or the adjacent flood prone areas ~~flood plain~~ in quantities deleterious to fish, wildlife, beneficial functions of riparian zones**,** or the quality and beneficial uses of water.

(c) Protecting and restoring native aquatic and riparian-associated species, the beneficial functions of riparian zones, and the quality and beneficial uses of water shall be given equal consideration as a management objective within any prescribed WLPZ and within any ELZ or EEZ designated for watercourse or lake protection and any other location where timber operations may affect riparian zones or the quality and beneficial uses of water.

(d) The measures set forth in this Section are meant to enforce the public's historical and legal interest in protection for wildlife, fish, and water quality and are to be used to guide timberland owners in meeting their legal responsibilities to protect public trust resources.

~~**(e)** The amendments to 14 CCR § 916 [936, 956] that became effective July 1, 2000 shall expire on December 31, 2009.~~

Note: Authority cited: Sections 4551, 4562.7 and 21000(g), Public Resources Code. Reference: Sections 4512, 4513, 4551.5, 4552, 4562.5, 4562.7, 21001(b), (f), 21002 and 21002.1, Public Resources Code; and Sections 100, 1243, 1243.5, 13001, 13050(f), 13146 and 13147, Water Code.

Amend 14 CCR § 916.2. [936.2, 956.2] Protection of the Beneficial Uses of Water and Riparian Functions.

(a) The measures used to protect each watercourse and lake in a logging area shall be determined by the presence and condition of the following values:

(1) The existing and restorable quality and beneficial uses of water as specified by the applicable water quality control plan and as further identified and refined during preparation and review of the plan.

(2) The existing and restorable uses of water for fisheries as identified by the DFG or as further identified and refined during preparation and review of the plan.

(3) ~~Riparian habitat~~ The beneficial functions of the riparian zone that provides for the biological needs of native aquatic and riparian-associated species as specified in 14 CCR § 916.4~~(b)~~ [936.4~~(b)~~, 956.4~~(b)~~] subsection (b) and 14 CCR § 916.9 [936.9, 956.9] when the plan is in a planning watershed with listed anadromous salmonids.

(4) Sensitive conditions near watercourses and lakes as specified in 14 CCR § 916.4~~(a)~~ [936.4~~(a)~~, 956.4~~(a)~~] subsection (a).

The maintenance, protection, and contribution towards restoration of ~~T~~these values shall be ~~protected from potentially significant adverse impacts from timber operations and restored to good condition, where needed,~~ achieved through a combination of the rules and plan-specific mitigation. The RPF shall propose, and the Director may require, adequate protection of overflow and changeable channels which are not contained within the channel zone.

(b) The State's waters are grouped into four classes based on key beneficial uses. These classifications shall be used to determine the appropriate ~~minimum~~protection measures to be applied during the conduct of timber operations. The basis for classification (characteristics and key beneficial uses) are set forth in 14 CCR § 916.5 [936.5, 956.5], Table 1 and the range of ~~minimum~~ appropriate protective measures applicable to each class are contained in 14 CCR §§ 916.3 [936.3, 956.3], 916.4 [936.4, 956.4], and 916.5 [936.5, 956.5] and 916.9 [936.9, 956.9] when the plan is in a planning watershed with listed anadromous salmonids.

(c) When the protective measures contained in 14 CCR §§ 916.5 [936.5, 956.5], and 916.9 [936.9, 956.9] when the plan is in a planning watershed with listed anadromous salmonids, are not adequate to provide for maintenance, protection or to contribute towards restoration ~~to~~ of beneficial uses of water set forth in 14 CCR § 916.5 [936.5, 956.5] Table 1, ~~feasible~~ additional measures to achieve these goals shall be developed by the RPF or proposed by the Director under the provisions of 14 CCR § 916.6 [936.6, 956.6], Alternative Watercourse and Lake Protection, and incorporated in the plan when approved by the Director.

(d) ~~The amendments to 14 CCR § 916.2 [936.2, 956.2] that became effective July 1, 2000 shall expire on December 31, 2009.~~

Note: Authority cited: Sections 4551, 4562.7 and 21000(g), Public Resources Code. Reference: Sections 751, 4512, 4513, 4551.5, 21000(g), 21001(b) and 21002.1, Public Resources Code; Sections 100, 1243, 13050(f), Water Code; and Sections 1600 and 5650(c), Fish and Game Code.

Amend 14 CCR § 916.5 [936.5, 956.5]. Procedure for Determining Watercourse and Lake Protection Zone (WLPZ) Widths and Protective Measures.

The following procedure for determining WLPZ widths and protective measures shall be followed:*****

*******(e)** The letter designations shown in the "Protective Measures and Widths" column in Table I correspond to the following:

"A" WLPZ shall be clearly identified on the ground by the RPF who prepared the plan, or supervised designee, with paint, flagging, or other suitable means prior to the preharvest inspection. For nonindustrial timber management plans, sample identification of the WLPZ prior to the preharvest inspection may be allowed. The sample shall be based upon a field examination and be consistent with the applicable provisions of 14 CCR §§ 916.4 [936.4, 956.4] and 916.5 [936.5, 956.5], representing the range of conditions found within the WLPZ. The Director shall determine if the sample identification is adequate for plan evaluation during the preharvest inspection. If sample identification is allowed, the remaining WLPZ shall be identified by an RPF or supervised designee prior to the start of timber operations within or adjacent to the WLPZ. The RPF shall notify the Department when the WLPZ has been identified.

"**B**" WLPZ shall be clearly identified on the ground by an RPF or supervised designee, with paint, flagging, or other suitable means, prior to the start of timber operations. <u>In</u> ~~W~~watersheds with ~~threatened or impaired values~~ <u>listed anadromous salmonids</u>, on the ground identification of the WLPZ shall be completed prior to the preharvest inspection. For all nonindustrial timber management plans, sample identification of the WLPZ prior to the preharvest inspection may be allowed. *****

*******"C"** In site-specific cases, the RPF may provide in the plan, or the Director may require, that the WLPZ be clearly identified on the ground with flagging or by other suitable means prior to the start of timber operations.

"D" To ensure retention of shade canopy filter strip properties of the WLPZ and the maintenance of a multi-storied stand for protection of values described in 14 CCR § 916.4(b) [936.4(b), 956.4(b)], residual or harvest trees shall be marked, including a base mark below the cut-line within the WLPZ by the RPF, or supervised designee. Outside of watersheds with ~~threatened or impaired values~~ <u>listed anadromous salmonids</u>, sample marking prior to the preharvest inspection is satisfactory in those cases where the Director determines it is adequate for plan evaluation. *****

"E" To ensure retention of shade canopy filter strip properties of the WLPZ and the maintenance of a multi-storied stand for protection of values described in 14 CCR § 916.4(b) [936.4(b), 956.4(b)], residual or harvest trees shall be marked, including a base mark below the cut line, within the WLPZ by the RPF or supervised designee. Outside of watersheds with ~~threatened or impaired values~~ <u>listed anadromous salmonids</u>, tree marking shall be done prior to timber falling operations. In watersheds with ~~threatened or impaired values~~ <u>listed anadromous salmonids</u>, trees shall be marked in advance of the preharvest inspection. *****

Note: Authority cited: Sections 4551, 4562.7 and 21000(g), Public Resources Code. Reference: Sections 4513, 4551.5 and 21001(f), Public Resources Code; Sections 100, 13000 and 13050(f), Water Code; and 33 USC Section 1288(b)(2)(F).

Amend 14 CCR § 916.9 [936.9, 956.9]. Protection and Restoration <u>of the Beneficial Functions of the Riparian Zone i</u>n Watersheds with <u>Listed</u>~~Threatened or Impaired Values~~ <u>Anadromous Salmonids.</u>

In addition to all other district Forest Practice Rules, the following requirements shall apply in any ~~planning~~ watershed with <u>listed anadromous salmonids</u> ~~threatened or impaired values~~, except in watershed with coho salmon where the standards listed under

916.9.1 and 916.9.2 shall apply. Requirements of 14 CCR § 916.9 [936.9, 956.9] precede other sections of the FPRs.

Geographic scope - Requirements for watersheds with listed anadromous salmonids differ depending on the geographic location of the watershed and geomorphic characteristics of the watercourse. Unique requirements for watersheds with listed anadromous salmonids are set forth for 1) watercourses in the coastal anadromy zone with confined channels, 2) watercourses with flood prone areas or channel migration zones, and 3) watercourses with confined channels located outside the coastal anadromy zone.

Watersheds which do not meet the definition of “watersheds with listed anadromous salmonids” are not subject to this section except as follows: The provisions of 14 CCR §§ 916.9 [936.9, 956.9], subsections (k)-(q), 923.3 [943, 963] and 923.9 [943.9, 963.9] also apply to planning watersheds immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids for purposes of reducing significant adverse impacts from transported fine sediment. Projects in other watersheds further upstream that flow into watersheds with listed anadromous salmonids, not otherwise designated above, may be subject to these provisions based on an assessment consistent with cumulative impacts assessment requirements in 14 CCR §§ 898 and 912.9 [932.9, 952.9] and Technical Rule Addendum No. 2, Cumulative Impacts Assessment. These requirements do not apply to upstream watersheds where permanent dams attenuate the transport of fine sediment to downstream watercourses with listed anadromous salmonids.

(a) G~~OAL~~oal - Every timber operation shall be planned and conducted to protect, maintain, and contribute to restoration of properly functioning salmonid habitat and listed salmonid species~~prevent deleterious interference with the watershed conditions that~~

~~primarily limit the values set forth in 14 CCR 916.2 [936.2, 956.2](a) (e.g., sediment load increase where sediment is a primary limiting factor; thermal load increase where water temperature is a primary limiting factor; loss of instream large woody debris or recruitment potential where lack of this value is a primary limiting factor; substantial increase in peak flows or large flood frequency where peak flows or large flood frequency are primary limiting factors)~~. To achieve this goal, every timber operation shall be planned and conducted to ~~meet the following objectives where they affect a primary limiting factor~~:~~.~~

(1**)** Comply with the terms of a Total Maximum Daily Load (TMDL). ~~that has been adopted to address~~ primary limiting f~~actors that may be affected by timber operations. if a TMDL has been adopted,, or not result in any measurable sediment load increase to a watercourse or lake.~~

(2) ~~Not result in any~~Prevent significant sediment load increase to a watercourse system or lake.

~~(2)~~**(3)** ~~Not result in any measurable~~Prevent significant ~~decrease in the~~ instability of a watercourse channel or of a watercourse or lake bank.

~~(3)~~**(4)** ~~Not result in any measurable~~ Prevent significant blockage of any aquatic migratory routes for any life stage of anadromous salmonids or listed species.

~~(4)~~**(**5) ~~Not result in any measurable~~ Prevent significant adverse effects to streamflow ~~reduction during critical low water periods except as part of an approved water drafting plan pursuant to 14 CCR 916.9(r) [936.9(r), 956.9(r)]~~.

~~(5)~~**(6)** Consistent with the requirements of 14 CCR § 916.9~~(i),~~ [936.9,956.9], subsections (f), (g), (h) and (v), ~~14 CCR § 936.9(i), or 14 CCR § 956.9(i),~~ protect, maintain, and restore trees (especially conifers), snags, or downed large woody debris that currently, or may in the foreseeable future, provide large woody debris recruitment needed for instream habitat structure and fluvial geomorphic functions.

~~(6)~~**(7)** Consistent with the requirements of 14 CCR § 916.9~~(g)~~ [936.9, 956.9], subsections (f), (g), (h) and (v), ~~14 CCR § 936.9 (g), or 14 CCR § 956.9(g),~~ protect, maintain, and restore the quality and quantity of vegetative canopy needed to:

(A) provide shade to the watercourse or lake to maintain daily and seasonal water temperatures within the preferred range for anadromous salmonids or listed species where they are present or could be restored; and

(B) ~~minimize daily and seasonal temperature fluctuations~~provide a deciduous vegetation component to the riparian zone for aquatic nutrient inputs ~~,(C) maintain daily and seasonal water temperatures within the preferred range for anadromous salmonids or listed species where they are present or could be restored, and (D) provide hiding cover and a food base where needed~~.

~~(7)~~**(8)** ~~Result in no substantial~~ Prevent significant increases in peak flows or large flood frequency.

(b) Pre-plan adverse cumulative watershed effects - Pre-plan adverse cumulative watershed effects on the populations and habitat of anadromous salmonids shall be considered. The plan shall specifically acknowledge or refute that such effects exist. ~~Where appropriate,~~When the proposed timber operations, in combination with any identified pre-plan watershed effects, will add to significant adverse existing cumulative watershed effects, the plan shall set forth measures to effectively reduce such effects.

(c) Objectives for timber operations or silvicultural prescriptions in WLPZs - Any timber operation or silvicultural prescription within ~~150 feet of any Class I watercourse or lake transition line or 100 feet of any Class II~~ any watercourse or lake protection zone ~~transition line~~ shall have protection, maintenance, or restoration of the beneficial uses of water, and properly functioning salmonid habitat and ~~or the for populations and habitat of anadromous salmonids or~~ listed aquatic or riparian-associated species as significant objectives. Specific objectives are described below.

(1) Core Zone: The primary objective for this zone is streamside bank protection to promote bank stability, wood recruitment by bank erosion, and canopy retention. Timber operations are generally excluded from this zone and limited to actions which meet the objectives stated above or improve salmonid habitat consistent with 14 CCR § 916.9 [936.9, 956.9] subsections (a) and (c).

(2) Inner Zone: The primary objective for this zone is to develop a large number of trees for large wood recruitment, to provide additional shading, to develop vertical structural diversity, and to provide a variety of species (including hardwoods) for nutrient input. This is accomplished through the establishment of high basal area and canopy retention by retaining or more rapidly growing a sufficient number of large trees. Additional specific objectives include locating large trees retained for wood recruitment nearer to the Core Zone and maintaining or improving salmonid habitat on flood prone areas and CMZs when present. Timber operations within WLPZs are limited to those actions which meet the objectives stated above or to improve salmonid habitat consistent with 14 CCR § 916.9 [936.9, 956.9] subsection (a) and (c).

(3) Outer Zone: The primary objective for this zone is to buffer the Inner and Core Zones and to provide the following functions: 1) wind resistance where windthrow is common or likely to occur, 2) additional wood recruitment, 3) microclimate control in the Inner or Core Zones for purposes other than limiting water temperature change, 4) habitat for terrestrial wildlife species that depend on riparian areas, and 5) an additional sediment filter on steeper slopes with high or moderate erosion hazard rating when tractor operations are proposed.

(4) Class II large watercourses (Class II-L): The primary objective is to maintain, protect or restore the values and functions of Class II-L type watercourses described below. Class II-L type watercourses: (i) can supply water and nutrients to a Class I watercourse during the month of July during an average hydrologic year, (ii) can supply coarse and fine sediment to the Class I channel, and (iii) may be able to supply wood of a size that would function as large wood for the Class I watercourse. Recruitment, delivery and retention of large wood in Class II- L type watercourses is also critical, as large wood increases sediment storage and decreases the rate of sediment transport to fish-bearing Class I watercourses. Other objectives stated in 14 CCR § 916.9 [936.9, 956.9] subsections (c) (1) and (2) above for the Core Zone and Inner Zone are also desired objectives for Class II-L type watercourses.

(5) A primary objective for all WLPZs is to implement practices to maintain, protect and contribute to restoration of properly functioning salmonid habitat and repair conditions detrimental to the species or species habitat. Practices to meet this objective include, but are not limited to, thinning for increased conifer growth; felling or yarding trees for wood placement in the channel; restoration of conifer deficient areas; management to promote a mix of conifers and hardwoods; abandonment and upgrading of non- functioning or high risk roads, watercourse crossings, tractor roads, and landings; and fuel hazard reduction activities that will reduce fire hazards and stand replacing wildfires which would result in significant adverse effects to salmonid species or riparian habitat.~~Additionally, for evenaged regeneration methods and rehabilitation with the same effects as a clearcut that are adjacent to a WLPZ, a special operating zone shall retain understory and mid-canopy conifers and hardwoods. These trees shall be protected during falling, yarding and site preparation to the extent feasible. If trees that are retained within this zone are knocked down during operations, that portion of the trees that is greater than 6" in diameter shall remain within the zone as Large Woody Debris.~~

~~The zone shall be 25 feet above Class I WLPZs with slopes 0-30% and 50 feet above Class I WLPZs with slopes > 30%.~~

(d) Measures to Offset Adverse Watershed Effects -

(1) The plan shall fully describe: (A) the type and location of each measure needed to fully offset sediment loading, thermal loading, and potential significant adverse watershed effects from the proposed timber operations, and (B) the person(s) responsible for the implementation of each measure, if other than the timber operator.

(2) In proposing, reviewing, and approving such measures, preference shall be given to the following: (A) measures that are both onsite (i.e., on or near the plan area) and in-kind (i.e., erosion control measures where sediment is the problem), and (B) sites that are located to maximize the benefits to the impacted portion of a watercourse or lake. Out-of-kind measures (i.e., improving shade where sediment is the problem) shall not be approved as meeting the requirements of this subsection.

(e) Channel zone requirements -

(1) There shall be no timber operations within the channel zone with the following exceptions:

(A) ~~timber harvesting that is~~ Actions directed to improve salmonid habitat ~~through the limited use of the selection or commercial thinning silvicultural methods~~ with review and concurrence by DFG.

(B) ~~timber harvesting~~ Actions necessary for the construction, reconstruction, removal, or abandonment of approved watercourse crossings.

(C) ~~timber harvesting~~ Actions necessary for the protection of public health, ~~and~~ safety and general welfare. This includes actions necessary to protect infrastructure facilities including, but not limited to, roads, bridges, powerlines, utilities, water drafting structures, homes, and other legally permitted structures.

(D) Actions to allow for full suspension cable yarding when necessary to transport logs through the channel zone.

(E) Timber harvesting in Class III watercourses ~~where exclusion of timber operations is not for protection of listed salmonids.~~ consistent with 14 CCR § 916.9 [936.9,956.9] subsection (h)(7).

(F) Actions reviewed by the RWQCB which seek to correct or remediate adverse impacts to the beneficial uses of water.

(2) In all instances where trees are proposed to be felled within the channel zone, a base mark shall be placed below the cut line of the harvest trees within the zone. Such marking shall be completed by the RPF that prepared the plan, or a supervised designee, prior to the preharvest inspection.

(f) Class I watercourses -

(1) For Class I watercourses, where fish are always or seasonally present or where fish habitat is restorable, any plan involving timber operations within the WLPZ shall contain the following information:

(A) Clear and enforceable specifications of timber operations within the Class I WLPZ, including a description of how any disturbance, or log or tree cutting and removal shall be carried out to conform with 14 CCR §§ 916.2 [936.2, 956.2], subsection (a) and 916.9 [936.9, 956.9], subsection (a).

(B) A description of all existing permanent logging road watercourse crossings.

(C) Clear and enforceable specifications describing how these crossings are to be modified, used, and treated to minimize risks, giving special attention to allowing fish to pass both upstream and downstream during all life stages.

(D) Clear and enforceable specifications for construction and operation of any new crossing(s) of a Class I watercourse to prevent direct harm, habitat degradation, water velocity increase, hindrance of fish passage, or other potential impairment of beneficial uses of water.

(E) Documentation of how proposed harvesting in the WLPZ contributes to the objectives of each zone stated in 14 CCR § 916.9 [936.9,956.9], subsection (c) and other goals in 14 CCR § 916.9 [936.9,956.9], subsection (a) (1)-(8). Documentation shall include the examinations, analysis, and other requirements listed in 14 CCR § 916.4 [936.4, 956.4], subsection (a).

(2) Class I watercourses with confined channels in watersheds in the coastal anadromy zone: The following are the minimum requirements for WLPZ delineation and timber operations in Class I WLPZs in watersheds in the coastal anadromy zone where confined channels are present. WLPZ width ranges from 100-150 feet slope distance, depending on the silvicultural system applied above the WLPZ. Three Zones are established within the WLPZs: The Core Zone is nearest to the water, the Inner Zone is the middle zone contiguous to the Core Zone, and the Outer Zone is furthest from the water and contiguous to the Inner Zone. Graphic depictions of zones and the abbreviated descriptions of the silvicultural prescriptions and operational requirements are shown in Figure 4. Table 1 specifies the enforceable standards to be used for protection of Class I watercourses for the area included in the coastal anadromy zone:

(A) Core Zone: The minimum width of the Core Zone shall be 30 feet measured from the watercourse transition line or lake transition line. No timber operations are permitted in this zone except for those listed in 14 CCR § 916.9 [936.9, 956.9], subsection (e)(1) (A)-(F), or those approved pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v). Sanitation-Salvage is prohibited except as provided in 14 CCR § 916.9 [936.9,956.9], subsections (s), (t), and (u).

(B) Inner Zone: The minimum width of the Inner zone shall be 70 feet measured from the landward edge of Core Zone. Timber operations are permitted in this zone when conducted to meet the goals of this section, objectives for the Inner Zone in 14 CCR § 916.9 [936.9, 956.9], subsection (c)(2), pursuant to 14 CCR § 916.9 [936.9, 956.9], subsections (e)(1)(A)-(F), or pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v). Harvesting prescriptions should focus on practices that use thinning from below. Silvicultural systems for harvesting are limited to the use of commercial thinning or single tree selection modified to meet the following requirements:

1. When commercial thinning is used, the QMD of conifer trees greater than 8 inches dbh in the preharvest project area shall be increased in the postharvest stand.

2. Sanitation-Salvage is prohibited except as provided in 14 CCR § 916.9 [936.9,956.9], subsections (s), (t), and (u).

3. Postharvest stand shall have a minimum 80% overstory canopy cover in the Coast and Southern Forest Districts of the coastal anadromy zone and a minimum 70% overstory canopy cover in the Northern Forest District of the coastal anadromy zone. The postharvest canopy may be composed of both conifers and hardwood species and shall have at least 25% overstory conifer canopy.

4. Postharvest stand shall retain the 13 largest conifer trees (live or dead) on each acre of the area that encompasses the Core and Inner Zones.

5. Large trees retained to meet 14 CCR § 916.9 [936.9, 956.9], subsections (f)(2)(B)(1.)(3.) above that are the most conducive to recruitment to provide for the beneficial functions of riparian zones (e.g., trees that lean towards the channel, have an unimpeded fall path toward the watercourse, are in an advanced state of decay, are located on unstable areas or downslope of such an unstable areas, or have undermined roots) are to be given priority to be retained as future recruitment trees.

(C) Outer Zone: The minimum width of the Outer Zone shall be 50 feet measured from the landward edge of Inner Zone. This zone is required where evenaged regeneration methods, seed tree removal, shelterwood removal, alternative prescriptions declared under 14 CCR § 913.6 [933.6. 953.6], subsection (b)(3) as most related to any evenaged silvicutural system**,** variable retention or rehabilitation of understocked areas will be utilized contiguous to the watercourse and lake protection zone. Timber operations are permitted in this zone when conducted to meet the goals of this section, including those for the Outer Zone in 14 CCR § 916.9 [936.9, 956.9], subsection (c)(3), and (5), pursuant to 14 CCR § 916.9 [936.9], subsection (e)(1)(A)-(F), or pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v). Silvicultural systems for harvesting are limited to the use of commercial thinning or single tree selection modified to meet the following requirements:

1. Postharvest stand shall have a minimum 50% overstory canopy cover. The postharvest canopy may be composed of both conifers and hardwood species and shall have at least 25% overstory conifer canopy.

2. Priority shall be given to retain wind firm trees.

(D) Preferred Management Practices in the Inner and Outer Zones: When timber operations are considered pursuant to 14 CCR §§ 916.3 [936.3, 956.3], subsection (c) and 916.4 [936.4, 956.4], subsection (d), the following Preferred Management Practices should be considered for inclusion in the Plan by the RPF and by the Director:

1. Preflagging or marking of any skid trails before the preharvest inspection;

2. Heavy equipment should be limited to slopes less than 35% with low or moderate EHRs;

3. Use feller bunchers or hydraulic heel boom loaders which do not drag/skid logs through the zone;

4. Minimize turning of heavy equipment which would result in increased depth of ground surface depressions; and

5. Use mechanized harvesting equipment which delimb harvested trees on pathway over which heavy equipment would travel.

(E) Additional Special Operating Zone: For situations contiguous to the Outer

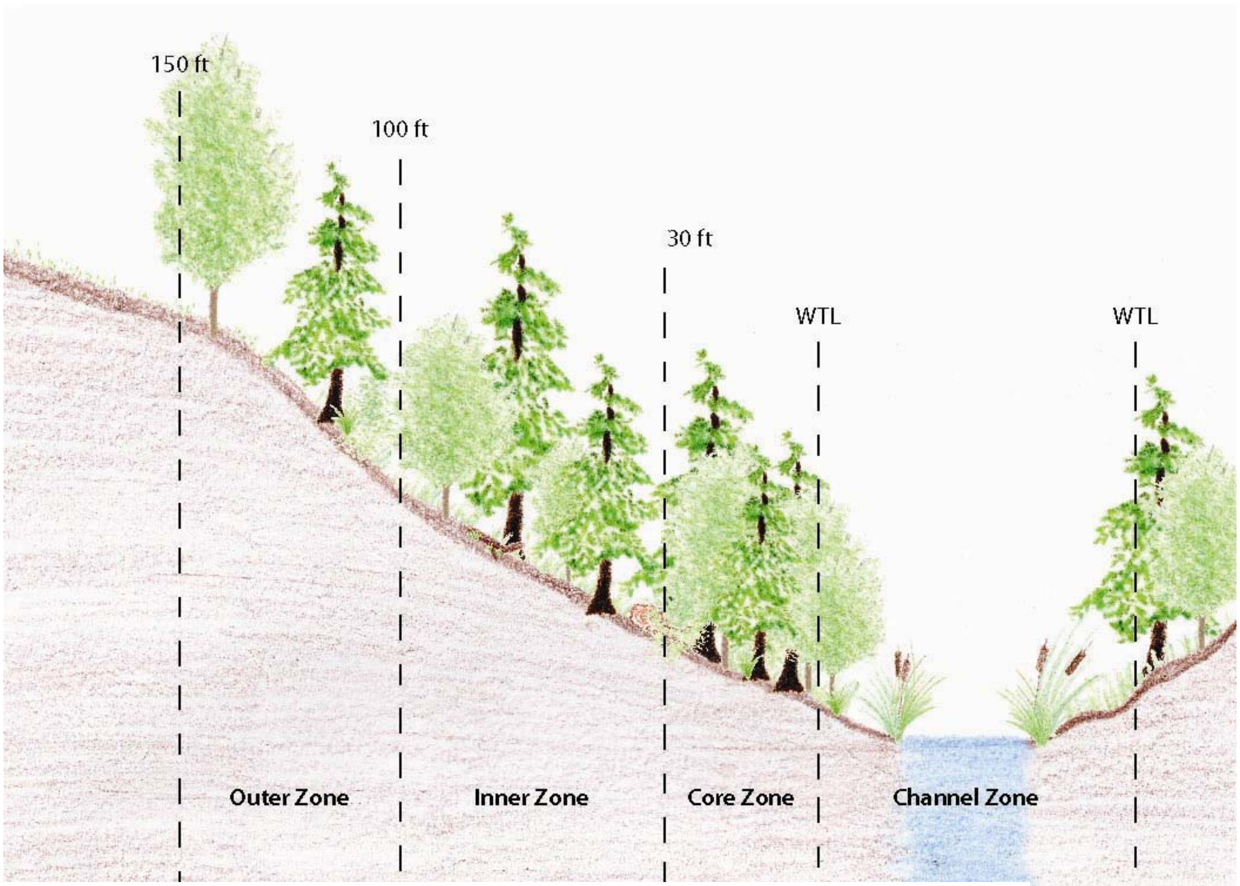
Zone where evenaged regeneration methods, seed tree removal step, shelterwood removal step, alternative prescriptions declared under 14 CCR § 913.6 [933.6, 953.6], subsection (b)(3) as most related to any evenaged silvicutural system, variable retention or rehabilitation of understocked areas with the same effect as a clearcut is used, slopes are greater than 50%, and the Outer Zone is located on any north aspect, the RPF shall consider the need for a special operating zone for purposes of shading the watercourse from direct low angle solar radiation from beneath the overstory canopy that is expected to have a potential significant adverse impact on water temperature. When the special operating zone is needed, the special operating zone shall retain understory and mid-canopy conifers and hardwoods. These trees shall be protected during falling, yarding and site preparation to the extent feasible. Width of the zone shall be 50 feet measured from the landward edge of the Outer Zone.

Table 1: Procedure for Determining WLPZ Widths and Protective Measures Class I WLPZs - Confined Channels - Coastal Anadromy Zone

Pursuant to 14 CCR 916.9[936.9,956.9](f)(2)

Zone Designation	**Zone width (ft.)**	**Overstory Canopy Cover**		**Large Tree Retention**	**Silviculture Requirements**	**Operational Requirements**
Channel Zone	Variable	Retain all trees except per 916.9 [936.9, 956.9](e)(1) A-F or 916.9 [936.9 956.9] (v)		Retain all trees except per 916.9 [936.9, 956.9](e) (1) A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v); no sanitation salvage except 916.9 (s)(t)and (u)	No timber operations except per 916.9 [936.9, 956.9] (e) (1)A-F or 916.9 [936.9, 956.9](v);
Core Zone per 916.9 [936.9 956.9] (f)(2)(A)	30 ft.	Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)		Retain all trees except per 916.9 [936.9, 956.9](e)(1) A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v); no sanitation salvage except 916.9 (s)(t)and (u).	No timber operations except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v);
Inner Zone per 916.9 [936.9 956.9] (f)(2)(B)	70 ft.	80% Coast and Southern Forest District of Coastal Anadromy Zone per 916.9 [936.9 956.9] (f)(2)(B)3.	70% in Northern Forest District of Coastal Anadromy Zone per 916.9 [936.9 956.9] (f)(2)(B)3.	13 largest trees /ac. per 916.9 [936.9 956.9] (f)(2)(B)4.	Increase QMD; No sanitation salvage except 916.9 (s)(t)and (u); commercial thinning or single tree selection only.	Preferred Management Practices in 916.9 [936.9, 956.9] (f)(2)(D)
Outer Zone per 916.9 [936.9 956.9] (f)(2)(C) Outer Zone applicable only where even-aged regeneration used adjacent to the WLPZ	50 ft.	50% per 916.9 [936.9 956.9] (f)(2)(C).1.		NA	Commercial thinning or single tree selection only; Retain wind firm trees.	Preferred Management Practices in 916.9 [936.9, 956.9] (f)(2)(D)
Special Operating Zone per 916.9 [936.9 956.9] (f)(2)(E)	50 ft.	NA		NA	SOZ applicable only where even-aged regeneration used adjacent to the WLPZ . Retain understory and midstory trees per 916.9 [936.9, 956.9] (f)(2)(E)	All other Forest Practice Rules

Figure 4: Graphic of profile view of Class I WLPZ with confined channels in watersheds in the coastal anadromy zone (not to scale)



Outer Zone:
50 ft. Outer Zone required only when even aged silv. system contiguous to WLPZ
Modified commercial thinning or single tree selection
50% overstory canopy (OSC)

Inner Zone:
Modified commercial thinning or single tree selection
Increase QMD
No Sanitation Salvage
Retain 80% OSC in the Coast and Southern Forest Districts of the coastal anadromy zone and 70% OSC in the Northern Forest District of the coastal anadromy zone
Retain 13 largest trees/ac.

(3) Class I watercourses with flood prone areas or channel migration zones: The following are the minimum requirements for WLPZ delineation and timber operations in Class I WLPZs in locations where flood prone areas and/or CMZs are present. WLPZ widths vary depending on the extent of the flood prone area and silvicultural system applied contiguous to the WLPZ.

There are up to five zones established within the WLPZ: The CMZ (when present), the Core Zone is the portion of the flood prone area nearest the water (and contiguous to the CMZ when present), the Inner Zone A is contiguous to the Core Zone , the Inner Zone B is contiguous to Inner Zone A and extends to the landward edge of the flood prone area, and the Outer Zone is hillslope area and is contiguous to the Inner Zone B and landward perimeter of the flood prone area. Table 2 specifies the enforceable standards to be used for protection of Class I watercourses with flood prone area or channel migration zones.
The zones and the abbreviated descriptions of the silvicultural prescriptions, and operational requirements are shown in Figure 5.

(A) Channel Migration Zone: When a CMZ is present, no timber operations are permitted in this zone except for those listed in § 916.9 [936.9, 956.9], subsection (e)(1)(A)-(F), or pursuant to 14 CCR § 916.9 [936.9,956.9], subsection (v).

(B) Core Zone: The minimum width of the Core Zone shall be 30 feet measured from the watercourse transition line or lake transition line. No timber operations are permitted in this zone except for those listed in 14 CCR § 916.9 [936.9, 956.9], subsection (e)(1) (A)-(F), or those approved pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v). Sanitation-Salvage is prohibited except as provided in 14 CCR § 916.9 [936.9, 956.9], subsections (s), (t), and (u).

(C) Inner Zone A: The Inner Zone A generally encompasses the portion of the flood prone area from 30 feet beyond the WTL (Core Zone perimeter) up to 150 feet from the WTL. The minimum width of the Inner Zone A shall be the greater of the area from the landward edge of Core Zone to the landward edge of the Inner Zone B or 70 feet. The maximum width is 120 feet. Timber operations are permitted in this zone when conducted to meet the goals of this section, including those for the Inner Zone in 14 CCR § 916.9 [936.9,956.9], subsection (c)(2), pursuant to 14 CCR § 916.9 [936.9, 956.9], subsections (e) (1)(A)-(F) or pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v). Harvesting prescriptions should focus on practices that use thinning from below. Silvicultural systems for harvesting are limited to the use of commercial thinning or single tree selection modified to meet the following requirements:

1. When commercial thinning is used, the QMD of conifer trees greater than 8 inches dbh in the preharvest project area shall be increased in the postharvest stand.

2. Sanitation-Salvage is prohibited except as provided in 14 CCR § 916.9 [936.9, 956.9], subsections (s), (t), and (u).

3. Postharvest stand shall have a minimum 80% overstory canopy cover in the Coast and Southern Forest Districts of the coastal anadromy zone and a minimum 70% overstory canopy cover in all other watersheds with listed anadromous salmonids. The postharvest canopy may be composed of both conifers and hardwood species and shall have at least 25% overstory conifer canopy.

4. Postharvest stand shall retain the 13 largest conifer trees (live or dead) on each acre of the area that encompasses the Core and Inner Zones.

5. Large trees retained to meet 14 CCR § 916.9 [936.9, 956.9], subsections (f)(3)(C)(1.)(3.) above that are the most conducive to recruitment to provide for the beneficial functions of riparian zones (e.g. trees that lean towards the channel, have an unimpeded fall path toward the watercourse, are in an advanced state of decay, are located on unstable areas or downslope of such an unstable areas, or have undermined roots) are to be given priority to be retained as future recruitment trees.

(D) Inner Zone B: The Inner Zone B is applicable when there are very wide flood prone areas. The Inner Zone B encompasses the portion of the flood prone area from the landward edge of the Inner Zone A (i.e.150 feet from the WTL) to the landward edge of the flood prone area. The landward edge of the Inner Zone B (i.e. the landward perimeter of the flood prone area) shall be established in accordance with flood prone area definitions in 14 CCR § 895.1. Timber operations are permitted in this zone when conducted to meet the goals of this section, including those for the Inner Zone in 14 CCR § 916.9 [936.9, 956.9], subsection (c)(2), 14 CCR § 916.9 [936.9,956.9], subsection (e) (A)-(F), or pursuant to 14 CCR § 916.9 [936.9,956.9], subsection (v). Silvicultural systems for harvesting are limited to the use of commercial thinning or single tree selection modified to meet the following requirements:

1. Postharvest stand shall retain the 13 largest conifer trees (live or dead) on each acre of the Core and Inner Zones.

2. Postharvest stand shall have a minimum 50% overstory canopy cover. The postharvest canopy may be composed of both conifers and hardwood species and shall have at least 25% overstory conifer canopy.

(E) Preferred Management Practices in the Inner Zone A and B of flood prone areas. When timber operations are considered pursuant to 14 CCR § 916.3 [936.3, 956.3], subsection (c) and 916.4 [936.4, 956.4], subsection (d), the following Preferred Management Practices should be considered for inclusion in the Plan by the RPF and by the Director when timber operations are conducted in the Inner Zones of the flood prone area.

1. Implement actions to improved salmonid habitat conditions: Implement maintenance and repair actions that contribute to improving undesired existing conditions and contribute to restoring properly functioning salmonid habitat.

2. Minimize Yarding and Skidding: Skid trails, yarding corridors, falling activities, and log yarding, should not alter the natural drainage or flow patterns. EEZ of 30 feet should be applied near side channels and areas of ponding. Very limited, pre-flagged, pre-approved prior to falling skid trails shall be used and abandoned so as to minimize risk of becoming new secondary channels by flood flows. Minimize or exclude, to the extent feasible, tractor skidding/crossings over, through, or along secondary channels (protection of overflow channels is a key element). Locate tractor roads on high ground areas to the greatest extent possible. When feasible, use feller bunchers which do not drag/skid logs through the zone, minimize turning of equipment which would result in increased depth of ground surface depressions, and utilize mechanized harvesting equipment which delimbs harvested trees on the pathway over which equipment would travel. Cable yarding corridors should be located at wide intervals consistent with practices that use lateral yarding. Full suspension should be used when possible.

3. Minimize Soil Erosion and Prevent Discharge: Design timber operations to avoid turbid runoff by treating any ground disturbance greater than 100 square feet. Operations shall be conducted only in dry soil conditions. Avoid disturbance of vegetation not intended for harvest that could increase the likelihood of erosion or damages the reinforcing root network on the channel banks, including any secondary overflow channel. Restore any tracks or trails to an original surface.

4. Avoid Road and Landing Use: All new roads and landings shall be located outside of zone. When feasible, minimize use of existing roads and landings in the flood prone area. No servicing of equipment within the flood prone area. Exceptions include the use of road and landings to accomplish actions to improved salmonid habitat conditions stated 14 CCR 916.9 [936.9, 956.9], subsection (f)(3)(E)(1.) above.

5. Avoid Slash concentration and Site Preparation: Logging slash shall not be disposed of or concentrated in side channels. When slash is treated within the flood prone areas, scatter slash and avoid piling or other concentrations that may obstruct flows in side channels. When feasible, concentrate/mulch slash in tractor roads. No mechanical site preparation, broadcast burning or pile burning.

6. Delineate Zone on the Ground: Locations of all WLPZ zones and CMZs shall be designated on the ground.

7. Avoid Use of Water Drafting Sites: Water drafting sites shall be located outside flood prone areas when feasible (exceptions could include, but are not limited to, drafting from an existing watercourse crossing that is appropriately engineered to facilitate properly functioning salmonid habitat and those sites designed and permitted pursuant to a waste discharge or steam alteration permits.

8. Avoid Disturbance to Critical Flood Prone Area Habitat: Avoid disturbance of abandoned meanders, oxbox lakes, or other features that provide off-channel habitat for fish during flood flows. Avoid activities that could increase potential for diversion or avulsion of stream flow out of existing channel, including breaching or lowering the elevation of natural levees. Retain adequate hydraulic roughness provided by trees on the floodplain surface, thereby slowing flood water velocity on floodplains, attenuating peak flood flows, and allowing sediment to be deposited. Retain existing deciduous hardwoods preferential to anadromous salmonid species and down large woody debris.

(F) Outer Zone: The width of the Outer Zone is 50 feet measured from the landward edge of Inner Zone. This zone is required where evenaged regeneration methods, seed tree removal, shelterwood removal, alternative prescriptions declared under 14 CCR § 913.6 [933.6], subsection (b)(3) as most related to any evenaged silvicutural system, variable retention or rehabilitation of understocked areas will be utilized contiguous to the watercourse and lake protection zone. Timber operations are permitted in this zone when conducted to meet the goals of this section, including those for the Outer Zone in 14 CCR § 916.9 [936.9, 956.9], selection modified to meet the following requirements:subsection (c)(3) and (5), pursuant to

14 CCR § 916.9 [936.9] subsection (e)(1) (A)-(F), or pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v). Silvicultural systems for harvesting are limited to the use of commercial thinning or single tree

1. Postharvest stand shall have a minimum 50% overstory canopy cover. The postharvest canopy may be composed of both conifers and hardwood species and shall have at least 25% overstory conifer canopy.

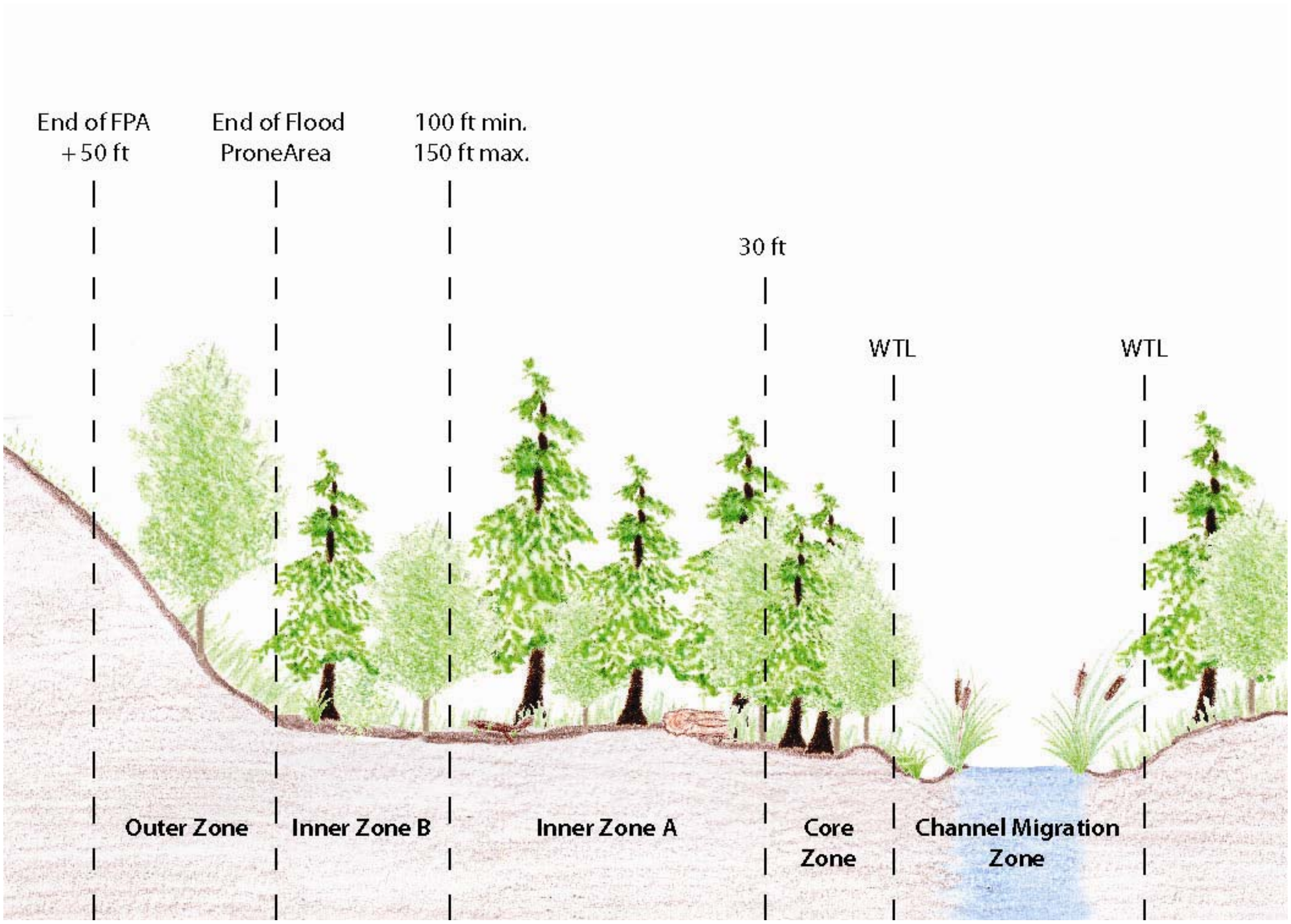
2. Priority shall be given to retain wind firm trees.

Table 2: Procedure for Determining WLPZ Widths and Protective Measures
Class I WLPZs – with flood prone areas or channel migration zones

Pursuant to 14 CCR 916.9 [936.9, 956.9] (f)(3)

Zone Designation	Zone width (ft.)	Overstory Canopy Cover		Large Tree Retention	Silviculture Requirements	Operational Requirements
Channel Zone or Channel Zone per 916.9 [936.9 956.9] (f)(3)(A)	Variable	Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)		Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v); no sanitation salvage except 916.9 (s)(t)and (u)	No timber operations except per 916.9 [936.9, 956.9] (e)(1) A-F or 916.9 [936.9, 956.9](v);
Core Zone per 916.9 [936.9 956.9] (f)(3)(B)	30 ft.	Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)		Retain all trees except per 916.9 [936.9, 956.9](e) (1)A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e) (1) A-F or 916.9 [936.9, 956.9](v); no sanitation salvage except 916.9 (s)(t)and (u).	No timber operations except per 916.9 [936.9, 956.9] (e) (1)A-F or 916.9 [936.9, 956.9](v);
Inner Zone A per 916.9 [936.9 956.9] (f)(3)(C)	Minimum 70 ft. Maximum 120 ft.	80% Coast and Southern Forest District of Coastal Anadromy Zone per 916.9 [936.9 956.9] (f)(3)(C)3.	70% in Northern Forest District of Coastal Anadromy Zone per 916.9 [936.9 956.9] (f)(3)(C)3.	13 largest trees /ac. per 916.9 [936.9 956.9] (f)(3)(C)4.	Increase QMD; No sanitation salvage except 916.9 (s)(t)and (u); commercial thinning or single tree selection only.	Preferred Management Practices in 916.9 [936.9, 956.9] (f)(3)(E)
Inner Zone B per 916.9 [936.9 956.9] (f)(3)(D)	Variable: distance from Inner Zone A to end of FPA.	50%		13 largest trees /ac. per 916.9 [936.9 956.9] (f)(3)(D)1.	Increase QMD; No sanitation salvage except 916.9 (s)(t)and (u); commercial thinning or single tree selection only.	Preferred Management Practices in 916.9 [936.9, 956.9] (f)(3)(E)
Outer Zone per 916.9 [936.9 956.9] (f)(3)(F) Applicable only where even-aged regeneration used adjacent to the WLPZ	50 ft.	50%		NA	Commercial thinning or single tree selection only; Retain wind firm trees.	Preferred Management Practices in 916.9 [936.9, 956.9] (f)(3)(E)

<u>Figure 5: Graphic of Profile View of Class I WLPZ in flood prone areas and channel migration zones (not to scale)</u>



<u>**Outer Zone**:</u>
<u>50 ft. Outer Zone required only when even aged silv. system contiguous to WLPZ</u>
<u>Modified commercial thinning or single tree selection</u>
<u>50% overstory canopy (OSC)</u>

Inner Zone B:
Modified commercial thinning or single tree selection
50% overstory canopy (OSC)
Retain 13 largest trees/ac.

<u>**Inner Zone A:**</u>
<u>Modified commercial thinning or single tree selection</u>
<u>Increase QMD</u>
<u>No Sanitation Salvage</u>
<u>Retain 80% OSC in the Coast and Southern Forest Districts of the coastal anadromy zone and 70% OSC in the Northern Forest District of the coastal anadromy zone</u>
<u>Retain 13 largest trees/ac.</u>

(4) Class I watercourses with confined channels outside watersheds in the coastal anadromy zone: The following are the minimum requirements for WLPZ delineation and timber operations in Class I WLPZs in locations outside of watersheds in the coastal anadromy zone where confined channels are present. WLPZ width is 100 feet slope distance, with an additional 25 foot ELZ depending on the silvicultural system applied contiguous to the WLPZ. Three zones are established within the WLPZs: The Core Zone is nearest to the water, the Inner Zone is the middle zone contiguous to the Core Zone, and the Outer Zone is furthest from the water and contiguous to the Inner Zone. Graphic depiction of zones and the abbreviated descriptions of the silvicultural prescriptions and operational requirements are shown in Figure 6. Table 3 specifies the enforceable standards to be used for protection of Class I watercourses for the area outside the coastal anadromy zone:

(A) Core Zone: The minimum width of the Core Zone shall be 30 feet measured from the watercourse transition line or lake transition line. No timber operations are permitted in this zone except for those listed in 14 CCR § 916.9 [936.9, 956.9], subsection (e) (1)(A)-(F), or those approved pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v). Sanitation-Salvage is prohibited except as provided in 14 CCR § 916.9 [936.9, 956.9], subsections (s), (t), and (u).

(B) Inner Zone: The minimum width of the Inner Zone shall be 40 feet measured from the landward edge of Core Zone. Timber operations are permitted in this zone when conducted to meet the goals of this section, including those for the Inner Zone in 14 CCR § 916.9 [936.9, 956.9], subsection (c)(2), pursuant to 14 CCR § 916.9 [936.9, 956.9], subsections (e)(1) (A)-(F) or pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v). Harvesting prescriptions should focus on practices that use thinning from below. Silvicultural systems for harvesting are limited to the use of commercial thinning or single tree selection modified to meet the following requirements:

1. When commercial thinning is used, the QMD of conifer trees greater than 8 inches dbh in the preharvest project area shall be increased in the postharvest stand.

2. Sanitation-Salvage is prohibited except as provided in 14 CCR § 916.9 [936.9,956.9], subsections (s), (t), and (u).

3. Postharvest stand shall have a minimum 70% overstory canopy cover. The postharvest canopy may be composed of both conifers and hardwood species and shall have at least 25% overstory conifer canopy.

4. Postharvest stand shall retain the 7 largest conifer trees (live or dead) on each acre of the area that encompasses the Core and Inner Zones.

5. Large trees retained to meet 14 CCR § 916.9 [936.9, 956.9], subsections (f)(5)(B)1.-3. above that are the most conducive to recruitment to provide for the beneficial functions of riparian zones (e.g., trees that lean towards the channel, have an unimpeded fall path toward the watercourse, are in an advanced state of decay, are located on unstable areas or downslope of such an unstable areas, or have undermined roots) are to be given priority to be retained as future recruitment trees.

(C) Outer Zone: The minimum width of the Outer Zone shall be 30 feet measured from the landward edge of Inner Zone. When evenaged regeneration methods, seed tree removal, shelterwood removal, alternative prescriptions declared under 14 CCR § 913.6 [933.6, 953.6], subsection (b)(3) as most related to any evenaged silvicutural system, variable retention, or rehabilitation will be utilized contiguous to watercourse and lake protection zones, an additional 25 foot ELZ is required contiguous to the Outer Zone.

Timber operations are permitted in the Outer Zone when conducted to meet the goals of this section, including those for the Outer Zone in 14 CCR § 916.9 [936.9, 956.9], subsection (c)(3) and (5) pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (e)(1) (A)-(F), or pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v). Silvicultural systems for harvesting are limited to the use of commercial thinning or single tree selection modified to meet the following requirements:

1. Postharvest stand shall have a minimum 50% overstory canopy cover. The postharvest canopy may be composed of both conifers and hardwood species and shall have at least 25% overstory conifer canopy.

2. Priority shall be given to retain wind firm trees.

(D) Preferred Management Practices in the Inner and Outer Zone:

When timber operations are considered pursuant to 14 CCR §§ 916.3 [936.3, 956.3], subsection (c) and 916.4 [936.4, 956.4], subsection (d), the following Preferred Management Practices should be considered for inclusion in the Plan by the RPF and by the Director:

1. Preflagging or marking of any skid trails before the preharvest inspection;

2. Heavy equipment should be limited to slopes less than 35% with low or moderate EHRs;

3. Use feller bunchers or hydraulic heel boom loaders which do not drag/skid logs through the zone;

4. Minimize turning of heavy equipment which would result in increased depth of ground surface depressions; and

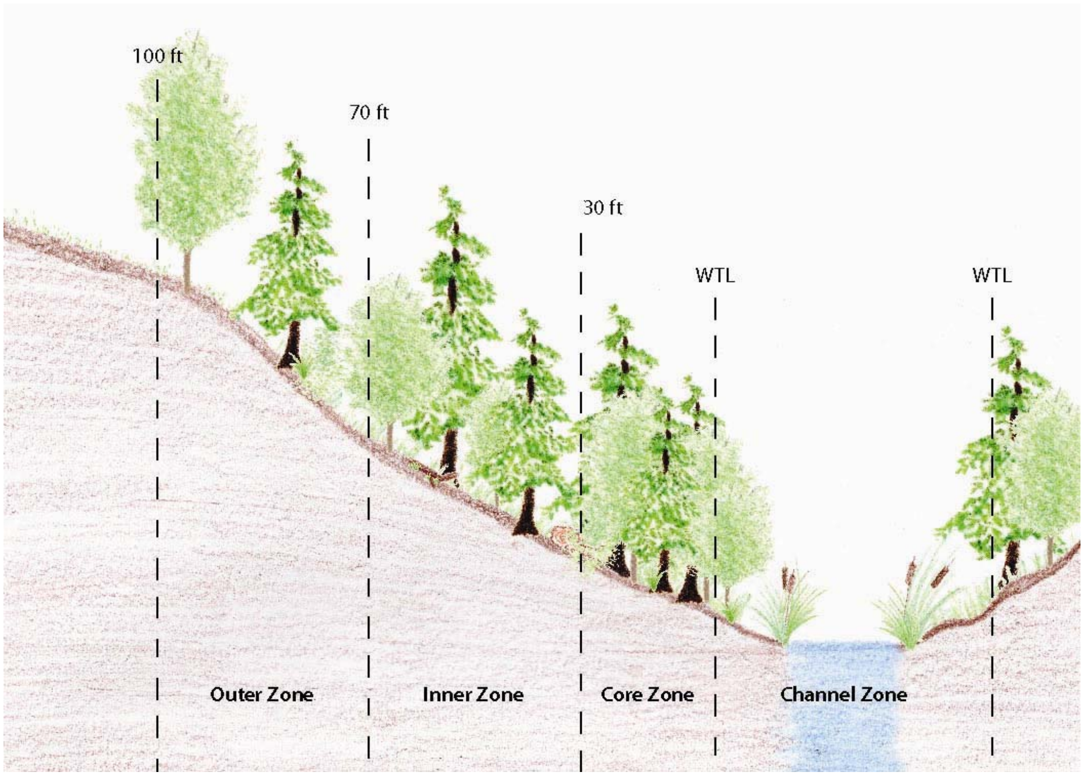
5. Use mechanized harvesting equipment which delimb harvested trees on pathway over which heavy equipment would travel.

Table 3: Procedure for Determining WLPZ Widths and Protective Measures Class I WLPZs - Confined Channels - Outside the Coastal Anadromy Zone

Pursuant to 14 CCR 916.9[936.9,956.9](f)(4)

Zone Designation	Zone width (ft.)	Overstory Canopy Cover	Large Tree Retention	Silviculture Requirements	Operational Requirements
Channel Zone	Variable	Retain all trees except per 916.9 [936.9, 956.9](e)(1) A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9](e)(1) A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e)(1) A-F or 916.9 [936.9, 956.9](v); no sanitation salvage except 916.9 (s)(t)and (u)	No timber operations except per 916.9 [936.9, 956.9] (e)(1) A-F or 916.9 [936.9, 956.9](v);
Core Zone per 916.9 [936.9 956.9] (f)(4)(A)	30 ft.	Retain all trees except per 916.9 [936.9, 956.9](e)(1) A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9](e)(1) A-F or 916.9 [936.9 956.9] (v)	Retain all trees except per 916.9 [936.9, 956.9] (e)(1) A-F or 916.9 [936.9, 956.9](v); no sanitation salvage except 916.9 (s)(t)and (u).	No timber operations except per 916.9 [936.9, 956.9] (e)(1) A-F or 916.9 [936.9, 956.9](v);
Inner Zone per 916.9 [936.9 956.9] (f)(4)(B)	40 ft.	70% per 916.9 [936.9 956.9] (f)(4)(B)3.	7 largest trees /ac. per 916.9 [936.9 956.9] (f)(4)(B)4.	Increase QMD; No sanitation salvage except 916.9 (s)(t)and (u); commercial thinning or single tree selection only.	Preferred Management Practices in 916.9 [936.9, 956.9] (f)(4)(D)
Outer Zone per 916.9 [936.9 956.9] (f)(4)(C)1.	30 ft.	50% per 916.9 [936.9 956.9] (f)(4)(C).1.	NA	Commercial thinning or single tree selection only; Retain wind firm trees.	Preferred Management Practices in 916.9 [936.9, 956.9] (f)(4)(D)
ELZ Applicable only where even-aged regeneration used adjacent to the WLPZ	25 ft.	NA	NA	All other Forest Practice Rules	All other Forest Practice Rules

Figure 6: Graphic of profile view of Class I WLPZ with confined channels outside watersheds in the coastal anadromy zone (not to scale)



Outer Zone:
Modified commercial thinning or single tree selection
50% overstory canopy (OSC)

Inner Zone:
Modified commercial thinning or single tree selection
Increase QMD
No Sanitation Salvage
70% OSC
Retain 7 largest trees/ac.

~~**(f)** The minimum WLPZ width for Class I waters shall be 150 feet from the watercourse or lake transition line. Where a proposed THP is located within the Sacramento or San Joaquin river drainages, and the Director and DFG concur; the RPF may explain and justify other WLPZ widths on areas where even aged regeneration methods, seed tree removal, shelterwood removal, alternative prescriptions, or rehabilitation will not be utilized adjacent to watercourse and lake protection zones and where slopes are less than 30%.~~

(g) Class II watercourses -

The following are the minimum requirements for Class II WLPZ delineation and ~~for~~ timber operations. Differing rules are specified for watersheds in the coastal anadromy zone, the Southern Subdistrict of the Coast Forest District, and areas outside the coastal andromy zone. WLPZ width ranges from 50 to 100 feet slope distance, depending on side slope steepness in the WLPZ and the watercourse type.

(1) Determine the Class II Watercourse Type: Class II watercourses are composed of two types - Class II-S (standard) watercourses and Class II-L (large) watercourses. A Class II-L watercourse is defined as a Class II watercourse that: (i) can supply water and nutrients to a Class I watercourse during the month of July during an average hydrologic year; (ii) can supply coarse and fine sediment to the Class I channel; and (iii) may be able to supply wood of a size that would function as large wood for the Class I watercourse. Identification of Class II-L watercourse types shall be based on one or more of the office methods specified under 14 CCR § 916.9 [936.9, 956.9] subsection (g) (1) (A) and the field methods specified under 14 CCR § 916.9 [936.9, 956.9], subsection (g) (1) (B). Class II-S watercourses are those classified as Class II watercourses pursuant to 14 CCR § 916.5 [936.5, 956.5], but do not meet the definition of a Class II-L watercourse.

(A) Office-based approaches to identify potential Class II-L watercourses:

1. Stream order: After classifying the watercourses in an area pursuant to 14 CCR § 916.5 [936.5, 956.5], map all Class II watercourses in the area of consideration on current 1:24,000 scale U.S. Geological Survey topographic maps and determine stream order following the stream order method in 14 CCR 895.1. Second order and third order Class II watercourses are potentially Class II-L watercourses.

2. "Blue Line" streams: Watercourses mapped with a blue or black line on current 1:24,000 scale U.S. Geological Survey topographic maps that are not Class I are inferred to be Class II-L watercourses.

3. Drainage area: A calculated drainage area known to produce mid-late summer flow based on past plan experience or local knowledge for an ownership or local region and extrapolated over the ownership or local area can indicate a Class II-L watercourses.

(B) Field-based approaches to identify potential Class II-L: Determination of Class II-L watercourses shall be verified in the field by direct channel observations and local experience using one or more of the following approaches.

1. Determine by direct observation or by local knowledge of common mid-summer flow conditions if office mapped Class II-L watercourses contribute flow to a Class I watercourse at least through approximately July 15th following a year with at least average precipitation.

2. Observe channel characteristics such as channel width at bankfull stage, channel depth at bankfull stage, channel slope, mean entrenchment ratio, the presence of springs or seeps, and the presence of aquatic animal and plant life that require mid-summer flow.

3. Use continuous streamflow monitoring data from headwater watercourses to determine the watershed drainage area necessary to initiate mid-summer streamflow for a given ecoregion and extrapolate this data to other headwater basins in that ecoregion.

(C) Based on (A) and (B) above, make a determination if the portion of the Class II watercourse being evaluated meets the definition of a Class II-L watercourse in 14 CCR § 916.9 [936.9, 956.9], subsection (c)(4).

(D) Include documentation in the plan explaining how the Class II-L determination(s) were made within the plan area.

(E) All Class II-L watercourses designated above shall incorporate requirements stated in 14 CCR § 916.9 [936.9, 956.9], (g)(2) for a distance of 1000 feet, or total length of Class II-L, which ever is less, measured from the confluence with a Class I watercourse.

(2) Class II WLPZ widths and operational requirements : All Class II WLPZs shall be composed of two zones regardless of the watercourse type: a Core Zone and an Inner Zone. The Core Zone is nearest to the water, the Inner Zone is contiguous to the Core Zone and is furthest from the water. The width of the Core and Inner Zones vary depending on the following three factors: (i) side slope steepness in the WLPZ, (ii) whether the watercourse is a Class II-S or Class II-L watercourse type, and (iii) whether the watercourse is within a watershed in the coastal anadromy zone or outside the coastal anadromy zone. Graphic depictions of zones and the abbreviated descriptions of the silvicultural prescriptions and operational requirements are shown in Figure 7.

(A) Core Zone: The width of Core zone varies from 0 feet to 30 feet measured from the watercourse or lake transition line. When established, no timber operations are permitted in this zone except for those listed in 14 CCR § 916.9 [936.9, 956.9], subsection (e)(1)(A)-(F), or practices approved pursuant to 14 CCR § 916.9 [936.9,956.9], subsection (v). Sanitation-Salvage is prohibited except as provided in § 916.9 [936.9, 956.9], subsections (s), (t), and (u). Table 4. summarizes the minimum width for the Core Zone.

Table 4. Core and Inner Zone widths.

Water Class	**Class II-S (feet)**				**Class II-L (feet)**			
Geographic location	**Watersheds in the coastal anadromy zone**		**Watersheds outside the coastal anadromy zone**		**Watersheds in the coastal anadromy zone**		**Watersheds outside the coastal anadromy zone**	
Slope class	Core Zone (feet)	Inner Zone (feet)	Core Zone (feet)	Inner Zone (feet)	Core Zone (feet)	Inner Zone (feet)	Core Zone (feet)	Inner Zone (feet)
<10%	0	50	0	50	30	70	20	80
10%-30%	15	35	10	40	30	70	20	80
30-50%	15	60	10	65	30	70	20	80
>50%	15	85	10	90	30	70	20	80

(B) Inner Zone: The widths of the Inner Zone vary from 35 feet to 90 feet and shall be measured from the landward edge of Core Zone or WTL, which ever is greater. Timber operations are permitted in this zone when conducted to meet the goals of this section, including those for the Inner Zone in 14 CCR § 916.9 [936.9, 956.9], subsections (c)(2)and (4), pursuant to 14 CCR § 916.9 [936.9,956.9], subsections (e)(1) (A)-(F) or pursuant to 14 CCR § 916.9 [936.9,956.9] subsection (v). Harvesting prescriptions should focus on practices that use thinning from below. Inner Zone widths are summarized in Table 4.

1. Class II-S watercourses: Any Class II-S watercourses shall receive protection in conformance with 14 CCR §§ 916 [936, 956] through 916.7 [936.7, 956.7] in addition to the requirements listed under 14 CCR §§ 916.9 [936.9, 956.9] (g)(2)(A) and (B).

2. Class II-L watercourses in the coastal anadromy zone: Silvicultural systems for harvesting are limited to the use of commercial thinning or single tree selection modified to meet the following requirements:

(i) When commercial thinning is used, the QMD of conifer trees greater than 8 inches dbh in the preharvest project area shall be increased in the postharvest stand.

(ii) Sanitation-Salvage is prohibited except as provided in 14 CCR § 916.9 [936.9, 956.9].

(iii) Postharvest stand shall have a minimum 80% overstory canopy cover in the Coast and Southern Forest Districts of the coastal anadromy zone and a minimum 70% overstory canopy cover in the Northern Forest District of the coastal anadromy zone. The postharvest canopy may be composed of both conifers and hardwood species and shall have at least 25% overstory conifer canopy.

(iv) Postharvest stand shall retain the 13 largest conifer trees (live or dead) on each acre of the area that encompasses the Core and Inner Zones.

(v) Large trees retained to meet 14 CCR § 916.9 [936.9, 956.9], subsections (g)(2)(B)2.-(i) and (iii) above that are the most conducive to recruitment to provide for the beneficial functions of riparian zones (e.g. trees that lean towards the channel, have an unimpeded fall path toward the watercourse, are in an advanced state of decay, are located on unstable areas or downslope of such an unstable areas, or have undermined roots) are to be given priority to be retained as future recruitment trees.

3. Class II-L watercourses outside watersheds in the coastal anadromy zone: Silvicultural systems for harvesting are limited to the use of commercial thinning or single tree selection modified to meet the following requirements:

(i) When commercial thinning is used, the QMD of conifer trees greater than 8 inches dbh in the preharvest project area shall be increased in the postharvest stand.

(ii) Sanitation-Salvage is prohibited except as provided in 14 CCR § 916.9 [936.9,956.9], subsections (s), (t), and (u).

(iii) Postharvest stand shall have a minimum 70% overstory canopy cover. The postharvest canopy may be composed of both conifers and hardwood species and shall have at least 25% overstory conifer canopy.

(iv) Postharvest stand shall retain the 7 largest conifer trees (live or dead) on each acre of the area that encompasses the Core and Inner Zones.

(v) Large trees retained to meet 14 CCR § 916.9 [936.9, 956.9], subsections (g)(2)(B)3.(i) and (iii) above that are the most conducive to recruitment to provide for the beneficial functions of riparian zones (e.g. trees that lean towards the channel, have an unimpeded fall path toward the watercourse, are in an advanced state of decay, are located on unstable areas or downslope of such an unstable areas, or have undermined roots) are to be given priority to be retained as future recruitment trees.

(3) Class II watercourses in the Southern Subdistrict of the Coast Forest District

In addition to all other Forest Practice Rules applicable to timber harvesting within the Southern Subdistrict of the Coast Forest District, the following rules apply within a Class II WLPZ. These requirements supersede any other requirements for Class II watercourses contained in 14 CCR § 916.9 (g).

(A). Retain all trees within the Class II WLPZ that meet the following criteria:

1. all trees located within the channel zone;

2. all trees that have boles that overlap the edge of the channel zone; and

3. all trees with live roots permeating the bank or providing channel grade control, with the following exception:

(i) 1/3 of the stems of redwoods with live roots permeating the bank or providing channel grade control may be harvested.

(B) Where sufficient spacing exists prior to harvesting, retained redwood trees greater than or equal to 12 inches dbh shall not be spaced more than 25 feet apart.

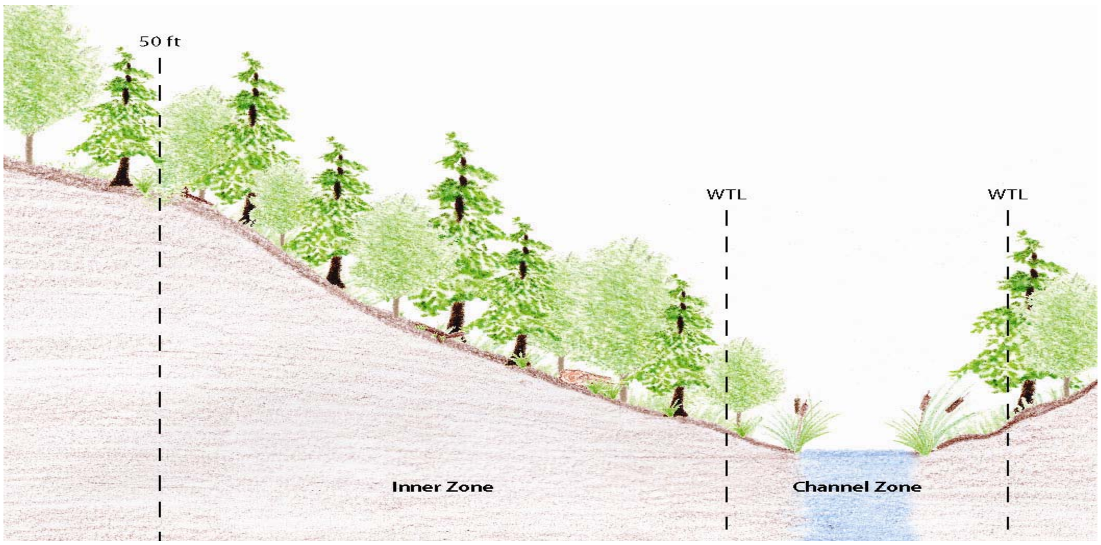
(C) A minimum of 80% overstory canopy shall be maintained within the channel zone. If 80% overstory canopy is not present within the channel zone, the existing overstory canopy within the channel shall not be reduced.

(D) No more than 1/3 of the conifers 18" dbh or larger may be harvested.

Figure 7: Graphic of profile view of WLPZs for Class II Watercourses (excluding the Southern Subdistrict) (not to scale)

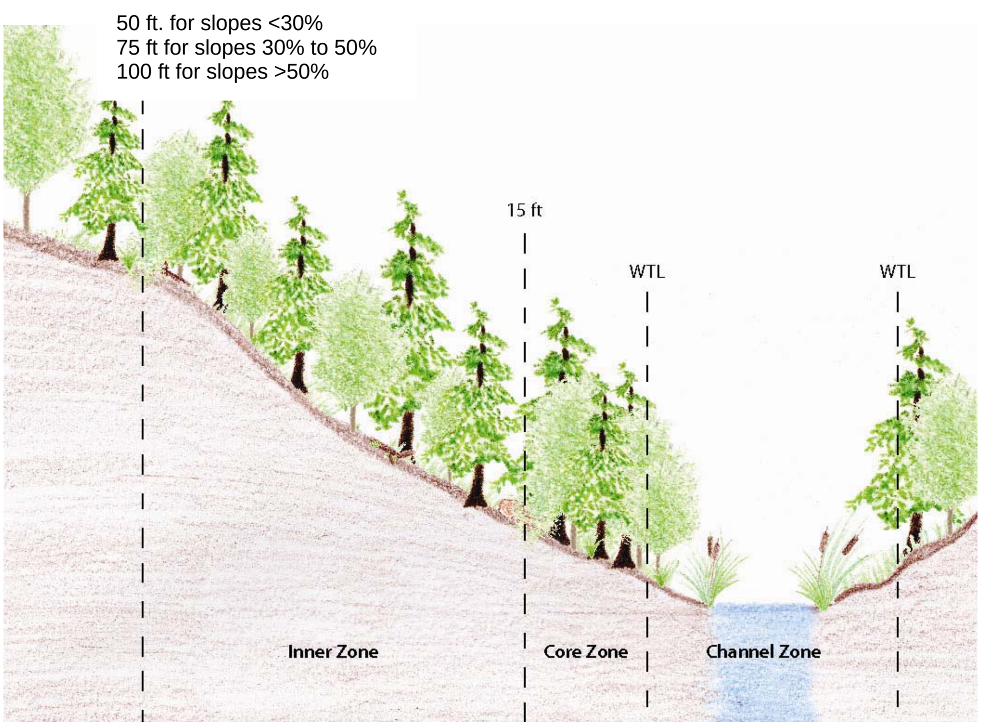
Class II Standard – Slopes <10%

Inner Zone: FPRs in 14 CCR 916 -916.7



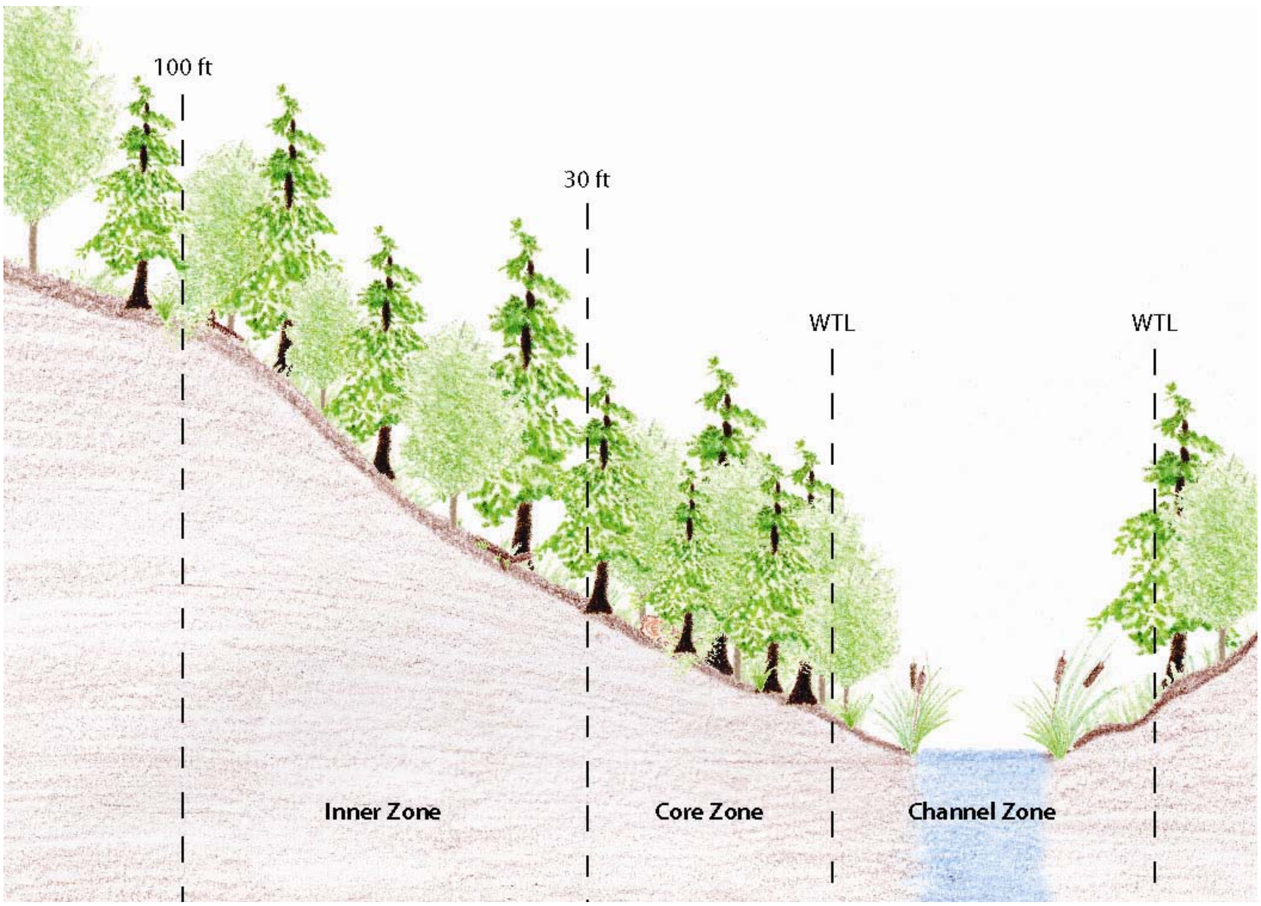
Class II Standard - Watersheds in the coastal anadromy zone

Inner Zone: FPRs in 14 CCR 916 -916.7



<u>Class II Large - Watersheds in the coastal anadromy zone</u>

<u>Inner Zone:</u>
<u>Modified commercial thinning or single tree selection</u>
<u>Increase QMD</u>
<u>No Sanitation Salvage</u>
<u>Retain 80% OSC in the Coast and Southern Forest Districts of the coastal anadromy zone and 70% OSC in the Northern Forest District of the coastal anadromy zone</u>
<u>Retain 13 largest trees/ac.</u>



~~**(g)** Within a WLPZ for Class I waters, at least 85 percent overstory canopy shall be retained within 75 feet of the watercourse or lake transition line, and at least 65 percent overstory canopy within the remainder of the WLPZ. The overstory canopy must be composed of at least 25% overstory conifer canopy post-harvest. Where a proposed THP is located within the Sacramento or San Joaquin river drainages, and the Director and DFG concur; the RPF may explain and justify other canopy retention standards on areas where even aged regeneration methods, seed tree removal, shelterwood removal, alternative prescriptions, or rehabilitation will not be utilized adjacent to watercourse and lake protection zones and where slopes are less than 30%. Harvesting of hardwoods shall only occur for the purpose of enabling conifer regeneration.~~

(h) Class III watercourses –

The following are the minimum requirements for timber operations in Class III watercourses, unless explained and justified in the plan and approved by the Director.

(1) Establish a 30 foot wide ELZ on both sides of the watercourse for slopes less than 30% and an additional 20 foot ELZ where sideslopes are >30%. The ELZ is measured from the WTL. Within the ELZ:

(A) no new construction of tractor roads permitted;

(B) no ground based equipment on slopes >50%; and

(C) ground-based operations are limited to existing stable tractor roads that show no visible evidence of sediment deposition being transported into the adjacent watercourse or to the use of feller- bunchers or shovel yarding.

(2) Retain all pre-existing large wood on the ground within the ELZ that is stabilizing sediment and is necessary to prevent potential discharge into the watercourse.

(3) Retain all pre-existing down wood and debris in the channel zone.

(4) Retain hardwoods, where feasible, within the ELZ.

(5) Retain all snags (except as required for safety) within the ELZ.

(6) Retain all countable trees needed to achieve resource conservation standards in 14 CCR § 912.7 [932.7, 952.7] within the ELZ.

(7) Retain all trees in the ELZ and channel zone which show visible indicators of providing bank or bed stability, excluding sprouting conifers that do not have boles overlapping the channel zone. Visible indicators of stability include roots that permeate the bank or provide channel grade control.

(8) Exceptions pursuant to 14 CCR § 916.9 [936.9, 956.9, subsections (e)(1) (A)-(F) are permitted in any ELZ and channel zone.

~~**(h)** For Class I waters, any plan involving timber operations within the WLPZ shall contain the following information:~~

~~**(1)** A clear and enforceable specification of how any disturbance or log or tree cutting and removal within the Class I WLPZ shall be carried out to conform with 14 CCR 916.2 [936.2, 956.2](a) and 916.9 [936.9, 956.9](a).~~

~~**(2)** A description of all existing permanent crossings of Class I waters by logging roads and clear specification regarding how these crossings are to be modified, used, and treated to minimize risks, giving special attention to allowing fish to pass both upstream and downstream during all life stages.~~

~~**(3)** Clear and enforceable specifications for construction and operation of any new crossing of Class I waters to prevent direct harm, habitat degradation, water velocity increase, hindrance of fish passage, or other potential impairment of beneficial uses of water.~~

(i) Section reserved for future use. ~~Recruitment of large woody debris for aquatic habitat in Class I anadromous fish-bearing or restorable waters shall be ensured by retaining the ten largest dbh conifers (live or dead) per 330 feet of stream channel length that are the most conducive to recruitment to provide for the beneficial functions of riparian zones. The retained~~

~~conifers shall be selected from within the THP area that lies within 50 feet of the watercourse transition line. Where the THP boundary is an ownership boundary, a class I watercourse, and the WLPZ on both sides of the watercourse currently meets the stocking standards listed under 14 CCR § 912.7 [932.7,952.7](b)(2)}; the five (5) largest dbh conifers (live or dead) per 330 feet of stream channel length that are the most conducive to recruitment to provide for the beneficial functions of riparian zones within the THP area shall be retained within 50 feet of the watercourse transition line~~**.**

~~The RPF may propose alternatives to substitute smaller diameter trees, trees that are more than 50 feet from the watercourse transition line, or other alternatives on a site specific basis. The RPF must explain and justify in the THP why the proposed alternative is more conducive to current and long-term Large Woody Debris recruitment, shading, bank stability, and the beneficial functions of riparian zones.~~

(j) Inner Gorge - Where an inner gorge extends beyond a Class I WLPZ*****outside a WLPZ.

(k) Year-round logging road, landing and tractor road use limitations -

~~From October 15 to May 1, the following shall apply: (1)no timber operations shall take place unless the approved plan incorporates a complete winter period operating plan pursuant to 14 CCR § 914.7(a) [934.7(a), 954.7(a)], (2)unless the winter period operating plan proposes operations during an extended period with low antecedent soil wetness, no tractor roads shall be constructed, reconstructed, or used on slopes that are over 40 percent and within 200 feet of a Class I, II, or III watercourse, as measured from the watercourse or lake transition line,~~. ~~and operations of trucks and heavy on logging roads and landings shall be limited to those with a stable operating .~~

(1) Logging roads, landings or tractor roads shall not be used when visibly turbid water from the road, landing or tractor road (skid trail) or an inside ditch associated with the logging road, landing or tractor road may reach a watercourse or lake in amounts sufficient to cause a turbidity increase in Class I, II, III or IV waters.

(2) Log hauling on logging roads and landings shall be limited to those which are hydrologically disconnected from watercourses to the extent feasible, and exhibit a stable operating surface in conformance with (1) above.

(3) Concurrent with use for log hauling, approaches to logging road watercourse crossings shall be treated for erosion control as needed to minimize soil erosion and sediment transport and to prevent the discharge of sediment into watercourses and lakes in quantities deleterious to the beneficial uses of water.

(4) Concurrent with use for log hauling, all traveled surfaces of logging roads in a WLPZ or within any ELZ or EEZ designated for watercourse or lake protection shall be treated for erosion control as needed to minimize soil erosion and sediment transport and to prevent the discharge of sediment into watercourses and lakes in quantities deleterious to the beneficial uses of water.

(5) Grading to obtain a drier running surface more than one time before reincorporation of any resulting berms back into the road surface is prohibited.

(l) **Extended Wet Weather Period -**~~Construction or reconstruction of logging roads, tractor roads, or landings shall not take place during the winter period unless the approved plan incorporates a complete winter period operating plan pursuant to 14 § CCR 914.7(a) [934.7(a), 954.7(a)] that specifically address such road construction . Use of logging roads, tractor roads, or landings shall not take place at any location where saturated soil conditions exist, where a stable logging road or landing operating surface does not exist, or when visibly turbid water from the road, landing, or skid trail surface or inside ditch may reach a watercourse or lake. Grading to obtain a drier running surface more than one time before reincorporation of any resulting~~

~~berms back into the road surface is prohibited.~~October 15 to May 1 shall be considered the extended wet weather period and the following shall apply:

(1) No timber operations shall take place unless the approved plan incorporates a complete winter period operating plan pursuant to 14 CCR § 914.7 [934.7, 954.7] subsection (a) that specifically addresses, where applicable, proposed logging road~~=~~, landing~~=~~ or tractor road construction, reconstruction and use during the extended wet weather period. Where logging road watercourse crossing construction or reconstruction is proposed an implementation schedule shall be specified.

(2) Unless the winter period operating plan proposes operations during an extended wet weather period with low antecedent soil wetness, no tractor roads shall be constructed, reconstructed, or used on slopes that are over 40 percent and within 200 feet of a Class I, II, or III watercourse, as measured from the watercourse or lake transition line during the extended wet weather period~~,~~. ~~and~~

(3) Logging roads, landings and tractor roads shall not be used when sediment from the logging road, landing or tractor road surface is transported to a watercourse or a drainage facility that discharges into a watercourse in amounts sufficient to cause a visible increase in turbidity in Class I, II, III, or IV waters.

(4) Logging roads and landings shall not be used for log hauling when saturated soil conditions result in the visible increase in turbidity specified in (3) above.

(m) Tractor Road Drainage Facility Installation- All Tractor roads*****

*****(n) Treatments to stabilize soils -** Within the WLPZ, and within any ELZ or EEZ designated for watercourse or lake protection, treatments to stabilize soils, minimize soil erosion, and prevent the discharge of sediment into watercourses or lakes in amounts deleterious to aquatic species or the quality and beneficial uses of water, or that threaten to violate applicable water quality requirements, shall be described in the plan as follows. ~~applied in accordance with the following standards:~~

~~**(1)** The following requirements shall apply to all such treatments.~~

~~**(A)** They shall be described in the plan.~~

~~**(B)** For areas disturbed from May 1 through October 15, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface.~~

~~**(C)** For areas disturbed from October 15 to May 1, treatment shall be completed prior to any day for which a chance of rain of 30 percent or greater is forecast by the National Weather Service or within 10 days, whichever is earlier.~~

~~(3)~~**(1)** ~~The treatment for other disturbed areas, including:~~ Soil stabilization is required for the following areas:

(A) ~~a~~Areas exceeding 100 contiguous square feet where timber operations have exposed bare soil~~,~~.

(B) ~~a~~Approaches to tractor road watercourse crossings between the drainage facilities closest to the crossing~~,~~.

(C) Disturbed road cut banks and fills, and

(D) ~~a~~Any other area of disturbed soil that threatens to discharge sediment into waters in amounts deleterious to the quality and beneficial uses of water~~,~~.

(2) Soil stabilization treatment measures may include, but need not be limited to, removal, armoring with rip-rap, replanting, mulching, ~~rip-rapping~~, ~~grass~~ seeding, installing commercial erosion control devices to manufacturer's specifications, or chemical soil stabilizers. ~~Where straw, mulch, or slash is used, the minimum coverage shall be 90%, and any treated area that has been subject to reuse or has less than 90% surface cover shall be treated again~~

~~prior to the end of timber operations. The RPF may propose alternative treatments that will achieve the same level of erosion control and sediment discharge prevention.~~

~~**(4)** Where the undisturbed natural ground cover cannot effectively protect beneficial uses of water from timber operations, the ground shall be treated by measures including, but not limited to, seeding, mulching, or replanting, in order to retain and improve its natural ability to filter sediment, minimize soil erosion, and stabilize banks of watercourses and lakes.~~

(3) Where straw or slash mulch is used, the minimum straw coverage shall be 90 percent, and any treated area that has been reused or has less than 90 percent surface cover shall be treated again by the end of timber operations.

(4) Where slash mulch is packed into the ground surface through the use of a tractor or equivalent piece of heavy equipment the minimum slash coverage shall be 75 percent.

(5) For areas disturbed from May 1 to October 15, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface that could deliver sediment into a watercourse or lake in quantities deleterious to the beneficial uses of water.

(6) For areas disturbed from October 15 to May 1, treatment shall be completed prior to any day for which a chance of rain of 30 percent or greater is forecast by the National Weather Service or within 10 days, whichever is earlier.

(7) Where the natural ability of ground cover is inadequate to protect beneficial uses of water by minimizing soil erosion or by filtering sediment, the plan shall specify protection measures to retain and improve the natural ability of the ground cover to filter sediment and minimize soil erosion.

(o) Erosion Site identification and remedies- As part of the plan , the RPF shall: **(1)** ~~i~~Identify ~~active erosion~~ sites in the logging area. where erosion and sediment production are ongoing during any period of the year and which pose significant risks to the beneficial uses of water~~,~~.

(2) ~~a~~Assess ~~them~~ those sites identified in 14 CCR § 916.9 [936.9, 956.9], subsection (o)(1) to determine whether feasible remedies exist.

(3) ~~and address in the planned feasible remediation for all sites that pose significant wristed beneficial uses of water~~ For sites that pose significant risks to the beneficial uses of water and where feasible remedies exist, the plan shall propose appropriate treatment.

(p) Erosion control maintenance period- The erosion control maintenance period*****shall be three years.

(q) Site preparation - Site preparation activities shall be designed***** under14 CCR 915.4 [936.4, 956.4]

(r) Water drafting - Water drafting for timber operations shall:

(1) Comply with Fish and Game Code Section 1600, et seq.

(A) Timber operations conducted under a Fish and Game Code Section 1600 master or long-term agreement that includes water drafting may provide proof of such coverage for compliance with this paragraph.

(2) Describe the water drafting site conditions and proposed water drafting activity in the plan, including:

(A) a general description of the conditions and proposed water drafting;

(B) a map showing proposed water drafting locations;

C) the watercourse classification;

(D) the drafting parameters including the months the site is proposed for use; estimated total volume needed per day; estimated maximum instantaneous drafting rate and filling time; and disclosure of other water drafting activities in the same watershed;

(E) the estimated drainage area (acres) above the point of diversion;

(F) the estimated unimpeded streamflow, pumping rate, and drafting duration,

(G) a discussion of the effects on aquatic habitat downstream from the drafting site(s) of single pumping operations, or multiple pumping operations at the same location, and at other locations in the same watershed;

(H) a discussion of proposed alternatives and measures to prevent adverse effects to fish and wildlife resources, such as reducing hose diameter; using gravity-fed tanks instead of truck pumping; reducing the instantaneous or daily intake at one location; describing allowances for recharge time; using other dust palliatives; and drafting water at alternative sites; and

(I) The methods that will be used to measure source streamflow prior to the water drafting operation and the conditions that will trigger streamflow to be measured during the operation.

(3) All water drafting for timber operations are subject to each requirement below unless the Department of Fish and Game modifies the requirement in the Lake or Streambed Alteration agreement that authorized the drafting operation, or unless otherwise specified below:

(A) All intakes shall be screened to prevent impingement of juvenile fish against the screen. The following requirements apply to screens and water drafting on Class I waters:

1. Openings in perforated plate or woven wire mesh screens shall not exceed 3/32 inches (2.38 millimeters). Slot openings in wedge wire screens shall not exceed 1/16 inches (1.75 millimeters).

2. The screen surface shall have at least 2.5 square feet of openings submerged in water.

3. The drafting operator shall regularly inspect, clean, and maintain screens to ensure proper operation whenever water is drafted.

4. The approach velocity (water moving through the screen) shall not exceed 0.33 feet/second.

5. The diversion rate shall not exceed 350 gallons per minute.

(B) Approaches and associated drainage features to drafting locations within a WLPZ or channel zone shall be surfaced with rock or other suitable material to minimize generation of sediment.

(C) Barriers to sediment transport, such as straw waddles, logs, straw bales or sediment fences, shall be installed outside the normal high water mark to prevent sediment delivery to the watercourse and limit truck encroachment.

(D) Water drafting trucks parked on streambeds and floodplains shall use drip pans or other devices such as absorbent blankets, sheet barriers or other materials as needed to prevent soil and water contamination from motor oil or hydraulic fluid leaks.

(E) Bypass flows for Class I watercourses shall be provided in volume sufficient to avoid dewatering the watercourse and maintain aquatic life downstream, and shall conform to the following standard:

1. Bypass flows in the source stream during drafting shall be at least 2 cubic feet per second.

2. Diversion rate shall not exceed 10 percent of the surface flow.

3. Pool volume reduction shall not exceed 10 percent.

(F) The drafting operator shall keep a log that records for each time water is drafted, the date, total pumping time, pump rate, starting time, ending time, and volume diverted. Logs shall be filed with the Department of Forestry and Fire Protection at the end of seasonal operations and maintained with the plan record. This requirement may be modified in the approved plan that covers the water drafting, but only with concurrence from the Department of Fish and Game.

(G) Before commencing any water drafting operation, the RPF and the drafting operator shall conduct a pre-operations field review to discuss the water drafting measures in the plan and/or Lake or Streambed Alteration Agreement.

(s) **Exemption notices -** No timber operations are allowed in a WLPZ, or within any ELZ or EEZ designated for watercourse or lake protection, under exemption notices except for:

(1) ~~h~~Hauling on existing roads~~,~~.

(2) ~~r~~Road maintenance~~,~~.

(3) ~~o~~Operations conducted for public safety~~,~~.

(4) ~~c~~Construction or reconstruction of approved watercourse crossings~~,~~.

(5) ~~t~~Temporary crossings of dry Class III watercourses that do not require notification under Fish and Game Code §1600 et seq~~,~~. ~~or~~

(6) ~~h~~Harvesting recommended in writing by DFG to address specifically identified forest conditions.

(t) **Emergency notices -** No timber operations are allowed in a WLPZ, or within any ELZ or EEZ designated for watercourse or lake protection, under emergency notices except for:

(1) ~~h~~Hauling on existing roads~~,~~.

(2) ~~r~~Road maintenance~~,~~.

(3) ~~o~~Operations conducted for public safety~~,~~.

(4) ~~c~~Construction or reconstruction of approved watercourse crossings~~,~~.

(5) ~~t~~Temporary crossings of dry Class III watercourses that do not require notification under Fish and Game Code §1600 et seq~~,~~.

(6) ~~h~~Harvesting recommended in writing by DFG to address specifically identified forest conditions~~,~~.

(7) ~~t~~The harvest of dead or dying conifer trees subject to the following conditions:

(A) Retention of all trees in the core zone of Class I and Class II-L watercourses.

(B) Within any WLPZ, ELZ, or EEZ designated for Class II or III watercourse protection, a minimum of two dead, dying, or diseased conifer trees per acre at least 16 inches diameter breast high and 50 feet tall shall be retained within 50 feet of the watercourse transition line.

(C) Trees to be harvested or retained shall be marked by, or under the supervision of, an RPF prior to timber operations within the WLPZ or ELZ/EEZ.

(D) Within the WLPZ or ELZ/EEZ, if the stocking standards of 14 CCR § 912 [932, 952].7 are not met upon completion of timber operations, unless the area meets the definition of substantially damaged timberlands, at least ten trees shall be planted for each tree harvested but need not exceed an average point count of 300 trees per acre.

(u) **Salvage logging -** No salvage logging *****for streamside salvage operations.

(v) Site-specific measures or nonstandard operational provisions -

(1) In consideration of the spatial variability of the forest landscape, the RPF may propose site-specific measures or nonstandard operational provisions in place of any of the provisions contained in this section. Site specific plans may be submitted when, in the judgment of the RPF, such measures or provisions offer a more effective or more feasible way of achieving the goals and objectives set forth in 14 CCR § 916.9 [936.9, 956.9], subsections (a) and (c), and would result in effects to the beneficial functions of the riparian zone equal to or more favorable than those expected to result from the application of the operational provisions required under 14 CCR § 916.9 [936.9, 956.9].

(2) Measures or provisions proposed pursuant to 14 CCR § 916.9 [936.9, 956.9], subsections (v) shall only be approved when the plan incorporates an evaluation of the beneficial functions of the riparian zone as set forth in subsection (3) below. In the event of measures limited in applicability to specific sites, the submitter may instead of an evaluation, obtain written concurrence from DFG prior to plan submittal. RPFs may request a preconsultation for the site specific plan and the Director may agree and provide staff from responsible agencies.

(3) The evaluation of the beneficial functions of the riparian zone shall be included in addition to any evaluation required by all other District Forest Practice Rules, may incorporate by reference any such evaluation, and shall include the following components scaled appropriately to the scope of the proposed measure(s) or provision(s) and the beneficial functions potentially affected.

(A) The following are required components of an evaluation conducted pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v)(3):

1. A description of the evaluation area. If the evaluation area is different than the watershed assessment area described pursuant to Technical Rule Addendum No. 2, the RPF shall briefly explain the rationale for establishing the evaluation area.

2. A description of the current condition of the riparian zone within the evaluation area related to the beneficial functions. The RPF may incorporate by reference any conditions described in the plan pursuant to 14 CCR § 916.4 [936.4, 956.4], subsection (a). The RPF shall use the best available information, at the appropriate scale, to describe the existing vegetation, timber stand characteristics, roads, skid trails, landings, channel types, unstable areas, flood prone areas, and overflow channels.

3. An identification of the beneficial functions that may potentially be affected by the proposed measure(s) or provision(s).

4. An identification of the potential effects to the beneficial functions, both positive and negative. The RPF may use a reasoned analysis to describe the effects and may assign ratings of high, moderate and low to those effects that may individually or cumulatively limit anadromous salmonid distribution and abundance in the watershed.

5. A detailed description of the site-specific measure(s) or nonstandard operational provision(s) proposed. The description should address at a minimum the relationships between the riparian stand characteristics and ecological functions, the relative importance of the beneficial functions of the riparian zone to the watercourse, the cost effectiveness of the measure(s) or provision(s), and the predicted consequences.

6. A schedule for implementing proposed management practices.

7. A plan for monitoring consistent with 14 CCR § 916.11.

(4) Measures or provisions proposed pursuant to 14 CCR § 916.9 [936.9, 956.9], subsections (v) shall only be approved when they meet the following additional standards:

(A) They must be based upon the best available science, and explained and justified in the plan.

(B) They must identify potential significant adverse impacts that may occur to listed salmonids or the beneficial functions of the riparian zone as a result of the proposed measure(s) or provision(s).

(C) They must identify feasible systems, methods, procedures or approaches proposed to avoid or mitigate identified potential significant adverse impacts to a level of insignificance.

(D) They must be written so they provide clear instructions and enforceable standards for the timber operator;

(E) They must provide that, where appropriate for implementation of the measure(s) or provision(s), the plan submitter is responsible for retaining an RPF to aid in interpreting the plan to the timber operator and timberland owner on a continuing basis to help assure compliance with the measure(s) or provision(s).

(F) They must identify each standard prescription that would be replaced by the measure(s) or provision(s) proposed.

(5) Guidance is provided below for site specific plans for flood prone areas:

(A) Site-Specific Plans for watercourses with flood prone areas or channel migration zones**:** This section is an optional approach to be used at the discretion of the plan submitter. When used, this section replaces requirements found in 14 § 916.9 [936.9, 956.9], subsection (f)(3). The goal of this approach is to allow RPFs to develop a site specific plan for salmonid habitat protection on a flood prone area. Site specific plans are to lead to development of properly functioning salmonid habitat and can include active management to restore the beneficial uses of the riparian zone.

(B) Timber operations are limited to the flood prone areas beyond the outer margin of a CMZ.

(C) RPFs are to propose riparian protection zones and management practices that are designed for local conditions.

(D) Site specific assessments shall include:

1. Identifying the issues that need to be considered for watercourse and riparian protections [refer to Table 1 of "*Flood Prone Area Considerations in the Coast Redwood Zone* "(Riparian Protection Committee Report, Cafferata et al 2005)

2. Describing processes that need to be considered for the issues identified above.

3. Developing a method to define a desired trajectory for watercourse and riparian conditions in the context of the goals of 14 CCR 916.9[936.9,956.9], subsection (a).

4. Defining how the proposed operations will aid reaching the desired trajectories.

5. Disclosing assumptions being made at each step and limits to both the science and the proposed management activities.

6. Identifying how to determine what needs to be monitored and how to conduct the monitoring.

7. Supporting documentation is required including but not limited to field data, NetMap analysis, large wood modeling results, etc.

(E) As described in the "*Flood Prone Area Considerations in the Coast Redwood Zone*"" (Cafferata et al 2005), the site-specific plan for Class I flood prone area management shall include:

1. an inventory of the flood prone area for all hydrologic, geomorphic, and biological functions present that can be affected by timber operations;

2. a determination of the category of inundation where management is proposed [i.e., very frequent (1-5 yr recurrence interval or RI), frequent (5-20 yr RI), moderately frequent (20-50 yr RI), or infrequent (50+ yr RI)]; and

3. an appropriate analysis for functions present in light of possible significant adverse impacts from management. Analysis for hydrologic functions may include how the flood prone area vegetative roughness will change with timber operations. Analyses for geomorphic functions may include how proposed operations will change bank stabilization, amount of soil disturbance on the flood prone area, and the potential for channel avulsion. Analyses for biological functions may include how harvesting will affect overflow channels, large wood recruitment, stream shading, riparian microclimate, organic matter input, and terrestrial wildlife habitat.

(F) Disclosure and analysis requirements increase with increased risk associated with the proposed level of activity and the increased frequency of inundation in the flood prone area. In particular, management proposed within the 20 year recurrence interval flood prone area in a watershed with coho salmon habitat or restorable habitat requires detailed analysis.

(G) In addition to considering how proposed prescriptions will affect flood prone area functions at the project level, site specific plans must consider a larger watershed perspective that includes consideration of the stream network and past activities in the watershed. Also, consideration must be given to the current condition of the flood prone area.

(H) Information provided in the "*Flood Prone Area Considerations in the Coast Redwood Zone* " (Cafferata et al 2005) is to be used for guidance in the coast redwood zone.

(I) The site-specific plan for Class I riparian management must: (1) have Review Team agencies pre-consultation and receive concurrence from the Review Team agencies, including DFG, and (2) include a monitoring component.

(6) Guidance is provided below for site specific plans for fire hazard reduction:

(A) For site specific plans that address WLPZs having conditions where catastrophic, stand replacing wildfire will result in significant adverse effects to salmonid species, riparian habitat or other wildlife species, the site specific plan shall address measure(s) or provision(s) that create fire resilient forests, promote reduced fire intensities, and retain functional habitat following a wildfire. Site specific plans proposed for fuel hazard reduction shall contain information demonstrating the potential for severe fire behavior and likelihood of stand replacing fires. Fuel reduction measure(s) or provision(s) shall be designed to reduce fire behavior to levels appropriate for the region and riparian area. Measure(s) or provision(s) include, but are not limited to, activities that eliminate the vertical and horizontal continuity among all vegetative fuels layer (surface fuels, ladder fuels and crown fuels), focus on reducing surface and ladder fuel hazards, and simultaneously meet goals and objectives of 14 CCR § 916.9 [936.9, 956.9] subsections (a) and (c).

(7) No site-specific measure(s) or nonstandard operational provision(s) proposed pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v) may be prescribed by an RPF or approved by the Director in lieu of the following rules:

(A) The rules contained in Subchapter 2 (Application of Forest Practice Rules); Article 2 (Definitions, Ratings, and Standards) and Article 11 (Coastal Commission

Special Treatment Areas) of Subchapter 4 (Coast Forest District Rules); Article 2 (Definitions, Ratings, and Standards) of Subchapter 5 (Northern Forest District Rules); Article 2 (Definitions, Ratings, and Standards) and Article 11 (Coastal Commission Special Treatment Areas) of Subchapter 6 (Southern Forest District Rules); and Subchapter 7 (Administration) of Chapter 4, Division 1.5 of the California Administrative Code; or

(B) Any rule pertaining to the width of the special treatment area adjacent to a wild and scenic river declared pursuant to PRC 5093.50, et seq.; or

(C) Any rules or parts of rules that incorporate practices or standards specified in the Forest Practice Act.

(8) The Director shall not accept for inclusion in a plan any site-specific measures or non-standard operational provisions as described in this section where the Department of Fish and Game or where two or more agencies listed in PRC § 4582.6 and 14 CCR § 1037.3 have submitted written comments which lead to the Director's conclusion that the proposed measures or provisions will not meet the goal of this section and the agencies participated in the review of the plan, including an on-the-ground inspection.

(9) Site-specific measures or nonstandard operational provisions proposed pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v) shall not be considered alternative practices pursuant to 14 CCR §§ 897 or 914.9 [934.9, 954.9], in lieu practices or site specific practices pursuant to 14 CCR § 916.1 [936.1, 956.1], or alternative prescriptions for the protection of watercourses or lakes pursuant to 14 CCR § 916. 6 [936.6, 956.6].

(10) Board staff and the Department shall work with agencies, stakeholders, and appropriate scientific participants (e.g., Monitoring Study Group, Technical Advisory Committee) in a transparent process to: (1) describe and implement two pilot projects, including monitored results, using site-specific or non-standard operational provisions;

and (2) provide recommendations to the Board for consideration for adoption as a technical addendum or in similar form, to provide detailed guidance for the application of site-specific nor non-standard operational provisions. The pilot projects and guidance shall address cumulative and planning watershed impacts, and the guidance may address the appropriate standard site-specific or non-operational provisions shall meet. A report on the progress of the pilot projects and implementation guidance shall be presented to the Board within 18 months of the effective date of this regulation.

~~**(v)** Nonstandard practices (i.e., waivers, exceptions, in-lieu practices, and alternative practices) shall comply with the goal set forth in subsection (a) above as well as with the other requirements set forth in the rules.~~

~~**(w)** The Director may approve alternatives provided the alternative practice will achieve the goal of this section. The Director shall not accept for inclusion in a plan any alternative practice as described in this section where two or more agencies listed in 4582.6 of the PRC and 14 CCR § 1037.3 have submitted written comments which lead to the Director's conclusion that the proposed alternative will not meet the goal of this section and the agency(ies) participated in the review of the plan, including an on-the-ground inspection.~~

~~**(x)** Other measures that would effectively achieve the goal set forth in 14 CCR § 916.9(a) [936.9(a), 956.9(a)] may be approved in accordance with 14 CCR 916.6 [936.6, 956.6].~~

~~**(y)**~~**(w)** Except when expressly required by 14 CCR § 916.9 [936.9, 956.9], subsections (w)(1)- (5) below, t~~T~~he provisions of 14 CCR § 916.9 [936.9, 956.9] shall not apply to a plan that is subject to:~~an incidental take permit based upon an approved Habitat Conservation Plan that addresses anadromous salmonid protection.~~

(1) a valid incidental take permit issued by DFG pursuant to Section 2081(b) of the Fish and Game Code that addresses anadromous salmonid protection; or

(2) a federal incidental take statement or incidental take permit that addresses anadromous salmonid protection, for which a consistency determination has been made pursuant to Section 2080.1 of the Fish and Game Code; or

(3) a valid natural community conservation plan that addresses anadromous salmonid protection approved by DFG under section 2835 of the Fish and Game Code; or

(4) a valid Habitat Conservation Plan that addresses anadromous salmonid protection, approved under Section 10 of the federal Endangered Species Act of 1973; or

(5) project revisions, guidelines, or take avoidance measures pursuant to a memorandum of understanding or a planning agreement entered into between the plan submitter and DFG in preparation of obtaining a natural community conservation plan that addresses anadromous salmonid protection.

~~(z) This section shall expire on December 31, 2009.~~

Note: Authority cited: Sections 4551, 4562.7 and 21000(g), Public Resources Code. Reference: Sections 751, 4512, 4513, 4551.5, 21000(g), 21001(b) and 21002.1, Public Resources Code; Sections 100, 1243 and 13050(f), Water Code; and Sections 1600 and 5650(c), Fish and Game Code.

Amend 14 CCR § 916.11 [936.11, 956.11]. Effectiveness and Implementation Monitoring.

(a) Where timber operations will be conducted within a WLPZ, the Director may require a post-harvest evaluation of the effectiveness of the mitigations and practices designed to protect the watercourse(s) or lake(s) as a condition of plan approval. The Director shall require such an evaluation if the necessity for the evaluation is supported by substantial evidence in the record. This evidence may include, but is not limited to, potential land failures, accelerated rate of road construction or harvesting within a watershed, concentration or intensity of harvesting activity near watercourses, and potential for accelerated windthrow. The design and implementation of the evaluation shall be done in consultation with the Director, the RWQCB or DFG, and THP submitter, and the sufficiency of the information requested by the Director shall be judged in light of reasonableness and practicality. The evaluation may utilize procedures including, but not limited, to:

(1) Procedures for effectiveness and implementation monitoring,
(2) Existing landowner monitoring programs, or
(3) Photographic monitoring

~~**(b)** This section shall expire on December 31, 2009.~~

Note: Authority cited: Sections 4551, 4562.7 and 21000(g), Public Resources Code. Reference: Sections 751, 4512, 4513, 4551.5, 21000(g), 21001(b) and 21002.1, Public Resources Code; Sections 100, 1243 and 13050(f), Water Code; and Sections 1600 and 5650(c), Fish and Game Code.

Amend 14 CCR § 916.12 [936.12, 956.12]. Section 303(d) Listed Watersheds.

For any planning watershed in which timber operations could contribute to the pollutants or stressors which have been identified as limiting water quality in a water body listed pursuant to 303(d) Federal Clean Water Act, the following shall apply:

(a) The Department shall, in collaboration with the appropriate RWQCB and SWRCB, prioritize watersheds in which the following will be done: 1) conduct or participate in any further assessment or analysis of the watershed that may be needed, 2) participate in the development of Total Maximum Daily Load (TMDL) problem assessment, source assessment, or load allocations related to timber operations, and 3) if existing rules are deemed not to be sufficient, develop recommendations for watershed-specific silvicultural implementation, enforcement and monitoring practices to be applied by the Department.

(b) The Department shall prepare a report setting forth the Department's findings and recommendations from the activities identified pursuant to (a) above. The report shall be submitted to the Board and the appropriate RWQCB. The report shall be made available to the public upon request and placed on the Boards' website for a 90-day period.

(c) Where the Department has recommended that the adoption of watershed specific rules is needed, the Board shall consider that recommendation as a proposal for rulemaking under the Administrative Procedures Act (Section 11340 et. seq. Gov Code) and shall begin that process within 180 days following receipt of that report.

(d) These watershed specific rules shall be developed in collaboration with the appropriate RWQCB, the landowner(s) or designee with land in the planning watershed, and other persons or groups within the watershed, and may also be incorporated into a TMDL implementation plan.

(e) The watershed specific rules shall remain in effect until the water body has been removed from the 303(d) list, or that the Board finds, after consulting with the appropriate RWQCB, that timber operations are no longer a significant source of the pollutant or stressor that limits water quality in the listed water body.

~~**(f)** This section shall expire on December 31, 2009.~~

Note: Authority cited: Sections 4551, 4562.7 and 21000(g), Public Resources Code. Reference: Sections 751, 4512, 4513, 4551.5, 21000(g), 21001(b) and 21002.1, Public Resources Code; Sections 100, 1243 and 13050(f), Water Code; and Sections 1600 and 5650(c), Fish and Game Code.

Amend 14 CCR § 923.3.[943.3, and 963.3] Watercourse Crossings.

Watercourse crossing drainage structures on logging roads shall be planned, constructed, reconstructed, and maintained or removed, according to the following standards. Exceptions may be provided through application of Fish and Game Code Sections ~~1601 and 1603~~ 1600 et seq. and shall be included in the THP.

(a) The location of all new permanent watercourse crossing drainage structures and temporary crossings located within the WLPZ shall be shown on the THP map. If the structure is a culvert intended for permanent use, the minimum diameter of the culvert shall be specified in the plan. ~~Extra culverts beyond those shown in the THP map may be installed as necessary.~~

(b) The number of crossings shall be kept to a feasible minimum.

(c) Drainage structures on watercourses that support fish shall allow for unrestricted passage of all life stages of fish that may be present, and shall be fully described in the plan in sufficient clarity and detail to allow evaluation by the review team and the public, provide direction to the LTO for implementation, and provide enforceable standards for the inspector.

(d) When watercourse crossings, other drainage structures, and associated fills are removed the following standards shall apply:

(1) Fills shall be excavated to form a channel that is as that close as feasible to the natural watercourse grade and orientation, and that is wider than the natural channel.

(2) The excavated material and any resulting cut bank shall be sloped back from the channel and stabilized to prevent slumping and to minimize soil erosion. Where needed, this material shall be stabilized by seeding, mulching, rock armoring, or other suitable treatment.

(e) All permanent watercourse crossings that are constructed or reconstructed shall accommodate the estimated 100-year flood flow, including debris and sediment loads.

(f) ~~Permanent~~ W~~w~~atercourse crossings and associated fills and approaches shall be constructed or maintained to prevent diversion of stream overflow down the road and to minimize fill erosion should the drainage structure become obstructed. The RPF may propose an exception where explained in the THP and shown on the THP map and justified how the protection provided by the proposed practice is at least equal to the protection provided by the standard rule.

(g) ~~Any~~ All new permanent culverts ~~installed~~ on ~~c~~Class I watercourses, where fish are always or seasonally present or where fish habitat is restorable, shall be planned, designed and constructed to allow upstream and downstream passage of fish or listed aquatic species during any life stage and for the natural movement of bedload to form a continuous bed through the culvert and shall require an analysis and specifications demonstrating conformance with the intent of this section and subsection.

~~**(h)** The amendments to 14 CCR § 923.3 [943.3, 963.3] that became effective July 1, 2000 shall expire on December 31, 2009.~~

Note: Authority cited: Sections 4551, 4551.5 and 21004, Public Resources Code. Reference: Sections 4512, 4513, 4551, 4551.5, 4562.5 and 4562.7, Public Resources Code; 40 CFR 130.2(q); and California Case Law: Natural Resources Defense Council, Inc. v. Arcata Natl. Corp. (1972) 59 Cal. App. 3d 959, 131 Cal. Rptr. 172.

Amend 14 CCR § 923.9. [943.9, 963.9] Roads and Landings in Watersheds with Listed~~Threatened or Impaired Values~~ Anadromous Salmonids.

In addition to all other district Forest Practice Rules, the following requirements shall apply in any planning watershed with listed ~~threatened or impaired values~~ anadromous salmonids, except in watersheds with coho salmon. In watersheds with coho salmon, the standards listed under 923.9.1 and 923.9.2 shall apply:

(a) Where logging road or landing construction or reconstruction is proposed, the plan shall state the location of, and specifications for, logging road and landing abandonment or other mitigation measures to minimize the adverse effects of long-term site occupancy of the road system within the watershed.

(b) Unless prohibited by existing contracts with the U.S.D.A. Forest Service or other federal agency, new and reconstructed logging roads shall be no wider than a single-lane compatible with the largest type of equipment specified for use on the road, with adequate turnouts provided as required for safety. The maximum width of these roads shall be specified in the plan. These roads shall be outsloped where feasible and drained with water breaks or rolling dips (where the road grade is inclined at 7 percent or less), in conformance with other applicable Forest Practice Rules.

(c) The following shall apply on slopes greater than 50% that have access to a watercourse or lake**:**

(1) Specific provisions of construction shall be identified and described for all new roads.

(2) Where cutbank stability is not an issue, roads may be constructed as a full-benched cut (no fill). Spoils not utilized in road construction shall be disposed of in ~~with~~ stable areas with less than 30 percent slope and outside of any WLPZ, EEZ, or ELZ~~.~~ designated for watercourse or lake protection. The Director, with concurrence from other responsible agencies, may waive inclusion of these measures where the RPF can show that slope depressions and other natural retention and detentions feature are sufficient to controls overland transport of eroded material.

(3) ~~Alternatively,~~ Logging roads may be constructed with balanced cuts and fills: ~~if properly engineered, or fills may be removed with the slopes recontoured prior to the winter period.~~

(A) If properly engineered, or.

(B) If fills are removed and the slopes recontoured prior to the winter period.

(d) In addition to the provisions listed under 14 CCR § 923.1~~(e)~~ [943.1~~(e)~~, 963.1~~(e)~~], subsection (e), all permanent or seasonal logging roads with a grade of 15% or greater that extends 500 continuous feet or more shall have specific erosion control measures stated in the plan.

(e) ~~Where situations exist that elevate risks to the values set forth in 14 CCR § 916.2(a), [936.2(a), 956.2(a)] (e.g., road networks are remote, the landscape is unstable, water conveyance features historically have a high failure rate, culvert fills are large) drainage structures and erosion control features shall be oversized, low maintenance, or reinforced, or they shall be removed before the completion of the timber operation. The method of analysis and the design for crossing protection shall be included in the plan.~~

(e) Where logging road networks are remote or are located where the landscape is unstable, where crossing fills over culverts are large, or where logging road watercourse crossing drainage structures and erosion control features historically have a high failure rate, drainage structures and erosion control features shall be oversized, designed for low maintenance, reinforced, or removed before the completion of the timber operation. The method of analysis and the design for crossing protection shall be included in the plan.

(f) Except when expressly required by 14 CCR § 923.9 [943.9, 963.9], subsections (f)(1)- (5) below, t~~T~~he provisions of 14 CCR § 923.9 [943.9, 963.9] shall not apply to a plan that is subject to: ~~an incidental take permit based upon an approved Habitat Conservation Plan that addresses anadromous salmonid protection.~~

(1) a valid incidental take permit issued by DFG pursuant to Section 2081(b) of the Fish and Game Code that addresses anadromous salmonid protection; or

(2) a federal incidental take statement or incidental take permit that addresses anadromous salmonid protection, for which a consistency determination has been made pursuant to Section 2080.1 of the Fish and Game Code; or

(3) a valid natural community conservation plan that addresses anadromous salmonid protection approved by DFG under section 2835 of the Fish and Game Code; or

(4) a valid Habitat Conservation Plan that addresses anadromous salmonid protection, approved under Section 10 of the federal Endangered Species Act of 1973; or

(5) project revisions, guidelines, or take avoidance measures pursuant to a memorandum of understanding or a planning agreement entered into between the plan submitter and DFG in preparation of obtaining a natural community conservation plan that addresses anadromous salmonid protection.

(g) ~~This section shall expire on December 31, 2009.~~

Note: Authority cited: Sections 4551, 4551.5, 4553, 4562.7 and 21000(g), Public Resources Code. Reference: Sections 751, 4512, 4513, 4551, 4551.5, 4562.5, 4562.7, 21000(g), 21001(b) and 21002.1, Public Resources Code; Sections 100, 1243 and 13050(f), Water Code; Sections 1600 and 5650(c), Fish and Game Code; and Natural Resources Defense Council, Inc. v. Arcata Natl. Corp. (1976) 59 Cal.App. 3d 959, 131 Cal.Rptr. 172.

Amend § 916.9.1 [936.9.1, 956.9.1]. Protection Measures in Watersheds with Coho Salmon.

In addition to all other district Forest Practice Rules, the regulations in 14 CCR § 916.9 [936.9, 956.9] as amended and effective on January 1, 2010 ~~following requirements~~ shall apply in any planning watershed with coho salmon.~~:~~

~~**(a)** GOAL - Every timber operation shall be planned and conducted to prevent deleterious interference with the watershed conditions that primarily limit the values set forth in 14 CCR 916.2 [936.2](a) (e.g., sediment load increase where sediment is a primary limiting factor; thermal load increase where water temperature is a primary limiting factor; loss of instream large woody debris or recruitment potential where lack of this value is a primary limiting factor; substantial increase in peak flows or large flood frequency where peak flows or large flood frequency are primary limiting factors). To achieve this goal, every timber operation shall be planned and conducted to meet the following objectives where they affect a primary limiting factor:~~

~~**(1)** Comply with the terms of a Total Maximum Daily Load (TMDL) that has been adopted to address factors that may be affected by timber operations if a TMDL has been adopted, or not result in any measurable sediment load increase to a watercourse system or lake.~~

~~**(2)** Not result in any measurable decrease in the stability of a watercourse channel or of a watercourse or lake bank.~~

~~**(3)** Not result in any measurable blockage of any aquatic migratory routes for coho salmon or listed species.~~

~~**(4)** Not result in any measurable stream flow reductions during critical low water periods except as part of an approved water drafting plan pursuant to 14 CCR 916.9.1(r) [936.9.1(r)].~~

~~**(5)** Consistent with the requirements of 14 CCR § 916.9.1(i) or 14 CCR § 936.9.1(i); protect, maintain, and restore trees (especially conifers), snags, or downed large woody debris that currently, or may in the foreseeable future, provide large woody debris recruitment needed for instream habitat structure and fluvial geomorphic functions.~~

~~**(6)** Consistent with the requirements of 14 CCR § 916.9.1(g) or 14 CCR § 936.9.1(g); protect, maintain, and restore the quality and quantity of vegetative canopy needed to: **(A)** provide shade to the watercourse or lake, **(B)** minimize daily and seasonal temperature fluctuations, **(C)** maintain daily and seasonal water temperatures within the preferred range for coho salmon or listed species where they are present or could be restored, and **(D)** provide hiding cover and a food base where needed.~~

~~**(7)** Result in no substantial increases in peak flows or large flood frequency.~~

~~**(b)** Pre-plan adverse cumulative watershed effects on the populations and habitat of coho salmon shall be considered. The plan shall specifically acknowledge or refute that such effects exist. Where appropriate, the plan shall set forth measures to effectively reduce such effects.~~

~~**(c)** Any timber operation or silvicultural prescription within 150 feet of any Class I watercourse or lake transition line or 100 feet of any Class II watercourse or lake transition line shall have protection, maintenance, or restoration of the beneficial uses of water or the populations and habitat of coho salmon or listed aquatic or riparian-associated species as significant objectives.~~

~~Additionally, for evenaged regeneration methods and rehabilitation with the same effects as a clearcut that are adjacent to a WLPZ, a special operating zone shall retain understory and mid-canopy conifers and hardwoods. These trees shall be protected during falling, yarding and site preparation to the extent feasible. If trees that are retained within this zone are knocked down during operations, that portion of the trees that is greater than 6" in diameter~~

~~shall remain within the zone as Large Woody Debris. The zone shall be 25 feet above Class I WLPZs with slopes 0-30% and 50 feet above Class I WLPZs with slopes > 30%.~~

~~**(d)** **(1)** The plan shall fully describe: **(A)** the type and location of each measure needed to fully offset sediment loading, thermal loading, and potential significant adverse watershed effects from the proposed timber operations, and **(B)** the person(s) responsible for the implementation of each measure, if other than the timber operator.~~

~~**(2)** In proposing, reviewing, and approving such measures, preference shall be given to the following: **(A)** measures that are both onsite (i.e., on or near the plan area) and in-kind (i.e., erosion~~

~~control measures where sediment is the problem), and **(B)** sites that are located to maximize the benefits to the impacted portion of a watercourse or lake. Out-of-kind measures (i.e., improving shade where sediment is the problem) shall not be approved as meeting the requirements of this subsection.~~

~~**(e)** Channel zone requirements~~

~~**(1)** There shall be no timber operations within the channel zone with the following exceptions:~~

~~**(A)** timber harvesting that is directed to improve coho habitat through the limited use of the selection or commercial thinning silvicultural methods with review and comment by DFG.~~

~~**(B)** timber harvesting necessary for the construction or reconstruction of approved watercourse crossings.~~

~~**(C)** timber harvesting necessary for the protection of public health and safety.~~

~~**(D)** to allow for full suspension cable yarding when necessary to transport logs through the channel zone.~~

~~**(E)** Class III watercourses where exclusion of timber operations is not needed for protection of coho salmon.~~

~~**(2)** In all instances where trees are proposed to be felled within the channel zone, a base mark shall be placed below the cut line of the harvest trees within the zone. Such marking shall be completed by the RPF that prepared the plan prior to the preharvest inspection.~~

~~**(f)** The minimum WLPZ width for Class I waters shall be 150 feet from the watercourse or lake transition line.~~

~~**(g)** Within a WLPZ for Class I waters, at least 85 percent overstory canopy shall be retained within 75 feet of the watercourse or lake transition line, and at least 65 percent overstory canopy within the remainder of the WLPZ. The overstory canopy must be composed of at least 25% overstory conifer canopy post-harvest. Harvesting of hardwoods shall only occur for the purpose of enabling conifer regeneration.~~

~~**(h)** For Class I waters, any plan involving timber operations within the WLPZ shall contain the following information:~~

~~**(1)** A clear and enforceable specification of how any disturbance or log or tree cutting and removal within the Class I WLPZ shall be carried out to conform with 14 CCR 916.2 [936.2](a) and 916.9.1 [936.9.1](a).~~

~~**(2)** A description of all existing permanent crossings of Class I waters by logging roads and clear specification regarding how these crossings are to be modified, used, and treated to minimize risks, giving special attention to allowing fish to pass both upstream and downstream during all life stages.~~

~~**(3)** Clear and enforceable specifications for construction and operation of any new crossing of Class I waters to prevent direct harm, habitat degradation, water velocity increase, hindrance of fish passage, or other potential impairment of beneficial uses of~~

~~water.~~

~~**(i)** Recruitment of large woody debris for aquatic habitat in Class I coho salmon-bearing waters shall be ensured by retaining the ten largest dbh conifers (live or dead) per 330 feet of stream channel length that are the most conducive to recruitment to provide for the beneficial functions of riparian zones. The retained conifers shall be selected from within he THP area that lies within 50 feet of the watercourse transition line. Where the THP boundary is an ownership boundary, a class I watercourse, and the WLPZ on both sides of the watercourse currently meets the stocking standards listed under 14 CCR § 912.7 [932.7,952.7](b)(2)}; the five (5) largest dbh conifers (live or dead) per 330 feet of stream channel length that are the most conducive to recruitment to provide for the beneficial functions of riparian zones within the THP area shall be retained within 50 feet of the watercourse transition line.~~

~~The RPF may propose alternatives to substitute smaller diameter trees, trees that are more than 50 feet from the watercourse transition line, or other alternatives on a site specific basis. The RPF must explain and justify in the THP why the proposed alternative is more conducive to current and long-term Large Woody Debris recruitment, shading, bank stability, and the beneficial functions of riparian zones.~~

~~**(j)** Where an inner gorge extends beyond a Class I WLPZ and slopes are greater than 55%, a special management zone shall be established where the use of evenaged regeneration methods is prohibited. This zone shall extend upslope to the first major break-in-slope to less than 55% for a distance of 100 feet or more, or 300 feet as measured from the watercourse or lake transition line, which ever is less. All operations on slopes exceeding 65% within an inner gorge of a Class I or II watercourse shall be reviewed by a Professional Geologist prior to plan approval, regardless of whether they are proposed within a WLPZ or outside of a WLPZ.~~

~~**(k)** From October 15 to May 1, the following shall apply: **(1)** no timber operations shall take place unless the approved plan incorporates a complete winter period operating plan pursuant to 14 CCR § 914.7(a) [934.7(a)], **(2)** unless the winter period operating plan proposes operations during an extended period with low antecedent soil wetness, no tractor roads shall be constructed, reconstructed, or used on slopes that are over 40 percent and within 200 feet of a Class I, II, or III watercourse, as measured from the watercourse or lake transition line, and **(3)** operation of trucks and heavy equipment on roads and landings shall be limited to those with a stable operating surface.~~

~~**(l)** Construction or reconstruction of logging roads, tractor roads, or landings shall not take place during the winter period unless the approved plan incorporates a complete winter period operating plan pursuant to 14 § CCR 914.7(a) [934.7(a), 954.7(a)] that specifically address such road construction. Use of logging roads, tractor roads, or landings shall not take place at any location where saturated soil conditions exist, where a stable logging road or landing operating surface does not exist, or when visibly turbid water from the road, landing, or skid trail surface or inside ditch may reach a watercourse or lake. Grading to obtain a drier running surface more than one time before reincorporation of any resulting berms back into the road surface is prohibited.~~

~~**(m)** All tractor roads shall have drainage and/or drainage collection and storage facilities installed as soon as practical following yarding and prior to either **(1)** the start of any rain which causes overland flow across or along the disturbed surface within a WLPZ or within any ELZ or EEZ designated for watercourse or lake protection, or **(2)** any day with a National Weather Service forecast of a chance of rain of 30 percent or more, a flash flood warning, or a flash flood watch.~~

~~**(n)** Within the WLPZ, and within any ELZ or EEZ designated for watercourse or lake protection, treatments to stabilize soils, minimize soil erosion, and prevent the discharge of~~

~~sediment into waters in amounts deleterious to aquatic species or the quality and beneficial uses of water, or that threaten to violate applicable water quality requirements, shall be applied in accordance with the following standards:~~

~~**(1)** The following requirements shall apply to all such treatments.~~

~~**(A)** They shall be described in the plan.~~

~~**(B)** For areas disturbed from May 1 through October 15, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface.~~

~~**(C)** For areas disturbed from October 16 through April 30, treatment shall be completed prior to any day for which a chance of rain of 30 percent or greater is forecast by the National Weather Service or within 10 days, whichever is earlier.~~

~~**(2)** The traveled surface of logging roads shall be treated to prevent waterborne transport of sediment and concentration of runoff that results from timber operations.~~

~~**(3)** The treatment for other disturbed areas, including: **(A)** areas exceeding 100 contiguous square feet where timber operations have exposed bare soil, **(B)** approaches to tractor road watercourse crossings between the drainage facilities closest to the crossing, **(C)** road cut banks and fills, and **(D)** any other area of disturbed soil that threatens to discharge sediment into waters in amounts deleterious to the quality and beneficial uses of water, may include, but need not be limited to, mulching, rip-rapping, grass seeding, or chemical soil stabilizers. Where straw, mulch, or slash is used, the minimum coverage shall be 90%, and any treated area that has been subject to reuse or has less than 90% surface cover shall be treated again prior to the end of timber operations. The RPF may propose alternative treatments that will achieve the same level of erosion control and sediment discharge prevention.~~

~~**(4)** Where the undisturbed natural ground cover cannot effectively protect~~

~~beneficial uses of water from timber operations, the ground shall be treated by measures including, but not limited to, seeding, mulching, or replanting, in order to retain and improve its natural ability to filter sediment, minimize soil erosion, and stabilize banks of watercourses and lakes.~~

~~**(o)** As part of the plan, the RPF shall identify active erosion sites in the logging area, assess them to determine which sites pose significant risks to the beneficial uses of water, assess them to determine whether feasible remedies exist, and address in the plan feasible remediation for all sites that pose significant risk to the beneficial uses of water.~~

~~**(p)** The erosion control maintenance period on permanent and seasonal roads and associated landings that are not abandoned in accordance with 14 CCR § 923.8 [943.8] shall be three years.~~

~~**(q)** Site preparation activities shall be designed to prevent soil disturbance within, and minimize soil movement into, the channels of watercourses. Prior to any broadcast burning, burning prescriptions shall be designed to prevent loss of large woody debris in watercourses, and vegetation and duff within a WLPZ, or within any ELZ or EEZ designated for watercourse or lake protection. No ignition is to occur within any WLPZ, or within any ELZ or EEZ designated for watercourse or lake protection. When burning prescriptions are proposed, the measures or burning restrictions which are intended to accomplish this goal shall be stated in the plan and included in any required burning permit. This information shall be provided in addition to the information required under 14 CCR § 915.4 [935.4].~~

~~**(r)** Water drafting for timber operations from within a channel zone of a natural watercourse or from a lake shall conform with the following standards:~~

~~**(1)** The RPF shall incorporate into the THP:~~

~~**(A)** a description and map of proposed water drafting locations,~~

~~**(B)** the watercourse or lake classification, and~~

~~**(C)** the general drafting location use parameters (i.e., yearly timing, estimated total volume needed, estimated total uptake rate and filling time, and associated water drafting activities~~

~~from other THPs).~~

~~**(2)** On Class I and Class II streams where the RPF has estimated that:~~

~~**(A)** bypass flows are less than 2 cubic feet per second, or~~

~~**(B)** pool volume at the water drafting site would be reduced by 10%, or~~

~~**(C)** diversion rate exceeds 350 gallons per minute, or~~

~~**(D)** diversion rate exceeds 10% of the above surface flow; no water drafting shall occur unless the RPF prepares a water drafting plan to be reviewed and, if necessary a stream bed alteration agreement issued, by DFG and approved by the Director. The Director may accept the project description and conditions portion of an approved "Streambed Alteration Agreement" issued under the Fish and Game Code (F&GC 1600 et seq.) which is submitted instead of the water drafting plan described in 14 CCR § 916.9.1 [936.9.1] (r)(2)(D)(1-5).~~

~~The water drafting plan shall include, but not be limited to:~~

~~**1.** disclosure of estimated percent streamflow reduction and duration of reduction,~~

~~**2.** discussion of the effects of single pumping operations, or multiple pumping operations at the same location,~~

~~**3.** proposed alternatives and discussion to prevent adverse effects (e.g. reduction in hose diameter, reduction in total intake at one location, described allowances for recharge time, and alternative water drafting locations),~~

~~**4.** conditions for operators to include an operations log kept on the~~

~~water truck containing the following information: Date, Time, Pump Rate, Filling Time, Screen Cleaned, Screen Conditions, and Bypass flow observations,~~

~~**5.** a statement by the RPF for a pre-operations field review with the operator to discuss the conditions in the water drafting plan.~~

~~**(3)** Intakes shall be screened in Class I and Class II waters. Screens shall be designed to prevent the entrainment or impingement of all life stages of fish or amphibians. Screen specifications shall be included in the plan.~~

~~**(4)** Approaches to drafting locations within a WLPZ shall be surfaced with rock or other suitable material to avoid generation of sediment.~~

~~**(s)** No timber operations are allowed in a WLPZ, or within any ELZ or EEZ designated for watercourse or lake protection, under exemption notices except for:~~

~~**(1)** hauling on existing roads,~~

~~**(2)** road maintenance,~~

~~**(3)** operations conducted for public safety,~~

~~**(4)** construction or reconstruction of approved watercourse crossings,~~

~~**(5)** temporary crossings of dry Class III watercourses which do not require a "Streambed Alteration Agreement" under the Fish and Game Code, or~~

~~**(6)** harvesting recommended in writing by DFG to address specifically identified forest conditions.~~

~~**(t)** No timber operations are allowed in a WLPZ, or within any ELZ or EEZ designated for watercourse or lake protection, under emergency notices except for:~~

~~**(1)** hauling on existing roads,~~

~~**(2)** road maintenance,~~

~~**(3)** operations conducted for public safety,~~

~~**(4)** construction or reconstruction of approved watercourse crossings,~~

~~**(5)** temporary crossings of dry Class III watercourses which do not require a "Streambed Alteration Agreement" under the Fish and Game Code,~~

~~**(6)** harvesting recommended in writing by DFG to address specifically identified forest conditions,~~

~~**(7)** the harvest of dead or dying conifer trees subject to the following conditions:~~

~~**(A)** Recruitment of large woody debris for aquatic habitat in Class I coho salmon-bearing waters shall be ensured by retaining the ten largest dbh conifers (live or dead) per 330 feet of stream channel length that are the most conducive to recruitment to provide for the beneficial functions of riparian zones. The retained conifers shall be selected from within the area of operations that lies within 50 feet of the watercourse transition line. Where the area of operations is bounded by an ownership boundary that corresponds with a class I watercourse, and where the WLPZ on both sides of the watercourse currently meets the stocking standards listed under 14 CCR § 912.7 [932.7](b)(2), the five (5) largest dbh conifers (live or dead) per 330 feet of stream channel length that are the most conducive to recruitment to provide for the beneficial functions of riparian zones shall be retained within 50 feet of the watercourse transition line within the area of operations.~~

~~The RPF may provide alternatives to substitute smaller diameter trees, trees that are more than 50 feet from the watercourse transition line, or other alternatives on a site specific basis. The RPF must provide with the notice an explanation and justification why the alternative provided is more conducive to current and long-term Large Woody Debris recruitment, shading, bank stability, and the beneficial functions of riparian zones.~~

~~**(B)** Within any WLPZ, ELZ, or EEZ designated for Class II or III watercourse protection, a minimum of two dead, dying, or diseased conifer trees per acre at least 16 inches diameter breast high and 50 feet tall shall be retained within 50 feet of the watercourse transition line.~~

~~**(C)** Trees to be harvested or retained shall be marked by, or under the supervision of, an RPF prior to timber operations within the WLPZ or ELZ/EEZ.~~

~~**(D)** Within the WLPZ or ELZ/EEZ, if the stocking standards of 14 CCR § 912 [932].7 are not met upon completion of timber operations, unless the area meets the definition of substantially damaged timberlands, at least ten trees shall be planted for each tree harvested but need not exceed an average point count of 300 trees per acre.~~

~~**(u)** No salvage logging is allowed in a WLPZ without an approved HCP, a PTEIR, an SYP, or an approved plan that contains a section that sets forth objectives, goals, and measurable results for streamside salvage operations.~~

~~**(1)** This section does not apply to emergency operations under 14 CCR § 1052.~~

~~**(v)** Nonstandard practices (i.e., waivers, exceptions, in-lieu practices, and alternative practices) shall comply with the goal set forth in subsection (a) above as well as with the other requirements set forth in the rules.~~

~~**(w)** The Director may approve alternatives that provide equal or better protection for coho salmon and achieve the goal of this section.~~

~~**(1)** Any alternative proposed under this subsection for timber operations in a watershed with coho salmon shall only be included in a plan: i) after consultation and written concurrence from DFG prior to plan submittal, and ii) with a clear demonstration of compliance with the issuance criteria described under Fish and Game Code § 2081(b) as determined by DFG.~~

~~**(2)** The Director shall not accept for inclusion in a plan any alternative practice as described in this section where two or more agencies listed in 4582.6 of the PRC and 14 CCR § 1037.3 have submitted written comments which lead to the Director's conclusion that the proposed alternative will not meet the goal of this section and the agency(ies) participated in the review of the plan, including an on-the-ground inspection.~~

~~**(x)** Other measures that would effectively achieve the goal set forth in 14 CCR § 916.9.1(a) [936.9.1(a)] may be approved with written concurrence from DFG **(i)** in accordance with 14 CCR 916.6 [936.6], or **(ii)** pursuant to a coho salmon watershed evaluation for timber operations when the plan incorporates minimization and mitigation measures based on the watershed evaluation, and with written concurrence from DFG. The watershed evaluation must include the components set forth below and shall be included in addition to all other District Forest Practice Rules.~~

~~**(1)** The following are required components of a watershed evaluation:~~

~~**(A)** Description of assessment area.~~

~~**(B)** Status of coho salmon within each planning watershed in the assessment area.~~

~~**(C)** Status of coho salmon habitat conditions and water quality within each planning watershed in the assessment area.~~

~~**(D)** Identification and prioritization of limiting factors. A reasoned analysis shall assign ratings of high, moderate and low to those factors which may individually or cumulatively limit coho salmon distribution and abundance in the watershed.~~

~~**(E)** Proposed planning watershed specific management practices to prevent or control discharges and environmental impacts from timber operations that could contribute to the identified high and moderate risk limiting factors, and; corrective actions that would reduce or eliminate the high and moderate risk limiting factors on the landscape and mitigate the impacts of timber operations which cause or contribute to those limiting factors.~~

~~**(F)** A plan and schedule for implementing proposed management practices.~~

~~**(G)** A program for monitoring implementation and effectiveness of the management practices.~~

~~**(y)** The operational provisions of 14 CCR §§ 916.9.1 [936.9.1] and 916.9.2 [936.9.2] shall not apply to a plan under which the incidental take from timber operations of Coho Salmon within the planning watershed is already authorized pursuant to the following:~~

~~**(1)** a valid incidental take permit issued by DFG pursuant to Section 2081(b) of the Fish and Game Code; or~~

~~**(2)** a federal incidental take statement or incidental take permit, for which a consistency determination has been made pursuant to Section 2080.1 of the Fish and Game Code; or~~

~~**(3)** Section 2835 of the Fish and Game Code under a valid natural community conservation plan approved by DFG.~~

~~**(z)** The operational provisions of 14 CCR §§ 916.9.1 [936.9.1] and 916.9.2 [936.9.2] shall not apply to a plan that specifies project revisions, guidelines, or take avoidance measures pursuant to a memorandum of understanding or a planning agreement entered into between the plan submitter and DFG, which DFG has determined will avoid take of coho salmon.~~

Note: Authority cited: Sections 4551, 4562.7 and 21000(g), Public Resources Code. Reference: Sections 751, 4512, 4513, 4551.5, 21000(g), 21001(b) and 21002.1, Public Resources Code; Sections 100, 1243 and 13050(f) Water Code; and Sections 1600 and 5650(c), Fish and Game Code.

§ 923.9.1 [943.9.1, 963.9.1]. Measures for Roads and Landings in Watersheds with Coho Salmon.

In addition to all other district Forest Practice Rules, the <u>regulations in 14 CCR §§ 923.3 [949.3, 963.3] and 923.9 [943.9, 963.9] as amended and effective on January 1, 2010</u> ~~following requirements~~ shall apply in any planning watershed with coho salmon.~~:~~

~~**(a)** Where logging road or landing construction or reconstruction is proposed, the plan shall state the locations of and specifications for road or landing abandonment or other~~

~~mitigation measures to minimize the adverse effects of long-term site occupancy of the transportation system within the watershed.~~

~~**(b)** Unless prohibited by existing contracts with the U.S.D.A. Forest Service or other federal agency, new and reconstructed logging roads shall be no wider than a single-lane compatible with the largest type of equipment specified for use on the road, with adequate turnouts provided as required for safety. The maximum width of these roads shall be specified in the plan. These roads shall be outsloped where feasible and drained with water breaks or rolling dips (where the road grade is inclined at 7 percent or less), in conformance with other applicable Forest Practice Rules.~~

~~**(c)** Logging Road Watercourse Crossing Drainage structures on watercourses that support fish shall allow for unrestricted passage of all life stages of fish that may be present, and shall be fully described in the plan in sufficient clarity and detail to allow evaluation by the review team and the public, provide direction to the LTO for implementation, and provide enforceable standards for the inspector.~~

~~**(d)** Any new permanent culverts installed within class I watercourses shall allow upstream and downstream passage of fish or listed aquatic species during any life stage and for the natural movement of bedload to form a continuous bed through the culvert and shall require an analysis and specifications demonstrating conformance with the intent of this section and subsection.~~

~~**(e)** The following shall apply on slopes greater than 50%:~~

~~**(1)** Specific provisions of construction shall be identified and described for all new roads.~~

~~**(2)** Where cutbank stability is not an issue, roads may be constructed as a full-benched cut (no fill). Spoils not utilized in road construction shall be disposed of in stable~~

~~areas with less than 30 percent slope and outside of any WLPZ, EEZ, or ELZ.~~

~~**(3)** Alternatively, roads may be constructed with balanced cuts and fills if properly engineered, or fills may be removed with the slopes recontoured prior to the winter period.~~

~~**(f)** In addition to the provisions listed under 14 CCR 923.1(e) [943.1(e)], all permanent or seasonal logging roads with a grade of 15% or greater that extends 500 continuous feet or more shall have specific erosion control measures stated in the plan.~~

~~**(g)** Where situations exist that elevate risks to the values set forth in 14 CCR 916.2(a), [936.2(a)] (e.g., road networks are remote, the landscape is unstable, water conveyance features historically have a high failure rate, culvert fills are large) drainage structures and erosion control features shall be oversized, low maintenance, or reinforced, or they shall be removed before the completion of the timber operation. The method of analysis and the design for crossing protection shall be included in the plan.~~

~~**(h)** Tractor Road Crossing facilities on watercourses that support fish shall allow for unrestricted passage of all life stages of fish that may be present, and for unrestricted passage of water. Such crossing facilities shall be fully described in sufficient clarity and detail to allow evaluation by the review team and the public, provide direction to the LTO for implementation, and provide enforceable standards for the inspector.~~

~~**(i)** The operational provisions of 14 CCR §§ 923.9.1 [943.9.1] and 923.9.2 [943.9.2] shall not apply to a plan under which the incidental take from timber operations of coho salmon is already authorized pursuant to the following:~~

~~**(1)** a valid incidental take permit issued by DFG pursuant to Section 2081(b) of the Fish and Game Code; or~~

~~**(2)** a federal incidental take statement or incidental take permit, for which a consistency determination has been made pursuant to Section 2080.1 of the Fish and Game Code; or~~

~~**(3)** Section 2835 of the Fish and Game Code under a valid natural community conservation plan approved by DFG.~~

~~**(j)** The operational provisions of 14 CCR §§ 923.9.1 [943.9.1] and 923.9.2 [943.9.2] shall not apply to a plan that specifies project revisions, guidelines, or take avoidance measures pursuant to a memorandum of understanding or a planning agreement entered into between the plan submitter and DFG, which DFG has determined will avoid take of Coho Salmon.~~

Note: Authority cited: Sections 4551, 4551.5, 4553, 4562.7 and 21000(g), Public Resources Code. Reference: Sections 751, 4512, 4513, 4551, 4551.5, 4562.5, 4562.7, 21000(g), 21001(b) and 21002.1, Public Resources Code; Sections 100, 1243 amd 13050(f), Water Code; Sections 1600 and 5650(c), Fish and Game Code; andNatural Resources Defense Council, Inc. v. Arcata Natl. Corp. (1976) 59 Cal.App. 3d 959, 131 Cal.Rptr. 172.

END

California Regional Water Quality Control Board
North Coast Region
Bob Anderson, Chairman

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5550 Skylane Boulevard, Suite A, Santa Rosa, California 95403
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Linda S. Adams
Secretary for Environmental Protection

Arnold Schwarzenegger
Governor

Questionnaire for economic considerations
For
Proposed Revisions to the Categorical Waiver of Waste Discharge Requirements for Timber Harvesting Activities on Non-Federal Lands in the North Coast Region

As you know, on June 4, 2009 the North Coast Regional Water Quality Control Board is scheduled to consider adoption of Order No. R1-2009-0038, revising the Categorical Waiver of Waste Discharge Requirements for Timber Harvesting Activities on Non-Federal Lands in the North Coast Region. The draft order can be viewed on our website at: http://www.waterboards.ca.gov/northcoast/board_decisions/tentative_orders/

We are requesting input from timberland owners and Registered Professional Foresters (RPFs) that would assist the Regional Board in further understanding the potential economic impacts the proposed changes to the Categorical Waiver may have. Your answers will provide the Board valuable information.

We are hoping that you can provide an estimate of the cost of preparation of technical reports for THPs and NTMPs that you believe are above and beyond requirements already required for compliance with the Forest Practice Rules (FPRs) in order to receive an approved enrollment in a categorical waiver. This estimate should not include the cost of implementation (except where the cost of implementation is specifically requested, as in the case of inspections). We ask that you send us your estimates by May 25, 2009 so that we will be able to present this information to the Water Board in our report.

We understand these are rough estimates and that different situations will require different levels of involvement. For that reason, the questions have been qualified as to the scope of a report, for instance, acreage and numbers of sediment sites for an Erosion Control Plan (ECP). A range of costs would be helpful. Also, in presenting this to the Board, we will explain the nature of the estimates. Any information you can provide as to how you arrived at an estimate is very helpful as well. We appreciate your willingness to take the time to give these questions your consideration.

Thank you for your time in responding. We believe the information will be valuable for completing the revision to the waiver. Please contact me at (707) 795-7235, or by email at jburke@waterboards.ca.gov, If you have any questions or need additional information.

Sincerely,

Jim Burke
Engineering Geologist.
Timber Division
NCRWQCB

Attachment: Cost Estimate for additional costs to comply with Proposed Revisions to Timber Waiver.

Please provide cost estimates for technical reports for the following hypothetical situations. : For example, 14CCR 916.9(o) requires identification and treatment of active erosion sites where feasible in the so-called T/I planning watersheds. What is the *additional* cost required for preparation of ECPs beyond that required by the FPRs? When estimating the cost of providing the required technical report on a *new* project, vs. an *existing* one, please consider how much of the required field work can be conducted concurrently with layout of the new plan and how much additional field work would be required to prepare the reports for existing plans.

Erosion Control Plans

1. Cost of preparation (not implementation) of an erosion control plan (ECP) on a new 100 acre THP or NTMP with ten controllable sediment discharge sources (CSDS) in both :, a) T&I watershed, and b) non-T&I watershed.

I am not sure it would be significantly different T&I vs. non-T&I. I assume the controllable sediment sources are all road-related and therefore, readily accessible and that the sites do not mandate any specialized engineering. In addition to the 10 sites that must be specifically addressed, you would also have to address general erosion control practices as well. In this case, specific site and general recommendations can be field-judged concurrently in the same field visit.

Cost:

2. Cost of preparing an ECP on an ***existing and previously approved*** 100 acre NTMP with 10 CSDS that has already been enrolled in the Waiver. The estimate should represent the cost for additional work (field and office) required to comply with the Categorical Waiver reporting requirements, but not to fix the sites.

While you may not have to specifically address the 10 sites in detail, you still have to conduct a general field trip to assess other conditions to be addressed in the ECP.

Cost:

3. Cost of conducting two winter period inspections per year and a brief annual summary report for a 100 acre THP or NTMP. Assume that the purpose of the inspections is to inspect the entire road system, not just ECP sites.

Even though it will not probably take a full day to conduct the actual winter inspections (assuming no major problems are encountered), if you pack a shovel and chainsaw on the ATV, you will touch up waterbars and cut logs out of the road, etc., so you can easily dedicate a day to each visit.

Cost:

Road Management Plans

1. Cost of preparing a road management plan for a *new* 100 acre NTMP with one mile of road and 20 watercourse crossings. Assume the road plan would contain the following:
    a. The location of all roads and watercourse crossings within the logging area;
    b. The current status of each road, including road surface material, road and watercourse design, and use restrictions;
    c. Work needed to address road upgrades;
    d. The future plan and implementation schedule for each road; and
    e. Work needed to address maintenance of the road for specific uses
    f. A long term inspection and maintenance schedule designed to ensure that prevention and minimization measures are functioning as intended and to identify and correct any problems that could cause sediment discharge in a timely manner. All roads must either be:
        i. inspected and maintained annually, or
        ii. hydrologically maintenance free, i.e., do not alter natural hydrology of the hillslope, or
        iii. decommissioned

Cost :

2. Cost of preparing a road plan for an *existing* 100 acre NTMP with one mile of road and 20 watercourse crossings, assuming the road plan would contain the same information listed above.

Cost:

State of California
Regional Water Quality Control Board
North Coast Region

James Burke
May 28, 2009

EXECUTIVE OFFICER'S SUMMARY REPORT
8:30 a.m., June 4, 2009
North Coast Regional Water Board
Hearing Room
5550 Skylane Boulevard, Suite A
Santa Rosa, California

ITEM: 6

SUBJECT: **PUBLIC HEARING** to Consider Adoption of a Mitigated Negative Declaration and Order No. R1-2009-0038, Categorical Waiver of Waste Discharge Requirements for Discharges Related to Timber Harvesting Activities On Non-Federal Lands in the North Coast Region.

Today, the Regional Water Board will be considering adoption of tentative Order No. 2009-R1-0038, (attachment 1), which would revise the existing Categorical Waiver of Waste Discharge Requirements for Timber Harvesting Activities on Non-Federal Lands in the North Coast Region (the Categorical Waiver), Order No. R1-2004-0016. An Initial Study and draft Mitigated Negative Declaration to comply with the California Environmental Quality Act (CEQA) to support adoption of the Order is also to be considered concurrently with the tentative order (attachment 2).

The Regional Water Board adopted the current Categorical Waiver in 2004. The waiver expires on June 23, 2009. The Categorical Waiver is part of a multi-tiered regulatory approach, that includes: general Waste Discharge Requirements Order No 2004-0030 (GWDRs) for timber harvesting activities for projects that do not meet waiver criteria, a conditional waiver for timber harvesting activities on Federal lands, and several individual WDRs for larger watershed wide activities on private land.

The basic intent of the Categorical Waiver is to provide a framework to regulate those activities that are part of timber harvesting that pose a threat to water quality but that can be conditioned to lessen the potential impacts and waived from issuance of individual or general WDRs, while ensuring protection of water quality from discharges of sediment and temperature increases.

Proposed revisions to the Categorical Waiver address both minor (i.e., grammar and document organization) as well as more substantial revisions which include; expanding the waiver categories, and revising the eligibility criteria, application and enrollment procedures). New findings provide the rationale for waiving specific categories of timber harvesting activities and the conditions of the waiver.

The following is a list of the most notable of the proposed changes/addition:

- Development of an Erosion Control Plan (ECP) would be required of an entire NTMP (non-Industrial Management Plans) and THPs, with a grandfathering clause and compliance schedule for existing NTMPs.
- Two winter period inspections per year would be required for THPs and during active NTOs for NTMPs.
- As part of erosion and sediment control measures, surface runoff from logging roads would be required to be hydrologically disconnected.

- Landowners of NTMPs would be required to develop and submit a long term management plan for roads.
- Shade and canopy retention requirements exceeding those currently required by current Forest Practice Rules would be required in order to comply with the Basin Plan Temperature Objective.
- THPs that have clear cutting as the silvicultural technique would be allowed, with the condition of significantly widened stream side riparian management zones of 300, 200, and 100 feet on Class I, II, and III watercourses, respectively.

A Regional Board staff report provides technical details to support the tentative order and the recommended revisions to the current Categorical Waiver is attached (attachment 3).

The proposed revisions listed above are intended to comply with:

a). The State Water Resources Control Board's (SWRCB) Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS Implementation Policy) and,

b). Total Maximum Daily Loads (TMDLs) for watersheds throughout the region, to prevent controllable sediment discharges, and protect and restore natural levels of shade to prevent elevating water temperatures, and reverse declines in populations of anadromous salmonids.

The Comment Period for the Categorical Waiver began on April 9, 2009 with the concurrent release of an initial study and draft mitigated negative declaration for the Categorical Waiver which updates the original negative declaration issued in 2004 to comply with the California Environmental Quality Act (CEQA) (attachment 2). Regional Board staff held public workshops in Fortuna on March 24, 2009 and in Yreka on April 8, 2009. The purpose of the workshops was both to inform interested members of the public of the proposed revisions to the Categorical Waiver as well as to receive comments from those members of the public. The current draft under consideration reflects changes to an early draft based on comments from members of the public at those workshops.

The Regional Water Board received 17 comment letters during the comment period that are included in the agenda package (attachment 4). Regional Water Board Staff written responses to all public comments received by May 9, 2009 are provided in attachment 5. Some modification of the draft proposed Categorical Waiver occurred as a result of comments received by agencies and the public. To help identify the changes, a copy of the tentative order with all the changes since the original draft highlighted in underline and strikeout is provided in attachment 6.

PRELIMINARY
STAFF RECOMMENDATION: Staff recommends adoption of the Mitigated Negative Declaration and Order No. R1-2009-0038.

Attachments
1. Tentative Order No. R1-2009-0038
2. Initial study and mitigated negative declaration
3. Regional Board Staff Technical Report
4. Comment letters received
5. Response to comments
6. Comparison of tentative order in this agenda to original draft

California Regional Water Quality Control Board
North Coast Region
Bob Anderson, Chairman

Linda S. Adams
Secretary for Environmental Protection

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Arnold Schwarzenegger
Governor

September 3, 2009

Mr. George D. Gentry
Executive Officer
Board of Forestry and Fire Protection
Post Office Box 944246
Sacramento, California 94244-2460

Subject: Comments on the proposed Anadromous Salmonid Protection Rules (previously the Threatened or Impaired Watershed Rules) dated May 8, 2009, as revised July 24, 2009, Title 14 of the California Code of Regulations

File: Timber, General

Dear Mr. Gentry:

Enclosed are comments on the latest draft of proposed Anadromous Salmonid Protection Rules, as revised July 24, 2009 (formerly referred to as Threatened or Impaired Watershed Rules), Title 14 of the California Code of Regulations. We previously submitted extensive comments on the draft version distributed May 8, 2009. At this time, we have not received BOF response to the earlier comments and therefore, these attached comments are in large part similar.

We are also providing a more extensive evaluation of the effect of the proposed ASP Rules relative to the Basin Plan Water Quality Objective for temperature. The report, titled *Evaluation of Anadromous Salmon Protection Rules Relative to the Water Quality Objective for Temperature*, is enclosed as an attachment to our comments on the proposed rules.

Overall, we have attempted to identify where we believe there are opportunities to improve the ASP Rules' consistency with state and regional water board requirements and policies. We urge the Board of Forestry to take an active role in recognizing and addressing the water board and US Environmental Protection Agency designations of streams and watersheds with consistent regulations that go beyond listed salmonid species to the other beneficial uses of water that may be impaired from timber harvesting activities.

Unfortunately, the review and revision of section 916.12 regarding Clean Water Act section 303(d) listed streams is not included in the proposed ASP Rule package. To our knowledge, section 916.12 has never been used. We urge the BOF to revisit section

916.12 with an eye towards addressing stream listings by the water boards and US EPA and recognizing those other beneficial uses of water. Such an approach is consistent with what the BOF has already done in recognizing the federal and state listings of endangered species and developing rules specific to addressing needed protections for those listings. We are prepared to engage in a process with your staff to modify and develop rules to address water quality listed waterbodies as well.

If you or your staff have any questions regarding our comments, please contact me at 707-576-2693.

Sincerely,

for Robert Klamt, Chief
Timber and Nonpoint Source Division

Enclosures: 1) Memo from Maggie Robinson and David Fowler, Staff review of the proposed Threatened or Impaired Watershed Rules, 2009
2) Memo from Bryan McFadin, Evaluation of Anadromous Salmon Protection Rules Relative to the Water Quality Objective for Temperature

090309-DLF-ASP-RuleCoverLetter-Final.doc

California Regional Water Quality Control Board
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Arnold Schwarzenegger
Governor

September 3, 2009

To: Robert Klamt
Chief, Timber Harvest and Non-point Source Division

From: Maggie Robinson, David Fowler
Representing review staff

Subject: Review and Comments on the Board of Forestry proposed revisions to the Anadromous Salmonid Protection Rules (previously the Threatened or Impaired Watershed Rules) dated May 8, 2009, as revised July 24, 2009

General Comments

The North Coast Regional Water Quality Control Board staff (Regional Water Board staff) have completed reviewing the proposed Anadromous Salmonid Protection Rules (ASP Rules, previously the Threatened or Impaired Watershed Rules). We recognize the proposed changes to the rules contain many commendable goals and objectives with the intent to address the beneficial functions of riparian buffers for anadromous salmonids and the impacts of timber operations. The following are general overall comments on the rule package followed by more specific comments keyed to the page in the proposed rules.

Regional Water Board staff recommend that the goals and objectives of the proposed ASP Rules also recognize the need to protect all beneficial uses of water and comply with water quality objectives in accordance with the Water Quality Control Plan for the North Coast Region, also known as the Basin Plan. Although the proposed ASP Rules leave intact the current wording with regard to watersheds listed under Section 303(d) of the federal Clean Water Act (303(d) listed), the proposed ASP Rules do not adequately address the potential for cumulative effects from timber operations in 303(d) listed watersheds, particularly those watersheds listed for sediment and/or temperature impairments. Pursuant to Clean Water Act 303(d), the goal for sediment-impaired waters is to recover water quality to the point the waters can be de-listed. Total Maximum Daily Loads (TMDLs) have been or are being developed for listed watersheds.

We recognize the level of effort expended by the Board of Forestry and Fire Protection (BOFFP) reviewing the scientific literature regarding the beneficial functions of riparian buffers for anadromous salmonids and the impacts from timber operations. However, due to limited salmonid population data and the heavy disturbance in watersheds prior to the collection of sediment yield and temperature data, a time period reflective of reference conditions is not available in most areas. Therefore, it should be recognized that the sediment reduction and temperature goals of the TMDLs are only conservative starting points to stimulate positive changes and response in the channel. The Forest Practice Rules (FPRs) should lead to compliance with TMDLs. TMDL implementation should be clearly incorporated into the proposed ASP Rules.

Conflicts with Water Quality Objectives

The FPR framework defines protective measures that are more protective in streams with known fisheries than those where they are absent. The Water Quality Objectives defined in regional Water Quality Control Plans, however, apply to all waters of the state, regardless of whether species are known to be present. For instance, the Water Quality Objectives for Temperature states that natural receiving water temperatures shall not be altered, whereas the proposed rules is less protective for class II streams than for class I streams. Pg 43 of the Initial Statement of Reasons (IOSR) document states:

> "Adequate shade retention and high numbers of large conifer trees for large wood recruitment are required for large Class II watercourses, since watershed products such as heated water, wood, and fine sediment can be transported into fish-bearing Class I watercourses from these reaches. Since these watercourses are not fish-bearing, however, it is appropriate to have the standards in this secondary zone for wood and shade retention somewhat lower than for Class I watercourses."

This reasoning implies that streams where fish are not present only need water quality protections to protect fish in higher order reaches downstream. This approach is inconsistent with the Water Quality Objectives in regional Water Quality Control Plans and will create a situation in which CAL FIRE would approve plans that would be in violation of the Basin Plan Water Quality Objectives. We suggest that rules be developed that are consistent with applicable Water Quality Objectives in all stream reaches, particularly with respect to temperature. As the BOFFP has been responsive to the need to address both state and federal salmonid listings, likewise they should be responsive to state and federal Clean Water Act section 303(d) listings for other beneficial uses of water.

ASP geographic limitation

While the proposed ASP Rules include application to one planning watershed upstream of the limit of anadromy, they remain limited in geographic extent. The effects of upstream disturbance on salmonid habitat must be recognized and the ASP Rules should be modified to add protection for upstream watersheds in order to have a realistic chance of restoring salmonid populations. Water entering salmonid habitat needs to be cool, sediment inputs controlled and large wood inputs enhanced as an integral part of any projects near a stream zone.

Preferred Management Practices (PMPs)

We strongly support the inclusion of “Preferred Management Practices” within the Class I Watercourse and Lake Protection Zones (WLPZs) (Proposed Rule Sections 916.9(f)(2)(D), 916.9(f)(3)(E), and 916.9(f)(5)(D)). However, we are concerned that the proposed language requires they only “should be considered.” We recommend implementation of adequate PMP should be required rather than considered.

Winter Road Operations

As written, the proposed ASP Rules would allow the discharge of visibly turbid water to a watercourse, in violation of existing Basin Plan prohibitions and water quality standards. In other words, the thresholds defined as indications of when “saturated soil conditions” exist do not give adequate warning of when a Basin Plan violation may be imminent. Instead, they represent conditions where a violation has already occurred. Regional Water Board staff recommend that thresholds with clear indicators of when a violation may be imminent, instead of when it has already occurred, be developed and implemented.

Minimum vs Appropriate standards

The proposed rule section 916.2(b) contains a simple word change from “minimum” to “appropriate,” essentially shifting the meaning from the minimum protective measures necessary for protecting waters of the State, to now being the “appropriate” protective measures. We do not concur. The BOFFP and CalFire do not have the legal authority to determine the “appropriate” level of protection for water quality. The State and Regional Water Boards have been granted that mandate and authority by the Legislature. The protection measures prescribed by the Forest Practice Rules should continue to be considered the minimum necessary.

Site-specific or nonstandard measures

The proposed rule section 916.9(v) would allow for site-specific management, designed for the specific conditions of an individual watershed. While we agree, in concept, that a site-specific approach may provide a superior method for determining appropriate watershed protection measures than the standard rules, it is unclear the scope and rigor of analysis required in order to justify nonstandard practices. Furthermore, there will be an inherently greater level of resources required to review site-specific plans. We are concerned the Regional Water Board, as well as Cal Fire and others involved in THP reviews, do not have adequate staff resources that would be required. If this proposal is approved, we suggest that THPs that propose alternative plans, be removed from the standard THP review timeline, to allow appropriate review and oversight for site-specific plans in complex watersheds. We also recommend that clear direction be given on where and when such an approach may be used and the level of analysis required in order to make implementation clear, effective, and enforceable.

Optional Amendments to ASP Rule changes

The proposed rules contain numerous optional amendments along with the recommended rule changes. Generally, the proposed optional amendments that pertain to water quality protection recommend reduced protection to those in the proposed change. Regional Water Board staff recommend that the BOFFP do not adopt any of the proposed optional amendments except Optional Amendment 23.

Finally, it is important to note that several very important items are not addressed by the proposed ASP Rules. These include monitoring of adaptive management practices, cumulative effects assessment, and requirements for 303(d) listed water bodies. These omissions make it impossible to reduce the potential impacts to a level of insignificance.

We recognize that a great deal of effort was spent in reviewing the current scientific literature regarding the beneficial functions of riparian buffers for anadromous salmonids and the impacts of timber operations. However, neither the proposed ASP Rule text nor the accompanying supporting documents identify which references have been used to support the conclusions and ultimately the recommended changes to the ASP rules. The Initial Statement of Reasons (IOSR) document identifies many literature sources as the basis of the various proposed rules, however the ISOR lacks in discussing the justification for the proposed rules. The document lacks specifics that would describe how the proposed rule relates to the literature source, and how the proposed rule meets the stated goals. It is not enough to describe a rule and cite literature to support the rule, without describing what aspects of the cited literature support the rule. Additionally, many of the references cited are not peer-reviewed papers or articles but rather internal memoranda that are, in turn, relying on previous internal memos to arrive at a recommendation. Regional Water Board staff suggest that a clear distinction be made in the bibliographic references between internal memoranda, self published documents, and peer-reviewed papers.

Specific Comments

The following relate to specific sections of the proposed ASP Rules. Each comment is referenced to the corresponding Rule section (14 CCR) and page number.

Re: 895.1 Definitions Stable Operating Surface (page 10, lines 6 through 13)
The proposed ASP rules change the definition of stable operating surface from one that prevents the surface of logging roads or landings from generating waterborne sediment in amounts sufficient to cause turbidity increases in downstream Class I, II, III, or IV watercourses or in drainage facilities that discharge to Class I, II, III, or IV watercourses, to "*a road or landing surface that can support vehicular traffic and has a structurally sound road base appropriate for the type, intensity and timing of intended use*."

Regional Water Board staff are concerned that this change can result in turbidity increases in Class I, II, III, and IV watercourses in violation of the Basin Plan. Staff recommend that the original definition be left in the rules and that the new definition simply be added to it.

Re: 895.1 Definitions, Stream Order (page 10, line 18 through page 11 line 11)
Except within very limited settings, stream order is not an appropriate tool for completely differentiating stream types or processes. It does not fully predict the ability to transport sediment or the presence or absence of habitat. A stream of a certain order in one specific location may have entirely different values and habitat from a stream of the same order in a different location. The use of stream order alone will likely result in inappropriate protection measures, and increased field scrutiny.

Re: 898 Feasibility Alternatives (page 15, line22)
Regional Water Board staff support cumulative effects assessments with respect to impacts that may combine with listed stressors in 303(d) listed waterbodies. However, the use of the word "may" makes measures to help attain water quality standards in a listed waterbody optional. This is in conflict with the Basin Plan and the Porter Cologne Water Quality Control Act (California Water Code Section 13000 et seq.). Regional Water Board staff suggest changing lines 21 through 23 to, "The plan preparer shall provide feasible mitigation measures to reduce any such impacts from the plan to a level of insignificance, and **shall** provide measures, insofar as feasible, to help attain water quality standards in the listed portion of the waterbody."

Re: 916 Intent of Watercourse and Lake Protection (page 17, lines 16 through 19)
The Regional Water Board staff supports the proposed additions, both to avoid threatened violations of legal requirements and the recognition of watersheds listed as water quality impaired under Section 303(d) of the Federal Clean Water Act. The proposed additions are consistent with the Porter Cologne Water Quality Control Act.

Re: 916 Intent of Watercourse and Lake Protection (page 17, lines 21)
We are concerned about the proposal to change the level of consideration given to the quality and beneficial uses of water relative to timber production from "equal" to "appropriate." It is difficult to determine the meaning of "appropriate levels of consideration." What is considered appropriate by one may not be considered appropriate by another. It is the responsibility of the regional water boards, who have the legal mandate and authority, to determine if adequate consideration has been given to the quality and beneficial uses of water. Regional Water Board staff suggest changing line 21 to "… while providing equal ~~consideration~~ protection for the quality and beneficial uses of water~~ relative to that productivity~~."

Re: 916 Intent of Watercourse and Lake Protection (page 18, line 10)
Language should be added to state that watercourse and lake protection measures should ensure that water quality objectives, as described in an applicable approved water quality control plan, are maintained where they are currently being met, and their attainment is not hindered or delayed in areas where they aren't currently being met.

Re: 916(a) Intent of Watercourse and Lake Protection (page 18, lines 12 through 16)
It appears subsection (a) was split into two sentences in an attempt to break up a run-on sentence. The split, however, removes the existing goal of restoring the beneficial uses of water where they are impaired. This implies that subsequent references to

maintaining, protecting, and restoring resources exclude the beneficial uses of water. As such, we strongly oppose this revision. We propose the new sentence on lines 3 through 5 read: "insofar as feasible, the beneficial uses of water, native aquatic and riparian-associated species, and the beneficial functions of riparian zones shall be restored where they are impaired.

Re: 916.2(a)(3), 916.2(b), 916.2(c) Protection of the Beneficial Uses of Water and Riparian Functions (page 20, lines 7, 8, 22, 24, and 25)
The added words "when the plan is in a planning watershed with listed anadromous salmonids" change the rules to exclude many watersheds currently protected. In addition, it may exclude watersheds that are listed as water quality impaired under Section 303(d) of the Federal Clean Water Act. It is important to acknowledge that water runs down hill, and what happens above the limit of anadromy affects the downstream receiving waterbodies. Increased stream temperatures and sediment generated in a planning watershed above the limit of anadromy *will* be delivered down stream and *does* have the potential to negatively impact listed anadromous species and other downstream beneficial uses.

Re: 916.2(b) Protection of the Beneficial Uses of Water and Riparian Functions (page 20, line 17)
The Regional Water Board staff strongly oppose the proposed ASP Rules word change from "minimum" to "appropriate." This change implies that the protective measures prescribed in the FPRs are *in all cases* the measures that will serve to satisfy the water quality mandate to protect, maintain, and restore beneficial uses. The inclusion of allowances for site-specific exceptions in 916.9(v) demonstrates that this is not the case. The protection measures prescribed by the FPRs should be viewed as the foundation upon which to build, and considered the minimum protections required. In some specific cases, greater protections may be required, in others, when supported by a site-specific analysis, less protections may be allowed. Calling the protection measures prescribed in the FPRs the "appropriate" appears at odds with the very next section (916.2(c), "when the protective measures … are not adequate") and the BOFFPs desire to move away from a "one-size-fits-all" approach. Also, as stated above, the BOFFP and CalFire do not have the legal authority to determine the "appropriate" level of protection for water quality. The State and Regional Water Boards have been granted that mandate and authority by the Legislature.

Re: 916.5(e) Procedure for Determining Watercourse and Lake Protection Zone (WLPZ) Widths and Protective Measures (page 22, lines 3, 13, and 20 through 22)
The Regional Water Board staff oppose the proposed change from "watersheds with threatened or impaired values" to "watersheds with listed anadromous salmonids." This may exclude watersheds that are listed as water quality impaired under Section 303(d) of the Federal Clean Water Act, many of which are upstream of, are hydrologically connected to, and have the potential to affect watersheds with listed anadromous salmonids.

Re: 916.9 Title (page 23, lines 2 and 3)
Regional Water Board staff strongly oppose deleting "Watersheds with Impaired Values" from the title of this section. Regional Water Board staff are very concerned that watersheds with impaired values have been deleted from this section. The proposed change is inconsistent with the wording of section 916, which explicitly states the intent to provide protection to watersheds listed under Section 303(d) of the federal Clean Water Act, The proposed ASP Rules do not adequately address the potential for cumulative effects from timber operations in 303(d) listed watersheds, particularly those watersheds listed for sediment and/or temperature impairments.

Re: 916.9 Geographic Scope (page 23, lines 18 through 25, and page 24, lines 1 through 5)
The effects of upstream disturbance on salmonid habitat must be recognized and the ASP Rules should include protection for upstream watersheds in order to have a realistic chance of restoring salmonid populations. Fine sediment has the potential to travel downstream regardless of the limit of anadromy. Regional Water Board staff are concerned that the proposed exclusions in this section define protective measures that are more protective in streams with known fisheries than those where they are absent. The Water Quality Objectives defined in regional Water Quality Control Plans, however, apply to all waters of the state, regardless of whether species are known to be present.

Re: 916.9(a)(1) Goals (page 24, line 18)
Regional Water Board staff support compliance with the Total Maximum Daily Loads (TMDLs), but since section 916 states that this section does not apply to watersheds that "do not meet the definition of 'watersheds with listed anadromous salmonids," it may imply that watersheds that do not meet the definition of "watersheds with listed anadromous salmonids" do not need to comply with the terms of a TMDL. Pursuant to Clean Water Act 303(d), the goal for impaired waters is to recover water quality to the point the waters can be de-listed. The Forest Practice Rules should lead to compliance with TMDLs in all impaired watersheds, not just those with known anadromous salmonids.

Additionally, it is unclear whether this section is referring to the allocation goals of the TMDL itself, a TMDL action plan, or the TMDL implementation policy. Regional Water Board staff recommend that this section be amended to state: "Comply with the terms, recommendations, guidelines, or goals of a technical Total Maximum Daily Load (TMDL), a TMDL implementation plan, or TMDL implementation policy."

Re: 916.9(a)(2) Goals (page 24, line 22)
In addition to being sediment impaired, many watercourses are impaired due to excessive temperature. Additionally, Regional Water Board staff are concerned about the use of the word "significant. "Significant" is a very subjective term with no clear meaning. Regional Water Board staff recommend revising the section to state: "(2) ~~Not result in any~~ Prevent ~~significant~~ sediment load or solar radiation increase to a watercourse or lake."

Re: 916.9(a)(3, 4, 5) Goals (page 24, line 24, page 25, lines 1 through 4)

The Regional Water Board staff oppose the proposed change from “measurable” to “significant.” On the one hand, “significant” is a very subjective term with no clear meaning, but on the other connotes a statistical meaning that may be unreasonable. What is significant under one standard may not be significant under another. “Measurable” is a term with a clear and objective meaning that is both verifiable and enforceable. Either the existing language should be retained or the word “measurable” should be deleted without substituting “significant.” In other words, Regional Water Board staff recommend either retaining existing wording or making the following revisions:

“(3) ~~Not result in~~ Prevent any ~~measurable decrease in~~ instability of a watercourse channel or of a watercourse or lake bank.

“(4) ~~Not result in~~ Prevent any ~~measurable~~ blockage of any aquatic migratory routes for any life stage of anadromous salmonids or listed species.

“(5) ~~Not result in~~ Prevent any ~~measurable~~ adverse effects to streamflow ~~reductions during critical low water periods except as part of an approved water drafting plan pursuant to 14 CCR § 916.9(r) [936.9(r), 956.9(r)], subsection (r)~~.”

Re: 916.9(a)(7)(A) Goals (page 24, lines 14 through 16)

As proposed, this section does not meet the Water Quality Objectives for Temperature. Regional Water Board staff recommend the section be amended to state: “(A) provide shade to the watercourse or lake so that the natural receiving water temperature shall not be altered and to maintain daily and seasonal water temperatures within the preferred range for anadromous salmonids or listed species where they are present or could be restored; and”

Re: 916.9(a)(7)(B) Goals (page 24, lines 17 through 21)

This section should be removed. This section previously addressed the need for minimizing temperature fluctuations. It has been modified with the goal of providing a deciduous vegetation component for nutrient inputs. In our review of THPs over the past 20 years, we are not aware of situations where streams needed additional nutrient inputs from deciduous vegetation. For that matter, we have not been made aware of any situation where nutrients are a limiting factor for anadromous fish populations in our Region. Our experience is that fish are far more limited by increased temperature and reduced shade, which is best provided by conifers. This appears to be an attempt to allow the taking of conifers so deciduous trees can provide nutrients in a situation where nutrients have not been shown to be limiting anadromous fish populations.

Re: 916.9(b) Pre-plan adverse cumulative watershed effects (page 26, lines 4 and 5)

The proposed additional wording appears to remove the requirement to address existing adverse watershed effects. The proposed wording implies that existing adverse watershed conditions need be addressed *only* if the proposed timber operations would “add significantly” to existing effects. This proposed addition appears to be at odds with the stated goal of “the restoration, enhancement, and maintenance of the beneficial uses of water.” Regional Water Board staff suggest retaining the existing language:

"~~Where appropriate, t~~The plan shall ~~set forth~~ include measures to effectively reduce such effects."

Re: 916.9(c)(4) Class II large watercourses (page 27, lines 11 through 24)
Regional Water Board staff are concerned that the stated objectives for Class II watercourses do not address temperature or that flow from a Class II watercourse can effect the temperature of receiving Class I waters. The Regional Water Board suggests adding temperature considerations to the list of objectives and protective measures to address elevated temperatures in Class II watercourses.

Re: 916.9(f)(2)(E) Class I watercourses with confined channels in watersheds in the coho salmon ESU, Additional Special Operating Zone (page 37, line 4)
In order to be consistent with the Water Quality Objectives for Temperature, Regional Water Quality staff recommend replacing the term "significant adverse impact on" with "to measurably alter."

Re: 916.9(f)(3)(C)(3) Class I watercourses with flood prone areas or channel migration zones, Inner Zone A (page 42, lines 2 and 3)
Regional Water Board staff oppose the reduced canopy retention standards in watersheds with listed salmonids outside of the Coast and Southern Forest Districts.

Re: 916.9(g)(1)(A)(1) Class II large watercourses, Stream Order (page 63, line 21 through page 64, line 3)
While Regional Water Board staff are encouraged that the "Office-based approach to identify Class II-L watercourses" is to be conducted after a preliminary field investigation pursuant to section 916.5, we are nevertheless concerned that the definitive method for designating a Class II-L watercourse is based solely on stream order. As stated earlier, except within very limited settings, stream order is not appropriate for differentiating stream types or processes. It does not fully predict the ability to transport sediment or the presence or absence of habitat. The use of stream order alone will likely result in inappropriate protection measures.

Re: 916.9(g)(1)(B) Class II large watercourses, field-based approaches (page 64, lines 12 through 15)
Regional Water Board staff are concerned that field based approaches "may" be used for verification of the "office-based approach to identify Class II-L watercourses." Regional Water Board staff are also concerned that the intent of this section appears to be to allow the downgrading of a Class II-L to a Class II-S, without the complimentary requirement to upgrade a Class II-S watercourse, determined through the "office-based approach," to a Class II-L watercourse should the field conditions warrant.

<u>Re: 916.9(g)(1)(D) Class II Large watercourses, distance from a Class I watercourse (page 65, line 23 though page 66, line 4)</u>
This approach is inconsistent with the Water Quality Objectives contained in regional Water Quality Control Plans, since it may allow temperature alteration upstream of the 1,000 foot distance and may create a situation where plans could be approved that lead to exceedences of Water Quality Objectives. Class II-L protection measures should extend the entire length of the watercourse where Class II-L conditions exist. Regional Water Board staff suggest the following wording: "<u>**(D)** All Class II-L watercourses designated above shall incorporate requirements stated in 14 CCR § 916.9 [936.9, 956.9], (g)(2) for the greater of either a distance of 1000 feet measured from the confluence with a Class I watercourse or the total length of Class II-L.</u>"

<u>Re: 916.9(k)(1) and (2) Year-round logging road, landing and tractor road use limitations (page 85, lines 18 through 24)</u>
The threshold of visibly turbid water that may cause a turbidity increase in receiving waters is an inappropriate standard. The described conditions don't merely "threaten" to violate the applicable Basin Plan water quality standards, they are a violation of those standards. The threshold does not give adequate warning of when a Basin Plan violation may be imminent. Instead, they represent conditions where a violation has already occurred. The Regional Water Board recommends that the section be amended to prohibit sediment discharges that threaten to violate applicable legal requirements.

<u>Re: 916.9(k)(3) and (4) Year-round logging road, landing and tractor road use limitations (page 86, line 1 through line 9)</u>
The "quantities deleterious to the beneficial uses of water" requires interpretation and has in the past led to disagreements between the agencies and between the public and reviewing agencies. It causes conflict between the differing review and approval standards of the various agencies. The Regional Water Board suggests that the section be amended to prohibit sediment discharges that threaten to violate "Water Quality Requirements" as defined in Regional Board Orders R1-2004-0030 Section I.L and R1-2009-0038 Attachment A:

> "'Water Quality Requirements' means a water quality objective (narrative or numeric), prohibition, TMDL implementation plan, policy, or other requirement contained in a water quality control plan adopted by the Regional Board and approved by the State Water Board, and all other applicable plans or policies adopted by the Regional Board or State Water Board, including, but not limited to, the State Water Board Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality Waters in California."

<u>Re: 916.9(l)(2) Winter period operations (page 87, line 4)</u>
The term "low antecedent soil wetness" is undefined and therefore it is not possible to determine when extended periods with low antecedent soil wetness may exist. Antecedent soil moisture may be defined in several of different ways, each with its own unique units, values, and appropriate applications. The term "low antecedent soil wetness" should either be defined or removed.

Re: 916.9(l)(3) and (4) Winter period operations (page 87, lines 8 through 13)
Similar to section 916.9(k)(1) and (2), the threshold of visibly turbid water that may cause a turbidity increase in receiving waters is an inappropriate standard. The described conditions don't merely "threaten" to violate the applicable Basin Plan water quality standards, they are a violation of those standards. The threshold does not give adequate warning of when a Basin Plan violation may be imminent. Instead, they represent conditions where a violation has already occurred. The Regional Water Board recommends that the section be amended to prohibit sediment discharges that threaten to violate applicable legal requirements.

Re: 916.9(n)(4) Treatments to stabilize soils (page 88, line 24 through page 89, line 2)
This section exists in the current FPRs, but has been deleted from the proposed ASP Rules. It removes the requirement to ensure that once important function of a buffer is to protect beneficial uses of water from upslope timber harvest operations. The Regional Water Board strongly recommends restoring this section in the proposed ASP Rules.

Re: 916.9(v)(8) Agency concurrence with site-specific measures (page 106, line 23 through page 107, line 3)
Regional Water Board staff are concerned that limiting the consideration for rejecting site-specific measures to comments from the Department of Fish and Game or "two or more agencies … [that have] participated in the review of the plan, including an on-the-ground inspection" may add a significant burden to the review process. Additionally, this section, as written, appears to unequally burden reviewing agencies, giving preferential consideration to the Department of Fish and Game. Due to the increased burden on resources to adequately review and inspect THPs that propose site-specific measures under 916.9(v), Regional Water Board staff suggest that such THPs be removed from the standard THP review timeline, to allow appropriate review and oversight for site-specific plans in complex watersheds.

Optional Amendments

Re: Optional Amendment 100: Reduces Class I Inner Zone retention
Regional Water Board staff oppose Optional Amendment 100. In order to maintain adequate shade and prevent the risk of elevated temperatures, a minimum of 80% post harvest canopy should be maintained in the Class I Inner Zones.

Re: Optional Amendment 9: Restricts Outer Zone Class I protections
Regional Water Board staff oppose Optional Amendment 9. The Optional Amendment unnecessarily restricts the Class I Outer Zone protections. The first of the two conditions that could require Outer Zone protections would be extremely difficult to implement and enforce. It requires an Outer Zone only "where windthrow is a demonstrated occurrence," which may only become apparent postharvest.

Re: Optional Amendment 101: Restricts Outer Zone Class I protections in watersheds outside the Costal Anadromy Zone
Regional Water Board staff oppose Optional Amendment 101. The Optional Amendment unnecessarily restricts the Class I Outer Zone protections. The first of the two conditions that could require Outer Zone protections would be extremely difficult to implement and enforce. It requires an Outer Zone only "where windthrow is a demonstrated occurrence," which may only become apparent postharvest.

Re: Optional Amendment 102: Determine the Class II Watercourse Type
Regional Water Board staff support *portions of* Optional Amendment 102. While we strongly oppose the use "Blue Line Streams" (optional 916.9(g)(1)(A)(2)) for any determination of watercourse type, we support field verification (optional 916.9(g)(1)(B)) of watercourse clasification.

Re: Optional Amendment 103: Class II WLPZ widths and operational requirements
Regional Water Board staff oppose Optional Amendment 103. This optional amendment represents a reduction of protections measures for both Class II-S and Class II-L watercourses.

Re: Optional Amendment 104: Retain hardwoods within the ELZ
Regional Water Board staff oppose Optional Amendment 104. Hardwoods should be retained for the entire width of the ELZ.

Re: Optional Amendment 105: Substitutes "non-merchantable conifers" for "countable trees" within the ELZ
Regional Water Board staff oppose Optional Amendment 105. All "countable" trees, not simply non-merchantable conifers, should be retained within the ELZ.

Re: Optional Amendments 20: Eliminates prevention of waterborne sediment transport from road surfaces
Regional Water Board staff strongly oppose Optional Amendment 20. In order to reduce the risk of sediment transport to a watercourse, the traveled surface of logging roads should be treated to prevent waterborne transport of sediment and concentration of runoff that results from timber operations.

Re: Optional Amendment 22: Requires showing of "quantities deleterious" before treatment of disturbed soil prior to rain
Regional Water Board staff oppose Optional Amendment 22. The term "quantities deleterious" is very subjective and unclear. The lack of a defined standard will likely lead to disagreement between agency staff and reduced protection from sediment delivery.

Re: Optional Amendment 23: Adds protection where natural ground cover is inadequate
Regional Water Board staff support Optional Amendment 23. Where the natural ability of ground cover is inadequate to protect beneficial uses of water, it is appropriate to propose protection measures to retain and improve the natural ability of the ground cover to filter sediment and minimize soil erosion.

Re: Optional Amendment 26: Removes “equal to or more favorable” requirement to site-specific measures.

Regional Water Board staff strongly oppose Optional Amendment 26. Site-specific measures designed for the specific conditions of an individual watershed are only appropriate when they provide protections that are equal to or more favorable than the standard rules. Site-specific management proposals should not provide a less favorable result.

Re: Optional Amendments 27: Restricts agency determination that proposed site-specific measures are not adequate

Regional Water Board staff oppose Optional Amendment 27. Regional Water Board staff favor the primary “two or more agencies” wording. It is assumed that the agencies will base their determination on “substantial evidence in the record” in light of their legislative mandates.

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California Regional Water Quality Control Board
North Coast Region
Bob Anderson, Chairman

Linda S. Adams
Secretary for Environmental Protection

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Arnold Schwarzenegger
Governor

September 3, 2009

To: Robert Klamt
Chief, Timber and Non-point Source Division

From: Bryan McFadin, PE
Senior Water Resource Control Engineer

Subject: Evaluation of Anadromous Salmon Protection Rules Relative to the Water Quality Objective for Temperature

Introduction

This document is intended to identify and describe Regional Water Board staff concerns regarding stream temperature issues that remain unaddressed by Cal Fire's proposed *Anadromous Salmon Protection Rules*. Regional Water Board staff have reviewed the proposed *Anadromous Salmon Protection Rules* (ASP rules) originally published May 8, 2009, re-noticed July 24, 2009, as well as the *Initial Statement of Reasons, Questions and Answers "Threatened and Impaired Watershed" regulation proposal A Basis for the Initial Statement of Reason* (Q&A), and the *Scientific Literature Review of Forest Management Effects on Riparian Functions for Anadromous Salmonid*s (literature review) documents. We believe that the proposed rule package represents a substantial step forward in protection of stream temperatures in California. In particular, we believe the designation of no-cut "core zones" accompanied with high retention "inner zones", as well as the establishment of the Class II-L stream classification, are major steps towards ensuring that forest practices will not result in exceedences of the water quality objective for temperature. Implementation of the proposed rules will substantially reduce the number of temperature-related conflicts in the timber harvest review process.

The literature review presents discussion of many of the factors and thermodynamic processes that affect stream temperature. Many of the thermodynamic principles outlined in the literature review are concepts that we agree on. Some of these include:

- Shade is a key factor, and the most important factor in limiting heat inputs from the dominant heat source, solar radiation.
- The relative importance of riparian vegetation varies by location.
- Riparian effectiveness depends on vegetation height and density.

- The effectiveness of riparian vegetation in providing shade to a watercourse decreases with channel width.
- Solar exposure is influenced by channel morphology, width, orientation, and topography.
- Stream temperatures are ultimately determined by a suite of factors.
- Thermal conditions respond to downstream riparian conditions as water flows downstream.
- Stream temperatures respond to tributary and groundwater inputs.
- Temperatures are moderated by hyporheic exchange, the magnitude of which is a function of bed composition and channel morphology.
- Heat exchange is affected by the depth, velocity, and volume of a stream.
- Air temperatures vary by location, and affect stream temperatures.
- Timber harvest can influence microclimate.

Despite these broad areas of agreement, there remain aspects of the science of stream temperatures and the approach to managing them that our staff interpret differently. These remaining issues are:

- Managing for natural temperatures vs. a specified temperature range or criterion.
- The concept of stream temperature relaxation downstream of heat inputs.
- The influence of forestry activities on microclimate, and effects of microclimate on stream temperatures.

Our concerns related to each of these aspects are described in detail, below.

Natural Temperatures vs. Specified Range:
The Regional Water Quality Control Boards are charged with protecting the water quality of waters of the state by ensuring compliance with water quality objectives (e.g. temperature, suspended sediment, settleable material, dissolved oxygen, etc) and protection of beneficial uses (e.g. cold freshwater habitat; rare, threatened, or endangered species; spawning, reproduction, and/or early development, etc.), as described in each regions' respective Water Quality Control Plan.

The North Coast Region's water quality objective for temperature states:

> "The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.
>
> At no time or place shall the temperature of any COLD water be increased by more than 5°F above natural receiving water temperature.
>
> At no time or place shall the temperature of WARM intrastate waters be increased more than 5°F above natural receiving water temperatures."

The term “COLD” refers to cold freshwater habitat and “WARM” refers to warm freshwater habitat. The cold freshwater habitat beneficial use is defined as:

> “Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.”

Similarly, the warm freshwater beneficial use is defined as:

> “Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.”

The water quality objective for temperature identifies the natural temperatures that occur at a site as the default temperature standard, with an allowance for limited temperature alteration if it can be demonstrated that the alteration won’t harm the beneficial uses. In practice, the most sensitive beneficial use of concern has most often been considered those related to salmonids, and in those cases the biological temperature requirements for rearing salmonids have used to defined the criteria for adverse impacts. This application is too narrow to be fully protective, especially considering the definition of COLD beneficial use. There may be other temperature sensitive species present in a waterbody that also require special management considerations, such as the southern torrent salamander. In all cases, the thermal needs of all beneficial uses present in a waterbody must be considered before an increase in temperature can be allowed.

The ASP Rules were developed to address the habitat needs of salmonids. The literature review discusses the temperature requirements of salmonids, and establishes the maintenance of those temperature conditions as a criterion for successful forest management. For example, the literature review states:

> “…some streams need more shade to maintain a suitable temperature regime than others because of its (sic) location and physical characteristics.” -Ch 3, pg 21

and,

> “…streams that are naturally cool may become more favorable for growth as a result of shade reduction and stream warming.”
> –Ch3, pg 22

Together, these statements imply that the thermal environment is protected as long as temperatures are within the range suitable for salmonids, and that streams that are colder than necessary to support salmonids can accommodate temperature increases. This approach is not compliant with the WQO for temperature, however, because the objective prohibits temperature increases without a demonstration that all beneficial uses wouldn’t be adversely affected.

An implicit assumption within the literature review discussion of streams that do not support salmonids (variously described in the literature review as headwater streams, low-order streams, and Class II streams) is that forest practices are protective of salmonids if thermal impacts do not persist in downstream reaches where salmonids are present. The protection of Class II watercourses is the area of the ASP rules (and forest practice rules, generally) in which water temperature protections consistent with the Basin Plan temperature objective are most lacking. The establishment of the Class II-L watercourse designation and no-cut core zones are a substantial improvement over the previous rules. However, the rules remain oriented to protection of watercourses that have the potential to affect Class I streams, rather than the thermal protection of the cold-water ecosystems of Class II streams themselves.

The literature review discussion on page 17, chapter 3, concluded that because the magnitude of the headwater stream flows are small relative to the flow of fish-bearing receiving waters, the temperature of the receiving water is unlikely to be affected by temperature increases. This may be true, however the approach is only protective of the salmonid species in the Class I stream and ignores beneficial uses in the Class II streams. There is no discussion of the importance of the headwater streams in providing thermal refugia in the fish-bearing streams, which is more commonly the case in the north coast region, nor is there a discussion of the beneficial uses present in Class II streams and the thermal requirements of those beneficial uses. This logic results in the 916.9(g)(1)(B)(2) provision that allows a forester to re-classify a Class II-L watercourse to a Class II-S if she or he can demonstrate that the resulting downstream temperature of the receiving water will result in a temperatures above a specified temperature. The language goes on to dismiss very minimal mid to late-summer tributary streamflow as ecologically insignificant, based on the receiving Class I temperature, without acknowledging the beneficial uses of the Class II.

In justification of additional riparian protections along Class II streams the *Questions and Answers* document states the following:

> "High shade and high numbers of conifer trees are required for large Class II watercourses, since watershed products such as heated water, wood, and fine sediment can be transported into fish-bearing Class I watercourses from these reaches. Since these watercourses are not fish-bearing, however, it is appropriate to have the standards in this secondary zone for wood and shade retention somewhat lower than the Class I watercourses."

This statement implies that some warming of Class II streams is acceptable because fish are not present. This approach is not compliant with the Basin Plan WQO for temperature, because the objective prohibits temperature increases without a demonstration of no adverse effects to beneficial uses.

The same logic is implicit in the ASP rule provisions of 916.9(g)(1)(D) that increase Class II-L riparian protections upstream of Class-I watercourses. The justification given for the increased protections is temperature protection. If the increased protections are required to protect the temperature within 1000’, what about the remainder of the Class II stream? This approach is also not compliant with the Basin Plan WQO for temperature.

The water quality objective for temperature requires that a cautious approach to stream temperature be followed, and that no stream temperature increase is allowable without a demonstration that the beneficial uses won’t be adversely affected. By referencing the natural state as the default standard, the temperature objective ensures that <u>all</u> beneficial uses are protected in <u>all</u> of the waters of the state, our basic legal mandate. The proposed ASP rules are designed solely for the protection of salmonids. Thus, the proposed rules do not ensure compliance with the Basin Plan water quality objective for temperature in situations where salmonids are not present or where they are not the beneficial use most sensitive to elevated temperatures.

Relaxation vs. Acceleration

The proposed ASP rules incorporate the concept of stream temperature “relaxation” downstream of reaches with elevated heat inputs. The relaxation concept rests on the assumption that a stream that has had its temperature elevated in a reach exposed to solar radiation will lose heat and return to its original temperature once it leaves the exposed reach and re-enters a reach with the original conditions (Figure 1). The Literature Review discusses studies that reported cooling in the downstream direction, but is silent regarding studies that reported no downstream cooling following harvest (e.g. Brown et al 1971, Storey and Cowley 1997 as cited in Moore et al 2005) The literature review also states that the temperature response is a function of many variables, that the factors governing downstream temperature response are consistent, and that the primary drivers would apply anywhere. The Literature Review further states more research is needed in California. Regional Water Board staff agree that more research is needed on this topic. Because the relaxation concept is dependent on equilibrium temperature, it is prudent to evaluate this concept given the climatic conditions of California now and in the future.

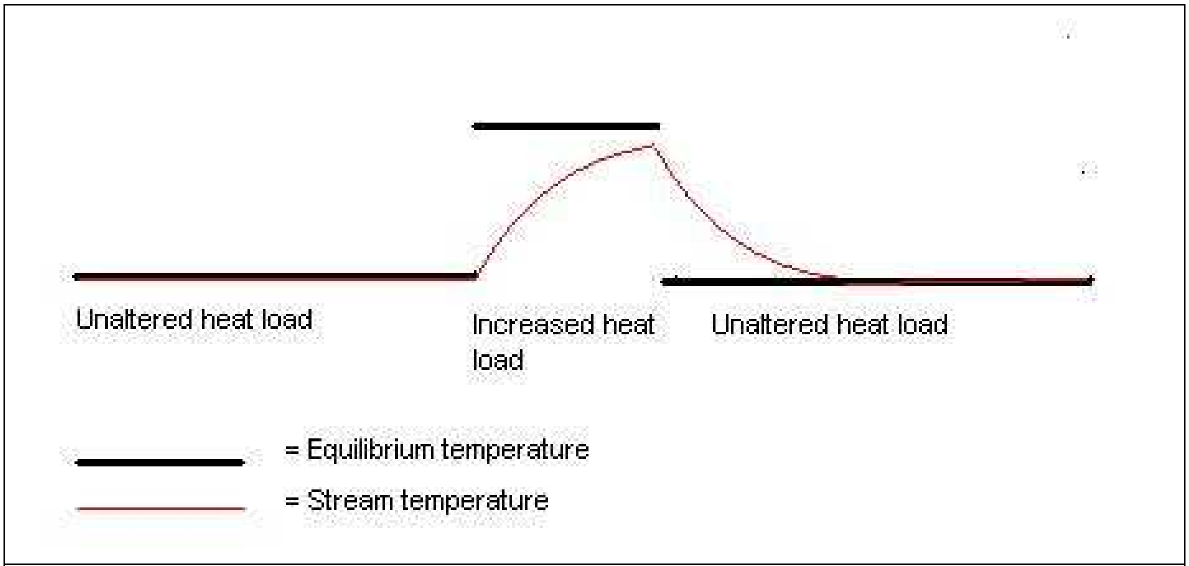

Figure 1: Graphic illustration of the stream temperature relaxation concept.

What the Literature Review does not do is recognize that the initial equilibrium temperature for such an example may not be "natural" and thus not meet the Basin Plan WQO for temperature in the first place. Given that equilibrium temperature is a fundamental concept in the stream temperature relaxation concept, it is notable that the *Literature Review* lacks any discussion that puts stream temperature dynamics in the context of equilibrium temperature. Equilibrium temperature is defined as the temperature that occurs when a balanced is achieved between heat sources and sinks (Bogan et al, 2003, Caldwell et al, 1991).

The second law of thermodynamics guarantees the temperature of a stream will trend towards the equilibrium temperature. Newton's law of cooling tells us that the rate of temperature increase will be proportional to the difference between the waterbody's temperature and the equilibrium temperature. This process continuously determines stream temperatures (Bogan et al, 2003). Effective management of stream temperatures for coldwater ecosystems is about limiting heat inputs to streams that are below equilibrium in order to minimize the rate of heating as the waterbody trends toward equilibrium (Figure 2).

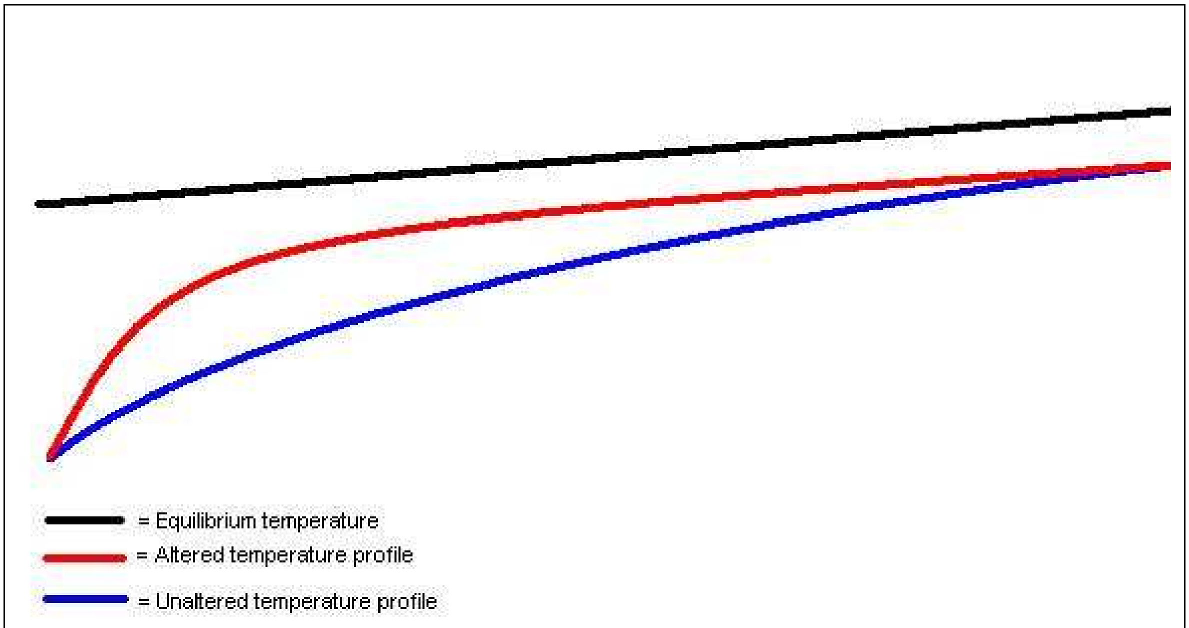

Figure 2: Illustration of difference in temperature profiles due to buffering.

In cases where water temperatures are relatively far from equilibrium temperature (such as downstream of springs, areas of high groundwater discharge, or melting snow) an increase in heat load may cause an increase in temperature that can't be mitigated by downstream conditions (Figure 3). In those situations the result is an acceleration of stream temperature in the downstream direction, rather than a localized increase quickly followed by an equal decrease. Management measures should be designed to prevent increased heat loads when the temperature of a waterbody is uniquely cold, regardless of stream classification.

Regardless of the downstream cooling that may or may not occur, any temperature increase more than 5 ^{o}F constitutes a Basin Plan violation, and any increase in water temperature that adversely affects beneficial uses constitutes a Basin Plan violation. Given that stream temperatures are very sensitive to solar radiation inputs (Sound Watershed Consulting 2009), it is not unlikely that even modest increases in solar radiation can result in temperature increases of 5 ^{o}F or more.

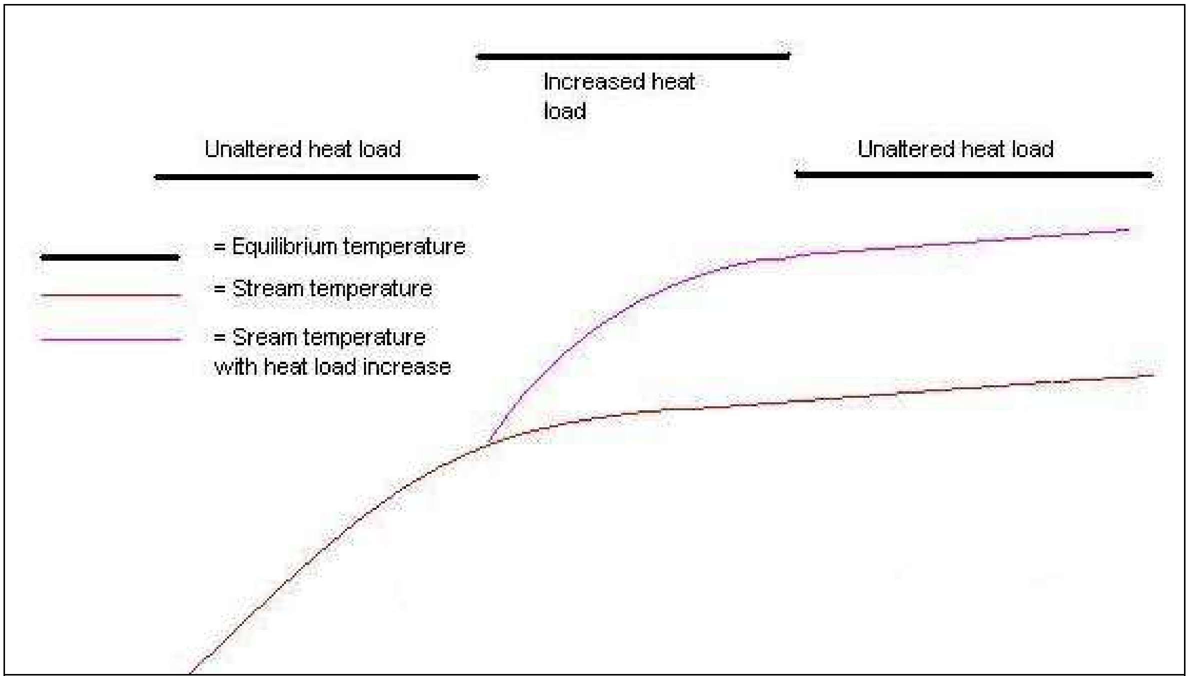

Figure 3: Graphic illustration of temperature acceleration concept.

Forest management and regulatory approaches that incorporate the concept of temperature relaxation should also consider the possibility of temperature acceleration as the response to the same management action, depending on the setting. The factor that determines whether or not a stream will “relax” is the equilibrium temperature. Streams that cool downstream of riparian harvest do so because the equilibrium temperature increases through the affected reach, then decreases in the downstream cooling reach. In these situations, the stream is already near equilibrium temperature. This is not always the situation, however.

One of the major heat sinks downstream of heat sources is the loss of heat to the hyporheic zone via conduction (Johnson 2004, Moore et al 2005). In these cases the heat is not lost from the stream environment. Rather, the alluvial substrate retains some of the heat, while some is lost to the largest heat sink, the earth (Poole and Berman 2001). These alluvial substrates are habitat for benthic species whose incubation and growth rates are affected by temperature (Moore et al 2005).

The use of the equilibrium temperature concept as a decision making criterion may be a reasonable approach for quantifying a waterbody’s sensitivity to increased heat loads. Regional Water Board staff suggest a collaboration with Cal Fire staff on an approach prior to making use of the equilibrium concept in forest management decision making.

Microclimate
The Literature Review discussion concludes that none of the studies reviewed demonstrated a stream temperature change attributable to changes in microclimate, and summarily dismisses the concept that management-related changes in near-stream

microclimate may affect stream temperatures. The Literature Review justifies this, in part, by pointing out that the heat exchange between air and water occurs at rates that are an order of magnitude less than rates of heat input from solar radiation. Regional Water Board staff agree that solar radiation dominates all other natural heat sources, but also recognize that air temperature is perhaps the single largest factor that determines equilibrium temperatures, particularly in streams with low solar radiation inputs (Bogan et al, 2003).

We find the Literature Review's conclusion regarding microclimate inconsistent with their discussion of the coastal influence on water temperatures. We recognize that fog is a factor near the coast, but note that even the streams with 75-100% canopy closure showed an average temperature difference of approximately 1.5 ^{o}C temperature between those in and out of the zone of coastal influence (Figure 3, Literature Review). We also note that the majority of microclimate studies in the literature focus on defining the change in microclimates that occur as a result of vegetation removal, while very few studies have evaluated stream temperature changes associated with microclimate changes. Given the lack of definitive study results, what is known regarding stream heat exchange, and climate changes in the future, Regional Water Board staff have determined that more study of this topic is prudent.

Summary

In conclusion, we commend Cal Fire staff and the Board of Forestry for proposing rules that provide significant riparian protections. The proposed rules will result in riparian protections that achieve the water quality objective for temperature in a substantial number of situations in the North Coast, particularly Class I streams. It is clear, however, that these rules were not developed to comply with the water quality objective for temperature, specifically. The Basin Plan is hardly mentioned in the rules, and the literature review, *Question and Answers*, and *Initial Statement of Reasons* documents do not identify the water quality objective for temperature as being a management criterion, or a water quality standard that must be met for compliance with the law. The fact that water temperature increases are anticipated as a result of implementation of the rules, without any discussion of the effects on beneficial uses, also indicates that these rules were not crafted to achieve compliance with the Basin Plan. One might also question of the requirements of the California Environmental Quality Act are met in terms of identifying and mitigating water temperature effects.

Without an analysis of effects of temperature increases on beneficial uses, Regional Water Board staff are unable to make a determination that the proposed rules ensure compliance with the water quality objective for temperature. Additionally, the possibility of temperature increases more than 5 ^{o}F must also be evaluated. Without these analyses, and given the narrow geographic extent of the application of the proposed rules, we are left to conclude that the proposed rules do not fully comply with the Basin Plan, and must identify the real possibility that many timber harvesting plans compliant with the rules may need modifications in order to comply with the Basin Plan. This is likely true to a larger extent in other regions that do not have the geographic extent of anadromous salmonids, and to which even Class I streams would not receive the additional protections of the proposed rules.

Additionally, without these analyses the proposed rules are not sufficient for certification as a third party regulatory program, consistent with the Non-Point Source Policy, and thus cannot serve as the basis as a waiver of waste discharge requirements. That fact has been stated in public meetings in the last year, most notably during the Regional Water Board hearing on the conditional waiver for timber harvesting on non-federal lands on June 4, 2009. Regional Water Board staff wish to resolve the remaining issues in order to move towards waiver certification, and wish to do so collaboratively with Cal Fire staff. We urge the Board of Forestry and Fire Protection to direct its staff to work with the Regional Water Board staff to bring the Forest Practice Rules into compliance with water quality regulations regarding beneficial use protection from elevated water temperature.

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State of California
North Coast Regional Water Quality Control Board

Staff report prepared for

The Revised Categorical Waiver of Waste Discharge Requirements

for

Timber Harvesting Activities on Non-Federal Lands
in the North Coast Region

Draft Order No. R1-2009-0038

By

Jim Burke

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I. Introduction

The Regional Water Board will be considering adoption of tentative Order No. 2009-R1-0038, which if adopted would revise the existing Categorical Waiver of Waste Discharge Requirements for Timber Harvesting Activities on Non-Federal Lands in the North Coast Region (Categorical Waiver), Order No. R1-2004-0016. An Initial Study and draft Mitigated Negative Declaration to comply with the California Environmental Quality Act (CEQA) to support adoption of the Order is also to be considered concurrently with the tentative order. The Regional Water Board adopted the current Categorical Waiver in 2004. The waiver expires on June 23, 2009.

The Categorical Waiver is an integral part of a multi tiered regulatory approach, that includes: General Waste Discharge Requirements Order No 2004-0030 (GWDRs) for timber harvesting activities for projects that do not meet Waiver criteria, a conditional waiver for timber harvesting activities on Federal lands, and several individual WDRs for larger watershed wide activities on private land.

Basis for the revisions to the current Waiver

The proposed revisions are intended to comply with the waste discharge prohibitions contained in the Action Plan for Logging, Construction, and Associated Activities from the Water Quality Control Plan for the North Coast Region (the Basin Plan), State Water Resources Control Board's (SWRCB) Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS Policy), Total Maximum Daily Loads (TMDLs) for watersheds throughout the region, and to prevent controllable sediment discharge, to protect and restore natural levels of shade to prevent elevating water temperatures, and reverse declines in populations of anadromous salmonids.

The basic intent of the Categorical Waiver is to identify those timber harvesting activities that pose a lower threat to water quality and therefore do not require the same level of oversight that individual or general Waste Discharge Requirements would provide. While regulatory oversight is reduced, protection of beneficial uses of water is maintained.

Revision Process

The Comment Period for the Categorical Waiver began on April 9, 2009 with the concurrent release of an initial study and draft mitigated negative declaration (Attachment 2) for the Categorical Waiver which updates the original negative declaration issued in 2004 to comply with the California Environmental Quality Act (CEQA).

Prior to the release of the tentative order, the Regional Water Board staff held public workshops in Fortuna on March 24, 2009 and in Yreka on April 8, 2009. Robert Klamt, Chief of the Regional Board's Timber Harvest Division, also gave a presentation to the Board of Forestry on May 6, 2009, which included an extensive question and answer session. The purpose of the workshops was both to inform interested members of the public of the proposed revisions to the Categorical Waiver, to respond to questions members of the public, and to receive comments as early as possible in the process of revising the waiver. The current draft under consideration reflects changes made in response to exchanges during these meetings.

The Regional Water Board received 17 comment letters during the comment period that are included in the agenda package (Attachment 4). Regional Water Board Staff written responses to all public comments received by May 9, 2009 are included in Attachment 5. Based on further review and consideration of the comments received, Regional Board staff will be providing recommendation for modifications to the tentative Order. These modifications may include clarifications and more substantive recommendations. All recommendations are provided to the Regional Board in the form of track changes to highlight any changes made to the original draft Order.

Summary of Proposed revisions to the Categorical Waiver

The tentative Order includes both minor (i.e., grammar and document organization) as well as more substantial changes (i.e., revising the categories, eligibility criteria, application and enrollment procedures and, monitoring requirements). New findings provide the rationale to support additional general and specific conditions of the waiver.

The following is a list of the most notable of the proposed changes/additions:

Non-Industrial Management Plans (NTMPs)

- Erosion Control Plans (ECP) would be required to be developed and implemented for entire NTMP. Previously enrolled NTMPs would have five years or more to submit an ECP for the entire NTMP
- Yearly winter period inspections would be required during periods when timber harvesting operations are being conducted
- Landowners would be required to develop long term road management plans. The implementation schedule would be proposed by landowner
- As an erosion and sediment control measure, surface runoff from logging roads would be required to be hydrologically disconnected to the extent feasible
- As a measure to achieve the Basin Plan Temperature Objective, shade and canopy retention requirements would be required that may exceed minimum current Forest Practice Rules .

Timber Harvesting Plans (THPs)

- Erosion Control Plans (ECP) would now be required to be developed and implemented for THPs. This is a similar requirement already established in the general WDR. Previously enrolled THPs would be automatically covered under the revised Waiver, and would not be required to meet the new specific conditions.
- Two winter period inspections per year would be required
- As part of erosion and sediment control measures, surface runoff from logging roads would be required to be hydrologically disconnected

- As a measure to achieve the Basin Plan Temperature Objective, shade and canopy retention requirements would be required that may exceed minimum current Forest Practice Rules.
- THPs that proposed clear cutting could now be enrolled in the waiver, provided that stream side riparian management zones are increased to 300 feet on fish bearing watercourses (Class I), 200 feet for watercourses with aquatic habitat for non-fish aquatic species (Class II), and 100 feet on watercourses with no aquatic habitat (Class III).

II. Detailed Discussion of Revisions

The following section describes in greater detail the background of the Categorical Waiver, the process of revising the waiver, significant changes and the rationale and justification for making the changes, compliance with CEQA, and consideration of the economic impacts to landowners resulting from the changes to the waiver.

a. <u>Background</u>

The current Categorical Waiver for timber operations was adopted by the Regional Water Board on June 23, 2004 (Order No. R1-2004-0016). The waiver defines five categories of timber harvesting activities or Projects that when in compliance with general and specific conditions, result in “low impact” to water quality and can therefore be waived from the issuance of Waste Discharge Requirements. To be eligible, each project must first be approved by California Department of Forestry and Fire Protection (now referred to as CAL FIRE). As the lead agency for timber harvesting activities and operations in California, CAL FIRE’s approval process has been certified as a CEQA functional equivalent process. Additional conditions and eligibility criteria contained in the waiver are above and beyond the FPRs and are intended to meet water quality requirements. The number and type of Projects enrolled in the Categorical Waiver since its approval in 2004 are listed in Table 1.

Table 1: Enrollment in Categorical Waiver (2004 to present)*

Year	Cat C (TMDL)	Cat D (Modified THP)	Cat E (NTMPs)	Cat F (THPs)	Compared to Total**	
					NTMPs	THPs
2004	3	1	1	6	21	305
2005	1	1	14	15	27	258
2006	9	5	20	18	28	233
2007	0	5	11	13	21	207
2008	0	2	2	9	20	199
Total	**13**	**14**	**48**	**63**	**96**	**897**

* Cat A (Fire Safe) and Cat B (Emergencies and Exemptions) are automatically enrolled in the waiver and the number are not tracked.

**This is the year that the NTMP or THP was filed with Calfire. However, these projects are not required to be enrolled in the waiver until timber harvesting operations begin. Consequently, projects may actually enroll in the waiver during a future year

Several of the proposed new Waiver conditions may be more restrictive than the current conditions. However, the revised Waiver also proposes to allow THPs that have clearcut silviculture to be enrolled, which is currently not eligible under the current waiver.

b. Basis for Revising the Waiver

The process of revising and updating the existing Categorical Waiver was guided by the following principles and needs:

- To balance the additional requirements to ensure the necessary level of protection of water quality while not making compliance so rigorous that few if any plans would qualify, essentially revising the waiver out of existence.

- To incorporate any new policy, regulation, and Basin Plan amendments, such as
    - sediment and temperature TMDLs that have been adopted since 2004
    - the State Water Resources Control Board's (SWRCB) Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS), which was approved in 2004.
    - Total Maximum Daily Load Implementation Policy Statement for Sediment Impaired Receiving Waters in the North Coast Region,
    - Regional Board's 'Guidelines For Implementation And Enforcement Of Discharge Prohibitions Relating To Logging, Construction, Or Associated Activities' (Section 4, pg. 26-29, Basin Plan 2007),
- Declining populations of anadromous salmonids in river systems throughout the north coast region and the changes in Federal and State Endangered Species Act (ESA) listings for steelhead trout and coho salmon in the North Coast Region.

The most significant changes are intended to prevent controllable sediment discharge and protect and restore natural levels of shade to prevent elevating water temperatures, and reduce water temperatures where they are elevated.

c. Total Maximum Daily Load (TMDL)

The U.S. EPA has established sediment TMDLs for 19 watersheds in the North Coast Region, and temperature TMDLs for 7 of those watersheds. Regional Water Board staff are also developing or in the process of developing TMDLs in additional watersheds, such as the Klamath River, Russian River, Elk River, and Freshwater Creek. The TMDL process provides a quantitative assessment of water quality problems, contributing sources of pollution, and the pollutant load reductions or control actions needed to restore and protect the beneficial uses of an individual waterbody impaired from loading of a particular pollutant.

Based on a review of TMDLs from throughout the North Coast Region, roads and road and harvest related mass wasting are some of the most common and significant sources of anthropogenic sediment discharge.

Regional Water Board staff conducted temperature studies during development of temperature TMDLs in the Scott and Shasta River watersheds. The studies and resulting temperature TMDLs attribute loss of effective shade caused by reductions in near stream canopy as one of the most significant factors affecting water temperature. Based on results of these studies, Regional Board staff are recommending to revise waiver conditions to require additional canopy retention on non-fish bearing streams as a direct and effective measure to meet the Basin Plan temperature objective.

d. Non-Point Source (NPS) Discharge

It is now recognized that in many areas nonpoint source discharges, such as stormwater runoff, are the principal sources of contaminant discharges to surface water and groundwater. In contrast to point sources, which discharge wastewater of predictable quantity and quality at a discrete point (usually at the end of a pipe), nonpoint source discharges are diffuse in origin and variable in quality. Management of nonpoint source discharges is in many ways more difficult to achieve, since it requires an array of control techniques customized to local watershed conditions.

The Porter-Cologne Water Quality Control Act (Porter-Cologne Act) was amended in 1999 to require the SWRCB to develop guidance to enforce the state's NPS pollution control program. The SWRCB adopted the NPS Implementation and Enforcement Policy on May 20, 2004. Nonpoint source pollution is a significant source of anthropogenic sediment discharge to streams throughout the North Coast Region, with timber harvesting and associated roads and skid trails being one of the major contributors. Polluted runoff from nonpoint sources accounts for more than 76 percent of the water bodies where Total Maximum Daily Loads (TMDLs) are required.

The NPS policy provides the State and Regional Boards consistent guidance on tools to regulate all nonpoint sources of pollution, using existing permitting authorities already established in Porter-Cologne. Nonpoint source pollution must be regulated by one of the following:

1. Basin Plan prohibitions

   The north coast region has adopted Basin Plan Prohibitions specific to timber harvest activities; logging, road construction, and associated activities:

   Prohibition 1: The discharge of soil, silt, bark, slash, sawdust, or other organic and earthen material from any logging, construction, or associated activity of whatever nature into any stream or watercourse in the basin in quantities deleterious to fish, wildlife, or other beneficial uses is prohibited.

Prohibition 2: The placing or disposal of soil, silt, bark, slash, sawdust, or other organic and earthen material from any logging, construction, or associated activity of whatever nature at locations where such material could pass into any stream or watercourse in the basin in quantities which could be deleterious to fish, wildlife, or other beneficial uses is prohibited.

2. Waste Discharge Requirements (WDRs)
The Region a has implemented a multi-tiered regulatory approach that includes: General Waste Discharge Requirements, Order No 2004-0030 (GWDRs) for timber harvesting activities, and several individual WDRs for larger watershed wide activities on private land.

3. Waivers of WDRs.
Categorical waivers are also an integral part of the Region's regulatory program for regulating non-point source pollution resulting from timber harvesting activities. In June 2004, the Regional Water Board adopted Order No. R1-2004-0016, Categorical Waiver for Discharges Related to Timber Harvest Activities on Non-Federal Lands in the North Coast Region (Categorical Waiver). Following THP approval by CAL FIRE, and prior to beginning timber harvest activities, landowners must apply for coverage under the General WDRs, the Categorical Waiver, an individual wavier or WDR, or in some cases a Watershed-wide WDR.
In March 2004, the Regional Water Board adopted Order No. R1-2004-0015, Categorical Waiver for Discharges Related to Timber Activities on Federal Lands Managed by the United States Department of Agriculture, Forest Service (USFS) in the North Coast Region. The USFS must seek coverage under this Waiver prior to beginning timber harvest activities.

Revisions to the Categorical Waiver, such as expanded ECP coverage, are intended in part to comply with the NPS policy. Furthermore, for waivers to be effective, they must be:

- conditional, meaning they can be terminated at any time,
- consistent with any applicable Basin Plan,
- subject to renewal every five years,
- enforceable.

e. Recent ESA Listings

State and Federal ESA listings for evolutionarily significant units (ESUs) for coho have been revised since the existing Categorical Waiver was approved in June 2004. Changes in State and Federal listings for anadromous salmonids include the following:

- In March, 2005, coho salmon between the Oregon border and Punta Gorda in Humboldt County were listed as threatened under the State ESA and continue to be listed as threatened under the Federal ESA.
- Coho salmon between Punta Gorda and San Francisco Bay were listed as endangered by the California ESA in March, 2005 and in August, 2005 under the Federal ESA

Steelhead trout and Chinook salmon remain listed as threatened under the Federal ESA throughout much of the North Coast Region. Both State (California Department of Fish and Game) and Federal (NOAA Fisheries) have approved or are working on recovery plans for listed Pacific salmonids. Protection and restoration of terrestrial habitat by reduction of anthropogenic sediment sources and retention of natural shade, which are goals of existing and revised waiver conditions, are essential components of any recovery plan.

f. Guidelines For Implementation And Enforcement Of Discharge Prohibitions Relating To Logging, Construction, Or Associated Activities (Section 4, pg. 26-29, Basin Plan, 2007)

The Basin Plan, amended in January 2007, includes guidelines with the objective of (1) defining the criteria by which the Regional Water Board will consider that violations of the prohibitions have occurred or threaten to occur; (2) instructing the Regional Water Board staff of procedures and actions they will take in implementing the prohibitions; (3) advising all potential dischargers of the scope and intent of the prohibitions; and (4) advising all interested parties that it is the intent of this Regional Water Board to carry out its responsibilities in this matter in a reasonable and effective manner. The proposed Waiver revisions are consistent with the Basin Plan.

III. **New Findings and Directives**

Significant new findings are presented below along with a brief summary of justifications and references supporting each one.

Finding 9

Populations of several species of anadromous salmonids listed as threatened or endangered under both the Federal Endangered Species Act or the California Endangered Species Act have declined significantly during the past half century in the majority of waterbodies in the North Coast Region. Degradation of freshwater habitat by land use activities is a major contributing factor to the decline in populations, with discharges of waste from timber harvesting and associated activities among the most significant factors.

Supporting basis

Declines in populations of all species of Pacific salmonids that were once plentiful throughout the North Coast Region have been well documented. The causes of the declines may be varied and the subject of much debate, however, it is widely recognized that degradation of terrestrial habitat due to various land uses is a major factor. There is abundant evidence that timber harvesting has been one of the land uses that has had profound impacts on waterbodies in the region and is associated with the degradation of salmonid habit and the resulting population declines. Widespread post

WWII tractor logging, with significant road and skid trail construction and practices that pre-dated the current Forest Practice Rules (FPRs) caused massive disturbance, resulting in huge anthropogenic sediment inputs to streams and loss of riparian habitat and shade.

Many of these past practices are now longer permitted under the FPRs. The impacts of modern timber harvesting practices are less well understood. However, many studies have established a direct link between upslope disturbance from timber harvesting and declines in salmonid populations. Reeves et al. (1993) found that coastal river basins where timber harvest exceeded 25% disturbance supported only one salmonid species, while river basins with lower percent harvesting supported more diverse assemblages. Coats and Miller (1981) concluded that river basin tributaries that were harvested at greater than 30% of the watershed in a ten year period suffered substantial sediment impacts. Among the many additional studies that show a direct causal link between timber harvesting and impacts to salmonid are Brown, et al. (1994), Cederholm, et al. (1981), and Meehan (1991).

<u>Finding 10</u>
Harvest methods resulting in intensive canopy removal, such as clearcutting, can cause impacts to water quality from higher and more intensive peak flows, increased surface erosion, and higher rates of mass wasting. Unevenaged management or evenaged management that retains a substantial overstory canopy is less likely to result in adverse impact to water quality. As such, harvesting methods that result in intensive canopy removal are limited under this Waiver. Intensive canopy removal, such as clearcutting, is allowed under this Waiver when buffers are provided for streams that are significantly larger than the minimum required under the Forest Practice Rules.

<u>Supporting basis</u>
Some of the effects of intensive timber harvesting, particularly clearcutting, include changes in hillslope hydrology and slope stability, increases in sediment discharges, and changes in downstream channel morphology. Forest canopy intercepts, traps, and reevaporates approximately 20% of storm rainfall (Reid, 2000).   Consequently, removing canopy affects hydrologic processes throughout the watershed. There is an increase in the effective rainfall that reaches the forest floor, which increases the amount of surface runoff and infiltration (Jones and Grant, 1996).

Ziemer (1981a) documented increased peak flows following logging, particularly during storm events that occur early in the rainy season. Increased runoff and higher peak flows increase discharge throughout a drainage during storm events, causing an increase in the amount of sediment that can be mobilized and transported to a watercourse. Lewis (1998) found increases in suspended sediment load correlated with increased flows following logging. Recently clearcut slopes are more susceptible to mass wasting (landslides) due to loss of material strength provided by the root system of trees (Ziemer, 1981 b) and increased pore water pressures (Keppeler, 1994). Several studies, including Robison et al. (1999), Schwab (1983), Swanson and Dyrness (1975), Gresswell et al. (1979), have observed increased rates of landslides on recent clearcuts, so that a causal connection can be inferred.

Tree removal also affects groundwater and soil moisture conditions. Increased infiltration rates can cause a rapid rise in transient perched groundwater levels causing an increase in pore pressure. Increased pore pressure in the subsurface decreases effective soil strength, thereby increasing the risk of causing or reactivating landslides (Reid, 2000). Another significant factor leading to an increase in pore pressures after removing trees is the decrease in the amount of groundwater removed by evapotranspiration. Keppeler (1994) found increases in the pore water pressures following clearcut logging in Caspar Creek.

Finding 11

Timber harvesting activities on landslides, or on those portions of the landscape that are vulnerable to landsliding, can increase rates of sediment delivery from landslides. This increase in the rate of landslide related sediment delivery can be prevented or minimized by avoiding or minimizing ground disturbance and canopy removal on vulnerable areas, or implementing recommendations made as a result of site characterization by a licensed geologist experienced in slope stability investigations. As such, no timber harvesting activities may be conducted under timber harvesting plans covered by this Waiver on landslides and geomorphic features related to landsliding without site characterization and input into Project design by a licensed geologist.

Supporting basis

See above discussion of impacts of canopy removal on slope stability.

Construction of logging roads and skid trails associated with timber harvesting activities on steep forested slopes with high landslide potential likely causes more landslides than any other factors. Review by a licensed geologist on areas identified as vulnerable to mass wasting processes is necessary to characterize the risk of increasing the rate of landslide related sediment delivery from timber harvesting activities and inform management decisions to minimize that risk.

Finding 12

Sediment discharge sources, or threatened discharge sources, from past timber harvest activities are present throughout the north coast region and continue to pose risks to water quality. A condition of the Waiver requires landowners to prepare Erosion Control Plans, which identify controllable sediment discharge sources and implement prevention and minimization measures, thereby eliminating a significant pollutant source from those Project areas.

Supporting basis

Preparation of erosion control plans submitted to comply with water quality requirements is widely accepted throughout the timber industry as a standard part of timber harvesting planning. Current regulations from various state and federal agencies are intended to prevent and minimize creation of new sediment discharge sources. Erosion control plans are an effective means for landowners to survey, identify, and implement plans to treat existing controllable sediment discharge sources (CSDS) that meet the following conditions:

1. is discharging or has the potential to discharge sediment to waters of the state in violation of water quality requirements or other provisions of this Categorical Waiver,
2. was caused or affected by human activity, and
3. may feasibly and reasonably respond to prevention and minimization management measures.

CSDS sites can vary from a recently constructed site that is not functioning properly to older sites, often referred to as “legacy” sites, that were results of activities that predated current regulations and harvesting practices. For example, so called Humboldt crossings were stream crossing that were made with logs placed into a stream with no water conveyance and covered with dirt to create a running surface for log trucks and heavy equipment. During storm events, these crossing may fail, resulting in a discharge of earthen material into the stream. Many crossings such as these and other types of sites with stored sediment remain scattered across the landscape throughout the North Coast Region, much of it in a position where it may discharge to watercourses, constituting a threatened discharge.

Many old sites may have initially failed in the past, but stored sediment, that will continue to discharge over time, remains. The prevalence of existing sites on timberlands in the region essentially represent “time release” sediment sources widely distributed throughout most watersheds. Much of the anthropogenic sediment originally discharged from past timber harvesting remains stored in fluvial systems as is attested by the large number of watersheds listed as impaired due to excess sediment. Ongoing discharge of sediment from dispersed sources likely reduces the capacity of streams to remove the stored material and slows the process of recovery. Erosion control plans are one of the most effective tools for achieving TMDL and NPS Policy compliance and restoration of impaired beneficial uses.

The third element from the definition of a CSDS above, “*may feasibly and reasonably respond to prevention and minimization management measures*,” allows a good deal of flexibility and professional judgment. Regional Water Board staff and landowners frequently weigh the relative merits of treating a site against the potential impacts from renewed disturbance of the site and unresolved disagreements are uncommon.

<u>Finding 13</u>

Most water bodies in the North Coast Region are listed as impaired due to either excess sediment and/or elevated water temperature (Section 303(d) of the Clean Water Act). Discharges of sediment resulting from past land use activities, with timber harvest being one of the leading sources, are recognized as major contributing factors causing the *impaired conditions. Federal regulations require that a total maximum daily load (TMDL) be established for 303(d) listed water bodies for each pollutant of concern.*

Supporting basis
With the exception of the Smith River, every major watershed in the North Coast Region has been listed under Section 303d of the Clean Water Act for impairments due to excess sediment and/or elevated water temperatures. Technical TMDLs from throughout the region as well as many other published watershed studies and reports such as the North Coast Watershed Assessment Program [NCWAP], the Klamath Resource Information System [KRIS], Reid (1994), Reid (1993), Ligon (1999), Dunne et al. (2001), have established a strong causal connection between upslope disturbance from timber harvesting activities and in-stream impacts. There is clear and substantial evidence that severe impacts to streams throughout the north coast resulted from timber harvesting activities conducted prior to the enactment of the Forest Practice Act and implementation of the Forest Practice Rules. It is less clear what are the ongoing impacts that occur from current timber harvesting activities conducted in accordance with the Forest Practice Rules. There is general agreement that the magnitude of impacts to streams from timber harvesting under the FPRs have decreased dramatically over impacts from earlier logging. Some maintain that no impacts occur from timber harvesting under the FPRs. Examples exist of watershed wide impacts occurring from timber harvesting occurring when significant amounts of road construction and intense harvesting are concentrated within a watershed in a short period of time, such as evidenced in Elk River and Freshwater Creek in Humboldt County.

The Board of Forestry's Monitoring Study Group, a multi-agency group who's goal is to develop and implement a long-term monitoring program that will provide timely information on the implementation and effectiveness of forest practices related to water quality, have repeatedly found that the FPRs are mostly effective when implemented properly.

Finding 14
The United States Environmental Protection Agency (EPA) has established sediment TMDLs for 19 watersheds in the North Coast Region. The majority of these TMDLs identified erosion from roads and timber harvest as major contributing factors to sediment discharge from anthropogenic sources and called for significant reductions in such discharges. The EPA includes recommendations to reduce sediment delivery from the major sources identified in those TMDLs. The Total Maximum Daily Load Implementation Policy Statement for Sediment Impaired Receiving Waters in the North Coast Region (TMDL Implementation Policy), provides that the Regional Water Board shall control sediment pollution by using existing permitting and enforcement tools. The goals of the Policy are to control sediment waste discharges to impaired water bodies so that the TMDLs are met, sediment water quality objectives are attained, and beneficial uses are no longer adversely affected by sediment.

Supporting basis
Combined with Finding 15

Finding 15
The TMDL Implementation Policy also directed staff to develop the Staff Work Plan to Control Excess Sediment in Sediment-Impaired Watersheds (Work Plan) that describes the actions staff are currently taking or intend to take over the next ten years, as resources allow, to control human-caused excess sediment in the sediment-impaired water bodies of the North Coast Region. This Order furthers the objectives defined in the TMDL Implementation Policy and Work Plan. Conditions and eligibility criteria required for enrollment in this Waiver are intended to contribute to reductions in anthropogenic sediment discharges from the sources identified by EPA and constitute early implementation of TMDLs, thus furthering the objectives contained in the Work Plan.

Supporting basis
Regarding findings 14 and 15, the Categorical Waiver is an essential component of the Regional Water Board’s regulatory framework for the TMDL Implementation Policy. Approximately 61% of the North Coast Region drains to rivers and streams that are impaired by too much sediment (2006 Clean Water Act Section 303(d) list).
As part of the an effort to control sediment waste discharges and restore sediment impaired water bodies, the Regional Water Board adopted the Total Maximum Daily Load Implementation Policy Statement for Sediment Impaired Receiving Waters in the North Coast Region, which is also known as the Sediment TMDL Implementation Policy, on November 29, 2004. This Policy was adopted through Resolution R1-2004-0087. The Sediment TMDL Implementation Policy states that Regional Water Board staff shall control sediment pollution by using existing permitting and enforcement tools. The goals of the Policy are to control sediment waste discharges to impaired water bodies so that the TMDLs are met, sediment water quality objectives are attained, and beneficial uses are no longer adversely affected by sediment.
The Sediment TMDL Implementation Policy also directs staff to develop: (1) a Work Plan, that would describe how and when permitting and enforcement tools are to be used; (2) the Guidance Document on Sediment Waste Discharge Control; (3) the Sediment TMDL Implementation Monitoring Strategy; and (4) the Desired Conditions Report
Supporting basis for Findings 16 through 19 are combined

Finding 16
The temperature of a stream is significantly influenced by the amount of solar radiation the stream receives. Removing shade canopy in riparian zones can increase the amount of solar radiation that reaches a watercourse, potentially resulting in an increase in water temperature. Canopy retention standards above the minimums established in the Forest Practice Rules and restrictions on shade reduction required under this Waiver are necessary to meet Basin Plan Temperature Objectives.

Finding 17
The North Coast Region has adopted Temperature TMDLs for 12 watersheds in the north coast region of California. These watersheds include three of the major Klamath

River tributaries: the Salmon, Scott, and Shasta River watersheds. The twelve temperature TMDLs have evaluated the effects of shade on stream temperatures and have consistently reached the same conclusion regarding stream shade. These conclusions are consistent with published literature and temperature analyses conducted in the Pacific Northwest.

The Basin Plan contains the following temperature objectives, which apply to surface waters:

- *The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.*
- *At no time or place shall the temperature of any COLD water be increased by more than 5°F above natural receiving water temperature.*
- *At no time or place shall the temperature of WARM intrastate waters be increased more than 5°F above natural receiving water temperature.*

<u>Finding 18</u>
Given the similarity among the majority of north coast watersheds and the universal nature of the laws of thermodynamics, the conclusions of shade-related analyses from previous temperature TMDLs apply region-wide, and especially to those tributaries not already assigned TMDL shade allocations. In order to protect, maintain, or restore natural water temperature, riparian shade controls are also needed in many watersheds not subject to an existing TMDL Action Plan or in watersheds that are not currently impaired due to elevated water temperatures.

<u>Finding 19</u>
The load allocation for excess solar radiation assigned in previous TMDLs is also an appropriate allocation for excess solar radiation to meet Basin Plan temperature objective in watersheds throughout the North Coast Region. The load allocation for solar radiation is expressed as its inverse, shade. The load allocations for this source category are the shade provided by topography and full potential vegetation conditions at a site, with an allowance for natural disturbances such as floods, wind throw, disease, landslides, and fire. Riparian zone canopy and shade retention standards included as conditions of this Waiver are intended to preserve natural shade to meet the Basin Plan temperature objective.

<u>Supporting basis for Findings 16 through 19.</u>
Much of the documentation supporting findings 16 through 19 is contained in the TMDLs and staff reports for the Scott and Shasta Rivers. Much of the supporting work is based on temperature studies conducted by Regional Water Board staff during development of the TMDLs, and is described in detail in those documents. While the water temperature studies conducted for development of those TMDLs is specific to the Scott and Shasta Rivers, application of some aspects of their conclusions to a wider geographic extent can be supported due to the universal nature of the physical processes involved in transfer of heat to streams.

Direct solar radiation is the primary factor influencing stream temperatures in summer months. The energy added to a stream from solar radiation far outweighs the energy lost or gained from evaporation or convection (Beschta and others, 1987; Sinokrot and Stefan 1993; Johnson, 2004). Because shade limits the amount of direct solar radiation reaching the water, it provides a direct control on the amount of heat energy the water receives.

Shade is created by vegetation and topography; however, vegetation typically provides more shade than topography. The shade provided to a water body by vegetation, especially riparian vegetation, has a dramatic, beneficial effect on stream temperatures. The removal of vegetation decreases shade, which increases solar radiation levels, which, in turn, increases stream temperatures. Additionally, the removal of vegetation increases ambient air temperatures, can result in bank erosion, and can result in changes to the channel geometry to a wider and shallower stream channel, all of which also increase water temperatures.

The following reasoning supports the approach of applying the principles governing increases in water temperature to guide specific conditions regulating canopy retention in the Categorical Waiver throughout the Region:

- Temperature modeling results show that reducing canopy along the riparian zone from 95% to 85% does not result in a significant increase in water temperature, but reducing canopy from 95% to 50% results in an increase in stream temperature between 0.5 C to 1.5 C, with an additional 0.5 C increase when microclimate effects are considered,
- These results indicate that minimum canopy retention standard allowed under the FPRs can lead to increases in stream temperatures *under scenarios simulated in the model [note- different modeled scenarios could lead to significantly different results, including the potential for both larger as well as smaller changes in stream temperatures],*
- Forest Practice Rules for retention of canopy on Class II watercourses may not meet the Basin Plan Temperature Objective,
- The Temperature Objective applies to streams throughout the entire region, *not just those waterbodies impaired due to elevated water temperature*,
- The best strategy for maintaining (or restoring) the natural temperature regime of surface waters is to maintain (or restore) natural shade,
- Riparian conditions throughout the region vary in an infinite number of ways, and as such, there is an infinite number of site specific tactics for maintaining (or restoring) natural shade on streams.
- The revised categorical waiver allows landowners the flexibility to propose site specific prescriptions for harvesting trees in the riparian zone when they can demonstrate to the satisfaction of Regional Water Board staff that the proposed prescriptions meet the temperature objective,
- Landowners wishing to harvest trees in the riparian zone may also choose the general default strategy that Regional Water Board staff determined to be adequate to meet the temperature objective for harvesting trees in the riparian

zone, along fish bearing streams (Class I) and streams with aquatic habitat for non-fish aquatic species (Class II), which is to retain 85% of overstory canopy within 75 feet of a Class I (50 feet for Class II) and 65% overstory canopy in the remainder of the WLPZ.

We acknowledge that in comparing different scenarios with the model we took a conservative approach. In developing protection standards to meet Basin Plan objectives and meet the waiver “low impact” standard, we have acted out of an abundance of caution and believe that a conservative approach is warranted. We believe that the result from the temperature model showing an increase in water temperature when canopy along the riparian zone is reduced from 85% to 50% is valid under the modeled conditions, as is the conclusion that Forest Practice Rule minimum canopy retention standards for Class II watercourses do not fully meet the Basin Plan temperature objective. While it may not be realistic to assume that the canopy throughout the entire riparian zone would be harvested to the minimum levels allowed at any given time, many watersheds in the north coast region have been subject to quite high rates of harvest under current rules and it is useful to evaluate the worst case scenario.

IV. New or Revised Special Conditions

The new conditions that will result in additional work by Dischargers fall into three general categories;

1. Erosion Control Plans (ECPs) required for NTMPs and THPs
2. Road Management Plans (roads) for NTMPs
3. Shade canopy retention requirements to implement Basin Plan Temperature Objective.

The section below describes new or revised conditions that apply to the sections of the waiver that apply to NTMP (Categorical Waiver E) and THP (Categorical Waiver F) which have the most significant revisions and may result in additional cost to landowners. The majority of the new conditions address either conditions to minimize sediment discharges or that prevent elevated receiving water temperature.

Erosion Control Plans (ECPs) and Road Management Plans are two important tools to achieve the objective of reducing and preventing sediment discharges from current and former timber harvesting practices. They are discussed together because there is significant overlap between them, both in their goals, which are prevention and minimization of sediment discharge, as well as spatially, in that the majority of ECP sites are typically located on roads.

Much of the ongoing sediment discharges from timberlands comes from old truck roads, skid trails, watercourse crossings, and landings used for timber activities that have resulted in soil, rock, and other earthen materials placed in locations where it is or can be discharged (threatened discharges) to waters of the state in violation of the waste discharge prohibition 2 from the Action Plan for Logging, Construction, and Associated Activities contained in the Basin Plan, which states:

> *"The placing or disposal of soil, silt, bark, slash, sawdust, or other organic and earthen material from any logging, construction, or associated activity of whatever nature at locations where such material could pass into any stream or watercourse in the basin in quantities which could be deleterious to fish, wildlife, or other beneficial uses is prohibited."*

Part of an active THP requires that older roads are upgraded to current standards. Removing sediment that is temporarily stored in a position where it will likely discharge to streams is widely accepted within the timber industry as effective means of reducing sediment inputs from both past and ongoing timber activities. Expanding the practice of development and submission of ECPs to the waiver is a reasonable adaptation of existing practice to restoration of sediment impaired waterbodies and furthers the goal of implementation of TMDL and NPS Policy.

It would not be in the public interest to waive waste discharge requirements without a concurrent effort to treat threatened discharges within the project site concurrently with timber harvesting activities. The following is a summary of the ECP and road management plan requirements:

a. Development of Erosion Control Plans (ECP) will be required for an entire area of a new Non-industrial Timber Management Plan (NTMP) (Cat Waiver E) prior to seeking coverage under the revised Non-Federal Timber Waiver. Currently, the ECP is required only for those portions of an NTMP where harvest operations occurred. Extending the ECP to the entire plan area will increase the likelihood that potential sediment discharge sources will be identified and treated prior to failure.

   In response to potential economic strain this additional requirement would place on landowners, NTMPs that were waived under the 2004 waiver will have five years to prepare an ECP and until the first NTO submitted after June 4, 2014 to implement with this condition.

b.. Development of Erosion Control Plans (ECP) will be required for THPs (Cat F). The current waiver does not require the THPs include an ECP. The new requirement will likely result in controllable sediment discharge sources being identified and corrected on a larger land base. ECPs are commonly prepared for THPs that are enrolled in the Region's General WDR.

c. Two winter period inspections are proposed along with preparation of an annual report for Categories E and F. Inspections are intended for landowners to monitor project areas to ensure measures to prevent and minimize sediment discharges are effective, to identify and correct problems in a timely manner, and to provide a feedback mechanism to the Regional Water Board on the effectiveness of conditions of the Non-Federal Timber Waiver. This is an essential component, which will likely increase the effectiveness of ECPs in controlling sediment discharge. A monitoring component also complies with one of the key elements of the NPS Implementation and Enforcement Policy.

d. Road management plans are intended to continue to prevent and reduce sediment discharges once timber harvest activities are completed. Portions of roads where surface runoff can directly discharge to watercourses would be required to be treated, such as by hydrologically disconnecting, to the extent feasible. Hydrologically disconnecting roads means minimizing alteration of natural drainage patterns and preventing concentrated storm runoff from discharging into watercourses. This is an effective method to reduce the potential for sediment delivery to watercourses from surface erosion on roads on a greater land base than previous waivers.

   Since roads used for logging of NTMPs are often used for other uses other than logging, the waiver proposes to require long term management plans for roads (Road Plan) be developed for all NTMPs. The goal of Road Plans is to prevent and minimize sediment discharge from roads by ensuring that roads and road watercourse crossings meet current standards and are maintained on a regular basis. The Road Plan requires Project proponents to inventory roads and road watercourse crossings and implement a schedule for upgrading and maintaining road segments that do not meet current standards. Landowners would have five years after enrolling their NTMP in the Wavier to submit the Road Plan.

<u>Shade canopy retention requirements to implement Temperature Objective.</u>

In order to be waived from the issuance of waste discharge requirements, a NTMP and or THP should implement the most conservative and protective method to ensure that the temperature objective is met and natural levels of shade on streams are maintained. The Basin Plan temperature objective for COLD interstate waters, specifies that the following applies to surface waters:

"The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.
At no time or place shall the temperature of any COLD water be increased by more than 5°F above natural receiving water temperature."

Elevated water temperature can be a significant limiting factor for anadromous salmonid and is often linked to the loss of riparian vegetation and to a lesser extent excess sediment. During preparation of the Scott River Temperature TMDL, Regional Water Board staff studied the affects of reductions in direct shade on streams from removal of trees in the riparian zone that provide direct shade to watercourses. Temperature modeling conducted as part of that study showed that reductions in canopy density along the entire riparian zone along three miles of stream from 95% to 85% produced minimal changes in water temperature. However, when shade was reduced from 95% to 50%, significant water temperature increases of 0.5 C to 1.5 C would occur. When microclimate effects are taken into account temperatures may increase an additional 0.5 C. The results of the temperature study demonstrates the canopy retention standards for Class II watercourses in the Forest Practices Rule, which allow for removal of 50% of the total canopy (shade) covering the ground, is not adequate to maintain natural shade.

To comply with the Regional Water Board water temperature objective, project proponents may propose an approach for meeting that objective. In lieu of an acceptable approach to meeting the temperature objective for natural stream temperatures, project proponents can comply with a minimum 85% overstory canopy within the first 50 feet of watercourses that have cold-water beneficial uses or that are within 1000 lineal feet of a fish bearing streams (defined as Class II watercourse and lake protection zone (WLPZ) in the Forest Practice Rules) and 65% retention within the remainder of the WLPZ. The current Waiver requires THPs to retain a 70% overstory canopy throughout the entire Class II WLPZ. The current waiver does not require NTMPs to maintain WLPZ canopy beyond that established in the forest practice rules.

The recommended condition provides for project proponents to propose shade canopy to be retained, based on site specific conditions, when it can be demonstrated that such alternatives provide equal or better protection. The shade requirement may extend outside the WLPZ when the overstory canopy within the first 75 feet of a Class I WLPZ (50 feet for Class II WLPZs) is less than 85% or when the overstory canopy beyond the first 75 feet of a Class I WLPZ (50 feet for Class II WLPZs) is less than 65%. The 2004 Non-Federal Timber Waiver did not contain conditions for retention of shade trees beyond the Forest Practice Rules. This is intended to meet the region wide Basin Plan temperature objective.

<u>THPs that have Clearcutting can be waived</u>
To encourage more THPs to qualify for the waiver, a new condition is proposed that would allow project proponents of THPs that have clearcutting to be waived when additional stream buffers are in place: Landowners and representatives of the timber industry have expressed their wish that more plans be eligible for the waiver. Since the purpose of the Waiver is for low impact projects, we have sought to craft conditions that would expand the pool of plans for which it would be appropriate to waive WDRs, while still ensuring that such plans could be considered to be “low impact.”

The new eligibility criterion is proposed that allows evenaged (ie. clearcutting) harvesting methods, which is defined in the Waiver as post harvest canopy closure of less than 65%, comprised of commercial species at least 30 feet in height. To be eligible, the Project must include a riparian management zone (RMZ) within 300 feet of a Class I watercourse, 200 feet from a Class II watercourse, and 100 feet of a Class III watercourse. Harvesting within the RMZ would be: 1) no harvest for the first 30 feet on Class I and II watercourses and 10 feet for Class III watercourse; 2) retention of 85%

total canopy between 30 and 150 feet from Class I watercourses, 30 and 100 feet of Class II watercourses, and 50 feet of Class III watercourses; and 3) retention of 65% overstory canopy between 150 and 300 feet Class I watercourses, 100 and 200 feet of Class II watercourses, and 50 and 100 feet of Class III watercourses.

Expanding the waiver to include clearcutting with riparian zone restriction may increase the number of harvest plans that will be eligible for the Waiver while ensuring that timber harvesting activities do not pose a significant threat to water quality.

I. <u>Economic considerations</u>

We recognize that some of the proposed conditions represent and additional cost to the landowner. It is important for the Regional Board to consider economics in its decision process for this Waiver. We have asked stakeholders for estimates of what it might cost to comply with the conditions of the updated waiver. In these economic considerations, we hope to provide the board with a range of costs that stakeholders believe they may incur when complying with new requirements under the updated waiver.

A full economic analysis is beyond the scope of this project. A full economic analysis would require research on normalized costs of conducting inspections, preparing technical documents, implementing erosion control measures, and reducing harvest. It would also require research into the cost equivalents of environmental benefits that would occur as a result of the increased protections under the waiver. Such an analysis would be invaluable but would require a staff time commitment greater than that for the waiver renewal itself. It is not reasonable at this time to provide a full economic analysis.

Instead, we hope to provide specific examples of what stakeholders believe to be the economic impacts of waiver compliance. We have asked stakeholders for estimates of what it will cost to comply with the conditions of the updated waiver and have attempted to solicit an average cost of compliance by asking generalized questions with given acreages. We received responses from three professionals, and are not including in the discussion any actual estimated dollar amounts. We did not ask for the costs of implementing the waiver, such as installing culverts and upgrading roads, because ownerships within our region are too diverse to offer a generalized impression of these costs. Case-by-case discussion of the proposed revisions follows:

- Development of Erosion Control Plans (ECP) will be required for an entire area of a new Non-industrial Timber Management Plan (NTMP) prior to seeking coverage under the revised Non-Federal Timber Waiver.

  Based on comments made during the public workshop on March 24, 2009 in Fortuna, this new condition will add a financial cost for landowners with existing NTMPs, as it requires a forester to conduct a survey of the project area and prepare the inventory and implementation schedule. In order to somewhat reduce the potential economic impact to these landowners, older NTMPs that were waived *under the 2004 waiver will have until the first NTO submitted after June 4, 2014 to comply with this condition.*

For new NTMPs, the added costs associated with development of an ECP would be associated with the time it takes to prepare the ECP and make estimates as to volume and probability of delivery at each site. The forester will already be evaluating the entire plan area so minimal additional costs would be incurred for spending additional time in the field. The added costs associated with the development of an ECP on new NTMPs is minimal.

- A new condition for Category F that ECPs be developed and implemented for Timber Harvesting Plans (THP). `

  Again, the added costs associated with development of ECPs for category F THPs would be associated with the time it takes to write up the ECP and make estimates as to the volume and probability of delivery at each site. The forester will already be evaluating the entire plan area so minimal additional costs would be incurred for spending additional time in the field. The added costs associated with the development of an ECP for category F THPs is minimal.

- Erosion control plans submitted for compliance with conditions of Categories E and F now will include two winter period inspections of the project area and submittal of an annual report to the Regional Water Board.

  Added costs for two winter inspections on category E and F plans would be associated with taking the time to do the inspections or paying a forester to do them, writing the inspection report, and sending it in. These would be entirely new costs for category E and F plans. The Waiver does not require that qualified professionals conduct the inspections. This can eliminate the additional expense of paying a forester by allowing landowners to conduct the inspections. The inspections constitute an unknown, but recognized additional cost to verify that the erosion control measures are performing adequately, and to identify and correct them where they are not.

- Once timber harvest activities are completed, roads on THPs and NTMPs will now be required to be hydrologically disconnected from watercourses, to the extent feasible. Road segments that cannot feasibly be hydrologically disconnected from watercourses shall be treated to prevent and minimize surface erosion.

  This condition closely resembles FPR criterion for roads, which 14CCR 923.4 requires must be, "maintained in a manner which minimizes runoff, soil erosion, and slope instability and which prevents degradation to the beneficial uses of water during timber operations and throughout the prescribed maintenance period." This condition is needed to encourage landowners to stabilize the surface on road segments that cannot be disconnected from watercourses. There is no specific rule requiring stabilizing the surface of road segments that drain directly to watercourses.

Added costs for hydrologically disconnecting roads would vary widely based on ownership. Some ownerships will already have disconnected some or all of their roads and the number of watercourse crossings on ownerships will vary.

On new THPs and NTMPs, the forester will already be evaluating the entire plan area so minimal additional costs would be incurred for spending additional time in the field. On existing NTMPs, the landowner would incur the cost of evaluating the road system. The added costs from performing the work of hydrologically disconnecting the roads would vary based on how much road in an ownership is already disconnected and how many watercourse crossings exist. The additional cost of stabilizing the surface on road segments the drain directly to watercourses would vary from significant for the most robust treatments, such as paving or chip sealing, to minimal treatments such as slash packing (packing tree branches and other vegetation generated during timber operations into the road surface) or seeding and mulching. The added costs for hydrologically disconnecting roads can be expected to range from minimal to high based on the ownership.

- Long term management plans for roads (Road Plan) will now be required to be developed for all NTMPs.
  Much of what is required under the proposed Road Plans is already required under the FPRs. Added costs for developing long term management plans would vary based on ownership. There would be overlap with the ECP requirement described above and with existing requirements under the FPRs. Costs would be related to inventorying the road system, designing and writing up a management plan, performing inspections and writing reports according to a self-designed inspection and reporting plan, and performing additional road work. The added costs for developing long term management plans would range from minimal to high based on the ownership.

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SECTION G
SEDIMENT BUDGET

INTRODUCTION

A sediment budget has been constructed for the Garcia WAU for the time period 1952-2000. The purpose of the sediment budget is to determine the relative importance of different sediment sources, to assign priorities for erosion control, and evaluate stream channel conditions in relation to sediment deposition and transport. A sediment budget provides quantification of sediment delivery, transport, and storage in a watershed. This quantification is useful for source analysis, numeric targets, and allocation of responsibility as needed in a Total Maximum Daily Load (TMDL) for 303(d) listed rivers, such as the Garcia River. A TMDL requires numeric standards for non-point source pollution. When the non-point source pollutant in question is sediment, a sediment budget becomes a logical analytical technique for the watershed.

This module presents the methods, results and interpretation of a sediment budget created for the Garcia WAU. Input and change in storage for the sediment budget were determined from aerial photograph interpretation, field observations and predictive erosion equations.

Sediment Budget Defined

A sediment budget is an accounting of the sources and deposition of sediment as it travels from its point of origin to its eventual exit from a drainage basin (Reid and Dunne, 1996). The sediment budget takes the form of:

Input + Change in Storage = Output

Input in the Garcia WAU is from erosion delivered to watercourses from mass wasting, road surface erosion, surface erosion of mass wasting scarps, and skid trail surface erosion. Storage in the Garcia WAU is sediment stored in stream channel terraces and stream channel obstructions, such as debris dams. The change in storage is observed from stream bank erosion, downcutting of streamside terraces, narrowing or widening of the stream channel, or increase in the stream bed height. The change in storage is difficult to determine and is not presented in all locations, only where observations could be interpreted.

In theory the components of the sediment budget should balance if the sediment in the watershed is in equilibrium. This equilibrium can be distorted both by natural and land management induced impacts creating changes in any of the budget constituents of input, storage or output. It is important to discern the difference for appropriate interpretation of the sediment budget results.

The components of the sediment budget are inter-dependent. For example, large increases in input can overwhelm output of sediment in a watershed, creating large changes in storage. For this reason, a sediment budget can be a powerful tool in interpreting impacts to a watershed.

METHODS

This section presents the methods used in determining the various components of the sediment budget for the Garcia WAU. The methods for determining the input and change in storage in the sediment budget are presented in the following sub-sections of this Methods section and in the modules of this report. Output was not measured in this study.

Input

Input in the Garcia WAU is from erosion delivered to watercourses from mass wasting, hillslope surface erosion, road surface erosion, surface erosion of mass wasting scarps, and skid trail surface erosion. The methods for quantification of these estimated inputs are discussed in the surface and point source erosion and mass wasting modules of this report.

The inputs are broken into estimated proportions of fine and coarse sediment. It was assumed that the soils of the area consisted of 30% coarse (>2 mm in diameter) particles and 70% fine particles (<2 mm in diameter)(OCEI, 1997). For mass wasting inputs the proportion of sediment delivery was assumed to be 70% fine particles and 30% coarse particles. For road and skid trail inputs, field observations determined that 60% of the sediment delivered was from sheet wash on the road surface (fine particles) and 40% was from erosion of the road fill. Only the erosion from the road fill was assumed to have coarse particles associated with it. Based on these observations the total road and skid trail delivered sediment is assumed to be 12% coarse particles and 88% fine particles.

Output

The output of sediment in the Garcia River was estimated in the Garcia River Gravel Management Plan (Phillip Williams and Assoc., 1996). They estimate the sediment transport rate at Connor Hole on the Garcia River, site of the river flow gage. This provides an indication of the sediment transport at the mouth of the watershed. In the upper tributaries of the watershed, where this WAU occurs, that estimate is not considered reliable. Issues of sediment supply, particle attrition and transport capacity makes the information at the mouth of watershed difficult to accurately interpret in upper watershed areas.

Change in Storage

Sediment storage in the WAU was determined in streamside terraces and in storage sites of the stream bed, such as behind woody debris dams. Terrace volumes of individual discrete terraces are calculated by measuring length, width, and depth values with pace and tape measuring techniques. Large continuous terrace volumes (usually at the mouths of sub-basins of the WAU) are calculated by averaging width and depth of the terrace and measuring the length on the map. Channel storage volumes are determined by measuring the length, width, and depth of the active channel with the same techniques used on terraces. Depth is the limiting measurement in the accuracy of these techniques. For this study the depth of terrace deposition was assumed to be the distance from the deepest scour in the active channel to the top of the terrace surface. Field evidence used to determine depth of channel storage includes the depth of scour pools and depth measured at the downstream side of debris dams. When this information is not available a channel storage depth of one foot is assumed, an approximate average streambed scour depth. These techniques underestimate terrace and stream channel depths and thus storage volume must be recognized as a minimum estimate.

Cumulative terrace and channel storage volume is then calculated as a sum of individual terrace and stream data collected in the field. This data is used to extrapolate storage volumes to stream reaches not visited in the field. Field collected and extrapolated data is combined to calculate terrace and stream channel storage totals for each hydrologic unit. Based on field observations, the terraces in the response reaches of the hydrologic units in the WAU, with the exception of the main stem of the Garcia River, are assumed to have been created 30-40 years ago. This assumption is based primarily on even-aged alder stands about 30-40 years old found on the terraces. Furthermore, logging debris such as cut logs and truck tires are observed in the terrace stratigraphy, suggesting initial terrace deposition was during the period of modern forest management in the Garcia WAU, from the 1950's to the present. The stratigraphy of the terrace deposits show many layers of sediment ranging in thickness from 1 inch to 10 inches. Each individual layer is composed of a characteristic clast size. Clast sizes range from sand to gravel to cobble. The cobble layers are angular in shape, suggesting they have not been transported very far and were probably derived from hillslope erosion processes. We estimate the terraces were deposited over a few years to as much as 15 years, and represent multiple flood and sediment transport events. Hydrologic data for the Garcia River shows numerous flood events (magnitude > 2 yr. return interval) within the last 30-40 years, that are capable of moving large sediment loads, creating terraces as the flood wave recedes.

RESULTS AND DISCUSSION

Total Coarse Sediment Budget

The results of the coarse sediment inputs and estimated storage for select hydrologic units for South Fork and Rolling Brook planning watersheds for the time period 1952-2000 for the Garcia WAU, is presented in Table G-1. The input column represents the mass of the total coarse sediment inputs over the entire analyzed time period, 1952-1997. The terrace storage column represents the mass of coarse sediment that is currently in storage at the present. Terrace storage is assumed to have 80% coarse particles, based on bulk samples taken in the stream channel throughout the watershed. The net change column represents whether the difference in total coarse sediment inputs and terrace coarse sediment storage is a positive or negative value. A negative value could suggest input sediments are primarily being stored in streamside terraces and not available for routing through the channel network. A positive value could suggest that input sediments are being routed through the channel network, not held in storage, thus having a greater likelihood of influencing channel morphology. The estimated channel storage is the mass of the coarse sediment estimated to be within the active channel. Channel storage is assumed to have 80% coarse particles, based on bulk samples taken in the stream channel throughout the watershed. The channel storage is presented to allow interpretation of sediment routing in the context of the sediment budget. Due to the potential inaccuracies of the estimates of input and sediment storage no estimates of output based on the sediment budget were attempted.

Table G-1. Coarse Sediment Budget Components for Select Hydrologic Units for the South Fork Garcia River and Rolling Brook Planning Watersheds for the Garcia WAU, 1952-1997.

Planning Watershed	Hydrologic Unit	Input (tons)	Terrace Storage (tons)	Channel Storage (tons)	Net Change (+ or -)
Rolling Brook	Rolling Brook	37260	48437	8698	-
	Lee Creek	8580	3165	2503	+
	No Name Creek	28964	38149	17830	-
South Fork Garcia	South Fork	42446	31222	33356	+

Change in coarse sediment storage information was not available for Hutton Gulch, every Main Stem tributary, and North Fork Garcia in the WAU, so it could not be presented.

Both Rolling Brook and No Name Creek show a negative net change between total coarse sediment inputs and terrace storage. Observations of current channel morphology in both of these hydrologic units (see Table E-3, Stream Channel Condition) suggest the channels are currently degrading. The sediment budget data and channel observations suggest that high coarse sediment levels are not currently impacting channel conditions. However, in both Rolling Brook and No Name Creek there is still a high amount of coarse sediment stored in streamside terraces. These stored coarse sediments will likely be routed through the streams following bank erosion of the streamside terraces over time. Provided that the terrace sediments are released slowly and future coarse sediment inputs are not abnormally high, coarse sediment should not present a problem to channel conditions in Rolling Brook or No Name Creek. However, this will need to be monitored over time.

South Fork of the Garcia River showed a positive net change between total coarse sediment inputs and terrace storage. This high level of coarse sediment within the channel network is affecting current channel morphology and streambed substrate. It could be many years before this high level of coarse channel sediments are routed through the channel network and the morphology of the South Fork returns to a less aggraded condition.

Lee Creek also showed a positive net change between total coarse sediment inputs and terrace storage. Lee Creek had been recently impacted with several large mass wasting events which has provided a large component of coarse sediment in the channel network. Observations of the lower response reach of this hydrologic unit were not available due to lack of access. However, this hydrologic unit is very steep and likely will route coarse sediment quickly. The recent mass wasting is what is currently providing the high level of channel coarse sediments compared to inputs and terrace storage.

Background Sediment Yield

The determination of background or natural sediment yield in a managed watershed is difficult. The difficulty comes when determining if sediment yield was created from a management impact or from a natural process. Often these two types of sediment yield are difficult to distinguish.

The mass wasting analysis has estimates of mass wasting delivery during a relatively unmanaged time period in the WAU, pre-1952. These estimates are presented to provide an indication of a possible background sediment yield in the Garcia WAU.

Prior to 1952 there was little forest management occurring in the Garcia WAU. Mass wasting was inventoried and quantified from 1952 aerial photographs. A rate from small inner gorge landslides, not observable in aerial photographs, was determined from current field observations (see Mass Wasting assessment). This rate was added to the mass wasting rate determined from aerial photographs. We then make the assumption that the mass wasting and inner gorge estimates from the pre-1952 mass wasting analysis could represent an indication of a background sediment yield. Assuming that 20 years of mass wasting is observed in the aerial photographs a rate of sediment yield was calculated (Table G-2).

Table G-2. Background Sediment Yield Estimate by Garcia River Mass Wasting.

Estimate Method or Data Source	Planning Watershed	Rate (tons/sq. mi./yr.)
Pre-1952 Mass Wasting and Inner Gorge Sediment Delivery	South Fork	700
Pre-1952 Mass Wasting and Inner Gorge Sediment Delivery	Rolling Brook	680

The estimates of background sediment yield for the Rolling Brook and South Fork planning watersheds are similar. The estimates of background sediment yield are only from mass wasting, not included in this estimate is natural surface erosion (which is difficult to estimate). Because of this it is assumed that the estimates of background sediment yield are at the low end of the range in natural sediment yields. How much higher the natural sediment yield could be is difficult to say, but it is safe to assume that there would be tremendous variability annually based on both climatic and physical conditions. Therefore, an average input rate approaching the natural background sediment yield is a reasonable goal. But, sediment input rates should not be interpreted for any given year against this estimated background rate.

Inputs

The sediment inputs for the Garcia WAU are from road erosion, skid trail erosion, mass wasting, and erosion of scarps from mass wasting. The inputs from each of these sources is summarized by time period and planning watershed in Chart G-1 and Table G-3.

Chart G-1. Total Estimated Sediment Input Rate by Time Period for L-P Ownership in each Planning Watershed of the Garcia WAU.

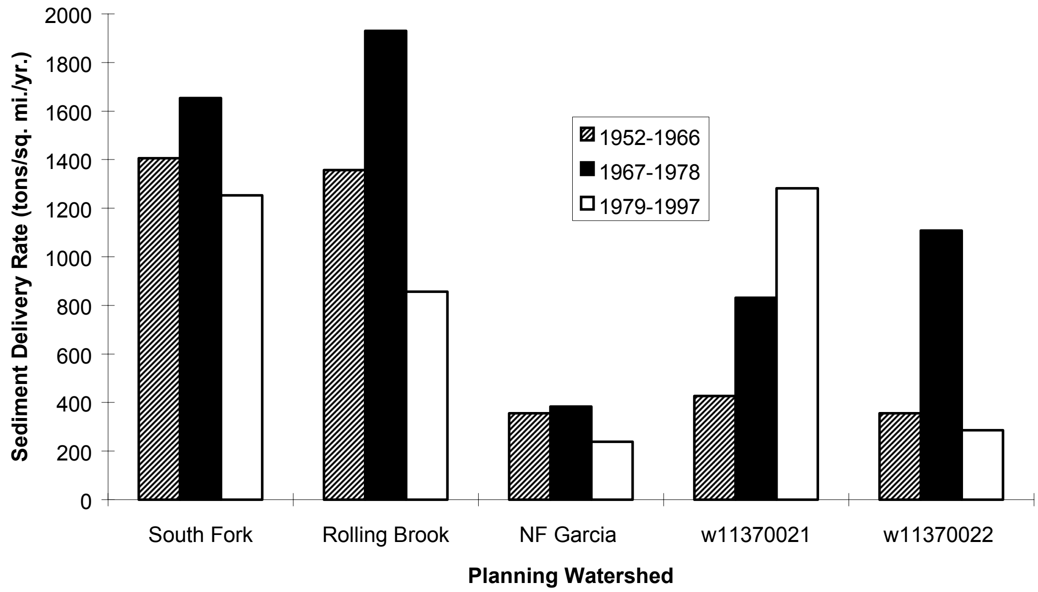

Table G-3. Sediment Inputs by Source and Time Period for MRC Ownership in Planning Watersheds of the Garcia WAU.

Planning Watershed	Time Period	Mass Wasting ($t/mi^2/yr$)	Roads ($t/mi^2/yr$)	Skid Trails ($t/mi^2/yr$)	Scarps ($t/mi^2/yr$)	Total ($t/mi^2/yr$)
South Fork	1952-1966	668	407	368	10	1453
	1966-1978	1333	398	130	15	1876
	1978-2000	730	367	159	4	1260
Rolling Brook	1952-1966	801	256	347	10	1414
	1966-1978	1670	259	180	15	2123
	1978-2000	602	226	152	4	985
NF Garcia	1952-1966		0	356		356
	1966-1978	110	112	155	15	392
	1978-2000		82	157		239
E. Eureka Hill	1952-1966		71	356		427
	1966-1978	573	88	155	15	831
	1978-2000	1043	78	157	4	1282
Inman Creek	1952-1966		0	356		356
	1966-1978	2045	198	155	15	2413
	1978-2000		129	157		286

In every planning watershed, except for one, the rate of sediment delivery is lower in the most recent time period (1979-2000). The planning watershed East of Eureka Hill was the only planning watershed showing a large increase in the sediment delivery rate in 1979-2000. This was due to high mass wasting inputs in the East of Eureka Hill planning watershed during the 1979-2000 time period.

The majority of the Garcia WAU shows a decreasing trend in sediment delivery. The mass wasting inputs identified in the 1996 photo analysis increased by 25% due to field observations. The road erosion rate is increased by up to 100% on certain roads due to field observations. If field observations would have been available for the earlier time periods (1952-1966, 1967-1978) the sediment delivery rates would be much higher. This would give a greater contrast to the decreasing trend in sediment delivery in the WAU, with the current rates being lower relative to earlier rates.

In every planning watershed, except for East of Eureka Hill, the rate of sediment delivery is greatest in the 1966-1978 time period. This is due to a large sediment delivery from mass wasting during that time period. We hypothesize that heavy tractor logging and road building in the 1950's and 1960's left many unstable road and skid trail areas. This combined with a large hydrologic event in 1974 (about 30 year recurrence interval) created a large influx of mass wasting sediment observed in the 1978 photos. If this is the case much of the sediment from the 1966-1978 time period could be attributed to the 1950's and 1960's. However, we do not have field observations to prove this, it can only be hypothesized.

In every planning watershed except the South Fork of the Garcia River the current sediment input rates (1979-1997) are approaching or below the estimated background sediment rate (approximately 680-700 tons/sq. mi./yr.). Future forest management operations should be performed such that sediment input rates in the Garcia WAU are closer to a natural background sediment rates. Many of the prescriptions developed in this Watershed Analysis should help achieve this goal.

In all but one planning watershed of the Garcia WAU mass wasting is the largest source of sediment delivery (Table G-4). In the North Fork Garcia River skid trails have provided the highest sediment delivery since 1952. In these two planning watersheds the ownership is very small, and is primarily on upper slopes near ridges where few mass wasting events were observed. Because of this skid trails were the primary source for sediment delivery to watercourses.

Table G-4. Percent of Total Sediment Delivered from 1952-1997 by Input Source for MRC Ownership in each Planning Watershed of the Garcia WAU.

Planning Watershed	Mass Wasting	Roads	Skid Trails	Mass Wasting Scarps
South Fork	59%	26%	15%	1%
Rolling Brook	67%	17%	15%	1%
NF Garcia	9%	20%	69%	1%
East of Eureka Hill	66%	9%	24%	1%
Inman Creek	62%	12%	25%	0%

It must be emphasized that the percentages presented in Table G-4 are derived from the entire time period of modern forest management in the Garcia WAU, from the 1950's until the present (see appendix for percentages by time period). The percentage of sediment delivery must be interpreted as such. The current California Forest Practice Rules mandate high road standards, greater use of cable yarding, and restrictions near watercourses. All of these standards will alter the amount and responsibility of sediment delivery in the Garcia WAU currently and in the future.

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A Summary Report of Water Quality Status and Trends

Elk River

August 2005

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Executive Summary

The overarching hypothesis behind and impetus for PALCO's Habitat Conservation Plan is that improvements in forest practices will reduce erosion rates and therefore sediment supplied to the stream system and increase riparian function resulting in greater LWD recruitment to the stream. Changes in these "hillslope" processes will then translate to improved fish habitat and water quality conditions than generally existed on PALCO lands at the time the HCP was formally adopted in 1999. The Elk River watershed has experienced extensive road upgrading and new riparian and landslide protection measures for nearly 8 years.

PALCO monitors a number of characteristics of water quality and fish habitat in the watershed to ensure that the management controls are achieving ecological and water quality goals, and to provide a basis for adaptive management. This report summarizes some of the information on a watershed basis to provide an overview of current conditions and identify any recovery in water quality or fish habitat conditions that may have occurred thus far in the relatively short time period since the HCP has been implemented. During this period, 3 large storm events have occurred to stress the system, including the most intense 24-hour rainstorm ever observed in 117 years of record at Eureka.

The period of record in the monitoring program is relatively short (2002-2005). Nevertheless, some trends are evident in the sediment yield, water quality and habitat data collected in the Elk River watershed.

Sediment Yield from Erosion Processes

- A geomorphically effective event occurred in HY2003 that produced more sediment than in average rainfall years, but far less than occurred in HY 1997, the peak of the erosion history in the watershed.

- Sediment input to streams from landslides and roads has declined significantly since 1997 when large inputs occurred, especially in the North Fork Elk River based, on field and aerial photo assessment.

Suspended Sediment in the Streams

- All sites show decline in the sediment load passing through the system, even when the effect of rainfall volume is factored in.

- Lower sediment yield results in lower durations of high turbidity defined as level where fish feeding avoidance begins.

- Sediment yields are greatest in the lower reaches of the North and South Forks and the mainstem, coincident with the sediment depositional zones of fine sediment. Sediment yield appears to increase within these reaches, rather than cumulatively from the entire watershed suggesting sources exist within this section. This is consistent with observations of erosion processes by Stahlman (2003).

- Sediment budget estimates from erosion processes agree reasonably well with observed sediment export from the watershed. Agreement is very close at many sites, and under or estimated at some sites.

Sediment in the Stream Bed

- Spawning and incubation habitat is found in the upper reaches of the watershed. Sites occurring in sites of known fish spawning are in good condition for sediment sizes <0.85 mm. The lower segments of the river have very high levels of fine sediment and are not considered suitable for spawning.

- Levels of fines <6.35 mm is generally higher than PFC targets at all sites, with little change during the period of observation.

- The lower river segments near the junction of the North and South Forks and along the mainstem of Elk River are depositional zones marked by deposits of very find sediments not suitable for fish spawning or incubation. There has been some small improvement in fines sediment content at the mainstem site.

Sediment on the Bed Surface

- There has been no consistent change in average particle size of the stream bed surface.

Large Woody Debris

- All sites are showing accumulation of woody debris. Sites were generally low in woody debris, and this trend would be considered positive in the upper portions of the watershed where salmonids spawn and rear.

Pool Depth

- All sites are showing some or significant deepening of pools, probably in association with accumulation of large woody debris. Deepening of pools improves salmonid rearing habitat. No site has yet attained the PFC goal of 1.0 m. Average pool depth appeared to increase following the large storm of 2002. However, gains in pool depth have been maintained during the last two average rainfall years.

Water Temperature

- Water temperature in most of the watershed is within PFC matrix target <16.8 deg C. The Lower North Fork Elk Site exceeded this target in 2005.
- Water temperature was generally higher in the watershed in 2005 following increases in air temperature over the period. Most of the streams in the upper portion of the watershed have dense conifer overstory. The lower segments on the well developed floodplain areas are dominated by deciduous or open stands following earlier decades of management in the riparian forests. These segments are near, or slightly exceed temperature targets for salmonids.

General Comments

Woody debris is accumulating at a relatively fast rate, and is apparently having a deepening effect on pools throughout the watershed.

A number of channel cross-sections and thalweg profiles have also been measured in the watershed. We have not shown these data. However, generally, there has been little change in channel dimensions as determined by these cross-sections anywhere in the watershed. A small amount of channel erosion has been documented at the lowermost mainstem Elk River site, but there is no general trend in enlargement of channel area. It is not clear that evacuation of sediment would be expected in the upper reaches of the watershed given current channel dimensions and bed characteristics. However, sediment deposition in lower reaches is significant, and not markedly changed as indicated by 11 sparsely distributed channel cross-sections in three river segments. However, these cross-sections also show channels at or near capacity to convey current natural bankfull flood events.

From a geomorphic perspective, it appears that, at this time, the primary response of streams to changing hillslope input processes is a trend towards increasing large scale channel roughness in the form of large wood pieces and bedforms. Neither fine scale channel roughness, such as the sediments in the channel bed, nor channel dimensions other than pool depth are not showing much change to reduced sediment load, with a few exceptions.

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Overview

In common with other timberlands on the North Coast, PALCO's land management measures applied in Elk River have evolved over time—particularly those that prevent and minimize sediment delivery and direct management practices around riparian forests. Beginning in 1998, PALCO began managing its lands utilizing sediment control strategies contained in its state and federally approved Habitat Conservation Plan and in cooperation with the North Coast Regional Water Quality Control Board (NCRWQCB).

Identifying sediment sources and implementing special sediment control practices during winter harvesting operations is an emphasis of that work. A number of scientific studies have been initiated to improve the understanding of how sediment is generated on PALCO's lands. These studies have been used to develop more effective sediment prevention, minimization and restoration strategies. Continual improvement is an important objective of PALCO's management system, and monitoring programs provide a basis for learning and updating our understanding of how to manage the land and the condition of our natural resources

The overarching hypothesis behind PALCO's Habitat Conservation Plan is that improvements in forest practices will reduce erosion rates and therefore sediment supplied to the stream system and increase riparian function resulting in greater LWD recruitment to the stream. Changes in these "hillslope" processes will then translate to improved fish habitat and water quality conditions than generally existed on PALCO lands at the time the HCP was formally adopted (1999).

It is recognized that the recovery from past erosion rates associated with harvest activities, especially those observed in the 1990's, will not be instantaneous following the significant change in management practices since 1999 with implementation of the HCP. There are many "legacy" sources following 130 years of forest management and it takes time to work through the at-risk sites on roads and to find and resolve sediment sources. In addition, new practices may not always be 100% effective. Improving management practices is an ongoing and adaptive process.

The HCP is a 50-year agreement and trend monitoring is a key part of the overall plan. PALCO monitors a number of characteristics of water quality and fish habitat in the watershed to ensure that the management controls are achieving ecological and water quality goals, and to provide a basis for adaptive management. When the HCP was adopted, it could not be known how it may require for changes in erosion or riparian processes at the watershed to manifest in improved water quality conditions at locations within the watershed.

Identifying trends in these conditions is an important objective of PALCO's trends monitoring program. Much of the data on erosion primarily begins with the Watershed Analysis and related studies with on-going updates with post management or storm event updates. On-going monitoring projects include annual measurement of stream flow, suspended sediment, channel characteristics, and fish populations on a more limited basis, with the most reliable and consistent data collected since 2002.

In this report we summarize some of the information on a watershed basis to provide an overview of current conditions and identify any recovery in water quality or fish habitat conditions that may have occurred thus far. Information used in this watershed synthesis includes:

- Erosion processes
- Sediment yield, turbidity, and flow in streams
- Channel characteristics

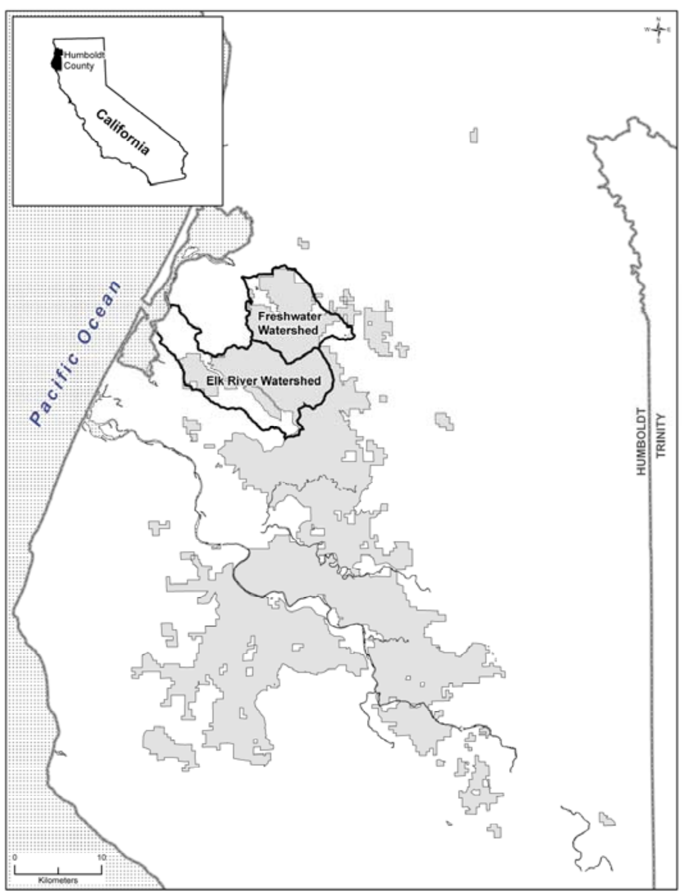
The intent of this report is to provide an overview of status and trends in the watershed focusing on these characteristics. This report will primarily display a variety of a data at a sub watershed and watershed scale, most of which has previously been provided and reviewed by Federal and State agencies in separate annual reports.

Watershed Background

Elk River watershed is located on the coast of northern California (40°44' N, 124°2' W). The Elk River watershed is located approximately 5 miles east of Eureka in Humboldt County (Figure 2.1) and drains into Humboldt Bay at the south end of Eureka. The watershed contains two major forks, the North and South forks. The watershed area is about 43.2 mi^2 (111.9 km^2) above the confluence of North Fork and South Fork of Elk River. The watershed area for North Fork and South Fork are about 22.4 mi^2 (58.0 km^2) and 20.5 mi^2 (53.1 km^2), respectively.

The Elk River consists of 385 miles (619 km) of Class I to III streams.

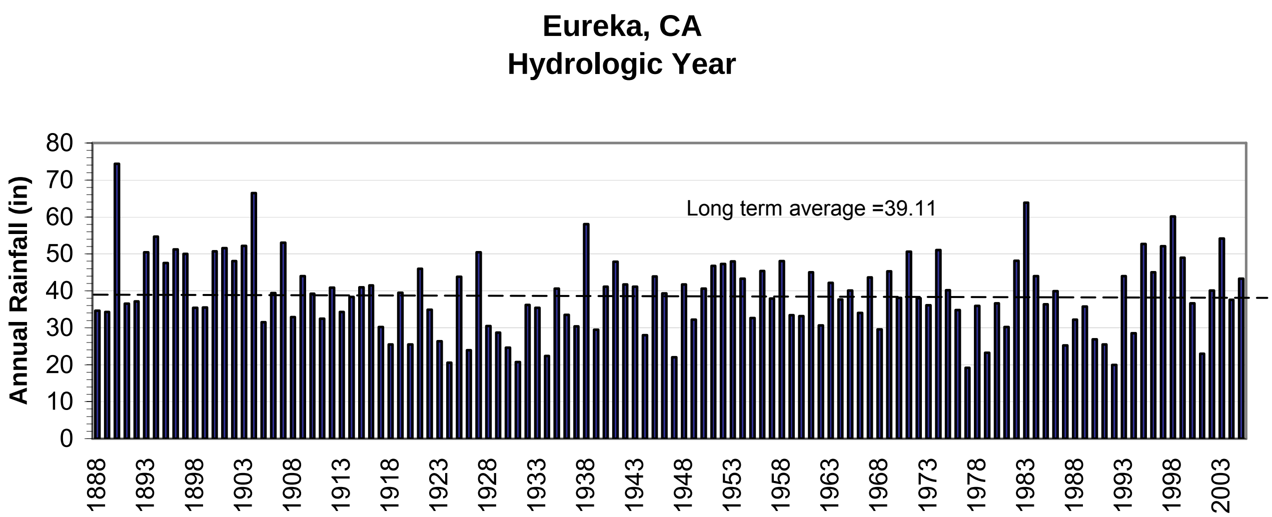
Figure 1 General location of the Freshwater Creek watershed with PALCO ownership shown as shaded.



Climate

The climate in the area can be described as Mediterranean; summers are dry, followed by wet winters with roughly 90% of average annual rainfall occurring between October and April. Precipitation is mostly rainfall, and average annual rainfall is 39.11 inches as recorded by NOAA at the Woodley Island station in Eureka. In this report, rainfall is calculated for the "hydrologic year" that runs from October 1 – September 30 and is numbered for the year in which it ends.

Figure 2. Rainfall history at NWS weather station on Woodley Island in Eureka.



Annual rainfall has been near average for hydrologic years (HY) 2004 and 2005. HY 2003 was 39% above average, with annual rainfall of 54.2 inches.

Significant storm events that produce landslides are generally associated with high rainfall intensities. PALCO's HCP considers a rainfall event that exceeds 3" per day as a potentially "geomorphically effective event". That is, this daily rainfall indexes large storms with erosion capability. Importantly, this threshold assumes that landslides as well as other erosion processes that occur only during larger storm events may be triggered at this intensity of rainfall. Rainfall of 4" per day exceeds most landslide thresholds available from the scientific literature (e.g., Caine 1980, Innes 1983).

Figure 3 shows the maximum daily rainfall recorded each year at the NWS station in Eureka. In the 117 years of rainfall record at Eureka, daily rainfall has been between 3-4" on 19 occasions, between 4 and 5" on 10 occasions, and over 6" per day just once. It is interesting to note that the 4" daily rainfall event that occurred in HY1997 was the first such event to occur following a span of 36 years. Larger events were more common in the first half of the century.

In the past 9 years, 4"+ daily rainfall events have occurred 4 times (Table 1). The event in 1997 occurred prior to the adoption of the HCP. Intense storms have occurred 3 times since the HCP. A significant rainfall event occurred Dec 27-28, 2002. Within a 24-hour period, 6.79 inches of rain fell in Eureka. This was by far the largest single day rainfall event in the 117 years of record at the station setting many duration/volume records at the NWS station (PALCO 2004). The Dec 2002 event was the only occurrence of a geomorphically effective event in the most recent period from 2002 to 2005.

Figure 3. History of daily maximum rainfall from 1888 to 2005 at NWS station in Eureka, CA.

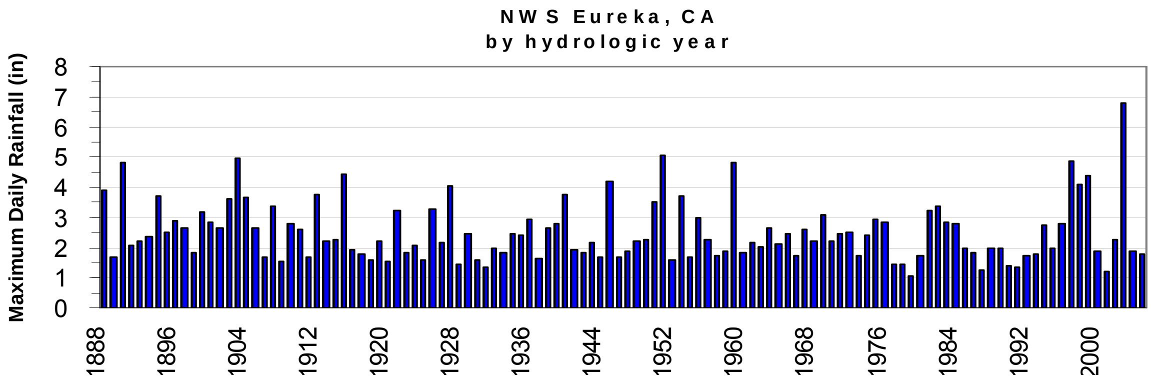


Table 1. Annual rainfall by hydrologic year (Oct-Sept) for recent years at NWS station at Woodley Island, Eureka, CA. Long-term average annual rainfall is 39.11 inches.

HY Year (October – September)	Annual Rainfall (in)	Maximum Daily Rainfall (in)	Rainfall Factor (Relative to Average)	Significant Geomorphic Event? [Daily rainfall>3.0 in]
1995	52.66	1.97	1.35	No
1996	45.04	2.81	1.15	No
1997	52.09	4.86	1.33	Yes
1998	60.10	4.12	1.54	Yes
1999	48.97	4.37	1.25	Yes
2000	36.24	1.89	0.93	No
2001	22.95	1.20	0.59	No
2002	40.07	2.26	1.02	No
2003	54.18	6.79	1.39	Yes
2004	37.58	1.89	0.96	No
2005 & thru July	43.30&	1.77	1.11	No

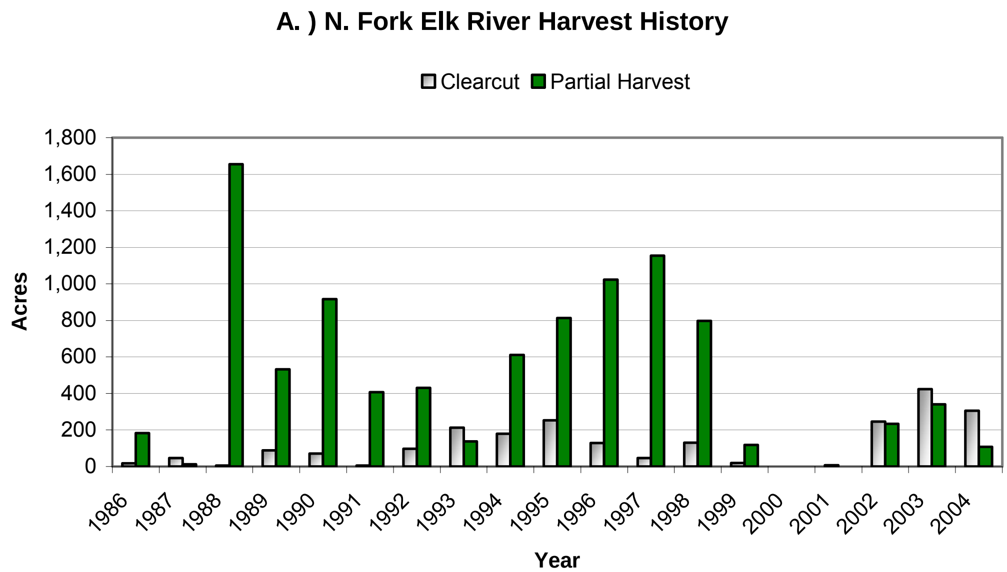
Vegetation

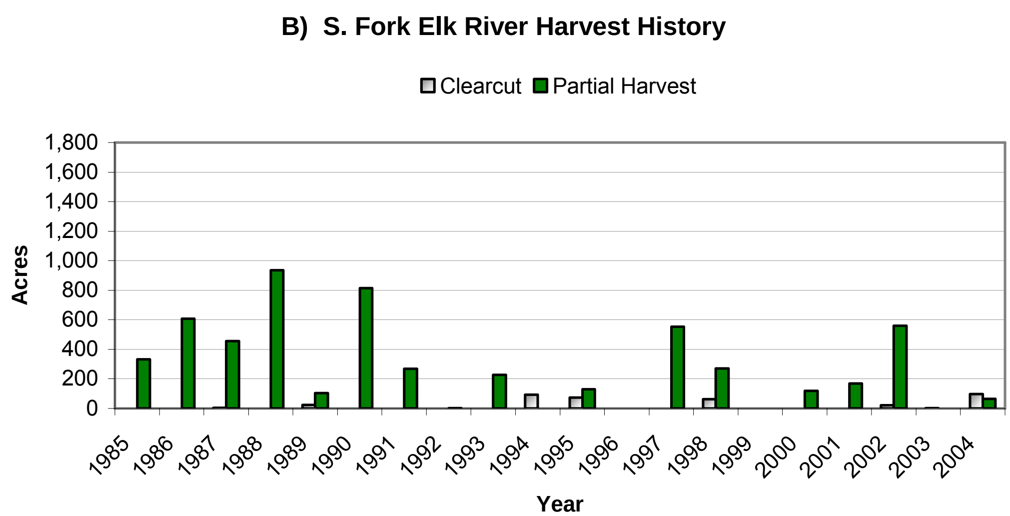
The forest is mostly comprised of a coniferous lowland forest community such as redwood (*Sequoia sempervirens*), western hemlock (*Tsuga herophylla*), Sitka spruce (*Picea sitchensis*), grand fir (*Abies grandis*) and Douglas-fir (*Pseudotsuga menziensii*).

The entire watershed has been harvested during the past 130 years. Recent harvest history is provided here for background reference. Earlier harvest history is provided in PWA (1998) and PALCO (2004). Highly detailed timber harvest history data exists in PALCO's GIS dating back to 1986.

Photograph 1. North Fork Elk River in 2004.

Figure 4. Recent harvest history in the Elk River watershed through 2004. Information is provided for North and South Forks individually.

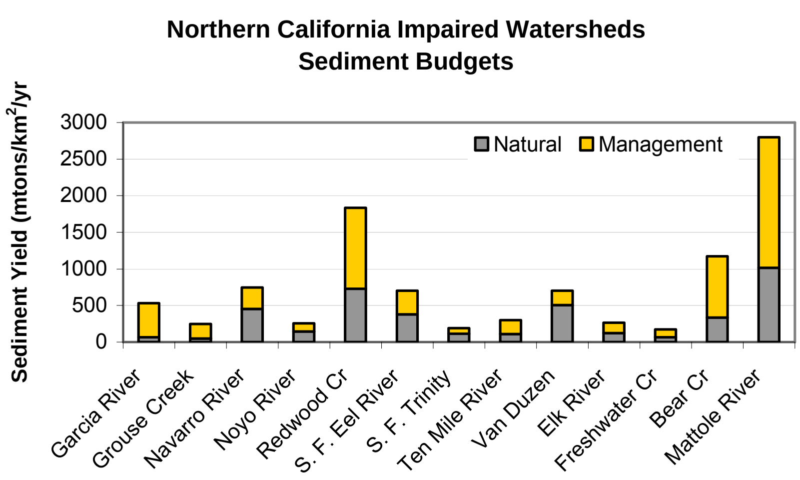




Erosion Processes

Like most of the rivers on the Northern Coast of California, Elk River is currently listed on the 303d list of impaired water bodies for sediment. Identification of sediment sources and evaluation of erosion history has been an ongoing activity on PALCO's lands in Elk River since 1998. Sediment budgets have been constructed for most of the rivers in Northern California as a means to conduct TMDL sediment source assessments for the purpose of completing source allocations and developing implement plans designed to correct sediment problems. Similar erosion studies in Elk River have characterized past and current discharges using remote sensing, field surveys, and empirical and physical modeling to identify sediment sources and construct sediment budgets (PWA 1998, PALCO 2004). Like other rivers in the region, Elk river has significant sources of management-related sediment leading to a near doubling of sediment, although erosion rates are relatively low compared to other rivers in the region.

Figure 5. Results of sediment budget studies for rivers of the northern coast of California, including Elk River.



Watershed Sediment Budget

Scientific investigation has been a cornerstone of PALCO's forest management program in Elk River. Two especially critical studies identified and quantified sediment sources and rates occurring throughout the history of logging in the watershed. A study by Pacific Watershed Associates (PWA, 1998) was commissioned by PALCO to identify sources of erosion and sediment delivery to stream channels, and to distinguish, where possible, between natural sediment sources and management-related sediment sources in the North Fork of the Elk River in particular. Although not individually reported, this study also involved erosion assessment in the South Fork of the Elk River.

An additional goal of the PWA assessment was to identify remedial measures and practices that would be employed to reduce future sediment production and delivery to streams in the watershed. These surveys formed the basis of road upgrading and restoration plans implemented in the basin.

Table 2. A summary of data collection for erosion studies in the Elk River watershed beginning in 1998.

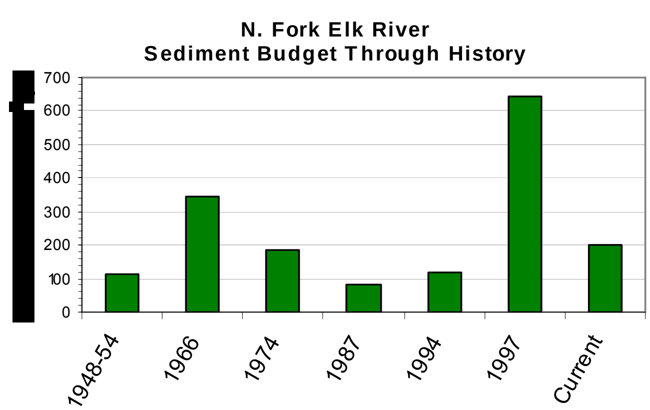
Study	Erosion Process	Source of Data
Pacific Watershed Associates 1998	Mass Wasting (landsliding)	• Mapping from aerial photography flown in 1954, 1966, 1974, 1987, 1994, 1997 • All road related landslides field sampled to determine volume/area relationships
	Roads	• A complete inventory of 133 miles of PALCO roads in the North Fork Elk River watershed. Detailed information collected at 602 individual sites including 335 stream crossings.
	Bank erosion, channel scour, and streamside landslides	• Surveys conducted on 3.6 miles of lower North Fork Elk River • Field measurements and mapping of small stream channels in old growth areas of the Headwaters Forest (PWA 1999) • Field sampling of low order stream channels on PALCO managed lands—18890 ft in selected locations
	Surface erosion of hillslopes	• Assessment of aerial photo series as above
Elk River Watershed Analysis (2004)	Surface erosion of hillslopes	• Field assessment of 11 recent harvest units in Freshwater Creek (in 1999) • Analysis of 1997 aerial photos
	Road surface erosion	• Field measurements of road dimensions by PALCO staff with QA/QC performed by Harza Engineering
	Deep-seated landslides	• Deep-seated landslide inventory (large earthflows and large landslides)
	Geotechnical soil properties	• Hart Crowser Inc. and Golder Associates gathered geotechincal data and samples for different landforms using Williamson drive probes and soil augers (122 samples) in Freshwater Creek. • Soil cohesion was determined by R. Prellwitz in Freshwater Creek.

The PWA (1998) study of erosion processes in the Elk River involved extensive field inventories and aerial photographic analysis of erosion processes (Table 2). PWA assessed all available aerial photographs taken during a 43 year period, inventoried most, if not all, of PALCO roads, and conducted extensive field assessments of stream channels of various sizes. In addition, a watershed assessment process known as "Watershed Analysis" was initiated in 2000 as a provision of PALCO's HCP. The Watershed Analysis involved a more comprehensive look at a variety of watershed processes important to salmonid habitat and the status of streams and fish than included in PWA report (1998). A large portion of the analysis focused on mass wasting and surface erosion processes but also included riparian forest and hydrology assessments. The Watershed Analysis assessments relied heavily on the PWA field assessments for North Fork Elk River reported in 1998, but included additional field assessments as listed in Table 2. A draft report of the Elk River Watershed Analysis was provided to the agencies and public in 2004 (PALCO 2004a).

Sediments within the Elk River Watershed derive primarily from four lithologic groups: The Hookton Formation and terraces, the Wildcat Group, the Central Belt Franciscan Complex, and the Yager terrane. The younger sediments of the Wildcat Group, Hookton Formation and terraces are gently folded over a basement of highly deformed Franciscan Complex. These formations are generally distributed along ridge tops in the western portions of the watershed for the Hookton Formation and along river reaches and capping uplifted, abandoned marine terraces. The Hookton Formation and terraces are prone to failure on steep unsupported slopes such as terrace risers. The Wildcat Group is found most extensively in the western portion of the watershed. The undifferentiated Wildcat Group consists predominantly of fine sandy siltstone, with minor mudstone, sandstone and a thin, locally present, basal conglomerate. The young, unlithified nature of the Wildcat Group, generally low cohesion, and hydrologic discontinuities between different lithologic members make the undifferentiated Wildcat Group potentially highly erodible and unstable by nature.

Erosion studies in the N. Fork Elk River watershed found that sediment has been contributed to Elk River from a variety of erosion processes and management activities
t

Figure 6. Sediment yield estimates for N. Fork Elk River through time.

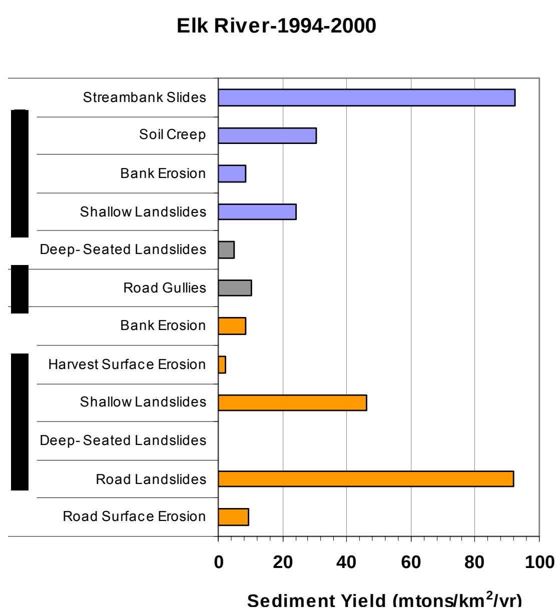


during the 130-yr history of land management (PWA 1998). Sediment yield in the watershed has varied over time (Figure 6). The time periods shown in Figure 6 depend on the availability of aerial photography. The period from 1994-1997 was particularly high, due to the erosional effects of management practices triggered by a large storm that occurred in December of 1996. This storm caused landsliding in the watershed, especially in the N. Fork, that significantly increased sediment yield relative to other periods. Storm characteristics are described in detail in PWA (1998) and PALCO (2004b). Current sediment input levels are more in line with periods prior to 1987 than the more recent period ending in 1997.

The sediment budget for the Elk River watershed as a whole as determined by information available in 2000 is shown in Figure 7 (see PALCO 2004 a, b). Investigations completed in 1998 found that a considerable amount of the current sediment yield of the watershed is associated with past practices that have left a legacy of existing and potential sediment problems in addition to sediments produced by forest practices under general use. Mass wasting, in particular, has been identified as a significant source of erosion in the watershed over the past 50 years.

There has been some controversy about some of the terms in the sediment budget and the allocation of sediment between natural and management sources. Separating natural and management-related sources was somewhat subjective and based on the field investigator's judgment. Disagreement with terms in the budget notwithstanding, it is clear that landslides have been the dominant source of sediment in this watershed during this time interval.

Figure 7. The Elk River sediment budget representing the period from 1994 to 2000. This period reflects the erosion effects of the large storm in Dec 1996 that triggered many landslides in the watershed.



The following erosion processes are active and potentially adversely affected by forest practices:

- Road-related surface erosion and landsliding
- Shallow and deep-seated mass wasting (landsliding) from naturally unstable slopes and recently harvested areas
- Surface erosion on hillslopes following removal of overstory vegetation and ground disturbance by logging machinery
- Bank erosion

These erosion processes have been described in more detail in PALCO's ROWD for Elk River (PALCO 2004b).

Landslide Occurrence

Landslide occurrence has declined in the Elk River in the significant storm events occurring since 1997 (Figure 8). The relationship of landslides to land uses in the watershed is discussed in more detail in PALCO (2004a and 2004b) and PWA (1998). The vast majority of landslides in the North Fork Elk in 1997 (90%) were associated with roads and legacy earthworks. Most of the sediment delivered in the December 2002 storm came from reactivation of old landslides that had originally occurred in earlier periods (Figure 9).

Figure 8. Total delivered landslide volume in North and South Fork Elk River in 3 recent periods.

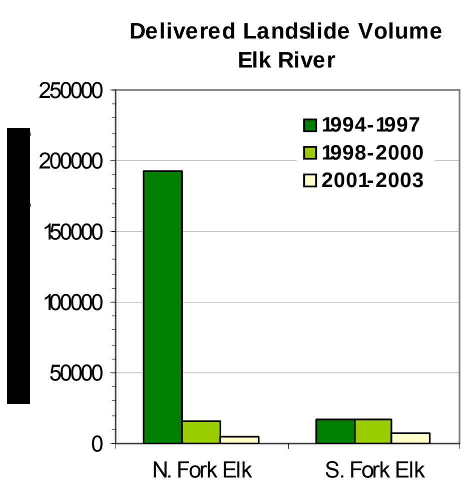
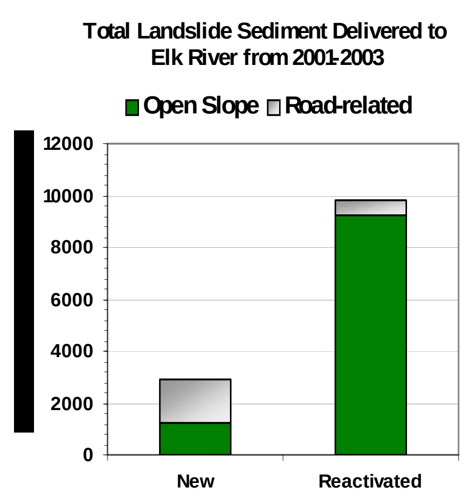


Figure 9. Landslide volume delivered in HY2003 from new and reactivated landslides.



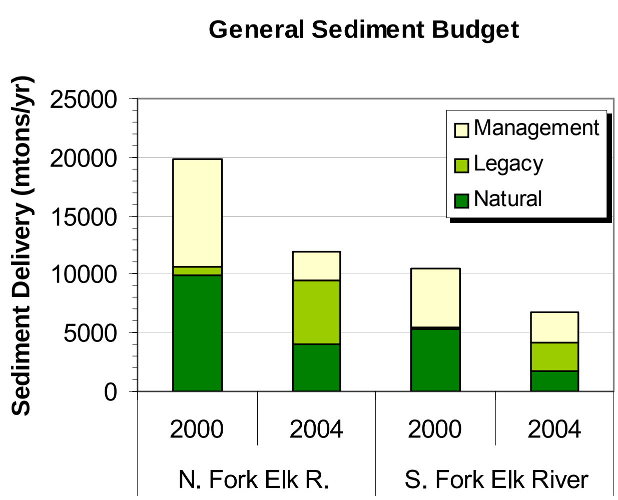
Total delivered volume of landslide sediments for the North and South Forks of Elk River for the three most recent periods is shown in Figure 10. Each period had at least one rainfall event with daily rainfall exceeding 4 inches.

Probably all of the sediment for the period ending in 1997 was delivered during the storm event of December 1996 (Hydrologic Year 1997) when maximum daily rainfall was 4.86 inches. During the period from 1998-2000 there were two storms with maximum daily rainfall exceeding 4”. Landslides in the 2001-2003 period occurred during the December 2002 event (HY2003) of 6.8 inches per rain in one day. There was a low volume of landslides delivered in the December 2002 storm, despite the magnitude of the rainfall. There have been no significant storms or landslides in HY 2004 and HY 2005.

Updates to the Sediment Budgets

The sediment budget shown in Figure 7 was originally compiled based on landslide occurrence following the 1997 storm event and the road condition prior to implementation of the HCP (termed the 2000 sediment budget). A current sediment budget was constructed using new landslide input values following the December 2002 event and reduced sediment inputs from road surfaces based on upgrading and storm-proofing roads (termed the current or 2004 sediment budget). Road improvement activities primarily improve road surfacing and reduce the hydraulic connectivity of the

Figure 10. General sediment budget for N. Fork and South Fork Elk River constructed in 2000 and the current sediment budget revised after the December 2003 storm event and road improvements. Budget is expressed as average tons delivered per year.



road surface to streams, thus reducing sediment delivery. They also help to prevent the occurrence of landslides.

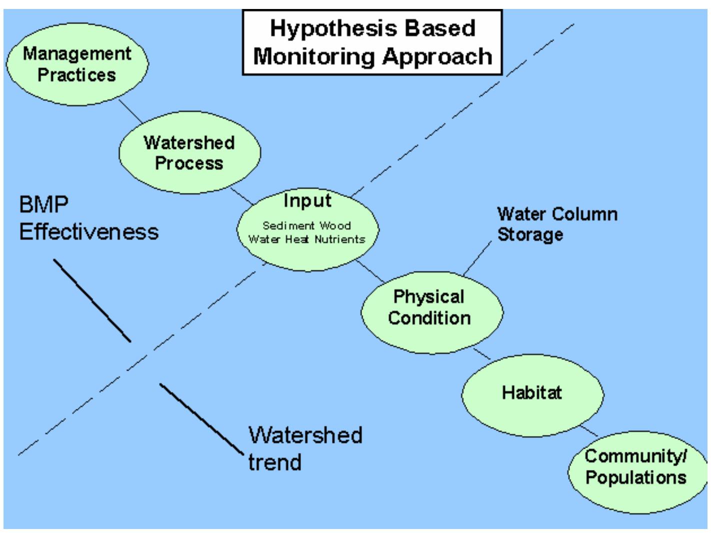
The estimated sediment budgets for the two recent periods for the N. Fork and S. Fork Elk River divided generally by natural and management related sources are shown in Figure 10. Note that the natural sediment numbers were also revised reflecting observed landslide occurrence in December 2002. We also moved some sediment that had been categorized as “natural” to “legacy” to reflect the uncertainty of what sediment sources belong in this category. This provides a more conservative sediment budget than provided in the Elk River Watershed Analysis (PALCO 2004a).

Streamflow, Sediment and Channel Trend Monitoring

Overview

A fundamental hypothesis of the water quality, geomorphology and fish habitat trends monitoring projects is that streams are responsive to the amount and type of watershed materials supplied from the watershed above in the form of sediment, large woody debris, nutrients, and temperature (Figure 11). Management practices in the watershed can influence the input of these natural materials from the watershed by disrupting watershed processes such as erosion, riparian forest functions and so on. The delivery of watershed products to downstream locations may individually or cumulatively affect the stream or water column condition, that in turn affects the quality and distribution of habitat conditions required by the organisms inhabiting the streams.

Figure 11. Theoretical framework of the water quality trends monitoring program.



The previous section has shown that sediment supply has been reduced in recent years, possibly reflecting new management practices on hillslopes, roads and in riparian areas applied since 1998. In the remainder of this report, we provide turbidity, stream channel, and habitat measures that should be responsive to changes in sediment or wood loading in the watershed (see PALCO 2004b for a review of management history and practices applied in the watershed.)

PALCO has also initiated water quality and stream channel monitoring to track trends in water quality and fish habitat characteristics and to identify when streams achieve desired water quality and fish habitat conditions (Table 3). This report will review a few of the most important measures, many of which are more comprehensively provided in PALCO (2004b).

For this report, we select a subset of parameters thought to be responsive to sediment and riparian conditions within the watershed, and therefore the management practices applied in the watershed to summarize response, although the exact relationship between watershed sediment load or a riparian forest condition and a channel measure cannot be predicted. PALCO's water quality trends monitoring projects collect many parameters characterizing turbidity, suspended sediment, streamflow, channel bed characteristics, large woody debris, fish habitat, and fish populations. This report will focus on a relatively few parameters in an attempt to provide an overall picture of trends in the watershed. We focus on the quantitatively determined parameters that are least influenced by measurement subjectivity among field surveyors.

The HCP establishes a series of channel and water quality metrics for PALCO streams known as the Preferred Future Conditions (PFC) that establish ecological goals for streams in the Habitat Conservation Plan. These targets are explicit numeric criteria and serve as targets or objectives that identify when channel or water quality conditions are considered good (Table 4). These PFC targets were synthesized from the available scientific literature by NOAA Fisheries and designed to identify fully functioning habitat for anadromous salmonids. PFC criteria may be compatible with NCRWQCB narrative standards for some beneficial uses.

Photograph 2. Eggs and alevins incubating in streambed gravels. Clean gravels are essential for successful survival through the incubation life history phase. The "cleanliness" of gravels is indexed by the proportion of a stream bed sample composed of fine sediments. Fines fill the voids between the gravels blocking water flow and smothering eggs. Low proportions of sediments less than sand size (0.85 mm) are considered desirable. Low proportions of sediments less than pea gravel size (6.35 mm) are important to prevent entombing the young within the gravels, preventing their emergence.

Sampling Design

Types of Studies

Sediment source studies have continued in the watershed in the form of trend and effectiveness monitoring studies as part of the HCP agreement and cooperative projects with the NCRWQCB (Table 3).

Turbidity and stream monitoring is conducted at 6 locations in the watershed. The streambed, wood, and temperature monitoring is conducted at 9 locations in the watershed. We use only PALCO stations in this study.

Table 3. Water quality and sediment related trend studies in the Elk River watershed conducted by PALCO.

TYPE OF MONITORING	Project	Elk River	Measurement since . . . .
Trends in beneficial uses	Continuous sediment and flow measurement at the outlet of major sub- drainages	9 (6 PALCO, 3 HSU)	Most since 2002
	Stream channel and fish habitat conditions	9	Most since 1997
	Stream Temperature of Class I streams	9	Most since 1997
	Fish and macroinvertebrate population sampling	5	Most since 1996
Effectiveness of BMP's	Landslide occurrence during triggering events-- Aerial photo interpretation of entire watershed Field visits to approximately 50% of landslides	Entire watershed (2003)	First triggering event occurred in Dec 27-28, 2002. Project initiated within 3 weeks.)

Methods

Sampling methods are described fully in PALCO procedures listed in Appendix A and annual reports to agencies. Methods are briefly described in this section.

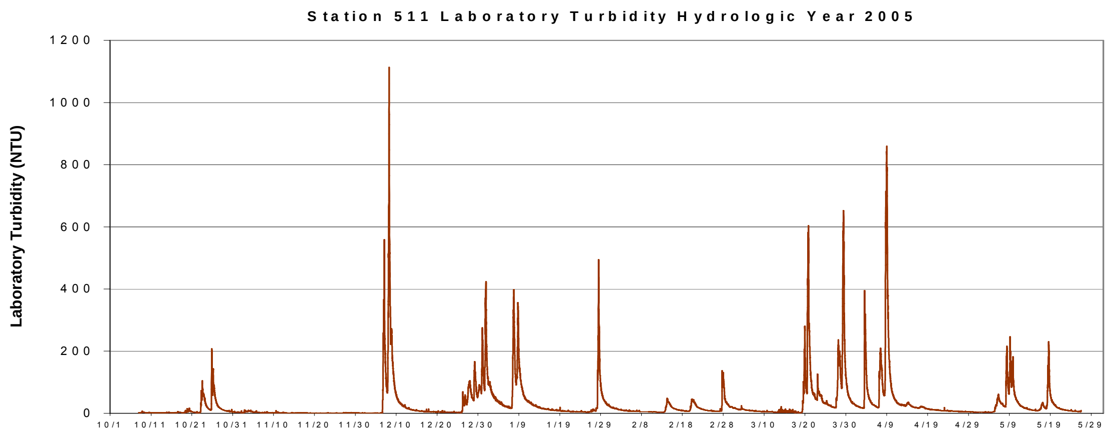
Suspended Sediment and Turbidity

Streams are equipped with continuous measuring turbidimeters and depth recorders. Electronically measured turbidity is measured every 15 minutes and calibrated with water samples collected or pumped from the streams and processed in the laboratory. Water samples are pumped from the stream triggered by changes in water depth. Depth recordings are calibrated with observations of staff plate depth. Stage/discharge relationships are developed at each site. See PALCO *Watershed Operating Protocols 1-5 describing streamflow and sediment sampling procedures, instrumentation, and laboratory methods*.

Photograph 3. Turbidity and stream flow field sampling.

This combination of measures allows the continuously recorded turbidity and depth to be translated to streamflow (m^3/s) and sediment load (metric tons). These are summed to produce annual sediment load, expressed in metric tons, or sediment yield per unit watershed area, expressed in mtons/km^2. A variety of turbidity instruments are used. Therefore, reported turbidity from the field is calibrated to the laboratory HACH 2100 N instrument by building relationships between field and laboratory turbidimeters with physically collected samples. Figure 12 is an example of the annual turbidity records at a turbidity trend station.

Figure 12. Example of annual turbidity measurement at N. Fork Elk River (station 511).



Streambed Sampling

Bulk sediment samples are shoveled from pool to riffle breaks, returned to the laboratory and sifted through a series of sieves to separate the sediment into size classes. The percent fines are the proportion of the total sediment sample less than 0.85 mm and particles less than 6.35 mm. In general, sediment sample findings are used as indicators of suitability for salmonid spawning and emergence survival success. Three sediment samples are collected using a standard shovel at three pool to riffle breaks within the sampling reach. See PALCO *Watershed Operating Protocol 13, Surface and Sub-surface Sediment Sampling* for full protocol.

Photograph 4. Streambed sediment

Pebble count measurements collected at riffles are used to determine the D_{50} (diameter of the median [50th of 100] particle) of the streambed surface. The hypothesis is that this sediment measure will indicate whether bedload sediments in a watercourse are generally becoming coarser or finer, relative to both sediment loading rates and cumulative effects from management activities.

Photograph 5. Measuring particle size of the streambed surface.

Using a transect method within bankfull boundaries, three riffles are surveyed within each monitoring reach with a 200 pebble count each, measuring the intermediate axis of each pebble. D50 values are calculated for each of three, 200-count surveys and averaged for the reach. See *PALCO Watershed Operating Protocol 13, Surface and Sub-surface Sediment Sampling* for full protocol.

Channel Form and LWD

PALCO conducts habitat typing on stream reaches to assess the abundance (i.e., the percentage of channel length composed of pools), size, and depth of pools at each sampling station. Habitat typing addresses matrix targets of pool-to-pool spacing based on bankfull widths, percent of surface area comprised of pool habitat, number of pools associated with large woody debris (LWD), and average residual pool depth. Residual pool depth is equal to the difference between maximum depth and pool tail crest depth.

Habitat typing measurements are done at each sampling station for a distance equal to approximately 30 times the average bankfull width. Habitat units are broken down to pool, riffle, or flatwater categories and not further. Basic physical measurements are taken and observations are made as to LWD influence and substrate type. See *PALCO Watershed Operating Protocol 14, Stream Habitat Typing* for full protocol.

Photograph 6. Pools associated with large woody debris during stormflow.

Large Woody Debris (LWD) within the stream channel is measured to determine the number, size, and volume of large wood available for creating fish habitat as well as its influences on channel morphology. LWD data collection addresses APFC targets for debris diameter, length, volume, and number of pieces per 100 feet.

LWD was measured for the entire sampling reach with a minimum piece size of 6 inches diameter and 6 feet in length. Diameter measurements were made at mid-piece and length measurements were made of the entire piece. In the calculation of mean lengths, diameters and volumes portions of the LWD in and out of the bankfull were used. Frequency was also calculated based on the number of pieces within 100 feet of stream length at the survey reach.

Photograph 7. Measuring large woody debris volume.

Water Temperature

Measurements of water temperature over the warmest part of the year (June through September) are taken with continuous recording data logger devices (Hobos or Optic Stowaways). MWAT is average daily mean temperature for the warmest consecutive 7-days during the season. (Maximum Weekly Average Temperature). Temperature data loggers are placed (within pvc cases) into the stream at a location that meets the requirements of having good thermal mixing, adequate cover, and the ability to maintain sufficient flow during the summer months.

Photograph 8. Stream temperature instrument.

Sampling Locations

Table 4 contains the list of sites identified by PALCO station number found in each subbasin. Monitoring locations identified by station number are shown in Figure 13. The turbidity trends sites and aquatic trends sites do not necessarily exist in the same location. We assume that each site is representative of the general trends of the reach and watershed above it.

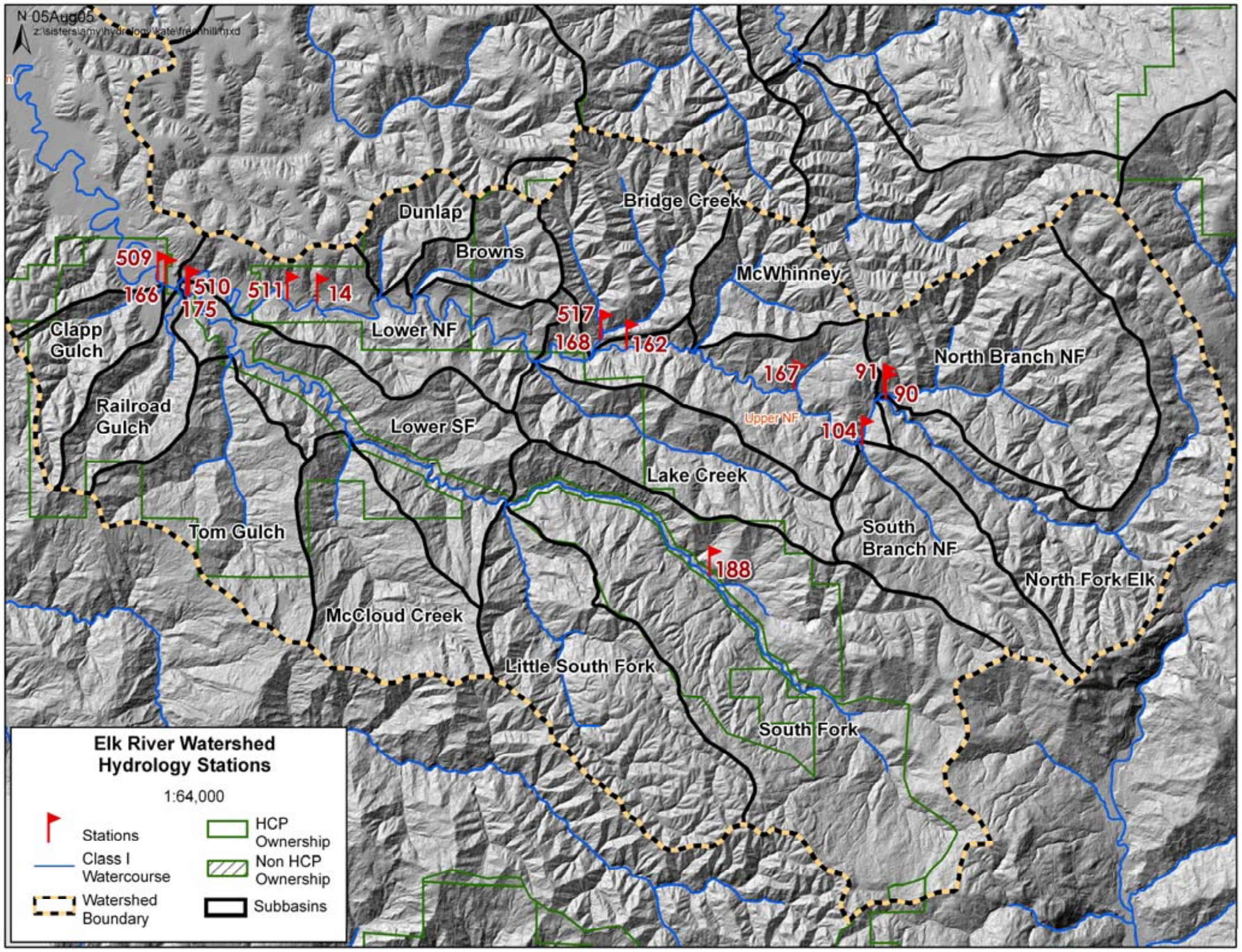
Fish habitat characteristics have been monitored in the Aquatic Trends Monitoring Project since 1998. Since initiation of the project, we have made a number of important improvements in field methods in some of the parameters, especially beginning in 2002. The methodology changes were sufficient that some data collected prior to 2002 cannot be compared to data collected after 2002. In addition, we have added and subtracted some sites so data may not be complete for all sites in all years.

Turbidity and suspended sediment measurement did not begin until November 2002, making hydrologic year 2003 the first complete year. Therefore, these sites were not initiated until nearly 6 years following the largest influx of sediment to the streams (e.g. Figure 5). Although PALCO's Aquatic Trends Monitoring Program has been measuring stream and temperature characteristics at most sites since 1998, major changes were made to streambed sediment sampling methods in 2002 so that data collected prior to this time are not comparable. Therefore, we limit the period of record to the interval from HY 2002 to HY2005 when methods were consistent. Harvest activities also resumed in the watershed in HY2003.

Table 4. Turbidity Trend and Aquatic Trend Monitoring Station numbers where each reported parameter was measured. All parameters are not measured in these designated watershed locations. ATM sites are located near, but not necessarily at turbidity trend monitoring stations. All sites are located in response reaches within the subbasin. Because locations of sites with subbasins may vary, the basin area above the sites may vary. Area above turbidity trends stations is generally used where there is overlap. Locations are mapped in Figure 13.

		Suspended Sediment		Streambed Sediment			Large Scale Roughness		Climate
Subwatershed	Basin Area (km^2)	Sediment Yield	Turbidity duration	% Less than 0.85 mm	% Less than 6.35 mm	D_{50} mm	LWD Density	Residual Pool Depth	Stream Temperature (MWAT)
Mainstem Elk River	111.56	509	509	166	166	166	166	166	166
Lower N. Fork Elk River	57.65	511	511	14	14	14	14	14	14
S. Fork Elk River	49.35	510	510	175	175	175	175	175	175
Bridge Creek	5.75	517	517	168	168	168	168	168	168
Lower Mid N. Fork Elk R.	35.48	--	--	162	162	162	162	162	162
Upper Mid N. Fork Elk R.	29.3	--	--	167	167	167	167	167	167
Upper N. Fork Elk R.	11.1	--	--	90	90	90	90	90	90
N. Branch N. Fork Elk River	10.35	--	--	91	91	91	91	91	91
S. Branch N. Fork Elk River	9.35	--	--	104	104	104	104	104	104
Upper South Fork Elk Below THP 520	18.96	183	183	--	--	--	--	--	--
Upper South Fork Elk above THP 520	15.67	188	188	--	--	--	--	--	--

Figure 13. Location map of monitoring sites in the Elk River watershed.



Monitoring Parameters Reported

The objective of this report is to provide an overview that synthesizes the array of parameters to build a picture of general response and trends for delineated watersheds or sub-basins. We assume that the various measures are representative of the general response reaches in the watershed, even if the parameters are not collected at exactly the same place. This report is not meant to be comprehensive in its review of trends in all parameters, but to provide an overview.

The parameters included in this report are listed in Table 5.

Table 5. Sediment, water quality and fish habitat parameters summarized in this report.

Type of Measure	Parameter	Why Important	Target Criteria
Sediment in stream flow	Annual Sediment Load (total tons, or expressed as sediment yield per unit area ($tons/km^2$)	Corresponds with sediment budget of all erosion processes in watershed and allocations.	Specified based on sediment budget
	% Hours during winter turbidity exceeds 70 ntu	Chronic high turbidity may limit fish feeding and affect growth. 70 ntu appears to be supported by fish feeding studies showing avoidance behavior	Not known
Size characteristics of stream bed gravel	Proportion of bed sediment sample < 0.85 mm	Incubating salmon eggs may be smothered if too high	11-16%
	Proportion of bed sediment sample < 6.35 mm	Incubating salmon eggs may be entombed if too high	25-25%
	Median size of particle on the surface of the streambed (D_{50})	Not known to be important to fish. May be sensitive to sediment supply.	65-95 mm
Channel form and LWD	Pool depth (residual) (m)	Deeper pools provide better rearing habitat for salmonids	Average depth >1.0 meter
	Large woody debris density (# Pieces LWD/100 ft)	Large woody debris creates hydraulic diversity and generally increases size and frequency of pools by controlling streambed scour.	Varies by channel width
Water Temperature	Average of the daily mean temperature of the 7 warmest consecutive days (MWAT, ^{o}C)	Warm temperatures may cause growth loss or mortality	$<16.8^{o}C$

Annual sediment load is expected to vary with rainfall. Sediment load is reported in actual amount as well as normalized to rainfall to assist the reader see trends within the normal climatic variability. The rainfall normalization method uses relationships described in Appendix B.

Data will be summarized in two ways. First, all data for each sub-basin will be displayed together. Second, some of the individual parameters will be summarized at the watershed scale.

For the subbasin summary, all available data will be displayed graphically for the period from 2002 to 2005. For Elk River, all parameters are available for the following basins as identified in Table 5.

- The entire Elk River as represented by stations listed for the Mainstem Elk River (Figure 14)
- The entire North Fork of the Elk River as represented by stations listed for the Lower North Fork Elk River (Figure 15)
- The entire South Fork of the Elk River represented by stations listed for the lower South Fork Elk River (Figure 16)
- Bridge Creek (Figure 17)
- The upper South Fork Elk River represented by station 188 (Figure 18)
- The upper South Fork Elk River presented by station 183 (Figure 19)

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Trend Monitoring Results Summarized by Sub-basin

Mainstem Elk River

Figure 14. Mainstem Elk River trend monitoring for HY 2002-2005.

A Summary of Climate and Sediment Measures Since 2002 for Mainstem Elk River

*Gray Shaded zones are target levels

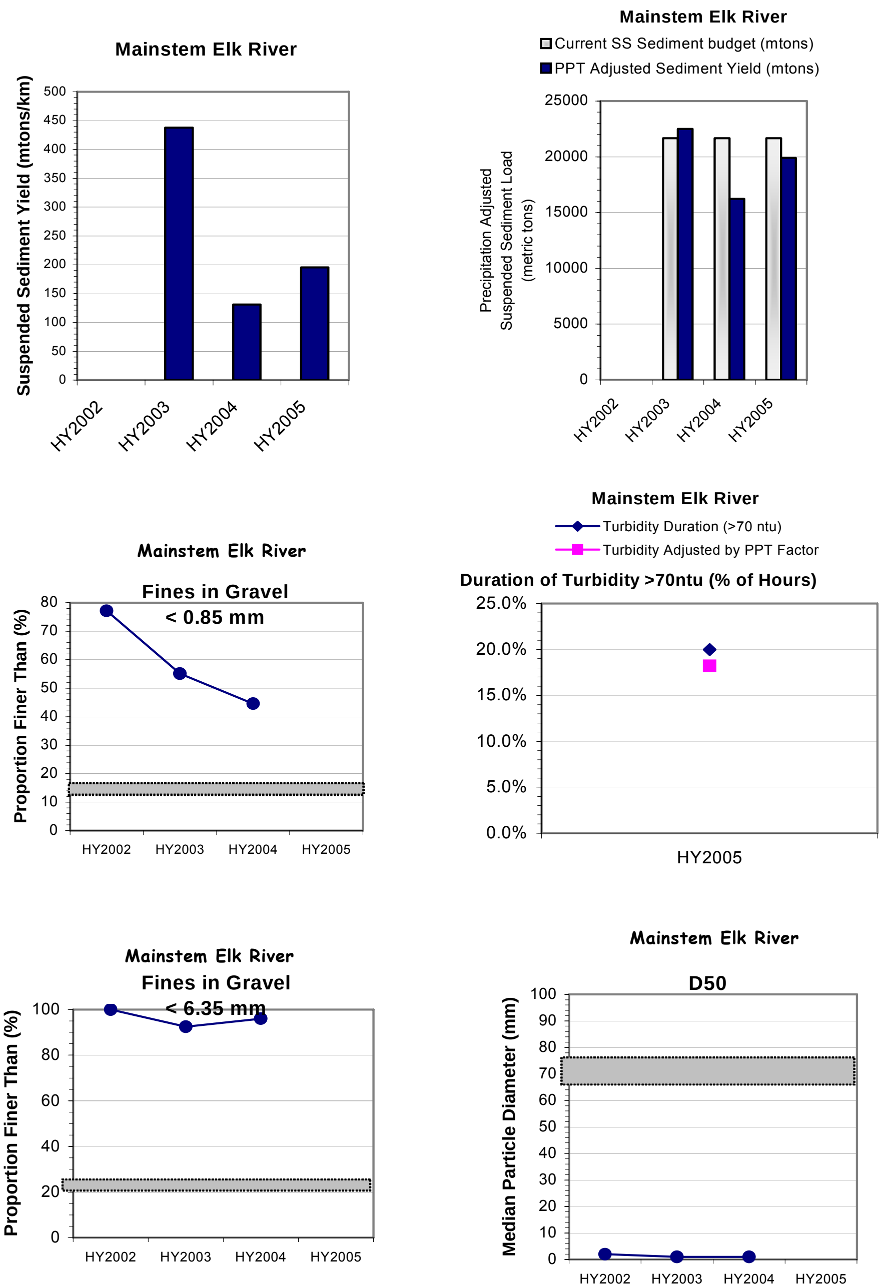
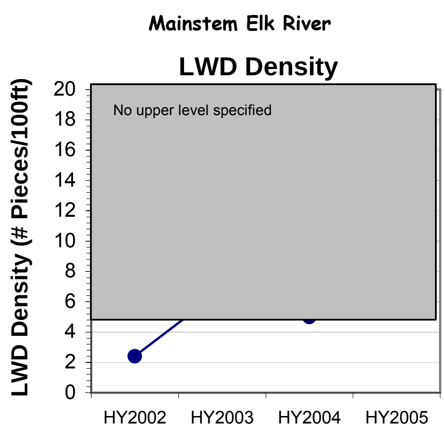
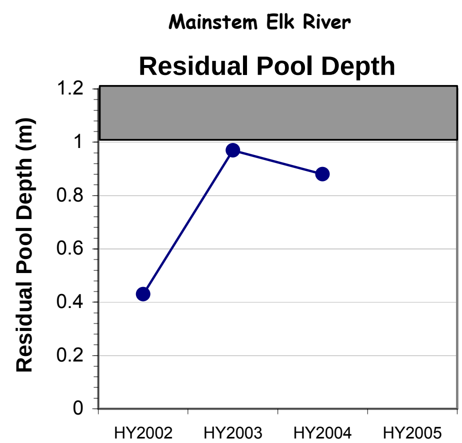
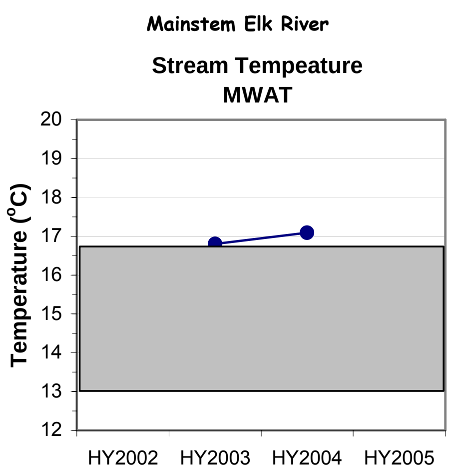


Figure 14. Mainstem Elk River trend monitoring for HY 2002-2005, continued.

A Summary of Climate and Sediment Measures Since 2002 for Mainstem Elk River







North Fork Elk River

Figure 15. North Fork Elk River trend monitoring for HY 2002-2005.

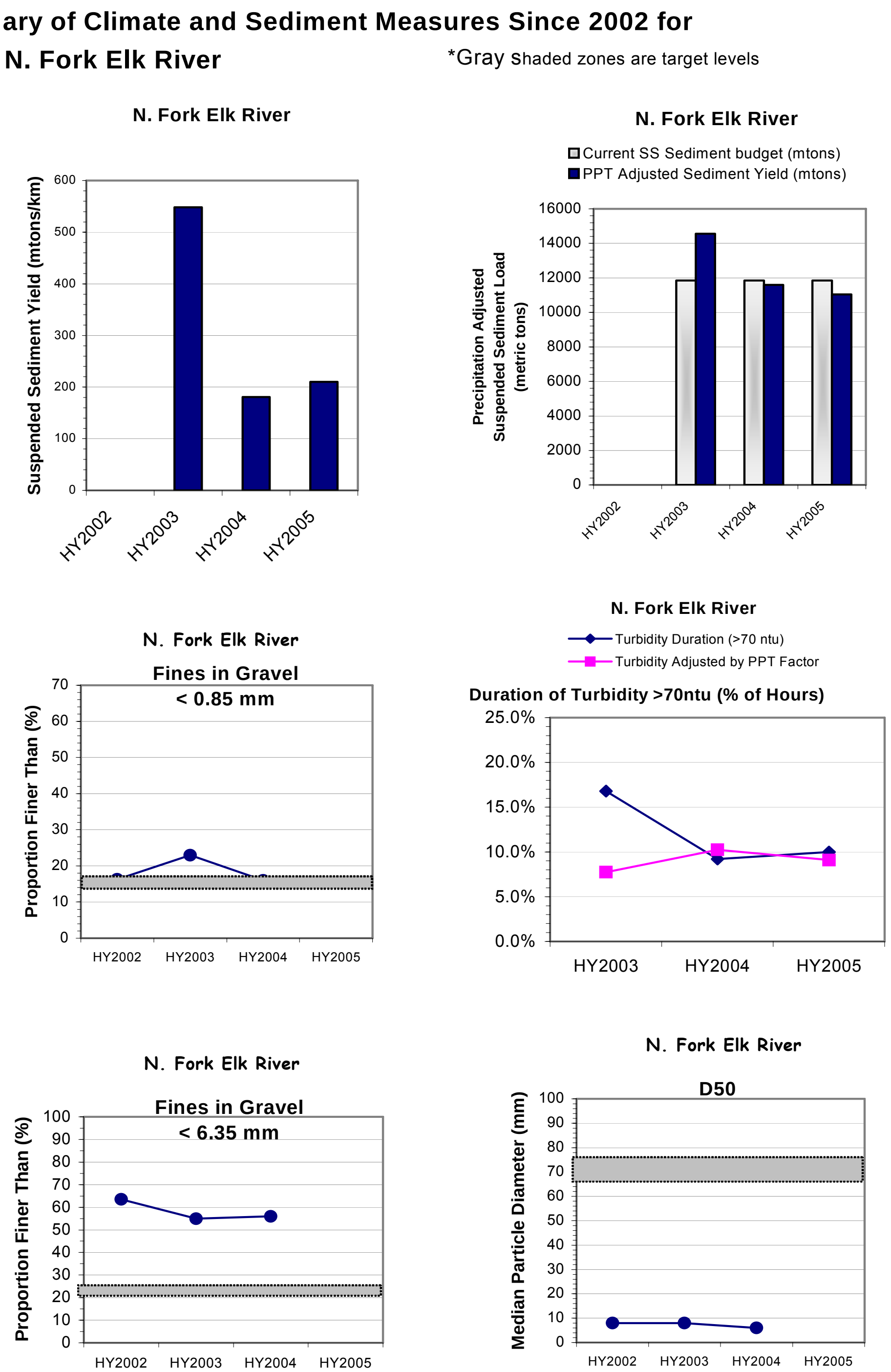
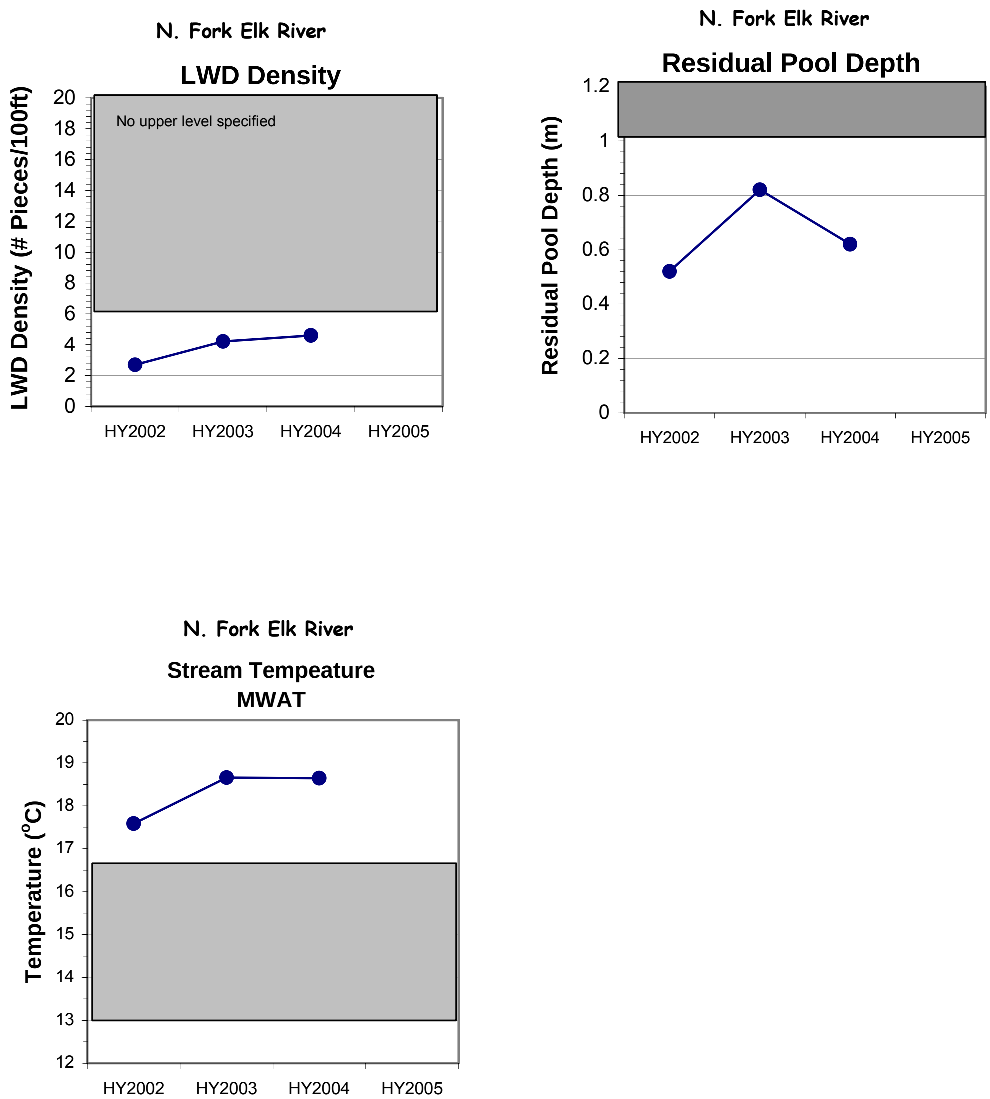


Figure 15. N. Fork Elk River trend monitoring for HY 2002-2005, continued.

A Summary of Climate and Sediment Measures Since 2002 for N. Fork Elk River



Lower South Fork Elk River near Junction with North Fork

Figure 16. Lower South Fork Elk River trend monitoring for HY 2002-2005.

A Summary of Climate and Sediment Measures Since 2002 for S. Fork Elk River

*Gray shaded zones are target levels

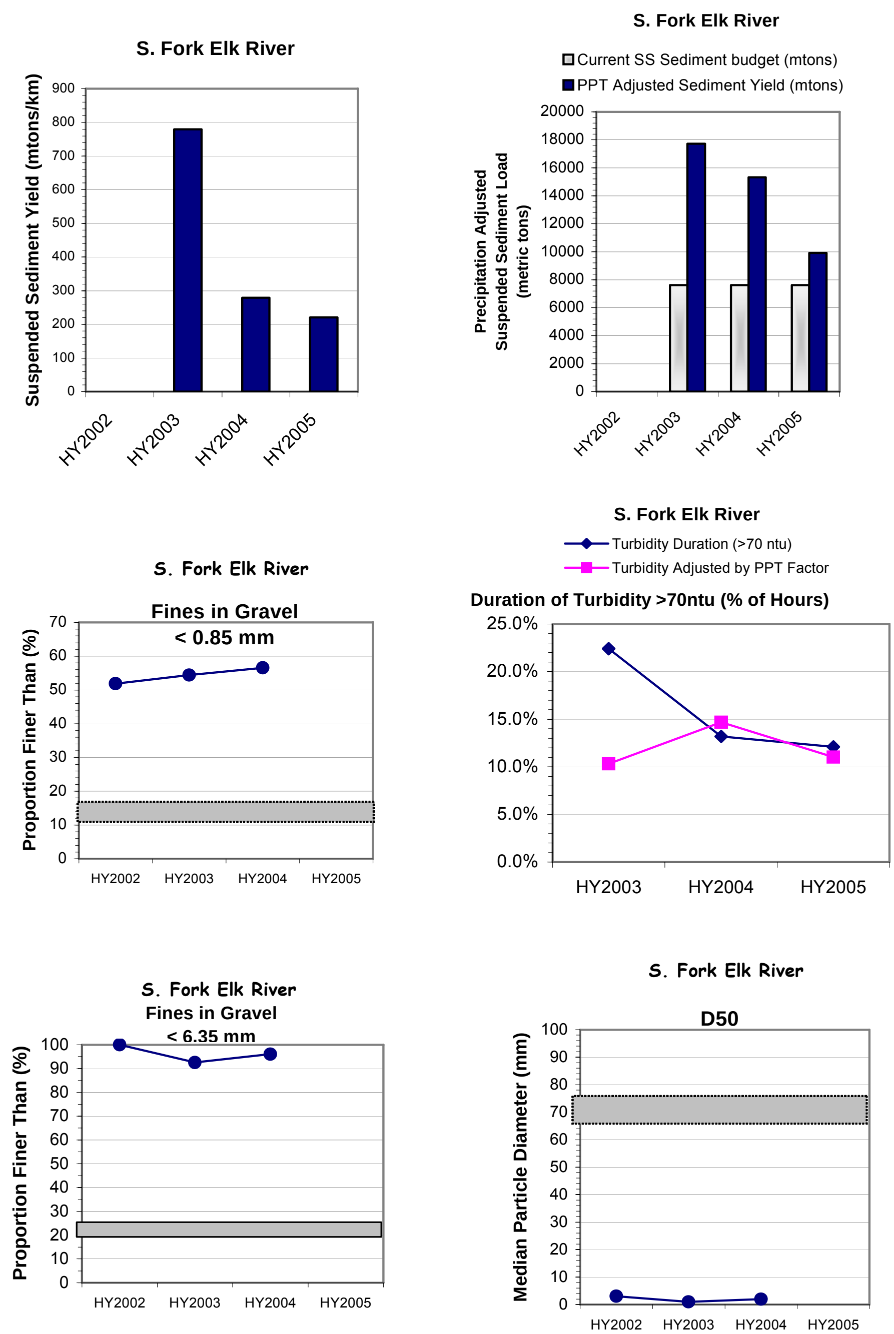
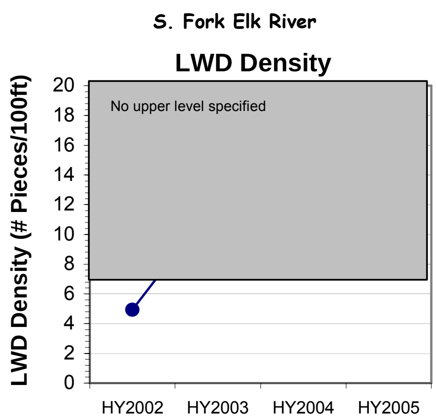
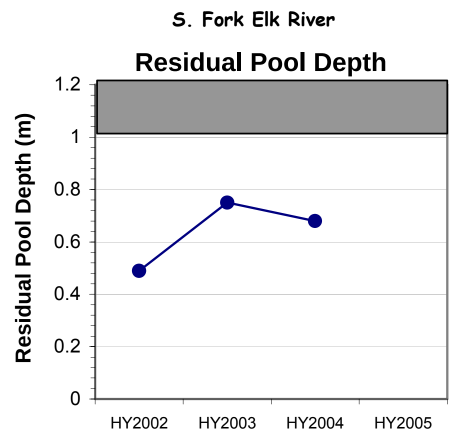
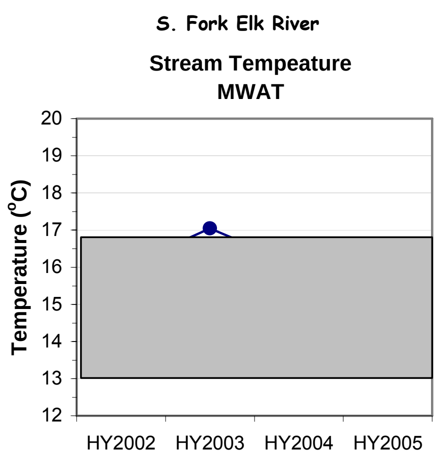


Figure 16. Lower South Fork Elk River trend monitoring for HY 2002-2005, continued.

A Summary of Climate and Sediment Measures Since 2002 for S. Fork Elk River







Bridge Creek

Figure 17. Bridge Creek trend monitoring for HY 2002-2005.

A Summary of Climate and Sediment Measures Since 2002 for Bridge Creek

*Gray shaded zones are target levels

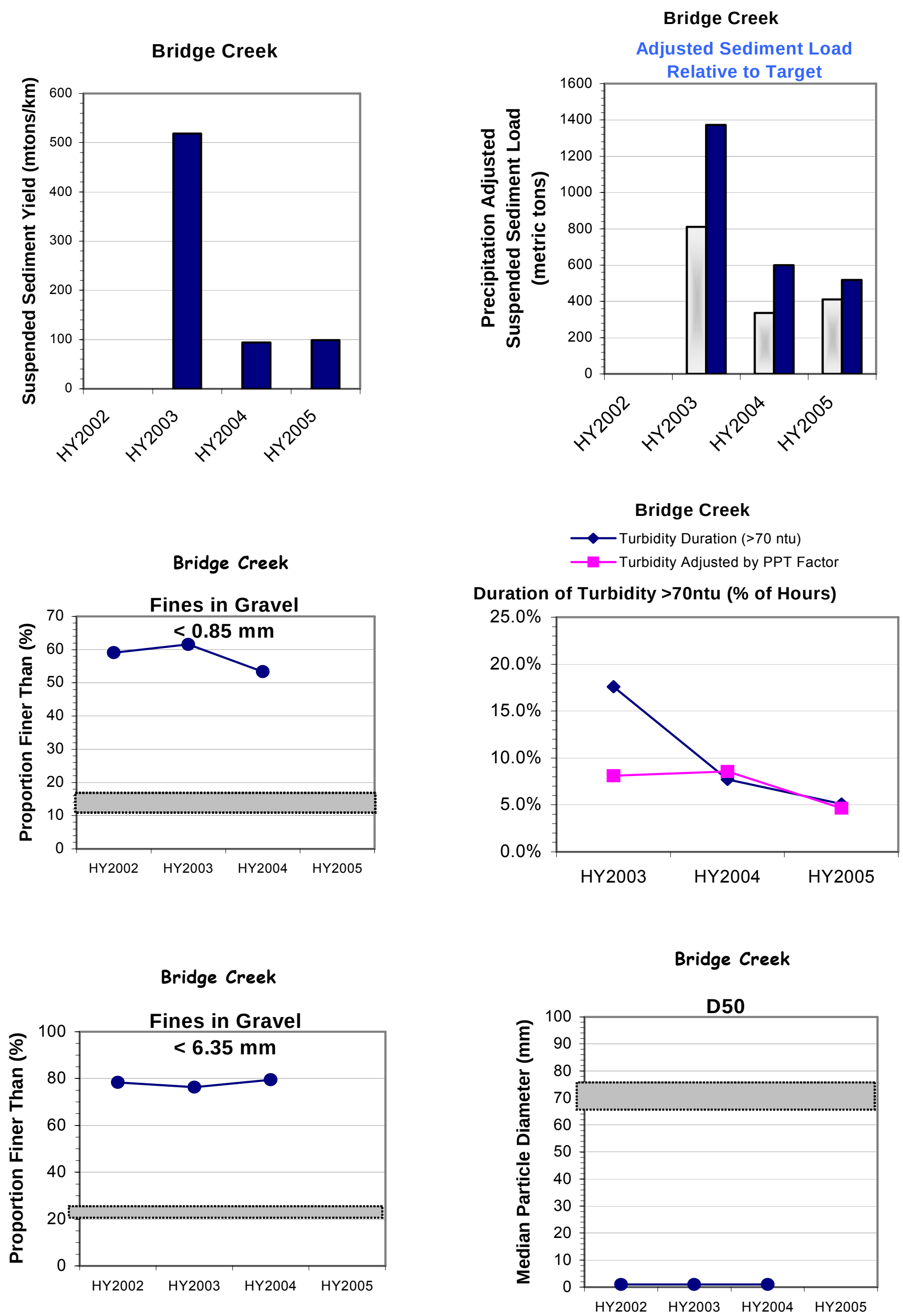
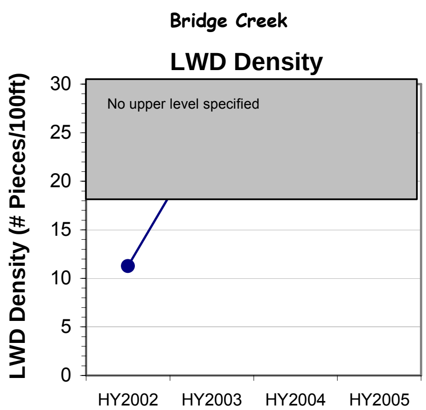
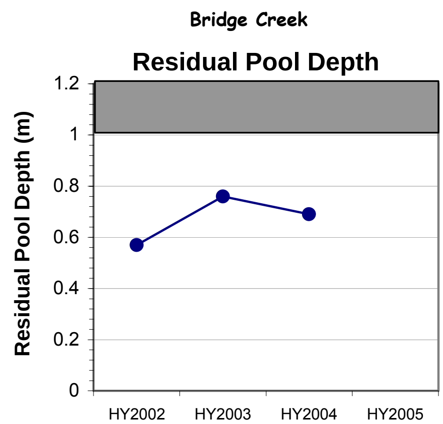
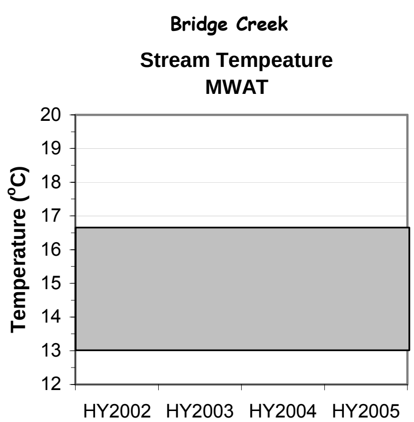


Figure 17. Bridge Creek trend monitoring for HY 2002-2005, continued.

A Summary of Climate and Sediment Measures Since 2002 for Bridge Creek

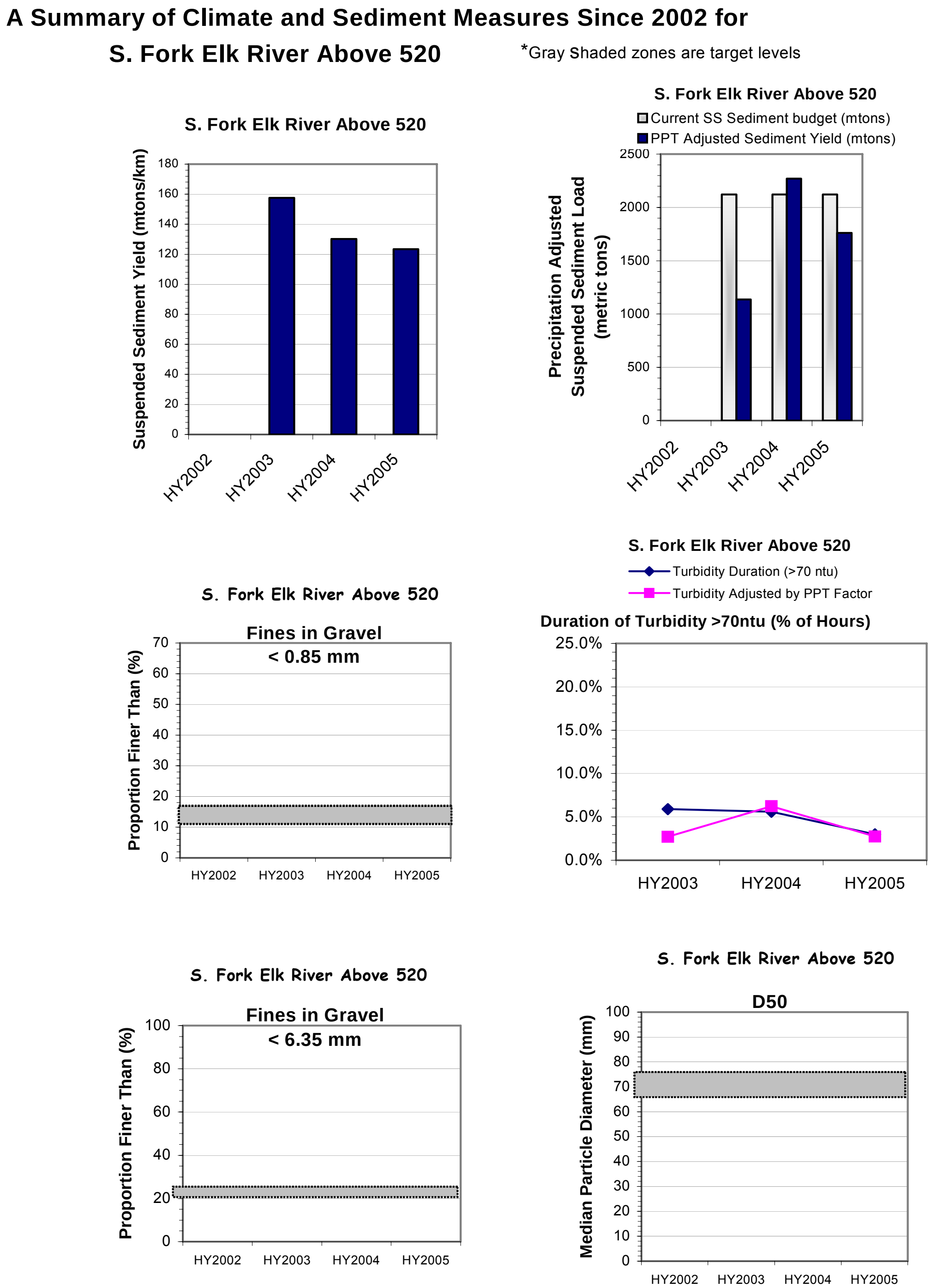






Upper S. Fork Elk River above THP 520 (Site 188)

Figure 18. Upper South Fork Elk River above THP 520 trend monitoring for HY 2002-2005. No data available for streambed sediments, LWD, or temperature.

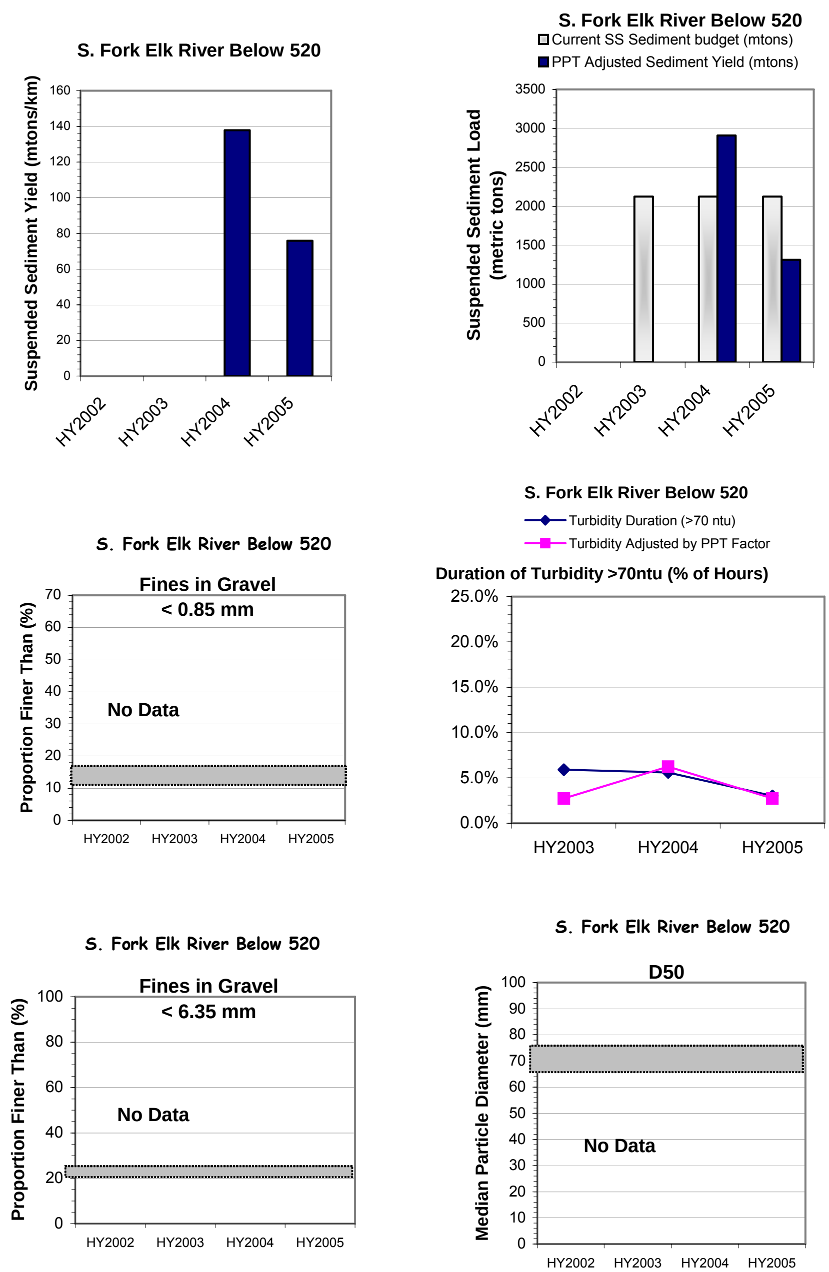


Upper South Fork Elk River below THP 520 (Site 183)

Figure 19. Upper South Fork Elk River below THP 520 trend monitoring for HY 2002-2005. No data available for streambed sediments, LWD, or temperature.

A Summary of Climate and Sediment Measures Since 2002 for
S. Fork Elk River Below 520

*Gray Shaded zones are target levels



Trend Monitoring Summarized by Watershed

In this section, the value of each parameter is shown for stations in the watersheds to provide an overview of conditions in the watershed. The watershed is depicted in a generalized schematic with the relative location of the station plotted. The values of each parameter are shown at the station. The most recent year's data is shown for each parameter. For Elk River, all parameters are available for the following basins as identified in Table 5.

- Annual sediment yield expressed as metric tons/km^2 (Figure 20),
- % of stream bed sample < 0.85 mm (Figure 21)
- % of stream bed sample < 6.35 mm (Figure 22)
- Median particle size of the stream bed surface expressed in mm (Figure 23)
- Residual pool depth expressed in meters (Figure 24)
- Water Temperature expressed as MWAT in deg C (Figure 25)

Note that LWD count is not shown in this figure because target levels vary so much by stream size that it is difficult to compare numbers spatially.

Figure 20. General trend in annual sediment yield at Elk River turbidity stations. Values are expressed as metric tons per square kilometer of watershed area.

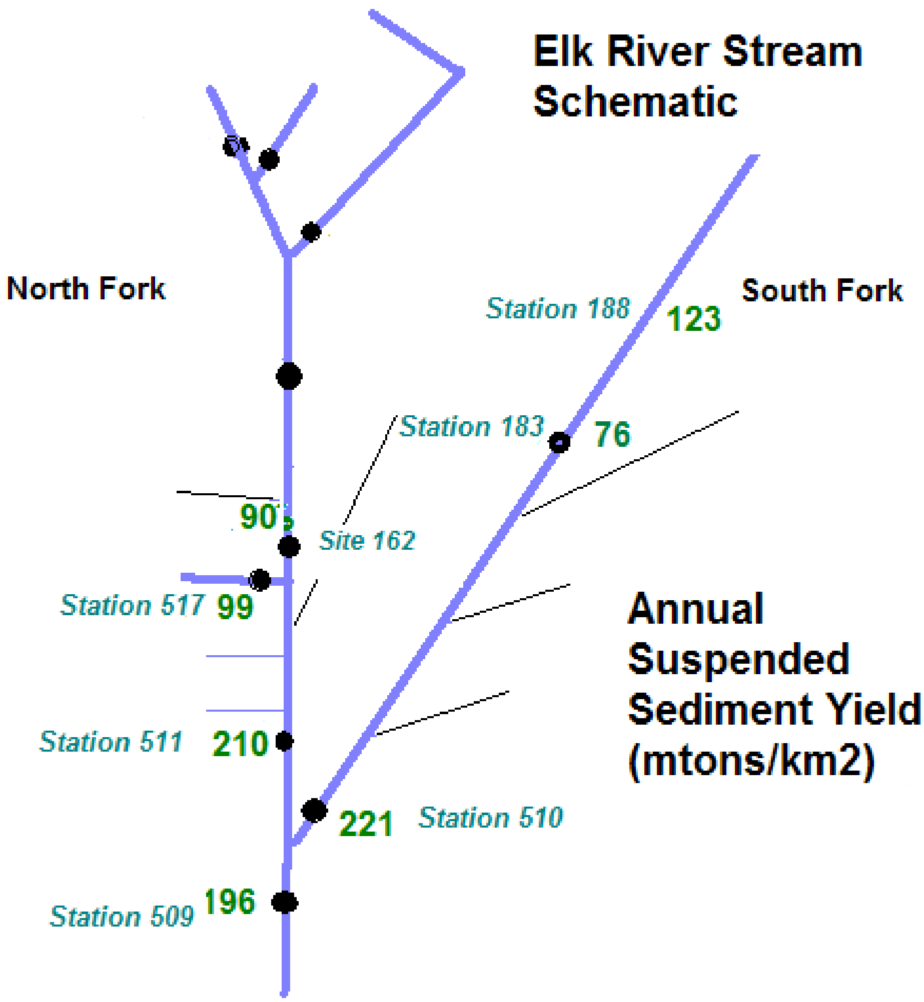


Figure 21. General trend in percent of bed sediment <0.85 mm at Elk River sampling sites. The PFC target value indicating good condition is 11-16%.

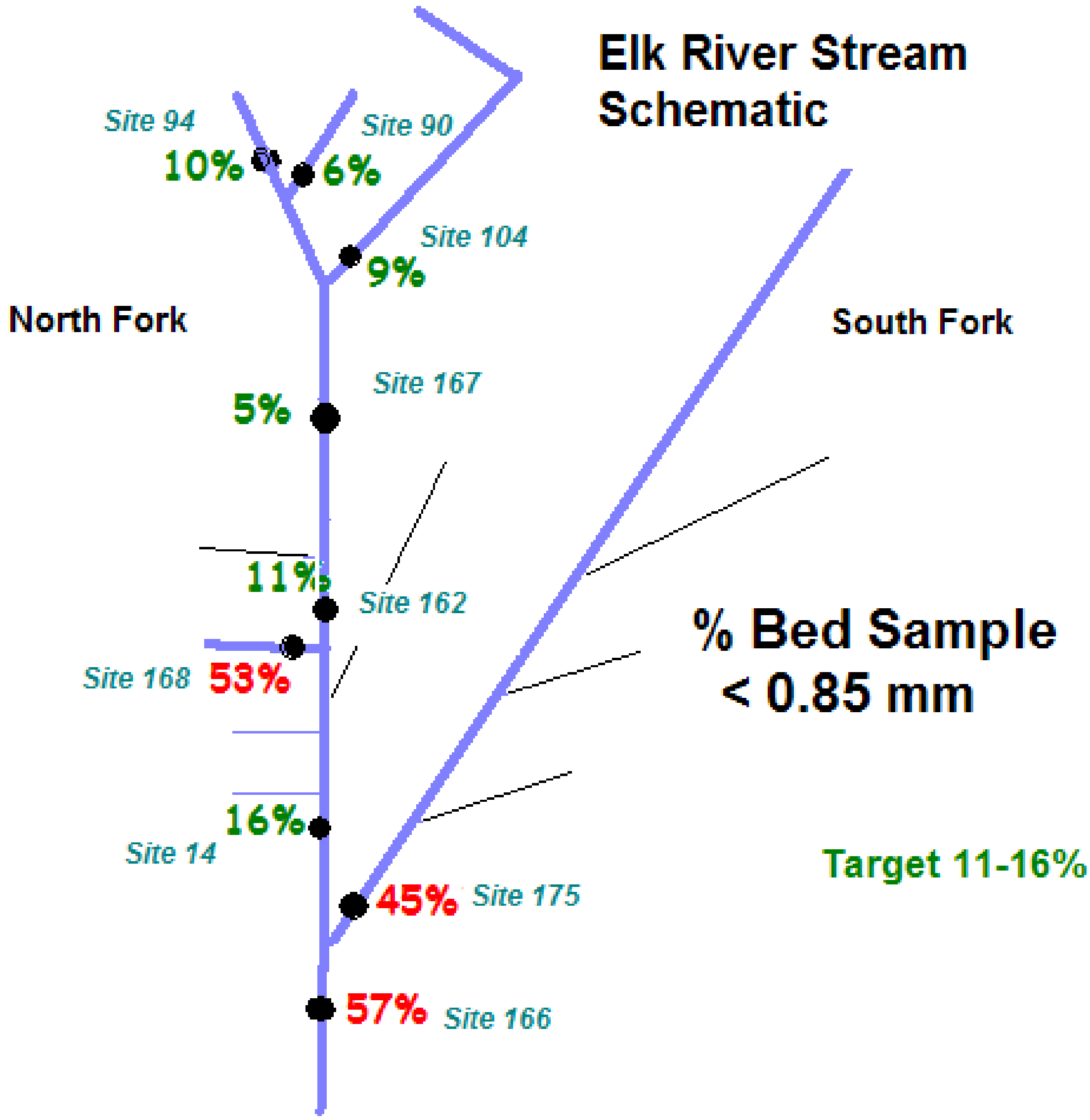


Figure 22. General trend in percent of bed sediment <6.35 mm at Elk River sampling sites. The PFC target value indicating good condition is 20-25%.

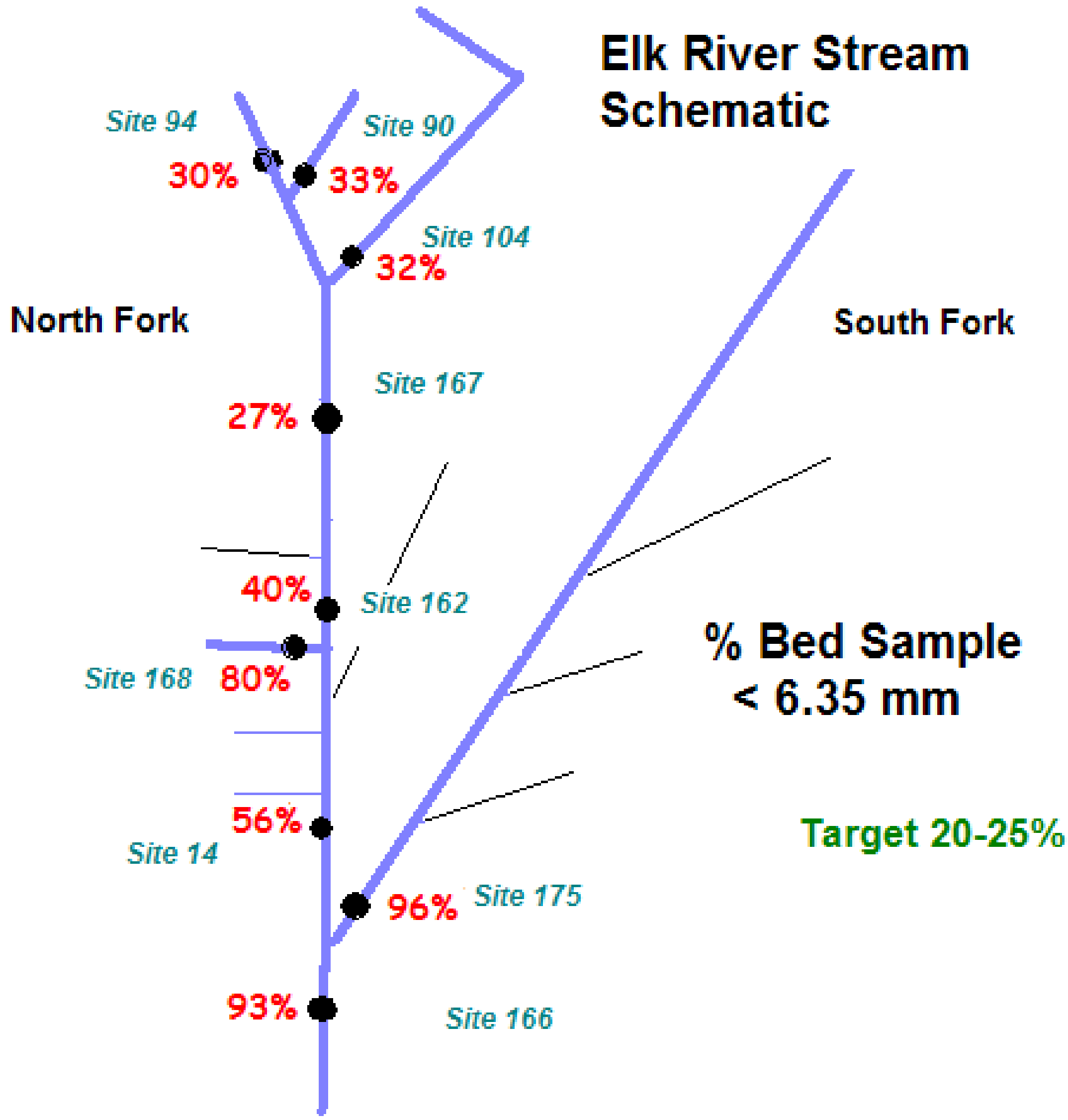


Figure 23. General trend in percent of bed sediment D_{50} at Elk River sampling sites. PFC target value indicating good condition is 65-95mm.

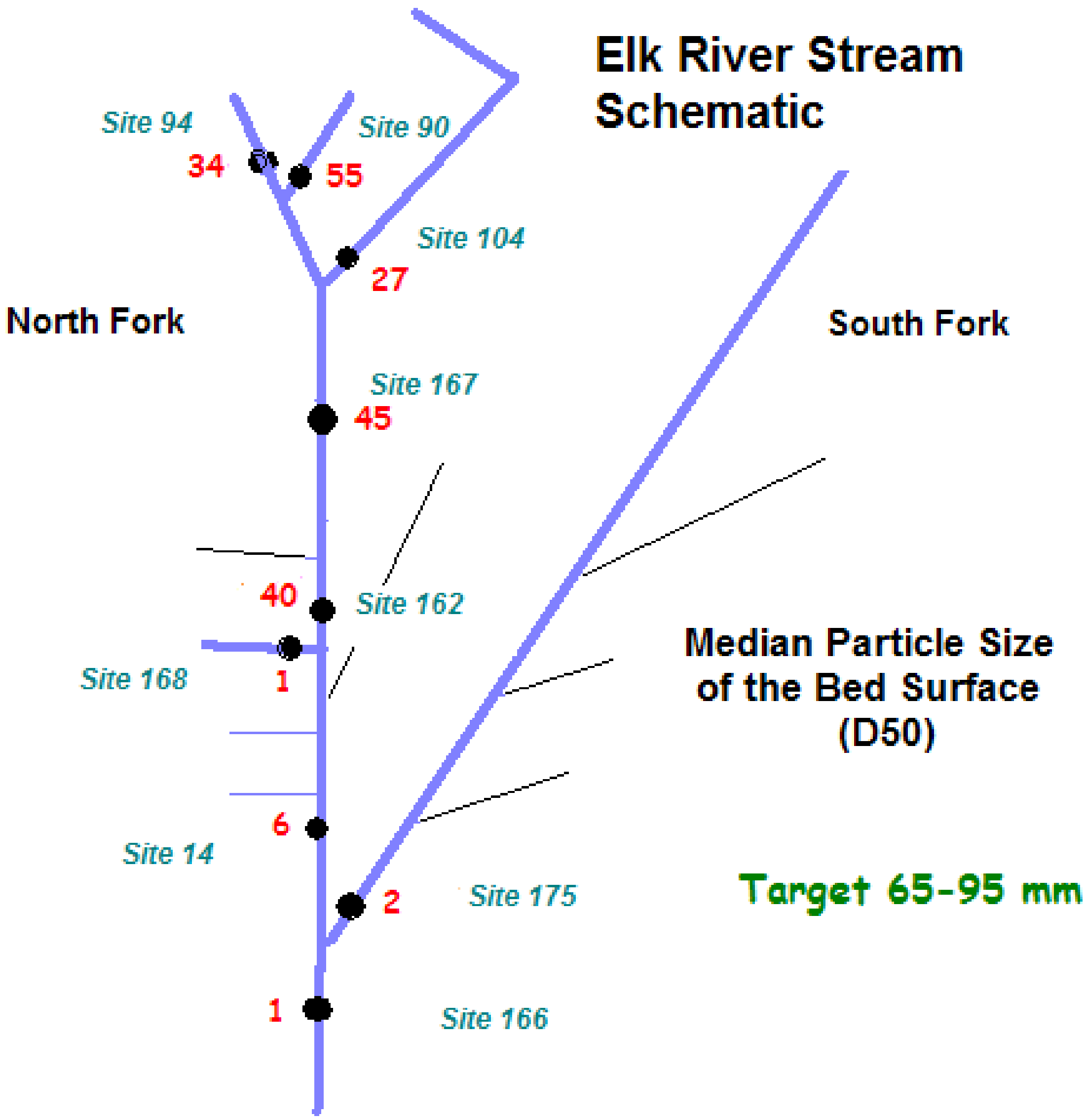


Figure 24. General trend in residual pool depth (m) at Elk River sampling sites. PFC target value indicating good condition >1.0 m. Green numbers (top) are depths measured in 2004. Orange numbers (bottom) are depths measured in 2002.

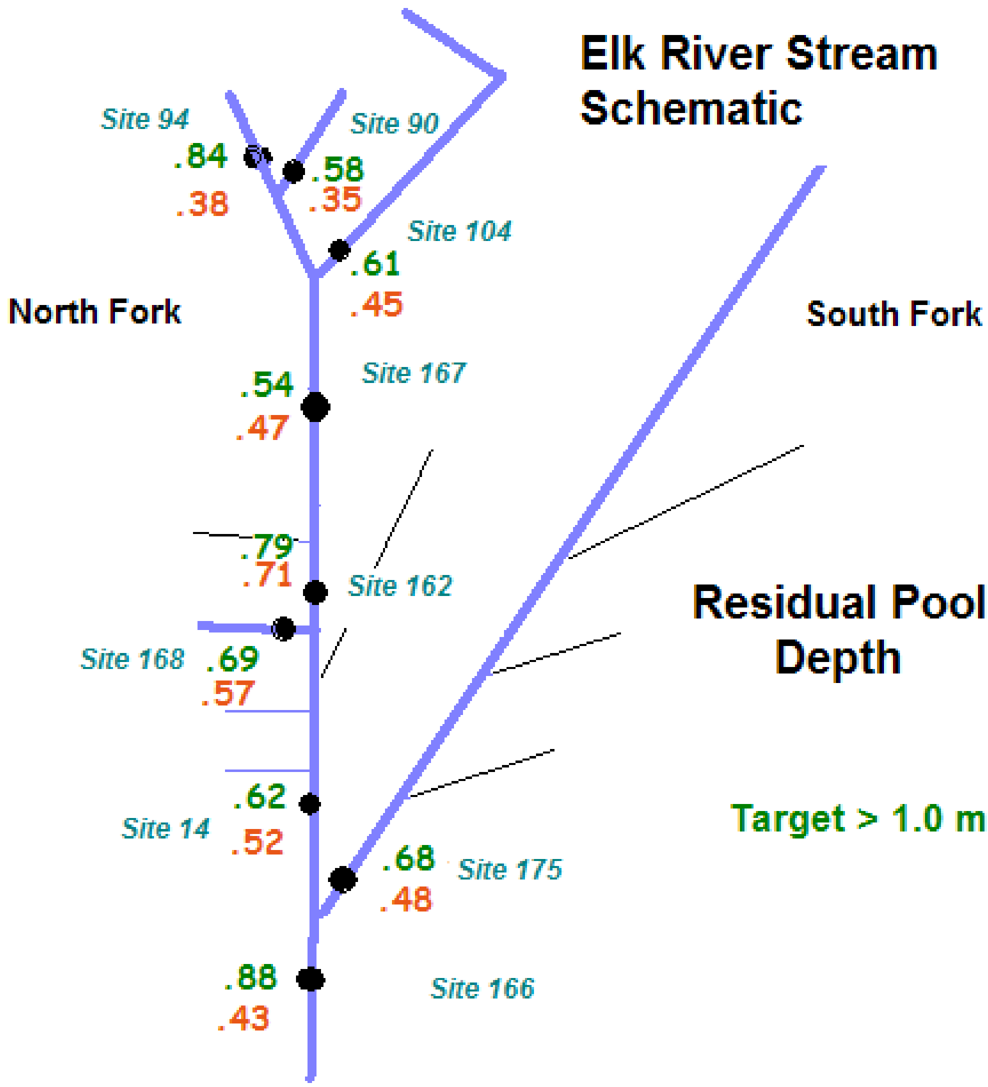


Figure 25. General trend in stream temperature (MWAT, deg C) at Elk River sampling sites. PFC target value indicating good condition <16.8 deg C.

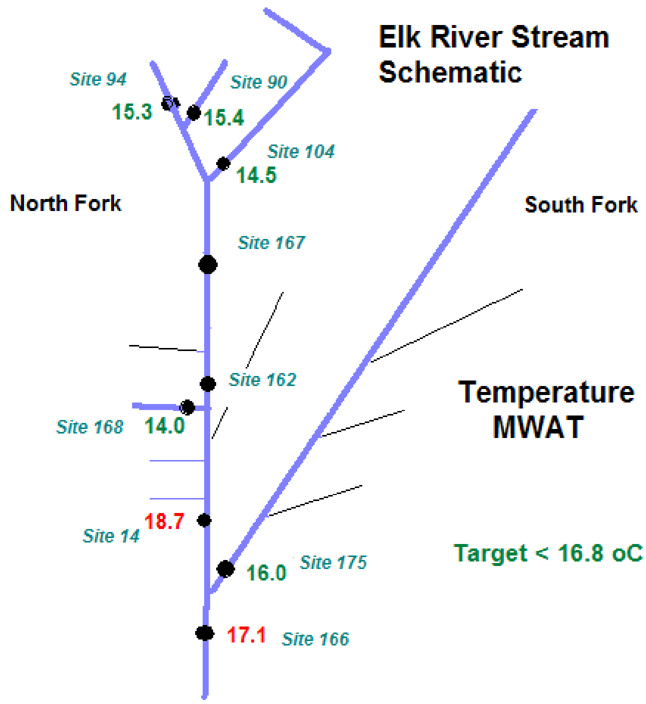
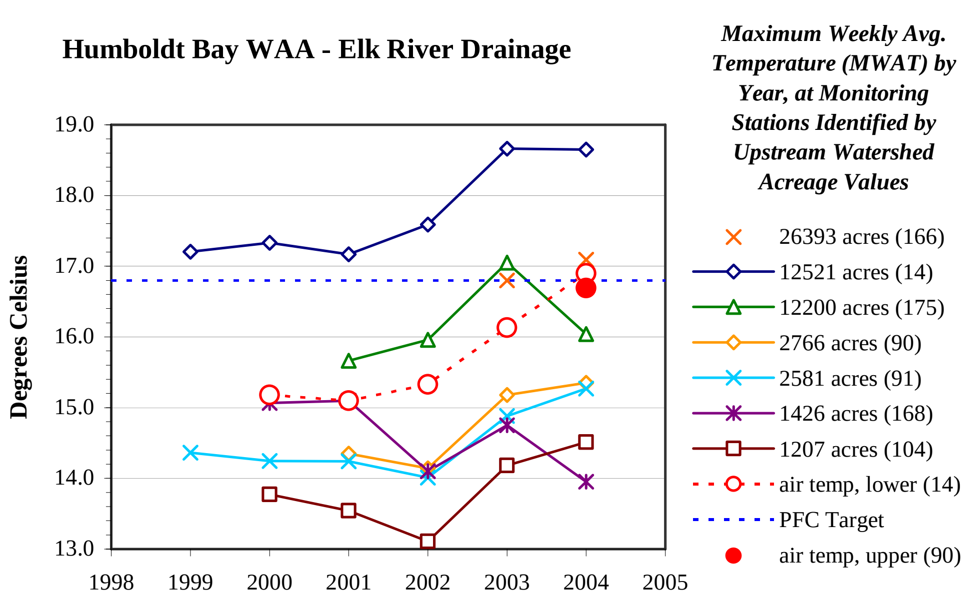


Figure 26. Trend at the watershed scale. Note air temperature patterns in the last 3 years.



Summary of Observations of Water Quality

The period of record in the monitoring program is relatively short (2002-2005). Nevertheless, some trends are evident in the sediment yield, water quality and habitat data collected in the Elk River watershed.

Sediment Yield from Erosion Processes

- A geomorphically effective event occurred in HY2003 that produced more sediment than in average rainfall years, but far less than occurred in HY 1997, the peak of the erosion history in the watershed.
- Sediment input to streams from landslides and roads has declined significantly since 1997 when large inputs occurred, especially in the North Fork Elk River, based on field and aerial photo assessment.

Suspended Sediment

- All sites show decline in the sediment load passing through the system, even when the effect of rainfall volume is factored in.
- Lower sediment yield results in lower durations of high turbidity defined as level where fish feeding avoidance begins.
- Sediment yields are greatest in the lower reaches of the North and South Forks and the mainstem, coincident with the sediment depositional zones of fine sediment. Sediment yield appears to increase within these reaches, rather than cumulatively from the entire watershed suggesting sources exist within this section. This is consistent with observations of erosion processes operative over long time scales by Stahlman (2003).
- Sediment budget estimates from erosion processes agree reasonably well with observed sediment export from the watershed. Agreement is very close at many sites, and under or estimated at some sites.

Sediment in the Stream Bed

- Spawning and incubation habitat is found in the upper reaches of the watershed. Sites occurring in sites of known fish spawning are in good condition for sediment sizes <0.85 mm. The lower segments of the river have very high levels of fine sediment and are not considered suitable for spawning.

- Levels of fines <6.35 mm is generally higher than PFC targets at all sites, with little change during the period of observation.

- The lower river segments near the junction of the North and South Forks and along the mainstem of Elk River are depositional zones marked by deposits of very find sediments not suitable for fish spawning or incubation. There has been some small improvement in fines sediment content at the mainstem site.

Sediment on the Bed Surface

- There has been no change in average particle size of the stream bed surface.

Large Woody Debris

- All sites are showing accumulation of woody debris. Sites were generally low in woody debris, and this trend would be considered positive in the upper portions of the watershed where salmonids spawn and rear.

Pool Depth

- All sites are showing some or significant deepening of pools, probably in association with accumulation of large woody debris. Deepening of pools improves salmonid rearing habitat. No site has yet attained the PFC goal of 1.0 m. Average pool depth appeared to increase following the large storm of 2002. However, gains in pool depth have been maintained during the last two average rainfall years.

Water Temperature

- Water temperature in most of the watershed is within PFC matrix target <16.8 deg C. The Lower North Fork Elk Site exceeded this target in 2005.

- Water temperature was generally higher in the watershed in 2005 following increases in air temperature over the period. Most of the streams in the upper portion of the watershed have dense conifer overstory. The lower segments on the well developed floodplain areas are dominated by deciduous or open stands following earlier decades of management in the riparian forests. These segments are near, or slightly exceed temperature targets for salmonids.

General Comments

Woody debris is accumulating at a relatively fast rate, and is apparently having a deepening effect on pools throughout the watershed.

A number of channel cross-sections and thalweg profiles have also been measured in the watershed. We have not shown these data. However, generally, there has been little change in channel dimensions as determined by these cross-sections anywhere in the watershed. A small amount of channel erosion has been documented at the lowermost mainstem Elk River site, but there is no general trend in enlargement of channel area. It is not clear that evacuation of sediment would be expected in the upper reaches of the watershed given current channel dimensions and bed characteristics. However, sediment deposition in lower reaches is significant, and not markedly changed as indicated by 11 sparsely distributed channel cross-sections in three river segments. However, these cross-sections also show channels at or near capacity to convey current natural bankfull flood events.

From a geomorphic perspective, it appears that, at this time, the primary response of streams to changing hillslope input processes is a trend towards increasing large scale channel roughness in the form of large wood pieces and bedforms. Fine scale channel roughness, such as the sediments in the channel bed, nor channel dimensions other than pool depth are not showing much change to reduced sediment load, with a few exceptions.

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Appendices

A. Brief description of sampling methodologies.

B. Brief description of relationship used to normalize annual sediment yield and load by annual rainfall.

Appendix A. Sampling Methodology

PALCO methods for measurement are available in detail in the following Watershed Operating Protocols:

Watershed Operating Protocols:

WOP-01 Hydrologic Site Selection, Monumenting and Documentation
WOP-02 Gaging Streams for Estimating Discharge
WOP-03 Instrumentation Methodology
WOP-04 Water Quality Grab Sampling and Field Turbidity Measurement
WOP-05 Laboratory analysis of suspended sediment
WOP-07 Laboratory Analysis of Bulk Sediment Samples
WOP-09 Stream Temperature Monitoring
WOP-10 Surveying Methods (Draft)
WOP-11 Stream and Riparian Canopy Cover Measurement
WOP-13 Surface and Sub-surface Sediment Sampling
WOP-14 Stream Habitat Typing Methods
WOP-15 Aquatic Trend Monitoring Site Selection, Monumenting, and Documentation
WOP-25 Streambed Surveying Methods (Draft)
WOP-30 Large Woody Debris Survey Methods

Pebble count measurements collected at riffles are used to address the APFC matrix target for D_{50} (diameter of the median [50^{th} of 100] particle). These sediment measures can be tracked over time to determine whether bedload sediments in a watercourse are generally becoming coarser or finer, relative to both sediment loading rates and cumulative effects from management activities.

- Using a transect method within bankfull boundaries, three riffles are surveyed within each monitoring reach with a 200 pebble count each, measuring the intermediate axis of each pebble. See *Watershed Operating Protocol 13, Surface and Sub-surface Sediment Sampling* for full protocol.

- D50 values are calculated for each of three, 200-count surveys and averaged for the reach.

Bulk sediment samples taken from pool to riffle breaks are used to assess the APFC matrix target for percent fines less than 0.85 mm and particles less than 6.35 mm. Bulk sediment samples are also used to assess the APFC Matrix targets of geomean diameter and Fredle Index values. In general, sediment sample findings are used as indicators of suitability for salmonid spawning and emergence survival success.

- Three sediment samples are collected using a standard shovel at three pool to riffle breaks within the sampling reach. See *Watershed Operating Protocol 13, Surface and Sub-surface Sediment Sampling* for full protocol.

- Samples are processed at the PALCO Sediment Laboratory using a dry-sieving method and a series of sieves ranging from 125mm to 0.075mm. See *Watershed Operating Protocol 07, Bulk Sediment Laboratory Processing* for full protocol.

- Laboratory sediment processing data is plotted on cumulative percent plots in order to determine the D50 values as well as calculate other matrix values. An example is included in the data discussion section for bulk sediment parameter.

Pool attributes, PALCO conducts habitat typing on stream reaches to assess the abundance (i.e., the percentage of channel length composed of pools), size, and depth of pools at each sampling station. Habitat typing addresses matrix targets of pool-to-pool spacing based on bankfull widths, percent of surface area comprised of pool habitat, number of pools associated with large woody debris (LWD), and average residual pool depth.

- Habitat typing measurements are done at each sampling station for a distance equal to approximately 30 times the average bankfull width. Habitat units are broken down to pool, riffle, or flatwater categories and not further. Basic physical measurements are taken and observations are made as to LWD influence and substrate type. See *Watershed Operating Protocol 14, Stream Habitat Typing* for full protocol.

- Multiple calculations are made from data to address APFC matrix targets. All calculations are standard summation calculation such as; residual pool depth is equal to the difference between maximum depth and pool tail crest depth.

Water temperature is measured over the warmest part of the year (June through September) are taken with continuous recording data logger devices (Hobos or Optic Stowaways). Temperature data are used to calculate the APFC matrix target for MWAT (Maximum Weekly Average Temperature).

- Temperature data loggers are placed (within pvc cases) into the stream at a location that meets the requirements of having good thermal mixing, adequate cover, and the ability to maintain sufficient flow during the summer months. See *Watershed Operating Protocol 09, Stream Temperature Monitoring* for full protocol.

- Maximum Weekly Average Temperature values were calculated based on APFC Matrix target references from US Fish and Wildlife and US EPA. MWAT calculations are further explained in *WOP-07 Stream Temperature Monitoring*.

Large Woody Debris (LWD) within the stream channel is measured to determine the number, size, and volume of large wood available for creating fish habitat as well as its influences on channel morphology. LWD data collection addresses APFC targets for debris diameter, length, volume, and number of pieces per 100 feet. The Watershed Operating Protocol for LWD is currently being drafted. The details of the survey and data calculations are as follows:

- LWD was measured for the entire sampling reach with a minimum piece size of 6 inches diameter and 6 feet in length. Pieces were categorized in relation to their position in channel regions (low flow, bankfull, out of bankfull) as well as their orientation in the stream. To increase accuracy in resurveying, each piece measured was tagged with a numbered washer and mapped by hand. Diameter measurements were made at mid-piece and length measurements were made of the entire piece (including portion smaller that 6 inches in diameter to a point determined by surveyor discretion)

- Geometric mean diameter and length were calculated and used to calculate the geometric mean volume of LWD for each station. In the calculation of mean lengths, diameters and volumes portions of the LWD in and out of the bankfull were used. Frequency was also calculated based on the number of pieces within 100 feet of stream length at the survey reach. All parameters were compared to PFC targets for LWD based on Bilby and Ward's findings (1989). PFC matrix targets for large woody debris are dependent upon an average channel width value. For analysis, equations from Bilby and Ward (1989) and associated regression line plots from USFWS were used to determine targets at each station.

- Calculations used to determine the PFC target for frequency of woody debris as a function of mean channel width are presented in the data discussion of the sampling parameters; large woody debris, section.

Streambed surveys (longitudinal and cross section profiles) are conducted to determine streambed elevation changes over time. Streambed profiles address APFC criteria for channel conditions, specifically width to depth ratios and measures of streambed scour and fill (originally criteria set for scour chains).

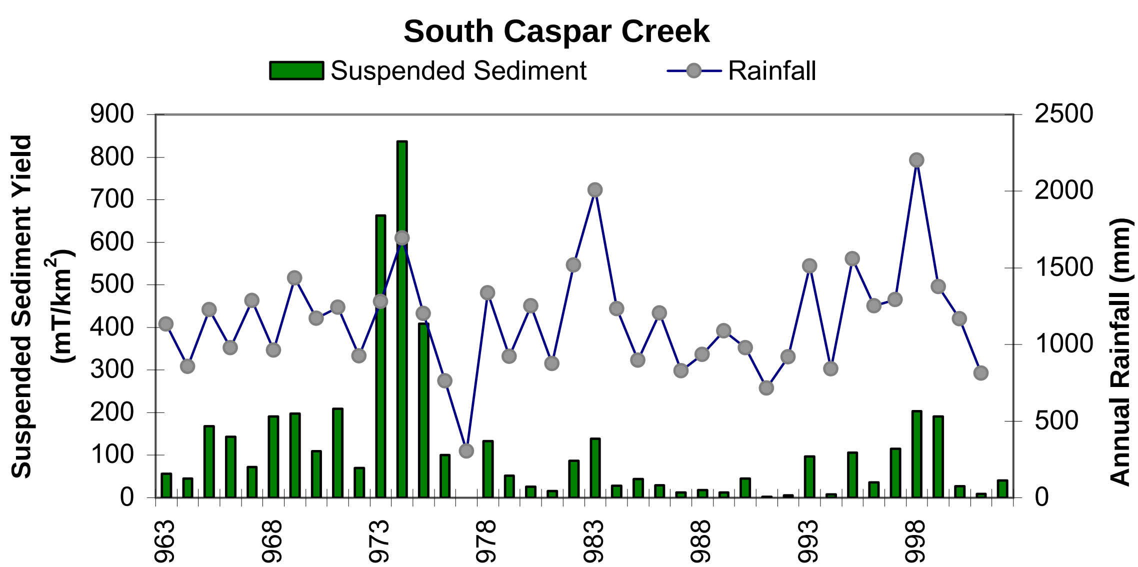
- A Topcon Total Survey Station was used in 2003 to collect streambed survey points. This was implemented to increase accuracy and repeatability of streambed surveys. Permanent critical points were installed at each monitoring station as reference to the three-dimensional sampling grid encompassing the monitoring reach.

Appendix B. Relationship used to normalize sediment load and yield by annual rainfall.

All other factors being equal, sediment yield will vary with annual rainfall, albeit with scatter about the relationship. To observe trends in suspended sediment related parameters due to changes in management practices, especially within a short measurement record, it is helpful to normalize the data for climatic variability. This section described a simple method to index rainfall effects in suspended sediment measures.

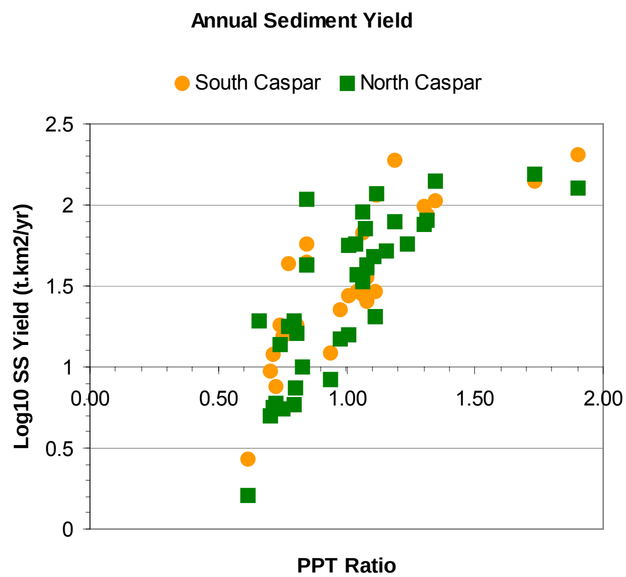
A good source of long term sediment yield data is available from the watershed studies at Caspar Creek. The long-term sediment yield record at Caspar Creek watershed shows annual variation that can be explained, in part, by the annual rainfall (Figure 1, appendix B). The large sediment yield in the period from 1973 to 1975 reflects the management effects with logging in those years.

Appendix B Figure 1. Annual sediment yield and rainfall at the South Fork Caspar Creek watershed. Data taken from RSL website.

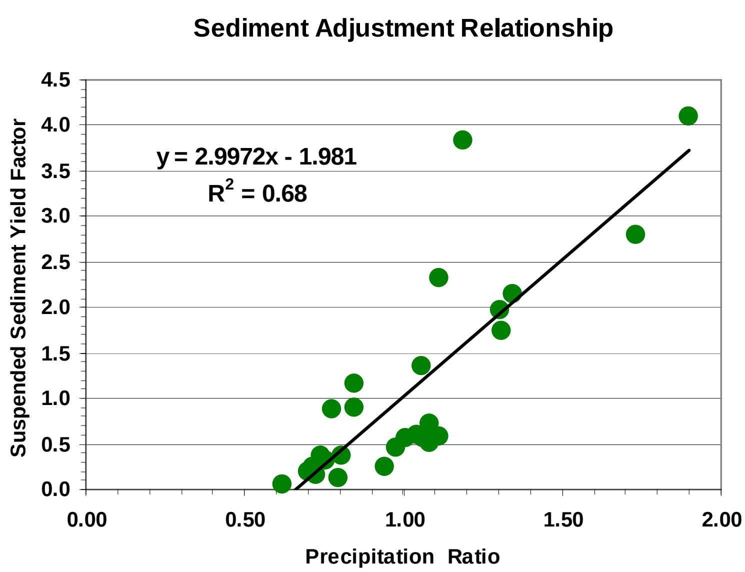


A rainfall factor can be computed as the proportion of the long-term annual rainfall. The relationship between the sediment yield expressed in Log10 units is shown in relationship to the annual precipitation factor in Figure 2 (Appendix B). Treatment years have been excluded from this data. Although not shown, the r^2 of this relationship is about 0.60.

Appendix B Figure 2. Annual sediment yield at North and South Fork Caspar Creek, expressed in Log10 in relation to the annual precipitation ratio.



Appendix B Figure 3. Sediment adjustment factor based on South Caspar Creek annual sediment yield.



We assume that the same general relationship between rainfall and annual sediment yield shown in Figure 2 (Appendix B)holds in the Elk River. To develop a precipitation index to adjust sediment yield in this watershed, we must also create a sediment yield factor from the Caspar Creek data by dividing each year's sediment yield by the long term average sediment yield. This results in the relationship shown in Figure 3 (Appendix B).

The suspended sediment related parameters (annual load, annual yield, turbidity duration) are normalized by multiplying the measured value using the sediment factor determined from the precipitation factor based on the annual rainfall. This may raise or lower the value depending on whether rainfall was above or below average.

LAGUNITAS CREEK
SEDIMENT AND RIPARIAN MANAGEMENT PLAN
REVIEW AND EVALUATION REPORT
1997 - 2009

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Draft - September 3, 2010

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ACKNOWLEDGEMENTS

We would like to express our appreciation for the support that we have received from the Marin Municipal Water District's Board of Directors throughout the implementation of the management plan. We also would like to express our appreciation for the valuable input and support from the Lagunitas Creek Technical Advisory Committee.

In addition, we would like to give special recognition to the District's Fishery Watershed Aides, Interns and Summer Helpers who provided great assistance to the implementation of the management plan. In chronological order, from upper left to lower right, our thanks and appreciation go to the following individuals:

Gregory Aull	Bridgette Tracey
Michael Cronin	Joel Barnard
Andrew Peri	Damien Bartholomew-Keller
Chris Niffeneger	Jacquelyn Neuffer
Colleen Proppe	Francesca Rohr
Melissa Diamont	Chaya Kranz
Jessica Sisco	Sean Quinlan
Vicki Burns	Amanda Morrison
Aviva Rossi	Roger (Lito) Brindle
Christian Hellwig	Evan Childress
Jon Goin	Marisa Piovarcsik
Nicholas Simpson	Deanna Morrell
Michael Bowers	Katherine Pofahl
Jacob Riley	Mark Rogers
Greg Vogeazopoulos	Andrew Wolf

ACRONYMS & ABBREVIATIONS

CESA	California Endangered Species Act
cfs	Cubic Foot per Second
COE	U.S. Department of the Army, Corps of Engineers
DFG	California Department of Fish and Game
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FishNet4C	Fishery Network of the Central California Coastal Counties
GIS	Geographic Information System
MMWD	Marin Municipal Water District
NMFS	National Marin Fisheries Service
NPS	National Park Service
RCD	Marin County Resource Conservation District
RWQCB	San Francisco Regional Water Quality Control Board
SPAWN	Salmon Protection and Watershed Network
State Parks	California Department of Parks and Recreation
SWRCB	California State Water Resources Control Board
TAC	Lagunitas Creek Technical Advisory Committee
TBWC	Tomales Bay Watershed Council
TMDL	Total Maximum Daily Load
TU	Trout Unlimited
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

The Marin Municipal Water District (MMWD) is an active partner in the management of the Lagunitas Creek watershed. Between 1997 and 2009, the District implemented a wide range of actions to benefit aquatic species in the watershed. The actions were conducted in compliance with a State Water Resources Control Board water rights order to the District. This report reviews all of those actions and presents the findings from that effort.

Raising Peters Dam and State Water Resources Control Board Order WR95-17

The Marin Municipal Water District's current involvement with fisheries management on Lagunitas Creek began in the mid-1970s. At that time, a severe, two-year drought prompted the District to raise Peters Dam, which forms Kent Lake and which had originally been built in 1953. As part of the permitting and regulatory process associated with the dam's raising, the State Water Resources Control Board (SWRCB) imposed a series of conditions designed to address the impacts associated with the dam's raising on downstream fishery resources, specifically the populations of coho salmon, steelhead trout, and California freshwater shrimp. The State Board approved the Kent Lake enlargement project and established interim instream flow standards for Lagunitas Creek. The SWRCB also directed the District to study the creek for a period of ten years, after which a plan to address impacts would be developed.

In response to the State Board's direction, the District conducted fisheries and hydrogeomorphology studies within Lagunitas Creek throughout the 1980s and early 1990s. Following review of the studies' results, the State Board held water rights hearings that culminated in 1995 with issuance of Order WR95-17. The Order specified mitigation measures designed to benefit the fishery resources within the creek to offset the effects associated with raising Peters Dam. Among the Order's requirements were maintaining minimum stream flows to support coho and steelhead during all life stages in the creek, implementing habitat enhancement projects, conducting monitoring to track trends in the fish and shrimp populations, and reporting.

Lagunitas Creek Sediment and Riparian Management Plan and Accomplishments

Key to the State Board's intent was the District's development and implementation of what became known as the *Lagunitas Creek Sediment and Riparian Management Plan* (SRMP). The SRMP was completed and approved in 1997. The plan set out a program that spanned ten-years of enhancement projects, monitoring studies, and associated other activities. The District also prepared the *Aquatic Resources Monitoring Workplan for the Lagunitas Creek Drainage*, which was incorporated into the SRMP. While the SRMP was designed as a ten-year effort, the District continues to implement elements of the SRMP today and continues to comply with all elements of Order WR95-17.

This report summarizes the activities that were conducted under the SRMP and all other activities conducted by MMWD in compliance with Order WR95-17, through 2009. The highlights and findings of the District's efforts are as follows:

- Releases of waters from Kent Lake to Lagunitas Creek occurred in accordance with the prescribed schedule, throughout the year, and to enhance upstream migration of adult salmon during the winter spawning seasons.
- Installation, maintenance and replacement of large woody debris structures at 42 sites along Lagunitas Creek has enhanced both summer and winter habitat for salmonids. They have created the kinds of habitat that were intended, including more frequent and deeper pools, refuge from high flows, and shelter from predators.
- Riparian revegetation and biotechnical bank stabilization projects were completed at seven sites along Lagunitas Creek. The sites have become successfully established and are protecting and enhancing the riparian corridor
- Sediment control projects were completed within the watershed at sites initially identified in the SRMP as well as at others identified through subsequent studies, to successfully stabilize erosion and reduce sediment loading in Lagunitas Creek.
- A variety of resource monitoring studies were completed and the District exceeded the monitoring effort developed for the SRMP. The data collected and analyzed has greatly benefited the District and other agencies and organizations involved in improving the watershed's overall health.
- Water temperatures at multiple locations within the watershed were monitored for compliance with the State Board's requirements.
- A Memorandum of Understanding (MOU) between multiple agencies was developed to address in a consistent and coordinated manner the management and maintenance of unpaved roads within the watershed.
- A multi-agency MOU was developed to establish guidelines regarding the management of existing and future woody debris in riparian areas, for stream habitat enhancement.
- The District was successful in obtaining grant funding to implement other project work directly related to fishery management in the Lagunitas Creek watershed, and MMWD also contributed million to the Lagunitas watershed by funding projects thorough its Willis Evans Habitat Improvement Grant Program.

To implement all of these actions, that District has provided nearly $8 million in funding to enhance the fishery resources of Lagunitas Creek, between 1997 and 2009. This includes over $7 million in District funding and almost $700,000 in grant funding.

The District has complied with Order WR95-17 to the best of its ability and its efforts have been significant. These actions have benefited the fishery resources of Lagunitas Creek and helped to forge a strong coalition of organizations working to continue the effort. Some issues warrant further analysis and joint action by all parties involved in restoring and protecting the health of the Lagunitas Creek watershed:

- For much of the period from 1995 to 2007, the juvenile coho population appeared to be increasing, while the juvenile steelhead population did not show a strong upward or downward trend. Since 2007, however, the coho population has declined sharply, both in Lagunitas Creek and throughout coastal California. The scientific consensus attributes this decline to a drop in ocean productivity. This unfortunate episode demonstrates that salmonid populations are influenced by many factors, including floods, droughts, ocean conditions, and freshwater habitat quality. Population gains resulting from habitat enhancement efforts can be undone by larger forces. Over the long term, however, habitat enhancement efforts stand the best chance of increasing salmonid populations and preventing their extinction.

- The woody debris project work has provided a diversity of habitats that help to ensure that salmonid populations do not fall below sustainable levels. These efforts alone, however, have not been enough to increase salmonid populations in the face of declining ocean productivity, floods, and other phenomena.
- To date the streambed monitoring effort has not detected an overall improvement in streambed conditions. Sediment dynamics are largely driven by episodic events, such as floods, that tend to overwhelm incremental, longer-term improvements in sediment delivery to the creek. Detecting an appreciable improvement in streambed conditions may require longer-term monitoring than what has been conducted so far.
- The water temperatures in Lagunitas Creek have remained within a suitable range for coho salmon during the monitoring period; On the hottest days of each year water temperatures did exceeded the requirements established by the State Board.

Lagunitas Creek Technical Advisory Committee

Throughout the plan's implementation, the Lagunitas Creek Technical Advisory Committee provided assistance to the District in reviewing the District's work in the SRMP and coordinating the efforts of various organizations working to improve the Lagunitas Creek ecosystem. The committee continues to serve as an important forum for information-sharing and now provides recommendations to all entities involved with fishery resource management within the Lagunitas Creek watershed.

Next Steps

The District has successfully completed the activities defined in the ten-year *Lagunitas Creek Sediment and Riparian Management Plan*. The District continues to meet the ongoing requirements of Water Right Order 95-17 and continues to implement various elements of the SRMP. As one of the entities responsible for fisheries management in the Lagunitas Creek watershed, the District continues to support the work of the Technical Advisory Committee, and to participate in joint efforts to restore and protect Lagunitas Creek resources. The District is developing a new plan for its activities in fisheries management and habitat improvement for Lagunitas Creek. The District will be developing recommendations for use by the Technical Advisory Committee in its collaborative effort to define joint and individual actions that can be implemented by partner agencies and organizations to ensure the protection and continued enhancement of the aquatic resources of Lagunitas Creek.

1.0 INTRODUCTION

1.1 History of State Water Board Order WR95-17

The Marin Municipal Water District (District, MMWD) diverts water from the Lagunitas Creek basin to supply water for over 190,000 residents in southern and central Marin County. The State Water Resources Control Board (SWRCB) regulates these diversions.

The District operates seven water supply reservoirs in Marin County, five of which are within the Lagunitas Creek watershed. Kent Lake, which is formed by Peters Dam, was originally constructed in 1954, and it marks the upstream limit of anadromous fish migration in the mainstem of Lagunitas Creek. Nicasio Reservoir, formed by Seeger Dam (built in 1961), is situated on Nicasio Creek, the largest tributary to Lagunitas Creek. Peters Dam and Seeger Dam block anadromous salmonid fish passage to about 50% of their historically available habitat. Upstream of Kent Lake are Alpine Dam (built in 1918), Bon Tempe Dam (built in 1948), and Lagunitas Dam (built in 1872) which actually blocked fish passage prior to Kent Lake.

In response to a severe, two-year drought in 1976-‘77, the District sought to increase its water storage capacity by raising Peters Dam and enlarging Kent Lake. The raising of Peters Dam was completed in 1982. The SWRCB, in its Decision 1582, approved the enlargement of Kent Lake established instream flow standards and directed the District to conduct studies on fisheries protection measures. The primary issues of concern were the impacts to anadromous salmonids (i.e., coho salmon and steelhead trout) and to California freshwater shrimp. The SWRCB indicated that final mitigation measures would be decided upon following the completion of the studies.

Throughout the 1980s and early 1990s, the District conducted studies on the fisheries and hydro-geomorphology of Lagunitas Creek. Additional studies were conducted by the California Department of Fish and Game (DFG). Then, beginning in 1992, the SWRCB held water rights hearings which culminated in 1995, with the SWRCB issuing Order WR95-17 (Appendix A).

In its 1995 Order WR95-17, the SWRCB ordered MMWD to develop and implement a ten-year sediment management plan, a riparian management plan, and a fishery resources monitoring workplan. The order was intended as mitigation to address the impacts of MMWD water diversions at Kent Lake on Lagunitas Creek. In response to the SWRCB order, MMWD developed the *Lagunitas Creek Sediment and Riparian Management Plan* (SRMP; MMWD 1997). The District also prepared the *Aquatic Resources Monitoring Workplan for the Lagunitas Creek Drainage* (Trihey & Associates 1996), which was incorporated into the SRMP, as an appendix.

1.2 Purpose of the Review and Evaluation Report

The purpose of this report is to state and review the activities that were conducted under the *Lagunitas Creek Sediment and Riparian Management Plan* and all other activities conducted by MMWD in compliance with SWRCB Order WR95-17 It is also intended to evaluate the results of those activities, to determine the effectiveness of the mitigation measures imposed by SWRCB Order WR95-17. This report summarizes activities through 2009. Some data from as early as the 1980s are included here. This report is not a requirement of Order WR95-17 and is not subject to SWRCB approval.

The *Lagunitas Creek Sediment and Riparian Management Plan* was approved by the District Board of Directors and by the SWRCB in the summer and fall of 1997, respectively. The plan was implemented for a period of ten years, 1997 – 2007, as originally intended. Many of the activities described in the plan continue to be implemented. Some programs and projects are still being conducted and all of the monitoring is still occurring. Also, Order WR95-17 does not specify an implementation period for most of its required elements, and all of those requirements will continue to be met.

1.3 Main Findings from the State Water Board Hearings for WR95-17

The raising of Peters Dam impounded more water, reducing peak flows and altering the timing of flows in Lagunitas Creek, downstream of Kent Lake. The studies and water rights hearings on Lagunitas Creek primarily focused on determining an instream flow regime that would mitigate impacts from the diversion of water in Kent Lake. A major objective of the water rights hearings was to establish instream flow standards that would protect the fishery resources of Lagunitas Creek. The SWRCB concluded that the District's water rights permits should be amended to require minimum flows for coho, steelhead, and California freshwater shrimp.

The studies and hearings also culminated with two main conclusions related to sediments and riparian habitat:

- The raising of Peters Dam changed the hydrograph of Lagunitas Creek and reduced the size and frequency of flushing flows that move sediments through the mainstem of Lagunitas Creek. The Kent Lake expansion reduced sediment transport capacity by an average of 10-20% (600 tons/year).

- Additional woody debris in the creek would improve fishery habitat and a riparian management plan would promote additional woody debris.

As a result of the altered hydrograph and reduced flushing capacities, sediments can accumulate in Lagunitas Creek, negatively impacting the fishery habitat. Sediments, particularly fine sediments, are detrimental to habitat by filling in pools that could otherwise provide rearing space for juvenile salmonids and California freshwater shrimp. The fine sediments can also accumulate in riffle habitats and smoother larger sediments (i.e., gravels and cobbles) that are utilized by coho and steelhead for spawning, thus reducing spawning habitat.

The past practice of large woody debris removal in the Samuel P. Taylor State Park area, resulted in the creek lacking woody debris, particularly through the State Park segment of the creek. Large woody debris is beneficial to coho and steelhead habitat in a number of ways: it results in deeper and more frequent pools, it accumulates smaller debris which provides shelter to smaller fish, and it creates backwater eddies that can be used as refugia during high flow events.

1.4 Elements of Order WR95-17

Order WR95-17 stipulates eleven requirements that relate to in-stream flows, sediment management, riparian management, monitoring, and reporting (see Appendix A):

1. Instream Flow Requirement

A schedule of minimum flows must be maintained at the U.S. Geological Survey (USGS) stream gage located in Samuel P. Taylor State Park (SP Taylor Park). During a normal water year, the minimum flow ranges from eight cubic feet per second (cfs) to 25 cfs, depending on the time of year. During a dry water year, the minimum flow ranges between six cfs and 20 cfs. In addition, a metered release of at least one cfs must be made from Kent Lake into Lagunitas Creek, directly below Peters Dam, at all times.

2. Upstream Migration Flows

Four upstream migration flows must occur, between November and February of each year, to provide for the upstream migration of anadromous fish. An upstream migration flow is at least 35 cfs for three consecutive days, at the USGS gage in SP Taylor Park.

3. Water Year Classification

A water year classification must be made that determines whether the year is normal or dry, and based on that determination, a minimum flow schedule shall be maintained. A normal year consists of a January 1st, 15-month index of 48 inches of precipitation and an April 1st, six-month index of 28 inches of precipitation. A dry year classification is defined as having rainfall amounts less than these indices.

4. Water Temperature

Mean daily water temperature, at the USGS gage in SP Taylor Park, must be at or less than 58 degree Fahrenheit during the summer months (May – October) and at or less than 56 degree during the winter months (November – April).

5. Special Circumstances

In the event the District determines that it cannot meet the flow and/or water temperature conditions, a process must be followed to notify and consult with the following agencies to attempt to develop an alternative operational plan: SWRCB, DFG, U.S. Fish & Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS).

6. Ramping

Water releases into Lagunitas Creek, from Kent Lake, must be controlled and minimize rapid changes in flow in Lagunitas Creek (i.e., reduce the potential for rapid increases or decreases in flow).

7. Control of Sediment

Prepare and implement a sediment control plan to reduce sedimentation in the Lagunitas Creek watershed. A draft and final plan must be developed in coordination with public agencies and allow for public review and input.

8. Riparian Management Plan

Prepare and implement a riparian management plan to improve riparian vegetation and woody debris within the Lagunitas Creek watershed. A draft and final plan must be developed in coordination with public agencies and allow for public review and input.

9. Monitoring Fishery Resources

Prepare and implement a workplan for monitoring the coho salmon, steelhead, and California freshwater shrimp populations of Lagunitas Creek. The plan must be developed in consultation with DFG, USFWS, and NMFS.

10. Gages

Ensure that a continuous record of daily stream flow and water temperature is maintained at the USGS gage in SP Taylor Park.

11. Reporting

Prepare and submit an annual report to the SWRCB that verifies the District's compliance with Order WR95-17, over the previous water year. The water year runs from October 1st through September 30th.

1.5 Goals of the Sediment and Riparian Management Plan

In response to the sediment and riparian management elements of Order WR95-17, the District combined these into a single plan; the *Lagunitas Creek Sediment and Riparian Management Plan* (MMWD 1997). In the Order, the SWRCB articulated what the goals for sediment management and riparian management were to be.

<u>Sediment Management</u>

Reduce sedimentation and provide an appreciable improvement in the fishery habitat within the Lagunitas Creek watershed.

<u>Riparian Management</u>

Improve the riparian vegetation and woody debris within the Lagunitas Creek watershed in order to improve habitat for fishery resources.

For the sediment and riparian management elements, the plan had to describe:

- specific sediment and riparian management programs and projects;
- party responsible for each program or project;
- estimated costs for each program or project;
- time schedule for implementation of each program or project;
- public participation process;
- monitoring program; and
- reporting procedures.

Following approval of an acceptable sediment and riparian management plan, the District was to provide the appropriate level of funding and resources to ensure effective implementation of the measures described in the plan.

<u>Monitoring Fishery Resources</u>

Monitor the coho salmon, steelhead and freshwater shrimp populations of Lagunitas Creek. Prepare a workplan that describes the scope of the monitoring studies to be conducted and provide sufficient funding and resources to assure satisfactory completion of the monitoring studies.

In response to this element of the Order, the District Developed and implemented the *Aquatic Resources Monitoring Workplan for the Lagunitas Creek Drainage, Marin County, California* (Trihey & Associates 1996). The workplan laid out four goals, all related to determining the status of each species and how MMWD actions and other management practices affect the aquatic resources of the Lagunitas Creek watershed. The four goals were:

1. To evaluate juvenile steelhead and coho salmon abundance in relation to MMWD management practices and/or SWRCB ordered mitigation measures;

2. To evaluate adult coho spawning and spawner returns in relation to MMWD management practices and/or SWRCB ordered mitigation measures;

3. To evaluate freshwater shrimp abundance in relation to MMWD management practices and/or SWRCB ordered mitigation measures; and

4. To evaluate the relationship between MMWD management practices and habitat conditions for aquatic resources.

1.6 Elements of the Sediment and Riparian Management Plan

There are four main components to the SRMP:

1. Site specific, on-the-ground, project work to reduce sedimentation and enhance instream and riparian habitat;

2. Monitoring efforts of project sites, pre- and post-construction, to evaluate project stability and effectiveness, and of aquatic resources and habitat;

3. Agency and public outreach efforts to collaborate and help support ongoing programs and projects, and to provide educational resource information; and

4. Policy development.

The SRMP acknowledges and reviews existing programs and projects in the watershed, being implemented by the District and others. The plan encourages continuation of those programs and projects.

<u>Sediment and Riparian Management Projects:</u>

- 35 sediment source control (i.e., erosion control) projects at sites throughout the watershed, including some in the San Geronimo Creek watershed, to reduce the load of fine sediments entering fish bearing streams.

- 43 large woody debris structures (i.e.,, large logs and boulders) installed and anchored at sites within the mainstem of Lagunitas Creek, to enhance instream habitat for salmonids.

- Seven riparian revegetation projects at sites along the banks of Lagunitas Creek, to improve shade cover over the creek, enhance instream habitat, and provide a future source of large wood for the creek.

Monitoring Programs

Project site monitoring has entailed:

- Site inspections of all project sites to determine if the sites are intact and stable;

- Snorkel surveys of woody debris project sites to evaluate use of the woody debris structures by salmonids and other fish;

- Stream bed mapping around the woody debris project sites to evaluate if and how the structures had affected stream bed depth (i.e., development of pool habitat, riffles, and/or gravel bars) at and in the vicinity of the structures;

- Site inspections and photographic documentation of riparian revegetation projects to record vegetation growth.

Fishery and aquatic resource habitat monitoring is described in greater detail below (see Section 1.7) and has included:

- Surveys for coho, steelhead, other salmonids and fish species;
- Surveys for California freshwater shrimp;
- Habitat typing surveys;
- Streambed and sediment monitoring surveys;
- Stream gage monitoring; and
- Water quality sampling

Outreach and Collaboration

The main vehicle for MMWD to conduct public outreach and collaboration has been through the Lagunitas Creek Technical Advisory Committee (TAC). The structure of the TAC is described below (see Section 1.8) and its revised charter and operating procedures are attached (Appendix B).

Policy Development

The District led efforts to prepare and approve two mulit-agency agreements, in the form of Memorandums of Understanding (MOUs), aimed at sediment reduction and riparian habitat management. Both MOUs were approved by six resource management agencies that are either land owners within the watershed or that have influence with private agricultural lands and other large, private land owners in the watershed. These agencies include:

- Marin Municipal Water District;
- County of Marin (County)
- Marin County Open Space District (MCOSD);
- California Department of Parks and Recreation (State Parks);

- National Park Service (NPS); and
- Marin County Resource Conservation District (Marin RCD).

Roads MOU - In 2001, MMWD initiated development of an MOU for Maintenance and Management of Unpaved Roads in the Lagunitas Creek Watershed (a.k.a., Roads MOU; Appendix C). The goal of the MOU is to manage and maintain unpaved roads in the most beneficial ways possible to minimize soil loss from dirt roads, reduce the potential for erosion, and reduce the amount of sediments entering the stream system. The MOU covers all unpaved roads throughout the watershed and distinguishes the watershed downstream of dams from the watershed upstream from dams, as the Primary and Secondary Resource Areas, respectively. Peters Dam, which forms Kent Lake, and Seeger Dam, forming Nicasio Reservoir, are the two dams that are the boundaries between the Primary (downstream) and Secondary (upstream) Resource Areas. In the case of the Roads MOU, the Marin County Fire Department (MCFD), Marin County Department of Public Works (DPW), and Marin County Community Development Agency (MCCDA) are also signatories to the MOU, acting through the Marin County Board of Supervisors (Supervisors).

Woody Debris MOU – In 2007, MMWD developed the MOU for Woody Debris Management in Riparian Areas of the Lagunitas Creek Watershed (a.k.a., Woody Debris MOU; Appendix D) The MOU established guidelines regarding the management and prioritization of naturally occurring woody debris and potential woody debris (i.e. standing trees), in riparian areas, for stream habitat enhancement. The guidelines are set out in an MOU attachment referred to as the *Best Management Practices for Woody Debris in Riparian Areas of Salmon Bearing Streams in the Lagunitas Creek Watershed*.

1.7 Elements of the Aquatic Resource Monitoring Workplan

The SWRCB Order directed the District to monitor the coho salmon, steelhead, and California freshwater shrimp populations in Lagunitas Creek. The District has taken this to mean it was to track the status and trends in the population of these species, along with trends in their habitats. Monitoring has been an important and major component of the SRMP. Each element is reviewed below.

<u>Juvenile Salmonid Surveys</u>

Juvenile salmonids are enumerated annually at a total of 13 sample sites: seven sites along the mainstem of Lagunitas Creek, two sites in Devil's Gulch, and four sites in San Geronimo Creek. These surveys have been conducted using a combination of electrofishing and snorkeling techniques.

<u>Spawner Surveys</u>

Salmon escapement and spawning activity are monitored each fall and winter. The surveys have been conducted weekly, weather and stream flow conditions permitting. Walking surveys are conducted through the mainstem of Lagunitas Creek, from Nicasio Creek to Peters Dam; through the mainstem of Devil's Gulch, from its mouth to about two miles upstream; and through the mainstem of San Geronimo Creek, from it's mouth upstream to Woodacre Creek. The District's spawner surveys have been coordinated with spawner surveys conducted by SPAWN and Trout Unlimited volunteers, through the fish-bearing tributaries to San Geronimo Creek and through the mainstem of San Geronimo Creek upstream of Woodacre Creek. In addition, the National Park Service has conducted spawner surveys through Cheda Creek, and through Olema Creek and its tributaries.

Shrimp Surveys

Annual surveys for California freshwater shrimp are conducted at eight sample sites in the mainstem of Lagunitas Creek. Shrimp have not been known to occur in Devil's Gulch or San Geronimo Creek so surveys were not conducted in these tributaries.

Habitat Typing Surveys

Habitat typing surveys along the mainstem of Lagunitas Creek, Devil's Gulch, and San Geronimo Creek are conducted every five years, or more frequently if heavy winters result in channel-forming flows.

Streambed Monitoring

Streambed sediment conditions have been monitored annually, following a streambed monitoring protocol. Streambed and sediment sampling has been conducted at eight sites along the mainstem of Lagunitas Creek, along with an annual reconnaissance walk-through of the mainstem of Lagunitas Creek from Tocaloma upstream to Shafter Bridge. Sampling at the eight sites included: surveys of the bed configuration and elevation; censuses of bed substrate conditions; sampling of sediment immediately beneath the bed; and analyses of sediment lithology to infer likely sources of the sediment by evaluating the proportion of various rock types in the bed gravels.

Stream Gage Monitoring

Stream flows have been monitored continuously at three stream gages: the USGS gage at SP Taylor Park; a second (and longer-running) USGS gage near Point Reyes Station; and an MMWD operated gage on San Geronimo Creek, in the town of Lagunitas.

Water Quality Monitoring

A water quality monitoring program has been conducted since 1995, consisting of monthly samples collected from four sites in the mainstem of Lagunitas Creek, Nicasio

Creek, and San Geronimo Creek. In addition, water temperature monitoring has been continuous at the USGS gage site in SP Taylor Park. Water temperatures have also been monitored intermittently at other locations in the watershed.

Other Species Surveys

Surveys for northern spotted owls and California red-legged frogs have been conducted at project sites in and around Lagunitas Creek. The spotted owl surveys have been part of a larger spotted owl monitoring effort, conducted in collaboration with the National Park Service, State Parks, and Marin County Open Space District.

1.8 Public Involvement during the Plan Implementation

Lagunitas TAC

In 1997, the MMWD Board of Directors established the Lagunitas Creek Technical Advisory Committee (TAC). The TAC served as the main forum for MMWD to conduct public outreach and collaboration on the Sediment and Riparian Management Plan. The TAC was established to review and provide input to MMWD regarding the implementation of the SRMP. Through this process, the MMWD Board hoped to ensure: 1) that MMWD benefited from the ideas and input of the committee members; 2) that interested agencies, community members, and the general public had access to information regarding the implementation of the plan; and 3) that the committee members and general public had adequate opportunities to comment on MMWD's implementation of the plan.

Under its original charter, the TAC consisted of representatives of interested agencies and environmental/community organizations. Each agency/organization was invited to have one representative and one alternate serve on the TAC, with all members approved by the MMWD Board. The TAC was chaired and staffed by MMWD. Former MMWD Board Member Jared Huffman chaired the TAC between 1997 and 2007 and was succeeded by Board Member David Behar in 2007 and 2008. The TAC met five times a year, including an annual field trip within the watershed.

Over the years, the TAC became a forum for sharing information and discussions on an array of issues pertaining to the management of the Lagunitas Creek watershed. In November of 2009, the TAC revised its charter and operating procedures (see Appendix B). The new charter broadened the focus of the TAC to discuss and advise other entities and activities in the Lagunitas Creek watershed, in addition to continuing to discuss and advise on District activities. The Chair now rotates amongst the participating entities.

Today the TAC is a collaborative, multi-party forum that provides its members the opportunity to leverage resources to implement programs and projects that will provide multiple benefits for water resources in the Lagunitas Creek watershed. The TAC serves as the information-sharing forum for its members on fisheries, water quality and ecosystem restoration issues in the Lagunitas Creek watershed, and the TAC offers advice to all of its members on optimal approaches to benefit the environment of the watershed.

2.0 DESCRIPTION OF THE LAGUNITAS CREEK WATERSHED

2.1 Drainage Basin Descriptions

<u>Lagunitas Creek</u>

Lagunitas Creek drains 103 square miles of west central Marin County, California and is the largest watershed in the county (Figure 1). The creek originates on Mt. Tamalpais and flows 22 miles before discharging into the southern end of Tomales Bay. There are four dams on the upper eight miles of Lagunitas Creek: Lagunitas Dam (built in 1872), Alpine Dam (1918), Bon Tempe Dam (1948), and Peters Dam (1954). Peters Dam, the most downstream of these dams, was raised in 1982, which made Kent Lake the largest of the water supply reservoirs operated by MMWD. Downstream of Peters Dam, Lagunitas Creek flows 14 miles and is accessible to anadromous fish. Several unregulated tributaries join the stream in this stretch including San Geronimo Creek, Irving Creek, Barnabe Creek, Deadman's Gulch, Devil's Gulch, Cheda Creek, McIsaac Creek, and Olema Creek. The most important of these unregulated tributaries for salmonids are San Geronimo Creek, Devil's Gulch, and Olema Creek. The other major tributary is Nicasio Creek, which is largely impounded by MMWD's Nicasio Reservoir. Seegar Dam (1960), which forms Nicasio Reservoir, is located approximately one mile upstream of the confluence with Lagunitas Creek; anadromous salmonids are supported within that one mile stretch.

Noteworthy landmarks along mainstem of Lagunitas Creek (going in a downstream direction) are: Peters Dam, Shafter Bridge, Inkwells Bridge (at the mouth of San Geronimo Creek), Irving Bridge, Samuel P. Taylor State Park campground and the campground bridge, Swimming Hole Bridge (i.e., the green bridge at Big Bend), Big Bend, Jewel, Tocaloma, the Tocaloma bridges (both the old bridge and newer Sir Frances Drake Boulevard Bridge), Platform Bridge Road, the Zanardi Ranch, Platform Bridge, the Point Reyes-Petaluma Road, the Gallagher Ranch and Gallagher bridge, Highway 1 Bridge, and the town of Point Reyes Station (see Figure 1). The U.S. Geologic Survey (USGS) topographic maps that cover the project vicinity are the Inverness, San Geronimo and Bolinas quadrangles.

The USGS operates two stream gage stations on Lagunitas Creek (Figure 2):

- Samuel P. Taylor State Park gage (station #11460400) located in Samuel P. Taylor State Park, about 1,000 feet upstream from the mouth of Devil's Gulch; and
- Point Reyes Station gage (station #11460600) located on the Gallagher Ranch, about halfway between the mouth of Nicasio Creek and the town of Point Reyes Station.

In addition, MMWD operates a gage station on San Geronimo Creek (station #K4) located at the Lagunitas Road bridge, in the lower quarter segment of the San Geronimo Creek drainage.

Between Shafter Bridge and Tocaloma, Sir Frances Drake Boulevard and a bike path (the old railroad grade; also called the Cross Marin Trail) run parallel to Lagunitas Creek, on opposite sides of the creek from one another. Between Tocaloma and the mouth of Nicasio Creek, Platform Bridge Road runs parallel to the east side of Lagunitas Creek with a dirt road (the old railroad grade) running along the west side. From the mouth of Nicasio Creek to Point Reyes Station, the Petaluma-Point Reyes Road follows the creek, along the northern side, with the old railroad grade and agricultural lands on the other side.

Downstream of Kent Lake, Lagunitas Creek is a perennial stream with minimum flows maintained by releases from Peters Dam. In summer, the wetted stream channel is generally about 20-50 feet wide with typical flow patterns of pools, glides, riffles, and runs. The substrate is a mix of sand/silt, gravel, cobbles, small boulders, and bedrock. The stream banks support a relatively dense forest dominated by redwood, bay, alder, tanoak, big leaf maple, boxelder, and willow. The understory layer is dominated by tree saplings with shrubs such as thimbleberry and dogwood, as well as blackberry and poison oak vines. The herbaceous layer is composed of ferns, nettle, and scattered tussocks of sedge. In some areas, the understory is a dense blanket of periwinkle.

Most of the land along mainstem Lagunitas Creek is publicly owned (see Figure 1). Landowners include MMWD, the California Department of Parks and Recreation (State Parks), and the National Parks Service (NPS). MMWD manages Lagunitas Creek and its watershed, upstream of the confluence with San Geronimo Creek, for water supply, habitat, and public use open space. Downstream of the confluence with San Geronimo Creek, the watershed runs through Samuel P. Taylor State Park, Golden Gate National Recreation Area, and privately owned parcels near the mouth. The State Parks land are managed for public recreation and habitat. The NPS lands are managed for habitat, public use open space, and as agricultural grazing lands. The private lands are mostly managed as agricultural grazing lands.

San Geronimo Creek

The San Geronimo Creek watershed is a 9.3 square mile sub-basin that is a mixture of residential development, public open space, and grazing lands. The majority of land within the San Geronimo Valley is privately owned, including residential properties, some grazing and other agricultural land, two horse stables, and the 158-acre San Geronimo Golf Course. The Marin County Open Space District owns and manages about 2,240 acres of open space lands that account for about 37% of the watershed (these lands include Roy's Redwoods, the Gary Giacomini Open Space Preserve, and the Maurice Thorner Memorial Open Space Preserve).

There are several important tributaries to San Geronimo Creek that support anadromous salmonids, including: Woodacre Creek, Willis Evans Canyon, Larsen Creek, Montezuma Creek, and Arroyo Creek. Within the mainstem of San Geronimo Creek, anadromous fish passage extends upstream to the Dixon Weir in Woodacre. MMWD owns a water treatment plant and the surrounding land along the creek. There are seven bridge crossings of San Geronimo Creek: Railroad Avenue, San Geronimo Valley Drive, Creamery Road, Meadow Way, Montezuma Road, Mountain View Avenue, and Lagunitas Road. Other notable landmarks include the San Geronimo Golf Coarse, Roy's Pools, Castro Pool, MMWD's Lagunitas Booster Station, and the Inkwells. San Geronimo Creek merges with Lagunitas Creek at Shafter Bridge just below the bedrock feature known as the Inkwells. The confluence is approximately ½ mile below Peters Dam.

Nicasio Creek

The Nicasio Creek watershed is a 37 square mile sub-basin and the largest tributary to Lagunitas Creek. The watershed is made up almost entirely of privately owned properties that are managed as agricultural ranch and residential lands. The watershed is notably less densely forested than the rest of Lagunitas Creek, although there is a fairly densely wooded riparian corridor along the one-mile stretch of Nicasio Creek that is downstream of Seeger Dam. There are no tributaries that enter Nicasio Creek downstream of Seeger Dam. Along this one-mile stretch, the creek is crossed twice by Point Reyes-Petaluma Road. A small cement processing plant at the confluence of Nicasio Creek and Lagunitas Creek is the most notable landmark below Seeger Dam.

Olema Creek

The Olema Creek watershed is a 14.5 square mile sub-basin with Olema Creek flowing in nearly a straight line through the rift valley of the San Andreas Fault. Most of the watershed is NPS land, managed for habitat, public use open space, and agricultural grazing. The town of Olema is situated in the lower portion of the drainage. The most important tributary is the John West Fork of Olema Creek, which supports anadromous salmonids. Olema Creek is crossed by Bear Valley Road, in the town of Olema, and John West Fork is crossed by Highway 1.Olema Marsh at the confluence of Olema Creek, Bear Creek, and Lagunitas Creek is one of the largest freshwater marshes in Marin County. In the early 1920s, Olema Creek between the town of Olema and its confluence with Lagunitas Creek was straightened into the three-kilometer long "Olema Canal" that drained the surrounding land for agricultural production. Olema Creek is currently reclaiming its historic configuration in an interesting example of restoration through a change in management, which in this case consists of no longer maintaining the straightened channel.

At the mouth of Lagunitas Creek are the Giacomini Wetlands, an area covering 550 acres that until recently had been diked, drained and managed as a dairy ranch. In 2008

NPS removed levees, reestablished tidal action, and restored estuarine habitat that is once again available to salmonid smolts and many other species.

2.2 Watershed Resources

The Lagunitas Creek watershed is of statewide significance for coho salmon (*Onchorynchus kisutch*), steelhead trout (*O. mykiss*), and California freshwater shrimp (*Syncaris pacifica*). The Central California Coast Evolutionarily Significant Units (ESUs) of coho and steelhead have been listed as endangered and threatened, respectively, under the federal and California Endangered Species Acts. The California freshwater shrimp is listed as endangered under both state and federal ESAs.

Coho salmon populations have declined substantially from historic levels throughout their California range. Coho are now found in fewer than half of the streams they once inhabited in California. Although present coho numbers in Lagunitas Creek watershed are considerably lower than historic levels, the watershed supports the largest and most stable coho population south of the Noyo River (Mendocino County, CA) and is of great importance to the Central California Coast ESU. Coho salmon are anadromous fish that spend their adult life in the ocean and migrate up freshwater streams to spawn from late October to early February. Their eggs hatch and the fry emerge in the late winter and early spring. After rearing for about a year in freshwater, juvenile coho migrate to the ocean, transitioning to smolts during their outmigration.

Lagunitas Creek also supports an important population of Central California Coast steelhead. Steelhead numbers have also declined throughout their range in California, but in Lagunitas Creek, as well as other small coastal streams, they have not declined as dramatically as coho. Steelhead are an anadromous form of rainbow trout and utilize the Lagunitas Creek watershed for spawning and rearing much as coho do, though the species' life histories differ in a couple of important ways. Steelhead juveniles spend one to three years rearing in freshwater, whereas coho generally migrate to the ocean after one year. Also, adult steelhead often survive spawning, return to the ocean, and spawn again in a later year, whereas coho die after spawning.

Resident rainbow trout are not specifically known to occur in Lagunitas Creek, downstream of any reservoirs, but there has not been any systematic sampling and analysis (i.e., otolith analysis) of fish in the upper tributary drainages to confirm that they do not have any resident rainbow trout. The four mainstem Lagunitas Creek reservoirs (Lagunitas, Bon Tempe, Alpine, and Kent) have all been stocked with hatchery-raised rainbow trout at various times. Lake Lagunitas and Bon Tempe Reservoir are regularly stocked with catchable-size rainbow trout, between the months of October and June. Kent Lake was periodically stocked with rainbow trout fingerlings up until May 2002 and has not been stocked since. Stocking of fingerlings into Alpine Lake continued but it was last stocked in May 2004. The 1.5 mile section of Lagunitas Creek between Alpine Dam and Kent Lake does support a population of self-sustaining (i.e., reproducing) rainbow trout. Juvenile trout observed in the spring and summer of 2005 appeared to be the offspring of trout spawning in this section of the creek. There have also been juvenile trout observed in the tributary streams to Lake Lagunitas (East, Middle, and West Fork Lagunitas Creek) that appeared to have hatched in the creek, as opposed to being planted fry.

The California freshwater shrimp is endemic to lowland, perennial streams in Marin, Napa, and Sonoma Counties. Human related impacts including channelization, introduced fish predators, pollution, and water withdrawal have extirpated the shrimp from the majority of the habitat within their historic range. Lagunitas Creek has one of the largest remaining populations of California freshwater shrimp and is the only shrimp stream to run through protected lands making it a significant stronghold for the only extant *Syncara* species.

A small array of other native fish species inhabit Lagunitas Creek and its tributaries, including Tomales roach (*Lavinia symmetricus*), Sacramento sucker (*Catostomus occidentalis*), Pacific lamprey (*Lampetra tridentata*), three-spined stickleback (*Gasterosteus aculeatus*), prickly sculpin (*Cottus asper*), riffle sculpin (*C. gulosus*), and coast range sculpin (*C. aleuticus*). The lamprey, like the coho and steelhead, is an anadromous species.

Chinook salmon (*O. tshawytscha*) and chum salmon (*O. keta*) have been observed in Lagunitas Creek in recent years. Ranchers in the watershed also report having seen these salmonids in the 1960s and '70s. The Chinook salmon that have been observed are a fall-run population, which are listed as threatened within the Coastal California ESU. However, this ESU ends at the Russian River and does not extend down to include the Lagunitas Creek watershed, so the status of the Chinook that have been observed in the creek is uncertain.

Other special status species that occur in the watershed include the spotted owl (*Strix occidentalis,* threatened), California red-legged frog (*Rana draytonii,* threatened), foothill yellow-legged frog (*R. boylii*, California Species of Special Concern), and tidewater goby (*Eucyclogobius newberryi,* endangered). Surveys for spotted owls have determined that they occur within Marin County in fairly high density with several nesting pairs occupying territories in the Lagunitas Creek watershed. Red-legged frogs occur within the Olema Creek drainage and the tidally influenced portion of mainstem Lagunitas Creek, and have only rarely been observed elsewhere in the watershed. The foothill yellow-legged frog occupies a couple of tributary streams to Kent Lake and may sporadically occur in streams throughout the watershed. The tidewater goby has been documented in the tidal estuary of Lagunitas Creek (Reichmuth 2007).

Notable aquatic species that also occur in the watershed include river otter (*Lutra canadensis*), California giant salamander (*Dicamptodon ensatus*), California and rough-skinned newts (*Taricha torosa* and *T. granulosa*, respectively), northwestern pond turtles (*Actinemys marmorata marmorata*; California Species of Special Concern), and the non-native signal crayfish (*Pacifasticus leniusculus*). In addition, there are other amphibians and a myriad of macroinvertebrate species

2.3 Land Ownership within the Watershed

The land ownership status within the watershed is depicted on Figure 1. The lands are roughly: 23% Federal (NPS); 4% State (State Parks); 23% MMWD; 3% Other Public (MCOSD); and 47% Private.

The watershed lands below Kent Lake and Nicasio Reservoir consist of public lands owned and managed by Marin Municipal Water District, California State Parks, National Park Service, and Marin County Open Space District. There are also privately owned lands. The public lands are managed as open space lands for natural resource protection, recreation, transportation, and some grazing. The privately owned lands are managed for agriculture (mostly grazing) and low density residential development. Historic land uses included some timber harvest, limited gravel extraction (in and around Tocaloma only), and a variety of agricultural uses. The towns within the San Geronimo Valley, at Nicasio, Point Reyes Station, and Olema support residential development, small businesses, and schools.

Above Kent Lake, the watershed lands are entirely owned by MMWD and are managed as open space lands for water supply, natural resource protection, and recreation. Above Nicasio Reservoir, the watershed is mostly in private ownership, with MMWD lands limited to Nicasio Reservoir and a surrounding perimeter of land. The private lands are managed for agriculture and rural residential development, along with the Town of Nicasio.

3.0 PROJECTS IMPLEMENTED

3.1 Summary and Review of Projects

Project work conducted under the Sediment and Riparian Management Plan is characterized as listed below:

Sediment Management Projects		
Sediment Source Control	-	33 Sites
Sediment Traps	-	2 Sites
Gravel and Cobble Placement	-	2 Sites
Riparian Management Projects		
Large Woody Debris (LWD)	-	65 Structures
Riparian Revegetation	-	8 Sites

A listing of all projects is shown in Table 1. This indicates that most of the sediment management projects and all of the riparian management projects have been completed. Each year, individual projects were implemented and an annual review of project work is presented in Table 2. A summary of projects, by project type, is shown in Table 3. A more detailed review of the sediment management projects is provided in Table 4.

3.1.1 Sediment Management

The SRMP called for implementing erosion control work at 34 sites throughout the watershed (Figure 3), removing sediment periodically from four sediment traps, and enhancing streambed spawning conditions by placing gravel and cobbles at four sites. The work completed to date has included sediment source control work at 33 sites, sediment removal from two sediment traps, and gravel placement at two sites. The objectives of the sediment management projects have been to:

- Control fine sediment at its source;
- Trap fine sediment before it enters anadromous fishery areas; and
- Increase the supply of beneficial size gravel and cobble to the reach of Lagunitas Creek between Peters Dam and Shafter Bridge.

<u>Estimated Sediment Reduction</u>

The sediment source reduction projects have stabilized an estimated 357 tons/year of sediment that would have otherwise entered the stream; and maintaining the sediment traps has removed approximately 1,240 cubic yards of sediment (see Table 1).

Sediment source control projects have consisted of installing headcut and gully stabilization treatments, bank stabilization treatments, road drainage improvements, and road removal/decommissioning.

3.1.2 Riparian Management - Woody Debris Projects

The SRMP called for the construction of 42 large woody debris (LWD) structures in Lagunitas Creek (Figure 4). The objectives of these structures included:

- Increasing pool habitat (both increasing pool frequency and pool volumes);
- Trapping small debris to provide cover and refuge from predators;
- Creating backwater eddies to provide flow refuge; and
- Retaining gravels in shallow waters at LWD sites, to enhance spawning habitat.

MMWD began installing LWD in 1998 and by 2003 had constructed 45 structures. Then during the winter of 2005-06 18 structures were destroyed by high stream flows. MMWD replaced 13 of those structures in 2006 and 2007, as well as constructing an additional structure (WD-32a) to compensate for a structure (WD-32) that wasn't performing as well as intended. By 2007 MMWD had constructed 60 LWD structures in Lagunitas Creek, including replacements for two structures destroyed in 2001 and 2002, at a total cost of over $660,000. Five structures were built in 2009, which completed the replacement of structures destroyed in 2005-06, and brought up to 65 the total number of individual LWD structures constructed under the Plan.

3.1.3 Riparian Management - Riparian Revegetation Projects

Revegetation along the stream banks of Lagunitas Creek was completed at seven sites, most of which were along the segment between Peters Dam and Shafter Bridge. Native riparian tree and shrub species were planted after first removing (by hand) the non-native periwinkle from the planting sites. The plantings consisted of redwood, alder, ash, bay, big leaf maple, buckeye, hazelnut, and thimbleberry.

The largest riparian revegetation project was implemented at site R7. Located along the mainstem of Lagunitas Creek, between Tocaloma and Nicasio Creek, the project was intended to revegetate a 130-foot long eroding bank that had been threatening Platform Bridge Road,. A willow brush mattress with seven LWD structures was installed along the eroding bank. The project was also expanded upstream, where additional revegetation with LWD structures were installed.

3.2 Project Trade-Offs/Substitutions

The SRMP allowed for flexibility in the selection, timing, and implementation of specific sediment and riparian management projects. These provisions recognized that watershed conditions might change and make implementation of a specific measure infeasible and need to be substituted by another project. Sediment source sites might also become more or less active and shift their priority level and new sediment sources might develop and become priority sites. Also, landowners might not allow the District to implement a project on their property. If any of these conditions arose with a project site then MMWD was to seek to implement an equivalent project on a different site.

Over the course of the plan period, five sediment source sites have been substituted with other project work. All five sites are in the Devil's Gulch drainage and include site numbers 13.7, 13.17, 13.40, 13.66, and 13.115 (see Table 1). These sites have been substituted with road drainage improvement work within the Devil's Gulch drainage. Site 13.7 was dropped at the suggestion of Lagunitas TAC, which recommended sediment control measures at this site not be implemented. Site 13.7 is on an unnamed tributary to Devil's Gulch that is upslope from the Devil's Gulch road, in SP Taylor Park and it was determined that it was not worth the effort and impacts to the hillslope and forest in this area to implement. Site 13.40 is not connected to a drainage and may not deliver sediment to Devil's Gulch. Site 13.66 was intended to be a sediment basin where the Devil's Gulch road crosses a tributary stream but this crossing was removed and so can not be developed as a sediment trap. The area at site 13.115 was regraded and converted to a vineyard and is no longer a significant source for sedimentation. These five project sites were substituted with equivalent sediment reduction work through 3.5 miles of road drainage improvements along the entire Devil's Gulch road (the 2.3-mile road that runs parallel to the creek, through S.P. Taylor Park and on up through NPS lands) and the Devil's Gulch ranch road (the 1.3-mile road that runs out along the ridge to the west of the creek, on NPS lands). The road drainage improvement work was identified during a 2005 assessment by Pacific Watersheds Associates (PWA 2005). This includes work at 27 discrete treatment sites, along with road shaping (i.e., outsloping and rolling dips) at various locations along the entire 3.5 miles of roads. The 8.5 tons/year of estimated sediment yield, from the four sites, plus the 400 cubic yards of storage at the 13.66 sediment trap, were substituted with the road drainage improvement efforts that would amount to an estimated 3,138 cubic yards of future sediment yield being stabilized. The road drainage improvements were completed at nine of the 27 treatment sites in 2006, along the Devil's Gulch road through SP Taylor Park. The remaining improvements, on NPS lands, are still outstanding project work (see Section 3.4 below).

Riparian revegetation site R6 was implemented at woody debris site WD-13, which was less than ¼ mile downstream from where it had originally been planned. The original site was immediately downstream of Shafter Bridge, where the bank substrate was quite rocky and where there was already good alder and willow growth. The stream bank at WD-13 had been destabilized when the huge redwood tree, used for WD-13, had fallen over. This location seemed to provide more benefit for the riparian canopy and also served to help stabilize the stream bank.

All of the woody debris structures were constructed at the site identified in the plan, or at a site in very close proximity to it. Several of the woody debris structures were designed somewhat differently than had been initially described in the plan. However, most of the descriptions for the woody debris structures were conceptual, with goals identified but not specifically designed. One factor that led to a change in design concept was the U.S. Fish & Wildlife Service concern that channel-spanning structures, could potentially impede the movement of California freshwater shrimp, so we generally stayed away from that type of design. The other and more important factor is that our effectiveness monitoring has identified successful woody debris designs, and we have attempted to replicate those successes. Each year, we reviewed the woody debris structures with the Lagunitas TAC and we gained concurrence from the TAC on all of the woody debris structures.

3.3 Related Additional Project Work

The District has implemented a considerable amount of additional project work in the Lagunitas Creek watershed that was not called for in the SRMP, but that had similar goals. Most of this additional project work was funded, in part, through grants from DFG, through their Fisheries Restoration Grants Program (FRGP), or from the RWQCB, through Proposition 13. Each had considerable cost share contributions from MMWD.

3.3.1 Additional Sediment Management Work

<u>San Geronimo Creek Watershed Planning Program (2002)</u>

This study and planning effort conducted a sediment source site assessment of the entire San Geronimo Creek Watershed. The study, led by Stetson Engineers and coordinated with MMWD and MCOSD personnel and private citizen volunteers, identified 298 sediment source sites in the watershed during the summer and fall of 2001. Stetson Engineers identified the 75 top sediment producing and field priority sites and selected the 27 highest sediment producing sites that appeared to have suitable repair feasibility and repair access. These 27 sites were further evaluated to allow Stetson to select the top ten sediment producing sites to be pursued for repair and stabilization. The project also included a review and summary of the hydrologic record for San Geronimo Creek, back to 1979, and an analysis of stream temperatures at four monitoring locations within the mainstem of the creek.

<u>Lagunitas Creek Watershed Roads Improvements – MMWD Lands Project (2003)</u>

Implemented between 2001 and 2003, this project consisted of watershed road work to reduce sedimentation into the Lagunitas Creek system. Four dirt roads were identified, all within the portion of the Lagunitas Creek watershed that drains downstream of Kent Lake and into coho salmon and steelhead trout habitat. The four dirt roads that were targeted for improvements included:

1. Shafter Grade, from near Shafter Bridge to Bolinas Ridge (about two miles in length) The work included surface improvements such as rolling dips, outsloping where possible, and drainage improvements.

2. Bolinas Ridge Road from above Kent Lake to Samuel P. Taylor State Park (about one mile in length) received similar improvements as Shafter Grade.

3. San Geronimo Ridge Road from Shafter Bridge to Woodacre (about four miles in length). This road received similar treatments as Shafter Grade and Bolinas Ridge.

4. Shafter Knoll Abandoned Road above Shafter Bridge on San Geronimo Ridge (about one mile). This abandoned road was decommissioned by removing culverts and restoring drainage crossings to the original contour, stabilizing the cut slopes on the uphill side of the road surface, and closing off each end of the road by replacing the material that was previously graded to develop the road surface, thus restoring the original contour.

San Geronimo Creek Bank Stabilization Project (2005)

Two segments of stream bank erosion along San Geronimo Creek were stabilized in 2005, utilizing biotechnical bank stabilization techniques. These were two of the top ten highest priority sites that had previously been indentified and prioritized by Stetson Engineers in the 2001 – 2002 San Geronimo Creek Watershed Planning Program. They were identified as sites ST-3 and ST-8, indicating third and eighth highest priorities. Both segments are along the mainstem of San Geronimo Creek, through and immediately downstream from MMWD's San Geronimo Treatment Plant, in Woodacre.

Site ST-3: A 200-foot section of stream bank was stabilized by regrading a steep, nearly vertical, eroding stream bank, installing a willow brush mattress and incorporating large woody debris in the creek channel. Upstream from this, a deeply undercut bay tree was stabilized by filling the cavity beneath it with redwood logs and boulders; the logs were placed to allow for crevices to still be utilized by fish as flow refuge habitat.

Site ST-8: The other stream bank segment entailed installing a 60-foot long log crib-wall under a very large, deeply undercut oak tree. The crib wall is about eight feet tall and made from redwood logs, backfilled with rip-rap. Live willow cuttings were incorporated into the toe of the crib wall. The slope above the wall was stabilized with erosion control fabric and planted with native riparian trees and shrubs.

Lagunitas Creek Watershed Sediment Reduction and Enhancement Project–GIS (2007)

In 2005-2007, MMWD compiled a GIS dataset of all roads in the Lagunitas Creek watershed. This was a task initially identified in the Roads MOU. The project had two goals: 1) utilize Geographic Information System (GIS) technology to develop a comprehensive dataset of the road and trail network within the watershed, and 2) apply GIS tools in a series of analyses that could evaluate the potential sediment contribution from these roads. The roads GIS provides the basis for multiple agencies and organizations to track road management activities in the watershed, recording assessments, drainage improvements, and maintenance and monitoring activities.

Lagunitas Creek Sediment Reduction - Peters Dam Area (2008)

This project implemented road repairs at 28 high priority sediment reduction project sites, on MMWD lands, that collectively reduced road-related sediment delivery into Lagunitas Creek by 4,000 to 6,000 cubic yards. Work for this project was completed in 2008. The specific project sites were initially identified by Pacific Watershed Associates (PWA) through the District's *Mt. Tamalpais Watershed Assessment and Erosion Prevention Plan* (PWA 2003). The project sites were further described in the *Mt. Tamalpais Watershed Road and Trail Management Plan and Associated Program EIR* (MMWD 2005). These sites were road related erosion sites located on MMWD lands that drain to Lagunitas Creek (i.e. downstream of Peters Dam).

3.3.2 Additional Riparian Management Work

LWD Structures WD-32A (2006) and WD-43 (2000)

Two large woody debris structures were constructed by MMWD that had not been described in the SRMP. LWD site WD-32A was installed in 2006, after the State Parks staff removed a very large douglas fir tree that had been identified as a hazard tree in their main picnic area. Following the guidance in the woody debris MOU, State Parks and MMWD collaborated to retain this doug fir tree and incorporate it into a LWD structure in Lagunitas Creek. LWD site WD-43 was installed in 2000, after two redwood logs had fallen across the channel of Lagunitas Creek. The logs spanned across the channel and were hung up on the banks, about ten feet above the summer low-flow channel. The logs were in a very straight, uniform section of the creek that had limit habitat complexity. The District dropped and anchored these logs into the channel. Within the first year, that channel had become quite complex and the structure had captured smaller debris that provide cover for fish.

Lagunitas Creek Riparian Management Projects - State Lands (2003)

This project, implemented in 2002 & 2003, establish native riparian vegetation along 500 ft. of stream bank in Samuel P. Taylor Park. The intent behind planting this particular section of stream back was that the District had installed woody debris structure WD-37/38 through this segment of stream with some open canopy. The riparian plantings of redwood, alder, willow, and other tree and shrub species would, over time, provide shade and cover to be associated with the woody debris habitat.

3.4 Outstanding Project Work

The road drainage improvement work along the unpaved roads in the NPS lands of Devil's Gulch still remains to be completed. This includes site specific treatments at 18 sites along the Devil's Gulch road and the Devil's Gulch Ranch road. Three of these 18 treatment sites are the same as three of the sediment control sites identified in the SRMP: sites 13.87, 13.104, and 13.108 (see Figure 3). The repairs for these 18 treatment sites, and the other road shaping work along the roads, was first proposed for implementation in 2005 but it has been held up in the permitting and approval process and MMWD has not been granted all of the necessary permissions to implement this work. Once started, the work will likely take two seasons to complete so it should be done by 2012, if not sooner.

Sediment source site SG-6, on San Geronimo Creek, has had some biotechnical bank stabilization work completed on it but a full bank stabilization, as described in the SRMP, has not been implemented. A headcut associated with this erosion site has been stabilized and some riparian revegetation has been implemented. This work was conducted by the Marin RCD though an agreement with MMWD for the San Geronimo Sediment Reduction program. That work was implemented in 1996 and has remained in place. A proposal to further stabilize the bank with a sackrete and rip-rap structure was not permitted. A follow-up proposal to regrade the bank was approved but has not been implemented by the District. This effort would extend onto the adjoining property and landowner approval has not been granted.

Sediment source site 12.13, along the Cross-Marin Trail on NPS land has also not been implemented. This is a small drainage culvert under the roadway of the trail. This site was discussed with NPS but no specific repair plan was implemented.

4.0 MONITORING EFFORT

The District's monitoring activities, conducted under the Sediment and Riparian Management Plan, have been extensive and conducted over a long time period (Table 5). This represents one of the largest and longest data sets for any stream in coastal California. The results and analyses of the monitoring effort are presented in the sections that follow (see Sections 5.0 through 9.0).

The monitoring effort has included the following elements:

Hydrologic Monitoring
- Frequency: Continuous Monitoring
- Locations:
  - USGS gage at SP Taylor Park
  - USGS gage at Point Reyes Station
  - MMWD Stream Gage on San Geronimo Creek
  - MMWD Gage on Kent Lake Release Structure

Fish Population Monitoring
- Frequency: Annual Surveys
- Locations:
  - Mainstem Lagunitas Creek (Gallagher Ranch to Peters Dam)
  - Mainstem San Geronimo Creek (Mouth the Woodacre Creek)
  - Devil's Gulch
- Surveys:
  - Juvenile Salmonid Electrofishing and Snorkel Surveys
  - Salmon Spawner Surveys (redds, adults and carcass counts)
  - Salmon Smolt Monitoring (Lagunitas Creek rotary screw trap)

California Freshwater Shrimp Population Monitoring
- Frequency: Annual Surveys
- Location: Lagunitas Creek mainstem
- Survey: Total capture analysis

Habitat Monitoring
- Frequency: Every 5 years or following winters with channel-forming storm events
- Locations:
  - Lagunitas Creek mainstem(Highway 1 Bridge to Peters Dam)
  - San Geronimo Creek (Mouth to Woodacre Creek)
  - Devils Gulch
- Survey: Habitat typing (DFG protocol)

Woody Debris Effectiveness Monitoring
  - Annual Surveys
  - Stream bed depth surveys around constructed LWD structures

    - Pre- and Post- construction surveys
    - Winter flow refuge assessments

Water Temperature Monitoring

- Frequency: Continuous Monitoring
- Locations:
    - Lagunitas Creek mainstem at the SP Taylor Park stream gage
    - 5 other locations
        - San Geronimo Creek; 4 locations
        - Devils Gulch; 1 location
        - Olema Creek; 1 location

Water Quality Monitoring

- Frequency: Monthly grab samples
- Locations: Four locations (mainstem Lagunitas Creek, 2 sites; Nicasio Creek; and San Geronimo Creek)
- Survey: Eight parameters (temperature; pH; turbidity; alkalinity; hardness; copper; total suspended solids; and settleable solids)

Sediment & Streambed Monitoring

- Sediment and Streambed Surveys
    - Annual Surveys
    - Lagunitas Creek mainstem; 8 sample sites
    - Reconnaissance surveys
    - Stream bed elevation surveys
    - Bed surface composition sampling
    - Sub-surface bed composition sampling
    - Rock –type (lithology) analyses
- Bed Scour Surveys
    - Scour chain monitoring 2002 – 2006
    - Lagunitas Creek mainstem; 5 sample sites
- Fine Sediment Study
    - Focused study 2004-2006
- Sediment Transport Monitoring
    - Annual monitoring
    - MMWD's San Geronimo Creek stream gage
    - Bedload sediment discharge measurements
    - Suspended sediment discharge measurements
- Sediment Source Investigations
    - Six independent sediment source surveys between 1987 and 2007
    - Field surveys to identify sediment source sites (erosion sites)
    - Middle and upper Lagunitas Creek watershed
    - San Geronimo Creek watershed
    - Devils Gulch watershed

5.0 INSTREAM FLOWS & WATER QUALITY

5.1 Hydrologic Record

The District complied with the instream flow condition specified in Order WR95-17 by maintaining a metered release of at least one cubic foot per second (cfs) from Kent Lake, at Peters Dam, at all times and maintained the minimum instream flows at the U.S. Geological Survey (USGS) gaging station at Samuel P. Taylor State Park (SPT).. Discharge graphs from the SP Taylor gage (Figure 5) and the Point Reyes Gage (Figure 6) are presented from USGS records. These graphs display the mean daily discharge, for water years 1996 – 2009, and the annual, instantaneous peak discharge, for the period of record through water year 2009.

For our monitoring purposes, MMWD determines the flow values on a daily basis, calculated from the 7:00 a.m. readings of the SP Taylor Park gaging station's telemark encoder. These readings are used to determine the rate of release from Kent Lake that will be needed each day in order to meet the SWRCB Order requirements. These daily calculations are considered representative of mean daily flows but they are not necessarily the mean daily flows calculated at the end of the water year by USGS. The annual water year discharge graphs, based on our daily calculations, are presented in Appendix E. Each graph covers a particular water year, from October 1 to September 30. Each graph compares actual daily flows in Lagunitas Creek, at the SP Taylor gaging station, with the flows released from Kent Lake, and the required flows under Order WR95-17. The vertical scale on the graph has been truncated at 100 cubic feet per second (cfs) to show greater detail in the 0-100 cfs range.

Lagunitas Creek Flows

Between water years 1996 and 2009, winter stream flows at the USGS gage in SPT peaked at a median of about 1,800 cfs during the height of the most severe storm event in each year (see Figure 5). The most severe events occurred during water years 1998 and 2006, when flows at the SP Taylor Park gage peaked at around 6,000 cfs and 10,000 cfs, respectively. Winter flows in Lagunitas Creek are most profoundly influenced by San Geronimo Creek, Kent Lake spills, and Nicasio Reservoir spills (which influence the Point Reyes Station gage; see Figure 6).

Kent Lake spilled over Peters Dam in most water years since the 1995 SWRCB Order was issued. The volume and duration of spills have varied from a short-term sheet flow, just cresting over the spillway, to an extended raging torrent (as occurred during the 2006 New Year's storm). An assessment of average daily Kent Lake spills of greater than 300 cfs and 600 cfs (Figure 7) provides an indication of when significant sediment movement and pool scouring may have occurred.

Summer flows at the SP Taylor gage have been maintained at eight cfs since the SWRCB Order of 1995. San Geronimo Creek contributes very little flow during the summer so the eight cfs base flow has been maintained almost entirely by Kent Lake releases. The summer base flow creates stable water surface elevations and wetted channel widths, which has simplified monitoring activities such as habitat typing surveys, woody debris monitoring and sediment and streambed surveys. Channel geomorphic conditions can be assessed with consistency due to the stable summer base flows.

San Geronimo Creek Flows

Stream flows records from MMWD's San Geronimo Creek stream gage are also presented as a discharge graph (Figure 8) for water years 1980 - 2007 and as a summary table of the hydrologic record for water years 1980 – 2009 (Table 6). Winter flows in San Geronimo Creek have peaked at greater than 1,000 cfs during most water years between 1996 and 2009. The storm events of 1998 and 2006 raised San Geronimo flows to around 2,000 cfs and 4,000 cfs, respectively.

Most notable of San Geronimo Creek are the very low summer flows. Summer flows are typically far less than one cfs and the minimum flows typically drop below 0.1 cfs (see Table 6). During the summer, San Geronimo Creek can become a series of pools connected by a trickle of water. Usually, pools are filled and spill, with a continuous flow of water but during the summers of 2008 and 2009, some riffles sections of San Geronimo Creek did go dry.

5.2 Upstream Migration Flows

The four required upstream migration flows (UMF), between November and February, were met each year. The November UMFs were met with supplemental releases from Kent Lake in all but one year since the 1995 SWRCB Order (Table 7). Those UFMs occurred in mid-November in nine years and in late November in four years. The December UMFs, which must occur at the beginning of December, were met with supplemental Kent Lake releases in eight years. The January and February UMFs were met with supplemental releases in three years and only one year, respectively. The rest of the time, the UMFs were met by storm runoff.

During the four-year period of 1999 to 2002, the November UMF occurred in late November. MMWD specifically requested the SWRCB allow MMWD to delay the start of the first artificial upstream migration flow from November 15th to November 27th. The purpose for delaying the November flow was to increase the likelihood of a coincident storm event with the November upstream migration flow. Our experience had been that delaying the timing of the first artificial upstream migration flow, and having the flow coincide with a storm event, appeared to be beneficial to spawning coho salmon. This modification was recommended and supported by the Lagunitas Creek TAC. The SWRCB was not enthusiastic about making any permanent changes to the Order but were more positive about allowing temporary changes each year. However, the

SWRCB eventually determined that there is no mechanism to allow for temporary modifications so, after four years, we went back to the schedule specified in the Order.

The UMFs were intended to ensure that there would be sufficient volume and depth of water in Lagunitas Creek for migrating adult salmonids to pass through riffles. Our adult spawner surveys documented that adult salmonids are able to pass at least up to Shafter Bridge with flows of eight cfs and they do not need the 35 cfs flows to pass through the creek. A secondary interest in the UMFs, although not a specific goal, has been whether they act as attraction flows to entice adult salmonids to migrate upstream to spawn. Our evaluations have indicated that the UMFs by themselves (i.e., without any coinciding storm runoff event) have little to no influence on adult salmonid spawning migration. Few adult salmonids were observed migrating upstream and spawning following most of the UMFs and a strong response was observed in only one year (see Table 7). The UMFs do not appear to be an attraction flow to entice salmonids to migrate upstream in Lagunitas Creek.

5.3 Water Year Classification

Since the issuance of the 1995 SWRCB Order, rainfall has been sufficient to classify every year as a "normal" rainfall year (Figure 9). There has been at least 28 inches of rainfall by the April 1st, six-month index and at least 48 inches of rainfall by the January 1st, 15-month index. The rainfall accumulations have been above the “dry year” conditions in every year. The annual rainfall index charts are presented in Appendix E.

5.4 Water Temperatures

Summertime water temperatures in Lagunitas Creek have been the one condition under Order WR95-17 that has been difficult to comply with at all times. In every year since the issuance of the SWRCB Order, summertime water temperatures, during the hottest days of the summer, have exceeded the May-October requirement of 58 degrees Fahrenheit. The water temperature during these hottest days has ranged between 59 and 65 degrees but in most days, the temperature exceeds the 58 degree threshold by only a few degrees. Water temperatures have exceeded the summer threshold from a low of only six days in 2001 to 59 days in 2006 (Figure 10). The annual summaries of mean daily water temperature data, collected by the District at the SP Taylor Park gage, and at the Kent Lake water release structure, are presented in Appendix E.

Winter time water temperatures are not a concern. The mean daily water temperature has exceeded the WR95-17 winter (November-April) requirement of 56 degrees infrequently and for relatively short periods of time, in March and April. In Water Year 1999, the 56 degree limit was exceeded on five days; in water year 2005, it was exceeded on two days; and in 2006, it was exceeded on nine days. The water temperatures during these days ranged between 56 and 59 degrees.

The primary temperature recorder at the SP Taylor Park gage has been located in a relatively deep, shaded pool, which appears to be representative of that stretch of Lagunitas Creek. A data logger has simultaneously recorded the water temperature coming out of Kent Lake, at the Kent release structure. Other date loggers have been used, at times, to monitor water temperatures at other locations in the watershed.

Water released from Kent Lake into Lagunitas Creek are consistently between 49°F and 54°F year round. Water temperatures are then strongly influenced by air temperatures, cooling as the water flows downstream during the winter and warming during the summer (Figure 11).

The Mean Weekly Maximum Temperature (MWMT), the highest seven-day average of maximum daily temperatures, has been correlated with coho presence or absence in coastal streams (Welsh et al 2001). In the Mattole River, coho were not found in tributaries where MWMT exceeded 64.4°F. In Lagunitas Creek, the highest recorded MWMT at the USGS gage in the state park was 66.6°F, recorded during the last week of June, 2006. The average MWMT between 1997 and 2006 was 63.5°F. The highest hourly temperature recorded in Lagunitas Creek was 68.6°F, recorded at the SP Taylor Park gage on July 22, 2006. This is still far below the upper incipient lethal temperature for coho of 79°F (Brett 1952), but above the temperature where growth stops (66°F, Armour 1991).

San Geronimo Creek temperatures vary seasonally to a greater degree than in Lagunitas Creek. Mean daily water temperatures varied from a low of 40°F to a high of 65°F between 1999 and 2004 (the last year for which data was available). Water temperatures were likely higher in 2003, but the temperature logger near the mouth of the creek was tampered with that summer. MWMT reached 66.2°F in 2004 near the mouth of the creek. Summer water temperatures have been as much as five degrees warmer near the mouth of San Geronimo Creek than upstream near the confluence with Woodacre Creek. Winter water temperatures vary by less than two degrees between upper and lower reaches of San Geronimo Creek.

Water temperature data were collected in Devil's Gulch at a single location near the mouth of the creek between 2001 and 2005. Mean daily water temperatures varied from 41°F to 62°F, but the data logger was lost during much of 2003, which was the warmest year during that period. MWMT was 64.0°F in 2004.

District monitoring activities have not identified any adverse impacts to coho or steelhead from the temperature regime that exists in the Lagunitas Creek system. District staff have conducted snorkeling and electrofishing surveys during the summer and early fall, during which no dead fish were witnessed and no physical or behavioral effects to the juvenile coho and steelhead were observed. We have also documented that coho and steelhead observed at Lagunitas Creek sample sites are generally larger than at San Geronimo Creek and Devil's Gulch sample sites (see Section 6.0).

Based upon the years of water temperature monitoring and in testimony presented at the hearings that preceded WR95-17, it appears that there will continue to be periodic, modest violations of the water temperature requirements in Order WR95-17, during the hottest days of the summer. The water temperatures at the SP Taylor Park gage cannot be maintained at or below 58 degrees Fahrenheit on all days during the summer period, in spite of continued releases of cold Kent Lake water. Water temperatures in Lagunitas Creek appear to be driven by ambient air temperature and solar radiation. There does not appear to be any adverse effect to salmonids in Lagunitas Creek from water temperatures slightly above those specified in WR95-17.

5.5 Water Quality Trends

The District's water quality monitoring program of the Lagunitas Creek watershed began in January of 1995, under an agreement with the Regional Water Quality Control Board. Water quality sampling has been conducted at four sample sites :

- Lagunitas Creek at Kent (between Peters Dam/Kent Lake and Shafter Bridge);
- Lagunitas Creek at Nicasio Creek (downstream of the Nicasio Creek confluence);
- Nicasio Creek (downstream of Seeger Dam/Nicasio Reservoir); and
- San Geronimo Creek (upstream of the mouth, at the Inkwells)

Water samples have been collected monthly at each site and analyzed at MMWD's water quality lab for the following eight parameters:

- Temperature;
- pH;
- Turbidity;
- Alkalinity;
- Hardness;
- Copper;
- Total Suspended Solids; and
- Settleable Solids

The results of this monitoring effort are summarized in Appendix F.

6.0 FISHERY RESOURCE POPULATION TRENDS

6.1 Salmonid Spawner Trends

The first spawner surveys in the Lagunitas Creek watershed were conducted by D.W. Kelley and Associates in 1982-83 and 1983-84 (Bratovich and Kelley 1988). Those surveys covered the major spawning reaches of Lagunitas Creek, San Geronimo Creek and Devil's Gulch, and also extended through most of the coho and steelhead spawning season from December through March. No further spawner surveys were conducted during the next 11 years, and the frequency and extent of the later spawner surveys have varied considerably.

Spawner surveys in 1995-96 omitted major spawning areas of Lagunitas and San Geronimo Creeks, and though surveys in 1996-97 were more extensive, they were also less frequent than in subsequent years. Starting in 1997-98, spawner surveys were conducted weekly from November through January and covered all major spawning reaches in Lagunitas Creek, San Geronimo Creek and Devil's Gulch. Spawner surveys in these reaches have been conducted consistently each year since. Members of the Salmon Protection and Watershed Network (SPAWN) and Trout Unlimited (TU) also began surveying two tributaries to San Geronimo Creek that season (Arroyo and Larsen Creeks). NPS staff also began conducting spawner surveys in Cheda Creek. By 2000-01 spawner surveys covered all major spawning areas in the tributaries and were conducted frequently enough to avoid missing coho redds that can become obscured by high flows and bed movement.

While spawner surveys have always recorded steelhead observations, they were extended into March specifically for steelhead beginning in 2001-02. The surveys are now conducted through mid-March, which has documented the peak of steelhead spawning each year. Estimating the size of steelhead runs has been hampered by high stream flows and associated turbidity, by steelhead's generally inconspicuous appearance, and by an uncertain relationship between numbers of fish and numbers of redds. Spawner surveys have, however, provided some indication of the size of steelhead runs returning to Lagunitas Creek.

During spawner surveys, we have also recorded observations of Chinook and chum salmon (both adults and redds of each species). The only modification to the surveys to accommodate these species is that the surveys have begun as early as late October in order to try to capture any early returning Chinook salmon. As described in the *Aquatic Resources Monitoring Workplan*, the spawner surveys were intended to be coho spawner surveys but we have broadened the focus to all salmon species and so they are now just called salmon spawner surveys.

A summary of all salmon spawning observations, between 1995-96 and 2008-09, is presented in Table 8. This includes total numbers of live adults and redds observed for all salmon species, in each year, and shows the average over the 14 year time period.

We have relied on total numbers of redds observed as the metric to compare spawning seasons. During spawner surveys, there are generally a small number of live fish and redds that cannot be positively identified and are classified as “unknown” (Table 8). Further explanation of the methods and results are presented in our annual salmon spawner survey reports (Ettlinger et al 2009).

Coho Salmon

The coho spawning runs have shown considerable variability between years (Table 8 and Figure 12) and up until 2007-08 the overall trend had been positive. The three largest coho runs, as measured by redd counts, occurred in 2003-04, 2004-05, and 2006-07; the largest of which, in 2004-05, was estimated at over 1,300 coho and produced 496 redds. Between 1996-97 and 2006-07, the coho runs were all larger than the runs in 1982-83 and 1983-84 (we are not including the run of 1995-96, which did not cover all major coho spawning areas). Coho runs therefore appear to have increased in size since the 1980s.

During the last two years, however, the coho runs have been very small and the 2008-09 run was abysmal, with only 26 redds observed. So while coho runs appear to have increased in size over the last 25 years, recent trends are unclear and may be pointing to an uncertain future for coho in the Lagunitas Creek watershed.

When viewed by their year class (Figure 13), there is some evidence to indicate that the coho population can recover from poor spawning runs and even thrive. One year class nearly doubled in size in a single generation, between 2000-01 and 2003-04. The strongest year class (which includes the 2004-05 coho run) showed a consistent increase in the coho run from 1995-96 up through 2004-05. The year class analysis also shows just how tenuous the coho population can be since that same strong year class experienced a 70% decline between 2004-05 and 2007-08. The weakest year class experienced a decline in excess of 80% between 2005-6 and 2008-09.

A notable conclusion from the spawner surveys is that the tributaries to Lagunitas Creek (i.e., San Geronimo Creek, the tributaries to San Geronimo Creek, and Devil’s Gulch) are extremely important to the coho population in the watershed (see Figure 12). In most years, the majority of coho redds were observed in the tributaries. The mainstem of Lagunitas Creek is also important and also has a high percentage of the spawning activity. In the years when significant rainfall has not occurred until after the coho spawning season has ended (in 1998-99 for example) the majority of spawning has occurred in the Lagunitas Creek mainstem. A related point is that the timing of coho runs coincides with rainfall. The peak of coho spawning occurred in December, in years when there was a substantial rain event in December. In some years, when there was little or no rain in December, the peak of the run did not occur until early January.

The size of coho runs are a product of the number of coho smolts entering the ocean and the marine survival rate of those fish. The number of coho smolts entering the ocean appears to be most strongly determined by stream flow conditions during the fish's first winter and spring and limited habitat during their second winter. High stream flows can scour redds and, perhaps more importantly, they can displace newly-emerged coho fry and overwintering juvenile coho. Ocean conditions, such as sea surface temperature and food availability, play an important role in marine survival, and ultimately determine the number of fish returning to Lagunitas Creek. The small coho runs of 2007-08 and 2008-09 appear to be the direct result of unusually poor ocean conditions in 2006 and 2007, respectively, when the smolts of those year classes entered the ocean.

<u>Steelhead</u>

Trends in the steelhead spawning runs (Figure 14). are difficult to gauge due to variability in the level of effort of our spawner surveys. Our ability to conduct surveys for steelhead has largely been determined by stream flow and water turbidity conditions. A strong correlation exists between the number of days of surveys and the number of live steelhead and steelhead redds observed. Moderate stream flows in 2006-07 and 2007-08 allowed for nearly weekly spawner surveys through mid- to late-March, which enabled the documentation of the largest steelhead runs on record. These runs appeared to be four to six times larger than the runs documented between 2002 and 2004, but prior surveys were not conducted as frequently. The apparent increasing trend in the size of steelhead runs is confounded by our increased survey effort over time and so we cannot be sure if the population was actually increasing. It does appear that the adult steelhead population did decline dramatically in 2008-09.

As with coho, the steelhead spawning record (see Figure 14) does indicate the importance of the tributaries to the steelhead population. In about half of the years, a slight majority of the steelhead redds were observed in San Geronimo Creek and Devil's Gulch.

6.2 Juvenile Salmonid Population Trends

The California Department of Fish and Game (CDFG) established the first population sampling sites for coho salmon and steelhead trout in the Lagunitas Creek system in 1970. Juvenile salmonid surveys have been conducted nearly every year since 1980, producing one of the longest-running datasets in coastal California. Currently, snorkeling and electrofishing surveys sample approximately 4% of San Geronimo Creek, Devil's Gulch and Lagunitas Creek upstream of its confluence with Nicasio Creek.

The abundance of juvenile coho and steelhead in the Lagunitas Creek basin has fluctuated widely since 1970 and has likely declined in comparison with anecdotal reports of large historic populations. Populations of both species, however, appear to be larger over the past 15 years than during the 1980s (Figure 15). Coho population estimates since 1993 have been nearly five times larger than 1980s' estimates, while steelhead estimates since 1993 have been about 50% larger than 1980s' estimates. Since 1995, the population estimates have been calculated by factoring habitat availability into the analysis, whereas for earlier estimates habitat data was unavailable for much of the watershed (Figure 16).

Coho Salmon

The juvenile coho salmon population of the Lagunitas Creek watershed has fluctuated dramatically since 1993. Between 2005 and 2006, the population declined by an estimated 88% (Figure 16). The population increased nearly five-fold in a single generation between 1999 and 2002 (Figure 17). These fluctuations are most strongly influenced by three factors: the number of spawning adults, peak stream flows during egg incubation, and spring stream flows shortly after fry emergence. Many coho redds were likely scoured in 1997-98 and 2005-06, resulting in small coho populations the following summers. Mean daily April stream flows in excess of about 90 cfs have also been correlated with lower coho fry survival. Relatively high April flows in 1999, 2005 and 2006 are believed to have caused significant mortality of coho fry. The three highest coho population estimates (1994, 2002 and 2007) were all associated with below-average winter and spring stream flows.

The juvenile coho data also reveals how important the tributaries to Lagunitas Creek are for the coho population (Figure 18). In most years, the majority of juvenile coho are rearing in San Geronimo Creek and Devil's Gulch. We have noted though that juvenile coho in the tributaries are considerably smaller than in mainstem Lagunitas Creek (Figure 19). Coho lengths in all three creeks appear to be density dependent, particularly in San Geronimo Creek and Devil's Gulch.

Steelhead

Fluctuations in the juvenile steelhead population are more difficult to explain than for coho. Spawner counts are strongly influenced by survey effort, as noted above, and this data has not been correlated with juvenile steelhead trends. In general there is less variability in the steelhead population than in the coho population (Figure 20), but there is some indication of a four-year pattern. Half of female steelhead spawners have been shown to be four years old (Shapovalov and Taft 1954), which could account for the four-year pattern (Figure 21). Juvenile steelhead estimates in San Geronimo Creek and Devil's Gulch are positively correlated with February and March stream flows. Low flows during these months likely inhibit spawning in the tributaries to Lagunitas Creek. The tributaries do play an important role in the juvenile steelhead population and when there is adequate flow for spawning steelhead to migrate into the tributaries, then a high percentage of the juvenile steelhead can be found in San Geronimo Creek and Devil's Gulch (see Figure 20). Juvenile steelhead rearing in the tributaries, like coho, are smaller than those rearing in mainstem Lagunitas Creek (Figure 22). However, for steelhead, the relationships between steelhead growth and abundance are not as strong as they are for coho.

6.3 Salmonid Smolt Production Trends

Smolt outmigration monitoring has only been conducted annually since 2006, so trends are preliminary at best. In 2006 MMWD participated in a smolt monitoring effort with the Marin RCD and Stillwater Sciences, Inc. as part of the *Lagunitas Creek Limiting Factors Analysis* (Stillwater Sciences 2008). Two rotary screw traps were installed in lower Lagunitas Creek, one at Tocaloma, a few miles upstream of the confluence with Nicasio Creek, and one at the Gallagher Ranch, 1.5 miles downstream of Nicasio Creek. SPAWN monitored smolt outmigration simultaneously using a funnel trap in lower San Geronimo Creek. NPS has conducted smolt surveys in Olema Creek since 2004.

Both Tocaloma and Gallagher smolt traps were only operated in 2006, but MMWD has continued to operate a single rotary screw trap at the Gallagher Ranch each year since. SPAWN has continued to monitor outmigration from San Geronimo Creek. In addition, SPAWN has used funnel traps to monitor salmonid migration out of Larsen Creek and Arroyo Creek, two tributaries to San Geronimo Creek.

Smolt outmigration from Lagunitas Creek is shown in Figure 23. This displays the total catch of coho and steelhead smolts, from MMWD's Gallagher trap, paired with the coho and steelhead smolt population estimates for each year. The smolt survey results from San Geronimo Creek (from SPAWN's data set) are also shown in Figure 24.

Coho Salmon

The coho smolt populations, migrating out of Lagunitas Creek, have ranged between 2,776 (2007) and 6,679 (2008) but in three of the four years the coho smolt population estimate was very close to 6,500 smolts. The outmigrating smolt population appears relatively consistent, regardless of the size of the juvenile coho population in the preceding fall. This points to a winter carrying capacity for Lagunitas Creek.

In the spring of 2006, an estimated 6,261 coho smolts migrated out of Lagunitas Creek. This represented 28% of the estimated fall 2005 population of 22,590 juvenile coho. An estimated 2,397 coho smolts migrated past the Tocaloma trap site, indicating that approximately 62% of coho smolts originated in the roughly five-mile stretch downstream of Tocaloma and pointing to an extremely important function of this lower reach of Lagunitas Creek. San Geronimo Creek produced an estimated 3,318 coho smolts, which was not statistically different from the number of smolts migrating past Tocaloma. The results also indicate that the area between San Geronimo Creek and Tocaloma (including Devil's Gulch and Lagunitas Creek upstream of Tocaloma) produced few to no smolts. Flows were extreme in 2005-06, exceeding 10,000 cfs on New Year's Eve and also exceeding 3,000 cfs in April 2006. For that year, at least, much of the upper portion of Lagunitas Creek likely did not provide adequate habitat for overwintering coho.

In 2007, an estimated 2,776 coho smolts migrated out of Lagunitas Creek. This was above the fall 2006 juvenile coho population estimate of 2,702, but within the population estimate margin of error, indicating that overwinter survival must have approached 100%. An estimated 1,232 coho migrated out of San Geronimo Creek, which was close to the fall estimate of 1,842 juvenile coho. Flows in 2006-07 were unusually low, peaking at only 650 cfs that winter, which likely explains the high overwinter survival of coho.

The 2008 and 2009 estimates of 6,679 and 6,373 coho smolts, respectively, provides further evidence for a winter carrying capacity for coho salmon in Lagunitas Creek. The 2008 smolt population was 80% smaller than the record high juvenile coho population estimate of nearly 37,000 coho in the fall of 2007. Flows during the 2007-08 winter were close to average, peaking at 1,990 cfs, but due to the exceptionally large juvenile coho population, available winter habitat was likely fully occupied. The 2009 smolt population was once again sharply lower than the fall juvenile coho estimate of just over 11,000. This decline occurred despite lower than average winter flows in 2008-09.

Steelhead

In 2006 an estimated 4,700 steelhead smolts emigrated from Lagunitas Creek, which was more than the 2005 1+ steelhead population estimate of 2,816. While having more smolts in the spring than 1+ juveniles in the fall is improbable, at best, these estimates do indicate a high level of overwinter survival of steelhead one year old and older.

In 2007, an estimated 7,300 steelhead smolts migrated out of Lagunitas Creek. This estimate is very approximate because the rotary screw trap was not operated on all days, including part of the peak migration period for steelhead. Despite the uncertainty, this estimate is far higher than the 2006 1+ steelhead population estimate of 2,696. This again indicates that overwinter survival of 1+ steelhead was very high in 2006-07, and that the fall 1+ estimate was likely too low.

Population estimates of 1+ steelhead have likely been underestimated due to the difficulty of electrofishing their preferred habitat, namely deep pools and deeply undercut banks. Based on our estimates of available pool habitat and the highest densities of 1+ steelhead ever observed at any sample site (0.9-1.3 fish/meter), 1+ populations could reach a theoretical population of about 10,000 fish in the Lagunitas Creek watershed. This is still only about 20% of the average 0+ steelhead population estimate, clearly indicating that the major period of mortality for juvenile steelhead is during their first winter. Stillwater Sciences correctly identified winter habitat for 0+ steelhead as the major limiting factor for steelhead in Lagunitas Creek (Stillwater Sciences 2008).

6.4 California Freshwater Shrimp Trends

Surveys for California freshwater shrimp were conducted in 1981, 1991, 1994 and every year since 1996. The amount of Lagunitas Creek surveyed has varied from 3.3 km in

1981 to 6.2 km in 2006. Surveys consist of sweeping an insect net through submerged roots and other vegetation and counting all captured shrimp. During the surveys, shrimp are identified as male, female or juvenile. Shrimp were also measured in 1991 and 1994.

The number of shrimp caught within the surveyed reaches has fluctuated between 986 and 5,661, without an observed upward or downward trend (Figure 25). The density of shrimp, expressed as the number of shrimp found per meter of surveyed bank, has fluctuated greatly since 1981. Shrimp densities rose sharply in 1997 but in 2001 fell back to the levels observed prior to 1997 (Figure 26). Shrimp habitat quality has been measured during every survey since 1996. No correlation has been found between shrimp abundance and habitat quality (i.e., physical habitat structure).

The distribution of shrimp within Lagunitas Creek has become increasingly restricted over time, based upon the number of pools surveyed and the number of pools containing shrimp (Figure 27). Li (1981) found 27% of shrimp at sites upstream of Tocaloma, including one shrimp as far upstream as the confluence with San Geronimo Creek. In 1991 less than 6% of shrimp were found upstream of Tocaloma. No shrimp have been found near the confluence of San Geronimo Creek since 1991, or in the upper State Park reach since 2002. The most upstream shrimp in 2005 and 2006 were found at the confluence of Devil's Gulch. Shrimp are now absent from nearly four kilometers of upper Lagunitas Creek that they occupied in 1991 (Serpa 2006). The absence of shrimp in the upper reaches of Lagunitas Creek may be related to summer water releases from Kent Lake, which increased in 1996. Summer water temperatures in this reach are likely cooler than in any other stream where shrimp occur. However, do not have any specific correlation to confirm a connection between shrimp abundance or distribution and water temperatures.

Increased summer water velocities may be another factor in the recent absence of shrimp from upper Lagunitas Creek. Summer water velocities may be too high to allow shrimp to return upstream after being displaced by high winter flows. Very little is known about shrimp movement or temperature tolerances, so we can only speculate about the relationship between stream flows and shrimp distribution in Lagunitas Creek. What remains unchanged over the last 25 years is that the reach between Tocaloma and Nicasio Creek is the stronghold of California freshwater shrimp in Lagunitas Creek. In that reach, at least, the shrimp population appears stable.

6.5 Aquatic Habitat Trends

Habitat typing surveys were conducted in Lagunitas Creek and two of its tributaries in 1992, 1995, 1997, 1998, 2003 and 2006. These surveys are intended to document the amount and distribution of salmonid habitat in these streams. Changes in aquatic habitat are summarized here, and have been more fully analyzed by Ettlinger (2008).

The proportion of pool habitat, which is favored by juvenile coho salmon, has varied between 28% and 62% in Lagunitas Creek. Much of that variability is likely the result of discrepancies between how different surveyors distinguished pools, runs and glides. More important than the total amount of pool habitat, however, is the frequency of pools in the surveyed streams (NMFS 1996). The number of pools per mile of stream has varied between 11 and 78 over the years and in different stream reaches. The 2006 habitat typing survey documented the lowest frequencies of pools in all reaches except Lagunitas Creek between Devil's Gulch and Shafter Bridge. That reach has been extensively enhanced with woody debris, which has likely increased the number of pools slightly. The frequency of pools was below the standard of "properly functioning" as defined by the National Marine Fisheries Service (NMFS 1996) in all surveyed reaches in 2006. The large flood event on New Year's Eve 2005 may have caused riffles to degrade and pools to lengthen, but the low frequency of pools is likely also related to the relative scarcity of large woody debris throughout the watershed.

MMWD has been installing large woody debris structures in Lagunitas Creek since 1998, and has increased the total amount of wood in the channel in the reaches that have been enhanced. Since 1998 the number of large logs between Devil's Gulch and Peters Dam has increased from 44 logs to 172 logs, mostly as a result of woody debris augmentation. Large woody debris cover in pools in this reach has increased from 1% to 4%. Large woody debris has remained stable in the rest of Lagunitas Creek at about 4% and in San Geronimo Creek at about 2% during this period. Large and small woody debris cover in Devil's Gulch pools has increased from about 5% to 8%.

Fish shelter in Lagunitas Creek pools (in the surveyed reaches upstream of Nicasio Creek) declined overall between 1998 and 2006. Average pool cover decreased from 26% to 17% during this period. Increases in large woody debris cover were more than offset by large declines in root mass, and terrestrial and aquatic vegetation. Fish shelter in San Geronimo Creek pools decreased from 23% in 1998 to 15% in 2006. Declines in root mass and small woody debris accounted for most of that change. Fish shelter has remained at approximately 15% in Devil's Gulch pools since 1995.

Habitat typing surveys have documented the dominant substrates in each habitat unit in the surveyed streams. Substrate conditions vary considerably between upstream and downstream reaches in Lagunitas Creek, so describing changes for the entire creek may oversimplify substrate conditions. Sands, silts and clays dominate the substrate downstream of Devil's Gulch, and these substrates were more prevalent in 2006 than during previous surveys. Gravels dominate the streambed upstream of Devil's Gulch, and fine sediments are rarely dominant. Fine sediments have remained dominant over about 11% of this reach since 1997, while gravel has become increasingly dominant over time. In 2006 73% of Lagunitas Creek upstream of Devil's Gulch was dominated by gravel.

Substrate conditions changed little overall in San Geronimo Creek between 1998 and 2006. Sands, silts and clays were the dominant substrate in approximately half the creek, while gravel dominated in about a third of the creek. Substrates appeared to become finer in the lower half of San Geronimo Creek during that period while becoming coarser in the upper reach. Substrate conditions in Devil's Gulch were only documented in 2003 and 2006, but gravel appears to have increased during that short period to become the dominant substrate over roughly half the creek. Fine sediments in Devil's Gulch decreased between 2003 and 2006.

Woody bank vegetation increased in all surveyed reaches of Lagunitas Creek between 1998 and 2006. Woody vegetation covered about 75% of the banks between Nicasio Creek and Tocaloma in 2006 and decreased moving upstream to about 60% upstream of Shafter Bridge. Bank vegetation in Devil's Gulch was only documented in 2003 and 2006, but appears to have increased from about 50% to 60% coverage in that period. Woody vegetation declined, however, in San Geronimo Creek between 1998 and 2006, from about 56% to 45% of the bank. The amount of unvegetated bank increased from about 25% in 1998 to nearly half of the banks surveyed in 2006. This decrease in bank vegetation along San Geronimo Creek, contrasted with increases elsewhere, is consistent with human-caused alteration of the banks. MMWD staff have incidentally observed such bank alterations over the years, but have not quantified their extent, so can only hypothesize that they are the primary cause of the observed declines in bank vegetation.

Canopy cover was documented in 2003 and 2006 and remained stable in most surveyed reaches. The Tocaloma to Devil's Gulch reach had the least canopy cover in 2006, at 47%. Canopy cover increased in more upstream reaches of Lagunitas Creek, reaching 73% upstream of Shafter Bridge. Canopy cover in San Geronimo Creek was approximately 70% in 2006 and 85% in Devil's Gulch.

7.0 SEDIMENT MANAGEMENT

7.1 Sediment Control and Evaluation Efforts

The District has implemented most of the sediment management project work identified in the Sediment and Riparian Management Plan (see Section 3.1, Tables 1 -4 and Figure 3). The District has also implemented a number of other erosion control projects that have contributed to the overall goal of reducing fine sediment loading into Lagunitas Creek. The sediment management project work was identified through a sediment source site assessment conducted in 1997. Since then, there have been four additional sediment source evaluations conducted by MMWD:

- Through a California Department of Fish and Game grant, MMWD completed the *San Geronimo Creek Watershed Sediment Source Sites Assessment and Evaluation* (Stetson Engineers 2002).

- The District evaluated all of the roads on its watershed lands, which includes a portion of the Lagunitas Creek watershed, under the *Mt. Tamalpais Watershed Road and Trail Management Plan* (MMWD 2005).

- With grant funding provide by the SWRCB, the District completed the *Lagunitas Creek Watershed Assessment and Erosion Prevention Planning Project - Cheda Ranch, McIsaac Ranch, and Samuel P. Taylor State Park* (Pacific Watershed Associates 2007).

- Also with SWRCB funding, the District compiled a GIS of all roads in the Lagunitas Creek watershed with the *Lagunitas Creek Watershed Sediment Reduction and Enhancement Project* (Lynx Technologies 2007).

There has been a shift in our focus on sediment management, from hillslope sediment source sites to roads. Streambed sedimentation is one of the primary factors that has been identified as constraining habitat values for coho salmon and steelhead inhabiting Lagunitas Creek and its tributary streams. Degraded streambed conditions have been attributed to the excessive load of fine sediments which enter the stream channel. The supply of fine sediments has been linked to erosion throughout the watershed. Dirt roads have been identified as one of the most significant causes of erosion and a direct source of fine sediments. Chronic inputs of sediment stem from road bed degradation connected to stream crossings. In addition, there is the potential for catastrophic sediment inputs, resulting from culvert failures, failing roadside fill materials or other stream crossing issues. As a human-induced sediment problem, roads also offer opportunities for restoration. It is this opportunity that helped the District secure the multi-agency agreement to address roads, through the roads MOU (see Appendix C).

To help evaluate the effectiveness of the sediment management effort, the District has sponsored annual streambed monitoring. As part of the streambed monitoring, bed scour monitoring was conducted between 2002 and 2006. In addition, the District has also maintained a stream gage on San Geronimo Creek where bedload sediment transport measurements have been collected. At the suggestion of the Lagunitas TAC, the District also sponsored a focused, fine sediment assessment of Lagunitas Creek, with field studies conducted in 2004 and 2005. The results of our monitoring studies are described below.

7.2 Sediment and Streambed Trends

A comprehensive review and evaluation of the sediment and streambed monitoring program has been prepared for the District, by Balance Hydrologics, Inc. (Hecht, Strudley and Brown 2010). We present a summary of the major findings by Balance Hydrologics but do not provide the details of their analyses here.

The evaluation by Balance Hydrologics summarizes and interprets 13 years of monitoring, conducted as a condition of SWRCB Order WR95-17, encompassing water years 1995 through 2007. A few qualitative observations made during the 2008 monitoring are also mentioned as is a discussion of monitoring that was conducted intermittently between 1979 and 1994. The evaluation characterizes the study base period to be 1980-1982, for comparison to present-day conditions.

The evaluation did not document an “appreciable improvement in streambed conditions,” as stipulated in Order WR95-17. Improvements in streambed conditions resulting from MMWD’s sediment control efforts may be very difficult to detect in the short term due to the highly variable nature of sediment dynamics in Lagunitas Creek. Sediment dynamics are largely driven by episodic events, such as floods, that tend to overwhelm incremental, longer-term reductions in sediment inputs. Longer-term monitoring may be necessary to detect incremental improvements to streambed conditions against a backdrop of episodic sediment delivery.

In addition to episodic events such as floods, droughts and debris flows, a major influence on sediment dynamics beginning in 1998 was an increase in large wood to the channel. Large wood entered the channel by many means, including the installation of woody debris structures by MMWD, a new management paradigm of leaving downed wood in the creek, rapid growth of trees during a period of above-average rainfall, extensive collapse of mature alders, the emergence of Sudden Oak Death, and apparently more frequent windstorms. New logjams increased fine sediment storage upstream of the wood. New woody debris structures scoured the streambed and temporarily increased the amount of bed sediment, as well as producing localized impacts to nearby streambed monitoring stations. The increasingly important influence of large wood on the streambed complicates comparisons with the 1980-82 base period.

The following is a timeline of major events and phenomena impacting the Lagunitas Creek streambed:

1980-82	Elevated sediment yields from San Geronimo Creek during the monitoring base period were likely ongoing effects of the 1976-77 drought and associated dieback of bank vegetation.
1982	A major flood produced large sediment yields.
1995-97	Debris flows at Big Bend contributed the equivalent of several years of expected bedload delivery from San Geronimo Creek.
1998	Large woody debris structures began to be installed by MMWD.
2001-03	Sediment delivery from San Geronimo Creek increased, but the sources are unknown.
2006-08	A major flood increased bed sedimentation, with continuing effects.

The major findings and conclusions from the streambed monitoring report by Balance Hydrologics (Hecht, Strudley and Brown 2010) are as follows:

► Runoff during the 1995-2007 period included a broad range of wet and dry years and several significant storm events.

- Although the 1995 to 2007 period began with four consecutive years of heavy sediment transport associated with above-average rainfall and runoff, the 13 years ended with a sequence of seven years of near- or below-normal rainfall interrupted only by Water Year 2006.
- Runoff in Lagunitas Creek at SPT was about 160 percent of the 1980-1994 period. Adjusting for the initial filling of the expanded Kent Lake, runoff from upstream of Peters Dam probably approached double the values of the 1980-1994 period.
- Mean runoff from San Geronimo Creek was virtually identical to the mean of the preceding 15 years (1980-1994).
- Higher flows at SPT but not in San Geronimo Creek indicate an overall increase in spills over Peters Dam. However, between 2000 and 2004 spills from Kent Lake were minimal, and combined with significant sediment loads from San Geronimo Creek, conditions were such that sediment would tend to accumulate.
- Bed conditions at the end of the 1995-2007 period appear to reflect the episodic influence of the very major storm on December 31, 2005, plus the much above average rainfall of the remainder of Water Year 2006.

► Several sequential events in 1995, 1996 and 1997 suddenly introduced large volumes of bed material into Lagunitas Creek at Big Bend.

- The volume of material mobilized at Big Bend is comparable to several years of expected bedload delivery from San Geronimo Creek.

- The associated coarse-sediment influx has overwhelmed all other influences on bed conditions downstream to at least Tocaloma.
- Aggradation and fining of the streambed reached a maximum during 2001-2003.
- Using the data collected at Big Bend and stations or reaches downstream to assess whether there is "appreciable improvement" in bed conditions is not recommended.

► San Geronimo Creek episodically delivers large pulses of fine sediment.

- Sediment yields during the 1980s base period appear to have been episodically elevated, even prior to the January 4, 1982 flood. Bank weakening associated with the 1976-1977 drought was a major factor in introducing the predominantly sandy sediment which impaired habitat in the channel during the early 1980s.
- Since late-winter 2001, and continuing into 2004, the bed throughout the study reach, especially upstream of Big Bend, appears to have been influenced by an influx of fine sediment, principally from San Geronimo Creek. Evidence for the influx includes decreases in the proportion of the bed occupied by cobbles and bedrock, an increase in the proportion of sand, and an increase in the rate of bedload transport (coarse-sediment discharge) at the San Geronimo Creek gage.
- The 2005 and 2006 storms resulted in further increases in both bedload transport and bed sedimentation, which continued through 2007 and into 2008 without clear signs of amelioration.
- The increased sediment yield from San Geronimo Creek during the 13-year period is likely being produced from longer-term sediment storage, such as the bed of the channel (incision), its banks (bank retreat), or remobilization of sediment previously stabilized by vegetation.

► Sediment enters Lagunitas Creek almost exclusively through tributaries and through localized changes in stream course.

- One notable exception to this is sediment input from debris flows and the meander cutoff at Big Bend.
- Under normal circumstances, very little sediment is mobilized from the banks of Lagunitas Creek itself, which in most locations are heavily vegetated or rocky.
- Sediment delivery varies considerably from year to year in all tributaries.
- Debris flows or related processes, typically delivering several hundred tons of sediment, have been observed to enter Lagunitas Creek from each tributary except for San Geronimo Creek and Devil's Gulch. The latter streams have experienced notable pulses of sediment delivery in 2002 to 2003 and 2006 to 2008.
- Tributary banks appear to be one set of primary sources of coarse sediment. In this respect, sediment delivery to Lagunitas Creek is distinctly different from other Marin streams, so markedly different sediment- and channel-management strategies are appropriate in this system.

8.0 RIPARIAN & WOODY DEBRIS MANAGEMENT

8.1 Large Woody Debris Construction

The District constructed a total of 65 LWD structures at 43 different sites, through a five-mile stretch of the mainstem of Lagunitas Creek (see Section 3.1, Tables 1-4, and Figure 4). Nine basic structure designs were installed: obstruction logs, staggered obstruction logs, digger logs, divide logs, creek constrictions, channel spanning structures, cover logs, treetops and boulder weirs. The LWD structures were installed to enhance in-stream habitat for salmonids in the following ways:

- Provide escape cover for juvenile salmonids within the structure and by trapping debris in and around the structure;
- Enlarge pool volume by creating scour flows around the structure;
- Provide high flow refuge habitat for juveniles and adults by creating backwater eddy flows; and
- Retard downstream migration of beneficial size gravel and cobbles to provide spawning habitat for adult salmon.

Our woody debris design selection not only considered past successes and failures, but also anchoring availability, flow conditions, and access constraints. Specific site conditions sometimes necessitated installing untested or less-than-optimal structure designs. MMWD crews constructed the LWD structures, generally using redwood logs found floating in Kent Lake. Construction was accomplished during the late summer months, without putting any heavy equipment into the creek.

The LWD structures have been regularly subjected to stream flows in excess of 2,000 cfs but were subjected to flows approaching 6,000 cfs in water year 1998 and 10,000 cfs during the New Years flood in water year 2006. During that flood event, 19 structures were damaged or completely dislodged; in most cases migrating downstream to another location. Over the next three years, all of them were repaired or replaced.

8.2 Woody Debris Habitat Enhancement and Fish Utilization

The effectiveness of individual woody debris structures has been evaluated based on their ability to collect small woody debris, provide summer cover and winter flow refuge for juvenile salmonids, scour pool habitat, increase juvenile salmonid densities, enhance spawning habitat and on their stability. Annual effectiveness monitoring has included snorkeling the structures and mapping changes in streambed topography, both pre-construction and then for two years following construction. A comprehensive review of the first 36 woody debris structures was conducted in 2003, with a follow-up evaluation of stream depth and snorkel survey results in 2008.

Snorkel surveys have shown that juvenile coho congregate in and around the LWD structures, with fewer fish in other parts of enhanced pools. The mean coho density in habitats with woody debris structures was 0.18 fish per square meter, significantly more than in other Lagunitas Creek pools (mean = 0.12, derived from electrofishing data). Within the LWD structures themselves, however, the mean coho density was six times greater than in adjacent non-enhanced areas. Coho densities increased at 24 of 27 sites where pre-construction densities were determined. Prior to LWD installation, coho densities at LWD sites were 60% lower, on average, than at established juvenile sample sites. One year after LWD installation, coho densities were 60% higher than at the sample sites. Two years after installation, coho densities were 87% higher than at sample sites.

Steelhead, unlike coho, have not been observed to be more abundant in woody debris structures. The mean steelhead density in habitats with woody debris structures was 0.22 fish per square meter, somewhat less than the 0.28 fish per square meter in other Lagunitas Creek pools. The mean steelhead density within the LWD structures was 0.27 fish per square meter, so approximately the same as in pools without woody debris.

Woody debris structures have, on average, increased channel depth by 20 cm, in the immediate vicinity of the structures. Structures that projected far into the creek, constricted the creek, or included multiple logs produced the greatest increases in stream depths. The most successful structure deepened the stream channel by 86 cm.

Between 1998 and 2003, 14 woody debris structures were constructed with the goal of enhancing spawning habitat, among other goals. Seven of the 14 structures had enhanced spawning habitat by 2007, in addition to another structure that achieved that goal unexpectedly. Effectiveness was determined by observing spawning near the structures where spawning had not been observed previously. Structures that were not successful generally did not encourage the deposition of suitable gravels either upstream or downstream of the structures.

One of the most important benefits of woody debris is providing flow refuge, both for coho parr during the winter and for newly-emerged coho fry in the spring. The effectiveness of LWD at providing flow refuge cannot be measured directly, but has been evaluated by observing the structures under various flow conditions and noting when the structures create low-velocity backwater habitat. All structures that were intended to provide flow refuge have provided backwater habitat under a range of flows, but have typically been overtopped by higher flows, which then created highly turbulent conditions. The only structures that did not provide the intended flow refuge were those that were destroyed during high flows. However, to date structures have not been specifically designed to provide flow refuge for newly-emerged fry, which are highly vulnerable to being displaced by spring freshets as low 100 cfs. The challenge in providing this kind of refuge will be providing a smooth transition from high flow areas to very low velocity backwater habitat, while at the same time not causing excessive deposition of fine sediments around the structure. Providing spring flow refuge habitat will be a major focus of the woody debris project in the future.

Evaluations of these woody debris structures have produced the following conclusions:

- Structures that produce a significant impediment to flow, identified as providing winter flow refuge, are more likely to successfully achieve other goals. These structures generally redirected creek flow to a substantial degree, helping to scour the streambed and increase creek sinuosity.
- Structures with multiple logs and rootballs are more effective than structures without these features.
- Treetops, while generally providing high-quality summer cover, often encouraged sedimentation in pools and were, with few exceptions, swept away during high flows.
- Collecting small woody debris is unpredictable and generally unsuccessful. Structures need to be in the direct path of the stream flow to catch small woody debris, and even then often fail to do so. Those structures that successfully collected small woody debris, however, also tended to increase pool depth and had higher juvenile coho densities.
- Encouraging spawning was generally unsuccessful and may not be a realistic objective of woody debris. When designing woody debris structures it is difficult to predict where gravel may be deposited around the structure. Coho and steelhead also require such specific environmental conditions for spawning (substrate, depth, flow, etc.) that creating those conditions using woody debris may be unrealistic. However, LWD structures in close proximity to suitable spawning sites can provide escape cover for adult salmonids, particularly for females holding near their redds.

8.3 Riparian Revegetation and Riparian Habitat Enhancement

The seven riparian revegetation sites identified in the Sediment and Riparian Management Plan were completed between 1999 and 2004 (see Section 3.1, Tables 1-4, and Figure 4). In addition, the District completed a riparian revegetation project on Lagunitas Creek and two bank stabilization projects on San Geronimo Creek that incorporated biotechnical techniques resulting in riparian revegetation (see Section 3.3).

The riparian revegetation was achieved by planting native tree and shrub species (e.g., redwood, alder, big leaf maple, buckeye, ash, bay, coyote brush). All of the planting areas did become established. However, the planting areas at sites R1 – R5, upstream of Shafter Bridge, were in well shaded areas and have since become overgrown by periwinkle (*Vinca sp*). None of the planting areas have grown up enough to provide any shade or cover to the creek but the plantings are stabilizing the soils and will one day mature. We used “DriWater,” an irrigation supplement, to irrigate the plantings. At the additional revegetation site along Lagunitas Creek, we also used a portable, battery-operated pump and hose system to assist with the irrigation, during the first two summers. The planting areas were periodically weeded and other maintenance care given to maintain the plantings.

The bank stabilization and riparian revegetation achieved at site R7 (on Lagunitas Creek at Tocaloma) and at site ST-3 (on San Geronimo Creek) have been the most successful at enhancing stream habitat. Both sites were badly eroded, steep, exposed stream banks that were stabilized with willow brush mattresses. In addition, the stream habitat at site R7 was enhanced with LWD structures built into the toe of the bank. At both sites, the willow brush mattresses have completely taken hold and become fully developed, willow-covered stream banks that provide shade and cover to the stream channel as well as stabilizing the banks.

Site R7 had initially been intended to simply be plantings of native vegetation but the TAC recommended installing a biotechnical bank stabilization structure, fearing bank erosion would continue and an emergency repair to save the road would likely be implemented that might have adverse impacts to the creek habitat. The TAC also recommended implementing work upstream of the bank to help keep the creek flows in the main channel and reducing erosive forces on the bank. The upstream work was implemented in Water Year 2003. During a site visit in January 2004, the TAC recommended the District seek advice from a hydrogeomorphologist for this project. The District contracted with McBain & Trush who conducted an assessment of the site and developed a bank stabilization/riparian revegetation plan for the 130-foot eroding bank. The plan modified an earlier willow brush mattress plan for this site, by adding seven woody debris structures and additional rock bank protection, and by opening a floodplain channel on the opposite side of the creek. In addition, the project included riparian revegetation with the planting of native trees and shrubs and additional willow sprigging throughout the entire project area. The project was implemented in 2004 by District staff, with assistance from the Marin Conservation Corps. Construction oversight was also provided by McBain & Trush. The revegetation plantings were installed in early December 2004. This completes a project that has been in the planning for several years with considerable input from the TAC.

The LWD structures at site R7 are stable and have scoured a deeper channel and pools in the creek and have provided instream structure for fish to utilize. Also, the LWD structures have helped to shift the thalweg of the channel away from the bank, thus relieving the erosive forces on the toe of the bank that had been contributing to the bank failure. The willow wall and LWD structures at site R7 were subjected to being completely overtopped by flooding the first winter following construction in 2004. This site was also completed flooded inundated during the flood on New Years 2006. All of the LWD structures and the willow brush mattress held during these flooding events.

During construction on site ST-3, the near vertical stream bank was graded back to a 2:1 slope; this necessitated removing a large bay tree that was at the top of bank. The logs from this bay tree were kept intact and placed in the stream channel to form a LWD structure; and two logs were also placed in the channel, at an upstream angle, to help redirect thalweg flow away from the bank. The thalweg of the channel has shifted away from the bank and a gravel bar has formed at the toe of slope. The LWD structures at site ST-3 were effective at protecting the bank and they provided instream habitat for fish.

The crib-wall structure constructed at site ST-8, on San Geronimo Creek, has been very effective at stabilizing the badly eroded and undercut stream bank. During the installation, we added some willow sprigs to the base of the crib wall. Some of those sprigs took hold and willows have become established. At the time that the crib wall was planned and installed, the channel through this section was a deep (4-5 foot deep) pool, one of the deeper pools in the upper portion of San Geronimo Creek. Since the installation of the crib-wall, the pool has largely filled in and a gravel bar has formed in front of the lower portion of the crib wall. Some riparian vegetation has even become established on the gravel bar. It is likely that this change in the channel resulted from the crib-wall changing hydrodynamics at the site, allowing sediments to settle into and fill the pool.

The willow brush mattress and crib-wall at sites ST-3 and ST-8, on San Geronimo Creek were inundated by flooding during their first winter following construction in 2005 (i.e., inundated by the 2006 New Years flood). Both of those structures held through the flood.

9.0 SYNTHESIS OF PHYSICAL & BIOLOGICAL DATA

At the request of the TAC, we attempted to evaluate the salmonid population trends and sediment and streambed trends in a synthesis to analyze if there are any relationships between sediment and salmonid populations. We have not found any convincing correlations. What we have found, is that juvenile numbers are driven by winter and spring flows. We developed a model of stream flow and salmonid populations that does explain the coho variability we have observed through our salmonid population monitoring surveys.

The intent of this analysis presented below was to evaluate if our data sets revealed any influences that sediment and streambed conditions may be having on the fish populations of Lagunitas Creek. In developing this analysis, we were seeking to identify if there are correlations between the sediment and streambed monitoring data and the fish population trends.

The parameters presented in the *Streambed Monitoring Report* (Hecht et al 2010) are bed-elevation, sub-surface material, embeddedness, and bed surface material. For our analysis, we focused on bed surface conditions. We compared the 1995-2008 bed surface monitoring data with coho redd observations and juvenile steelhead and coho population estimates (Table 9). The bed surface data includes proportions of sand, bedrock, organics, and cobble and mean particle size. The proportion of sand and mean particle size in riffles and pools were compared with redds, population estimates and egg-to-fry survival rates. The coho and steelhead redd observations and juvenile population estimates were data from the mainstem only of Lagunitas Creek (i.e., we did not include San Geronimo Creek or Devil's Gulch) so that the data sets would overlap geographically.

Figures 28 and 29 show the relationship between the bed surface composition of riffle habitats in Lagunitas Creek and the proportion of redds observed in Lagunitas Creek, downstream of the confluence with San Geronimo Creek. In this analysis, we investigated if spawning adult coho are influenced by particles sizes on the stream bed and whether they might selectively choose where to construct redds depending on sediment conditions in any given year. If coho spawners were to avoid mainstem Lagunitas Creek downstream of San Geronimo Creek, they could potentially spawn in the reach between San Geronimo Creek and Peters Dam, or in the tributaries to Lagunitas Creek.

Figure 28 demonstrates that the proportion of coho redds observed in Lagunitas Creek downstream of San Geronimo Creek was not correlated with the amount of sand in Lagunitas Creek riffles. Coho potentially select riffles for spawning based on their substrate composition, among other factors, but we found no evidence that coho select stream reaches based on the amount of sand in riffles. Figure 29 is similar to Figure 28 in that it shows no relationship between riffle substrate conditions and the locations of coho redds. During years when the median particle size of Lagunitas Creek riffles was relatively large, coho were no more likely to spawn downstream of San Geronimo Creek than during years when particle sizes were smaller.

We next considered the relationships between substrate conditions and juvenile salmonid abundance. Salmonid populations are most strongly influenced by substrate conditions during egg incubation. We hypothesized that relatively high levels of fine sediment in riffles may decrease egg and alevin survival, and result in lower juvenile salmonid populations. For this analysis we assumed that substrate conditions during egg incubation were best approximated by the measurements taken during the previous summer, but we also investigated whether substrate conditions and salmonid population estimates were correlated within the same year.

Figure 30 demonstrates no relationship between the proportion of sand in Lagunitas Creek riffles and either steelhead or coho abundance in the following year. This analysis was repeated investigating the relationships between sand in riffles and juvenile salmonid abundance during the same year. In that analysis we found a very slight positive correlation between the proportion of sand in riffles and Lagunitas Creek steelhead populations. The correlation was weak, and we are aware of no mechanism to explain how steelhead would benefit from higher amounts of sand in riffles.

Looking at the median particle sizes of Lagunitas Creek riffles (Figure 31), we found no evidence of impacts to juvenile salmonid populations within the range of particle sizes observed. Juvenile steelhead and coho were no more abundant following years when riffle substrates were relatively large than when riffle substrates were smaller.

Our final analysis of streambed conditions and juvenile salmonid abundance investigated the influence of streambed conditions on coho egg survival. We could not perform this analysis for steelhead egg survival due to a lack of consistent steelhead redd data. Coho survival to emergence has only been measured directly once, in 2006 (Stillwater Sciences 2008), so we looked into coho survival rates during the period from egg deposition through the end of coho fry's first summer. Survival during this period is a product of both egg and fry mortality, but we felt this analysis might shed some light on the influence of substrate conditions on incubation survival. We estimated the number of coho eggs laid by multiplying the number of coho redds observed each season by an average fecundity rate of 2,600 eggs per female (Stillwater Sciences 2008). Our analysis found, paradoxically, that coho egg-to-fry survival rates increased as the proportion of sand in Lagunitas Creek riffles increased (Figure 32). Particle sizes in riffles were very weakly, but negatively, correlated with survival rates. We are not aware of a mechanism to explain how increased sand in riffles benefits coho egg-to-fry survival, but all of these analyses failed to find evidence that streambed conditions are negatively impacting salmonids in Lagunitas Creek.

10.0 PROGRAM COSTS AND FUNDING

The Districts spent $7.16 million in operational and capital funds to implement the Sediment and Riparian Management Plan (Table 10) and comply with other elements of Order WR95-17. In addition, the District was awarded $691,000 in grant funding to implement other project work directly related to fishery management in the Lagunitas Creek watershed (Table 11). Also, MMWD contributed $110,000 to the Lagunitas watershed by funding projects thorough its Willis Evans Habitat Improvement Grant Program. Thus, in total, the District has contributed nearly $8 million in funding to enhance the fishery resources of Lagunitas Creek, between 1997 and 2009.

The District's efforts in Lagunitas Creek have been accomplished using a full-time fisheries staff of two biologists along with the seasonal assistance of between one and four annual Watershed Aides and Summer Helpers/Interns. There has been considerable involvement in the program by other District staff, including Senior staff, Engineering staff, Watershed staff, and the Special Projects Crew. The effort has gone into implementation of all aspects of the Lagunitas Creek fisheries program, including all project work and monitoring. District funding has covered the cost of staff labor, materials, supplies, equipment, environmental and engineering consulting services, and some construction contracts (see Table 10)

In addition to District funding, we successfully competed for State and federal grant programs and were awarded seven grants (see Table 11). With one exception, the grant funding has been used to implement projects that were not specifically called for in the Sediment and Riparian Management Plan and entailed work that went above and beyond the required mitigation of Order WR95-17 The grant funders included DFG (through the Fisheries Restoration Grants Program), and SWRCB & RWQCB (with Proposition 13 funding). One grant funded project was to implement sediment management projects, identified in the Sediment and Riparian Management Plan, with federal funding administered by DFG. These grants cover the 1997 – 2009 period and do not include other grant funding the District has received since 2009, which has been considerable, to conduct still other projects in the Lagunitas Creek watershed.

The District initiated the Willis Evans Watershed Habitat Improvement Grant Program in 2001 and funded projects through 2007. The program was developed to support projects that provide an appreciable, long-term improvement to habitat conditions in the Mt. Tamalpais Watershed and other watersheds within the MMWD sphere of influence. Thirteen projects, totally $110,000, were funded within the Lagunitas Creek watershed through this program (see Table 11).

11.0 CONCLUSIONS

The District has complied with all elements of SWRCB Order WR95-17 to the best of its ability. The District has implemented all of the riparian management projects identified in the Sediment and Riparian Management Plan (i.e., the woody debris and riparian revegetation sites) and most of the sediment management projects (erosion control projects). The District has implemented a considerable amount of additional sediment control, not identified in the SRMP, within the watershed. This additional project work has been implemented with the same goal and purpose of reducing fine sediment loading into Lagunitas Creek and its tributaries.

The District was successful in coordinating the development of two important, multi-agency MOU's: the roads MOU and the woody debris MOU. We have also implemented additional bank stabilization and riparian revegetation projects. Almost all of the additional project work has been accomplished with grants from DFG and the RWQCB. Finally, the District developed the Willis Evans Watershed Improvement Grant Program to provide funding to other groups working in the watershed. In total, we have far exceeded the habitat improvement work identified in the SRMP.

The District has accomplished and exceeded the monitoring effort developed for the SRMP (through the Aquatic Resources Monitoring Workplan). We have expanded the monitoring to include annual smolt surveys, several streambed scour surveys, and a fine sediment assessment. We have collaborated with other groups that are also conducting monitoring studies in the watershed (NPS, Marin RCD, RWQCB, and SPAWN) and have conducted additional monitoring (e.g., fry emergence trapping) with other groups. Our monitoring data set is extremely valuable for analyzing population dynamics and trends of the coho, steelhead and California freshwater shrimp populations of Lagunitas Creek, in addition to other species. These data are being utilized by DFG and NMFS in their coho and steelhead recovery efforts, by the RWQCB for their sediment Total Maximum Daily Load (TMDL) plan, and by the County to help develop their San Geronimo Valley Salmon Enhancement Plan.

Water temperatures in Lagunitas Creek have been monitored continuously since 1997, and have documented suitable temperatures for coho and steelhead throughout that period. During the hottest days of the spring and summer, however, water temperatures have exceeded SWRCB thresholds. Water temperatures are most strongly influenced by ambient air temperatures, and MMWD has essentially no ability to control water temperatures during the hottest days of the year. The observed water temperatures do not appear to have any adverse impact on the salmonid or shrimp populations of Lagunitas Creek.

The woody debris project work has been extremely successful at enhancing in-stream habitat for salmonids. The LWD structures have created the kinds of habitat that they were intended for and high densities of juvenile coho salmon have been seen utilizing them. These and other habitat enhancement efforts have provided a diversity of habitats that help to ensure that salmonid populations do not fall below sustainable levels.

The sediment management project work has been successful at stabilizing erosion sites and at reducing sediment loading into Lagunitas Creek. Improvements to streambed conditions resulting from reductions in sediment inputs are extremely difficult to detect, and while the streambed monitoring effort has successfully measured the variability in streambed habitat conditions, to date it has not detected an overall improvement in those conditions. Sediment dynamics are largely driven by episodic events, such as floods, that tend to overwhelm incremental, longer-term improvements in sediment delivery to the creek. Documenting appreciable improvement to streambed conditions may require continued sediment management and longer-term monitoring.

For much of the period from 1995 to 2007, the juvenile coho population appeared to be increasing, while the juvenile steelhead population did not show a strong upward or downward trend. Since 2007, however, the coho population has declined sharply, both in Lagunitas Creek and throughout coastal California. This decline was largely a result of a drop in ocean productivity, which demonstrates that salmonid populations are influenced by many factors that cannot be controlled, including floods, droughts and ocean conditions. Population gains resulting from habitat enhancement efforts can be undone by larger forces. Future fisheries conservation efforts at MMWD will focus on enhancing salmonid habitat specifically to increase the number of smolts entering the ocean, which will increase the likelihood that sustainable numbers of spawners will continue to return to Lagunitas Creek.

12.0 FUTURE ACTIONS

In 2007, the TAC developed, and presented to the District Board, recommendations for moving forward with fisheries management in Lagunitas Creek. These recommendations (Appendix G) were discussed by the Board.

At its meeting on October 3, 2007, the MMWD Board directed staff to:

1. Continue compliance with State Water Resources Order WR95-17 through maintaining stream flows and annual reporting;

2. Develop a ten-year summary report on the Lagunitas Creek Plan;

3. Develop a new fisheries management plan for Lagunitas Creek that consists of the District maintaining existing sediment and riparian enhancement projects and continuing with the current survey and monitoring program;

4. Pursue grant funding opportunities to support new projects;

5. Seek partners for extending monitoring and habitat restoration efforts to the lower portion and estuary of Lagunitas Creek; and

6. Maintain flexibility regarding project implementation to be conducted by any District crews and/or outside contractors, as is deemed most appropriate.

Staff has been moving forward with developing the new fisheries plan for Lagunitas Creek. This new plan will establish priorities for the District and give direction to staff for future actions on Lagunitas Creek.

The District is moving forward under the following important considerations for the development of the new fisheries plan:

- The District is not under a continuing requirement of Order WR95-17 to develop this new plan; it is essentially a voluntary endeavor but one related to District responsibilities for Lagunitas Creek.
- We are in a new era of collaboration and funding opportunities and there are more partners now working on fishery management in Lagunitas Creek.
- There are many lessons that have been learned over the past 11 years, about the fisheries and the watershed that can lend a great deal of information to this planning effort.

The District's new fisheries plan is being developed at around the same time as three other important planning efforts that have been completed or are currently underway: Marin County's San Geronimo Watershed Salmon Enhancement Plan; the National Marin Fisheries Service's Coho Salmon Recovery Plan; and the State Water Resources

Control Board’s sediment TMDL for Lagunitas Creek.

The District’s new plan will be structured to be consistent with the watershed goals and objectives to protect and enhance the fishery resources of Lagunitas Creek. The District’s approach to developing the new plan will be to work collaboratively with other agencies, organizations, and individuals to identify and craft a direction for the District for fisheries management into the future.

13.0 REFERENCES

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FIGURES

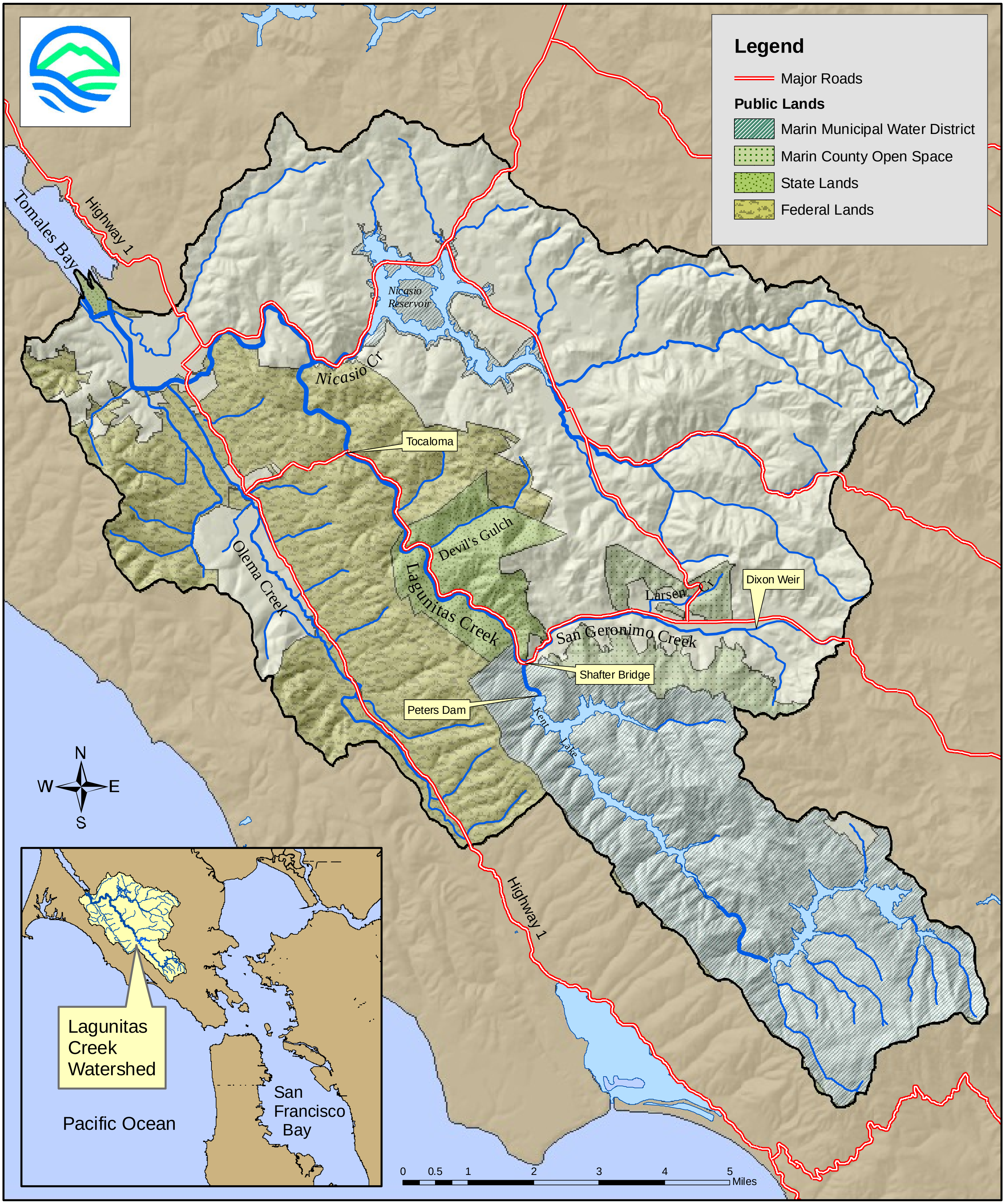


Figure 1. Map of the Lagunitas Creek Watershed

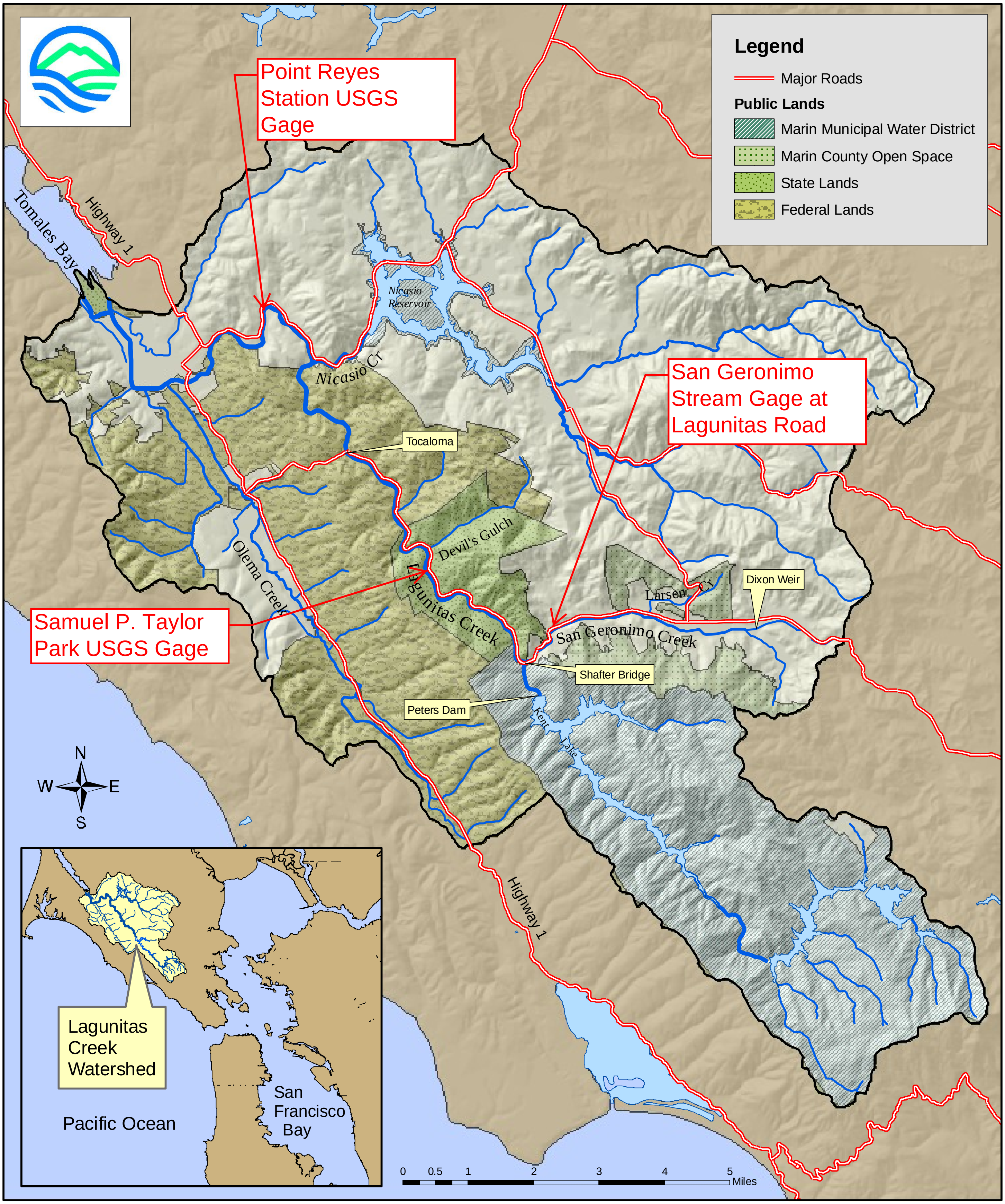


Figure 2. Stream gages on Lagunitas Creek and San Geronimo Creek.

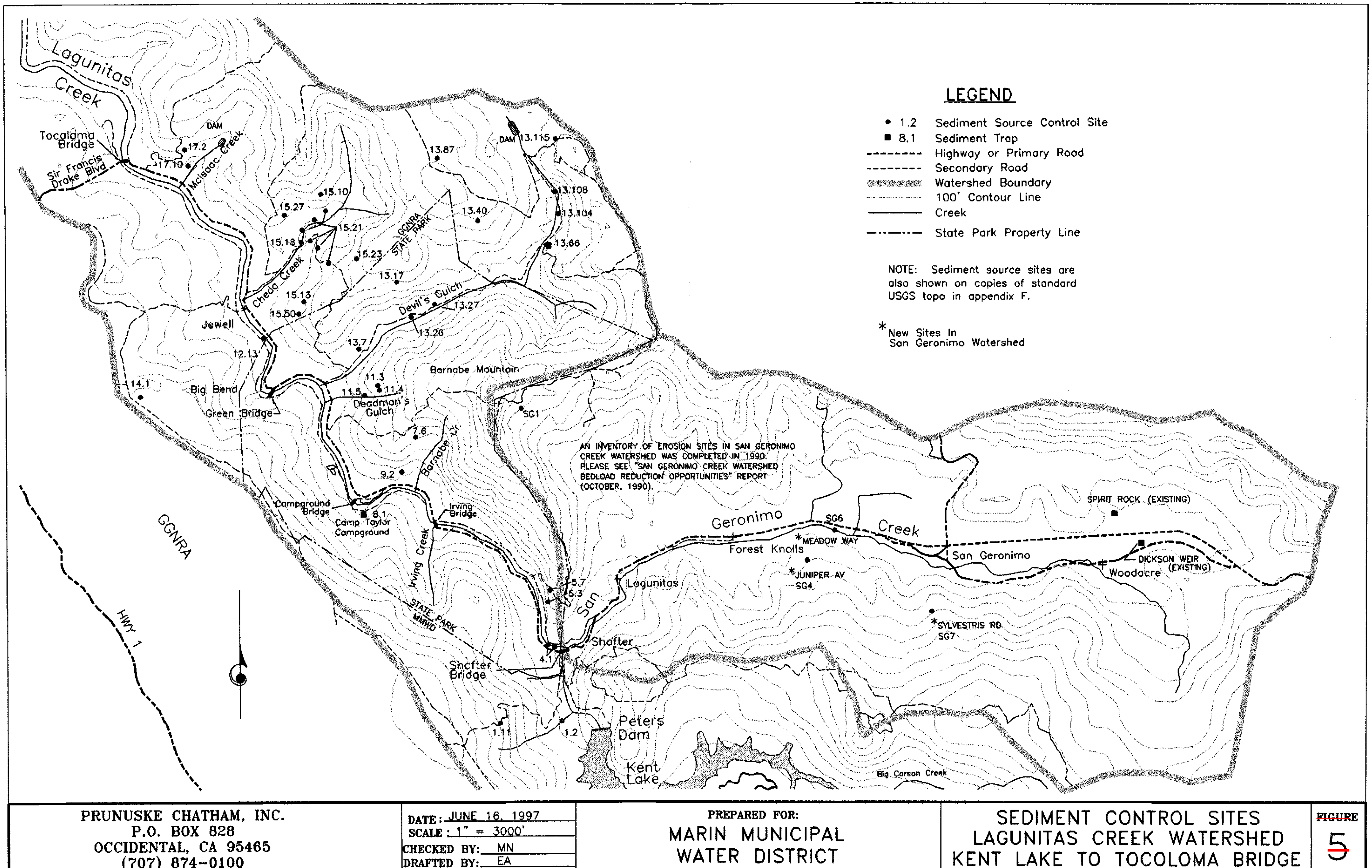


Figure 3. Sediment source sites identified in the Lagunitas Creek Sediment and Riparian Management Plan (Source: MMWD 1997) ~~- 52 -~~

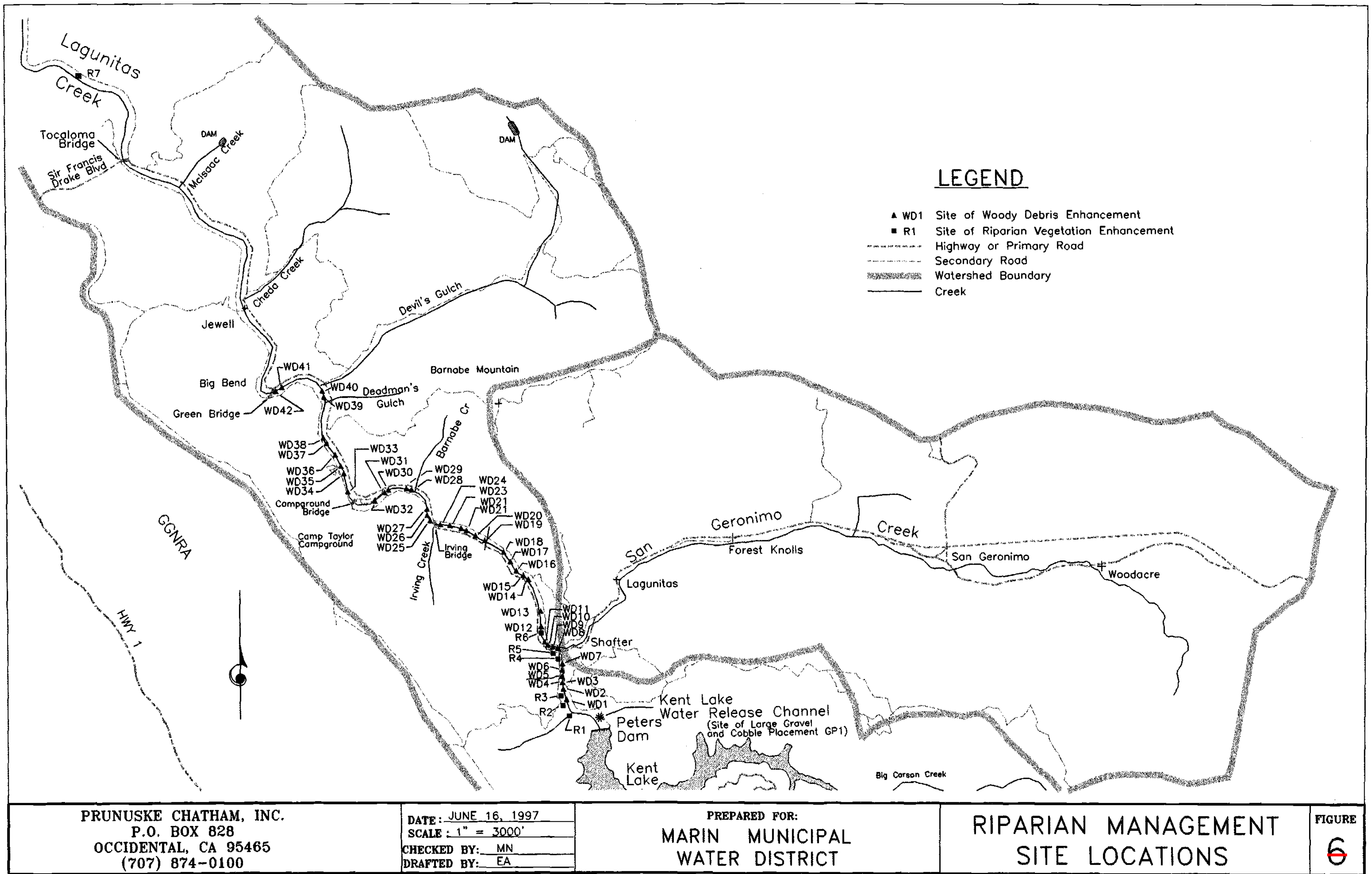
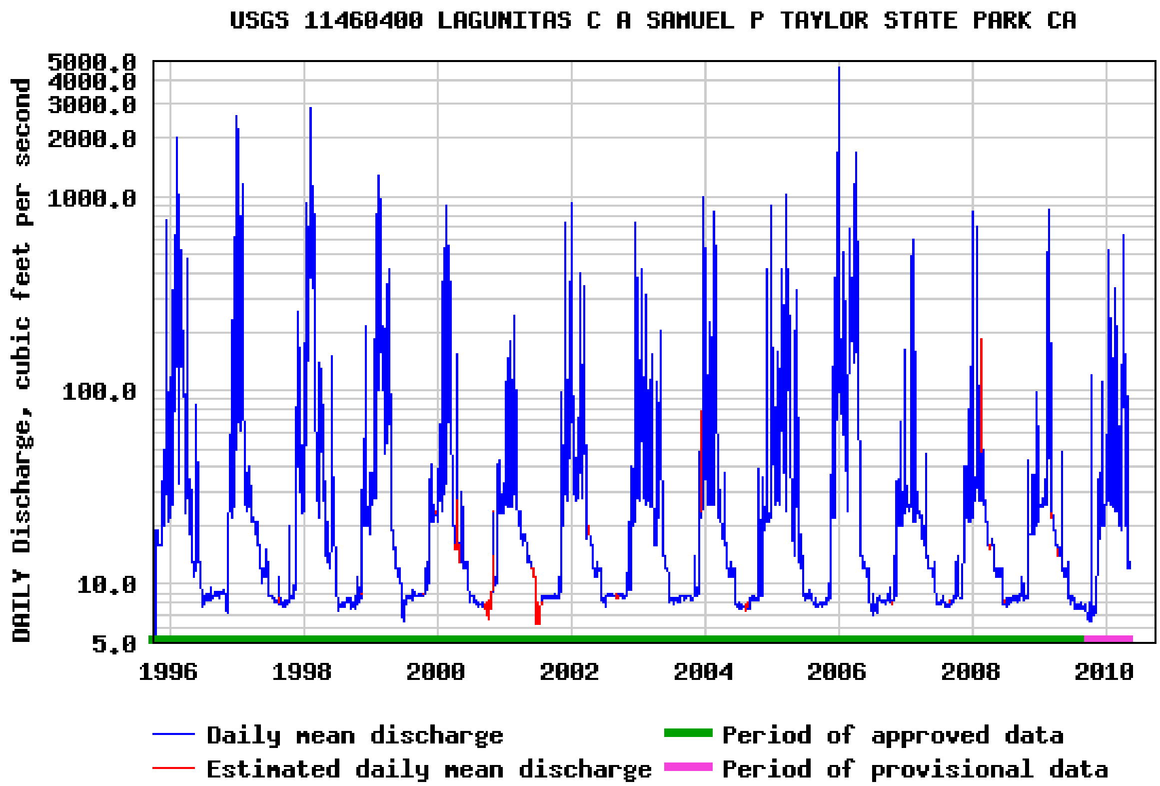


Figure 4. Large woody debris (WD) site identified in the Lagunitas Creek Sediment and Riparian Management Plan (MMWD 1997). ~~71~~

Mean Daily Discharge (cfs), Water Years 1996 – 2009



Peak Discharge (cfs), Water Years 1985 – 2008

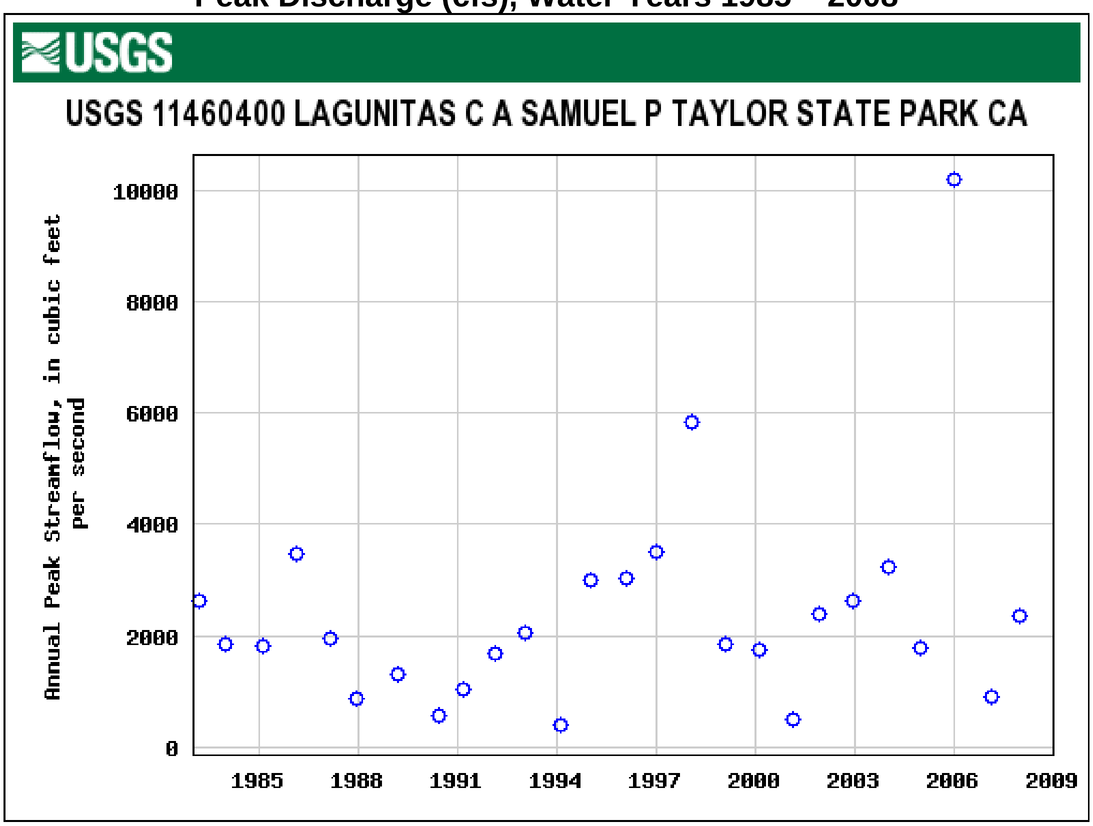
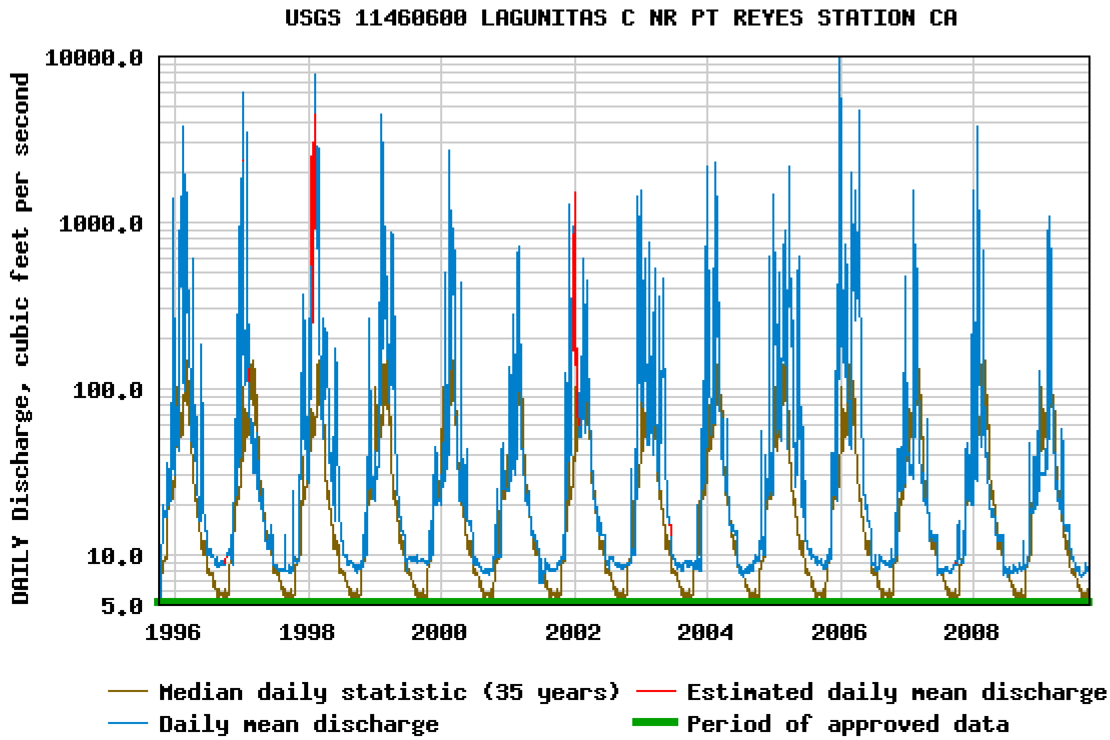


Figure 5. Stream flow records from the USGS stream gage at SP Taylor Park; mean daily WY 1996 – 2009, and peak discharge WY 1985 - 2008 (source: USGS 2010).

Mean Daily Discharge (cfs), Water Years 1996 – 2009



Peak Discharge (cfs), Water Years 1976 – 2008

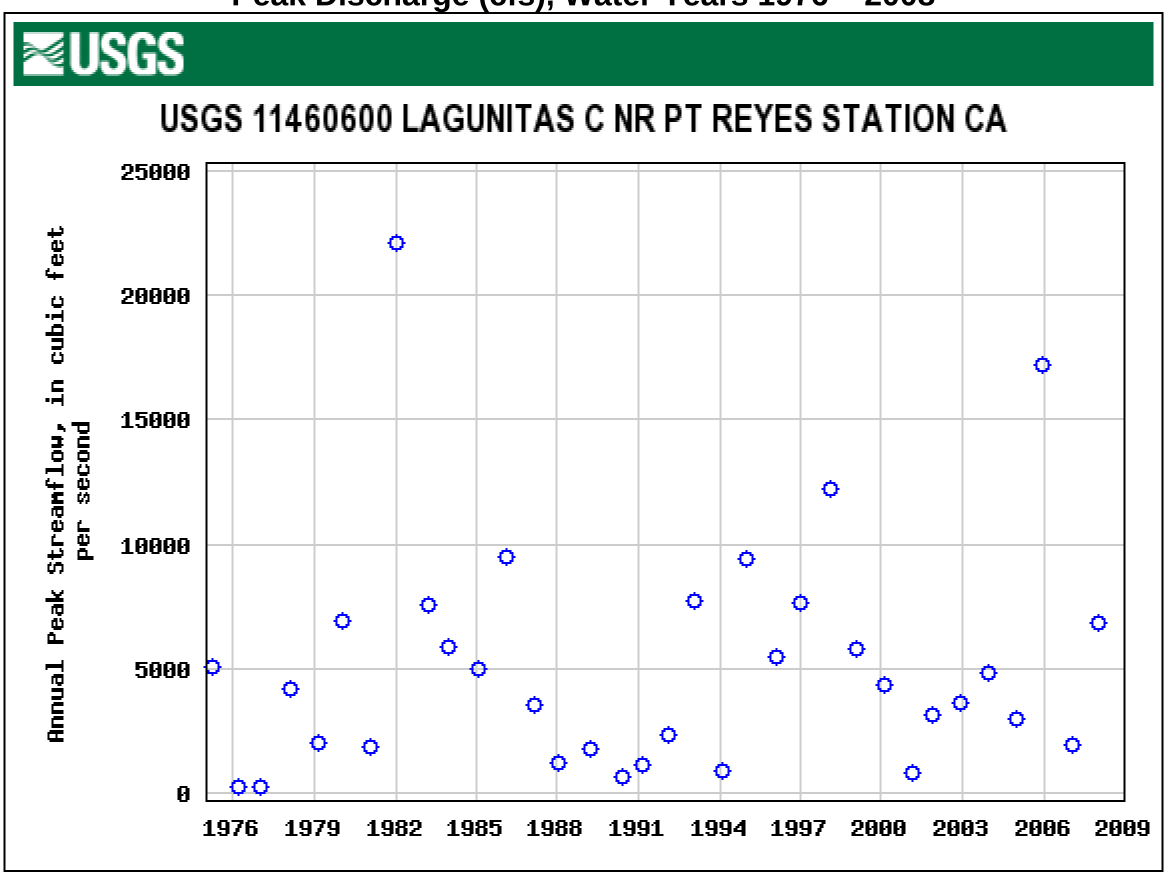
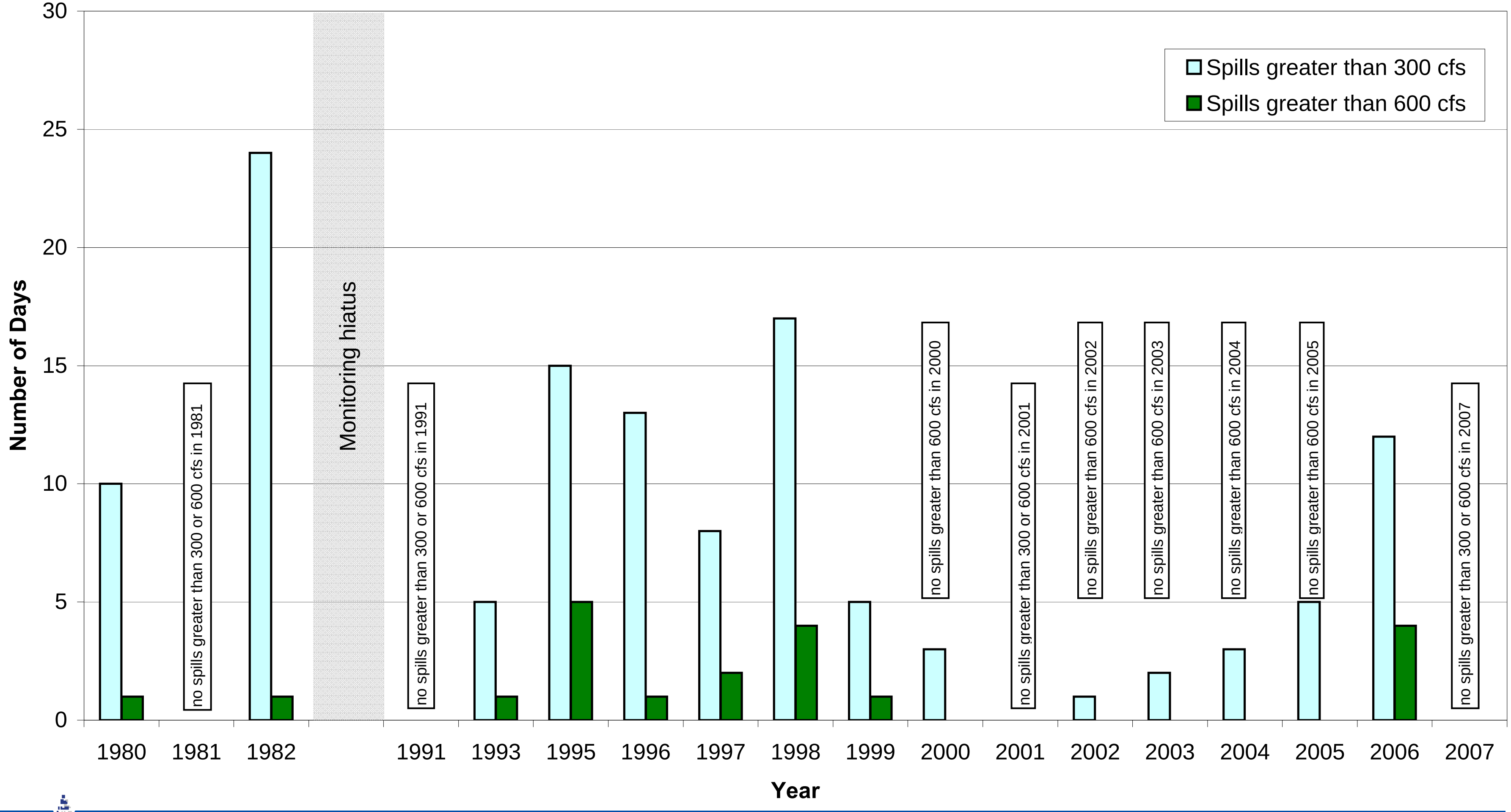


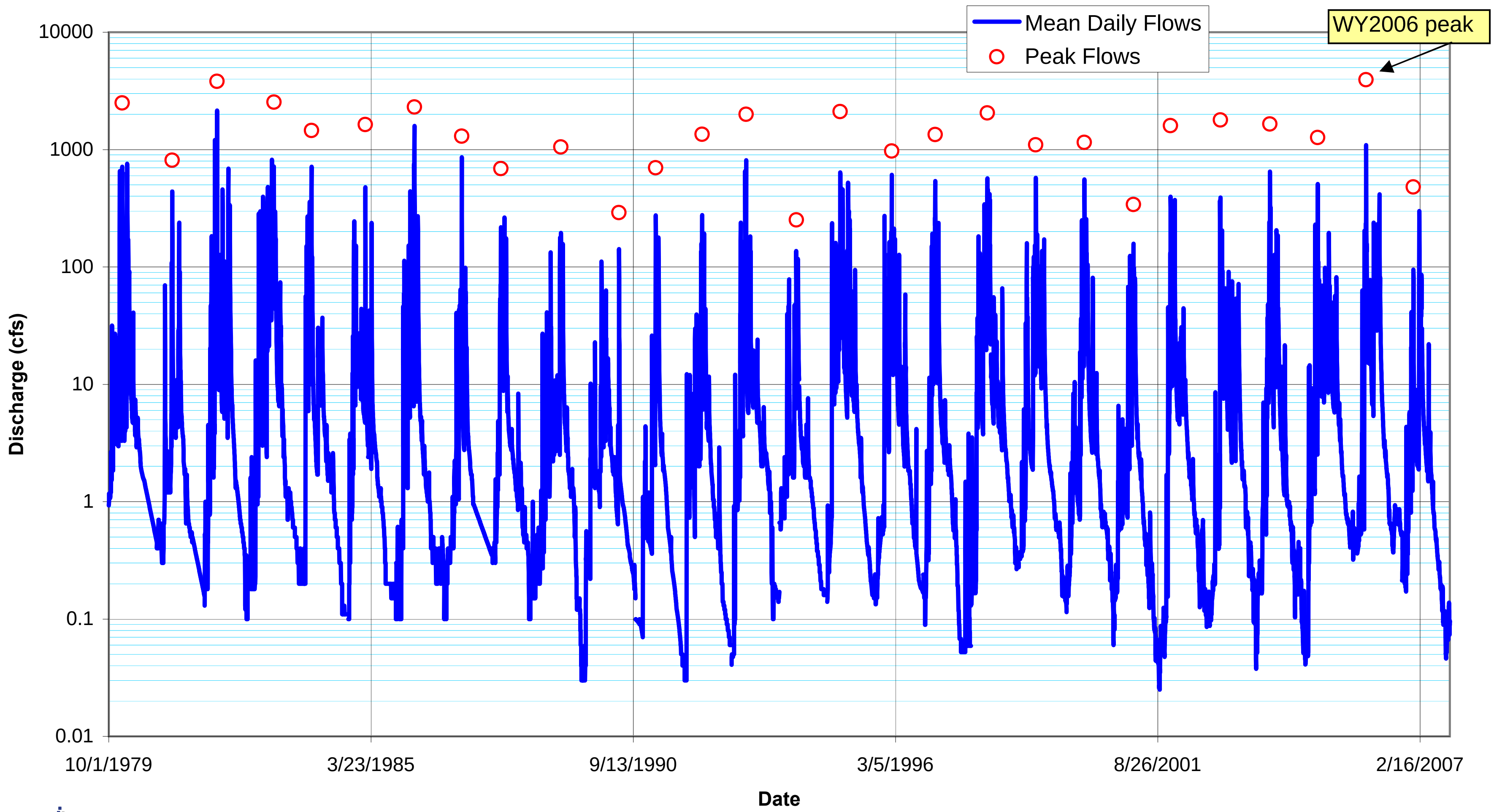
Figure 6. Stream flow records from the USGS stream gage near Point Reyes Station; mean daily WY 1996 – 2009, and peak discharge WY 1976 - 2008 (source: USGS 2010).



Balance Hydrologics, Inc.

~~**Figure 7.**~~ **Number of days with spills and high-flow releases exceeding thresholds of 300 and 600 cfs for years when bed-monitoring data were collected.** ~~See text for explanation.~~ [Source of flow data: MMWD]
(note: No spills in water years 2008 or 2009)

Figure 7. Average daily Kent Lake spills into Lagunitas Creek, water years 1980-2007; (source: Balance Hydrologics, Inc. 2008).



Balance Hydrologics, Inc.

~~Figure 5.~~ **Mean daily and instantaneous peak flow, San Geronimo Creek at Lagunitas Road Bridge, 1980-2007, Marin County, California.** Note peak flow in 2006, similar to peak flow recorded in water year 1982 (4-Jan. 1982).

Figure 8. Stream flows at MMWD's San Geronimo Creek stream gage, water years 1980-2007; (source: Balance Hydrologics, Inc. 2008).

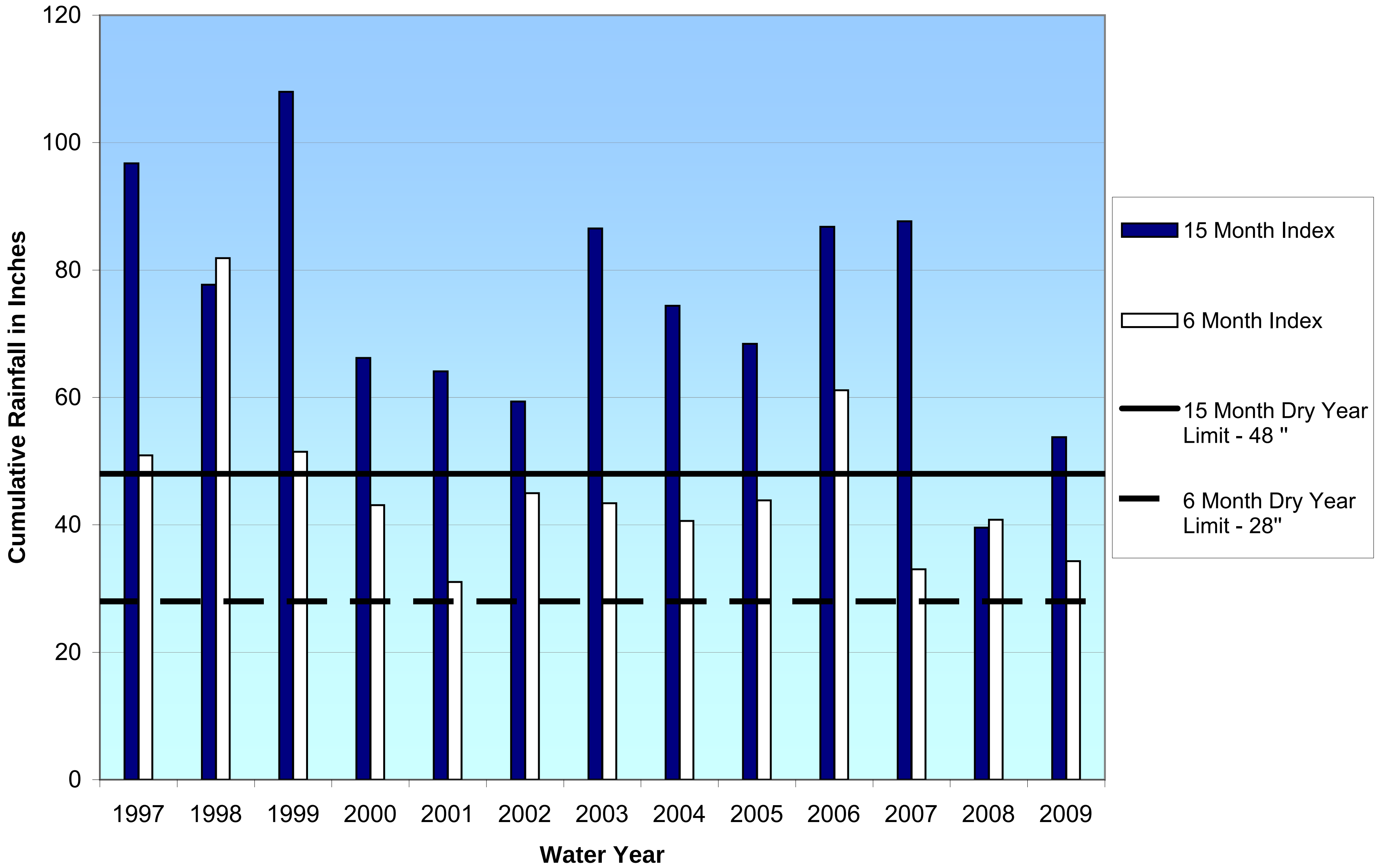


Figure 9. Lagunitas Creek watershed, water year classifications as an index of cumulative rainfall; Water Years 1997 - 2009.

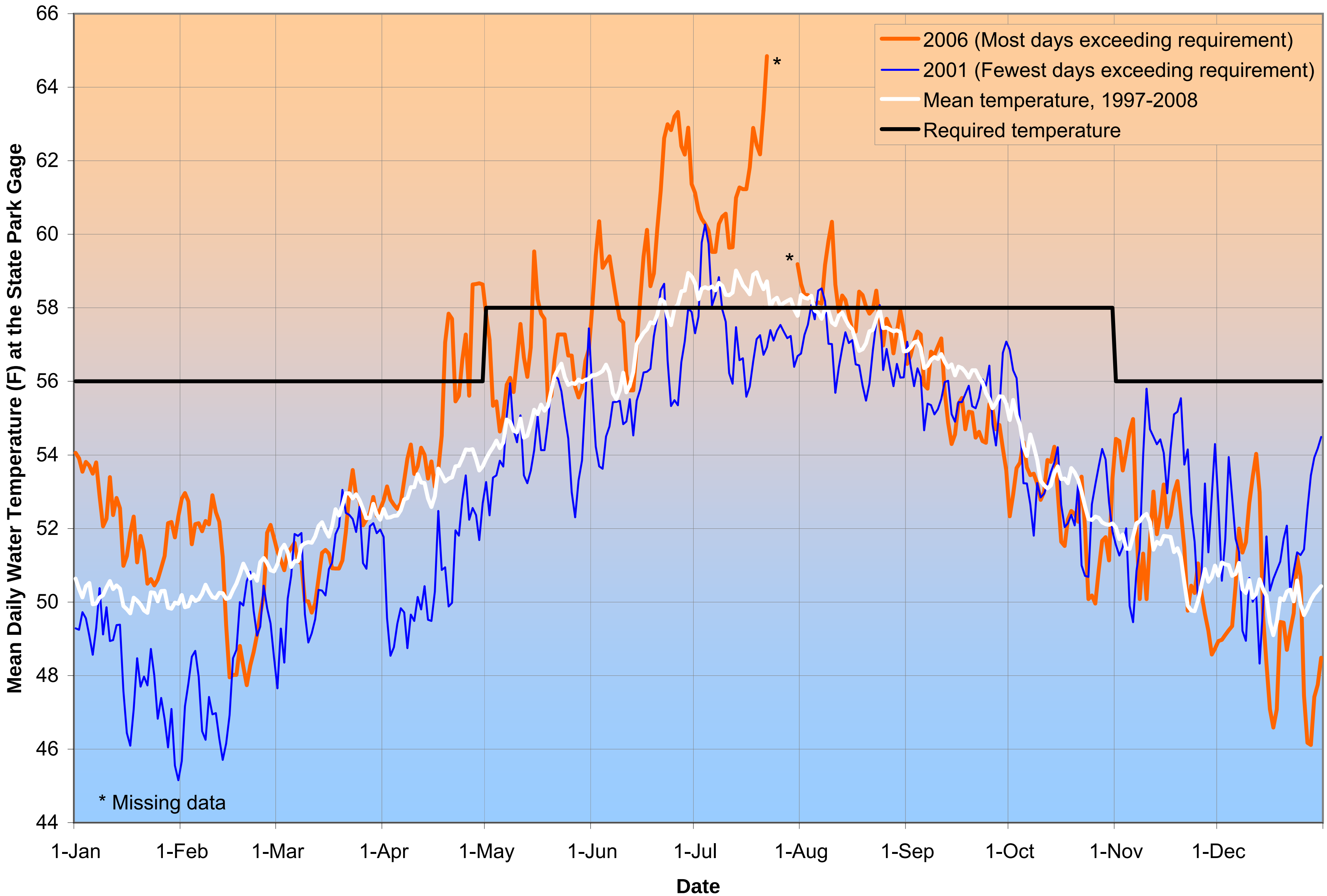


Figure 10. Mean daily water temperatures at the SP Taylor Park Park stream gage in Lagunitas Creek; water years 1997 - 2008.

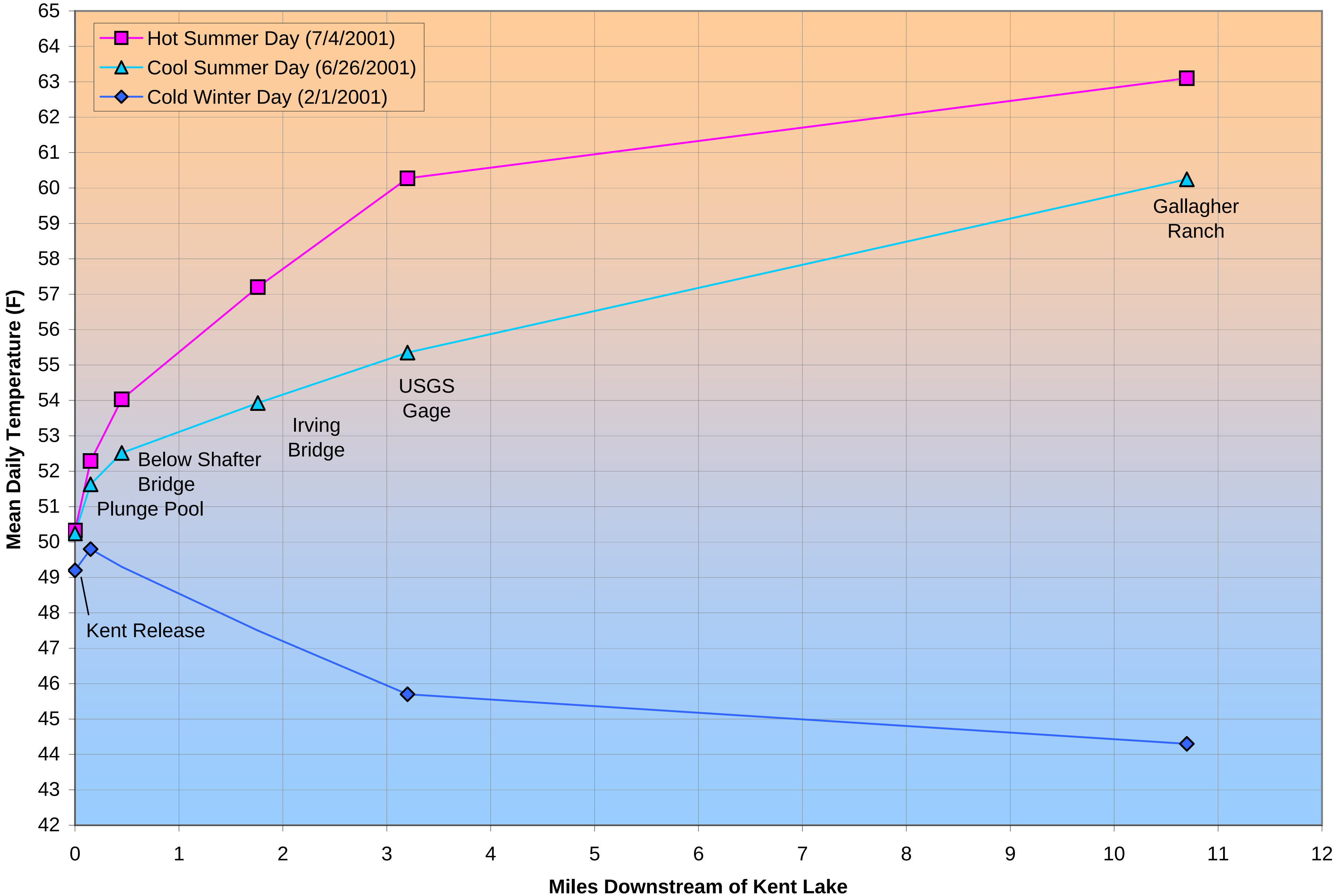
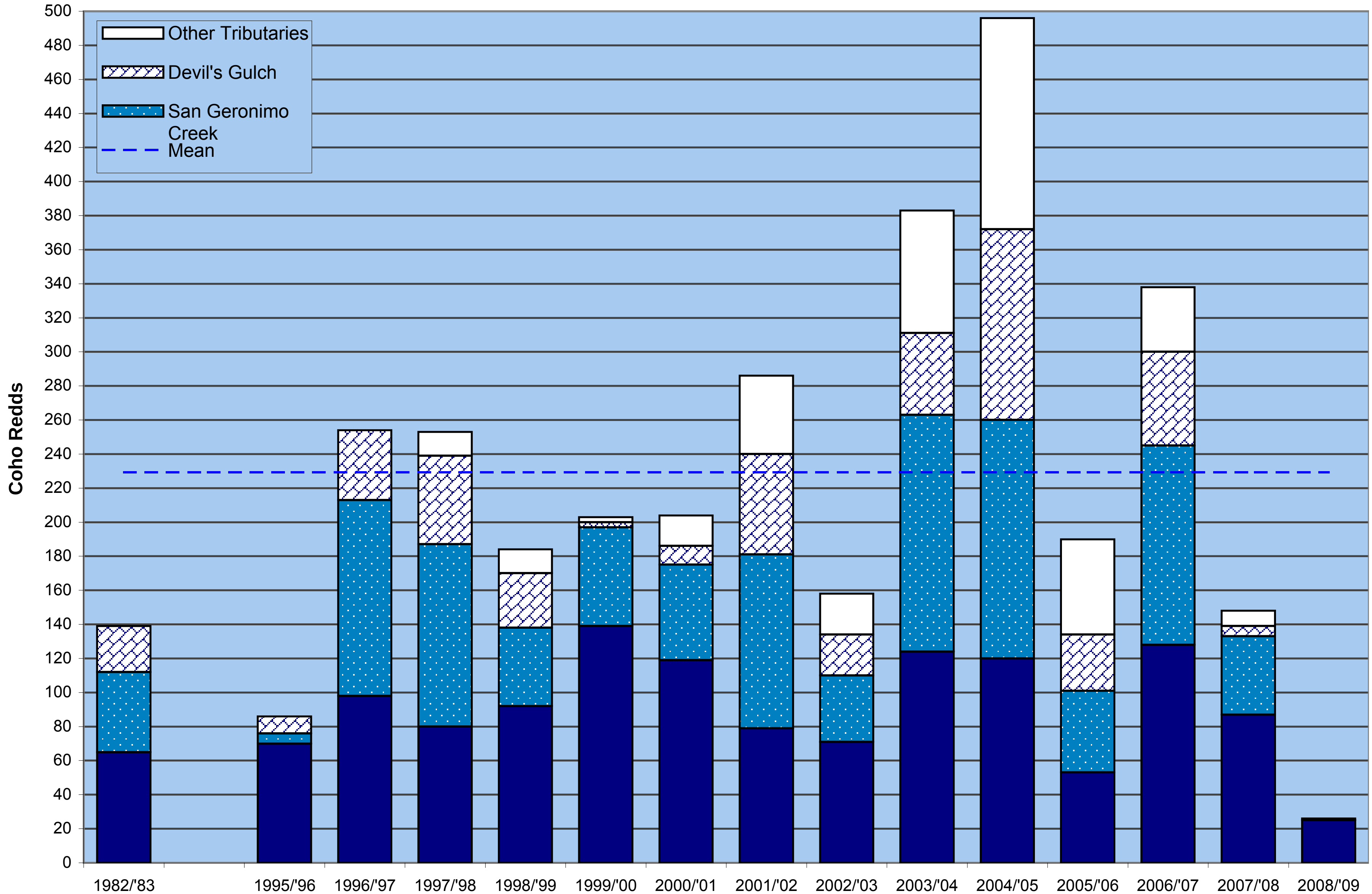


Figure 11. Water temperatures in Lagunitas Creek during three days in 2001.



Note: Tributaries to San Geronimo Creek were not surveyed prior to 1997/'98.

Figure 12. Coho redds by creek and spawning season in the Lagunitas Creek study area; 1982/83 and 1995/96 - 2008/09.

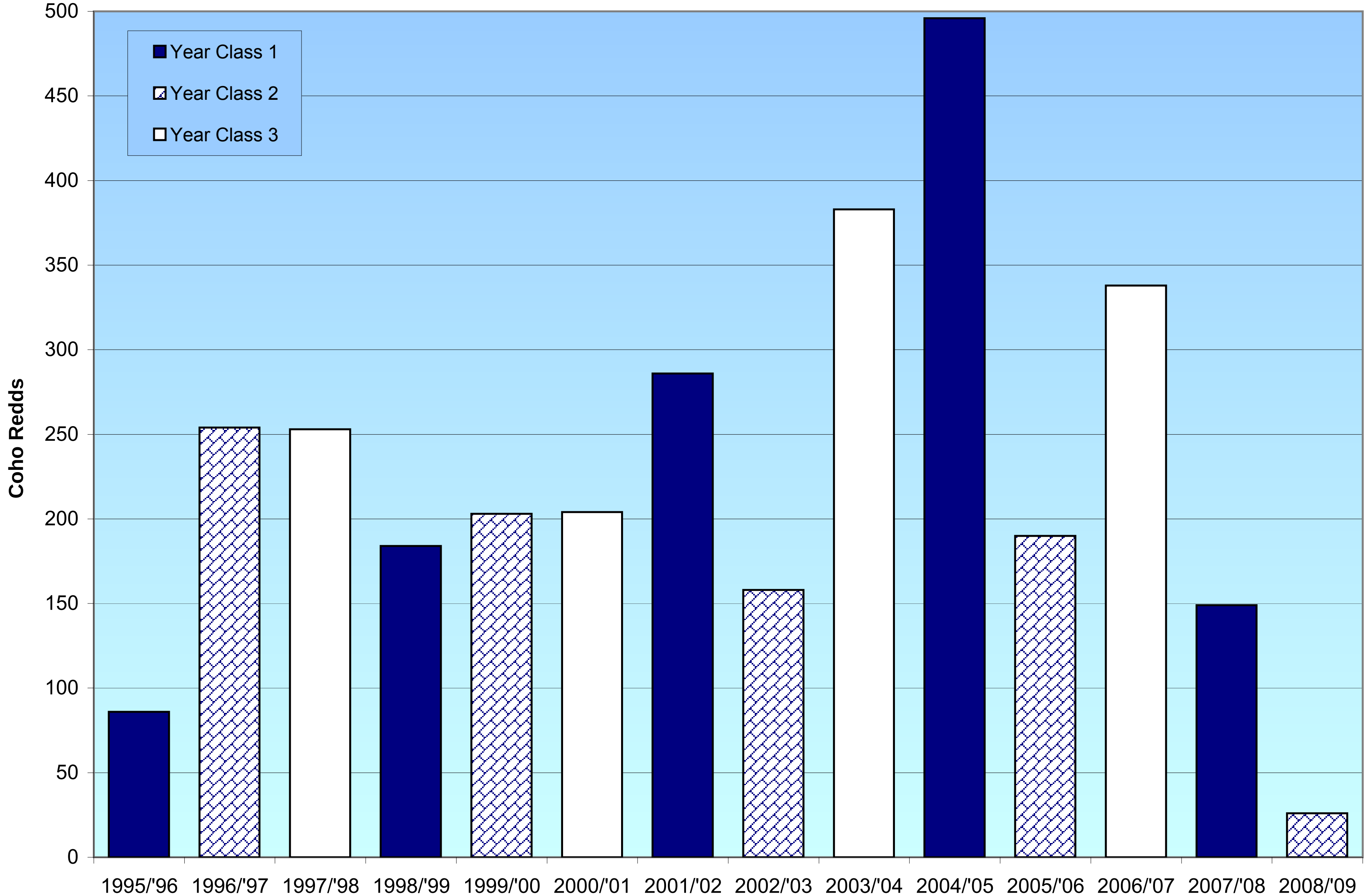


Figure 13. Coho spawning redds by year class in the Lagunitas Creek study area, 1995/06 - 2008/09.

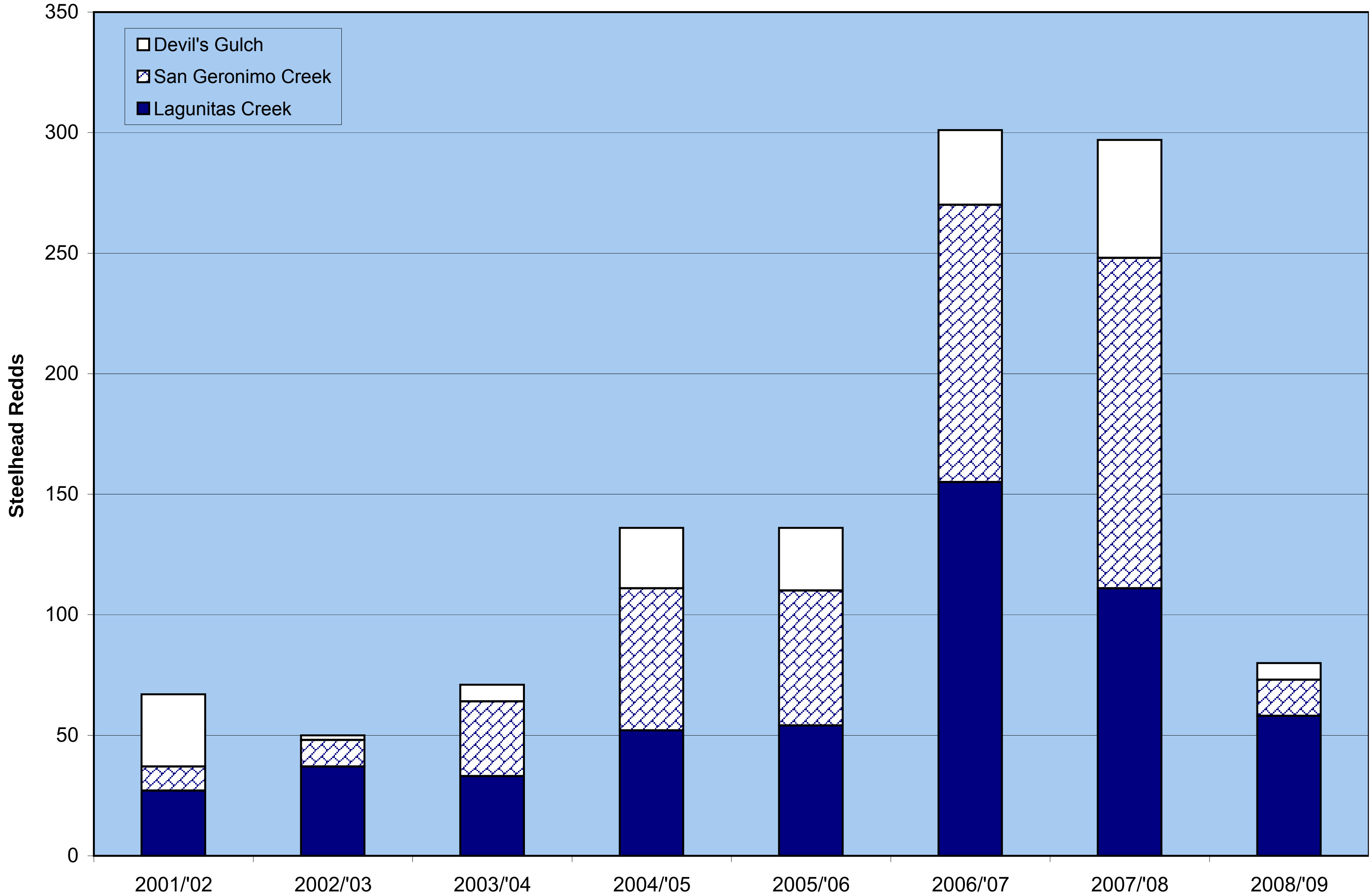


Figure 14. Steelhead redds by creek in the Lagunitas Creek study area, 2001/'02-2008/'09.

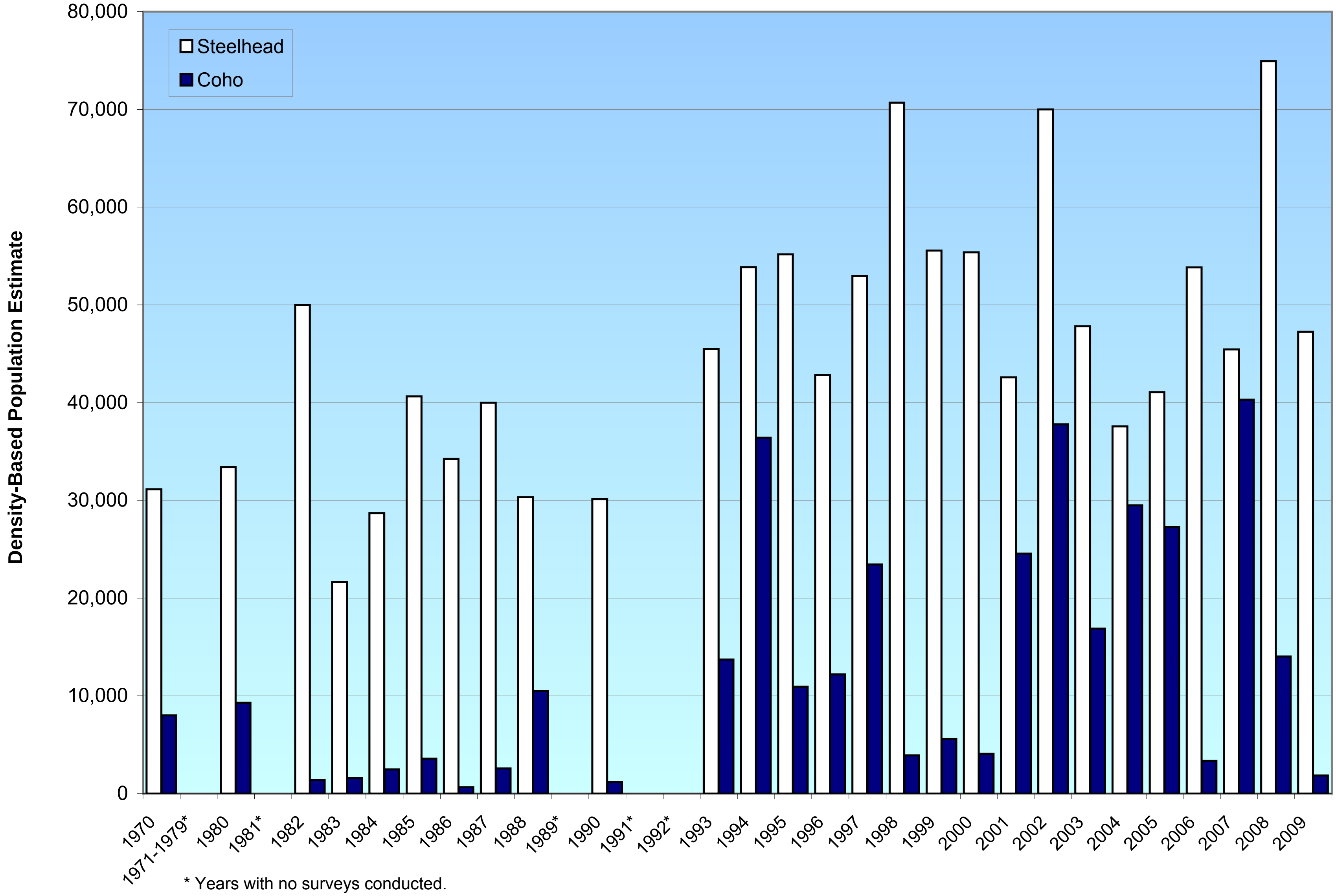


Figure 15. Population estimates, based exclusively on density data, of juvenile salmonids, in the Lagunitas Creek study area, 1970-2009.

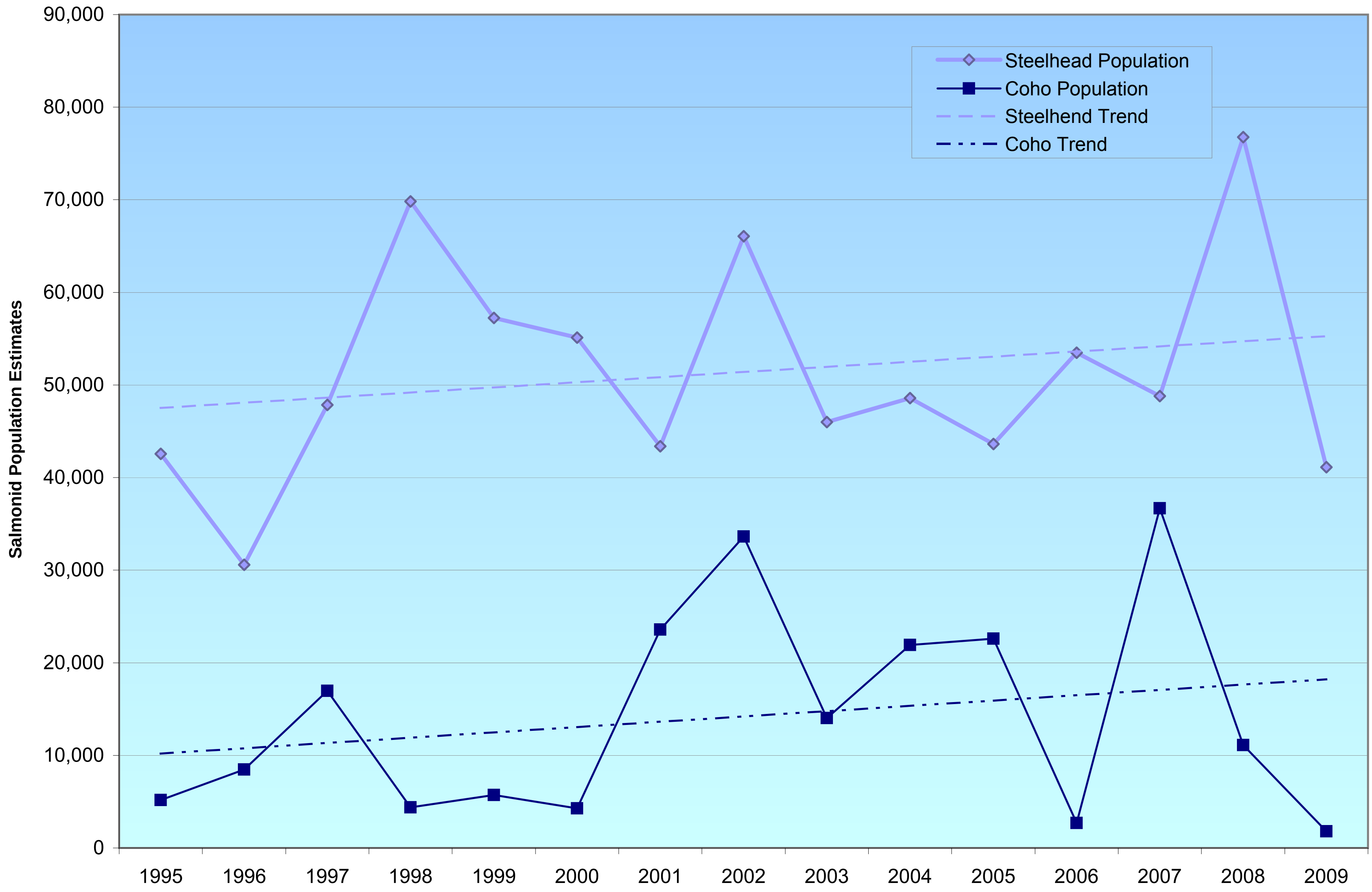


Figure 16. Population estimates, based on habitat data, of juvenile salmonids in the Lagunitas Creek study area, 1995-2009.

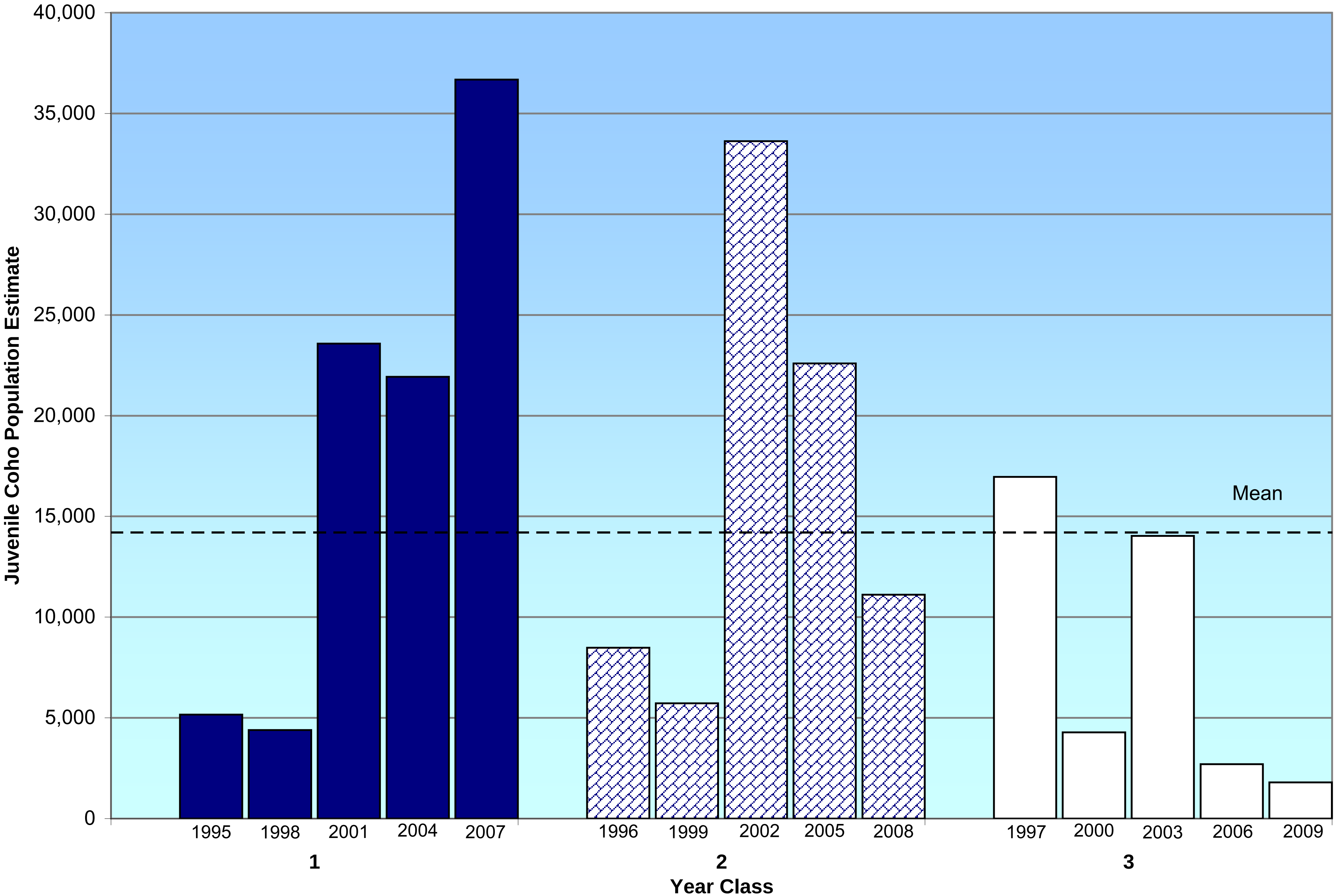


Figure 17. Population estimates, by year class, of juvenile coho in the Lagunitas Creek study area, 1995-2009.

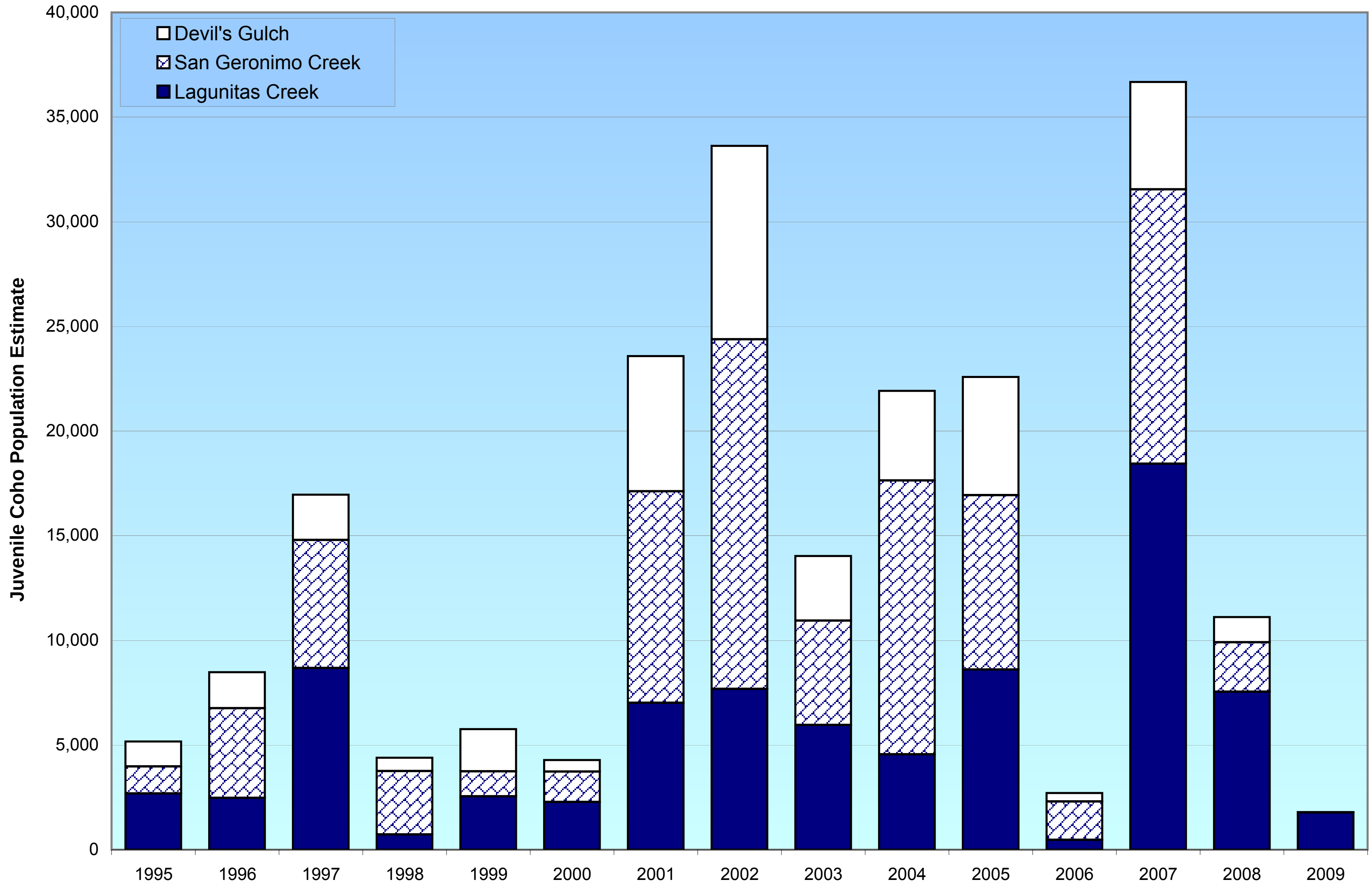


Figure 18. Population estimates, by creek, of juvenile coho in the Lagunitas Creek study area, 1995-2009.

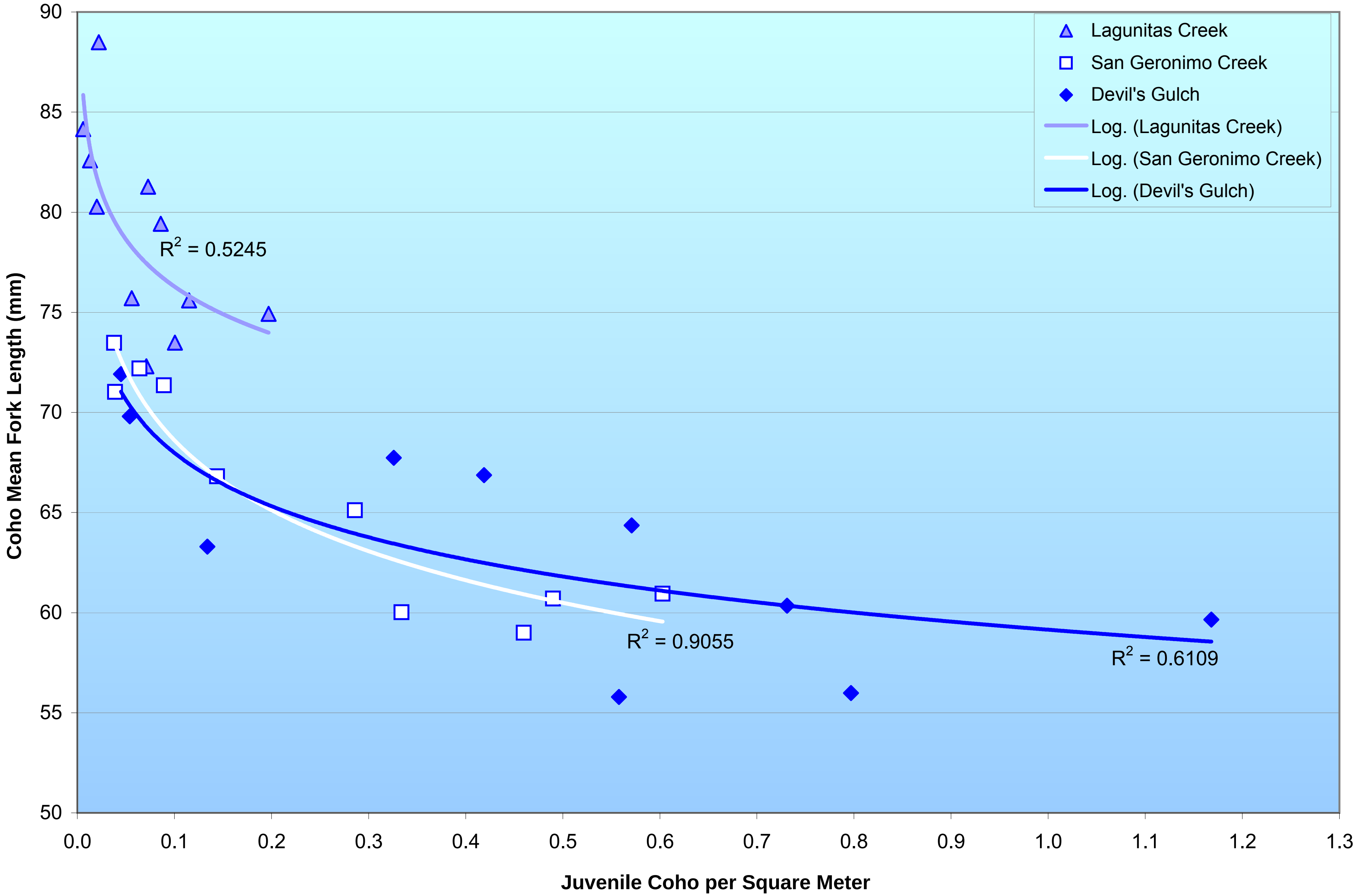


Figure 19. Juvenile coho lengths vs. coho densities in the Lagunitas Creek study area, 1999-2009.

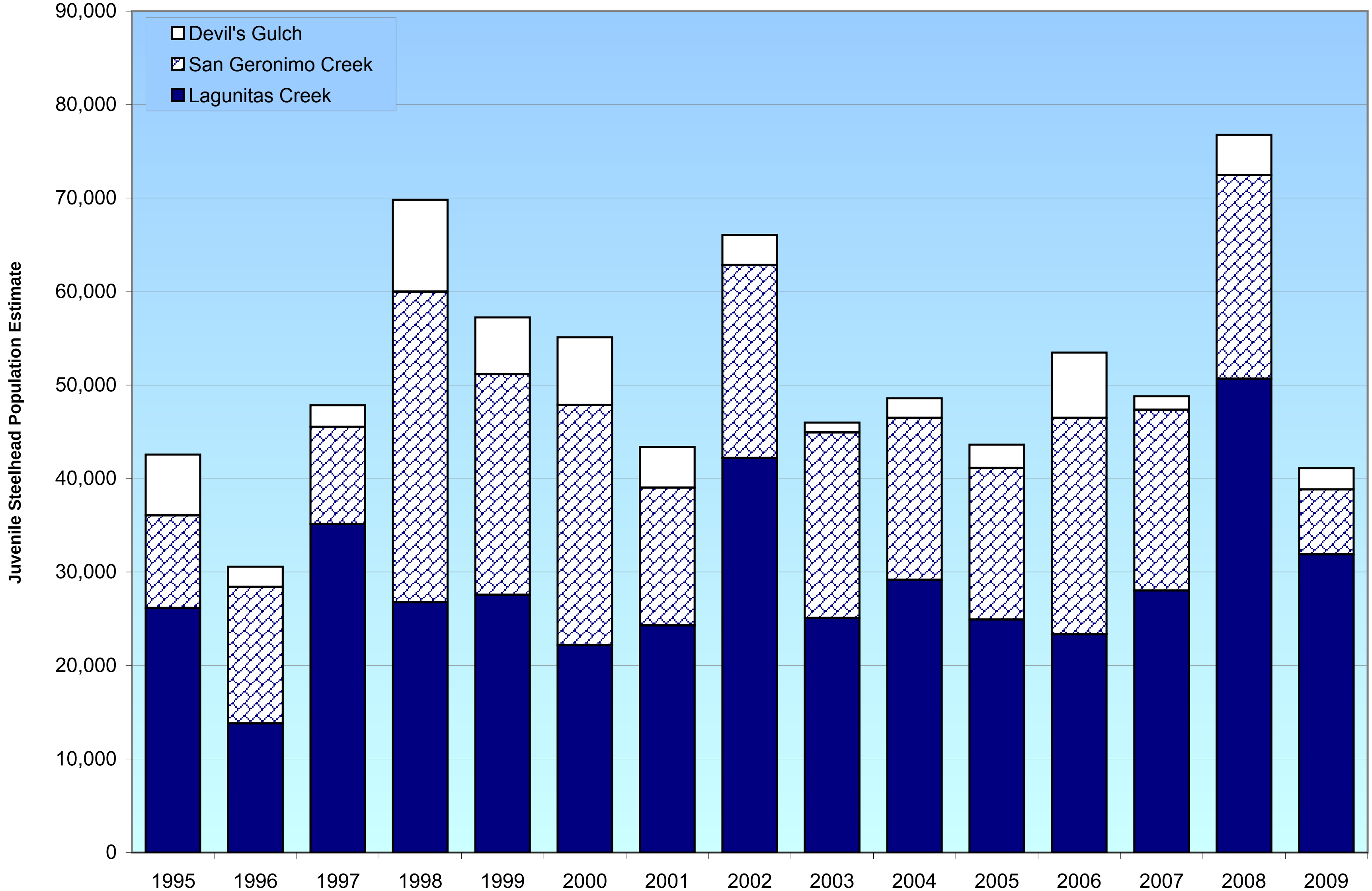


Figure 20. Population estimates, by creek, of juvenile steelhead in the Lagunitas Creek study area, 1995-2009.

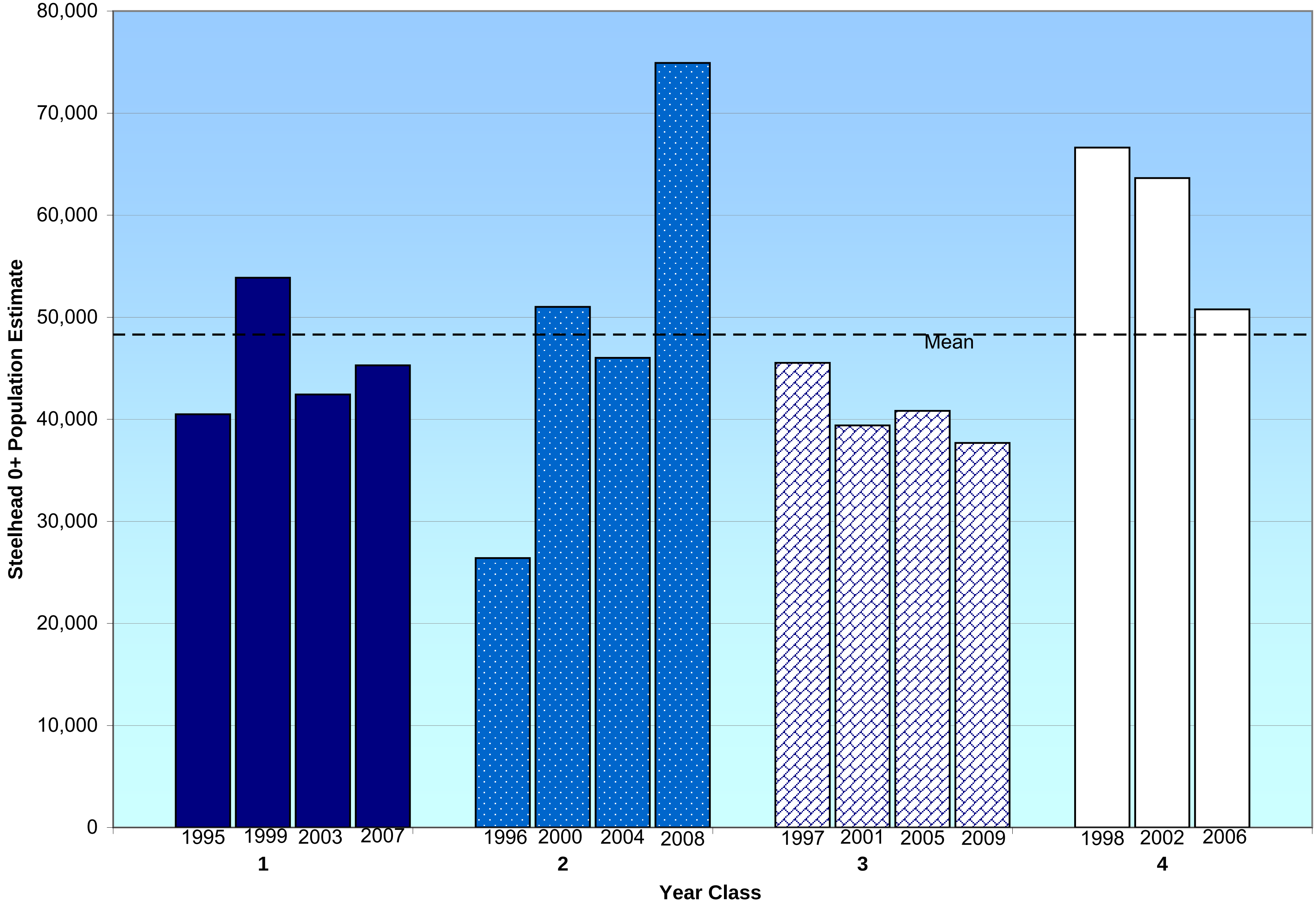


Figure 21. Population estimates, by year class, of juvenile steelhead in the Lagunitas Creek study area, 1995-2009.

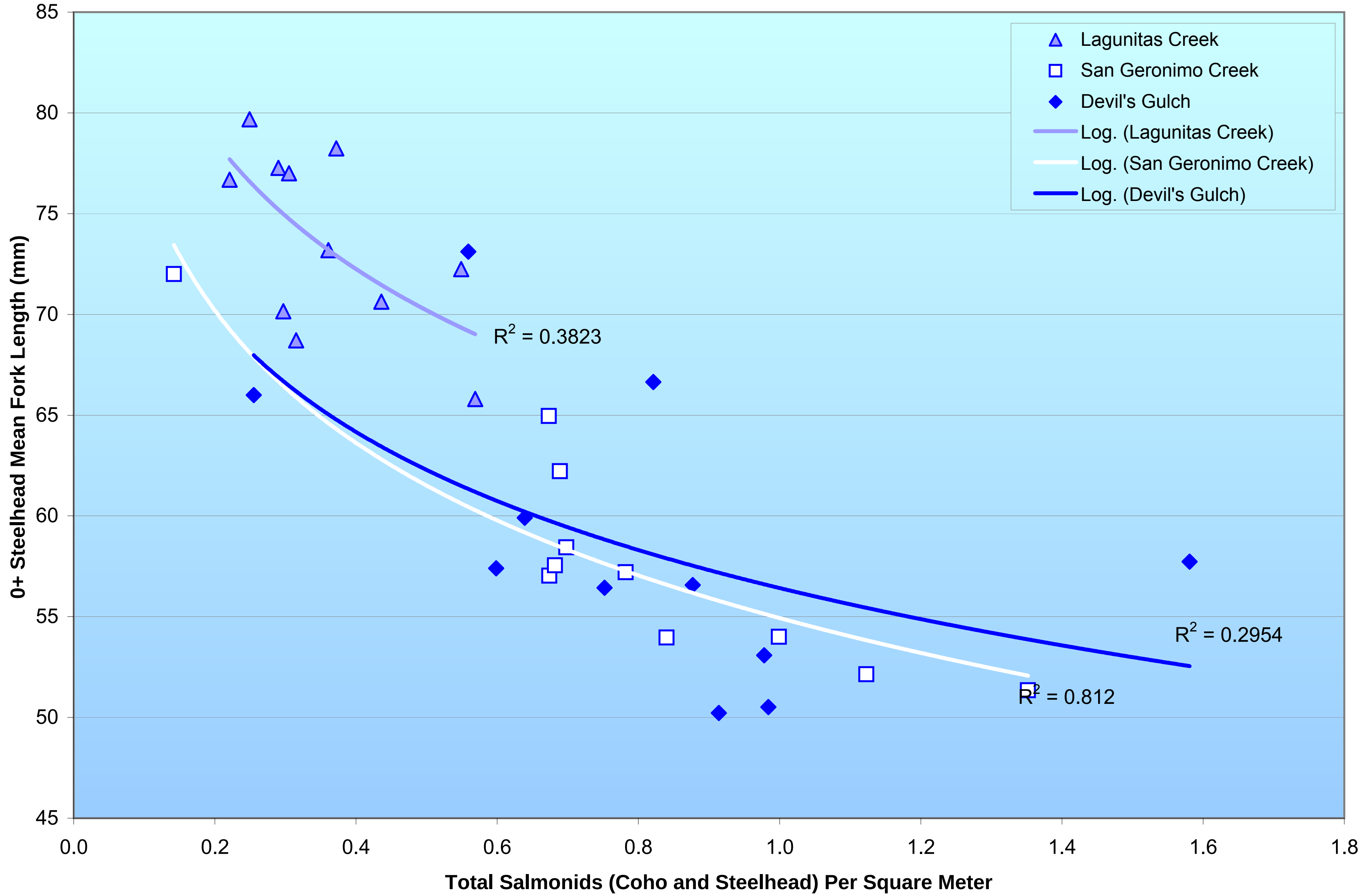


Figure 22. Juvenile Steelhead lengths vs. juvenile salmonid densities in the Lagunitas Creek study area, 1999-2008.

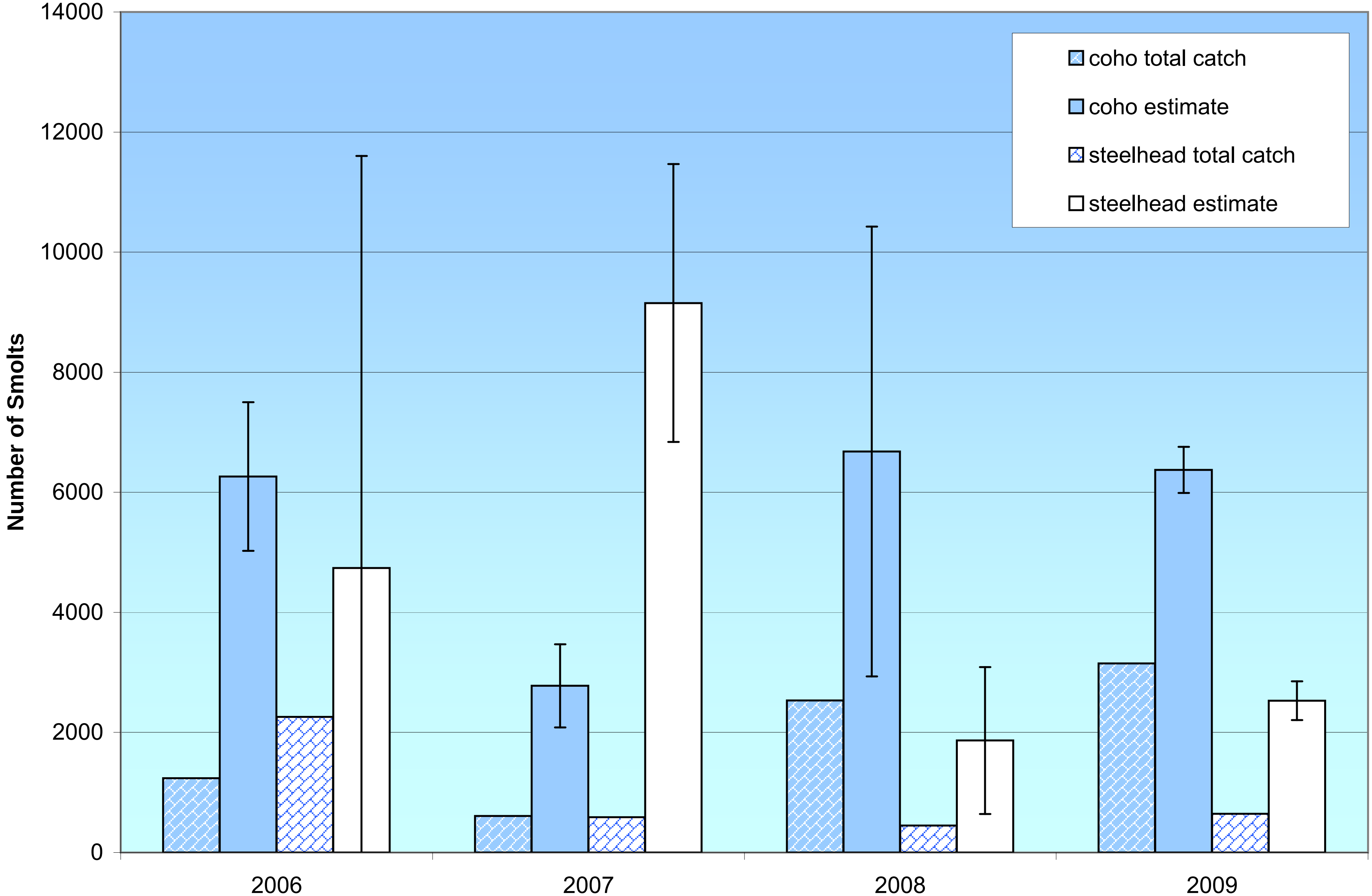


Figure 23. Smolt outmigration from Lagunitas Creek, at the Gallagher trap in lower Lagunitas, 2006-2009.

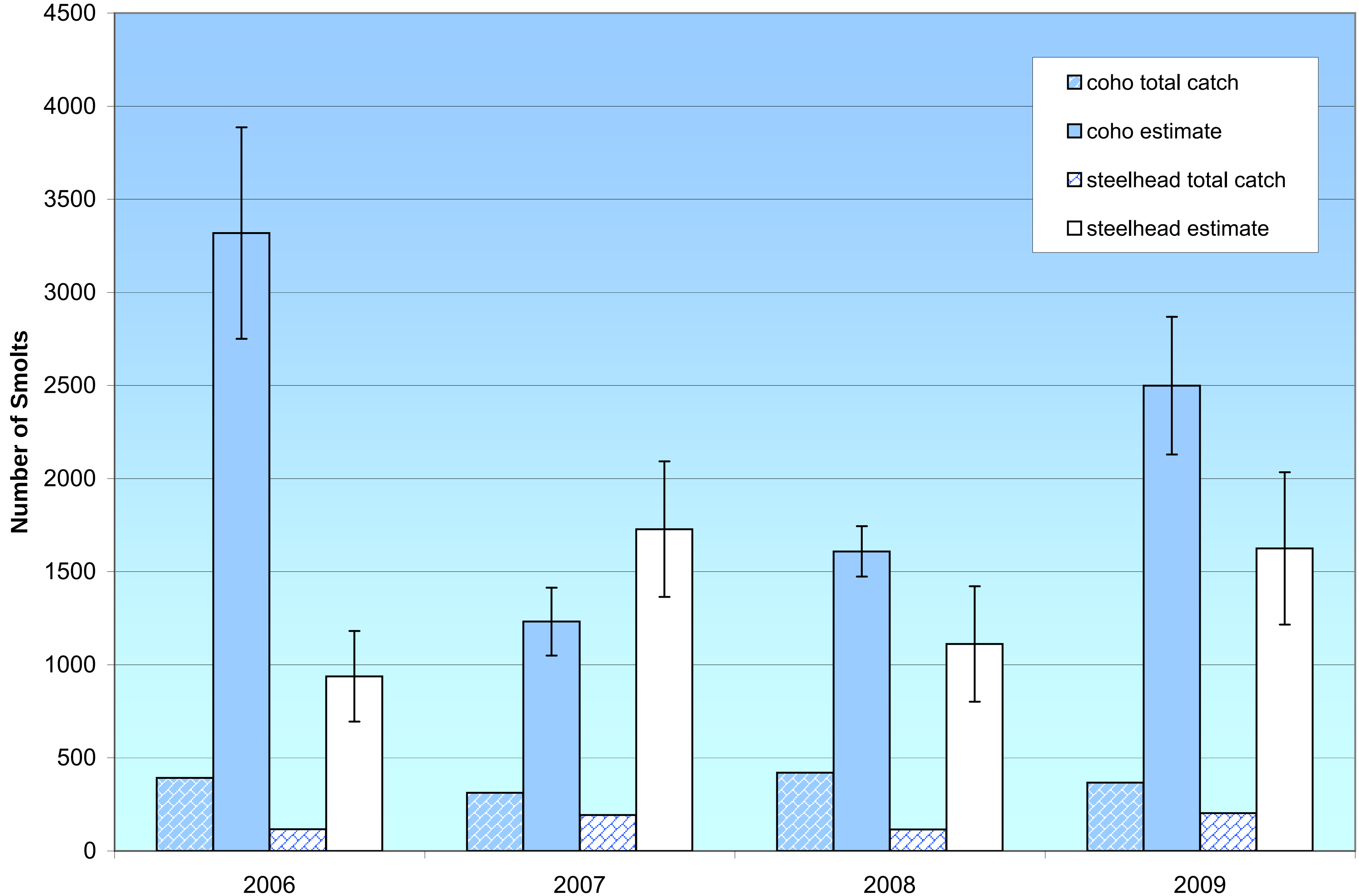


Figure 24. Smolt outmigration from San Geronimo Creek, 2006-2009 (data source: SPAWN).

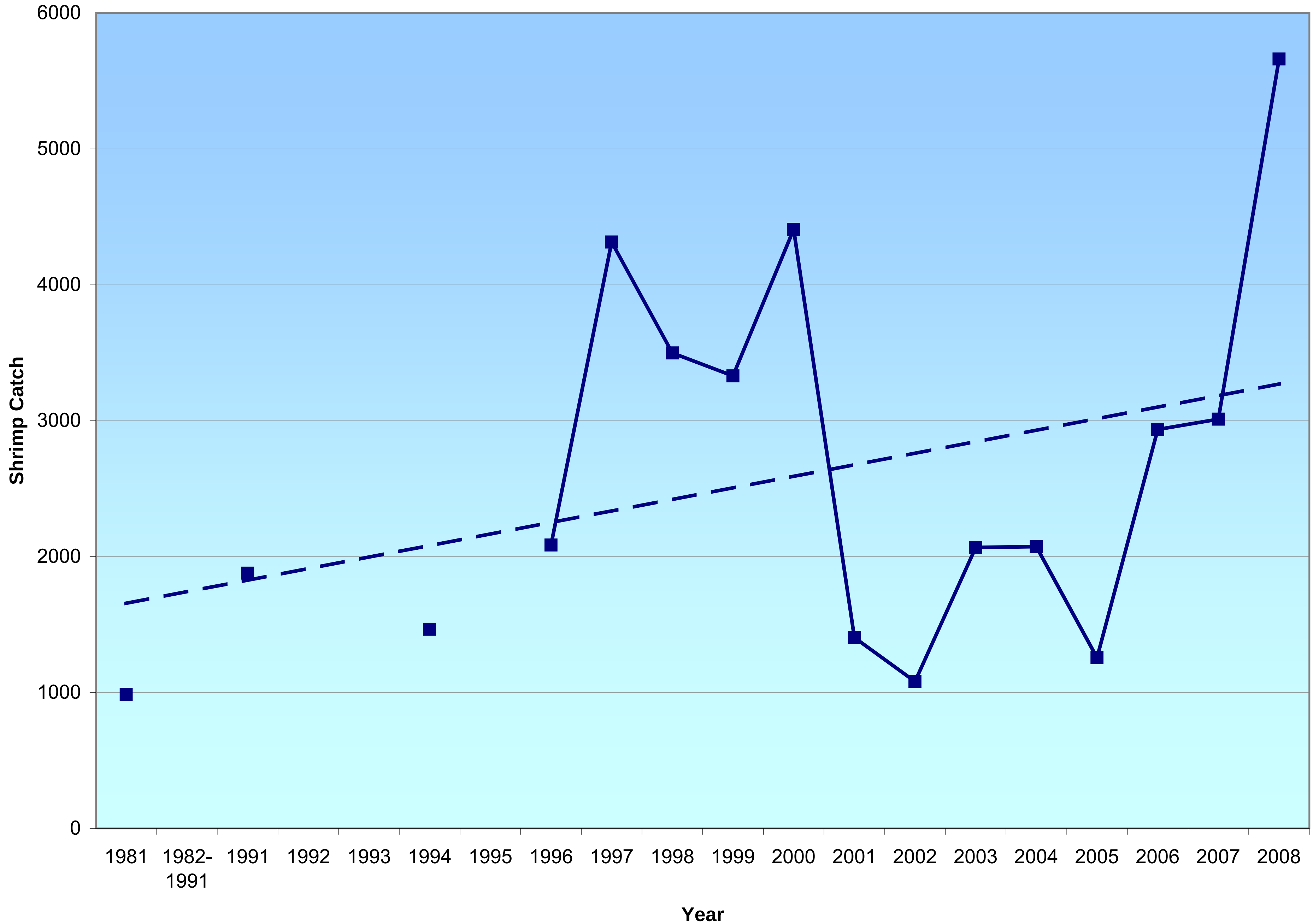


Figure 25. California freshwater shrimp total catch trend for Lagunitas Creek surveys, 1981-2008.

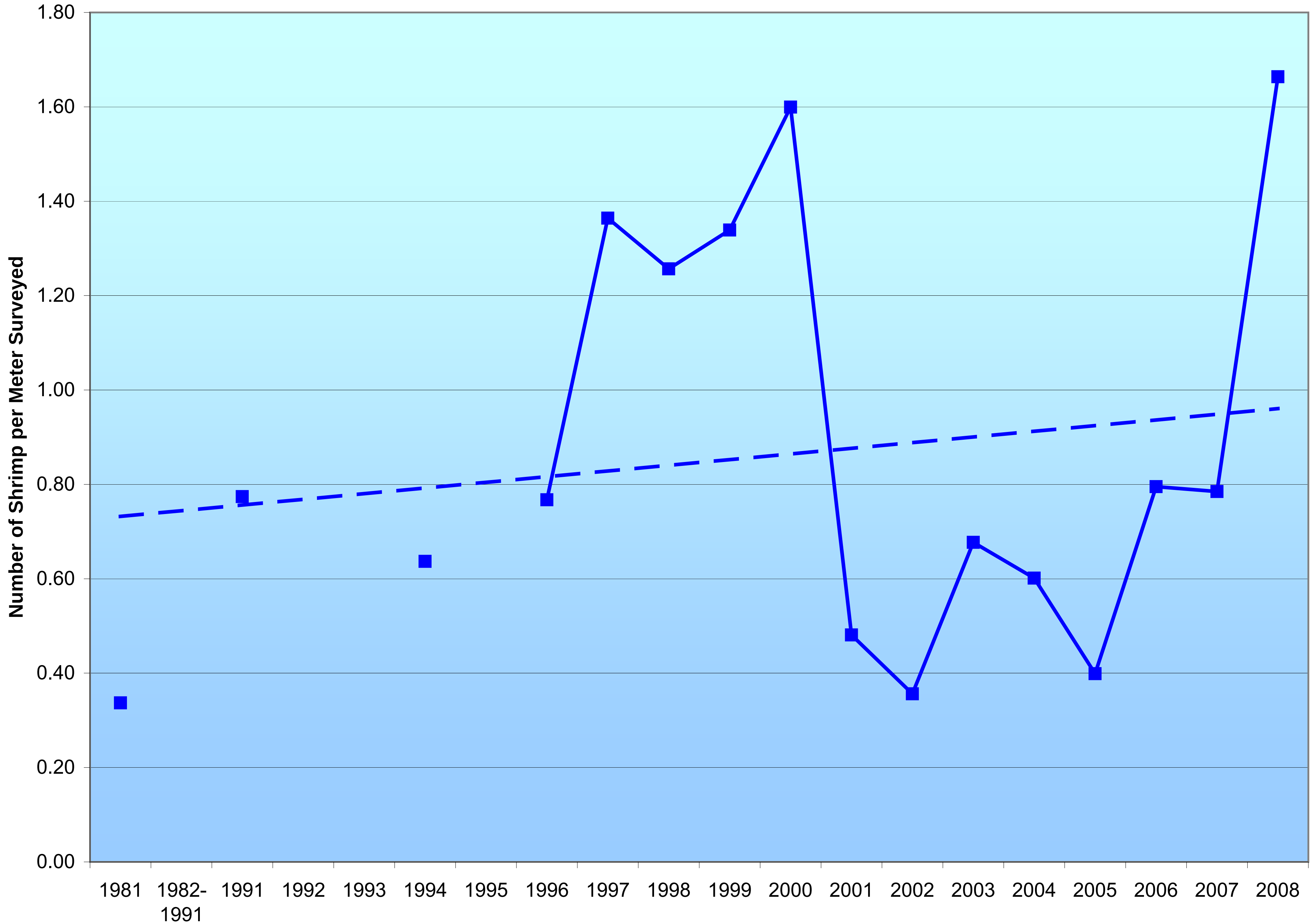


Figure 26. Density of California freshwater shrimp at the "Tocaloma" and "Below Zenardi" sample sites, Lagunitas Creek, 1981-2008.

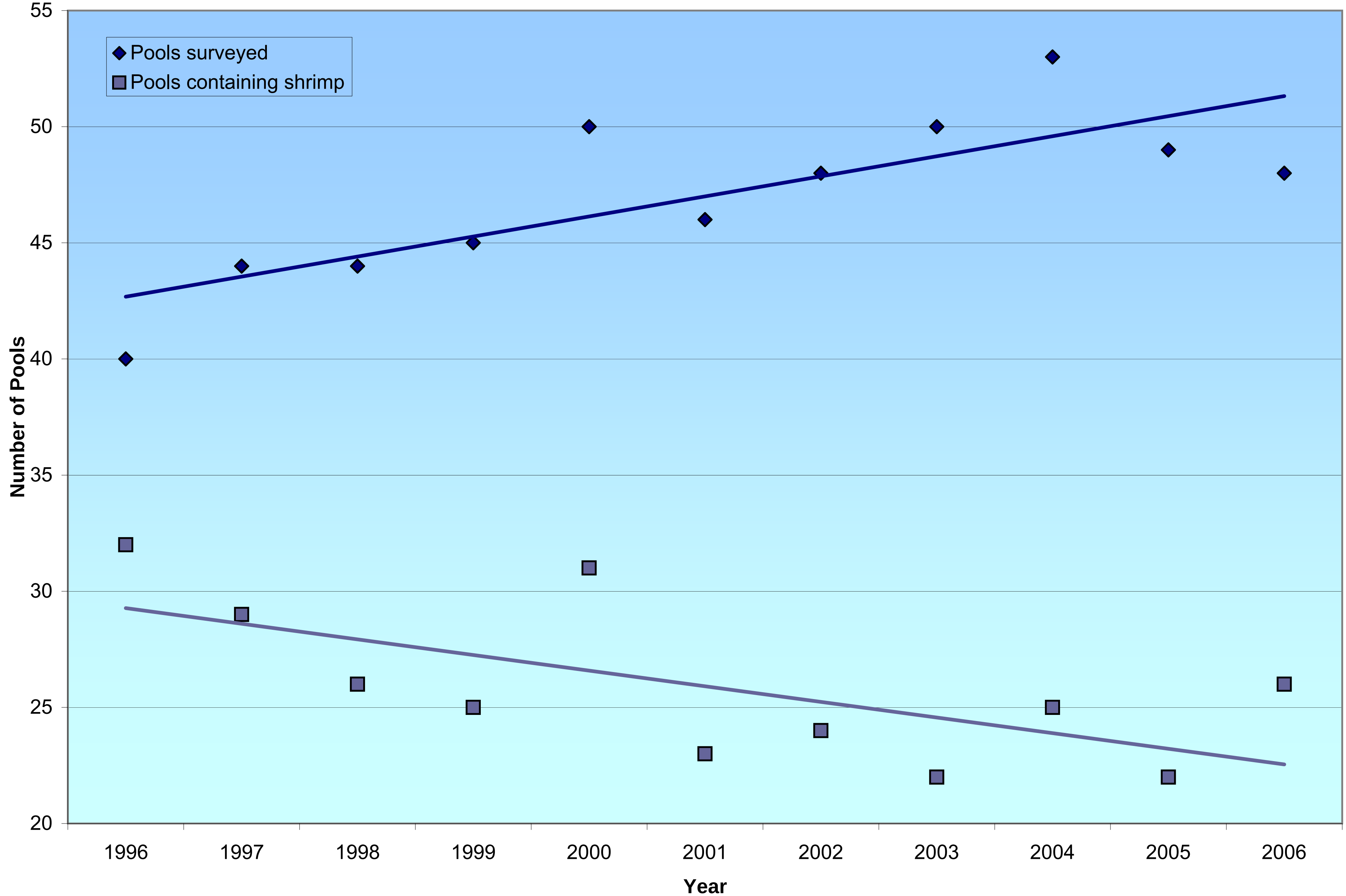


Figure 27. Number of pools surveyed and number containing California freshwater shrimp in the Lagunitas Creek study area, 1996-2006.

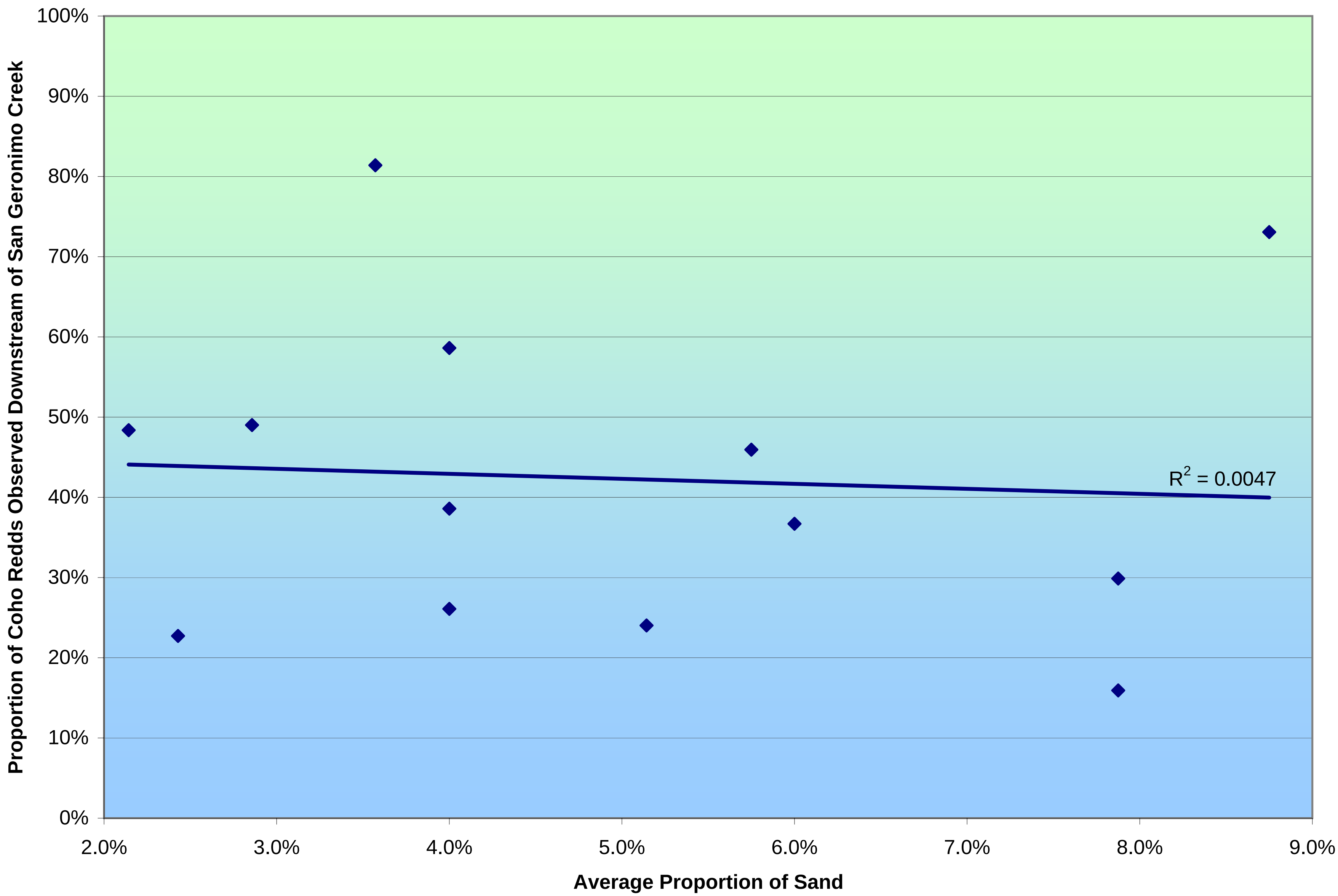


Figure 28. Average proportion of sand in Lagunitas Creek riffles and the proportion of coho redds downstream of San Geronimo Creek, 1995-2008.

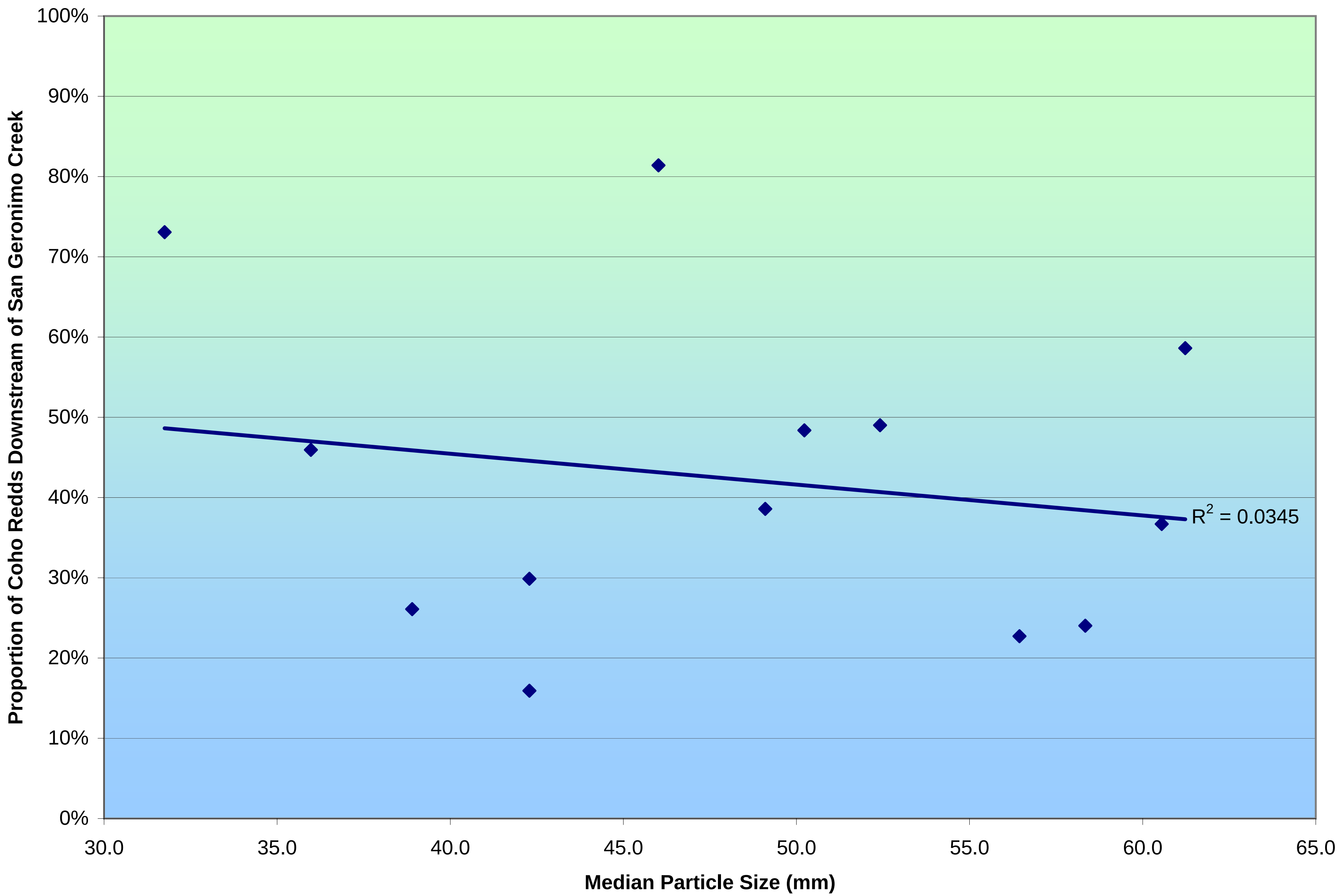
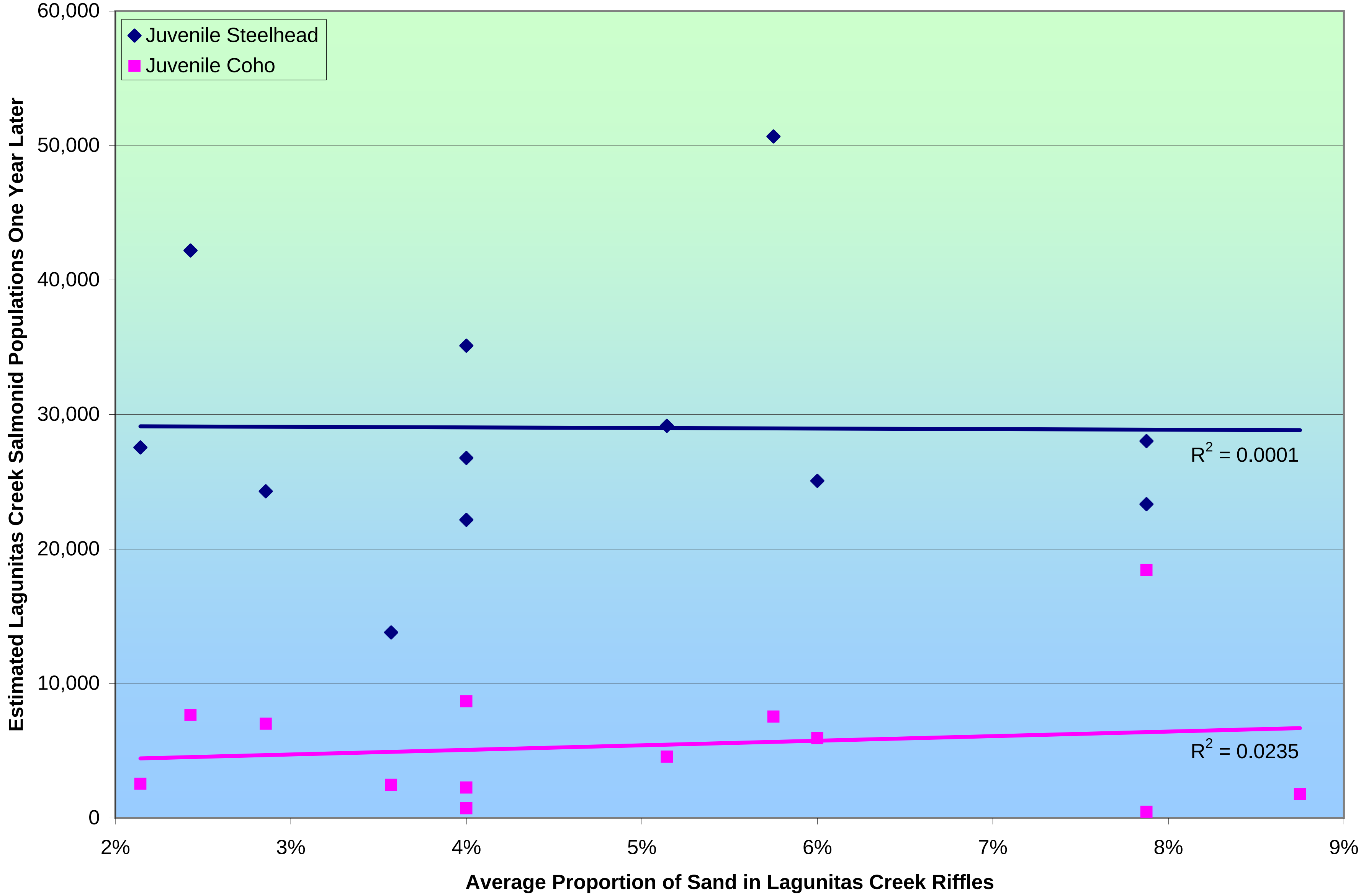


Figure 29. Median particle size in Lagunitas Creek riffles and the proportion of coho redds observed downstream of San Geronimo Creek, 1995-2008.



F igure 30. Average proportion of sand in Lagunitas Creek riffles and juvenile salmonid populations one year later, 1996-2009.

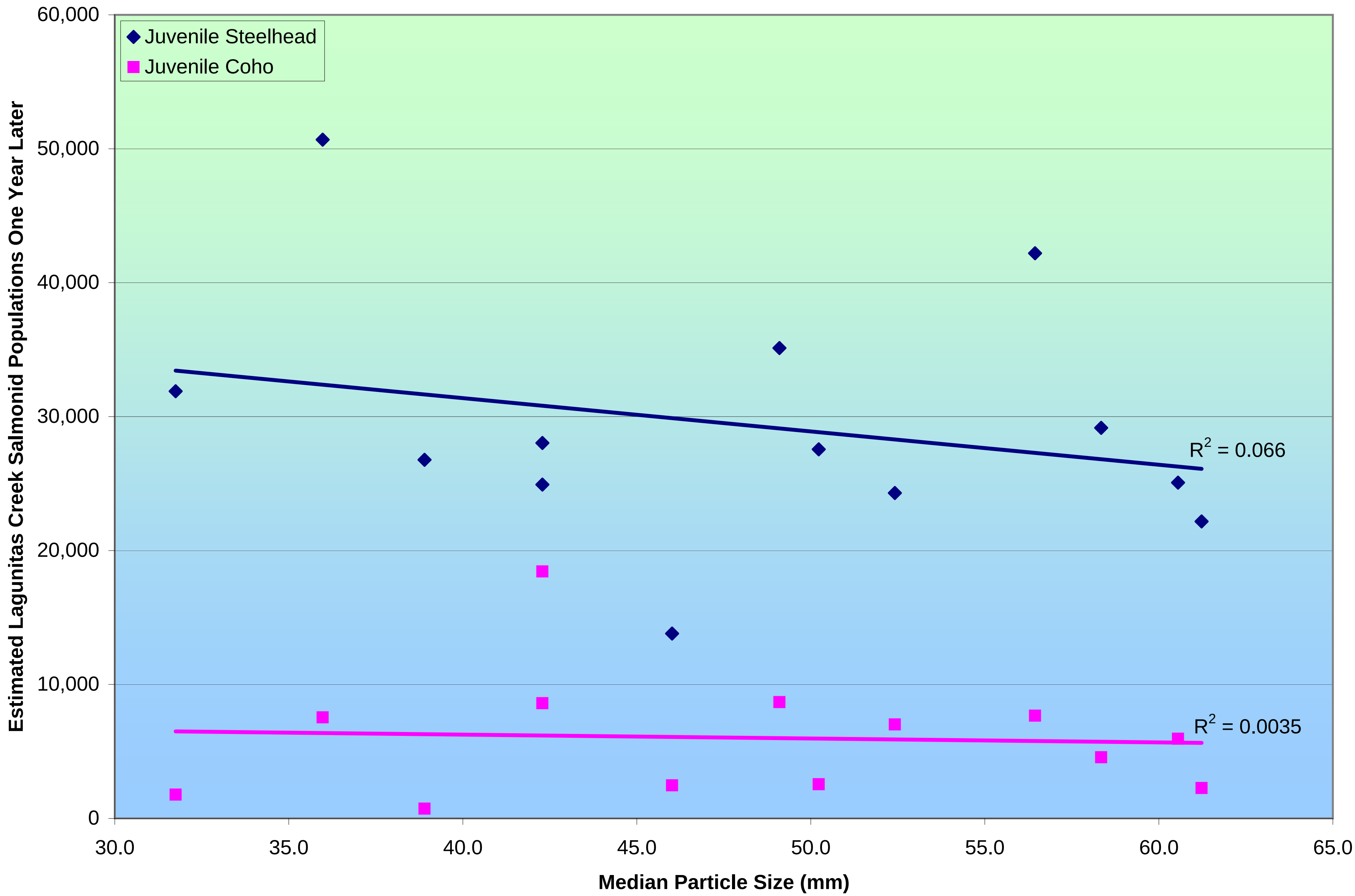


Figure 31. Median particle size in Lagunitas Creek riffles and juvenile salmonid populations one year later, 1996-2009.

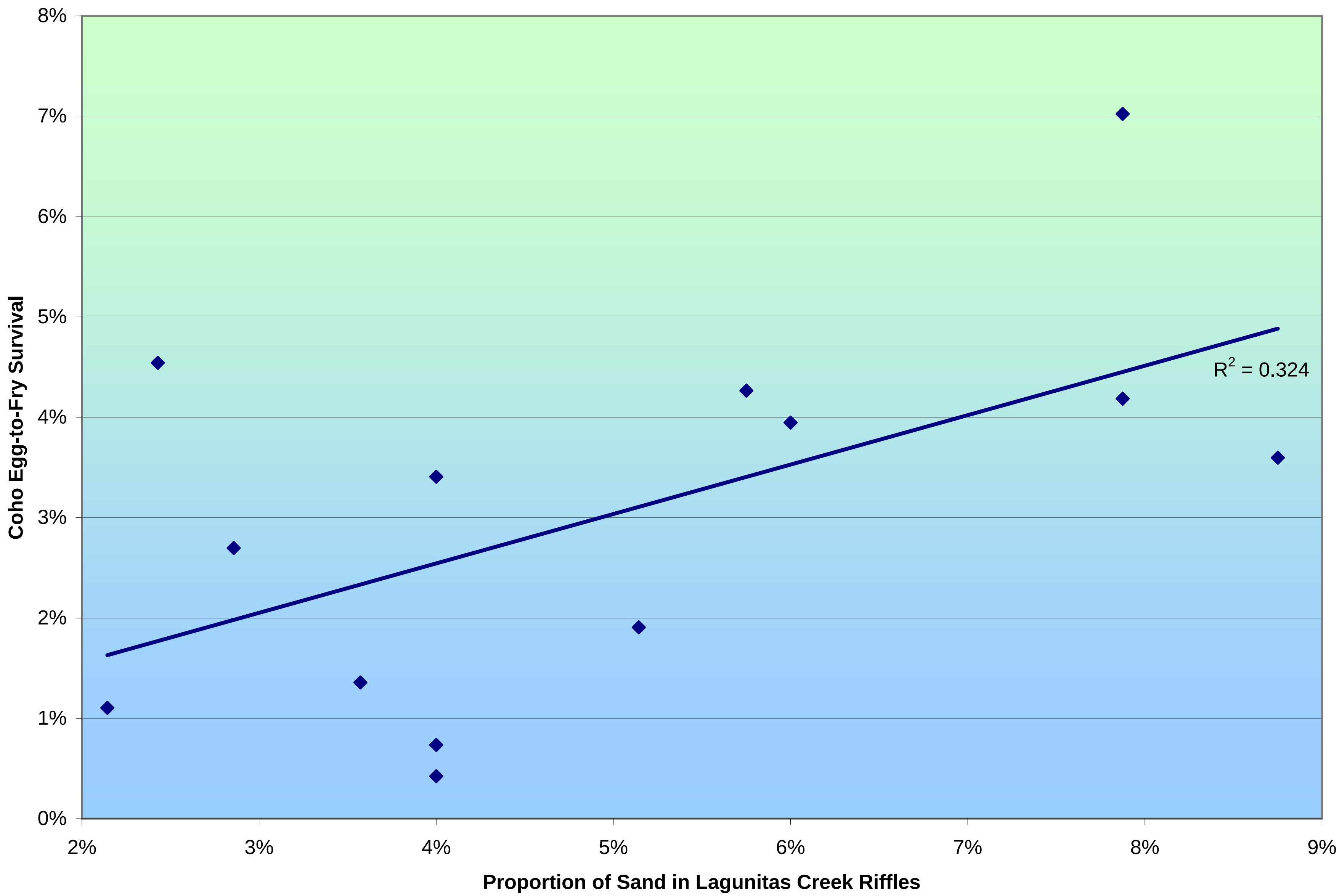


Figure 32. Proportion of sand in Lagunitas Creek riffles and the subsequent survival rate of coho eggs to fry, 1996-2009.

TABLES

Count	Project Site Number	Project Type	Priority Rank	Sediment Yield (tons/year)	Notes	Completed? (Y/N)	Sediment Savings (tons/year)
1	1.2	Sediment Control	1	120		Y	120
2	SG-6	Sediment Control	2	90		N	
3	15.23	Sediment Control	3	5		Y	5
4	17.2	Sediment Control	4	17		Y	17
5	15.5	Sediment Control	5	1.5		Y	1.5
6	11.3	Sediment Control	6	1		Y	1
7	13.87	Sediment Control	7	2		N	
8	SG-1	Sediment Control	8	2		Y	2
9	SG-7	Sediment Control	9	20		Y	20
10	11.4	Sediment Control	10	0.1		Y	0.1
11	14.1	Sediment Control	11	4		Y	4
12	13.27	Sediment Control	12	1		Y	1
13	15.21 (A)	Sediment Control	13	3		Y	3
14	15.21 (B)	Sediment Control	13	3		Y	3
15	15.21 (C)	Sediment Control	13	3		Y	3
16	15.21 (D)	Sediment Control	13	2		Y	2
17	15.21 (E)	Sediment Control	13	2		Y	2
18	15.21 (F)	Sediment Control	13	2		Y	2
19	15.27	Sediment Control	14	20		Y	20
20	17.1	Sediment Control	15	70		Y	70
21	15.1	Sediment Control	16	15		Y	15
22	SG-4	Sediment Control	17	20		Y	20
23	13.40	Sediment Control	18	3	Substitute w/road work	N	
24	15.13	Sediment Control	19	3		Y	3
25	15.18	Sediment Control	20	10		Y	10
26	13.115	Sediment Control	21	1.5	Substitute w/road work	N	
27	11.5	Sediment Control	22	0.5		Y	0.5
28	5.7	Sediment Control	23	0.5		Y	0.5

Table 1. Project list for MMWD's Lagunitas Creek Sediment and Riparian Management Plan.

Count	Project Site Number	Project Type	Priority Rank	Sediment Yield (tons/year)	Notes	Completed? (Y/N)	Sediment Savings (tons/year)
29	13.7	Sediment Control	24	2	Substituted w/road work	Y	2
30	9.2	Sediment Control	25	1		Y	1
31	13.108	Sediment Control	26	0.5		N	
32	13.104	Sediment Control	27	1		N	
33	13.26	Sediment Control	28	1		Y	1
34	4.1	Sediment Control	29	1.5		Y	1.5
35	5.3	Sediment Control	30	1		Y	1
36	7.6	Sediment Control	31	3		Y	3
37	13.17	Sediment Control	32	2	Substituted w/road work	Y	2
38	12.13	Sediment Control	33	0.5		N	
39	1.11	Sediment Control	34	20		Y	20
			TOTAL =	**455.6**			**357.1**
1	Spirit Rock Traps	Sediment Trap 1	n/a		Existing Spirit Rock Site - 200 yd3 storage	Y	200 yd3 (total)
2	Dickson Weir	Sediment Trap 2	n/a		Ext. Dickson Weir Site - 200 yd3 storage (cleaned 4 times)	Y	800 yd3 (total)
3	13.66	Sediment Trap 3	n/a	n/a	400 yd3 storage (Substituted w/road work)	N	0
4	8.1	Sediment Trap 4	n/a	n/a	40 yd3 storage (cleaned 6+ times)	Y	240 yd3 (total)
			TOTAL =				**1,240 yd3 (total)**
1	GP-1	Gravel Placement				N	
2	GP-2	Gravel Placement				Y	
3	GP-3	Gravel Placement				Y	
4	GP-4	Gravel Placement				N	

Table 1. Project list for MMWD's Lagunitas Creek Sediment and Riparian Management Plan.

Count	Project Site Number	Project Type	Priority Rank	Sediment Yield (tons/year)	Notes	Completed? (Y/N)	Sediment Savings (tons/year)
1	WD-1	Woody Debris				Y	
2	WD-2	Woody Debris				Y	
3	WD-3	Woody Debris				Y	
4	WD-4	Woody Debris				Y	
5	WD-5	Woody Debris				Y	
6	WD-6	Woody Debris				Y	
7	WD-7	Woody Debris				Y	
8	WD-8	Woody Debris				Y	
9	WD-9	Woody Debris				Y	
10	WD-10	Woody Debris				Y	
11	WD-11	Woody Debris				Y	
12	WD-12	Woody Debris				Y	
13	WD-13	Woody Debris				Y	
14	WD-14	Woody Debris				Y	
15	WD-15	Woody Debris				Y	
16	WD-16	Woody Debris				Y	
17	WD-17	Woody Debris				Y	
18	WD-18	Woody Debris				Y	
19	WD-19	Woody Debris				Y	
20	WD-20	Woody Debris				Y	
21	WD-21	Woody Debris				Y	
22	WD-22	Woody Debris				Y	
23	WD-23	Woody Debris				Y	
24	WD-24	Woody Debris				Y	
25	WD-25	Woody Debris				Y	
26	WD-26	Woody Debris				Y	
27	WD-27	Woody Debris				Y	
28	WD-28	Woody Debris				Y	

Table 1. Project list for MMWD's Lagunitas Creek Sediment and Riparian Management Plan.

Count	Project Site Number	Project Type	Priority Rank	Sediment Yield (tons/year)	Notes	Completed? (Y/N)	Sediment Savings (tons/year)
29	WD-29	Woody Debris				Y	
30	WD-30	Woody Debris				Y	
31	WD-31	Woody Debris				Y	
32	WD-32	Woody Debris				Y	
33	WD-33 (A)	Woody Debris				Y	
34	WD-33 (B)	Woody Debris				Y	
35	WD-33 (C)	Woody Debris				Y	
36	WD-34	Woody Debris				Y	
37	WD-35	Woody Debris				Y	
38	WD-36	Woody Debris				Y	
39	WD-37	Woody Debris				Y	
40	WD-38	Woody Debris				Y	
41	WD-39	Woody Debris				Y	
42	WD-40	Woody Debris				Y	
43	WD-41	Woody Debris				Y	
44	WD-42	Woody Debris				Y	
45	WD-43	Woody Debris				Y	
1	R-1	Riparian Revegetation				Y	
2	R-2	Riparian Revegetation				Y	
3	R-3	Riparian Revegetation				Y	
4	R-4	Riparian Revegetation				Y	
5	R-5	Riparian Revegetation				Y	
6	R-6	Riparian Revegetation			Implemented at WD-13	Y	
7	R-7	Riparian Revegetation			Biotech Bank Stabilization	Y	

Table 1. Project list for MMWD's Lagunitas Creek Sediment and Riparian Management Plan.

PROJECT NUMBER	PROJECT TYPE	PROJECT DESCRIPTION	CALENDAR YEAR COMPLETED
1.2	Sediment Control	Gully stabilization	1997
1.11	Sediment Control	Road drainage improvements	1997
Dickson Weir	Sediment Trap	Gravel removal from existing sedimen trap at Dickson Weir	1997
WD-1	**Woody Debris**	**Double log cross structure (with gravel placement added later)**	**1998**
WD-2	**Woody Debris**	**Boulder weir (with gravel placement added later)**	**1998**
WD-3	**Woody Debris**	**Tree top cover logs**	**1998**
WD-4	**Woody Debris**	**Double log cross structure**	**1998**
WD-5	**Woody Debris**	**Digger logs**	**1998**
WD-6	**Woody Debris**	**Digger logs**	**1998**
WD-7	**Woody Debris**	**Tree top cover log**	**1998**
11.3	**Sediment Control**	**Headcut repair**	**1998**
11.4	**Sediment Control**	**Road removal**	**1998**
11.5	**Sediment Control**	**Road stream crossing repair**	**1998**
SG-4	**Sediment Control**	**Road drainage improvements**	**1998**
WD-33c	Woody Debris	Anchored redwood digger log	1999
WD-37/38	Woody Debris	Tethered digger log and root ball	1999
11.4a	Sediment Control	Road removal, extension	1999
8.1	Sediment Trap	Sediment trap	1999
13.26	Sediment Control	Willow wall bank stabilization	1999
SG-1	Sediment Control	Headcut repair	1999
SG-7	Sediment Control	Road surface and drainage improvements	1999
GP-2	Sediment Management	Gravel placement, upstream from WD-1 double log cross structure	1999
R-1	Riparian Revegetation	Stream bank plantings	1999
R-2	Riparian Revegetation	Stream bank plantings	1999
R-3	Riparian Revegetation	Stream bank plantings	1999
R-4	Riparian Revegetation	Stream bank plantings	1999
WD-13	**Woody Debris**	**Obstruction log**	**2000**
WD-14	**Woody Debris**	**Anchored log and root ball**	**2000**
WD-25	**Woody Debris**	**Tree top cover logs**	**2000**
WD-33a	**Woody Debris**	**Divide and obstruction logs**	**2000**
WD-33b	**Woody Debris**	**Digger logs**	**2000**
WD-35	**Woody Debris**	**Obstruction log**	**2000**
WD-41	**Woody Debris**	**Tree top cover logs**	**2000**
WD-42	**Woody Debris**	**Tree top cover logs**	**2000**
WD-43	**Woody Debris**	**Double log cross structure**	**2000**
15.18	**Sediment Control**	**Willow wall and stream bank plantings**	**2000**
17.2	**Sediment Control**	**Headcut and gully repair**	**2000**
GP-3	**Sediment Management**	**Gravel placement, upstream from WD-2 boulder weir**	**2000**
WD-12	Woody Debris	Alternating, staggered obstruction logs	2001

Table 2. Projects completed by MMWD each year in Lagunitas Creek, 1997 - 2009.

PROJECT NUMBER	PROJECT TYPE	PROJECT DESCRIPTION	CALENDAR YEAR COMPLETED
WD-18	Woody Debris	Divide log structure	2001
WD-19	Woody Debris	Cover log	2001
WD-20	Woody Debris	Double obstruction logs	2001
WD-21	Woody Debris	Obstruction log	2001
WD-22	Woody Debris	Double obstruction logs	2001
WD-23	Woody Debris	Spider log structure	2001
WD-24	Woody Debris	Cover log	2001
WD-26	Woody Debris	Cover log	2001
WD-27	Woody Debris	Digger/spider log structure	2001
WD-28	Woody Debris	Cover log	2001
WD-29	Woody Debris	Digger log	2001
4.1	**Sediment Control**	**Headcut repair**	**2002**
14.1	**Sediment Control**	**Headcut repair**	**2002**
15.1	**Sediment Control**	**Headcut repair and log crib wall**	**2002**
15.13	**Sediment Control**	**Headcut repair and log crib wall**	**2002**
15.21A	**Sediment Control**	**Headcut repair**	**2002**
15.21B	**Sediment Control**	**Headcut repair and road wet crossing**	**2002**
15.21C	**Sediment Control**	**Sediment trap**	**2002**
15.21D	**Sediment Control**	**Road drainage improvement**	**2002**
15.21E	**Sediment Control**	**Road drainage improvement**	**2002**
15.21F	**Sediment Control**	**Road drainage improvement**	**2002**
15.23	**Sediment Control**	**Headcut repair**	**2002**
15.27	**Sediment Control**	**Headcut repair and brush check damns w/cattle crossing**	**2002**
15.5	**Sediment Control**	**Headcut repair and cattle crossing**	**2002**
17.1	**Sediment Control**	**Headcut/landslide repair and revegetation**	**2002**
WD-8	**Woody Debris**	**Rootball cover log**	**2002**
WD-9	**Woody Debris**	**Double deflection logs**	**2002**
WD-10	**Woody Debris**	**Double deflection logs**	**2002**
WD-11	**Woody Debris**	**Instream boulder cover**	**2002**
WD-15	**Woody Debris**	**Cover log**	**2002**
WD-16	**Woody Debris**	**Digger log**	**2002**
WD-17	**Woody Debris**	**Constriction log structure**	**2002**
5.3	Sediment Control	Headcut repair	2003
5.7	Sediment Control	Wet crossing and road drainage improvements	2003
9.2	Sediment Control	Wet crossing and culvert replacement	2003
WD-30	Woody Debris	Obstruction log	2003
WD-31	Woody Debris	Rootball log	2003
WD-32	Woody Debris	Rootball with treetop	2003
WD-34	Woody Debris	Downstream V-weir	2003

Table 2. Projects completed by MMWD each year in Lagunitas Creek, 1997 - 2009.

PROJECT NUMBER	PROJECT TYPE	PROJECT DESCRIPTION	CALENDAR YEAR COMPLETED
WD-36	Woody Debris	Obstruction log	2003
WD-38	Woody Debris	Digger log	2003
WD-39	Woody Debris	Staggered obstruction logs	2003
WD-40	Woody Debris	Creek constriction	2003
R7	Riparian Revegetation	Phase I: Willow Sprigging Woody Debris Installations on portion of site	2003
7.6	**Sediment Control**	**Headcut repair and revegetation**	**2004**
	Woody Debris Maintenance	**New logs at WD-7 and WD-11; re-anchoring of existing structures.**	**2004**
R7	**Riparian Revegetation**	**Phase II: Willow Brush Mattress, Woody Debris, Willow Sprigging, and Native Plant Installation on 130 feet of stream bank and upstream floodplain.**	**2004**
R5 & R6	**Riparian Revegetation**	**Plantings of native trees and shrubs along Lagunitas Creek**	**2004**
ST-3	Sediment Control	Streambank stabilization; bank grading & willow brush mattress; undercut stabilization; riparian revegetation.	2005
ST-8	Sediment Control	Streambank stabilization with log crib-wall and riparian revegetation.	2005
WD-1	**Woody Debris, reconstructed**	**Divide log structure**	**2006**
WD-3	**Woody Debris, reconstructed**	**Deflection structure**	**2006**
WD-7	**Woody Debris, reconstructed**	**Channel-spanning structure**	**2006**
WD-32	**Woody Debris, modified**	**Deflection log, pulled back into creek with new boulders**	**2006**
WD-32a	**Woody Debris, reconstructed**	**Channel-spanning structure**	**2006**
WD-36	**Woody Debris, reconstructed**	**Deflection log**	**2006**
WD-38	**Woody Debris, reconstructed**	**Deflection structure**	**2006**
WD-41	**Woody Debris, reconstructed**	**Deflection structure**	**2006**
WD-42	**Woody Debris, reconstructed**	**Deflection structure**	**2006**
Devil's Gulch Road	**Sediment Control**	**Road drainage improvements (outsloping, rolling dips, gravel wet crossings)**	**2006**

Table 2. Projects completed by MMWD each year in Lagunitas Creek, 1997 - 2009.

PROJECT NUMBER	PROJECT TYPE	PROJECT DESCRIPTION	CALENDAR YEAR COMPLETED
WD-22	Woody Debris, reconstructed	Obstruction log structure	2007
WD-24	Woody Debris, reconstructed	Obstruction log structure	2007
WD-26	Woody Debris, reconstructed	Obstruction log structure	2007
WD-27	Woody Debris, reconstructed	Obstruction log structure	2007
WD-28	Woody Debris, reconstructed	Obstruction log structure	2007
WD-29	Woody Debris, reconstructed	Creek constriction	2007
-	**-**	**No Project Work**	**2008**
WD-13	**Woody Debris, reconstructed**	Obstruction log structure	2009
WD-14	**Woody Debris, reconstructed**	Obstruction log structure	2009
WD-15	**Woody Debris, reconstructed**	Obstruction log structure	2009
WD-19	**Woody Debris, reconstructed**	Obstruction log structure	2009
WD-21	**Woody Debris, reconstructed**	Obstruction log structure	2009

Table 2. Projects completed by MMWD each year in Lagunitas Creek, 1997 - 2009.

	Number of Projects Completed			
YEAR	SEDIMENT CONTROL	WOODY DEBRIS (WD)	RIPARIAN REVEGETATION	NOTABLE COMMENTS
1997	3			Site 1.2 Constructed; Dickson Weir cleaned
1998	4	7		WD with Helicopter
1999	6	2	4	Revegetation Sites Upstream from Shafter Br.
2000	3	9		WD-33a & WD-33b
2001		12		
2002	14	7		Sediment Sites 15.21 A-F
2003	3	8	1	45 (Total) WD's Completed; R7 - Phase I
2004	1	*	3	* WD Maintenance only; R7 - Phase II
2005	2			ST-3 & ST-8
2006	1	9		Devil's Gulch Rd. in SPT Park; WD Reconstruction
2007		6		WD Reconstruction
2008				No Project Work
2009		5		WD Reconstruction
Total	37	65	8	
Total In Plan	42	42	7	
Sediment Controlled	357 Tons/Year Stabilized at Sediment Sites 840 Cubic Yards Removed from Sediment Traps			

Table 3. Summary of MMWD completed projects by project type; Lagunitas Creek, 1997 - 2009.

Priority Rank	Site Number	Project Description	Year Completed	Sediment Yield (tons/year)	Notes	Completed? (Y/N)	Sediment Savings (tons/year)
1	1.2	Gully stabilization	1997	120		Y	120
2	SG-6	Unstable, eroded stream bank	Not Completed	90		N	
3	15.23	Headcut repair	2002	5		Y	5
4	17.2	Headcut and gully repair	2000	17		Y	17
5	15.5	Headcut repair and cattle crossing	2002	1.5		Y	1.5
6	11.3	Headcut repair	1998	1		Y	1
7	13.87	Headcut repair, road decommissioning	Pending Completion	2		N	
8	SG-1	Headcut repair	1999	2		Y	2
9	SG-7	Road surface and drainage improvements	1999	20		Y	20
10	11.4	Road removal	1998	0.1	Site 11.4a - Road Removal Extension, Completed in 1999	Y	0.1
11	14.1	Headcut repair	2002	4		Y	4
12	13.27	Road drainage improvement	2006	1	Original bank stabilization substituted w/road work	Y	1
13	15.21 (A)	Headcut repair	2002	3		Y	3
13	15.21 (B)	Headcut repair and road wet crossing	2002	3		Y	3
13	15.21 (C)	Sediment trap	2002	3		Y	3
13	15.21 (D)	Road drainage improvement	2002	2		Y	2
13	15.21 (E)	Road drainage improvement	2002	2		Y	2
13	15.21 (F)	Road drainage improvement	2002	2		Y	2
14	15.27	Headcut repair and brush check damns w/cattle crossing	2002	20		Y	20
15	17.1	Headcut/landslide repair and revegetation	2002	70		Y	70
16	15.1	Headcut repair and log crib wall	2002	15		Y	15
17	SG-4	Road drainage improvements	1998	20		Y	20
18	13.40	Road drainage improvements	Pending Completion	3	Substitute w/road work	N	
19	15.13	Headcut repair and log crib wall	2002	3		Y	3
20	15.18	Headcut repair, bank stabilization, and revegetation	2002	10		Y	10
21	13.115	Road drainage improvement	Pending Completion	1.5	Substitute w/road work	N	
22	11.5	Road stream crossing repair	1998	0.5		Y	0.5
23	5.7	Wet crossing and road drainage improvements	2003	0.5		Y	0.5
24	13.7	Road drainage improvements	2006	2	Substituted w/road work	Y	2
25	9.2	Wet crossing and culvert replacement	2003	1		Y	1
26	13.108		Pending Completion	0.5		N	
27	13.104		Pending Completion	1		N	

Table 4. Project status of MMWD sediment control projects, Lagunitas Creek Sediment and Riparian Management Plan.

Priority Rank	Site Number	Project Description	Year Completed	Sediment Yield (tons/year)	Notes	Completed? (Y/N)	Sediment Savings (tons/year)
28	13.26	Willow wall bank stabilization	1999	1		Y	1
29	4.1	Headcut repair	2002	1.5		Y	1.5
30	5.3	Headcut repair	2003	1		Y	1
31	7.6	Headcut repair and revegetation	2004	3		Y	3
32	13.17	Road drainage improvements	2006	2	Substituted w/road work	Y	2
33	12.13	Culvert replacement and headcut repair	No Completed	0.5		Y	
34	1.11	Road drainage improvements	1997	20		Y	20
TOTAL =				**455.6**			**357.1**
n/a	Spirit Rock Traps	Sediment traps	N		Existing Spirit Rock Site - 200 yd3 storage	Y	200 yd3 (total)
n/a	Dickson Weir	Sediment trap	Y		Ext. Dickson Weir Site - 200 yd3 storage (cleaned 4 times)	Y	800 yd3 (total)
n/a	13.66	Sediment trap	Not Completed	n/a	400 yd3 storage (Substituted w/road work)	N	0
n/a	8.1	Sediment trap	1999	n/a	40 yd3 storage (cleaned 6+ times)	Y	240 yd3 (total)
TOTAL =							**1,240 yd3 (total)**
			N			N	
n/a		Gravel placement, upstream from WD-1 double log cross structure	1999			Y	
			Y			Y	
			N			N	

Table 4. Project status of MMWD sediment control projects, Lagunitas Creek Sediment and Riparian Management Plan.

	YEAR MONITORING OCCURRED																													
SURVEYS	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ELECTROFISHNG	X		X	X	X	X	X	X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	x	x
SNORKELING																				X	X	X	X	X	X	X	X	X	X	X
SPAWNERS			X	X												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SMOLTS																											X	X	X	X
SHRIMP		X										X			X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
HABITAT TYPING													LAG			SG DG		LAG	LAG SG DG	LAG				LAG SG DG			LAG SG DG			
WOODY DEBRIS																					X	X	X	X	X	X	X	X	X	X
WATER QUALITY																X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WATER TEMPERATURE																X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FLOW AT SPT				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FLOW AT SAN GERONIMO	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
STREAMBED SEDIMENT								X										X	X	X	X		X	X	X		X	X	X	X
SEDIMENT TRANSPORT																		X	X	X	X	X	X	X	X	X	X	X	X	X
FINE SEDIMENT																											X			
SEDIMENT SOURCE								X										X				X		X	X			X		

Habitat Typing Key: LG= Lagunitas Creek, SG= San Geronimo Creek, DG= Devils Gulch, SPT= Samuel P. Taylor

NOTE: The year monitoring occurred corresponds to when the surveys took place, not necessarily when the reports were produced.

Table 5. Summary of monitoring activities by the Marin Municipal Water District in the Lagunitas Creek study area, 1980-2009.

SAN GERONIMO CREEK STREAM GAGE - FLOW RECORDS (WY 1980 - 2009)

WATER	AVERAGE MEAN DAILY FLOW (cfs)												PEAK	MIN. MEAN
YEAR	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUN	JUL	AUG	SEPT	DISCHARGE (cfs)	DAILY FLOW (cfs)
1980	2.61	8.29	42.39	89.92	127.11	18.95	7.14	3.15	1.68	nd	nd	nd	2500	0.93
1981	0.52	0.47	4.94	41.19	6.24	27.34	4.41	1.11	0.55	nd	nd	nd	810	0.30
1982	0.79	21.71	100.27	124.27	41.40	60.34	73.91	2.73	1.03	0.54	0.23	0.32	3810	0.10
1983	1.90	38.98	45.36	80.20	148.30	170.21	22.01	11.23	1.29	1.05	0.58	0.29	2540	0.18
1984	0.22	33.43	101.98	9.09	2.90	11.19	2.98	1.90	1.08	0.43	0.17	0.11	714.17	0.11
1985	0.78	434.28	14.85	11.12	40.24	23.38	4.32	1.55	0.88	0.28	0.19	0.17	1630	0.10
1986	0.24	5.18	11.5	56.74	207.14	61.39	3.66	1.57	0.84	0.4	0.29	0.18	2350	0.10
1987	0.22	0.36	0.90	9.86	53.74	20.47	2.39	0.77	0.45	0.31	0.28	0.17	1300	0.10
1988	0.45	2.27	37.77	38.59	3.69	2.07	1.74	1.00	0.49	0.21	0.27	0.32	690	0.10
1989	0.39	4.39	10.45	4.44	4.12	50.48	4.71	1.60	1.05	0.16	0.05	0.17	1050	0.03
1990	1.11	2.55	1.40	11.42	13.31	6.46	1.91	10.13	1.29	0.67	0.35	0.23	290	0.15
1991	0.10	0.21	1.00	0.49	4.40	54.00	3.60	1.40	0.50	0.22	0.11	0.05	700	0.04
1992	0.79	1.75	3.90	6.30	40.00	21.00	4.00	1.20	0.73	0.33	0.11	0.07	1350	0.03
1993	0.61	1.00	31.20	98.10	35.00	10.00	7.50	2.90	2.90	1.30	0.24	0.16	2000	0.04
1994	0.82	2.97	10.73	7.00	31.29	4.16	2.13	1.96	0.91	0.44	0.23	0.16	252	0.16
1995	0.38	23.86	28.28	202.96	18.27	115.55	13.00	11.10	2.14	0.75	0.33	0.18	2100	0.14
1996	0.23	0.51	22.13	61.39	84.74	24.97	13.66	8.89	1.96	0.69	0.45	0.19	969	0.13
1997	0.33	2.68	64.86	86.89	6.73	3.44	2.04	0.90	0.36	0.06	0.13	0.20	1352	0.05
1998	0.48	18.03	21.14	97.62	190.40	13.19	13.07	8.56	4.40	1.40	0.69	0.32	2049	0.13
1999	0.43	10.53	10.81	26.22	99.71	29.96	24.01	2.71	1.31	0.66	0.41	0.17	1103	0.11
2000	0.29	2.00	1.66	23.59	96.46	26.81	8.10	3.61	1.12	0.69	0.39	0.16	1150	0.06
2001	0.66	0.87	1.37	18.26	42.04	12.90	1.86	0.60	0.29	0.19	0.06	0.05	341	0.03
2002	0.16	16.04	68.62	28.00	12.82	10.63	2.66	1.33	0.59	0.33	0.25	0.12	1595	0.05
2003	0.17	1.06	66.59	24.52	13.14	10.98	13.77	10.94	1.39	0.51	0.25	0.12	1789	0.04
2004	0.22	1.44	50.30	36.44	59.39	11.39	3.27	0.98	0.50	0.21	0.21	0.07	1648	0.04
2005	1.40	1.99	44.02	31.49	30.87	39.15	16.82	18.93	3.92	1.29	0.64	0.50	1264	0.05
2006	0.44	0.80	89.29	51.39	28.15	80.50	68.94	3.98	1.37	0.52	0.75	0.64	3937	0.37
2007	0.25	1.43	12.91	3.59	49.62	7.29	3.05	1.56	0.51	0.23	0.11	0.09	479	0.05
2008	0.63	0.53	5.87	82.22	32.36	4.52	1.64	0.80	0.37	0.12	0.02	0.01	1644	0.01
2009	0.06	1.25	2.91	1.70	51.17	20.24	2.53	3.28	0.66	0.33	0.14	0.07	641	0.01
1980-2009 Mean	**0.59**	**21.36**	**30.31**	**45.50**	**52.49**	**31.77**	**11.16**	**4.08**	**1.22**	**0.51**	**0.28**	**0.19**	**NOT APPLICABLE**	**NOT APPLICABLE**

= Pre-Order WR95-17

= Post-Order WR95-17

Table 6. Hydrologic record from MMWD's San Geronimo Creek stream gage, water years 1980-2009.

Last survey before flow	# Redds before flow	Last day of flow	Rain between surveys (in)	First survey after flow	# Redds after flow	Confounded by rain?	Response to flow	Comments
11/13/1995	7	11/17/1995	0.00	11/20/1995	0	No	None	
11/27/1995	0	12/3/1995	1.00	12/5/1995	13	Yes	N/A	
11/12/1996	1	11/17/1996	5.80	11/19/1996	2	Yes	None	
11/13/1997	0	11/16/1997	4.69	11/17/1997	16	Yes	N/A	
11/12/1998	3	11/18/1998	0.57	11/19/1998	1	No	None	
11/25/1998	1	11/27/1998	9.62	12/4/1998	9	Yes	N/A	
12/23/1998	14	1/3/1999	0.03	1/5/1999	30	No	Slight	10-14 redds per week in early Dec. No surveys late Dec. 30 redds after flow.
11/17/1999	1	11/22/1999	1.30	11/22/1999	7	Yes	N/A	
11/23/1999	7	12/2/1999	1.98	12/2/1999	16	Yes	N/A	
12/29/1999	4	1/6/2000	0.08	1/5/2000	11	No	Moderate	Spawning activity was already increasing prior to realease.
11/22/2000	6	12/3/2000	0.89	11/30/2000	20	Yes	N/A	Six-day UMF.
12/28/2000	2	1/5/2001	0.00	1/4/2001	1	No	None	No response. Redds after rain in following week.
11/15/2001	2	11/17/2001	0.11	11/19/2001	5	Maybe	Slight	Rain just before migration flow may confound response.
11/22/2002	2	12/2/2002	0.00	12/4/2002	15	No	Strong	Reason for strong response is unknown.
11/26/2003	0	12/3/2003	2.62	12/3/2003	42	Yes	N/A	
11/15/2004	0	11/17/2004	0.00	11/18/2004	14	No	Strong	Response possibly related to large runs this year.
12/2/2004	24	12/4/2004	0.00	12/6/2002	7	No	None	
11/10/2005	0	11/17/2005	0.00	11/17/2005	0	No	None	
11/16/2006	0	11/17/2006	0.12	11/21/2006	2	No	Slight	
11/22/2006	2	11/272006	1.74	11/30/2006	6	Yes	N/A	
2/1/2007	32	2/4/2007	0.00	2/5/2007	25	No	None	Counted coho, steelhead, Chinook and unknown redds
11/13/2007	0	11/18/2007	0.00	11/20/2007	4	No	Slight	
11/30/2007	6	12/4/2007	1.01	12/5/2007	21	Yes	N/A	
10/29/2008	0	11/5/2008	5.55	11/6/2008	0	Yes	None	
11/20/2008	0	12/4/2008	0.20	12/4/2008	4	No	Slight	
11/17/2009	0	11/19/2009	0.86	11/23/2009	0	Yes	None	

Summary	# releases	Releases <0.75" rain	Response to flow None	Slight (2-5 redds)	Moderate (6-10	Strong (>10 redds)
Mid-Nov	11	7	3	3	0	1
Late Nov	2	0	-	-	-	-
December	8	2	0	1	0	1
January	3	3	1	1	1	0
February	1	1	1	0	0	0
Total	25	13	5	5	1	2

Table 7. Salmon spawning responses to Upstream Migration Flows (UMFs) in Lagunitas Creek, 1995 - 2009.

Years	Chinook		Chum		Coho		Steelhead		"Unknown"	
	Live Fish	Redds	Live Fish	Redds	Live Fish	Redds	Live Fish	Redds	Live Fish	Redds
1995/'96	-	-	-	-	365	86	-	-	-	-
1996/'97	1*	-	-	-	549	254	-	-	-	-
1997/'98	-	-	1*	-	428	253	10	3	-	-
1998/'99	-	-	-	-	123	184	4	1	-	-
1999/'00	1	-	-	-	568	203	24	7	-	-
2000/'01	5	-	-	-	320	204	18	11	-	-
2001/'02	44	28	28	10	735	286	52	67	22	20
2002/'03	31	20	5	0	572	158	44	50	35	27
2003/'04	19	36	2	1	947	383	57	71	3	14
2004/'05	125	44	4	1	1342	496	57	136	172	70
2005/'06	10	8	0	0	679	190	73	136	38	12
2006/'07	40	40	1	1	886	338	588	303	47	44
2007/'08	4	0	0	0	238	148	475	297	18	32
2008/'09	1	1	0	0	43	26	45	80	14	5
Average:	26	22	5	2	557	229	121	97	44	28

Note: Prior to 2001/'02, surveys were conducted specifically for coho salmon between November and early February.
Steelhead were noted and other species were not known to spawn in Lagunitas Creek.
(-) Indicates that these salmonids and/or redds were not expected or noted.
* Carcass

Table 8. Adult salmonid spawning observations in the Lagunitas Creek study area, 1995/'96-2008/'09.