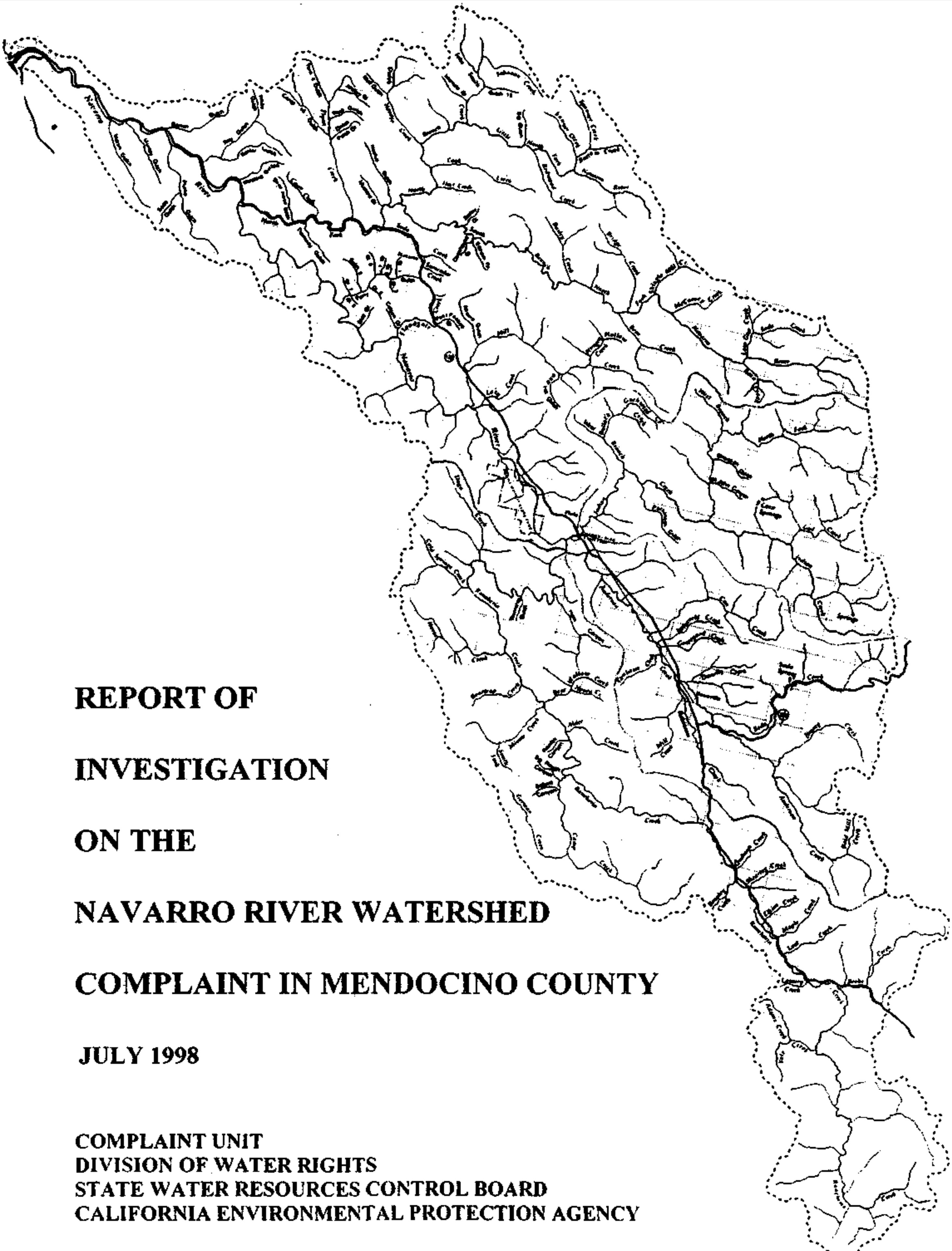

REPORT OF INVESTIGATION ON THE NAVARRO RIVER WATERSHED COMPLAINT IN MENDOCINO COUNTY

JULY 1998

COMPLAINT UNIT
DIVISION OF WATER RIGHTS
STATE WATER RESOURCES CONTROL BOARD
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

REPORT OF INVESTIGATION ON THE

NAVARRO RIVER WATERSHED

COMPLAINT

July 1998

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I. INTRODUCTION

In 1992, 1993 and 1994, the Division of Water Rights (Division) received water right complaints concerning public trust protection of the fishery resources in the Navarro River. Complaints were filed by the Department of Fish and Game, private individuals, and the Sierra Club Legal Defense Fund. The Sierra Club Legal Defense Fund filed its complaint on behalf of the Friends of the Navarro River Watershed, Sierra Club, California Sportfishing Protection Alliance, Friends of the River, Pacific Coast Federation of the Fishermen's Associations, United Anglers, California Trout, Trout Unlimited, and Mendocino Environmental Center. The complainants claim that water diversions from the Navarro River and its tributaries reduced the flow and, in some instances, dewatered the channels to the detriment of the fishery resources of the watershed.

The complainants recommend that the State Water Resources Control Board (SWRCB) take the following actions.

1. Identify illegal diversions and take actions to ensure these diversions comply with the laws related to water appropriations.

2. Amend water appropriation permits and licenses to assure bypass flows sufficient to protect fish and wildlife beneficial uses.

3. Restrain unreasonable riparian users and pre-1914 appropriators.

4. As an alternative to 2 and 3 above, conduct a statutory adjudication of Navarro River Basin water rights pursuant to Water Code section 2501, et seq.

5. Declare the Navarro River and its tributaries to be fully appropriated pursuant to Water Code section 1205, et seq.

II. BACKGROUND

This section is divided into three parts: (A) watershed description, (B) causes of anadromous fishery decline, and (C) remedial efforts in the watershed.

A. Watershed Description

The Navarro River Basin is a coastal watershed located in the Coast Range Geomorphic Province in southern Mendocino County approximately 120 miles north of San Francisco and about 30 miles west of Ukiah, the county seat. It is the largest coastal basin in Mendocino County. The 323 square mile watershed drains in a northwesterly direction, and it discharges to the Pacific Ocean about 15 miles south of the town of Mendocino. Topography of the basin varies from sea level to around 3,000 feet above sea level along the eastern ridges. The main stem of the Navarro is formed near the Philo area, where Anderson, Rancheria, and Indian Creeks join; its other major tributary is the North Fork. Figure 1 is a map of the watershed.

The Navarro River Basin is underlain by marine meta-sedimentary and meta-volcanic bedrock of the Franciscan complex and Yager Formation. The bedrock is overlain with colluvium and ravine fill, stream terraces, alluviated valleys, estuarine/lagoonal deposits, and marine terrace deposits.

Approximately 3,500 people reside in the watershed, and the principal communities are Yorkville, Philo, Boonville, and Navarro. Land use in the basin is divided among forestland (70%), agriculture (5%), and range land (25%). Significant viticulture and orchard enterprises thrive in the valley. Anderson Valley has also historically been a destination for visitors coming to enjoy the fisheries and recreation associated with the river. The open, agricultural and forested nature of this area, in which two popular state parks are situated (Hendy Woods and Navarro River State Parks), draws over 100,000 visitors annually, supporting a growing recreational industry.

There are no major dams on the Navarro River, and the watershed receives very little snowfall. Consequently, the flow is characterized by high "spikes" in the winter and spring associated with rainfall events with relatively low flow during the summer and fall. The flow in the downstream portion of the Navarro River usually diminishes to a rate of approximately 10 cubic feet per second (cfs) or less during the summer.

The irrigation of orchards and vineyards on the valley floor along the main branch of the Navarro -River constitutes the principal consumptive use of water. There are numerous small tributaries in the upper watershed but few water users with appropriative water rights.

B. Causes of Anadromous Fishery Decline

Although no specific population estimates for coho salmon and steelhead in the Navarro River watershed are known to exist or were made available to the SWRCB, anecdotal evidence indicates that the watershed historically supported substantial populations of these anadromous species. This section describes the probable causes of the population declines of these species in the watershed. The discussion is extracted from the federal register, which recently contained listing decisions under the Endangered Species Act for coho salmon (61 FR 56138, October 31, 1996) and steelhead (62 FR 43937, August 18, 1997; 63 FR 13347, March 19, 1998). The conclusions of a recent report on sediment production and channel conditions in the Navarro River watershed are also cited (Draft Navarro Watershed Restoration Plan; prepared by Entrix Incorporated (Entrix) on behalf of the Mendocino County Water Agency, Anderson Land Trust, and California Coastal Conservancy; April 8, 1998)

In the 1940s, estimated abundance of coho salmon in the Central California coast area ranged from 50,000 to 125,000 native coho salmon. Today, there are probably less than 6,000 naturally reproducing coho salmon in this area, and the majority of these fish are considered to be of non-native origin (either hatchery fish or from streams stocked with hatchery fish). Consequently, the National Marine Fisheries Service (NMFS) issued a final rule listing the coho salmon as threatened under the federal Endangered Species Act in both the Southern Oregon/Northern California Coast Evolutionarily Significant Unit (ESU) and the Central California ESU. (The Central California ESU extends from Punta Gorda in Humboldt County south to the San Lorenzo

River in Santa Cruz County, and includes the Navarro River.) The effective date of the listing was December 2, 1996.

The factors threatening naturally-reproducing coho salmon throughout its range are numerous and varied. For coho salmon in the Central California ESU, the present depressed condition is the result of several long-standing human-induced factors (e.g., habitat degradation, harvest, water diversions, and artificial propagation) that serve to exacerbate the adverse effects of natural environmental variability from such factors as drought and poor ocean conditions. The specific controllable in-basin factors affecting coho salmon populations include logging, agricultural and mining activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals and unscreened diversions for irrigation.

Direct diversion and storage of natural flows have altered natural hydrological cycles in many central California rivers and streams. Alteration of streamflows has increased juvenile salmonid mortality for a variety of reasons: migration delay resulting from insufficient flows or habitat blockages; loss of usable habitat due to dewatering and blockage; stranding of fish resulting from rapid flow fluctuations; entrainment into unscreened or poorly screened diversions; and increased water temperatures. In addition, reduced flows degrade or diminish fish habitats via increased deposition of fine sediments in spawning gravels, decreased recruitment of new spawning gravel, and encroachment of riparian and non-endemic vegetation into spawning and rearing areas.

Sufficient quantities of good quality water are essential for coho survival, growth, reproduction, and migration. Important elements of water quality include water temperatures within the range that corresponds with migration, rearing and emergence needs of fish and the aquatic organisms •--upon which they depend. Desired conditions for coho salmon include an abundance of cool (generally in the range of 53.3 °F to 58.3 °F), well oxygenated water that is present year-round, free of excessive suspended sediments and other pollutants that could limit primary production - and benthic invertebrate abundance and diversity.

Numerous studies have demonstrated that land use activities associated with logging, road construction, urban development, mining, agriculture, and recreation have significantly altered coho salmon habitat quantity and quality. Impacts associated with these activities include: alteration of stream bank and channel morphology, alteration of ambient stream water temperatures, elimination of spawning and rearing habitat, fragmentation of available habitats, elimination of downstream recruitment of spawning gravel and large woody debris, removal of riparian vegetation resulting in increased stream bank erosion, and degradation of water quality. Of particular concern is the increased sediment input into spawning and rearing areas that results . in the loss of channel complexity, pool habitat, suitable gravel substrate, and large woody debris.

Agricultural practices have also contributed to the degradation of salmonid habitat on the West Coast through irrigation diversions, overgrazing in riparian areas, and compaction of soils in upland areas from livestock. The vigor, composition and diversity of natural vegetation can be altered by livestock grazing in and around riparian areas. This in turn can affect the site's ability to control erosion, provide stability to stream banks, and provide shade, cover, and nutrients to the stream. Mechanical compaction can reduce the productivity of the soils appreciably and cause bank erosion. Mechanical bank damage often leads to channel widening, lateral stream migration, and excess sedimentation.

Urbanization has degraded coho salmon habitat through stream channelization, floodplain drainage, and riparian damage. When watersheds are urbanized, problems may result simply because structures are placed in the path of natural runoff processes, or because the urbanization activity touches the watershed, point source and non-point pollution occurs. Water infiltration is reduced due to extensive ground covering. As a result, runoff from the watershed is flashier, with increased flood hazard. Flood control and land drainage schemes may concentrate runoff, resulting in increased bank erosion which causes a loss of riparian vegetation and undercut banks and eventually causes widening and down-cutting of the stream channel. Sediments washed from -the urban areas contain trace metals such as copper, cadmium, zinc, and lead. These, together with pesticides, herbicides, fertilizers, gasoline and other petroleum products, contaminate drainage waters and harm aquatic life necessary for coho salmon survival.

The Navarro River Basin's water quality problems are believed to originate in large measure from accelerated erosion and sediment production. The Entrix report on sediment production in the watershed contains the following conclusion[1].

"Sediment production to streams throughout the Navarro River watershed is generally less today than it has been in the recent past (1950's-1970's). However, fine sediment deposition in channels is widespread. This is due to excess sediment production caused by roads, timber harvest, agriculture, grazing, grading, and other land disturbances. The effects of these high levels of sediment input to streams are most keenly felt in the lower gradient reaches of the major tributaries. These lower-gradient tributaries, primarily Anderson Creek in the Anderson Valley, and mid-to-upper Rancheria Creek, have also been subject to channel aggradation widening due to coarse sediment accumulation. These channel changes, in turn, result in increased bank erosion and input of additional sediment. Other significant impacts to channels and fish habitat that limit steelhead and coho distribution and abundance in the Navarro watershed are: (1) loss of large woody debris and (2) elevated stream temperatures. The loss of large woody debris is directly related to a reduction in habitat complexity, lack of high quality high-quality cover, and a reduction in the frequency of pools. High stream temperatures and large diurnal fluctuations in temperature are related to opening of the stream canopy, as well as to shallowing and widening of the channel due to sediment accumulation."

A large landslide that occurred in March of 1995 on the main stem of the Navarro River is a dramatic example of the instability prevailing in this watershed. Estimated to have moved 15 acres of hillside, this slide completely blocked the river and is anticipated to negatively impact water quality in the estuary for years to come as well as other downstream water uses, including the migration of salmonids.

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[1] Draft Navarro Watershed Restoration Plan. April 8, 1998 (Section 3.4, pg. 3-19).

High temperatures in the river are also a significant problem. Temperatures in the high 70's and low 80's have been recorded in Rancheria, Indian and Anderson Creeks. The U.S. Geological Service (USGS) has recorded daily maximum temperatures at its Navarro River gage during June, July and August that exceed the lethal temperature threshold for salmonids of 70 degrees Fahrenheit.

The in-basin factors that contributed to the decline of coho salmon populations are also responsible for the decline of steelhead. Historically, steelhead likely inhabited most coastal streams in Washington, Oregon, and California as well as many, inland streams in these states and Idaho. However, during this century, over 23 indigenous, naturally reproducing stocks of steelhead may have been extirpated, and many more are thought to be in decline in numerous coastal and inland streams. NMFS has identified six steelhead ESUs in California, and it has made the following ESA decisions for these ESUs.

1. Klamath Mountains Province ESU
Spawning Habitat: Cape Blanco, Oregon to the Klamath River in Del Norte County
ESA Status: Candidate Species

2. Northern California ESU
Spawning Habitat: Redwood Creek in Humboldt County south to the Russian River
ESA Status: Candidate Species

3. Central California Coast ESU
Spawning Habitat: Russian River south to Soquel Creek in Santa Cruz County
ESA Status: Threatened

4. Central Valley ESU
Spawning Habitat: Sacramento and San Joaquin rivers and tributaries
ESA Status: Threatened

5. South-Central California Coast ESU
Spawning Habitat: Pajaro River in Santa Cruz County south to the Santa Maria River
ESA Status: Threatened

6. Southern California Coast ESU
Spawning Habitat: Santa Maria River south to Malibu Creek
ESA Status: Endangered

NMFS determined, in a March 1998 federal register ruling, that steelhead in the Northern California ESU, which includes the Navarro River Watershed, should remain a candidate species under the federal ESA and should not be listed at this time. NMFS claims that available information and conservation measures indicate that steelhead populations in this area are at a lower risk of extinction than at the time they were first assigned candidate species status. However, because NMFS remains concerned about these populations, it will re-evaluate the status in this ESU within four years to determine whether listing as a threatened or endangered species is warranted.

C. Remedial Efforts in the Watershed

The State of California's program for steelhead conservation, which was a factor in the NMFS' decision not to list steelhead in the Northern California ESU, consists of several major elements: (1) the Governor's Watershed Restoration and Protection Council (WPRC) program, including ongoing state efforts to implement the watershed planning and habitat restoration objectives contained in Senate Bill (SB) 271 ; (2) the Department of Fish and Game's strategic management plans for steelhead in the ESU; and (3) a joint memorandum of Agreement between NMFS and the state. The principal element underlying these programs and plans is an effort to address all of the factors affecting steelhead populations through a Watershed Protection Program. An important initial focus of this effort is a review of California's forest practices regulations and their implementation and enforcement. Also, SB 271, which provides California Department of Fish and Game (DFG) with $43 million over six years for habitat restoration and watershed planning in coastal watersheds, will provide funding for some of the watershed efforts.

In addition to the regional and statewide efforts described above, local watershed protection efforts are also being made to protect and restore the Navarro River Watershed. The Mendocino County Water Agency, the California Coastal Conservancy, and the Anderson Valley Land Trust have initiated the Navarro River Watershed Restoration Project. This project is funded by grants from the Conservancy ($86,200) and from federal funds administered by the SWRCB ($83,800). The project will generate data to provide an overview of the ecological state of the Navarro River Basin and to recommend specific restoration/enhancement projects to benefit water quality in general and the salmon fishery in particular. The project will also study limiting factors to salmon production. The project will include analyses of hydrology, geomorphology, salmonid habitat and populations, water quality, water temperatures, stream flows, and land use patterns. A final-report presenting the study findings, conclusions, and restoration and implementation plans will be available from the Mendocino County Water Agency in the near future.

The Navarro River Watershed Restoration Project is meant to provide the necessary information for the local community and government agencies to implement a comprehensive watershed restoration and enhancement plan. It will provide community education and outreach on watershed issues. The Project is also intended to provide landowners with information and technical assistance, as well as guidance on funding, to allow them to undertake water quality and fishery habitat improvement projects.

A related effort was the formation of the Navarro River Habitat Restoration Advisory Group. This group was formed to share concerns and information about the natural resources and land use practices in the watershed and to coordinate restoration/enhancement activities. The group was also intended to coordinate the efforts of the Navarro River Watershed Restoration Project. The advisory group included the following organizations:

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[2] The next draft report should be publicly available this summer.

Anderson Valley Farm Center
Anderson Valley Community Services District
Anderson Valley Grange
Anderson Valley Land Trust
Anderson Valley Unified School District
Anderson Valley Youth
CA. Department of Fish & Game
CA Department of Parks & Recreation
CA Department of Transportation
California Regional Water Quality Control Board (North Coast Region)
CA State Coastal Conservancy
CA State Water Resources Control Board
Farm Bureau
Friends of the Navarro
Industrial Timberland Owners
Mendocino County Cattlemen's Association
Mendocino County Resource Conservation District
Mendocino County Water Agency
Navarro Estuary Project
Natural Resources Conservation Service
Non-Industrial Timberland Owners
Redwood Coast Watersheds Alliance
Salmon Trawlers Association
Sierra Club, Redwood Chapter
U.S. Army Corps of Engineers
Wine Growers
Woolgrowers Association

The North Coast Regional Water Quality Control Board (Regional Board), which is the regional agency responsible for water quality issues, is also involved in several activities in the watershed. (The SWRCB is the statewide agency responsible for water quality and water right programs, and the Regional Board is responsible for regional water quality control programs.) At the recommendation of the Regional Board, the Navarro River was included in the list of the state's impaired water bodies due to sedimentation. This list is required under section 303(d) of the Clean Water Act, and the Clean Water Act further requires that a Total Maximum Daily Load (TMDL) analysis be completed for all water bodies on the list. The purpose of a TMDL is to determine the assimilative capacity of targeted pollutants in a watershed, in this case principally sediment loads, and a program for their reduction. The Regional Board is currently in the

preliminary stages of the TMDL analysis for the Navarro River watershed and will be focusing on sedimentation and temperature issues. This TMDL analysis is scheduled for completion in 2000. Regular ongoing activities of the Regional Board also include several soil and groundwater cleanup actions and management of waste discharge permits. As indicated above, the Regional Board is also a member of the Navarro River Habitat Restoration Advisory Group and collaborates with the several members of that group concerning habitat restoration. The Regional Board also routinely reviews timber harvest plans to ensure that significant effects to water quality do not occur.

III. ANALYSIS OF COMPLAINT CONTENTIONS

The following three contentions are analyzed in this report:

A. The SWRCB should identify unauthorized diversions in the watershed.

B. The present level of diversions in the watershed is unreasonable.

C. The watershed is fully appropriated.

A. Contention: The SWRCB should identify unauthorized diversions in the watershed.

Response: In the past, the Division has not actively sought unauthorized diversions because of other priorities and limited resources. Instead, the Division relied upon the complaint process to identify unauthorized diversions that are causing harm to other parties or to public trust resources. However, in response to this complaint and other complaints, the Division recently began a pilot program to determine whether reservoirs without an apparent basis of right could be readily identified. The reservoirs are located using U.S. Geological Survey maps and aerial photographs, when available. Parcel maps are used to identify the owners. Three high resource value watersheds, including the Navarro River Watershed, were selected for the project.

The SWRCB identified 121 reservoirs in the Navarro River Watershed without any apparent water rights. The owners have been identified and requested either to identify their basis of right to store water or to file water right applications. Field investigations are in progress on reservoirs claimed to be outside the SWRCB's permitting authority.

In addition to this effort, Division staff investigated the water right status of five reservoirs identified by one of the complainants in September 1996. Staff determined that two of the reservoirs did not require water right permits because they either are filled with groundwater or collect only diffused surface runoff but not water from any stream with defined bed and banks. Owners of the remaining three reservoirs have been advised either to identify existing water rights or to file applications for storage. Once a reservoir has been determined to be within the SWRCB's permitting authority, owners declining to either file applications or remove the storage will be subject to formal enforcement actions by the SWRCB.

The Division has not yet initiated a project to identify unauthorized direct diversions. This decision is based on two considerations. First, unlike storage facilities, which can be identified through inspection of maps and photographs, the most effective way to find direct diversions is through field investigation. The dedication of resources for such inspections could be extensive. As a result of the SWRCB's request, the Governor's proposed budget for fiscal year 1998-99 contains additional resources for enforcement activities. Some of these resources may be used to evaluate a cost- effective means of identifying direct diversions without sufficient water rights. Second, experience from other areas of the state indicates that the majority of direct diversions without an apparent basis of right are usually riparian or pre-1914 diversions. Persons diverting under claim of riparian or pre-1914 right do not require a water right permit from the SWRCB. They are required to file a Statement of Water Diversion and Use in accordance with Water Code section 5100, et seq., but the SWRCB does not issue permits for these diversions or routinely place conditions on their operation. Even though the exact number of exercising riparian or pre-1914 appropriative water rights within the Navarro River watershed may be unknown, the impairment caused by these diversions is still reflected by the flows recorded at the Navarro River gaging station. These impaired flows are presented and analyzed in this report.

Conclusion: The Division will complete its pilot project to identify and bring into compliance reservoir owners in the Navarro River Watershed. The Division should not dedicate staff resources to seek out possible unauthorized direct diversions at this time. The emerging water right enforcement program should develop cost-effective ways of identifying unauthorized direct diversions and implement them. The Division should continue its existing practice of investigating diversions that are specifically identified through the complaint process.

B. Contention: The present level of diversions in the watershed is unreasonable.

Response: The complainants claim that summer diversions for agricultural irrigation have reduced stream flows so significantly as to strand salmon and steelhead in small pools where they-are vulnerable to predators, elevated water temperatures, and low dissolved oxygen. They further claim that in drought years these diversions have dried up portions of the Navarro River, most notably in 1992, resulting in substantial fish mortality as well as loss of recreational uses. The complainants believe that impairment of these beneficial uses contravenes the Regional Board Basin Plan, which designates fish and wildlife habitat and contact recreation as beneficial uses of ... the river.

The analysis of this contention is divided into five parts. First, the quantity of water that can be legally diverted, as documented in the SWRCB's records, is compared to the impaired flows at the USGS gage on the Navarro River. Second the results of the SWRCB's staff flow measurements in the river are described. Third, the effects of flow on temperature are described. Fourth, references in the complaint record to low flow conditions and dewatering events are summarized. Last, flows necessary to support the fishery are discussed.

1. Division Records on Water Rights in the Watershed

As of June 1, 1998, there were 40 licenses, 19 permits, two stock pond certificates, three small domestic registrations, and 16 Statements of Water Diversion and Use (Statements) on the Division's records for the Navarro River watershed. The total annual face value authorized for diversion under these rights is 2,511 acre-feet per annum (AFA) by direct diversion and 2,462 AFA by storage. The face value amounts were obtained directly from the water right, if specified, or calculated by multiplying the allowable rate of diversion by the days in the authorized season of diversion. These amounts reflect only the diversions known to the SWRCB and it is likely there are others under legitimate riparian and pre-1914 water rights. In addition to these existing rights, nineteen new water right applications have been filed with the Division. More applications are expected in the near future because of the Division's identification and notification of reservoir owners in the watershed without any apparent basis of right. As previously stated, the Division has located 121 small reservoirs without apparent water rights. A preliminary estimate of their total storage is 1,200 AF.

The above amounts represent the total potential impairment to the available flow of the Navarro River currently known to the SWRCB. However, the authorized diversions are unlikely to be taken simultaneously or at maximum levels.

The only long-term flow record available for the Navarro River is from the USGS Station No. ! 146800 located in the valley about nine miles upstream from the river's confluence with the Pacific Ocean. The watershed above the gage includes 303 square miles out of the total 323 square mile watershed area. Average daily flow records for this stream gage have been maintained since 1950. Figure 2 shows the annual Navarro River flows from 1950 through 1996. Gage records indicate that the average daily flow ranges from 0.23 cfs on July 13, 1977 to 64,500 cfs on December 22, 1955. The average annual runoff is about 370,000 AFA with a minimum of 18,035 AFA in 1977 and a maximum of 946,794 AFA in 1983. These records are impaired flows, reflecting the reductions created by the water rights on Division record, by riparian or pre-1914 diversions unknown to the Division, by possible illegal diversions, and by other natural losses within the watershed.

Table 1 shows the maximum authorized rate of direct diversion for the known water rights, partitioned into seasons, compared to the impaired average flow of the Navarro River at the . USGS gage near Navarro during the same periods. Virtually all the water demand occurs upstream of the Navarro gage. Most of the authorized diversions to storage (maximum authorized storage of 2,462 AFA) probably occurs in the November through March period. These amounts do not include the estimated 1,200 AFA of unauthorized storage and Table 1 does not include diversions to storage or diversion amounts proposed under applications.

Table 1: Maximum Diversion Rates for Known Water Rights And Average River Flows Recorded at the Navarro River Gage

Season	Authorized Rate	Average River Flow
November through March	21.7 cfs	1,080 cfs
April through May	32.0 cfs	312 cfs
June through October	6.1 cfs	27 cfs

Because this complaint alleges dewatering events and fishery impacts during the summer months, the Division analyzed the Navarro River flow records for the summer season, June 1 through October 31. An analysis of the conditions in the remaining seasons is being addressed in the Division's "Staff Decision on Pending Applications within the Navarro River Watershed." Results of that decision will establish if water is available for future appropriations and will recommend bypass terms and conditions, as appropriate.

Figure 3 is a plot of the average daily summer flow for each year and the minimum seven-day average summer flow for each year over the 44-year study period (1952 through 1996). Figure 3 shows that the average summer flow during the study period is typically above 10 cfs except during very dry years. The minimum seven-day average flow for the summer is typically below 10 cfs except in wet years. The lowest seven-day minimum flow for the 44-year study period was 0.28 cfs, occurring during the 1977 drought.

Figure 4 is a plot of the average daily flow for each day of the summer over the 44 years of record. For example, the average daily flows for June 1st is 80 cfs and for September 1st is 10 cfs, suggesting a three-month average decline of 88 percent. This decline in stream flow from June through September is typical for coastal streams dependent on seasonal precipitation. The plot also shows a flow recharge from precipitation events commencing in late October. Figure 4 indicates that from June through October the average daily flow after all impairments is typically above 10 cfs. Figures 5a and 5b are monthly exceedence curves of the average daily flows, illustrating the percentage of time different average flows have been exceeded. For example, the impaired average daily flows will exceed 30 cfs, 100 percent of the time for each day in June and about 50 percent of the time for each day in October. An impaired average flow of 20 cfs is exceeded about 40 percent of the time in July and about 70 percent of the time in October. However, the frequency of low flows is more meaningful from a fishery standpoint than the average flows.

Figure 6 is an exceedence curve for the minimum annual seven-day average flow (ie. the annual minimums of averaged consecutive seven-day flows passing the gage). This minimum seven-day average flow for the 44 years of record has exceeded five cfs, after, all impairment, approximately 60 percent of the time. This plot, in combination with the other plots and Table 1, indicate that there is sufficient water available in the Navarro River during the summer to satisfy historic-water diversions during average water years with some flows remaining for fishery purposes. However, in extreme dry years, there may be insufficient flows to satisfy all existing water users from surface supplies, and further additional diversions under low-flow conditions could dewater the river even at the downstream USGS gage.

2. SWRCB Staff Flow Measurements

As part of its complaint investigation, the Division conducted a stream flow measurement program on the river and its tributaries during the summers of 1995 and 1996. This program was

initiated to: (1) provide a better understanding of the watershed; (2) support the permitting

process for new applications by developing data for water availability analyses; (3) establish whether existing diversions are dewatering the river or its tributaries; (4) support a procedure to determine whether the watershed is fully appropriated; and (5) provide information to the Navarro River Watershed Restoration Project. Attachment A provides graphs and narrative descriptions of stations from the Division's water measurement activities for the summers of 1995 and 1996. During these periods, the Department of Water Resources Bulletin 120 shows that the North Coast Region recorded precipitation at 151 per cent of normal for water year 1994-1995 and 115 per cent of normal for water year 1995-1996.

Division staff did not observe any channel dewatering but there may have been dewatering events when staff was not present. Division staff was in the field for three two-day periods during the summer of 1996. Mendocino County Water Agency staff was in the field on other dates spaced approximately two weeks apart from Division visits and they did not report any channel dewatering events. Also, there were no reports of fish kills in the Navarro River watershed during the summers of 1995 and 1996.

Stage recorder charts from one of the Division's measuring sites suggest a channel section may have been dewatered for periods in excess of a day. The events occurred at Station #9 (Anderson Creek near Rancheria Creek) during the periods of July 25, 1995 through August 22, 1995 and September 20, 1995 through October 24, 1995 when flow tends to be quite low. The strip charts for Station #9 show that the water surface lowered to a level corresponding to zero cfs flow on the rating curve for approximately 24 hours and subsequently recovered to preceding levels. In 1996, the Station also observed five 8 to 14 hour events between June 28 and July 23 where flow rates dropped approximately 0.9 cfs. The duration and quick recovery of these events suggest that they were caused by upstream diversions. The recorder chart data for 1996 did not indicate any periods where there may have been a channel dewatering.

3. Effect of Flow on Temperature

Water temperature is a significant water quality parameter that can be affected by flow rates. Coho salmon and steelhead require cool water temperatures for survival and procreation. The original scope of the complaint investigation did not include a temperature analysis, but temperature monitoring is part of the Navarro River Watershed Restoration Project, which is described earlier in this report. As part of this project, Mendocino County Water Agency staff set automatic water temperature recorders in the Navarro River Watershed channels for the entire summer. In a cooperative effort with Division staff, these recorders were set in many of the locations used by the Division for flow monitoring in 1995 and 1996. The temperature recorders were normally placed in the deepest and shadiest locations that could be found at the sites, water temperatures at other locations could be higher. Graphic summaries of the temperature data collected by the Agency in 1995 and 1996 are provided in Attachment B.

A general review of the temperature data in the watershed for 1995 indicates that in all but one location the water temperature reaches a peak in late June to mid-July and then slowly declines. The temperature decline occurs at the same time flows are declining and maximum air temperatures are rising. (The maximum air temperature in Boonville is generally higher in August and September than in June and early July.) A similar pattern is seen in 1996 (excluding estuary temperatures), but on average the peak occurs slightly later in the year with most locations reaching a temperature maximum by the end of July. A possible explanation for this observation is that as surface runoff declines in the watershed, the base flow becomes principally supported by a cooler spring-fed or groundwater supply. However, the specific cause of the observation is not certain. In any event, the data do not appear to support the conclusion that increased summer flows are likely to result in reduced temperature conditions. If summer temperatures have degraded in the watershed, the causes could be related to opening of the stream canopy, as well as to shallowing and widening of the channel due to sediment accumulation, as described in the background section of this report.

For informational purposes, 1996 stream flow measurements were plotted against 1996 temperature measurements at two locations in the watershed: Anderson Creek #9 and North Fork Navarro River #16. The plots and the accompanying regression analyses are provided in Attachment C. The regression analyses indicate that a statistically significant relationship exists between flow and temperature at both locations with declining flows corresponding to reducing , temperature conditions. This result may be due to the difference in the source of the water at low flow conditions, as described above. The relationship is stronger at the North Fork of the

Navarro than at Anderson Creek. The existence of a significant statistical relationship between temperature and flow does not establish that a cause and effect relationship exists.

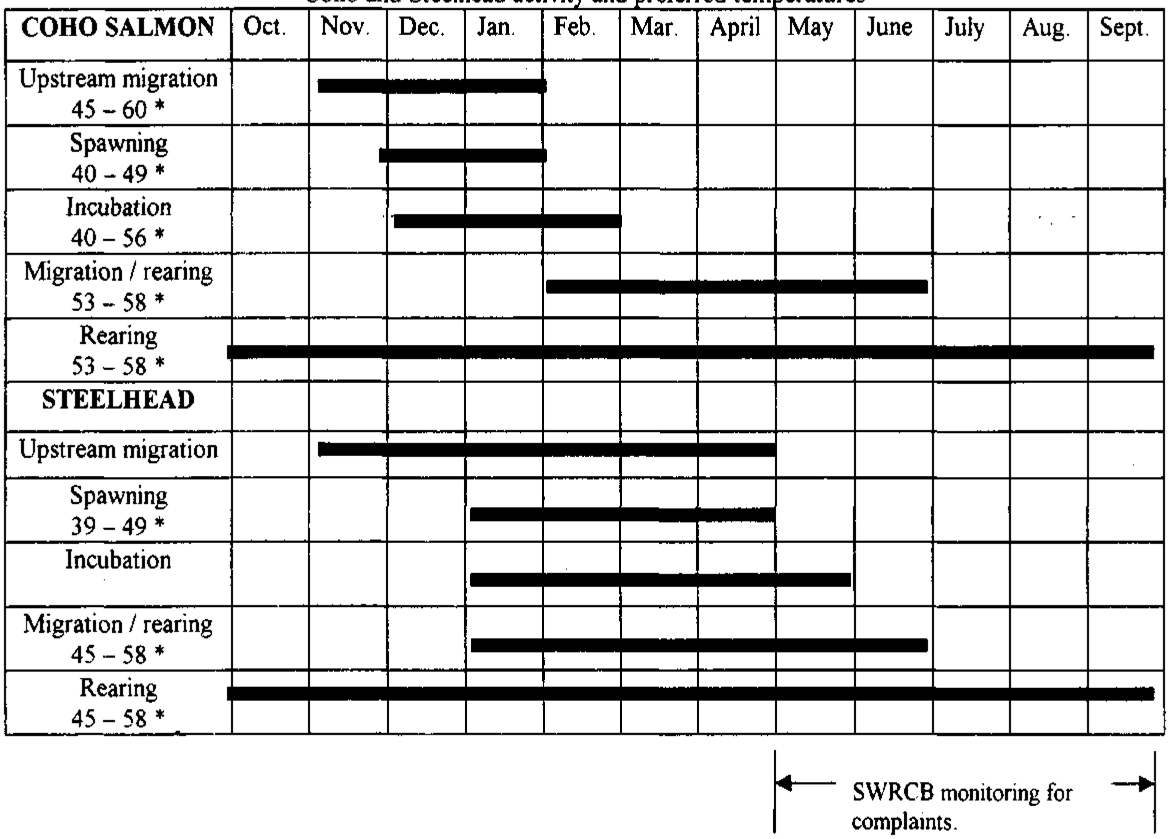
In order to illustrate the observation that stream temperatures decline after reaching a peak in early to mid-summer, the number of days from the maximum temperature at the above two stations were plotted against stream temperature. The plots and the accompanying regression analysis are provided in Attachment C. The correlation between these two parameters is better that the correlation between flow and temperature.

Although it is possible to speculate regarding the principal factors that may be affecting water temperatures in the watershed, water temperatures are probably affected by myriad factors and there is insufficient evidence to identify the dominant factors. Stream temperature is affected by: air temperature, amount of riparian canopy, amount and timing of water diversions, amount of cloud cover, amount of fog, flow rate, location of tributary in watershed, orientation of stream channel, presence of springs and groundwater recharge, time of temperature measurements, time of flow measurements, type of channel bottom (i.e., bed rock, sand; gravel, or cobbles), water temperature of water entering from upstream tributaries, and wetted perimeter of channel cross section. However, the reduction in stream flow that occurs during the summer tends to be associated with reductions in river temperatures not an increase in temperatures as postulated in the complaint.

Anadromous fisheries depend on the proper combination of several factors to maintain healthy populations. These factors include flow, temperature, dissolved oxygen, water quality, substrate conditions, availability of appropriate cover, and riparian habitat. Figure 7[3] shows the time period for different life cycles of coho and steelhead, the preferred temperature (°F) for each cycle and time period in which the Division and Mendocino County Water Agency conducted the flow and temperature monitoring programs.

3. * Source: <u>California Salmonid Stream Habitat Restoration Manual,</u> Second Edition, October 1994.

Figure 7
Coho and Steelhead activity and preferred temperatures



Since the Agency's measured temperature data in Attachment B were taken only during summer months, they can only be compared to the preferred temperature ranges for coho and steelhead rearing and out-migration cycles. This comparison indicates that temperature levels in the areas where measurements were taken are too high (above 58° F) for suitable salmon or steelhead habitat.

4. Anecdotal Evidence Regarding Low Flow Events

The Division's records contain anecdotal accounts of low/no flow conditions in the Navarro River and its tributaries. The first record is in July 1977 when Kevin Coughlin informed the SWRCB that there was no flow in the Navarro River near Philo and that two large agricultural growers had been running their pumps throughout the day. Mr. Coughlin further reported that fish kills were occurring. An additional report was filed by Tom Wodetzki in September 1992. Mr. Wodetzki claimed that he had recently observed the river drying up due to continuous pumping by nearby, upstream agricultural diversions.

The remaining accounts of channel dewatering and low flow events are found in newspaper articles published in the local paper in 1991 and 1992. An account of Anderson Creek in August of 1992 describes how some reaches downstream of the high school were dry and noted as many as fifteen pumps in the channel. However, there is no indication that any of these pumps were in operation. Letters to the editor in October and November of 1991 indicated that there was no discernible flow in Indian Creek. Further, in 1992, an article regarding Indian Creek described water temperatures between 79 °F and 86 °F.

5. Flow Needs for Fishery

In order to determine whether the Navarro watershed is overallocated, the flow needs of the fishery must be evaluated. This evaluation is also required to establish bypass flows and seasons of diversion for new applications. By letter dated November 30, 1995, the Division requested any information the DFG had on the flows needed to sustain the fishery in the Navarro River watershed. The DFG responded that they did not have any site-specific information for the Navarro River.

The Division recently proposed a methodology for estimating the bypass flows for the anadromous fish in the Russian River watershed. The Division may use the methodology to establish permit terms for applicants in that watershed. (See Staff Report on the Russian River Watershed, August 15, 1997. Excerpts from the staff report, with a few updates, are included as Attachment D.) The Russian River and the Navarro River watersheds are in close proximity, have-similar rain-dominated hydrologic characteristics, and support similar anadromous fisheries. Also the data used in developing this approach was from North Coast streams near the Navarro River watershed. Therefore, the methodology may have applicability to the Navarro River watershed. The methodology indicates that, in order to maintain the fishery in good condition from December 15 through March 31, bypass flow of approximately 60 percent of the annual average flow rate should be used for new appropriations. An equivalent level of protection from April 1 through December 14 results in bypass flow of approximately 30 percent of the annual average flow rate. The average annual flow at the USGS gage in the Navarro River is approximately 500 cfs. Consequently, preliminary estimates of the needed bypass flows at the USGS gage are 300 cfs for the winter and 150 cfs for the rest of the year.

These estimated flow needs are met through much of the winter season, but they are not achieved the rest of the year even under unimpaired conditions. The low flows in the summer under natural conditions may have historically been a limiting factor in the anadromous fish population.

Conclusion: Summer flow conditions may have historically been a factor limiting anadromous fish population in the Navarro River watershed. Summer diversions, therefore, have the potential to further limit populations. However, many of the summer diversions in the Navarro River watershed were in place when the fishery was at much higher levels then that of today. Other factors, principally sediment and temperature, now appear to be much more important factors limiting aquatic resources. The relative magnitude of the effects of these factors (flow, sediment loading, and temperature) cannot be distinguished. Information on the specific benefits to the fishery through improving flow conditions in this watershed does not currently exist. Also site-specific data to support minimum fishery flow criteria does not exist.

The impaired flow records indicate that there may not be sufficient flow during August and September of dry years to satisfy known existing water right diversions. However, the Division has not received any complaints from water users regarding lack of availability of water supplies. This suggests that existing water users may discontinue use or change to alternate water supplies during these low flow periods.

Without specific data on minimum fishery flow needs and the benefits of improving flow conditions, there does not appear to be sufficient evidence to determine whether existing summer diversions are unreasonable. However, further appropriation of water during the summer months could have the potential of significant adverse effects to the anadromous fish habitat.

C. Contention: The watershed is fully appropriated

Response: Water Code section 1205, et seq., authorizes the SWRCB to adopt a declaration that a stream system is fully appropriated for all or part of the year. After adoption of the declaration the SWRCB cannot accept new applications to appropriate water for the specified period, and the SWRCB may cancel pending applications. The declaration must be based on a previous water right decision in which the SWRCB determines that no water is available for appropriation. The procedure for resolving minor protested applications specified in Water Code section 1345, et seq., which includes a field analysis, staff report, and opportunity for hearing, can be used to satisfy the requirement for a previous water right decision.

Division records show that three previous decisions by the SWRCB addressed the availability of water within the Navarro River watershed. A description of each decision and its effects on water availability are summarized below.

> **DECISION 1009 -** Decision 1009 was adopted by the SWRCB on May 4, 1961. Application 17742 requested the direct diversion of 0.75 cfs from May 15 to October 15 of each year from an unnamed stream tributary to the Navarro River. The Decision concluded that water was not available for appropriation in this tributary because a downstream riparian water user required "substantially the entire surface flow of the unnamed stream during the major portion of the applicant's proposed diversion season." The entire unnamed stream is included within the SWRCB's Fully Appropriated Streams (FAS) pursuant to Water Code section 1205, et seq. The season of FAS is May 15 to October 31.
>
> **DECISION 1231 -** Decision 1231 was adopted by the SWRCB on August 25, 1965 Application 21256 requested the direct diversion of 0.33 cfs from May 1 to November 1 of each year from Indian Creek, which is tributary to the Navarro River. The DFG protested the application, claiming that Indian Creek is an important spawning and nursery area for steelhead. DFG recommended that two cfs be bypassed at the applicant's point of diversion at all times for the preservation of the fishery. The Division determined

that flow in Indian Creek was nearly always in excess of two cfs. Based on these findings, the SWRCB approved Application 21256 for the amount and season requested subject to the requirement to bypass two cfs for the protection of the Indian Creek fishery. Indian Creek is not included within the SWRCB's FAS listings.

DECISION 1281 - Decision 1281 was adopted by the SWRCB on August 31, 1967. Application 21853 requested the direct diversion of 0.55 cfs from May 1 to October 1 of each year from Anderson Creek, which is tributary to the Navarro River. A downstream licensee protested the application. He claimed that, in August of 1964, a dry year, he could pump for only three hours a day; afterwards, he had to wait overnight for his diversion sump to fill. Division staff made several stream measurements in 1966, a year with rainfall only slightly less than the average for the seven years from 1960 through 1966. Based on its analysis, the Division determined that, under average conditions, the amount of water required to fully satisfy Application 21853 would not be available beyond June 25, and after about July 25 there would no longer be any water available for this application. Consequently, the SWRCB approved, in part, Application 21853 with the diversion season reduced to May 1 to July 31. Anderson Creek watershed is included within the SWRCB's FAS listing from the confluence of Clow Canyon and Anderson Creek upstream. The season of FAS is August 1 to September 30.

Division staff is presently evaluating water right Application 29910 (Savoy) pursuant to the requirements of Water Code section 1345, et seq. A field inspection has been completed and a staff report will be completed in the near future. Application 29910 requests authorization to divert year-round from the mainstem of the Navarro River downstream of its confluence with the principal tributaries. The Division of Water Rights will issue a decision on this application including a finding whether water is available for all or part of the year. The applicant or the protestants can request reconsideration if they disagree with the Division's decision. If the Division finds that water is not available at the proposed diversion point for all or part of the year, the main stem of the Navarro River and its upstream tributaries will likely be included in the next hearing the SWRCB holds to consider amending the FAS list.

Conclusion: The process for declaring a stream reach fully appropriated is normally handled through the application process where a water availability analysis is performed The Application Section is currently processing several applications to appropriate water in the Navarro River watershed and is conducting a water availability analysis. The data collected as part of the complaint process is available to the Application Section. Therefore, determinations regarding fully appropriated streams in the watershed should be left to the application process.

IV. RECOMMENDATIONS

As indicated in the introduction, the complainants made the following three requests in the complaint.

1. Identify illegal diversions and take actions to ensure that these diversions comply with the laws related to water appropriations.

2. Declare the Navarro River and its tributaries to be fully appropriated.
3. Assure adequate bypass flows through an adjudication or some similar proceeding.

The Division initiated a program to identify illegal reservoirs and that program will continue until all identified reservoirs owners comply with the Water Code. In addition, the Division will consider, through the application process, whether the watershed should be declared fully appropriated for all or part of the year. If the Division recommends a FAS declaration, this recommendation will be considered by the SWRCB for adoption in an order at the next FAS hearing.

The third request deals with an adjudication of the watershed or some similar process under the SWRCB's authority to protect the public trust and to eliminate waste and unreasonable use. Adjudication requires either a court reference under Water Code section 2000, et seq., or a petition from one or more claimants of water under Water Code section 2500, et seq. Neither of these requirements has been met in this case. The SWRCB could initiate a public trust action in the watershed. However, the cause of the anadromous fish decline may be principally due to factors other than flow, and there is not adequate information available regarding the flow needs of the fishery in the summer. Consequently, the Division recommends that a public trust action should not be initiated at this time. If the complainants, DFG, or some other entity develops adequate information regarding the summer flow needs of the anadromous fishery, this recommendation can be reevaluated.

Watershed stewardship programs like those developing in the Navarro River watershed are becoming an important factor in protecting and enhancing environmental resources through the State. In some watersheds these collaborative efforts of local interests and state and federal agencies have implemented creative ways of improving resource values in the watershed through largely cooperative rather than regulatory mechanisms. One of the benefits of these locally based cooperative watershed programs is that funding for them can be pooled from many sources. The SWRCB has helped fund the Navarro Watershed Restoration Plan, and the Regional Board is actively working with this group. A prioritized list of restoration activities is emerging. Implementation of these restoration efforts should proceed forward while actions to protect and preserve environmental resources are implemented by both state and federal agencies.

Figures

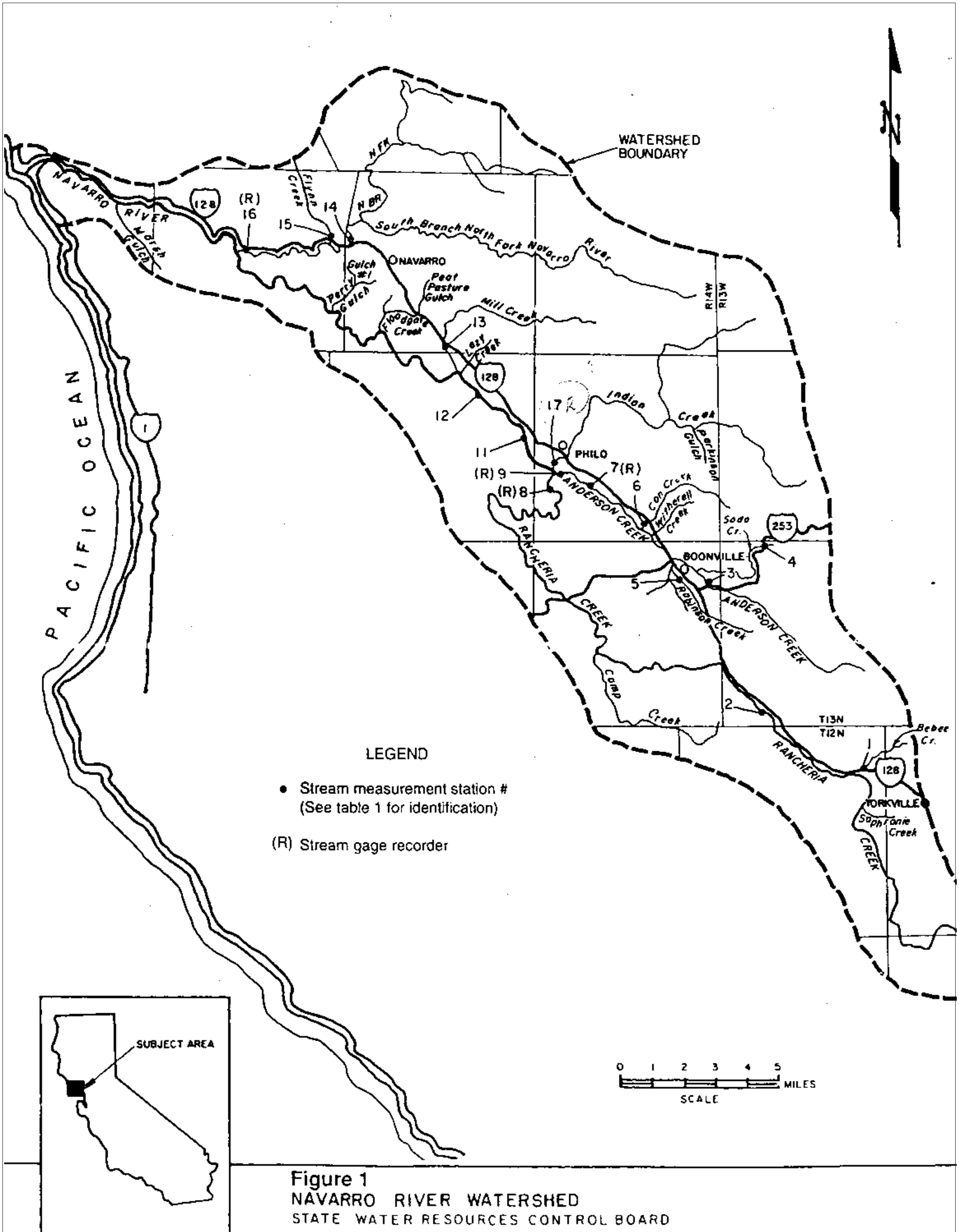


Figure 1
NAVARRO RIVER WATERSHED
STATE WATER RESOURCES CONTROL BOARD

DWG 3444

Figure 2
Navarro River near Navarro
USGS Station No. 11468000

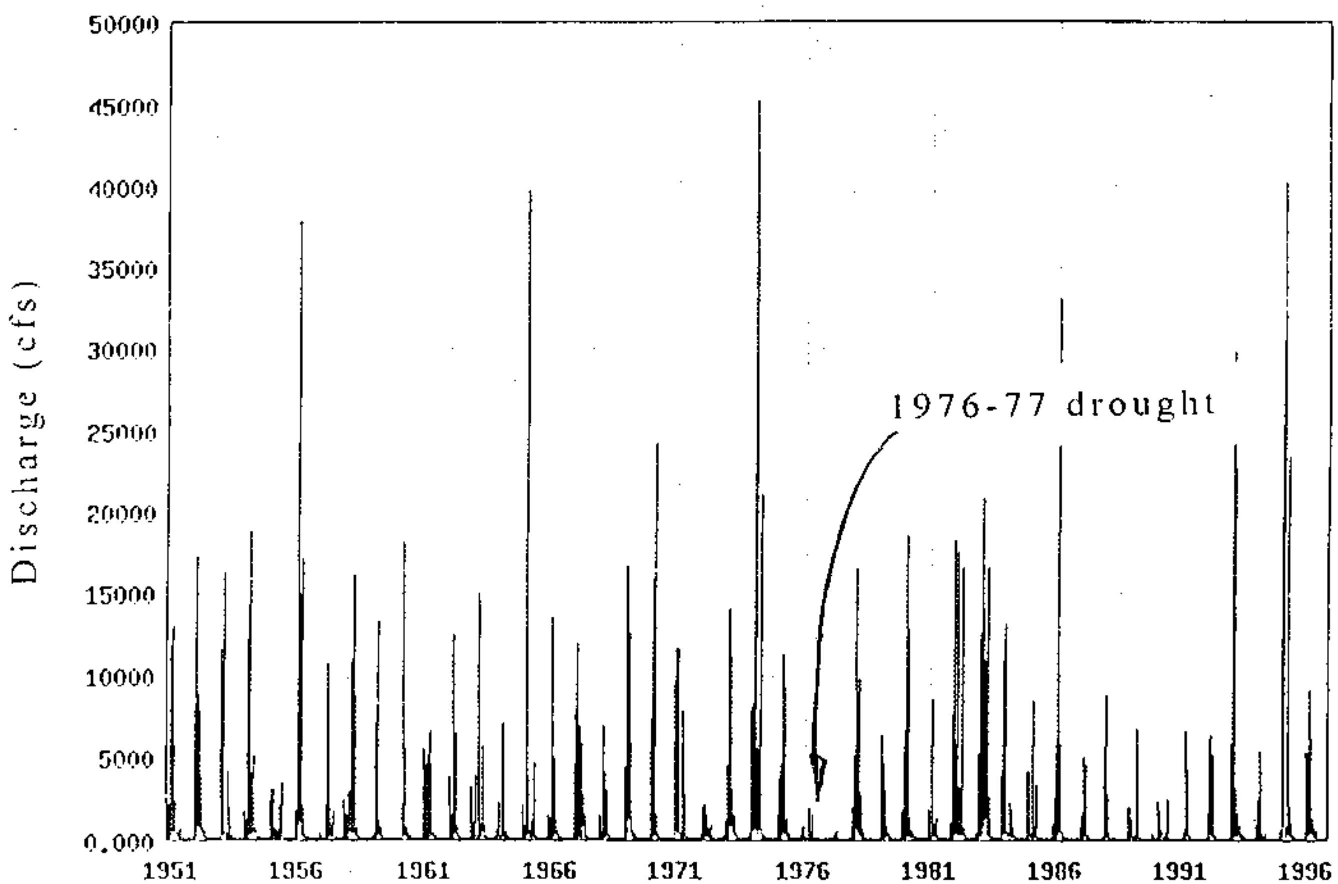
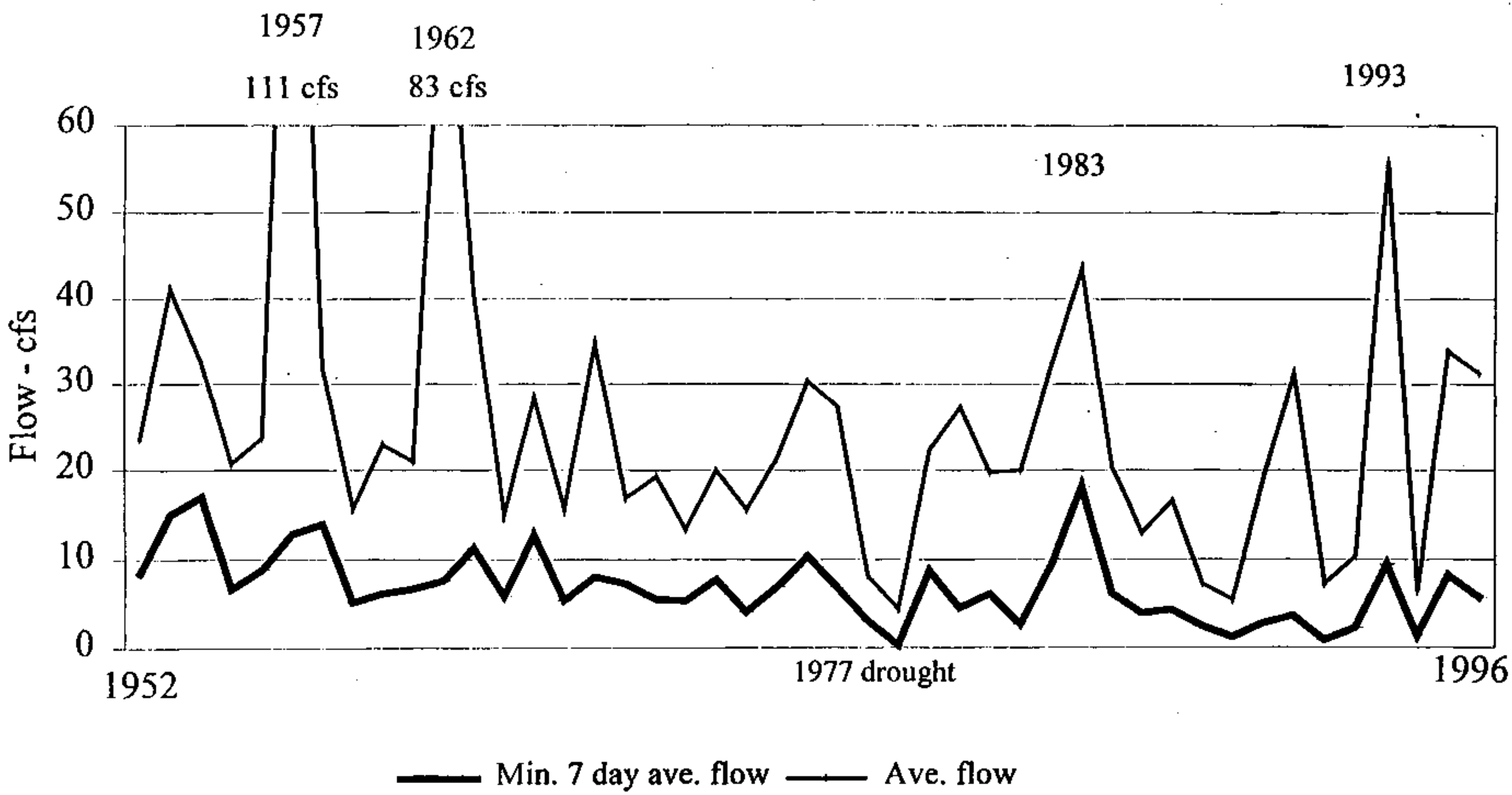


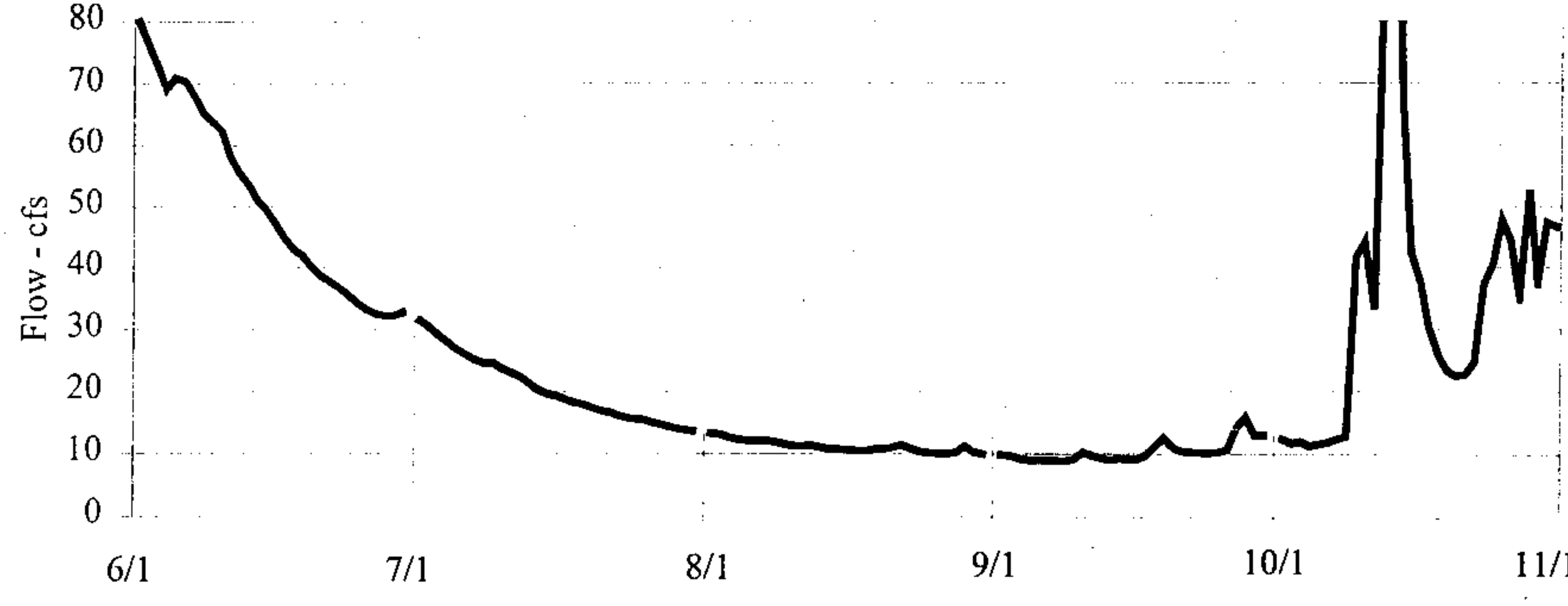
Figure 3
Navarro River USGS Gage
Average and Minimum Annual Summer Flows
(June through October)



* Flow rates are impaired values - after diversions have been made.

Figure 4
Navarro River USGS Gage
Ave. Daily Summer Flows 1952 - 1996
(June through October)

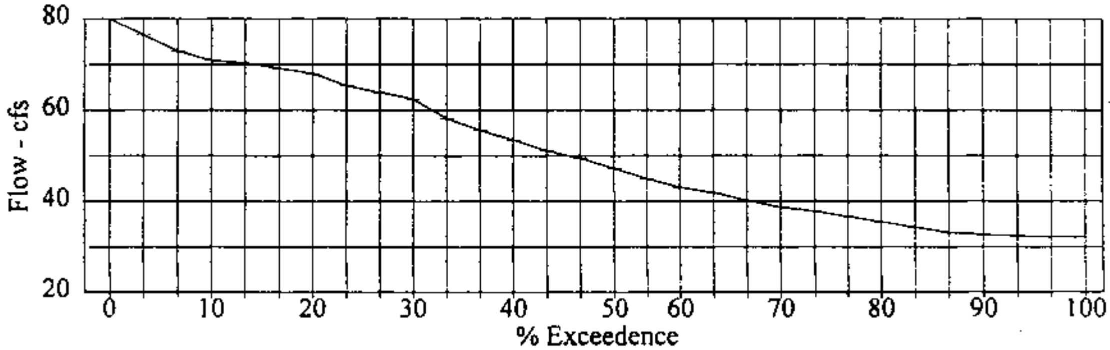
Max = 143 cfs



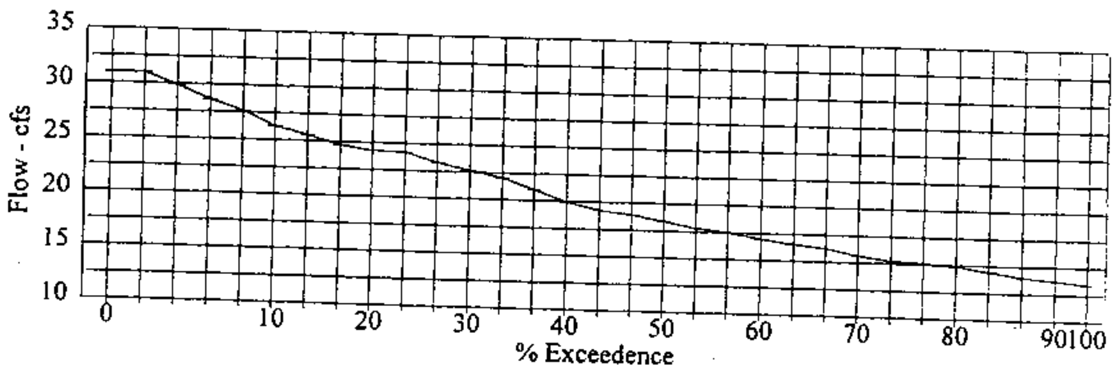
* Flow rates are impaired values - after diversions have been made.

Figure 5A
Navarro River USGS Gage Data
Monthly Exceedence of Average Daily Flows

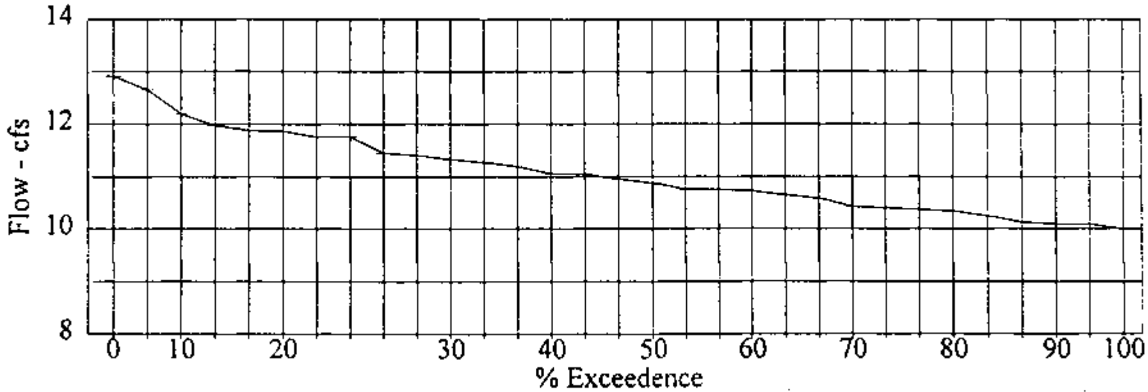
June



July



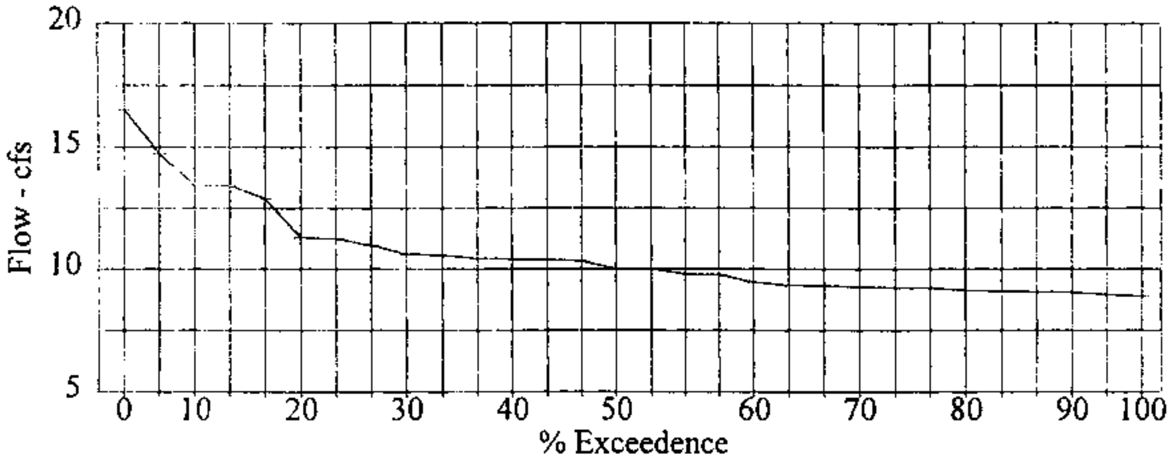
August



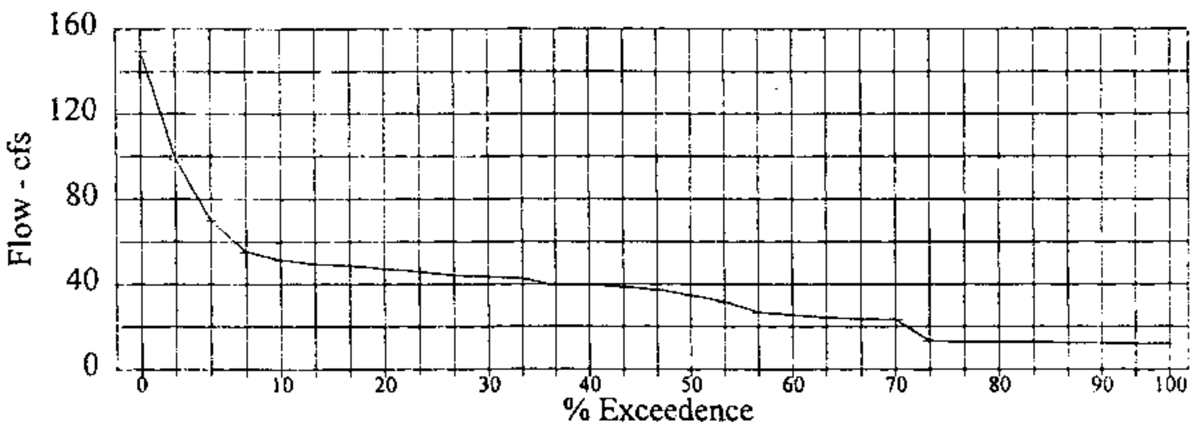
% Exceedence based on the 44 year average of daily flows.

Figure 5B
Navarro River USGS Gage Data
Monthly Exceedence of Average Daily Flows

September

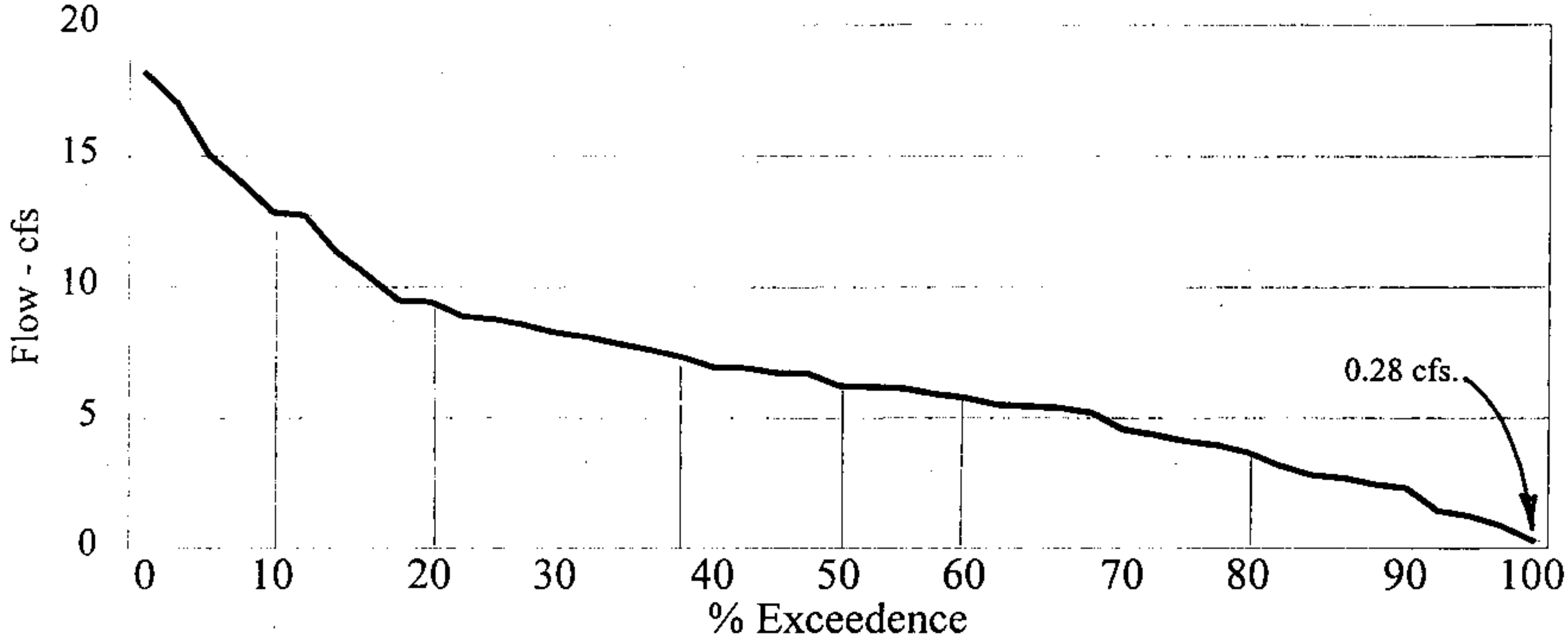


October



% Exceedence based on the 44 year average of daily flows.

Figure 6
Navarro River USGS Gage
Monthly Exceedence of Minimum 7 Day Ave. Flows
(June through October)



* Flow rates are impaired values - after diversions have been made.

Attachment A

Division's 1995 and 1996 Stream Flow Measurement Program

Attachment A

1996 Stream Flow Measurements
Navarro River Watershed

Introduction

Sixteen sites were monitored (see Figure A and Table A). Station 10 was not used for the summer of 1996 because of vandalism in 1995, and a new station (#17) was established. Stream stage recorders were set up at five of the locations (stations # 7, 8, 9, 16, and 17). Soda Creek and Robinson Creek went dry during the summer season. These two streams have relatively small watersheds and there were no obvious diversions of water noted. The results of the measurements made during the summer of 1995 were sent to the complainants and interested parties in a letter dated July 15, 1996. The principal subject of this attachment is the field measurements taken in the summer of 1996. Plots of the measurements taken in 1995 are also provided.

Division personnel made stream flow measurements in the middle of May and September and at the end of October. The Mendocino County Water Agency (Agency) made stream flow measurements in the middle of June and toward the end of July and September. Stage recorders were installed in June and their strip charts were reset each month.

Stream flow rates derived from field measurements are approximate and have importance in their relative values over time, not their absolute values. Flow rates are determined by measuring the velocity of the water current at a location and multiplying that velocity by the wetted cross section area of the stream. Such determinations are susceptible to the following inaccuracies, which can be cumulative:

1. accuracy of the flow meter;

2. accuracy of channel cross section dimensions over rough natural conditions;

3. heterogeneous velocity distribution across the wetted cross-section area of the stream;

4. the measurements are "snapshots" of flow at the time the measurements were made over a period of about 20 minutes, taken approximately one month apart.

Following is a brief summary of the data from the five recorders. Values of water stage as measured by the recorders are quite accurate since they are simply a recording of the water surface stage in the stream. However, in order to convert these readings into stream flow rates, the flow rates measured and stream stages observed must be compiled into a rating curve. The inaccuracies described above for stream flow measurements are therefore also applicable to values derived from the stage recorders and rating curves.

The trend of decreasing flow rates as the summer season progressed is quite apparent and was expected. Some strip charts from the stage recorders showed the timing, draw down, and duration of pumping upstream of their locations. Some charts also clearly showed the diurnal fluctuation in water surface elevations caused by changes in plant evapotranspiration between daylight and night hours.

Station #*7:* Anderson Creek "at York's" The strip charts for the recorder do not show any pumping events. However, they do show the diurnal fluctuation of the water surface elevation due to plant evapotranspiration. This diurnal draw down appears to average 0.01 foot and can result in a decrease of 1/2 cfs to 3 cfs depending on the flow rate in the creek at the time. There was a period in September when the flow ceased. Staff believes that during this time there may have been some minimal flow at night when evapotranspiration was minimal.

Station #8: Rancheria Creek, near Anderson Creek These charts also show the diurnal fluctuation of the water surface elevation. A large upward spike around October 18 appears to indicate runoff due to a rain event. However, since the other recorders did not show a similar spike, it may be an anomaly in the recorder or in the channel upstream of the recorder such as the release of a temporary blockage. One pumping event is shown as a drop in the water surface of 0.09 foot over a period of approximately 8 hours. The trace shows a quick recovery after pumping ceased.

Station #9: Anderson Creek near Rancheria Creek These charts also show the diurnal fluctuation of the water surface elevation. - Additionally, five pumping events are shown and are described as follows:

> On June 28, a surface drop of 0.03 foot for 14 hours resulting in a flow reduction from 4.4 cfs to 3.5 cfs during that period.
>
> On June 30, a surface drop of 0.02 foot for 8 hours resulting in a flow reduction from 3.8 cfs to 3.2 cfs during that period.
>
> On July 3, a surface drop of 0.03 foot for 12 hours resulting in a flow reduction from 3.5 cfs to 2.6 cfs during that period.
>
> On July 4, a surface drop of 0.03 foot for 12 hours resulting in a flow reduction from 3.8 cfs to 2.9 cfs during that period.
>
> On July 23, a surface drop of 0.02 foot for 12 hours resulting in a flow reduction from 0.4 cfs to 0.3 cfs during that period.
>
> September 17 and October 17 show storm events.

Station #16: N.F. Navarro R. near Dimmick State Park This recorder did not show any pumping events; just a steady lowering of the water surface throughout the summer.

Station #17: Indian Cr. above confluence with Navarro River This recorder did not show any pumping events. The charts show the diurnal fluctuation of the water surface elevation.

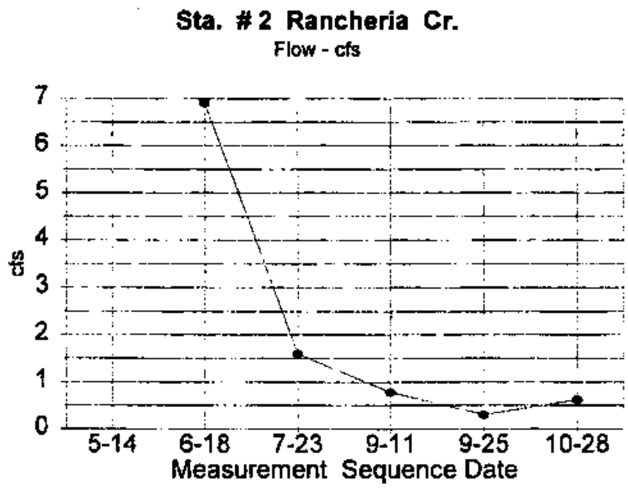
Navarro River Watershed
1996

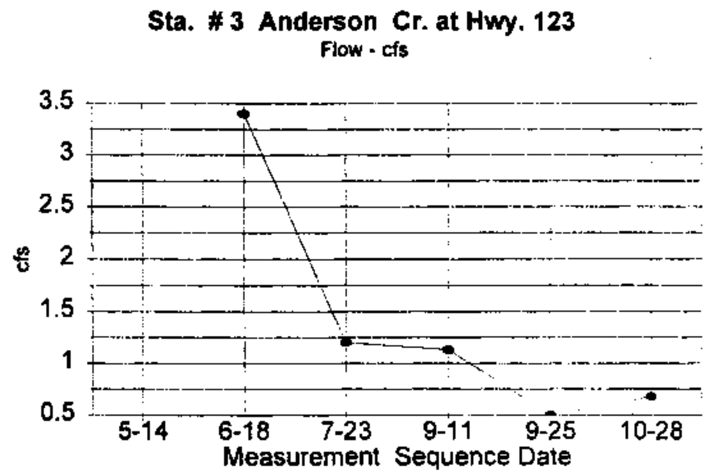
Station #	Location of stream flow measurements
1	Bebee Creek @ Hwy. 128
2	Rancheria Creek @ Fish Rock Road (mm 36.56)
3	Anderson Creek @ Highway 253 Bridge (mm 0.53)
4	Soda Creek @ Highway 253 (mm 3.5)
5	Robinson Creek @ Mountain View Road Bridge near Hwy 128
6	Con Creek @ Anderson Valley Way bridge culvert (near Highway 1
7 *	Anderson Creek on Connie Best's Property (Alan York)
8 *	Rancheria Creek Above Confluence with Anderson Creek
9 *	Anderson Creek Above Confluence with Rancheria Creek
10	Indian Creek @ Highway 128 (mm 23.48)
11	Navarro River @ Hendy Woods State Park
12	Navarro River @ Husch Vineyards (4400 Highway 128)
13	Mill Creek @ Highway 128 (mm 17.88)
14	North Fork Navarro @ Hwy 128 (mm 12.28)
15	Flynn Creek @ Highway 128 (mm 11.63)
16 *	North Fork Navarro River near Dimmick State Park (mm 8.28)
17 *	Indian Creek Near Confluence with Navarro R.

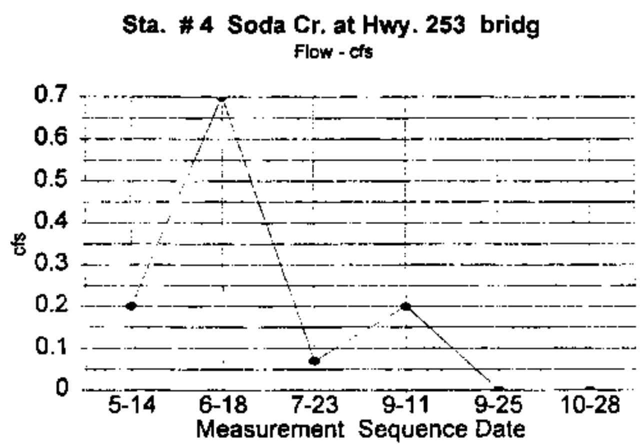
mm is the white paddle highway mileage marker on the side of the road.

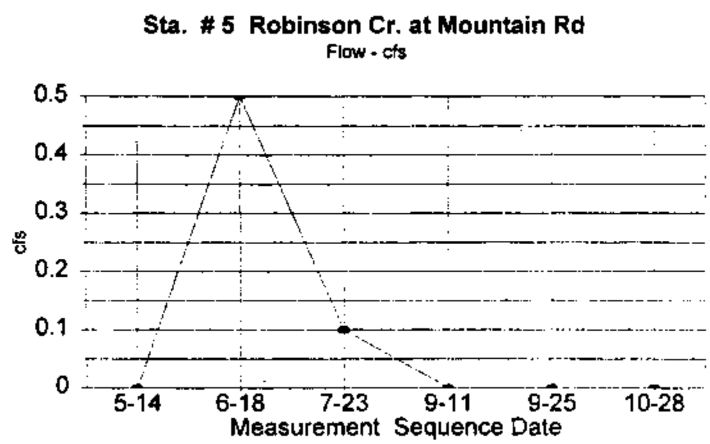
*   Indicates stations where stage recorder was installed

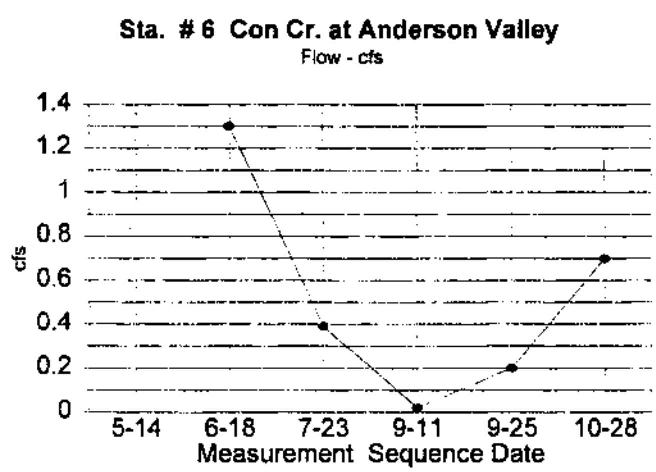
1996

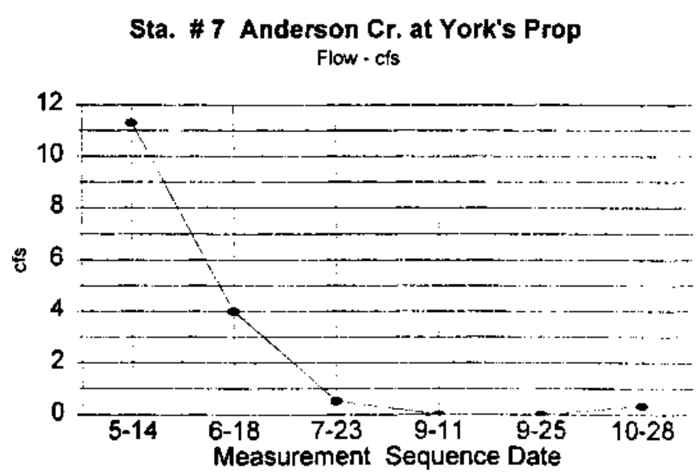

Sta. # 2 Rancheria Cr.
Flow - cfs
cfs
7
6
5
4
3
2
1
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date


Sta. # 3 Anderson Cr. at Hwy. 123
Flow - cfs
cfs
3.5
3
2.5
2
1.5
1
0.5
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

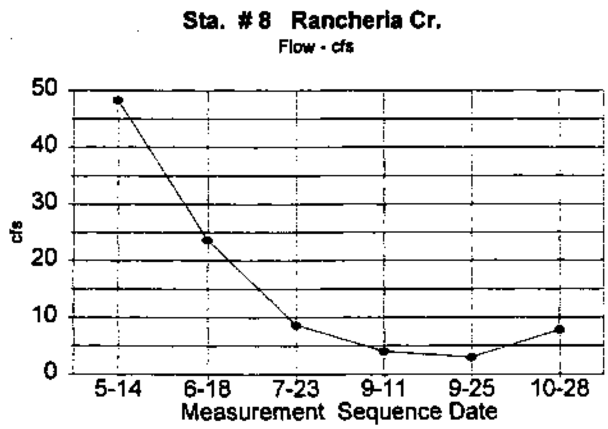

Sta. # 4 Soda Cr. at Hwy. 253 bridg
Flow - cfs
cfs
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

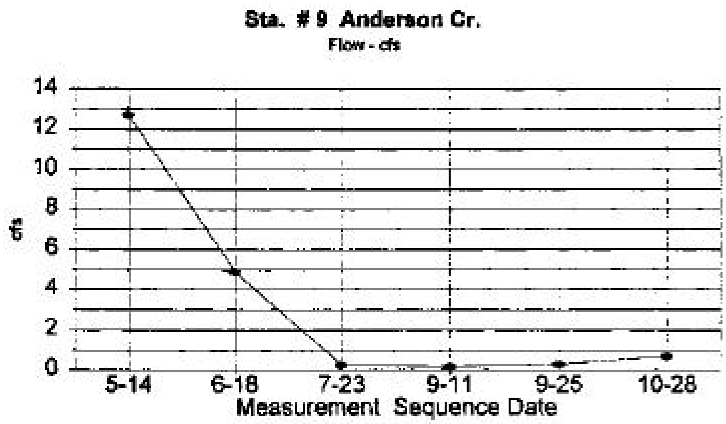

Sta. # 5 Robinson Cr. at Mountain Rd
Flow - cfs
cfs
0.5
0.4
0.3
0.2
0.1
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

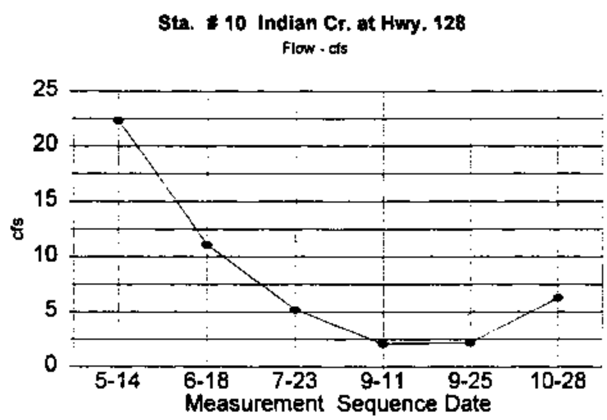

Sta. # 6 Con Cr. at Anderson Valley
Flow - cfs
cfs
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

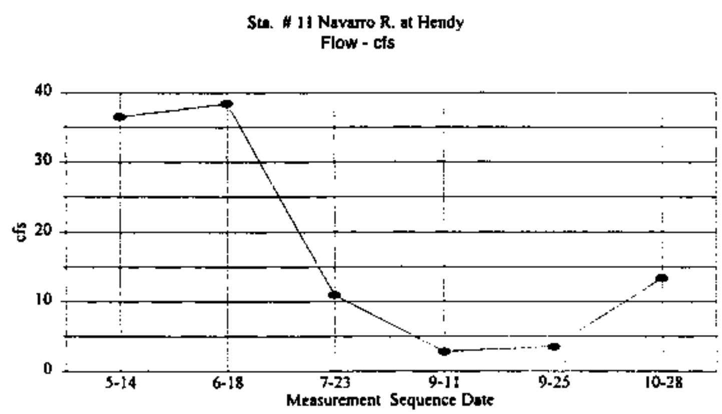

Sta. # 7 Anderson Cr. at York's Prop
Flow - cfs
cfs
12
10
8
6
4
2
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

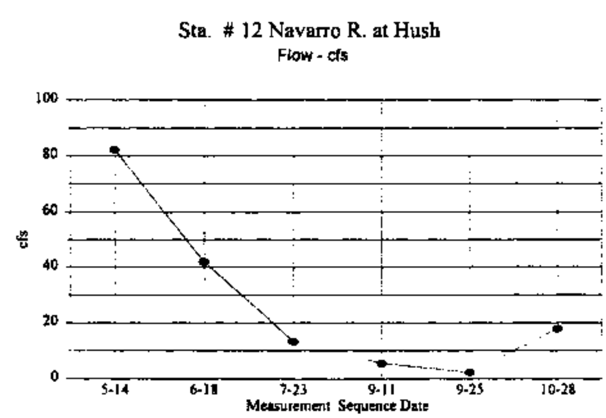
1996

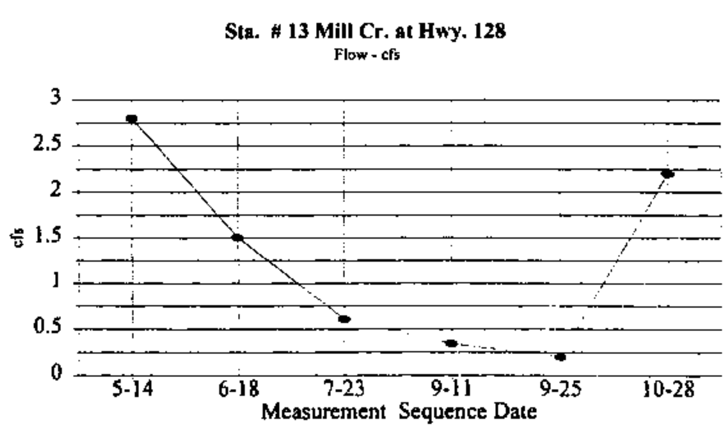

Sta. # 8 Rancheria Cr.
Flow - cfs
cfs
50
40
30
20
10
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date


Sta. # 9 Anderson Cr.
Flow - cfs
cfs
14
12
10
8
6
4
2
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

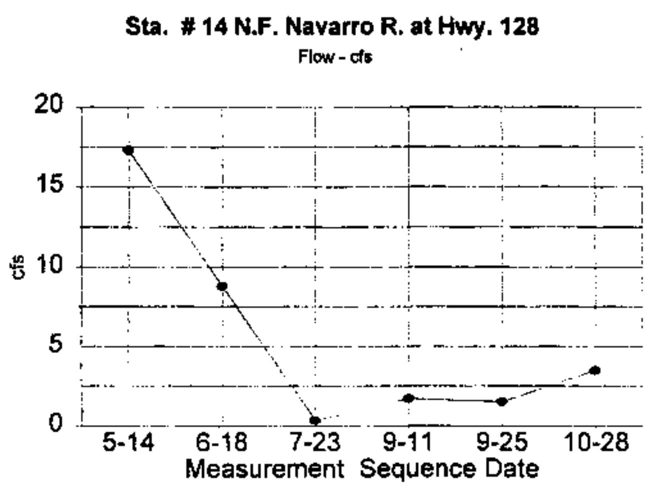

Sta. # 10 Indian Cr. at Hwy. 128
Flow - cfs
cfs
25
20
15
10
5
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

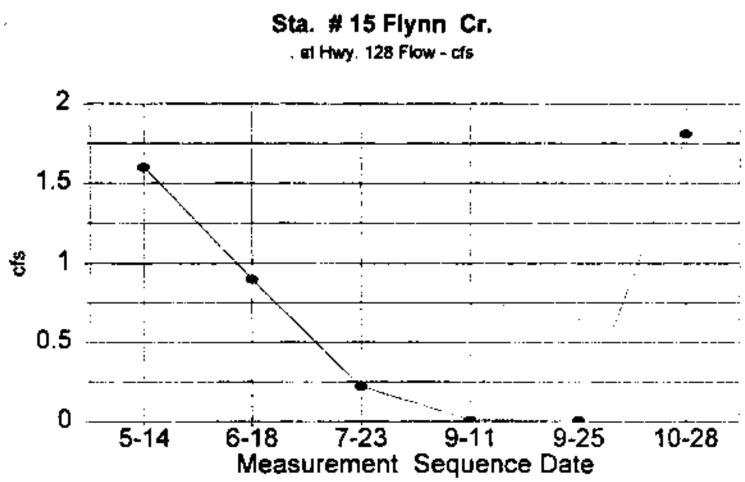

Sta. # 11 Navarro R. at Hendy
Flow - cfs
cfs
40
30
20
10
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

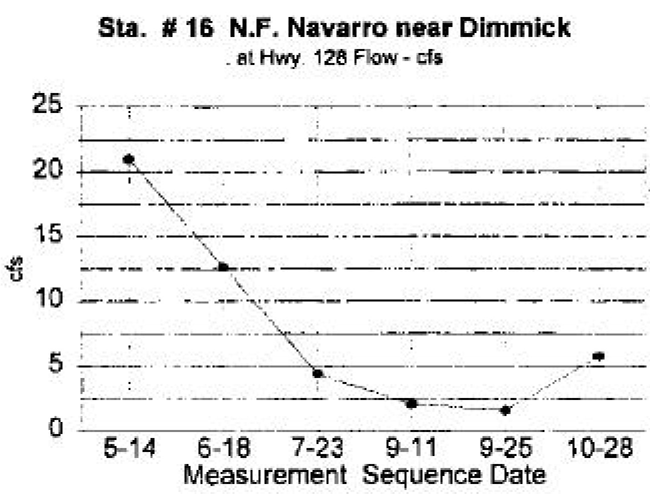

Sta. # 12 Navarro R. at Hush
Flow - cfs
cfs
100
80
60
40
20
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date


Sta. # 13 Mill Cr. at Hwy. 128
Flow - cfs
cfs
3
2.5
2
1.5
1
0.5
0
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

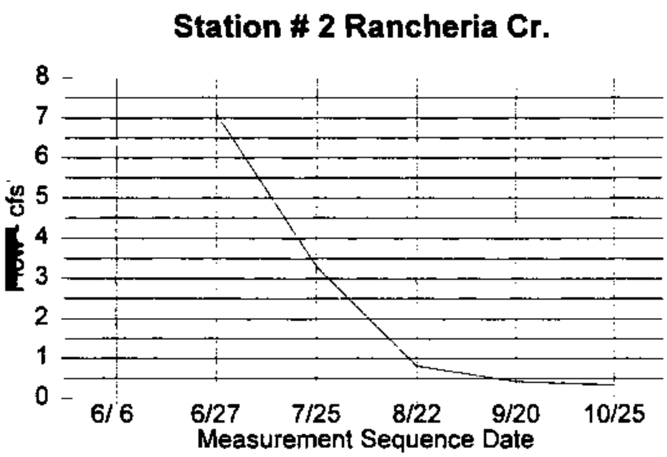
1996

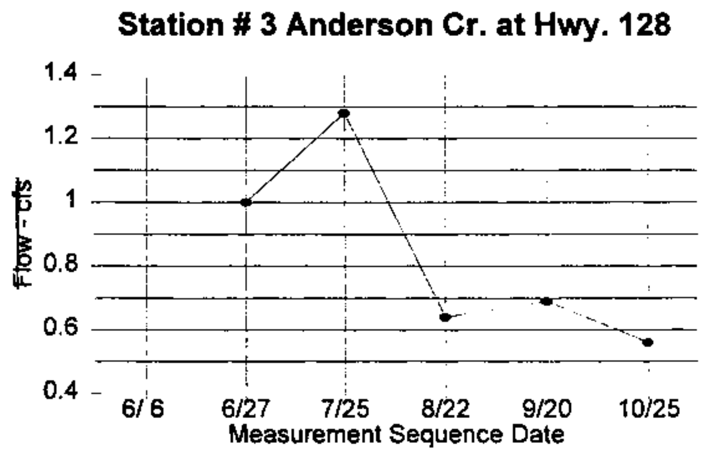

Sta. # 14 N.F. Navarro R. at Hwy. 128
Flow - cfs
20
15
10
5
0
cfs
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

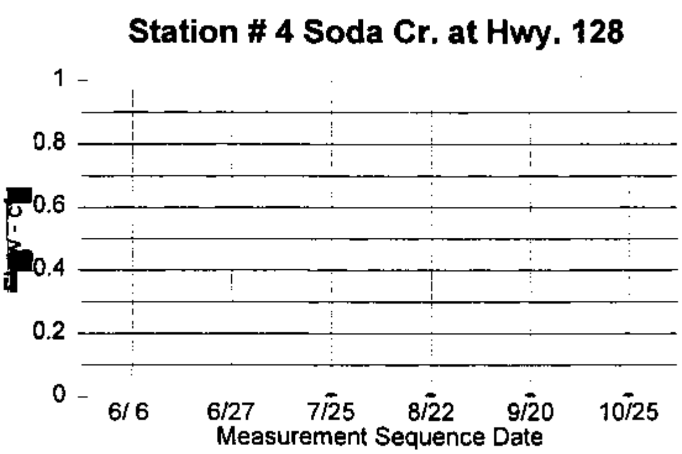

Sta. # 15 Flynn Cr.
at Hwy. 128 Flow - cfs
2
1.5
1
0.5
0
cfs
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

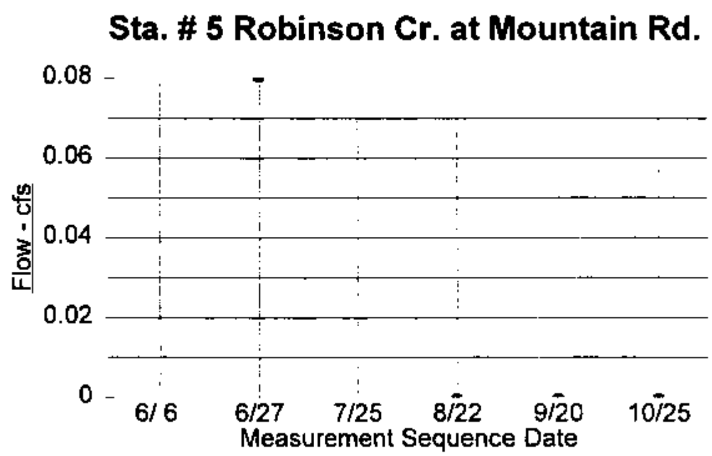

Sta. # 16 N.F. Navarro near Dimmick
at Hwy. 128 Flow - cfs
25
20
15
10
5
0
cfs
5-14
6-18
7-23
9-11
9-25
10-28
Measurement Sequence Date

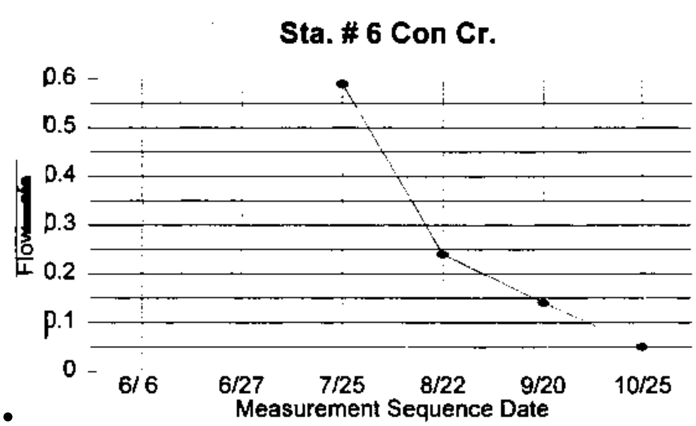
1995

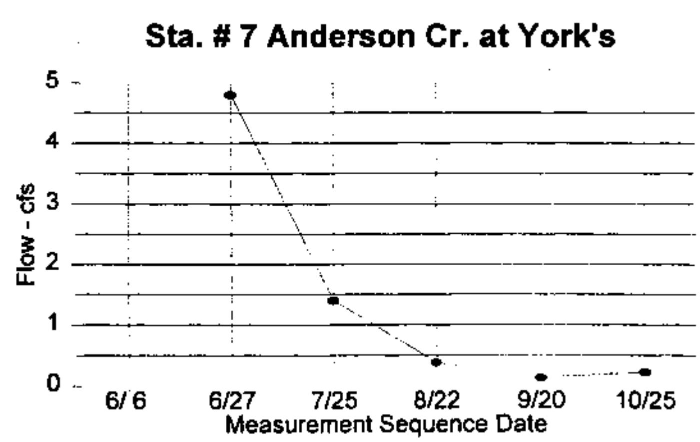








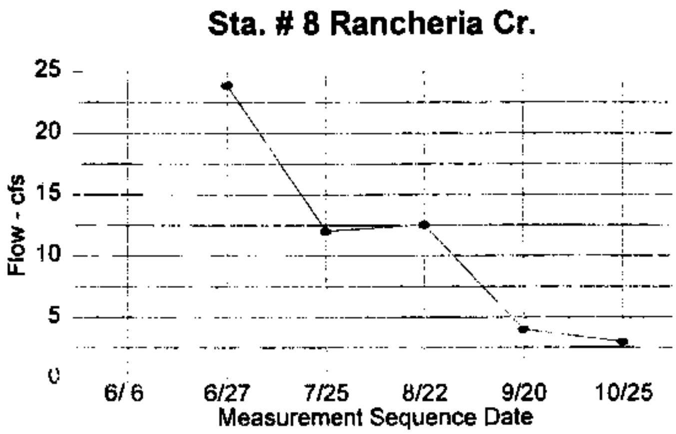


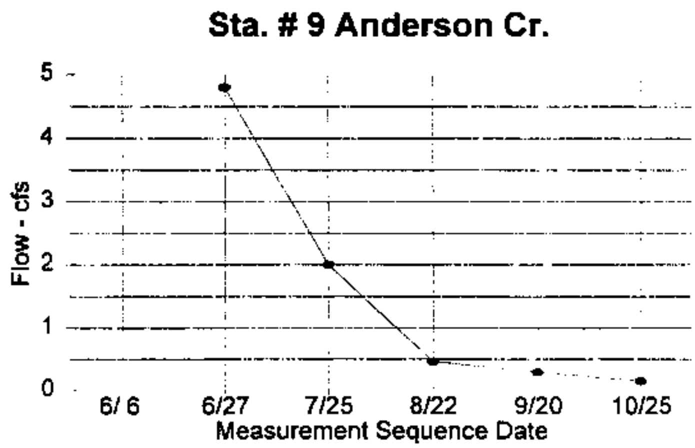


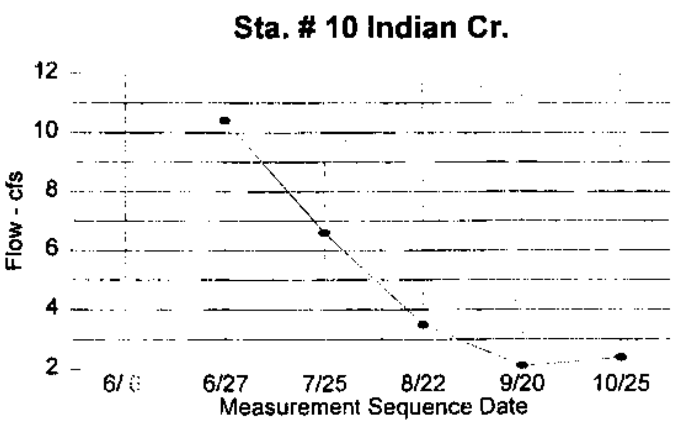
Station #1 at Beebe Cr. was for temperature readings only.
Station #4 and #5 went to 0 flow early in the summer.

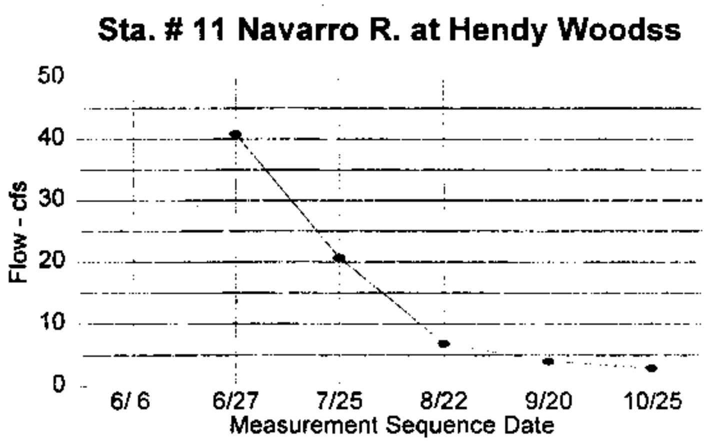
Navarro River Watershed Stream Flow Measurements

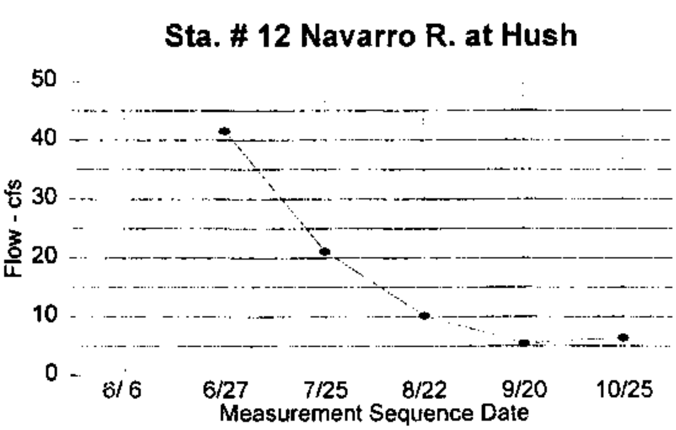
1995

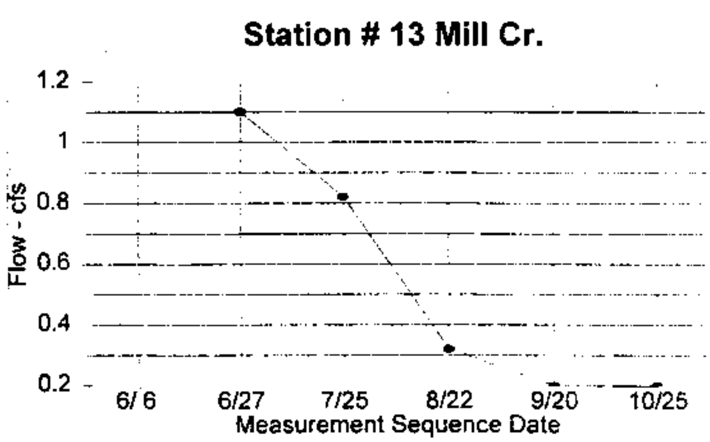




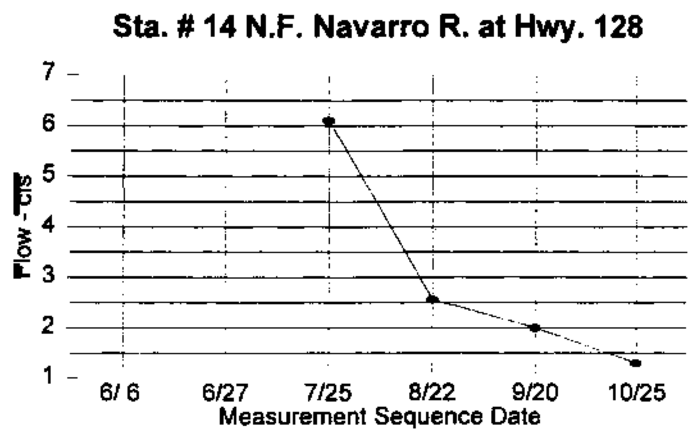


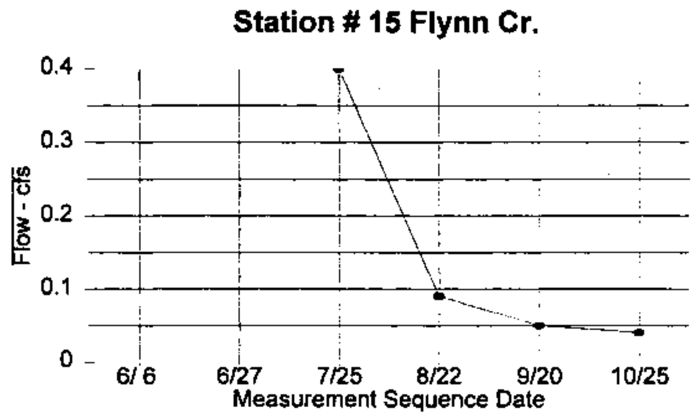


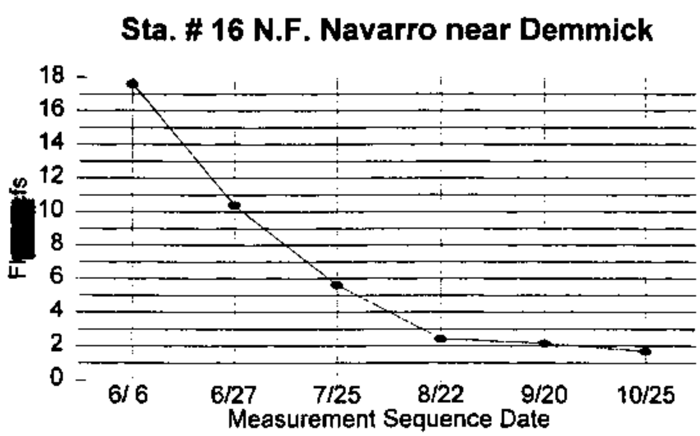




1995


Sta. # 14 N.F. Navarro R. at Hwy. 128
Flow - cfs
7
6
5
4
3
2
1
6/ 6
6/27
7/25
8/22
9/20
10/25
Measurement Sequence Date

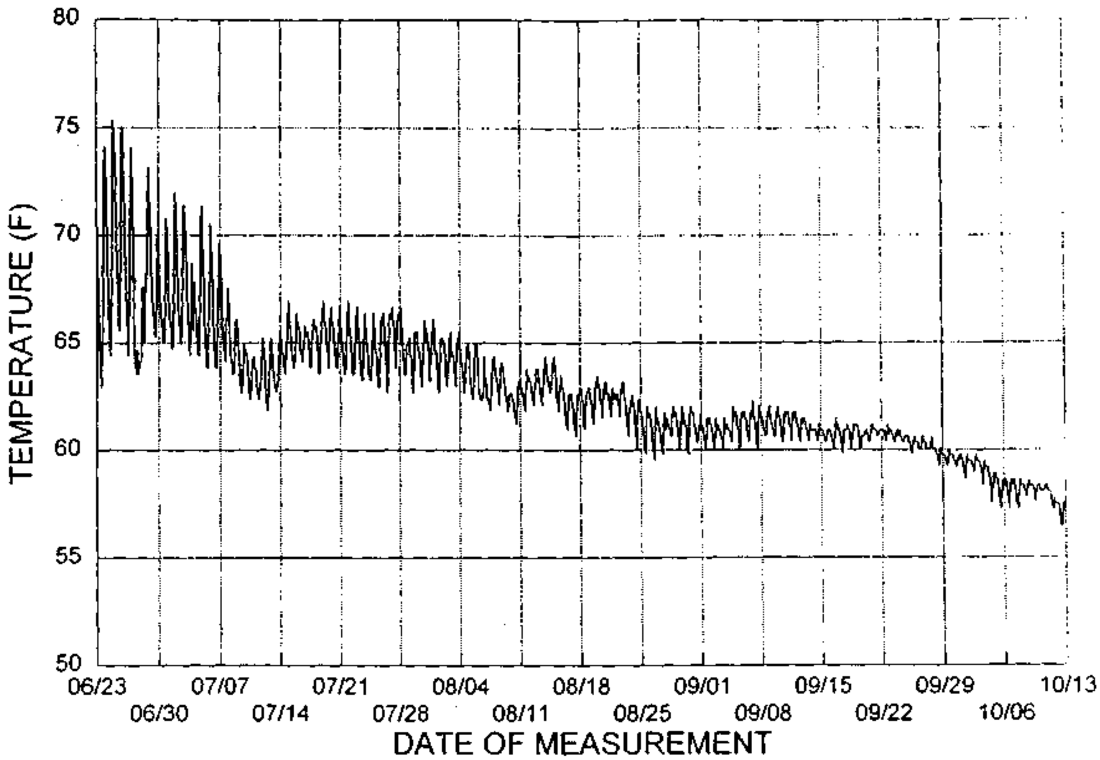

Station # 15 Flynn Cr.
Flow - cfs
0.4
0.3
0.2
0.1
0
6/ 6
6/27
7/25
8/22
9/20
10/25
Measurement Sequence Date


Sta. # 16 N.F. Navarro near Demmick
18
16
14
12
10
8
6
4
2
0
6/ 6
6/27
7/25
8/22
9/20
10/25
Measurement Sequence Date

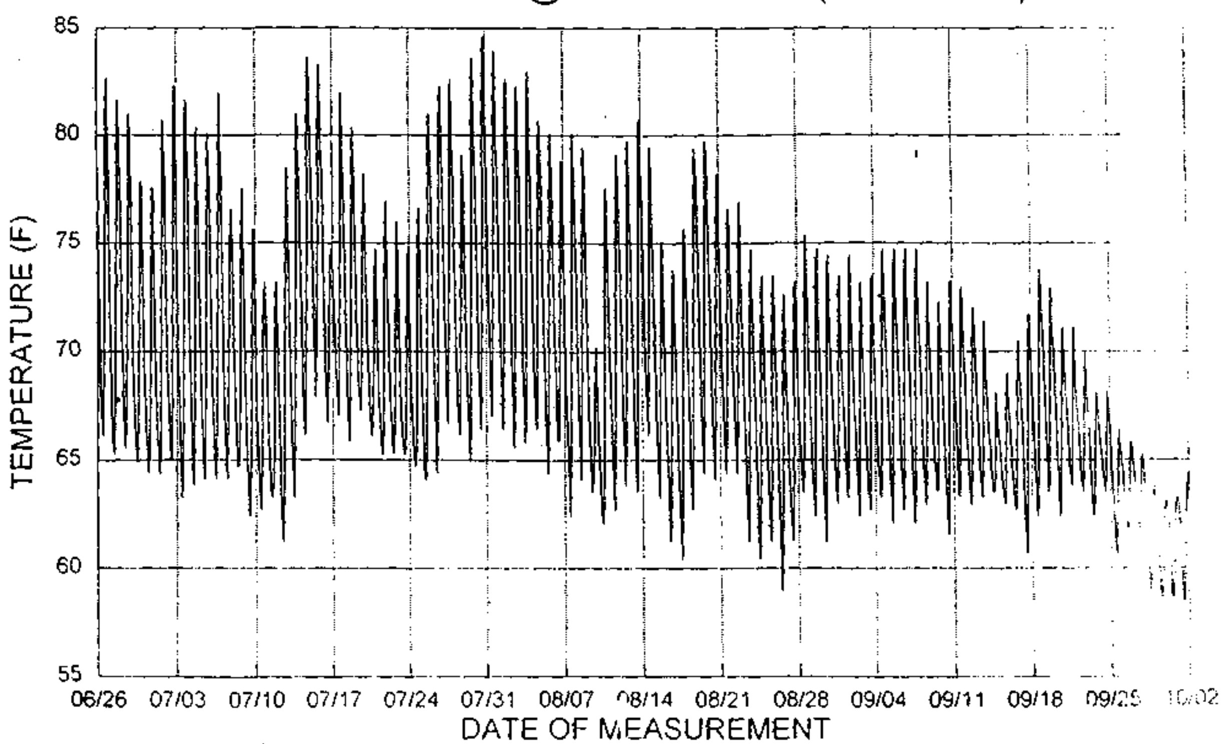
Attachment B

Mendocino County Water Agency's Water Temperature
monitoring Program results for the Summers of 1995 and 1996

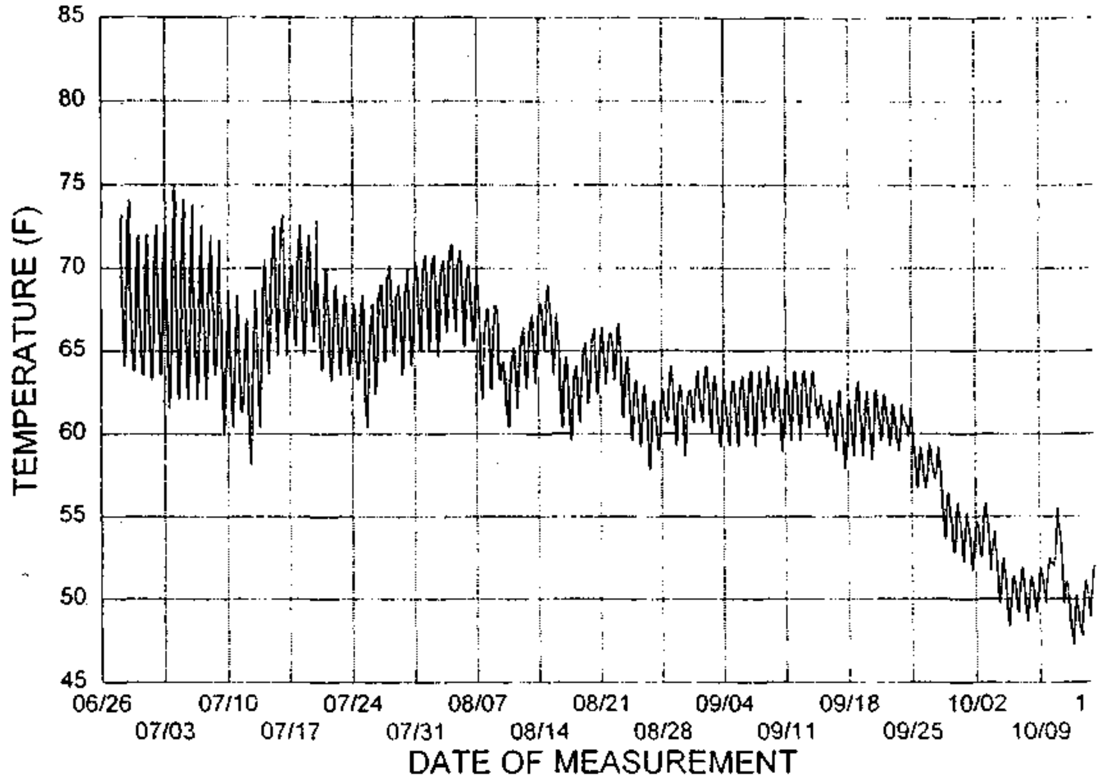
1995 POOL TEMPERATURE DAT
RANCHERIA CR. @ FISH ROCK RD. BRIDGE (SWRCB # 2)



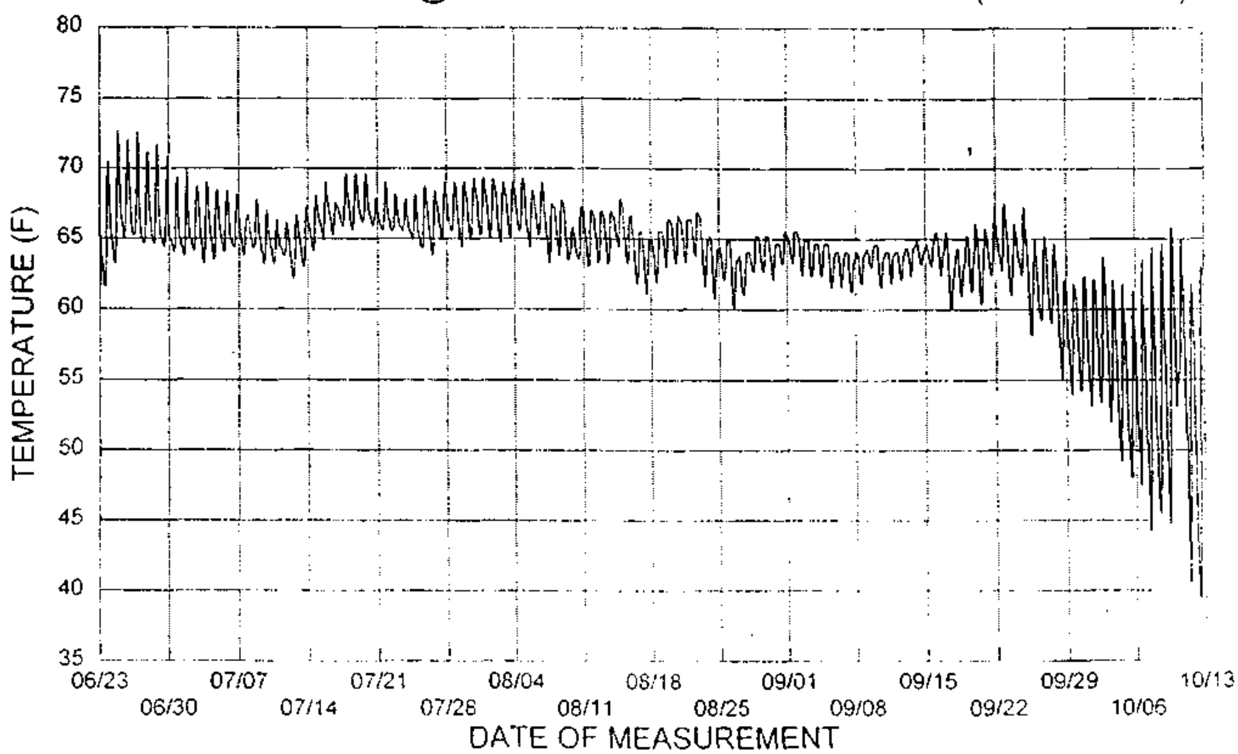
1995 POOL TEMPERATURE DATA
ANDERSON CR. @ HIGHWAY 253 (SWRCB # 3)



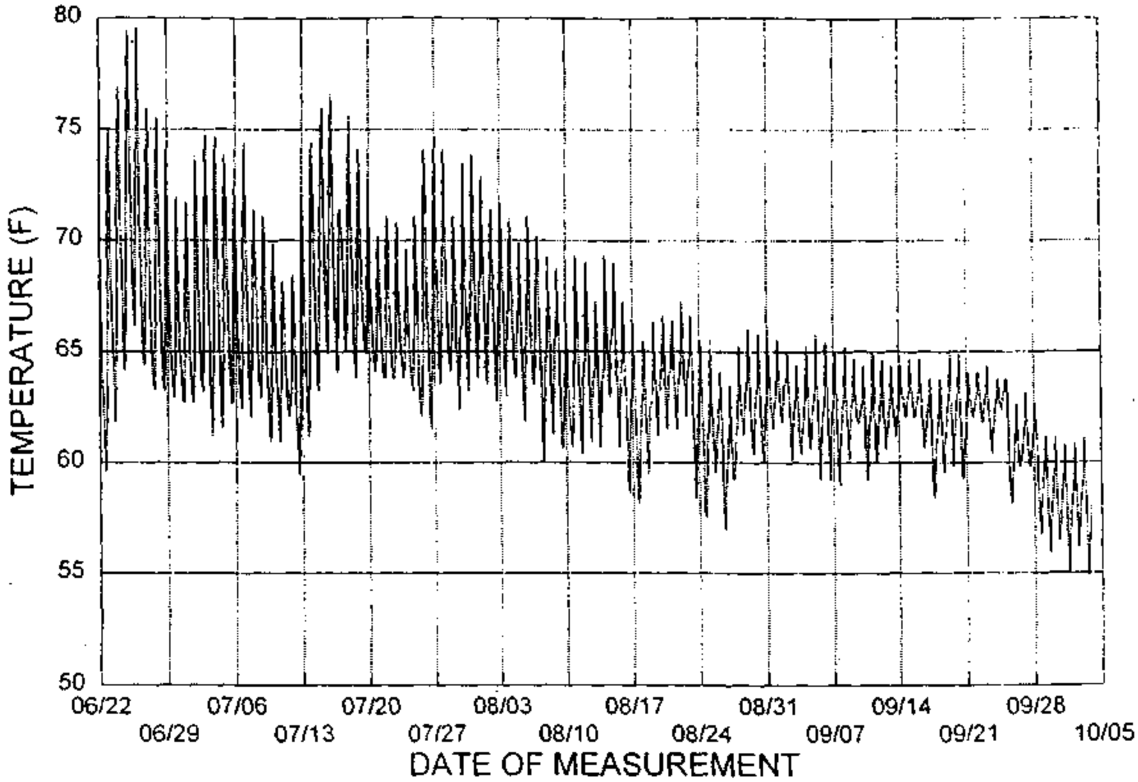
1995 POOL TEMPERATURE DATA
SODA CR. @ HIGHWAY 253 (SWRCB # 4)



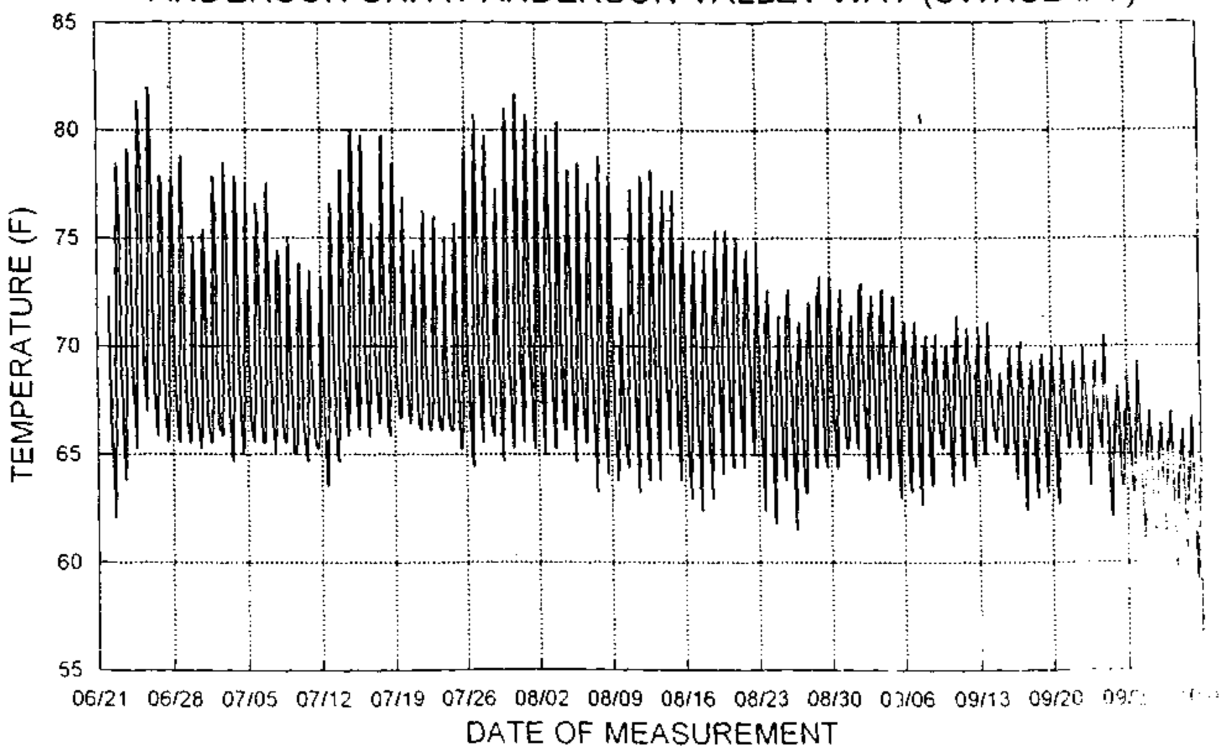
1995 POOL TEMPERATURE DATA
ROBINSON CR. @ MOUNTAIN VIEW RD. BRIDGE (SWRCB # 5)



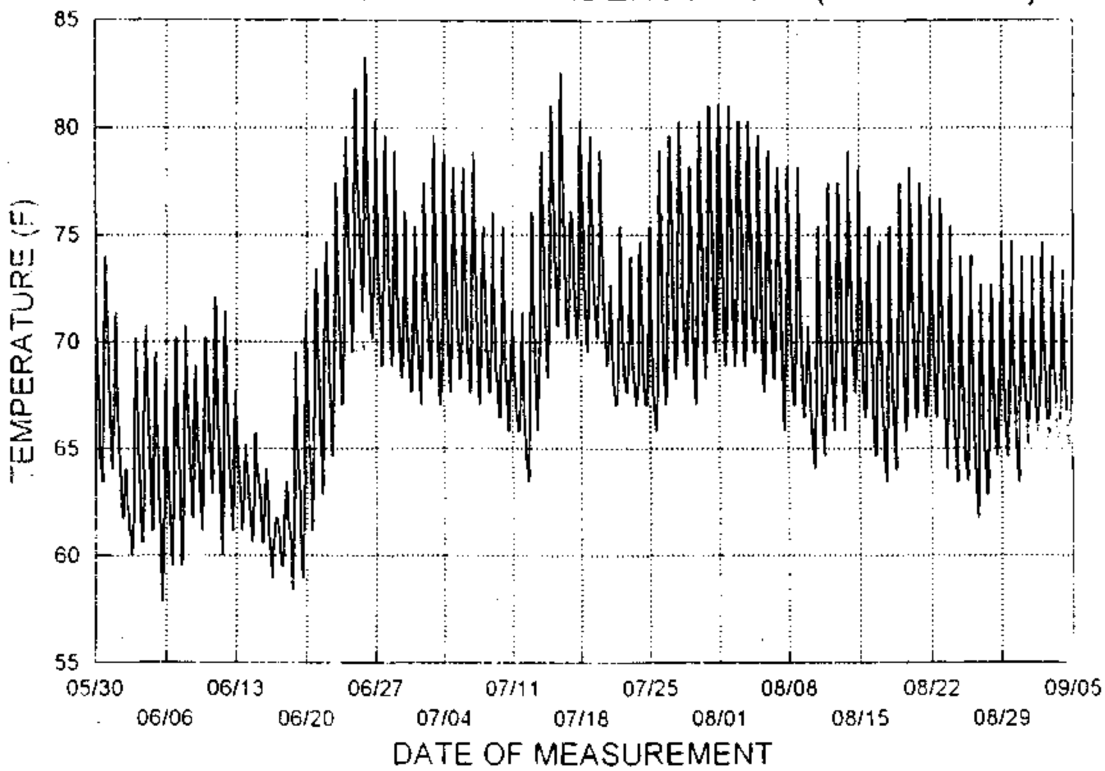
1995 POOL TEMPERATURE DATA
CON CR. AT HIGHWAY 128 (SWRCB # 6)



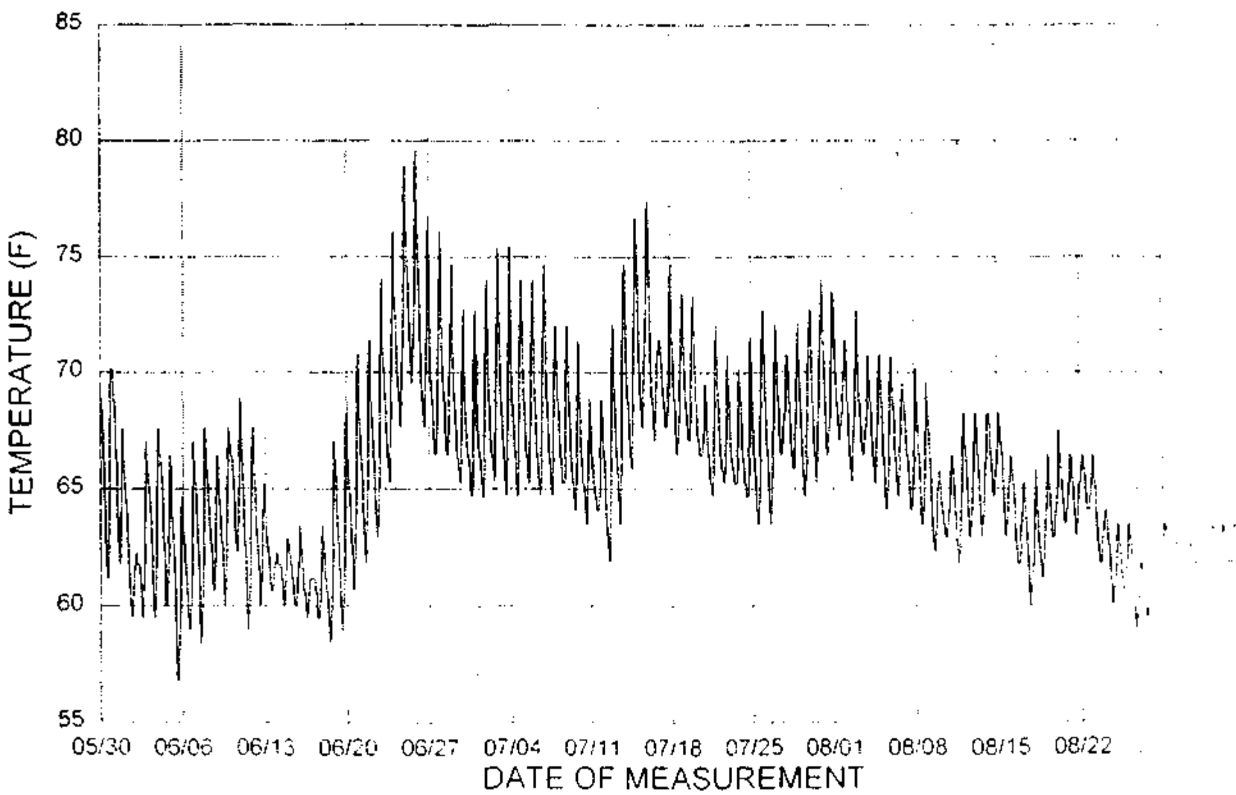
1995 POOL TEMPERATURE DATA
ANDERSON CR. AT ANDERSON VALLEY WAY (SWRCB # 7)



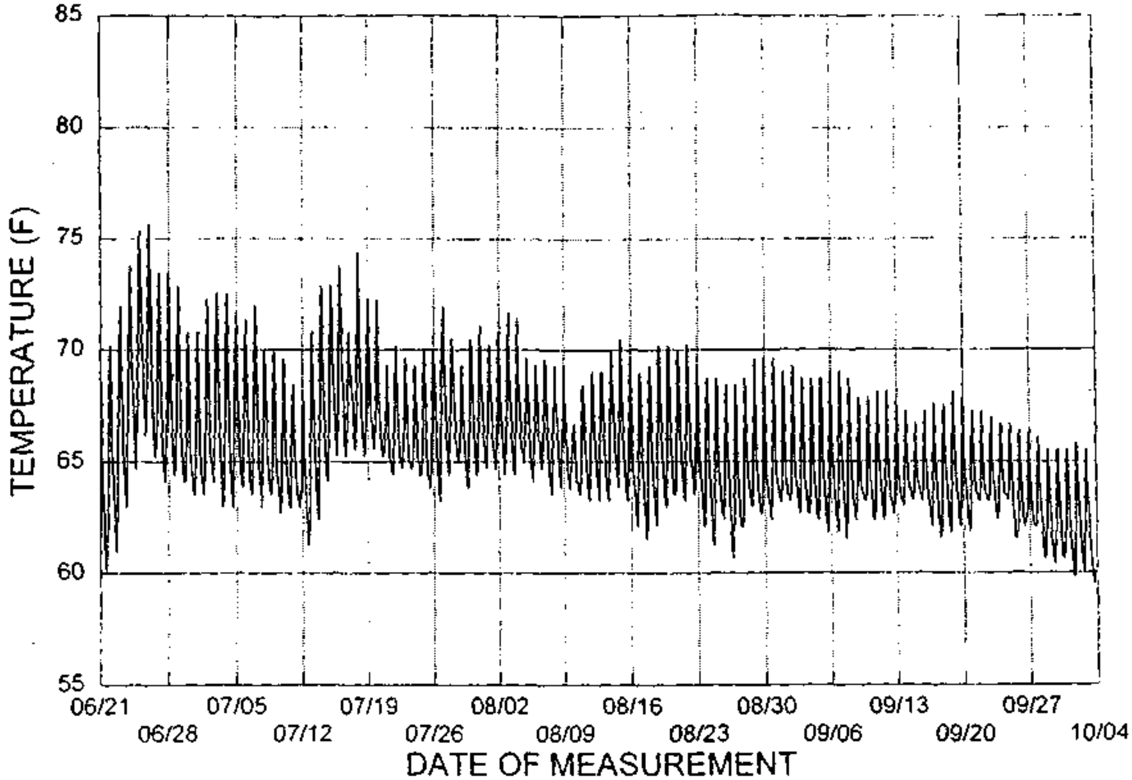
1995 POOL TEMPERATURE DATA
RANCHERIA CR. NEAR ANDERSON CR. (SWRCB # 8)



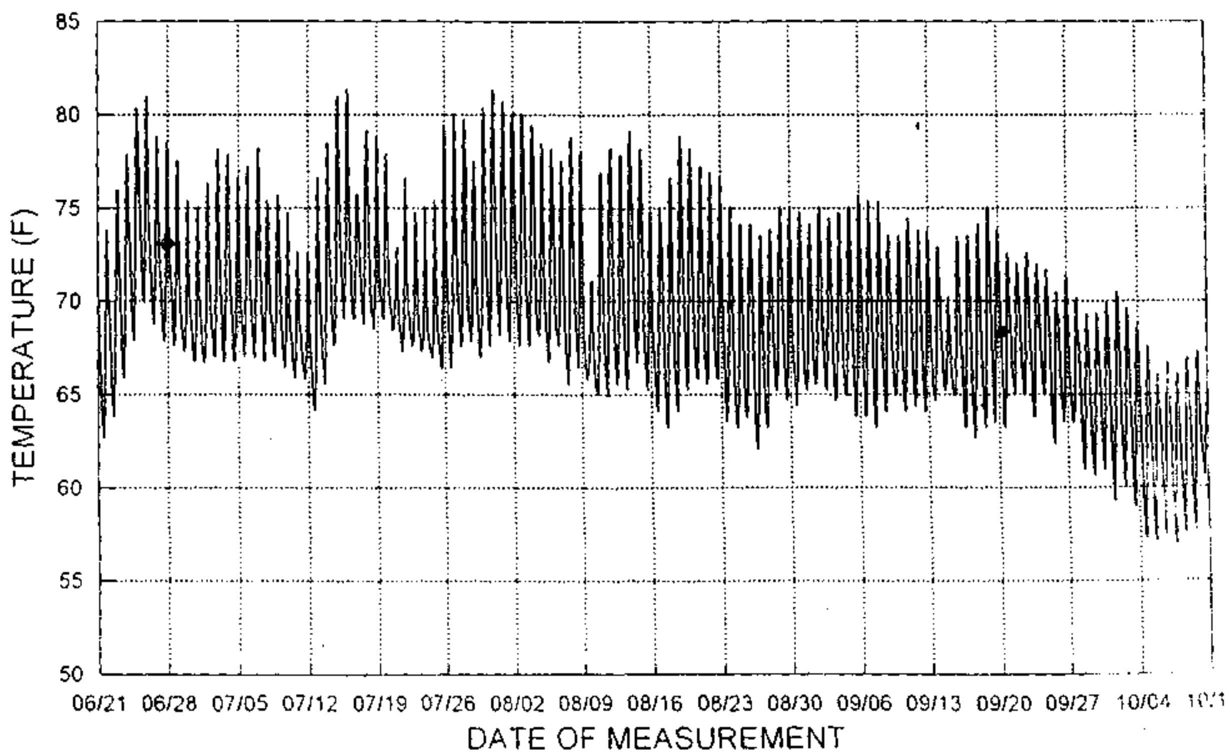
1995 POOL TEMPERATURE DATA
ANDERSON CR. NEAR PHILO (SWRCB #9)



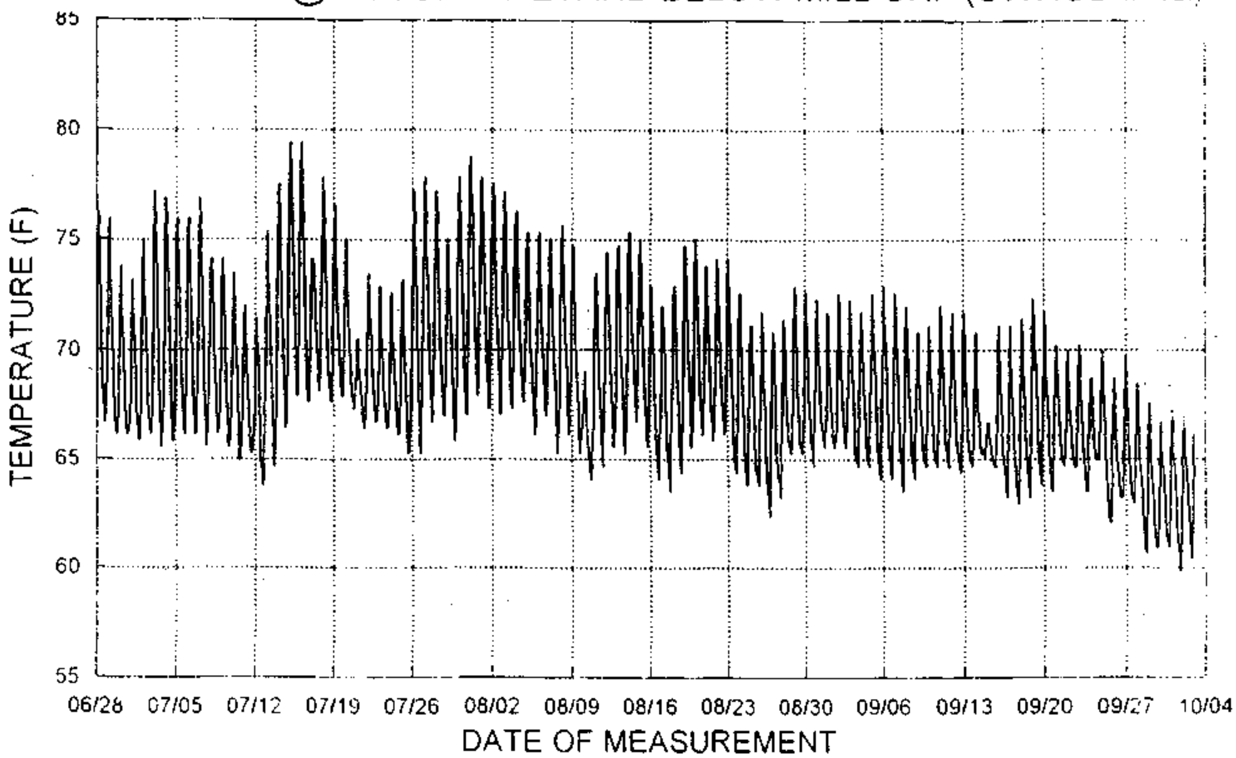
1995 POOL TEMPERATURE DATA
INDIAN CR. AT HIGHWAY 128 (SWRCB # 10)



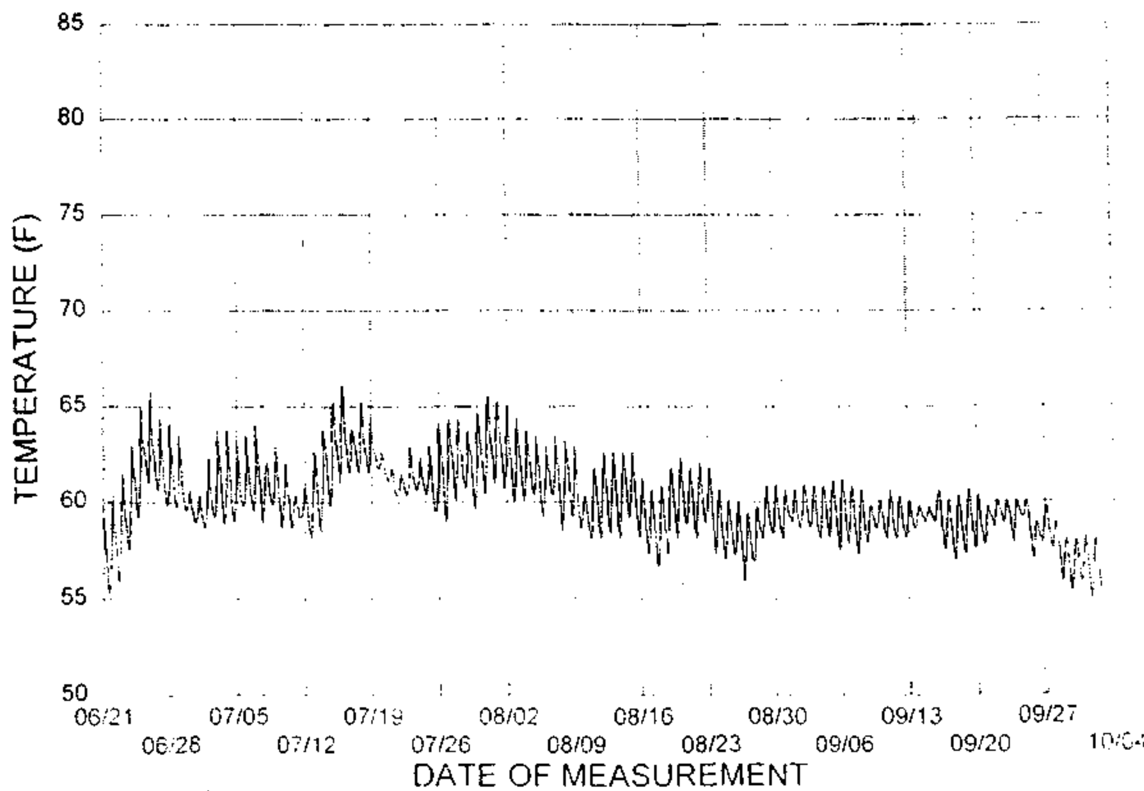
1995 POOL TEMPERATURE DATA
NAVARRO RIVER @ HENDY WOODS STATE PARK (SWRCB # 11)



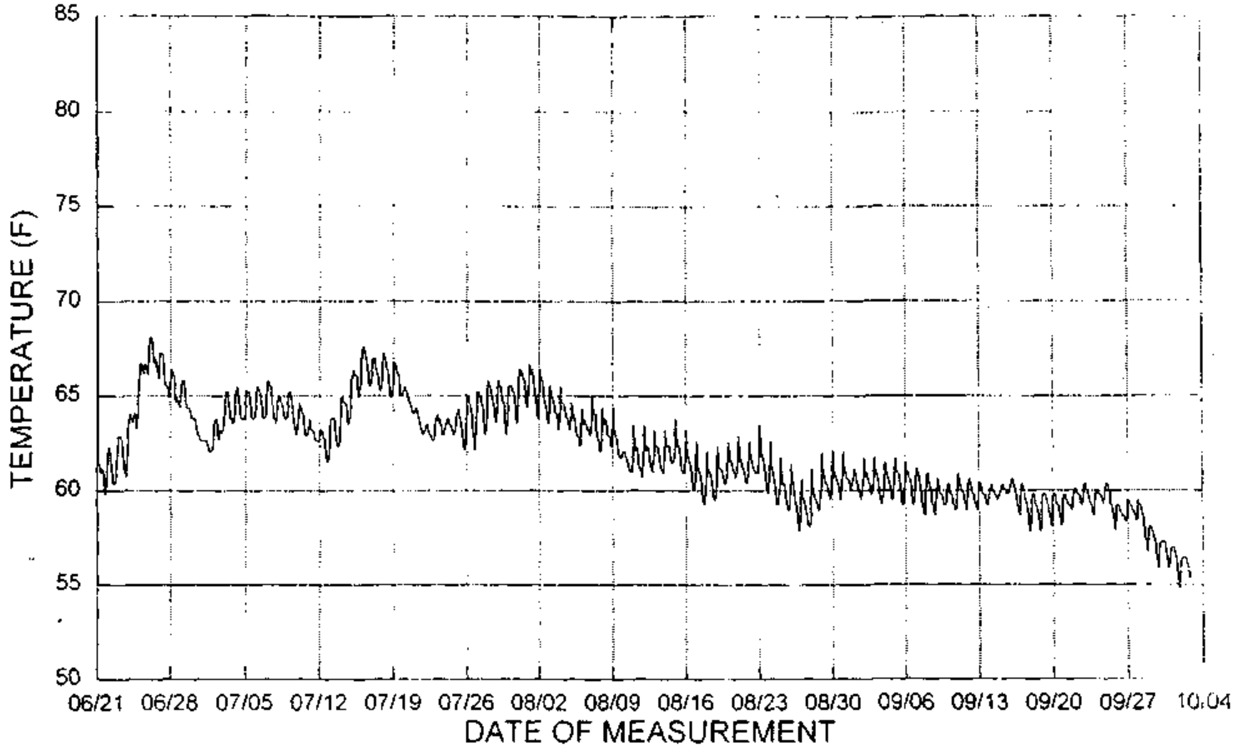
1995 POOL TEMPERATURE DATA
NAVARRO R. @ HUSCH VINEYARD BELOW MILL CR. (SWRCB # 12)



1995 POOL TEMPERATURE DATA
FLYNN CR. NEAR HIGHWAY 128 (SWRCB # 15)

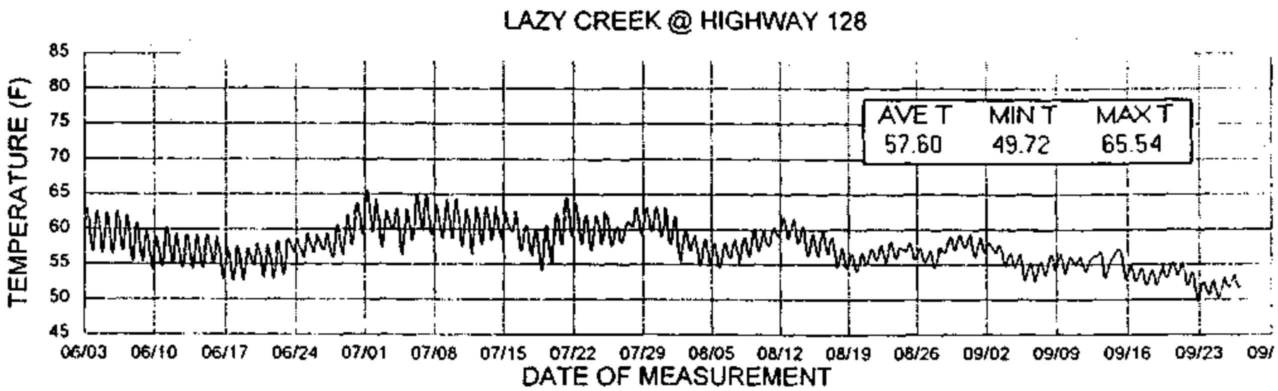


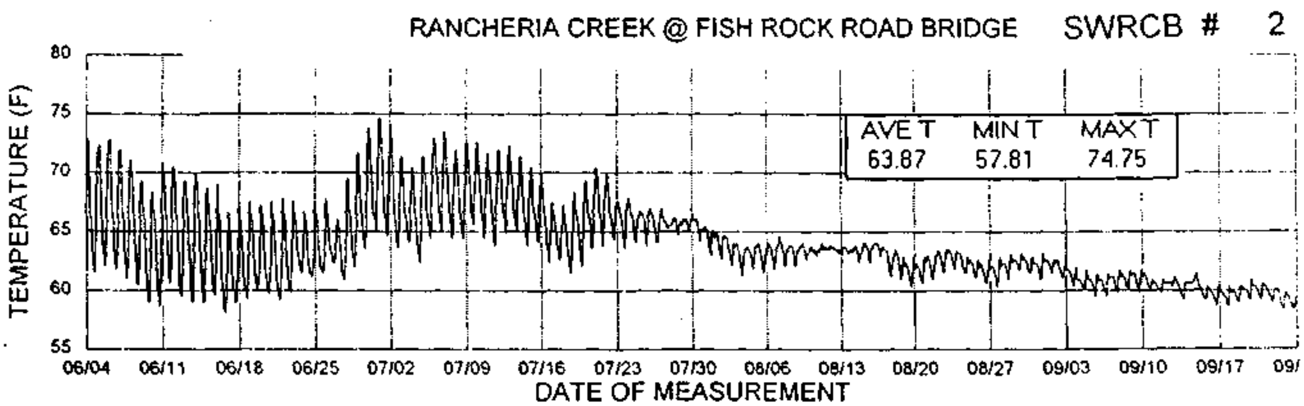
1995 POOL TEMPERATURE DATA
NORTH FORK NAVARRO NEAR DIMMICK SP (SWRCB # 16)

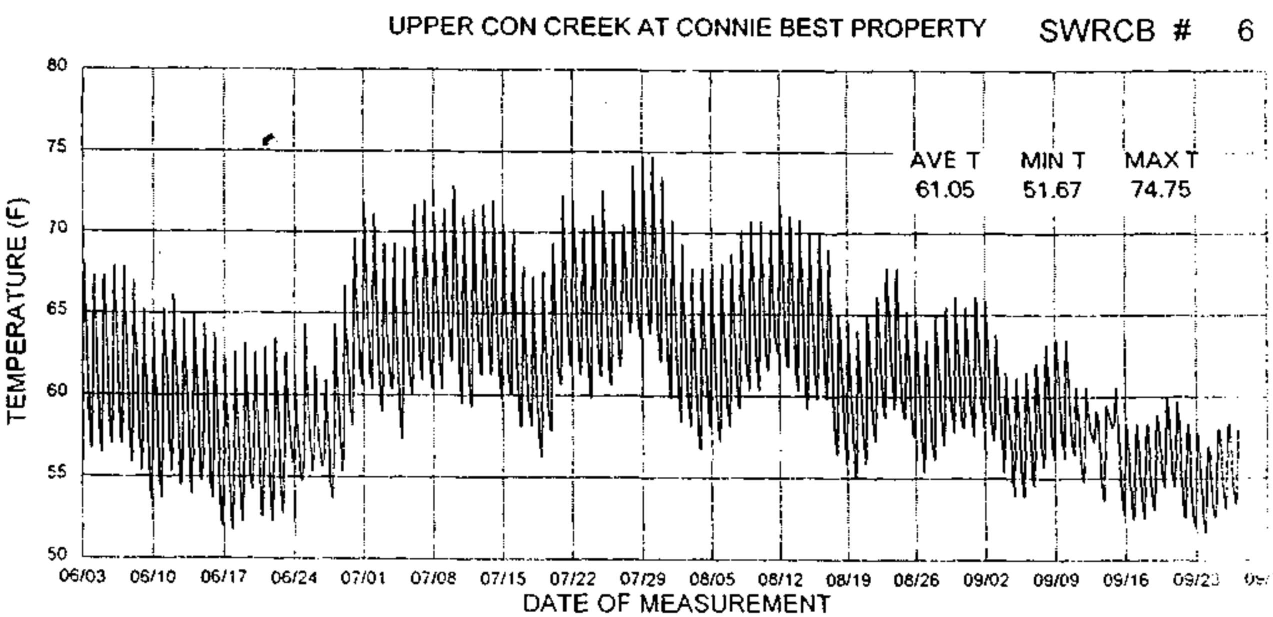


1996 Pool Temperature Data

Mendocino County Water Agency

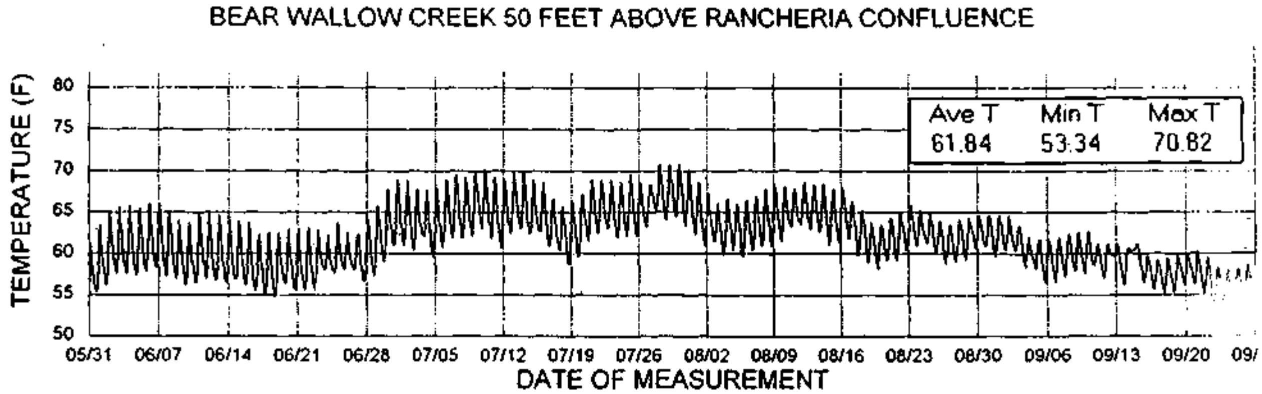


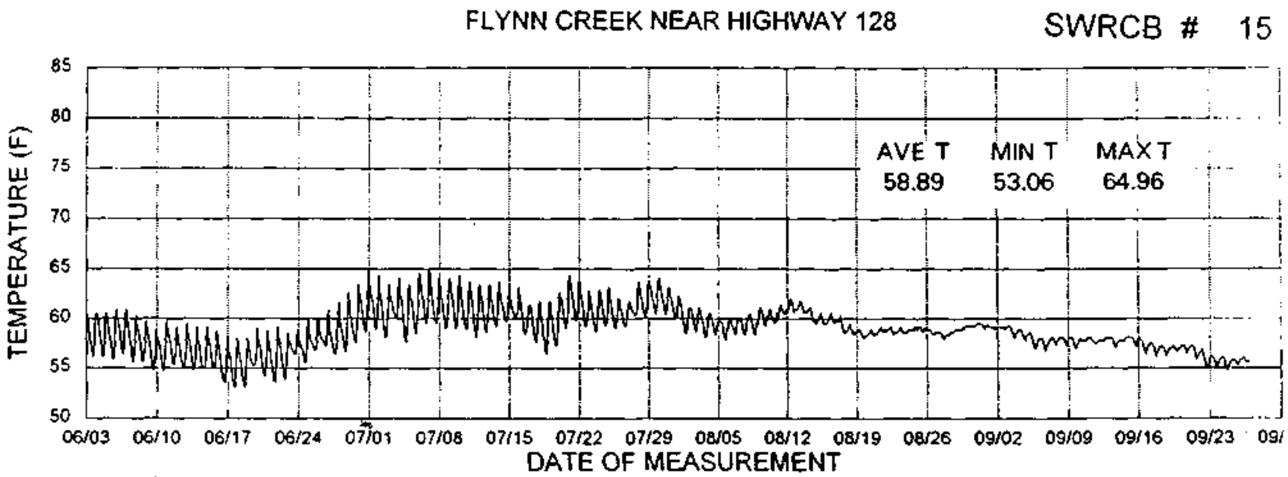


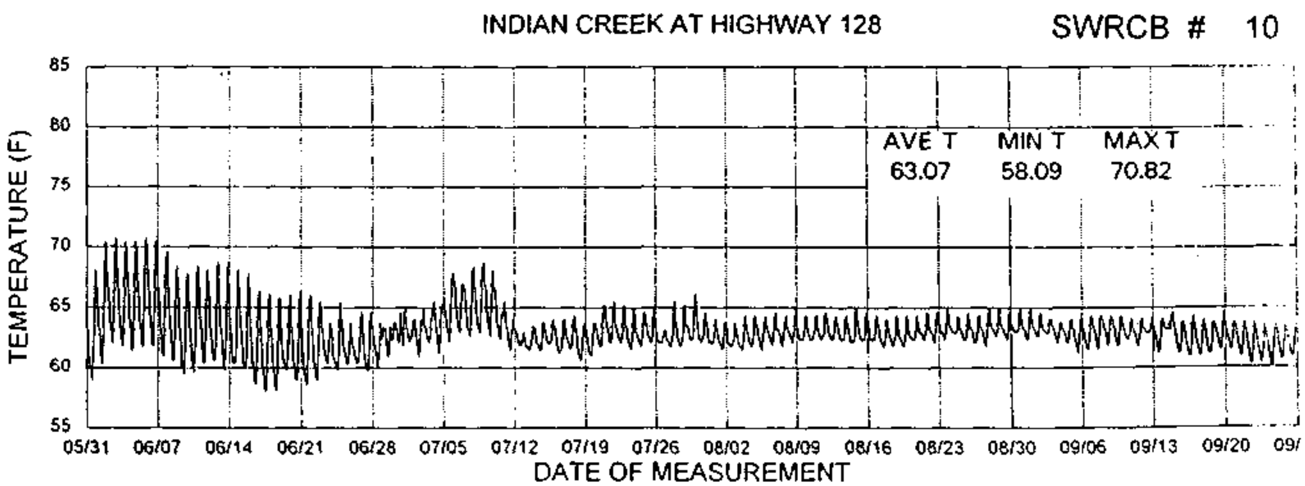


1996 Pool Temperature Data

Mendocino County Water Agency

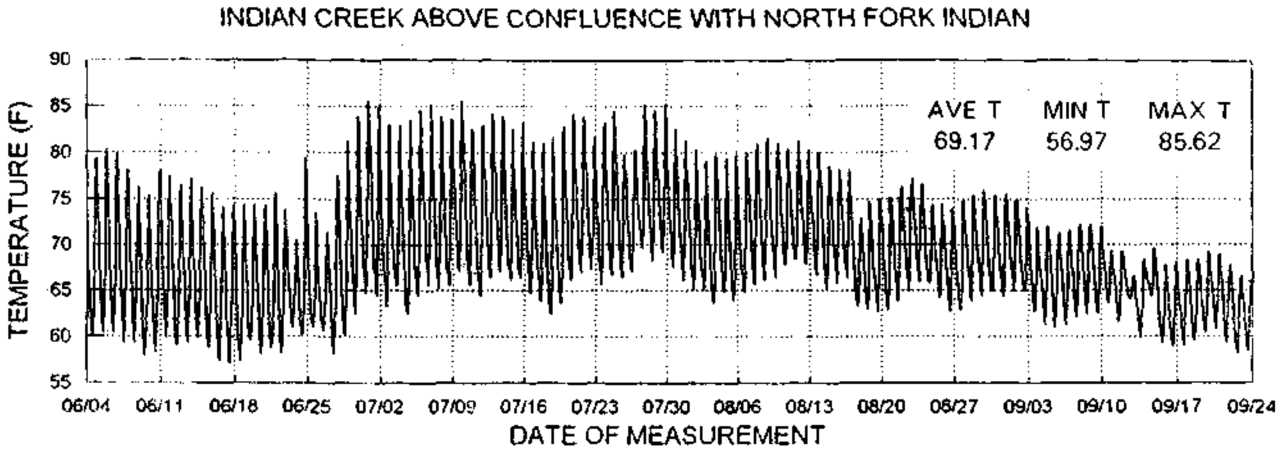


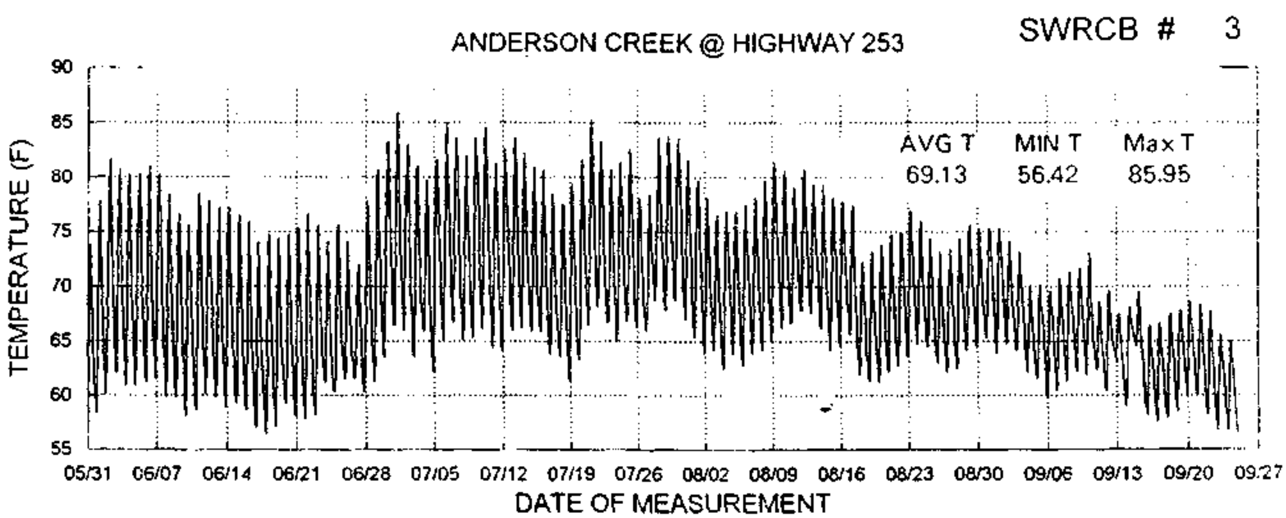


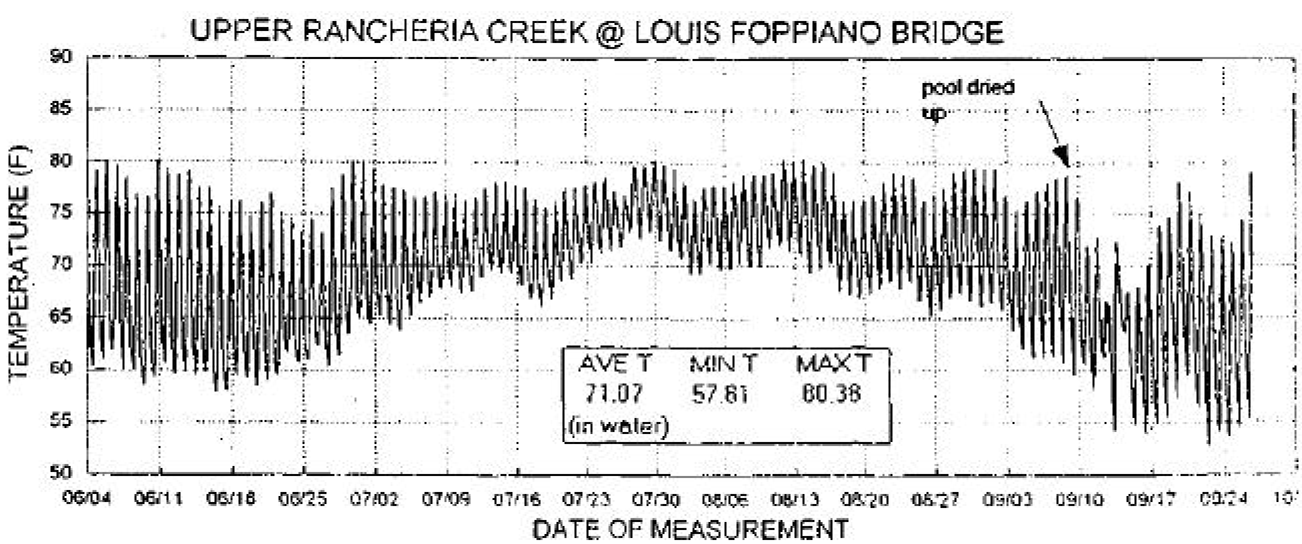


1996 Pool Temperature Data

Mendocino County Water Agency



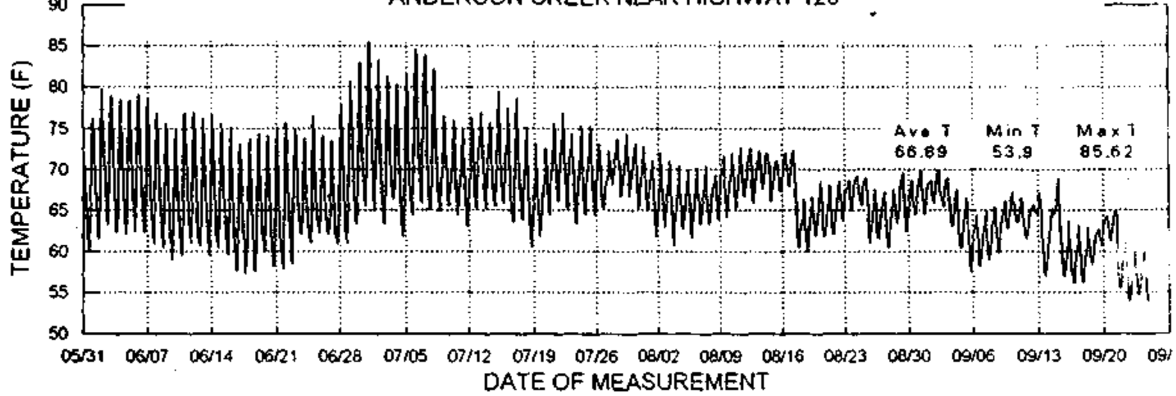




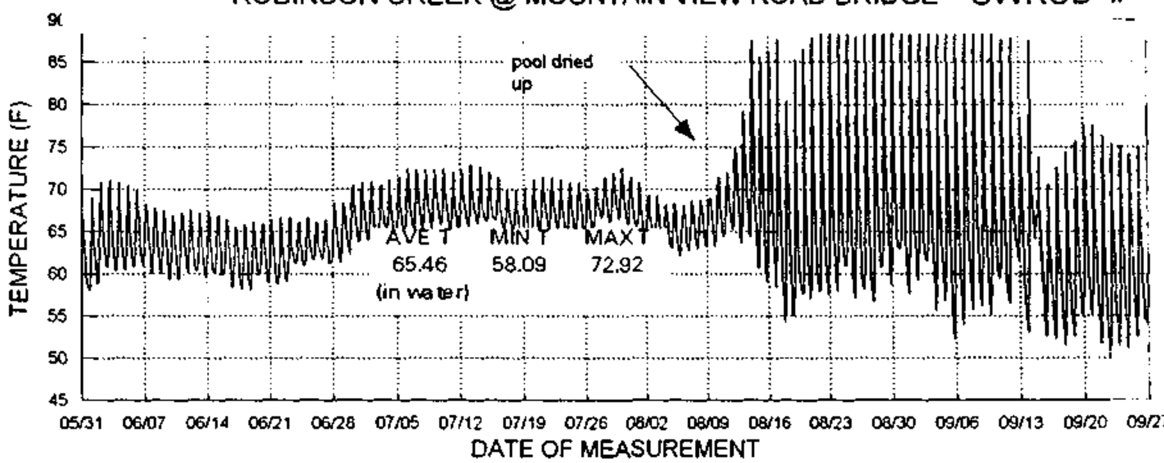
1996 Pool Temperature Data

Mendocino County Water Agency

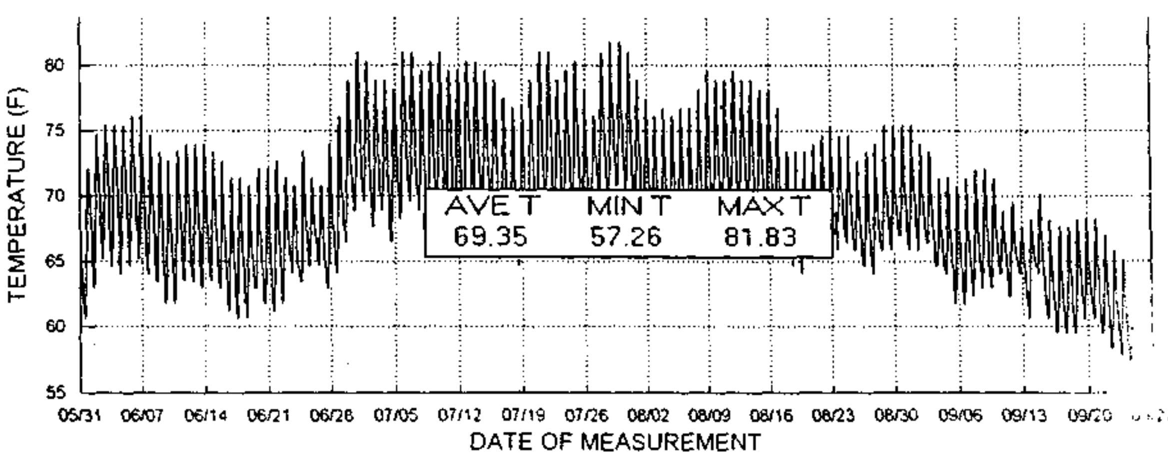
ANDERSON CREEK NEAR HIGHWAY 128 ?



ROBINSON CREEK @ MOUNTAIN VIEW ROAD BRIDGE SWRCB # 5

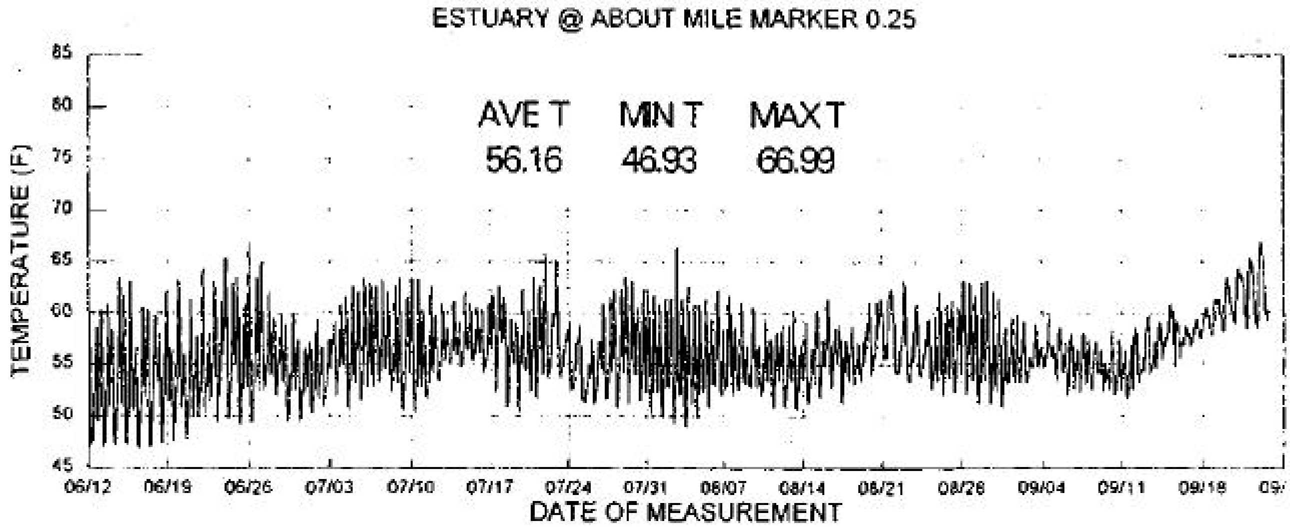


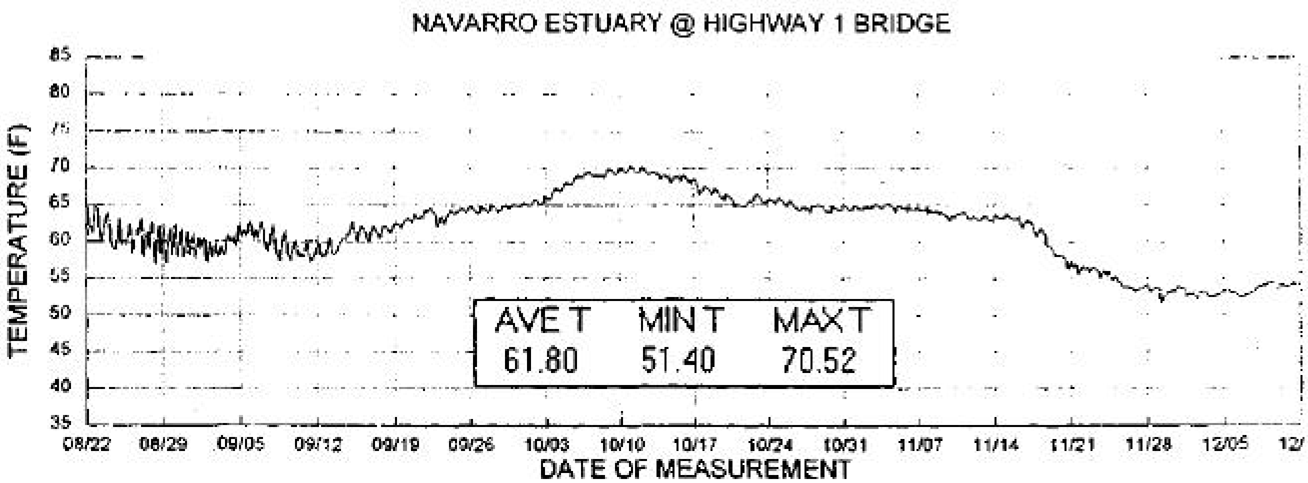
RANCHERIA CREEK NEAR CONFLUENCE WITH ANDERSON CREEK SWRCB # 8

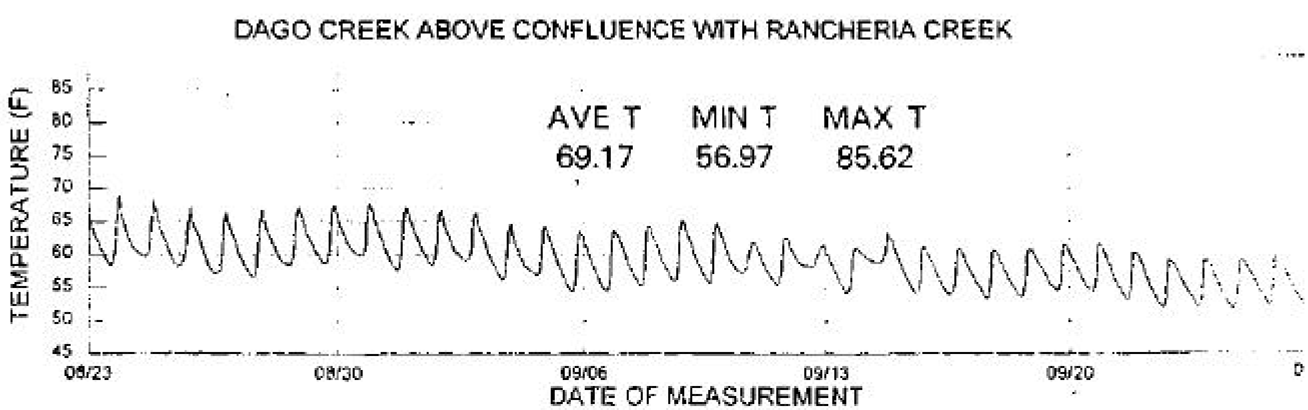


1996 Pool Temperature Data

Mendocino County Water Agency

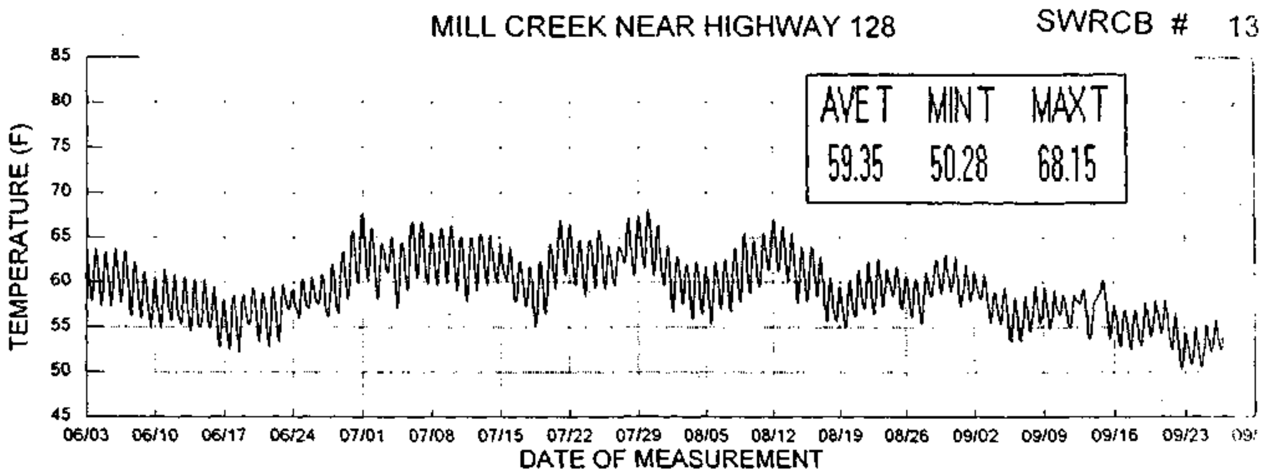


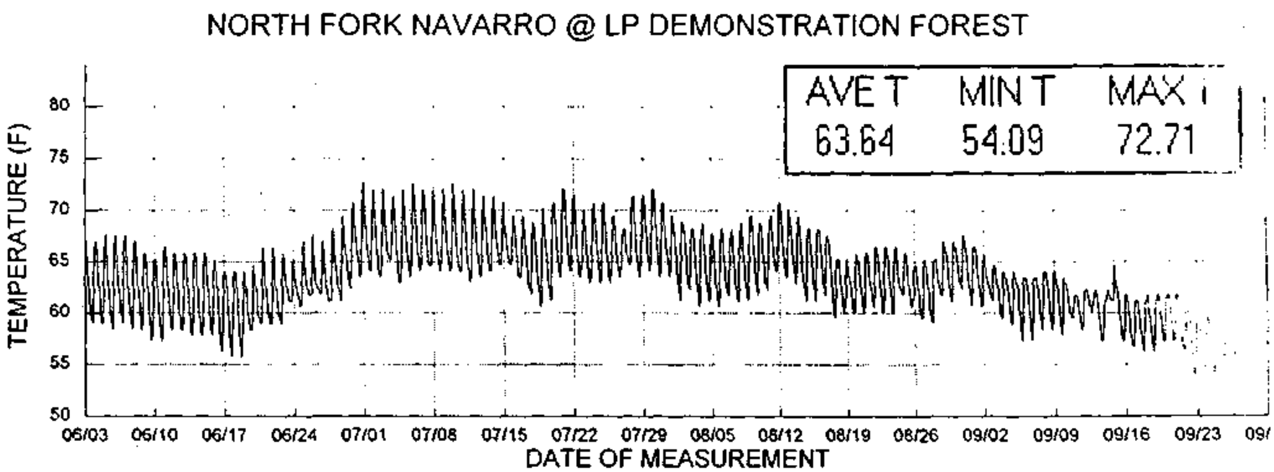


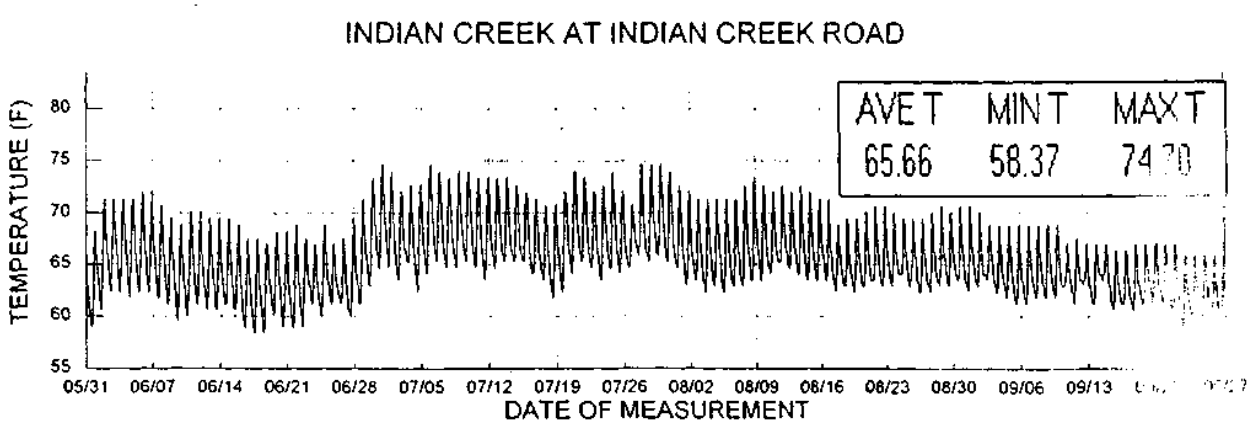


1996 Pool Temperature Data

Mendocino County Water Agency

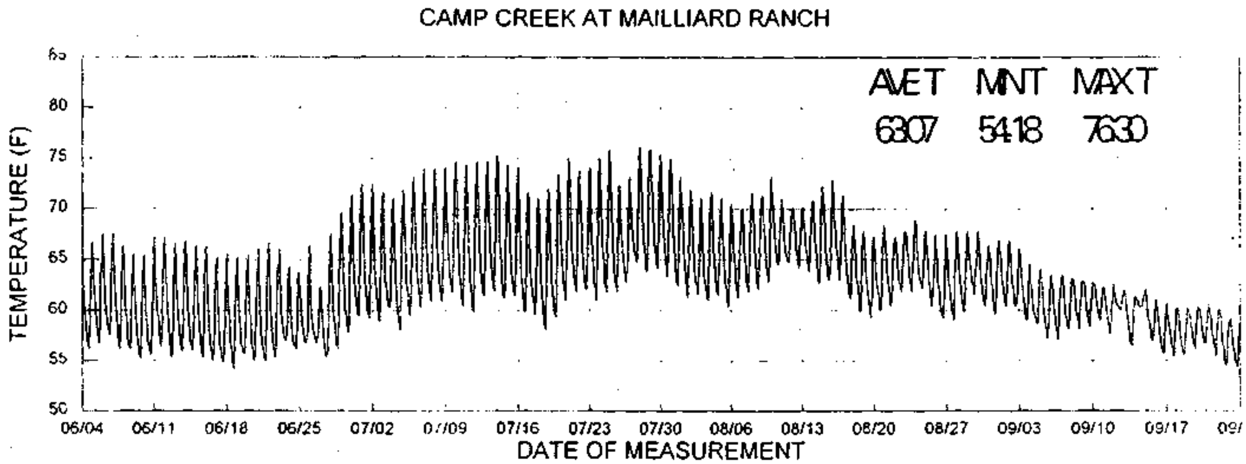


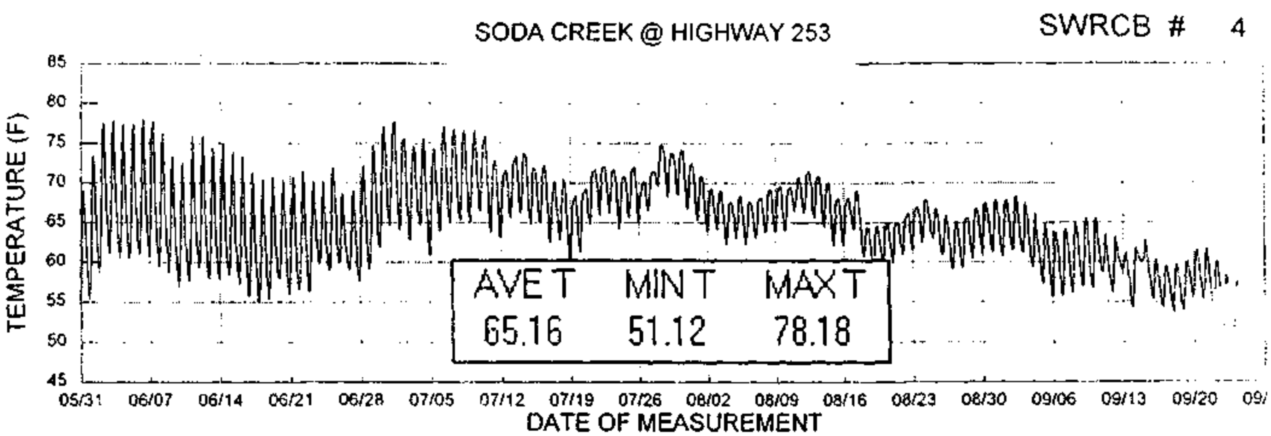


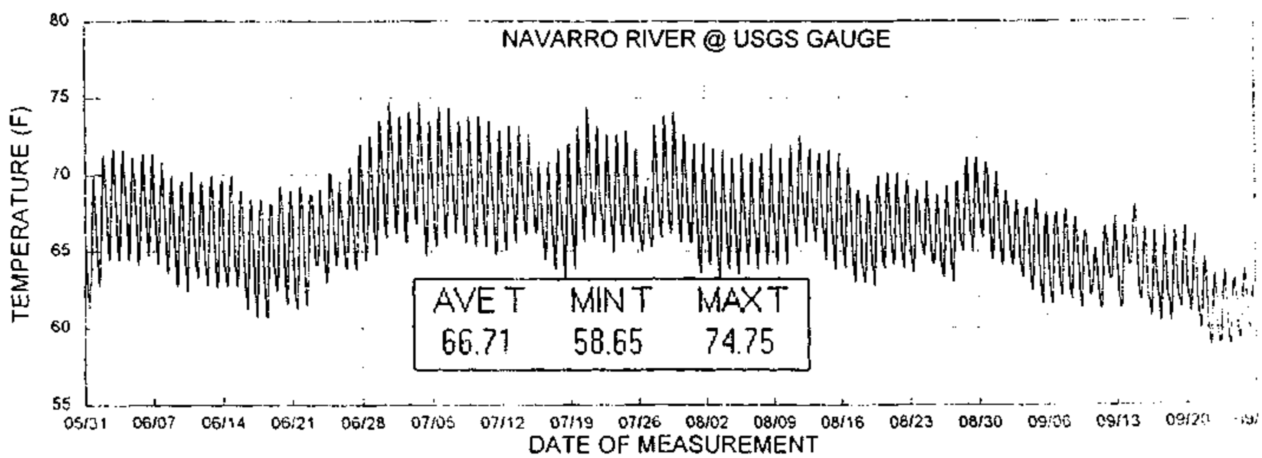


1996 Pool Temperature Data

Mendocino County Water Agency

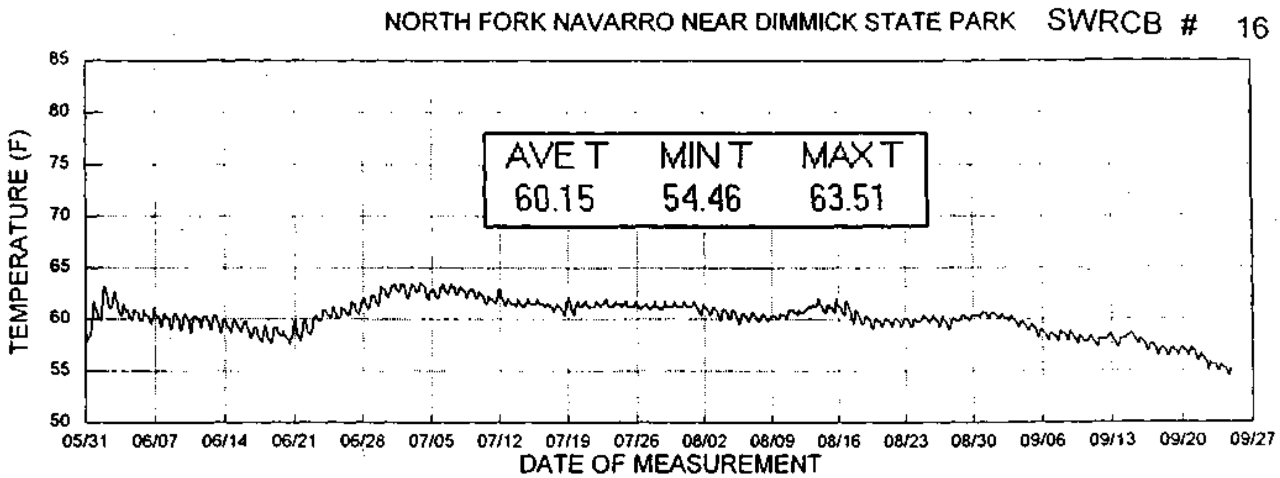


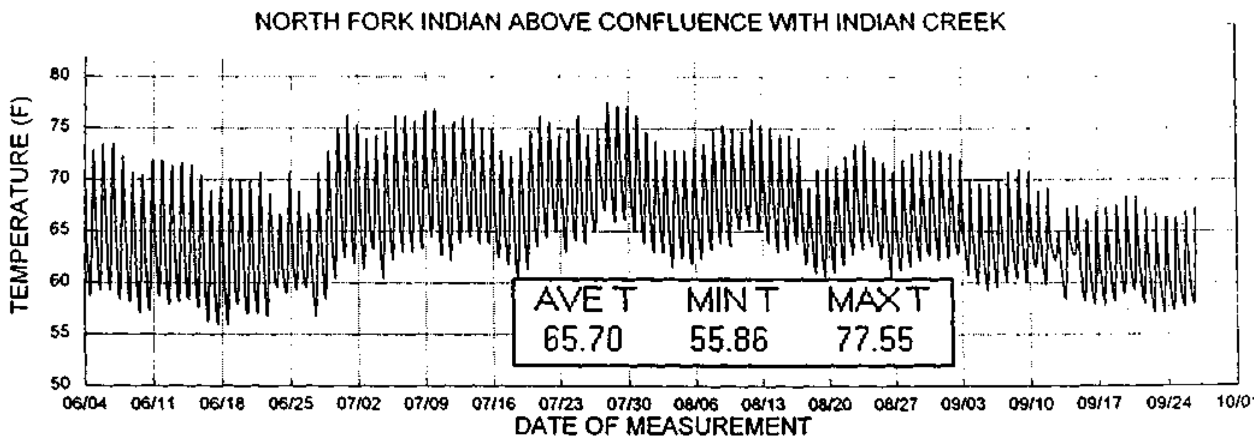


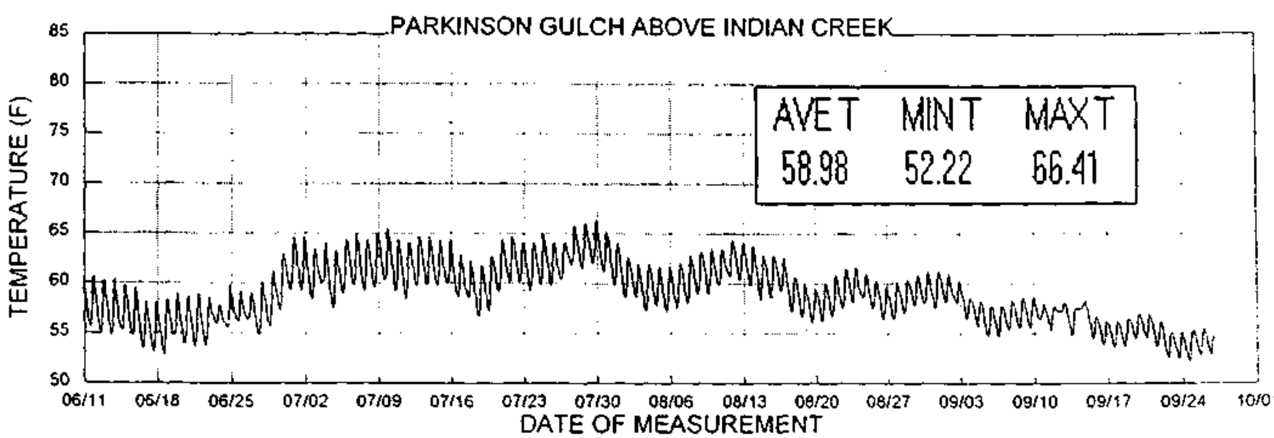


1996 Pool Temperature Data

Mendocino County Water Agency



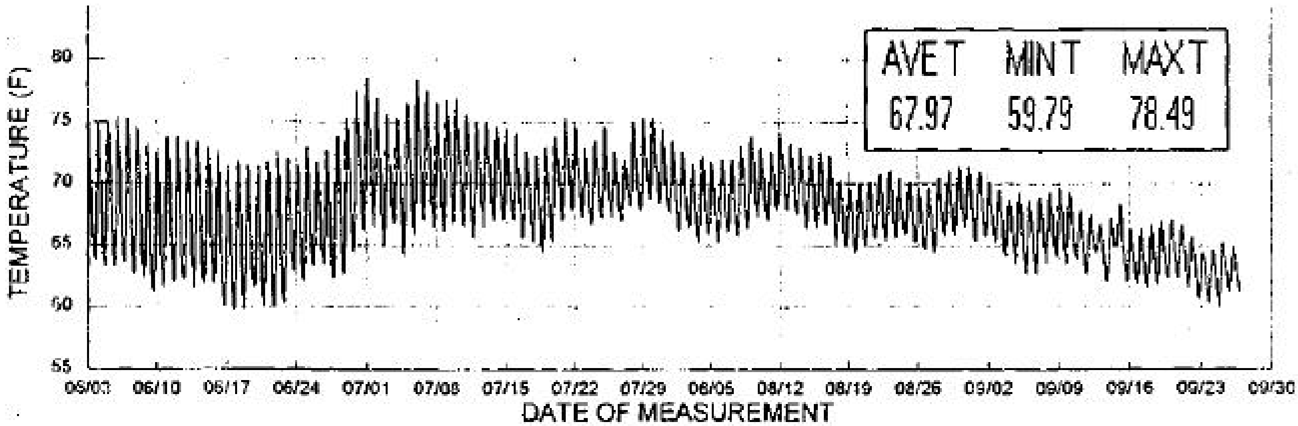




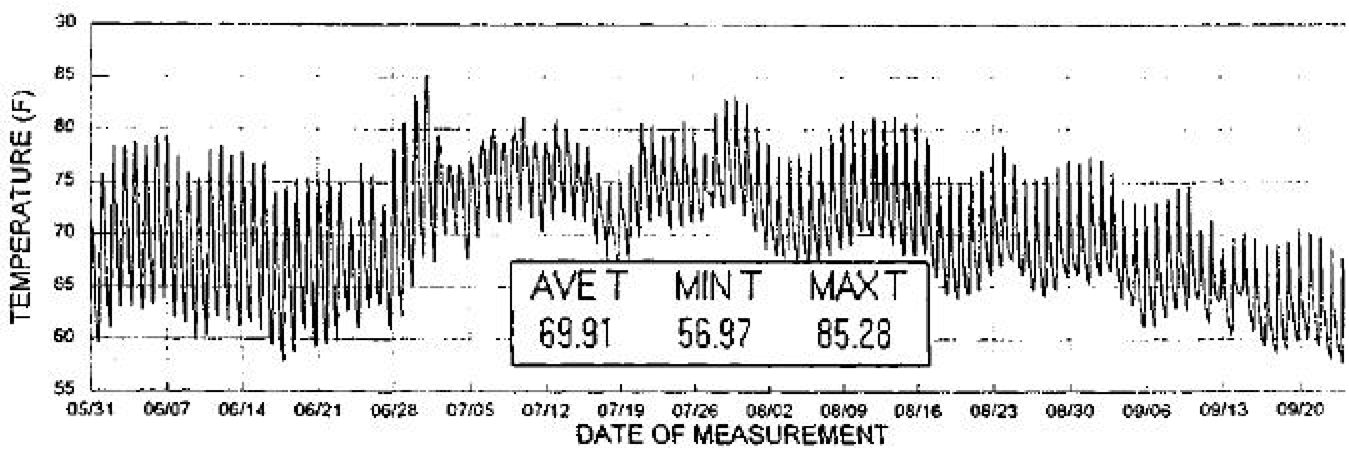
1996 Pool Temperature Data

Mendocino County Water Agency

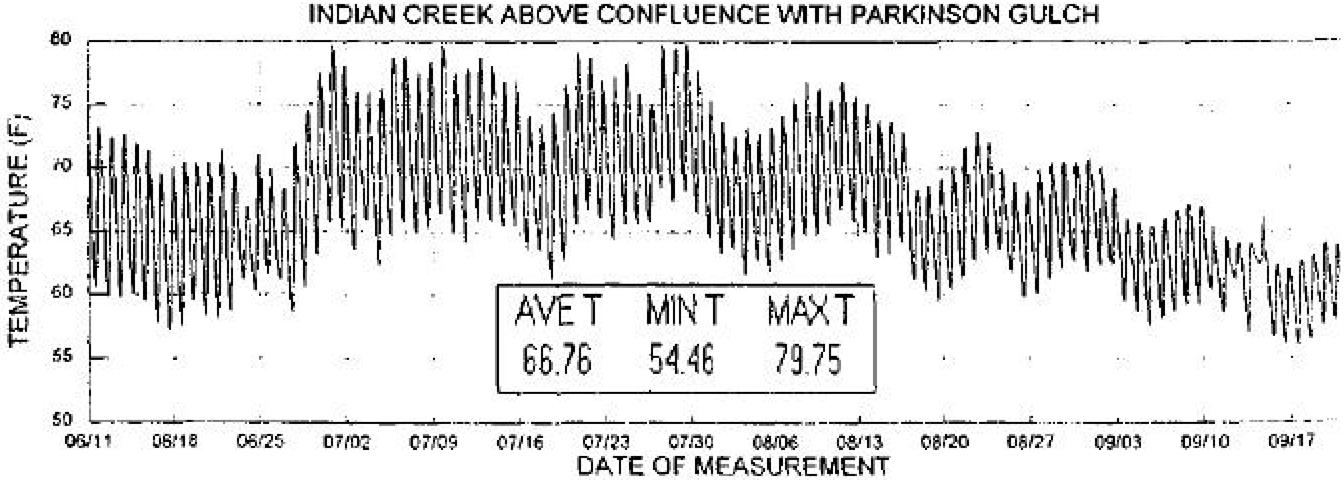
NAVARRO RIVER @ HUSCH VINEYARD BELOW MILL CREEK SWRCB # 12



RANCHERIA CREEK @ MOUNTAIN VIEW ROAD BRIDGE

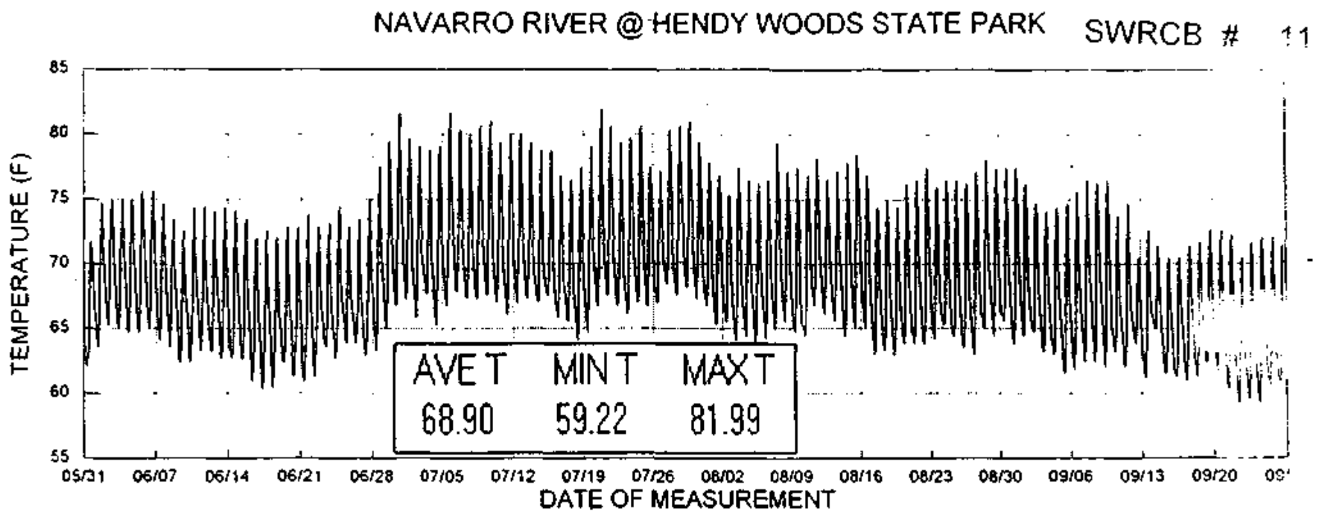


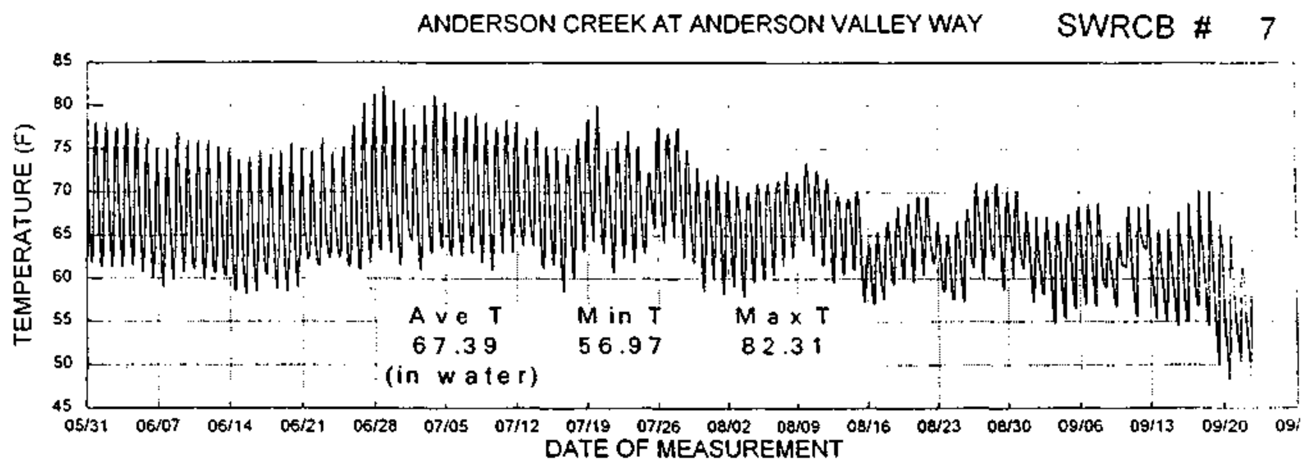
INDIAN CREEK ABOVE CONFLUENCE WITH PARKINSON GULCH

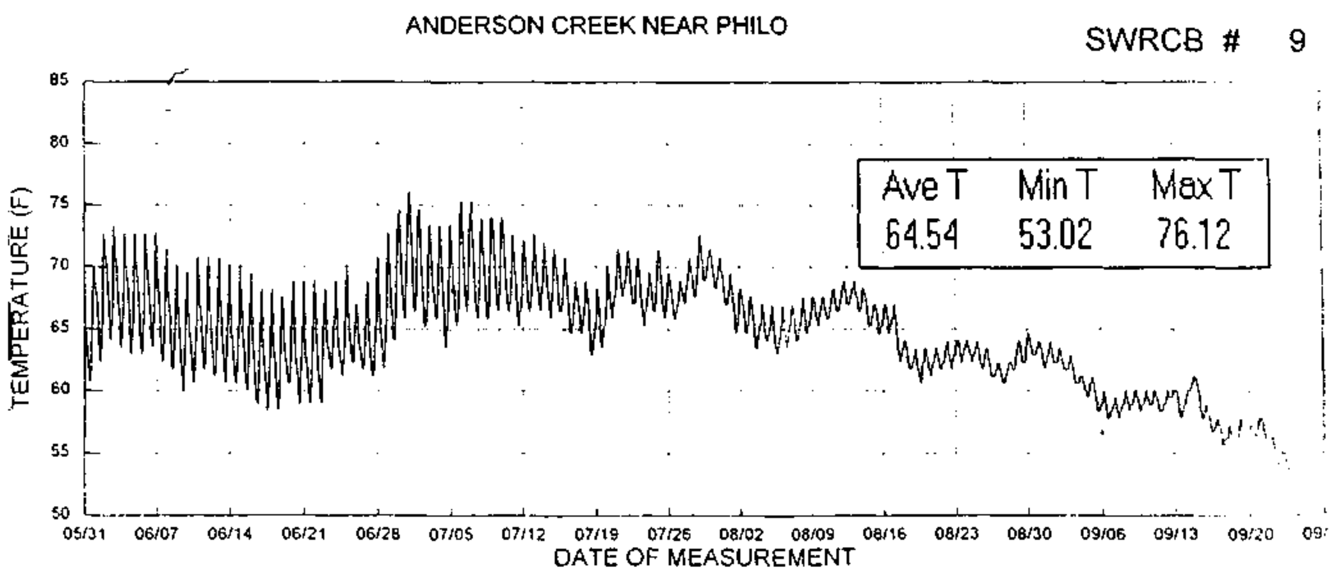


1996 Pool Temperature Data

Mendocino County Water Agency







Attachment C

Division's regression Analysis of Flow v. Temperature

and Days Since Peak v. Temperature

Attachment C

1996 Anderson Cr. Regression of Flow v. Temperature

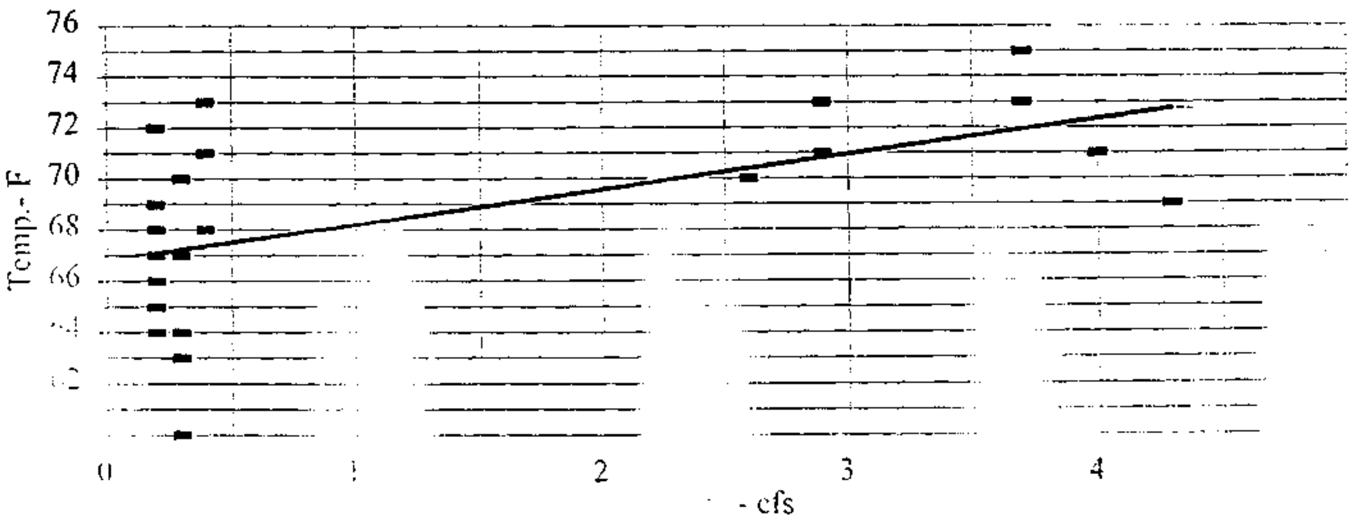
Sta. #9

Date	El.	Time	Q (cfs)	Temp.
6-27	0.81	17:20	4.3	69
6-28	0.80	17:20	4	71
7-2	0.79	17:20	3.7	75
7-3	0.79	17:20	3.7	73
7-11	0.76	17:20	2.9	73
7-15	0.76	17:20	2.9	71
7-20	0.76	17:20	2.6	70
7-24	0.62	12:00	0.3	70
7-26	0.64	12:00	0.4	71
7-29	0.64	12:00	0.4	73
8-2	0.64	12:00	0.4	68
8-5	0.61	12:00	0.3	67
8-9	0.60	12:00	0.2	68
8-12	0.59	12:00	0.2	69
8-16	0.59	12:00	0.2	67
8-18	0.60	12:00	0.2	66
8-23	0.61	17:30	0.3	64
8-27	0.61	17:30	0.3	63
8-30	0.60	17:30	0.2	65
9-2	0.60	17:30	0.2	64
9-13	0.61	17:30	0.3	60
9-25	0.60	16:30	0.2	72
9-27	0.60	16:30	0.2	67

Regression Output:		Q v. T
Constant		66.81
Std Err of Y Est		3.15
R Squared		0.32
No. of Observations		23
Degrees of Freedom		21
X Coefficient(s)	1.38	
Std Err of Coef.	0.44	

Anderson Ck.

SWRCB Sta. # 9

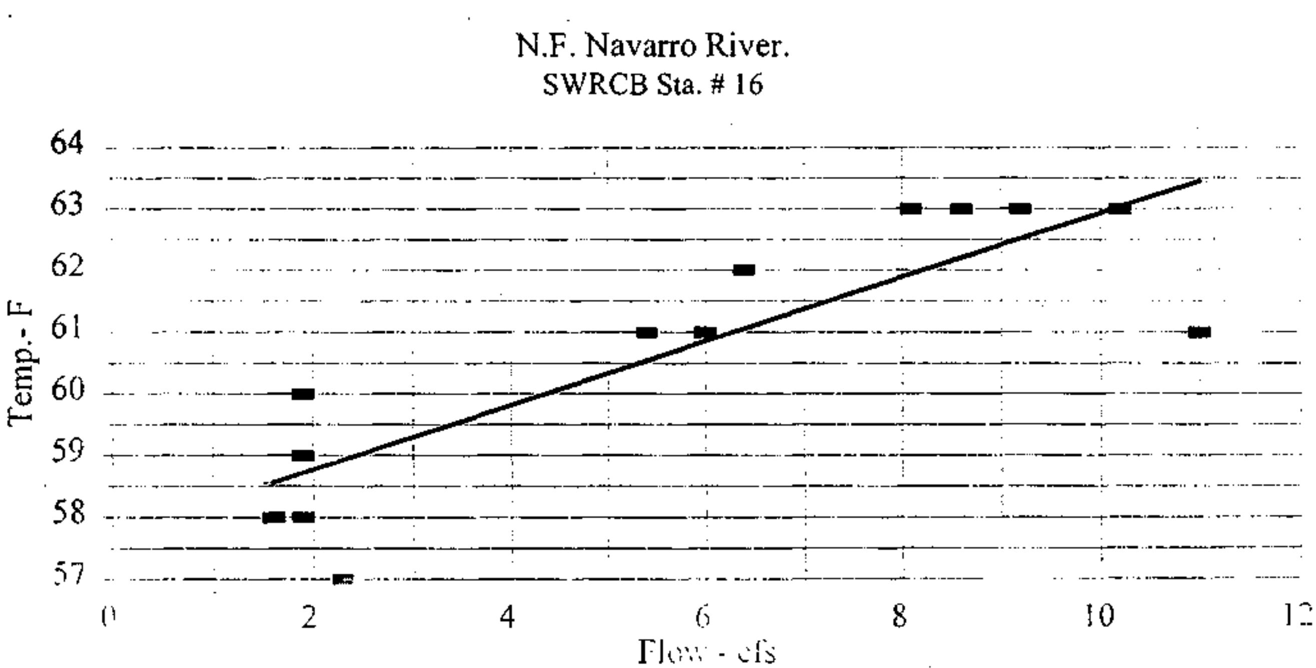


Attachment C

1996 N. F. Navarro R. Regression of Flow v. Temperature

Sta. #16

Date	El.	Time	Q (cfs)	Temp.	Regression Output:		Q v. T
6-27	0.55	13:20	11	61	Constant		57.73
7-1	0.53	13:20	10.2	63	Std Err of Y Est		1.18
7-3	0.49	13:20	9.2	63	R Squared		0.72
7-5	0.47	13:20	8.6	63	No. of Observations		13
7-9	0.46	13:20	8.1	63	Degrees of Freedom		11
7-15	0.40	13:20	6.4	62	X Coefficient(s)	0.52	
7-17	0.39	13:20	6	61	Std Err of Coef.	0.10	
7-19	0.37	13:20	5.4	61			
8-23	0.19	15:15	1.9	60			
9-4	0.19	15:15	1.9	59			
9-7	0.19	15:15	1.9	58			
9-13	0.17	15:15	1.6	58			
9-17	0.21	15:15	2.3	57			



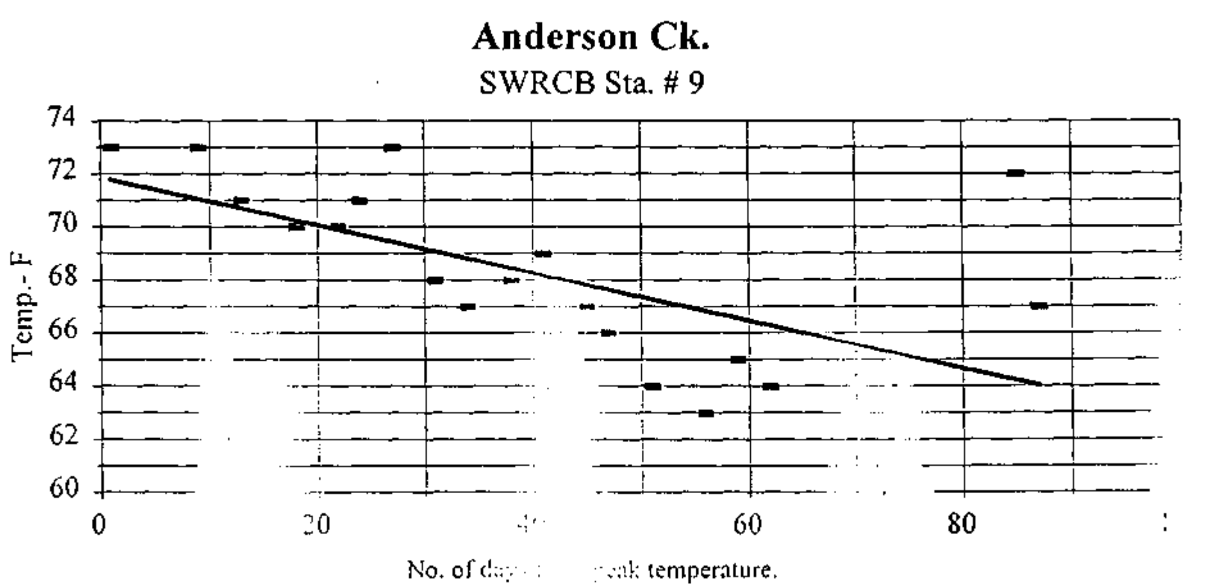
Attachment C

1996 Anderson Cr. Regression of Days Since Peak Temperature v. Temperature

Sta. #9

Date	El.	Time	Q (cfs)	Temp.	# of days from peak T
6-27	0.81	17:20	4.3	69	
6-28	0.80	17:20	4	71	
7-2	0.79	17:20	3.7	75	
7-3	0.79	17:20	3.7	73	1
7-11	0.76	17:20	2.9	73	9
7-15	0.76	17:20	2.9	71	13
7-20	0.76	17:20	2.6	70	18
7-24	0.62	12:00	0.3	70	22
7-26	0.64	12:00	0.4	71	24
7-29	0.64	12:00	0.4	73	27
8-2	0.64	12:00	0.4	68	31
8-5	0.61	12:00	0.3	67	34
8-9	0.60	12:00	0.2	68	38
8-12	0.59	12:00	0.2	69	41
8-16	0.59	12:00	0.2	67	45
8-18	0.60	12:00	0.2	66	47
8-23	0.61	17:30	0.3	64	51
8-27	0.61	17:30	0.3	63	56
8-30	0.60	17:30	0.2	65	59
9-2	0.60	17:30	0.2	64	62
9-13	0.61	17:30	0.3	60	73
9-25	0.60	16:30	0.2	72	85
9-27	0.60	16:30	0.2	67	87

Regression Output: Days v. T		
Constant		71.87
Std Err of Y Est		2.97
R Squared		0.38
No. of Observations		20.00
Degrees of Freedom		18.00
X Coefficient(s)	-0.09	
Std Err of Coef.	0.03	



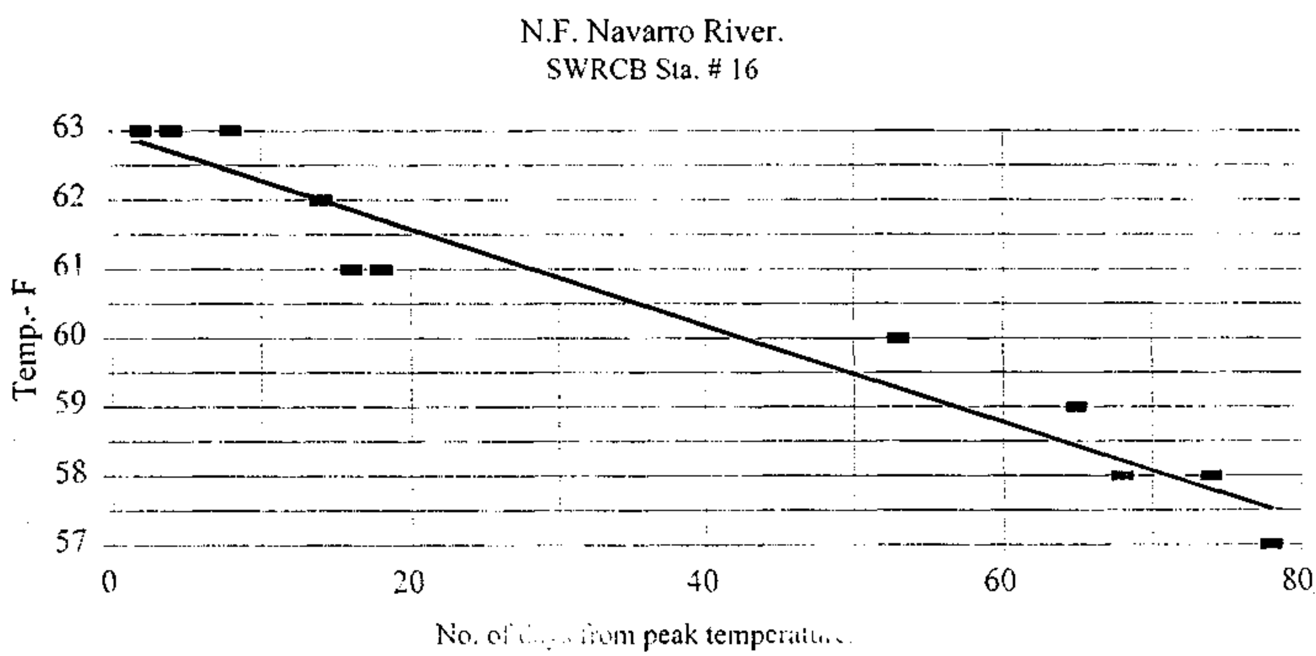
Attachment C

1996 N. F. Navarro R.

Regression of Days Since Peak Temperature v. Temperature

Sta. #16

Date	El.	Time	Q (cfs)	Temp.	# of days from peak T	Regression Output: Days v. T	
6-27	0.55	13:20	11	61		Constant	62.98
7-1	0.53	13:20	10.2	63		Std Err of Y Est	0.57
7-3	0.49	13:20	9.2	63	2	R Squared	0.94
7-5	0.47	13:20	8.6	63	4	No. of Observations	11.00
7-9	0.46	13:20	8.1	63	8	Degrees of Freedom	9.00
7-15	0.40	13:20	6.4	62	14	X Coefficient(s)	-0.07
7-17	0.39	13:20	6	61	16	Std Err of Coef.	0.01
7-19	0.37	13:20	5.4	61	18		
8-23	0.19	15:15	1.9	60	53		
9-4	0.19	15:15	1.9	59	-65		
9-7	0.19	15:15	1.9	58	68		
9-13	0.17	15:15	1.6	58	74		
9-17	0.21	15:15	2.3	57	78		



Attachment D

Division's Russian River Methodology

EVALUATION OF MEASURES NEEDED TO PROTECT FISHERY RESOURCES OF THE RUSSIAN RIVER WATERSHED

INTRODUCTION

The following discussion is taken from sections 3.0 through 5.2 of the Division's staff report, Russian River Watershed dated August 15, 1997. This attachment provides a brief summary of the life history of coho salmon and steelhead and describes the methodology used to develop bypass flows and diversion seasons to protect the fisheries of the Russian River.

3.0 LIFE HISTORY

3.1 GENERAL SALMONID Coho and steelhead, are anadromous salmonids. The life cycle begins as adult fish migrate from the ocean into streams. The adults lay their eggs in suitable gravel substrates. Coho die after spawning. Steelhead may return to the ocean and make several spawning runs during their lifetime. The alevin remain in the gravels after hatching. When the yolk sack is nearly absorbed, they emerge from the gravels as fry. The fry remain in the stream for various lengths of time, depending on species. The young fish migrate to the ocean as smolts and begin their rapid growth phase. After a period of one or more years, again depending on species, the maturing adults will return to their natal stream to repeat the cycle.

The general life histories of the two species are similar, however, the timing of life history stages. Specific habitat requirements between the two species also vary. Groot and Margolis (1991) provide thorough discussions of coho life histories. Shapovalov and Taft (1954) present life history information on steelhead as well as coho in California. Steiner Environmental Consulting (1996) and Sonoma County Water Agency (1996) discuss life history and habitat requirements for e species in relation to the Russian River.

3.2 COHO SALMON Within the Russian River, coho generally begin the spawning migration in November and continue through January, with the majority of spawning occurring in December. Coho spend one year in fresh water after hatching. Outmigration takes place in the spring. Most coho spend two years in the ocean, although some will return to fresh water after only one year and others after three years. Coho die after spawning. Coho spawn mainly in the lower tributaries of the Russian River.

3.3 STEELHEAD The spawning run for steelhead begins in December and continues through April, with most spawning occurring from January through April. Steelhead will remain in freshwater for one to four years after hatching. Outmigration usually occurs during the spring. Ocean residence for steelhead lasts one to three years. Steelhead are capable of making several spawning runs during their lifetime. Steelhead spawn in tributaries where fish travel upstream as far as flows permit (Table 3.0-1) (SEC, 1996).

4.0 STREAM FLOW CRITERIA

Prior to the advent of current fish habitat evaluation techniques, fishery biologists relied solely on personal experience to establish fish flow criteria. In developing stream flow criteria, the analyst must recognize that fish populations evolved under varying annual hydrologies and took advantage of changes in river flow during different stages of their life cycle. One steady flow throughout the year does not reflect the natural condition and would not provide good habitat for the various life stages of fish nor provide the channel forming events that are needed to maintain the streams geomorphic features.

There have been many methods developed for establishing stream flow protection. These methods tend to fall out on a continuum between two categories, standard-setting and incremental (Stalnaker, *et al.,* 1995). Examples of standard-setting methods include: 'aquatic base flow where the median flow for the lowest flow month is chosen as the minimum flow (Kulik, 1990); a technique that uses median monthly flows to mimic the natural stream flow pattern (Bovee, 1982); and, the Tennant Method (Tennant, 1976).

The Tennant Method, also known as the "Montana Method", is the most renowned of the standard-setting tools for fisheries (Stalnaker, *et al.,* 1995). This technique provides a quick, easy method for determining stream flows to protect aquatic resources in both warm and cold water streams. The Tennant Method recommends stream flow to support varying qualities of fish habitat based on percentages of the mean annual flow (Tennant, 1976). The Tennant Method is considered a good "rule-of-thumb" technique (Stalnaker, *et al.,* 1995).

Mid-range techniques that fall between basic standard-setting and incremental include: the "modified Tennant approach". The approach calls for a repetition of all of Tennant's steps and results in a set of recommendations tailored specifically to the species and stream of interest (Stalnaker, *et al.,* 1995). The wetted perimeter technique (Nelson, 1980) relates the stream's wetted perimeter to discharge; and, multiple attribute standard-setting methods including the Physical Habitat Simulation System (PHABSIM) which is most commonly used in California. PHABSIM analyzes the relationship between stream flow and physical habitat availability for various life stages of a species of fish incorporating several variables including: depth, mean column velocity, substrate composition, nose velocity, adjacent velocity, cover, and distance from cover (Hardy and Williamson, 1993).

The most commonly used incremental[1] technique used in California has been the Instream Flow Incremental Methodology (IFIM). The IFIM incorporates both macro- and microhabitat concepts. Macrohabitat characteristics include temperature, water quality, geology, slope, elevation, and water supply (Bovee, 1982). Microhabitat characteristics are the same variables used in PHABSIM analysis. An approach such as the IFIM typically requires hydrologic

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[1] Incrementalism is an approach to problem solving that refers to an institutional policy of slightly modifying procedures or positions from those previously established" (Bovee, 1982).

analyses, habitat models, sediment transport, water quality, and temperature analyses, along with trophic level studies, validation of species criteria, biomass studies, and population dynamics (Stalnaker, *et al.,* 1995).

The California Department of Fish and Game (CDFG) recommends the use of the IFIM for establishing stream flows. However, the IFIM is expensive and difficult to justify for small water diversions. For these smaller water diversions, information derived from detailed IFIM and PHABSIM techniques or other fishery studies should be evaluated to determine if any general relationships can be drawn for coastal streams in California.

4.1 ANALYSIS OF AVAILABLE FISHERY STUDIES

Salmonid spawning occurs from November through April within the Russian River watershed (Figure 3.0-1). Rearing for both steelhead and coho occurs year round. Spawning flows are generally higher than rearing flows (Baracco, 1977; Winzler and Kelly, 1978; Snider, 1985; Smith, 1986; Harding Lawson Associates, 1990). Therefore, spawning flows were considered the limiting factor during the and rearing flows during the rest of the year. The flows that provide optimum habitat for the two life stages of salmonid species are expressed as a percentage of the average annual unimpaired flow for each stream to see if a common percentage exists for the various streams evaluated.

<u>Studies on Other North Coast Streams</u> Due to the scarcity of information on fishery flows within the Russian River watershed, two additional instream flow studies were reviewed. These studies were conducted by the CDFG on Brush Creek in Mendocino County (Snider, 1985) and Lagunitas Creek in Marin County (Smith, 1986). Both of these studies used PHABSIM for determining what flows were required for steelhead and coho salmon within the creeks. These studies were selected because they dealt with coastal streams within the same general area as the Russian River.

<u>Brush Creek</u> The IFIM for Brush Creek was conducted using one study reach. Using the total weighted usable area curves for spawning, the study found that 50 cfs provided maximum spawning habitat for steelhead (Snider, 1985). Steelhead spawning flow needs were higher than those needed for coho salmon. Therefore, the flows for steelhead were used as the controlling factor for determining habitat suitability. Using the estimated runoff developed by Hecht, *et al.* (1983), these flows represent 114 percent of the average annual flow (44 cfs). The CDFG recommended a flow of 30 cfs for "optimum" spawning habitat in lower Brush Creek. This flow equated to providing 80 percent of the maximum steelhead spawning habitat and 98 percent of the maximum coho spawning habitat (Snider, 1985). The CDFG recommended optimum flow of 30 cfs, in this case, represents 68 percent of the average annual flow.

<u>Lagunitas Creek</u> The Lagunitas Creek IFIM study was conduced at four locations. The most upstream site was designated A and progressed alphabetically downstream to site D. There were marked differences between reaches, especially for coho. Coho spawning habitat is less abundant in reaches A and D, therefore, the habitat maximizes at much lower flows than in

reaches B and C (Smith, 1986). Although D is the most downstream reach it was not used in this analysis because of the reduced spawning habitat. The next most downstream reach (Reach C) was selected for detailed comparison.

As was the case with Brush Creek, Lagunitas Creek exhibited different habitat requirements for steelhead and coho. Steelhead requires 50 cfs for optimum spawning while coho requires only 35 cfs. The higher and more controlling spawning flow of 50 cfs was used as the optimum flow requirement. This flow was compared to the average annual unimpaired flow (69 cfs) calculated at Taylor State Park (Smith, 1986). It represents 72 percent of the average annual unimpaired flow.

The IFIM did not evaluate juvenile rearing habitat for coho. Therefore, only the rearing habitat needs for steelhead were analyzed. The optimum rearing flow for Reach C was 35 cfs for steelhead. This represents 50 percent of the average annual unimpaired flow.

<u>Conclusions:</u> Streams and rivers are dynamic systems. Therefore, generalizations are difficult to make. The above studies show high variability in the amount of stream flow needed for salmonid fisheries. Not only differences between species, but also differences between watersheds and along a single stream channel.

These studies estimated optimum spawning flows for coho and steelhead ranging from 68 to 114 percent of the average annual unimpaired flow. The higher 114 percent value is lowered to 68 percent if the "optimum" spawning habitat recommendations of the CDFG made for this stream are used. Optimum rearing habitat is attained with flows in the range of 20 to 50 percent of the average annual unimpaired flow (Table 4.1-1).

Table 4.1-1 : Fishery habitat flows as a percentage of average annual unimpaired flows.

Watershed	Optimal Spawning Flow (cfs)	Optimal Rearing Flow (cfs)	Average Annual Flow (cfs)	Spawning Flow as Percent of Average Annual Flow	Rearing Flow as Percent of Average Annual Flow
Big Sulphur	85	40	81	104%	49%
Dry Creek	400	80	399	100%	20%
Brush Creek IFIM	50	13	44	114%	29%
Brush Creek - CDFG recommended "optimum"	30	8	44	68%	18%
Lagunitas Creek	50	35	69	72%	50%

These results compare favorably with other standard-setting techniques. Tennant (1976) determined that providing 60 to 100 percent of the average annual flow would provide optimum habitat for fisheries. O'Shea (1995) examining the relation between stream discharge and wetted perimeter of Minnesota streams found that approximately 70 percent of the mean annual flow is needed for minimum instream flow requirements. Dr. Michael Healey suggested the uncertainty of what impacts may occur increases as flows drop below 70 percent of the natural flow (Centers for Water and Wildlands Resources, 1997).

The actual percentage of the hydrograph used to estimate needed bypass flows depends upon the level of protection being sought. Section 5937 of the Fish and Game Code states, in part, that "(t)he owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam." The Fish and Game Code does not define what it means when it says in "good condition". While this code section specifically applies to CDFG's role with respect to dams, it also provides important legislative guidance that the SWRCB takes into consideration with respect to all diversions of water.

During the Mono Lake hearings before the SWRCB, Mr. Darrell Wong, Associate Biologist with the CDFG, provided the following definitions:

> "The instream flows necessary to keep fish in good condition include those which will maintain a self-sustaining population of desirably-sized adult vertebrate fish which are in good physical condition, i.e. well proportioned and disease free. Fish populations should not be limited by lack of cover, food availability, poor water quality (including temperature), or lack of habitat necessary for reproduction. The fish populations should contain good numbers of different age classes; and habitats for these life stages should not be limiting. Therefore the 'good condition' requirement must include the protection and maintenance of the physical, biological, and chemical parameters which constitute the ecology of the stream. The ecological health of the stream will determine if fish, both vertebrates and invertebrates, are to be kept in good condition."
>
> "Sufficient flows to keep fish in good condition are those resulting in adequate water depths, velocities, water quality (including temperature), and substrates required for the maintenance of aquatic life. Adequate instream flows are necessary throughout the entire stream reach to maintain aquatic populations throughout the year for all life stages, including eggs in or on the substrate. Water temperatures within the range for adequate growth and reproduction are required. Substrate with low imbeddedness due to minimal fine sediment deposition generally increases stream productivity and invertebrate habitat, and increases trout spawning success. Adequate water depth will provide holding cover, feeding areas, and provide overwinter habitat for trout. Adequate water velocities are required for spawning, sediment transport, food item transport, and to provide a diversity of aquatic habitats. All of these factors should result in good somatic growth of fish life."

Decision 1631 (D-1631) established instream flow requirements for tributaries to Mono Lake to attain, at a minimum, good conditions for fish. The SWRCB determined that flows within the subject tributaries should provide 80 percent of the maximum WUA for dry years, 90 percent for normal years, and 100 percent for wet years. Since the Mono Lake tributaries are snow melt streams, they are not directly comparable to rain-fed coastal streams. However, the amount of habitat to keep fish in good condition as a percentage of the maximum available habitat should be comparable.

The flows established for Lee Vining Creek during the high flow period provide 55 percent of the average annual flow during dry years and 80 percent of the average annual flow during normal and wet years. On average, the minimum flows established during the high flow period in D-1631 provide 74 percent of the average annual flow. During the low flow period, the minimum flows provide 37 percent of the average annual flow in dry years and 60 percent of the average annual flow in normal and wet years. On average, the minimum flows during the low flow period provide 54 percent of the average annual flow.

Fish populations are usually under the most stress during dry years. Water availability analyses for water right purposes should use the dry year fish criteria and actual dry year flows to determine seasons of water availability. SWRCB staff is proposing to use the dry year criteria . established in D-l 631 as the criteria for the Russian River watershed. In a typical weighted usable area curve, 80 percent of the maximum WUA is provided by a flow of approximately 60 percent of the flow needed to provide 100 percent of the maximum WUA (Figure 4.1-2). For the studies evaluated, approximately 100 percent of the average annual flow provide the upper range of optimum conditions for spawning habitat. Therefore, 60 percent of the average annual flow should provide enough spawning habitat to keep fish in good condition under dry year conditions. Extrapolating this methodology to the low flow season, 50 percent of the average annual flow provide the upper range of optimum conditions for rearing conditions. Consequently, 30 percent of the average annual flow (0.6[50%]-30%) should provide good rearing conditions during dry years.

In view of the above information, SWRCB staff are proposing to establish a bypass flow requirement of 60 percent of the average annual unimpaired flow during the spawning season of salmonid species within the Russian River watershed. This level of flow should allow diversion of unappropriated water within the watershed without further impacting the fishery resources during the high flow period. This criteria is for dry year conditions and should be used with dry year hydrology to determine water availability. If only normal year hydrology is available, then a higher percentage should be used for fishery protection (perhaps 70 to 75 percent).

Late spring, summer, and fall rearing conditions are more problematic. The analysis of the available studies in or near the Russian River watershed suggest a range from 20 to 50 percent of the average annual flow provide for optimal rearing habitat. "Good condition" flows for dry years could be provided with 30 percent of the average annual flow. However, this flow rarely occurs during the spring, summer, or fall. Under natural conditions, flows that exist in the summer may limit population the size of salmonid fisheries. This analysis indicates that additional diversions during the spring, summer, and fall from the tributaries of the Russian River have the potential of significantly affecting salmonid populations. Site specific studies will be needed to demonstrate that such effects are not likely.

The results of this evaluation suggest using a simple percentage of the natural hydrology in obtaining a quick estimate of bypass flows needed to keep fish in good condition in Russian River tributaries. While such a method may be suitable for small projects and the development of flow bypass criteria, more detailed studies incorporating IFIM methodology should be used for larger projects and/or for determining minimum instream flows. In addition, this methodology is predicated on the continued availability of peak flows to maintain the dynamic fluvial geomorphologic processes of the stream system. Projects should be evaluated to ensure peak flows necessary to maintain stream dynamics are not significantly affected.

5.0 AUTHORIZED DIVERSION SEASON

An authorized season of diversion for new water projects depends on the hydrology and the needs for both instream uses and the prior rights of water users. The Division has conducted a water availability study for the purpose of determining permit terms for pending water right applications.

5.1 ONSET OF RAINS AND SUBSEQUENT RUNOFF

There are five USGS rainfall gauges within the Russian River watershed (Table 5.1-1). with periods of record ranging from 42 to 87 years. The average rainy season within the Russian River watershed can be determined by plotting the cumulative average rainfall over time (Figure 5.1-1). The inflection point where the curves begin season, around the middle of November. Where the curves begin to rise significantly indicates the beginning of the rainy season, around the middle of November. Where the curves begin to flatten out, or become horizontal, denotes the end of the rainy season. For the Russian River watershed, this generally occurs around the end of March. The same pattern, although on a smaller scale, is observed when data from only the below average water years are used (Figure 5.1-2). On average, the rainy season for the Russian River watershed is during the period from November 15 to March 31.

Table 5.1-1 : Rain gauge stations within the Russian River watershed.

Station	Years of Record
Cloverdale	1950-1991
Graton	1948-1992
Healdsburg	1931-1992
Ukiah	1906-1992
Santa Rosa	1932-1992

There is normally a delay between the onset of rainfall and the subsequent runoff. Examination of rainfall and streamflow data shows that there is not a significant rise in runoff until after several storm events have occurred. For a typical average year within the Russian River watershed, a significant rise in runoff occurs towards the end of November to the first part of December (Figure 5.1-1). During a typical dry year, this may not occur until January (Figure 5.1-2).

5.2 TRIBUTARIES

Hydrographs for a sampling of Russian River tributaries were developed (Figures 5.2-1 through 5.2-4). Superimposed on these hydrographs are the flow criteria of 60 percent of annual average flow for November through April period (spawning) and 30 percent of average annual flow for the remainder of the year (rearing).

In the tributary areas summer rearing habitat is generally considered the limiting factor for coho and steelhead (W. Cox, pers. comm.). During the summer, rearing habitat for young coho and steelhead is at a premium due to naturally low flows and high water temperatures. Stream flows in the spring, summer and fall are not sufficient to provide good rearing conditions and only a small percentage of these flows currently exist (Figures 5.2-1 through 5.2-4). Further depletion of these limiting flows by new water diversions would not be appropriate in most cases. The only period when water may be available for further appropriation after the needs of fish are met is the wet weather period of mid November through April. However, water is typically not available above the needed spawning flows until December.

Early rains, and subsequent runoff, are important for upstream migration (Sandercock, 1991; Shapovalov and Taft, 1954). Upstream migration for coho begins in November and extends until mid-January. In order to protect the early flows needed for adult salmonid upstream migrations, new water diversions should not begin until December 15.

Flows in March are typically above the criterion for spawning of 60 percent of the average annual flow. By April, flows are usually much less than this criterion. However, the timing of outmigration of young salmonids is more important in setting a diversion period. Smolt emigration may occur at any time conditions are satisfactory, but normally occurs from January through June (Trinity Associates, 1994; SEC, 1996; Sonoma County Water Agency, 1996). Shapovalov and Taft (1954) observed the out migration of coho smolts peaking around mid-March. During dry years, which can be critical times for fish, flows needed for spawning typically do not occur in April. Therefore, mid to late March should mark the end of the diversion season for new water diversions for most of the tributaries in the Russian River watershed.

With the listing of coho and the potential listing of steelhead, limiting the diversion season to December 15 through March 31 would help prevent new diversions from affecting stream flows needed by these species. This shortened diversion season will provide a level of protection for extant populations of coho and steelhead during upstream migration, spawning, and out migration, as well as other fishery resources within the Russian River watershed (Figure 5.2-5). New diversions of water during the summer and fall months should not be allowed because existing flows are likely needed to protect existing populations of salmonid species currently in decline.

8.0 **LITERATURE CITED**

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