KARUK TRIBE OF CALIFORNIA

DEPARTMENT OF NATURAL RESOURCES
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2006
WATER QUALITY
ASSESMENT REPORT

KLAMATH RIVER, SALMON RIVER, SCOTT RIVER, AND SHASTA RIVER

Karuk Tribe of California

Water Quality Assessment Report
2006

Prepared by
Karuk Tribe of California
Water Resources
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JUNE - OCTOBER 2006

1. BACKGROUND

The Karuk Tribe of California is the second largest Tribe in California, with over 3,500 Tribal members currently enrolled. The Karuk Tribe is located along the middle Klamath River in northern California. Karuk Ancestral Territory covers over 90 miles of the mainstem Klamath River and numerous tributaries. The Klamath River system is central to the culture of the Karuk People, as it is a vital component of our religion, traditional ceremonies, and subsistence activities. Degraded water quality and quantity has resulted in massive fish kills, increased populations of toxic algae, and pandemic fish diseases, in addition to the extreme limitations and burdens applied to our cultural activities.

2. PURPOSE

It is the mission of the Karuk Tribe of California to protect, promote, and preserve the cultural, resources, natural resources, and ecological processes upon which the Karuk People depend. This mission requires the protection and improvement of the quality and quantity of water flowing through Karuk Ancestral Territory and Tribal trust lands. The Karuk Tribe's Department of Natural Resources has been monitoring daily water quality conditions in the Klamath River since January of 2000 and tributaries to the Klamath River since 1998. The Karuk Tribe has been collaboratively involved in maintaining water quality stations along the Klamath River and its tributaries with the United States Fish and Wildlife Service (USFWS), the United States Geological Survey (USGS), and the Yurok Tribe.

This data is important to state and federal processes currently underway and provides information for Tribal Council and resource managers to make informed decisions. The Klamath Hydroelectric Project (KHP) is undergoing relicensing by the Federal Energy Regulatory Committee (FERC). Along with this process both Oregon and California will have to issue 401 certifications for the KHP. The North Coast Regional Water Quality Control Board (NCRWQCB) is developing and/or implementing Total Maximum Daily Loads (TMDL's) for the Scott, Shasta, Salmon, and Klamath Rivers. Tribes, counties, and the state of California have developed draft guidance for public health for a toxic blue green algae *Microcystis aeruginosa* and associated toxin microcystin. The water quality data the Karuk Tribe collects is essential to providing quality data regarding processes that involve and affect the Karuk Tribe.

The purpose of this study is to monitor the quality of water flowing into and out of Karuk Ancestral Territory and Tribal trust lands. The information produced allows the Karuk Tribe to give valuable input on land management decisions and demonstrates the Tribe's commitment to sound resource management. The data produced is indispensable in monitoring water quality conditions within the Klamath River System. We are building a long-term monitoring data set that lets us track these conditions and monitor for improvement. During 2006, Karuk Water

Quality employees performed all data collection, QA/QC, and database management. Funding for this project has come mainly through the Karuk Tribe's EPA 106 Water Pollution Control Program with some support from the USFWS Habitat Assessment Program.

3. MONITORING METHODS & QA/QC Summary

Monitoring Methods

The Karuk Tribe monitored six water quality stations in 2006: the Klamath River near Orleans, the Klamath River near Seiad Valley, the Klamath River below Irongate dam, and the Scott, Salmon and Shasta Rivers. The parameters collected were water temperature, dissolved oxygen (DO), pH, and specific conductance. These parameters were monitored using Hydrolab 4*a* datasondes, which collected the aforementioned parameters every half-hour. At all sites, the datasondes were deployed in early June and retrieved in October or no later than the end of November.

Water quality monitoring sites were visited at biweekly intervals. At this time audits were performed with a Hydrolab Quanta, a hand-held water quality instrument. The audits allowed field personnel to compare Quanta and datasonde readings taken before and after calibration. Calibration of the datasondes was performed in the field to minimize the amount of time the instruments were out of the water and thus not collecting data. Water quality probes were calibrated and serviced according to USFWS Quality Assurance/Quality Control protocol. These calibrations followed the manufacturer's instructions as outlined in the ***Maintenance/Calibration/Logging Procedures***[1] for the specific probe. During these regular visits, data was downloaded from the datasondes, bought back to the office, and reviewed.

QA/QC

The Department of Natural Resources Water Quality Program developed an EPA-approved Quality Assurance Project Plan (QAPP) to ensure that data generated from environmental measurement studies are technically sound and legally defensible. The QAPP summarizes procedures to be followed in administering federally funded programs that involve measurement of environmental parameters. The QAPP applies to special water quality studies involving surface and ground water bodies, as well as to surveillance and compliance monitoring of discharges.

Briefly, the QAPP requires that (a) physical and professional capabilities be adequate to perform the analysis for all parameters in the sampling plan; (b) sample collection, handling, and preservation be conducted according to EPA manuals; (c) time-sensitive samples be transported and analyzed within specific holding times; (d) sample integrity be provided for a legal chain of custody of samples collected for support of enforcement actions; (e) analytical methods be in accordance with standardized methods; and (f) analytical quality control procedures be established for intra-laboratory checking of reference samples. Laboratory records including reference sample results are to be available for EPA.

[1] Hydrolab, Corporation. "Maintenance, Calibration and Storage. "DataSonde 4 and MiniSonde Water Quality Multiprobes User's Manual. Revision G. 1999.

A detailed description of our QA/QC is available in our QAPP, however a brief summary for our datasonde monitoring data follows. For monitoring with datasondes, QA/QC was performed in both the field and the office. Every two weeks in the field, probes were examined, cleaned, and calibrated. In the office, data was reviewed to help locate failed probes or other malfunctions in a timely manner. Daily values (based on at least 46 of 48 measurements since data was collected in ½ hour intervals) were obtained utilizing an Excel spreadsheet. If there were less than 46 measurements for a 24-hour period that day's data was not used in the daily maximum, mean, and minimum calculations. A 24-hour "rest" period is required when calibrating DO on a Clark's membrane probe, which were used on the Hydrolab datasondes in 2006. This 24 hours of DO data was removed from the dataset for analysis. All data collected is included in the analysis that follows.

4. WATER QUALITY PARAMETERS

Water quality data collected included water temperature, dissolved oxygen, pH, and specific conductivity. These parameters are outlined and described below. Karuk tribal water quality standards are included where applicable.

Water Temperature

Water temperature varies both seasonally and diurnally (within a twenty-four hour period). Elevated temperatures may lead to increased metabolic rates in organisms and algal growth. Many factors can affect stream temperature, including discharge, air temperature, the amount of shaded cover (which significantly influences smaller streams), contribution of snow melt and springs (or cold water tributaries), aspect, amount of runoff from human influenced areas, and the length the stream must travel.

Temperature has an impact on many beneficial uses in the Klamath River, including cold water fish, subsistence fishing, cultural use, and recreational use. A common method to assess water temperature for streams that support salmonid populations is to compare sustained water temperatures to an acute and chronic temperature standard. The acute standard represents the lethal temperature for salmonids . The chronic temperature designation represents the maximum weekly average temperature (MWAT), which is the upper limit for optimum growth for salmonids. The Karuk Tribe's water quality objectives have set the maximum temperature threshold at 21°C and MWAT of 15.5°C[2]. The NCRWQCB is currently working on adding numeric temperature objectives for the Basin Plan.

Dissolved Oxygen

Dissolved oxygen (DO) varies both seasonally and diurnally, particularly in the summer when photosynthesis adds oxygen to the system during the day and respiration consumes it at night. In cold water, oxygen is more soluble; therefore the amount of available oxygen for salmonids is greater. Oxygen levels lower when water temperatures are elevated and more photosynthesis is occurring. A supersaturated (very high DO) environment may exist during daytime hours, but at night DO levels may drop to lethal levels due to microbial respiration and lack of photosynthesis.

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[2] Tripp, Sandi, and Susan Corum. Karuk Tribe of California. Department of Natural Resources. Water Quality Control Plan. Orleans, CA: 2002.

The Karuk Tribe's water quality objectives have established minimum DO levels for waters designated as Cold Freshwater Habitat (COLD) in the Karuk Tribe Water Quality Control plan, to be 6.0 mg/L. Areas providing Spawning, Reproduction, and/or Early Development habitat (SPWN) need to maintain a minimum DO of 9.0 mg/L for tribal trust fish species. The state of California has established a minimum DO level of 8.0 mg/L.

pH/Alkalinity

The pH level or alkalinity of water refers to the concentration of hydrogen and hydroxide ions in the water. Water becomes more acidic with higher concentrations of hydrogen ions and lower concentrations of hydroxide ions, likewise water will be more basic if there are more hydroxide ions present than hydrogen ions. Water temperature has a significant impact on the concentrations of these ions in water. As water temperatures rise, algae and plant photosynthesis increases, leading to a daily fluctuation of pH. Photosynthesis extracts dissolved CO_2 from the water column, which was previously in the form of carbonic acid, H_2CO_3. High levels of photosynthesis cause the pH to rise during the day and lower at night when respiration is occurring. High pH levels cause ammonium ions to go from an ionized state to a de-ionized form that is vastly more toxic to fish. The Klamath River has abundant ammonium ions due, in a large part, to agricultural runoff and nitrogen fixation by algae within the reservoirs. The pH or alkalinity also determines the solubility and biological availability of nutrients and other chemicals in water. Changes in pH can greatly influence how much of a nutrient or chemical is available for use by aquatic organisms. The Karuk Tribe has established a minimum pH objective of 6.5 and a maximum of 8.5. Changes in normal ambient pH levels shall not exceed 0.5 units within the range specified above in fresh waters with designated COLD or WARM beneficial uses[3].

Specific Conductance

Specific conductance is a measure of the electrical conductivity of water at 25°C, and is a function of the concentration of dissolved solids in solution. A solution with a high concentration of dissolved solids will yield a greater value for the specific conductance than a solution with lower concentrations of dissolved solids. Specific conductivity measures how well water can conduct an electrical current across a particular length. Conductivity increases with increasing amounts of unbound ions. These ions, which come from the breakdown of compounds, conduct electricity because they are negatively or positively charged when dissolved in water. Therefore, specific conductivity is an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution.

The Karuk Tribe's specific conductance objective is consistent with the NCRWQCB, which is 350 µs/cm for a 90% upper limit and 275 µs/cm for a 50% upper limit. The 90% upper and lower limits represent the 90th percentile values for a calendar year. Ninety percent or more of the values must be less than or equal to an upper limit and greater than or equal to a lower limit. The 50% upper and lower limits represent the 50 percentile values of the monthly means for a

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[3] Tripp, Sandi, and Susan Corum. Karuk Tribe of California. Department of Natural Resources. Water Quality Control Plan. Orleans, CA: 2002.

calendar year. Fifty percent or more of the monthly means must be less than or equal to an upper limit and greater than or equal to a lower limit.

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Flow

Stream flow (ft^3/sec) data are from USGS gauging stations located in the Klamath Basin and its tributaries. All water quality monitoring stations are directly associated with USGS gauging stations except the Shasta River and Scott River sites. The USGS Shasta flow gage is about one mile downriver of the monitoring site, and the nearest USGS flow gage on the Scott is about 20 miles upriver of the monitoring site. Flow rates in the Klamath Basin are affected by a variety of variables including rainfall, snow pack, dam releases, agricultural use, domestic use, evapotranspiration rates, and groundwater levels.

Stream flow has an impact on all of the water quality parameters mentioned above as well as for listed beneficial uses. For example, subsistence fishing for the Karuk Tribe at Ishi Pishi Falls is a flow-dependent fishery. Flow is also critical to provide ample habitat for Tribal Trust fish species. Adequate flows allow fish access to rearing, feeding, and cover habitat. Flows also need to be high enough to allow connectivity to cold water refugias and tributaries, so that fish may move freely into and out of these habitats to find relief from high summer water temperatures and other detrimental water quality parameters. Flow and how it relates to fish disease and toxic algae blooms is also being investigated in other studies.

5. WATER QUALITY STATIONS

The Karuk Ancestral Territory, located along the middle course of the Klamath River and the lower Salmon River in Northern California, includes an estimated 1.38 million acres within the Klamath River Basin. This portion of the Klamath Basin has over 1,900 miles of perennial streams, thousands of acres of wetlands and riparian areas, and approximately 107 lakes. Approximately 90 miles of the Klamath River transects the Territory. Several major tributaries flow into the Klamath within the Ancestral Territory. The USDA-Forest Service has defined 19 watersheds or sub-basins that exist wholly or partially in the Territory. The following tables summarize waters within the ancestral territory, tribal uses and goals of these waters, and impairments to these uses and goals. (Tables 1-2).

Atlas of Tribal Waters Within Ancestral Territory	
Total number of Klamath River miles	90
Total number of perennial stream miles	1,900
Total number of lake acres	442
Total number of wetland acres	UNKNOWN

Table 1 - Atlas of Tribal Waters within Ancestral Territory

Making Assessment Decisions	
Designated Beneficial Uses and Tribal Goals	**Parameter(s) to be Measured to Determine Support of Use of Goal**
Rare, Threatened, or Endangered Species (RARE)	Temperature, DO, pH, Conductivity,
Subsistence Fishing (FISH)	Temperature, DO, pH, Conductivity
Cold Freshwater Habitat (COLD)	Temperature, Turbidity
Cultural Contact Water (CUL-1)	Temperature, Phosphorus, Nitrogen
Cultural Non-Contact Water (CUL-2)	Temperature, Phosphorus, Nitrogen
Fish Consumption (FC)	Temperature, Phosphorus, Nitrogen
Water Contact Recreation (REC-1)	Temperature, Phosphorus, Nitrogen
Non-Contact Water Recreation (REC-2)	Temperature, Phosphorus, Nitrogen
Spawning, Reproduction, and/or Early Development (SPWN)	Temperature, DO, pH, Conductivity, Turbidity

Table 2 - Designated uses and tribal goals and what parameters are measured to monitor impairments to these uses and goals.

Use/Goal Support in Tribal Streams				
Designated Use or Tribal Goal	No. of Stream Miles Monitored/Assessed	No. of Stream Miles Fully Supporting Use or Goal	No. of Stream Miles Supporting Use or Goal but Threatened	No. of Stream Miles Not Supporting Use or Goal
RARE	178	0	156	22
FISH	178	0	0	178
COLD	178	0	16	162
CUL-1	178	0	16	162
CUL-2	178	0	16	162
FC	178	0	0	178
REC-1	178	0	16	162
REC-2	178	0	16	162
SPWN	178	0	0	178

Table 3 – Extent to which rivers meet designated uses or tribal goals.

For 2006, water quality monitoring stations were located at three fixed points along the mainstem Klamath River. These stations create a longitudinal profile of water entering and exiting the Mid-Klamath region. Three monitoring sites have been established on larger tributaries to the Klamath River, which are within and upstream of Karuk Ancestral Territory. The tributary sites are on the Salmon, Scott and Shasta Rivers. These sites are located near the mouths to highlight their influence on the mainstem Klamath. These tributaries also supported abundant runs of spring and fall Chinook, coho, steelhead, lamprey, and sturgeon (Salmon River only). The health of these tributaries is closely tied to the wellbeing of the Klamath River, the Karuk people, and the River's ability to support beneficial uses.

5.1 Klamath River Stations

The following section describes the Klamath River monitoring sites. Tables 3 and 4 summarize impairments to the Klamath River and identify sources of these impairments. The Klamath River is currently listed under the federal Clean Water Act (CWA) section 303(d) for temperature, dissolved oxygen, and nutrients. A TMDL is being developed for the Klamath and should be adopted by 2010.

Causes of Impairment in Klamath River		
Parameter	**Number Of Stream Miles Monitored or Assessed**	**Number Of Stream Miles Not Supporting Use or Goal**
Dissolved Oxygen	**140**	**140**
pH	**140**	**140**
Water Temperature	**140**	**140**
Phosphorous	**140**	**140**
Total Nitrogen	**140**	**140**

Table 4 - Causes of impairments in Klamath River

Sources of Impairment in Klamath River		
Source of Impairment	**Number Of Stream Miles Monitored or Assessed**	**Number Of Stream Miles Not Supporting Use or Goal**
Hydrological modification	**140**	**140**
Agriculture (livestock grazing)	**50**	**50**
Legacy Roads	**140**	**140**
Timber Harvesting	**140**	**140**
Mining Activities	**140**	**140**

Table 5 - Sources of impairments in Klamath River

5.1.1 Below Iron Gate Dam

This monitoring site is located just downstream of Iron Gate dam, the fish hatchery, and Bogus Creek at the USGS gauging site. Data collected here monitors the quality of water exiting the dam and entering the Mid-Klamath region. This site monitors a drainage area of approximately

4,630 square miles. This area of the Klamath is much drier than down river and is vegetated by oak woodlands.

The approximate location of this station is:
Latitude: 41°55'41" N
Longitude 122°26'35" W NAD27
Elevation: 2,162.44 feet above sea level

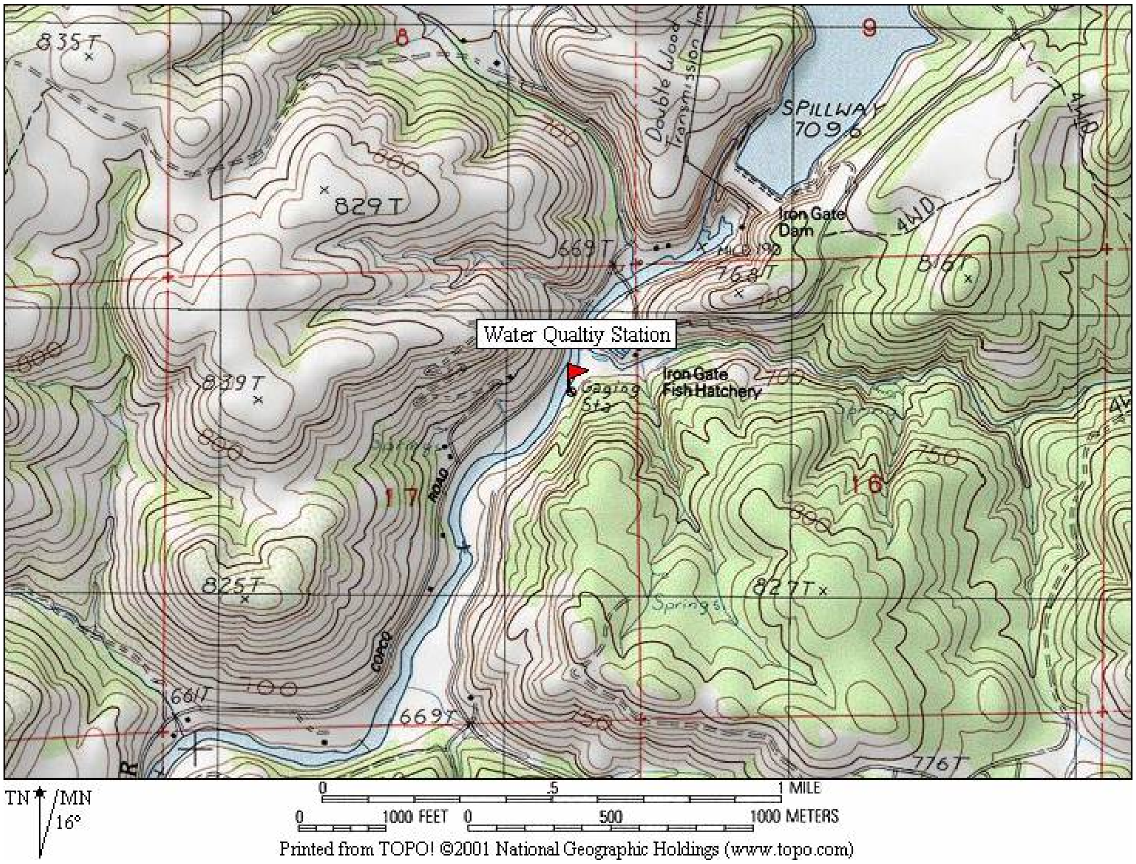

Figure 1 - Klamath River below Iron Gate Dam water quality station.

Figure 2 - Klamath River below Iron Gate Dam across river looking up from water quality station.

5.1.2 Near Seiad Valley

This monitoring site is locate at the USGS gauging station approximately 62 miles downriver from the Iron Gate Monitoring site and 2.2 miles south of the town of Seiad Valley. This site is at the more upstream end of Karuk Ancestral Territory and monitors a drainage area of approximately 6,940 square miles. This area is dominated by conifers and the topography is much steeper than the area surrounding the Iron Gate site. These landscape changes are captured in Figures 1-4.

The exact location of this station is:
Latitude: 41°51'14" N
Longitude 123°13'52" W NAD27
Elevation: 1,320.00 feet above sea level

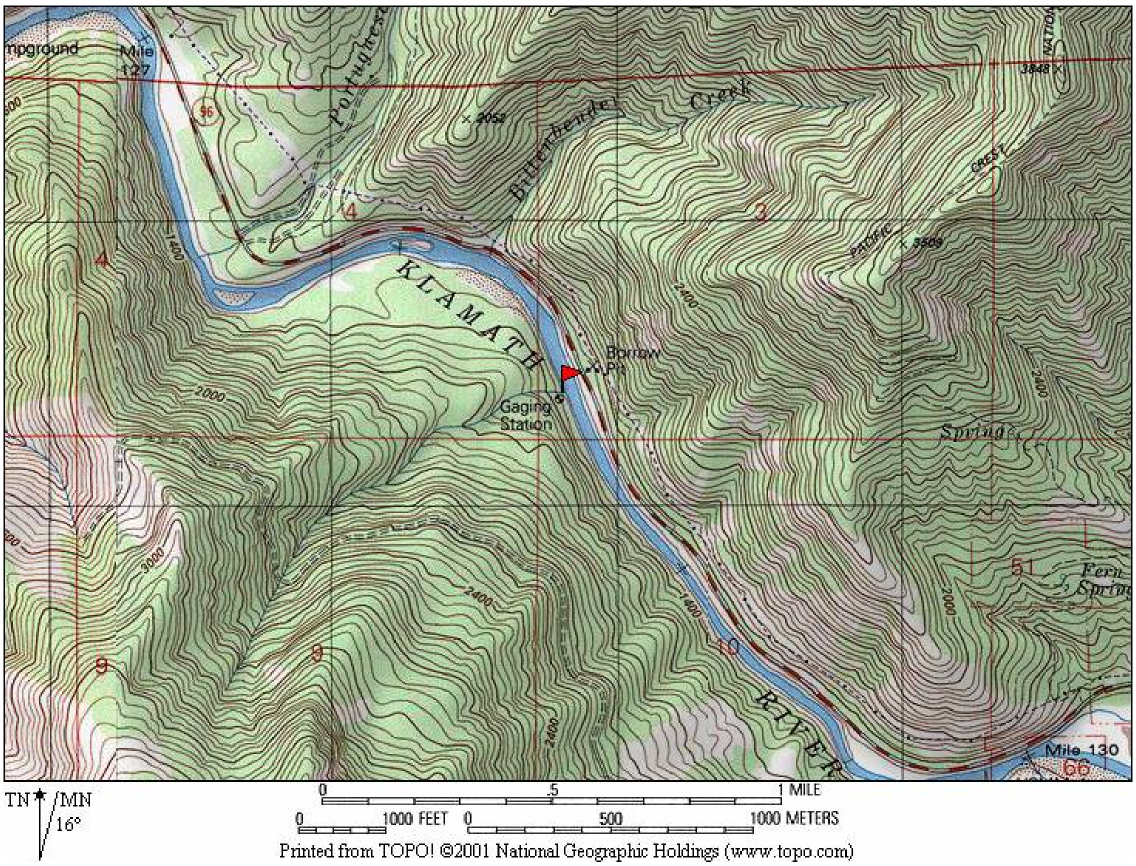

Figure 3 - Klamath River near Seiad Valley water quality station.

Figure 4 - Klamath River near Seiad Valley upstream of water quality station looking up river.

5.1.3 Near Orleans

The Klamath River station near Orleans is the lowest monitoring station on the mainstem. It is located at the more downstream end of Karuk Ancestral Territory. This station provides data for water quality parameters after the river has traveled through the Mid-Klamath region. This site monitors a drainage area of approximately 8,475 square miles. In this area the Klamath begins to fan out more and create larger flood plains and gravel bars (Figure 5-6). By this point, 12 major tributaries- designated Key Watersheds by the Northwest Forest Plan have entered the Klamath, in addition to numerous smaller tributaries.

The exact location of this station is:
Latitude: 41°18'13" N
Longitude: 123°32'00" W NAD 27
Elevation: 355.98 feet above sea level

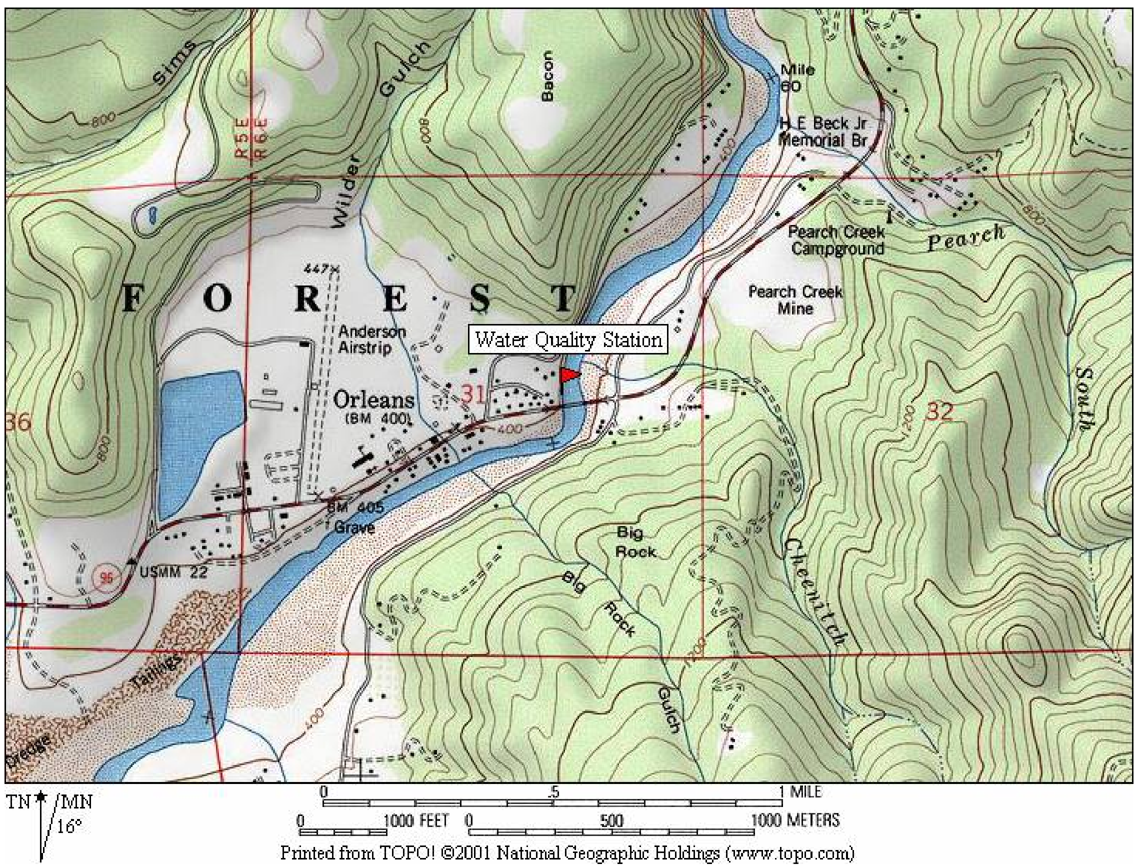

Figure 5 - Klamath River near Orleans water quality station.

Figure 6 - Klamath River near Orleans across the river of water quality station looking up river.

5.2 Tributaries

The Klamath River is a unique river in that it starts in flat land. It meanders through what were once massive wetlands and makes its way into the mountainous mid-Klamath region. Here the overall gradient and volume of the river increases and the water gets colder due to the many tributaries, which cascade into the Klamath. These tributaries are critical in maintaining water quality during the summer months. The Scott, Shasta and Salmon rivers were historically the largest tributaries in the mid-Klamath region. These rivers provided excellent spawning and rearing habitat for salmonids, steelhead, and lamprey. Mining, Logging and Agricultural uses of these watersheds have degraded the quantity and quality of habitat and water in these areas (Table 5-6).

Causes of Impairment in Major Tributaries		
Parameter	**Number Of Stream Miles Monitored of Assessed**	**Number Of Stream Miles Not Supporting Use or Goal**
Dissolved Oxygen	**38**	**38**
Water Temperature	**38**	**38**
pH	**38**	**38**
Total Nitrogen	**38**	**22**
Phosphorous	**38**	**22**

***** Shasta River measured from Yreka Creek to mouth-7 miles, Scott River from Canyon Creek to mouth- 15 miles, and Salmon River from Nordheimer Creek to mouth-16 miles.

Table 6 - Causes of Impairment in tributaries to Klamath River.

Sources of Impairment in Tributaries		
Source of Impairment	**Number Of Stream Miles Monitored or Assessed**	**Number Of Stream Miles Not Supporting Use or Goal**
Hydrological modification	**38**	**22**
Agriculture	**38**	**22**
Legacy Roads	**38**	**38**
Timber Harvesting	**38**	**38**
Mining Activities	**38**	**31**

Table 7 - Sources of impairment in tributaries to Klamath River

5.2.1 Salmon River

The water quality station on the Salmon River is located approximately 1 mile above the confluence with the Klamath River (Figure 7) at the USGS gage station. The Salmon River watershed drains an area of 480,178 acres. The Salmon River is listed in California's 303(d) list for temperature. The temperature TMDL for the Salmon River has been adopted by the State and EPA and implementation has begun. The data being collected is an important part of long-term monitoring of the system to see how well the implementation plan is working. The Salmon River also provides crucial habitat for tribal trust species such as green sturgeon, lamprey, Spring Chinook, Fall Chinook, and Coho salmon.

The exact location is:
Latitude: 41° 22' 37'' N
Longitude: 123° 28' 38'' W
Elevation: 167 m

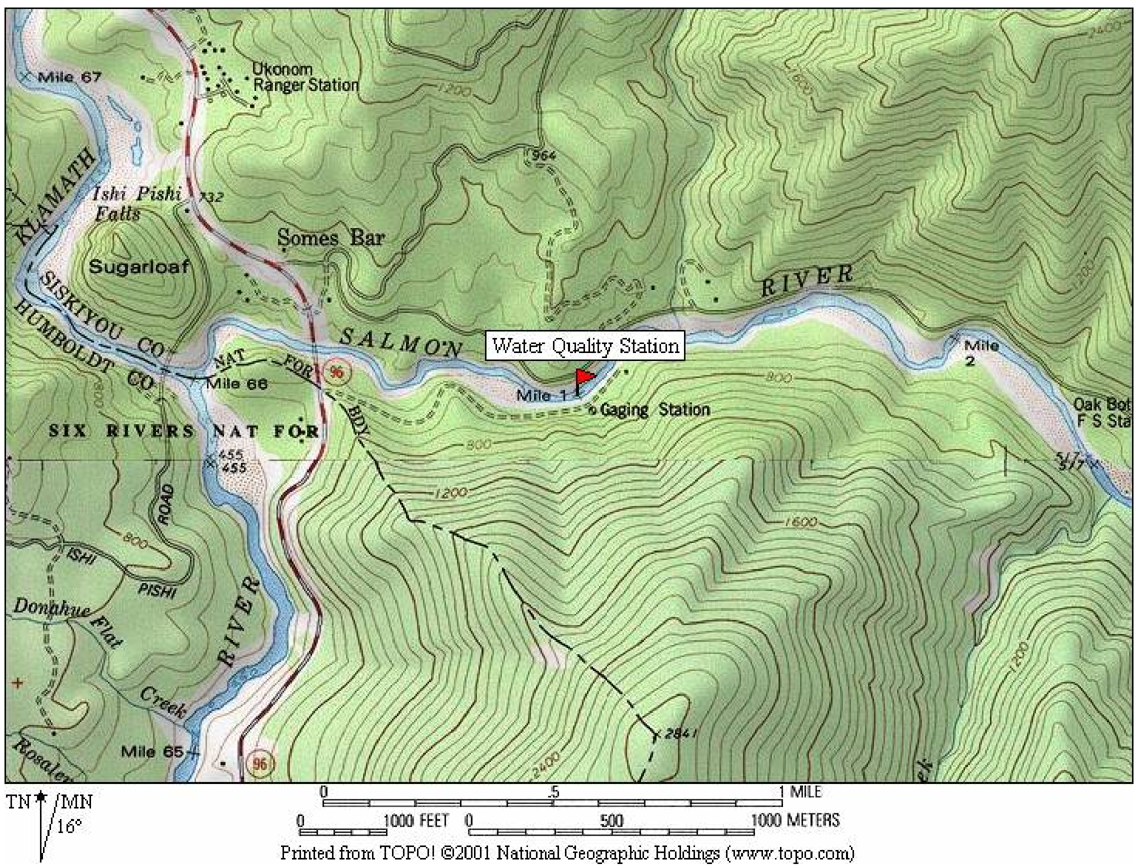

Figure 7 - Salmon River water quality station.

Figure 8 - Salmon River water quality station looking across the river and up stream.

5.2.2 Scott River

The Scott River water quality station is located about 1.25 miles from the confluence with the Klamath River (Figure 9). The drainage area for the Scott River water quality station is 520,612 acres. The Scott River is heavily diverted for agricultural use and listed on CWA section 303(d) list for sediment and temperature impairment. The TMDL has been adopted by the State and EPA and implementation has begun. Even though the Scott River is a major tributary to the Klamath, it contributes very little water once heavy irrigation begins in July (Figure 45). The Scott River used to be one of the predominant rearing locations for Coho, Fall Chinook, and Spring Chinook. The restoration of this tributary is critical to the future of the Karuk Tribal Trust fishery.

The approximate location of this station is:
Latitude: 41° 46’ 06” N
Longitude: 123° 01’ 34” W
Elevation: 489 m

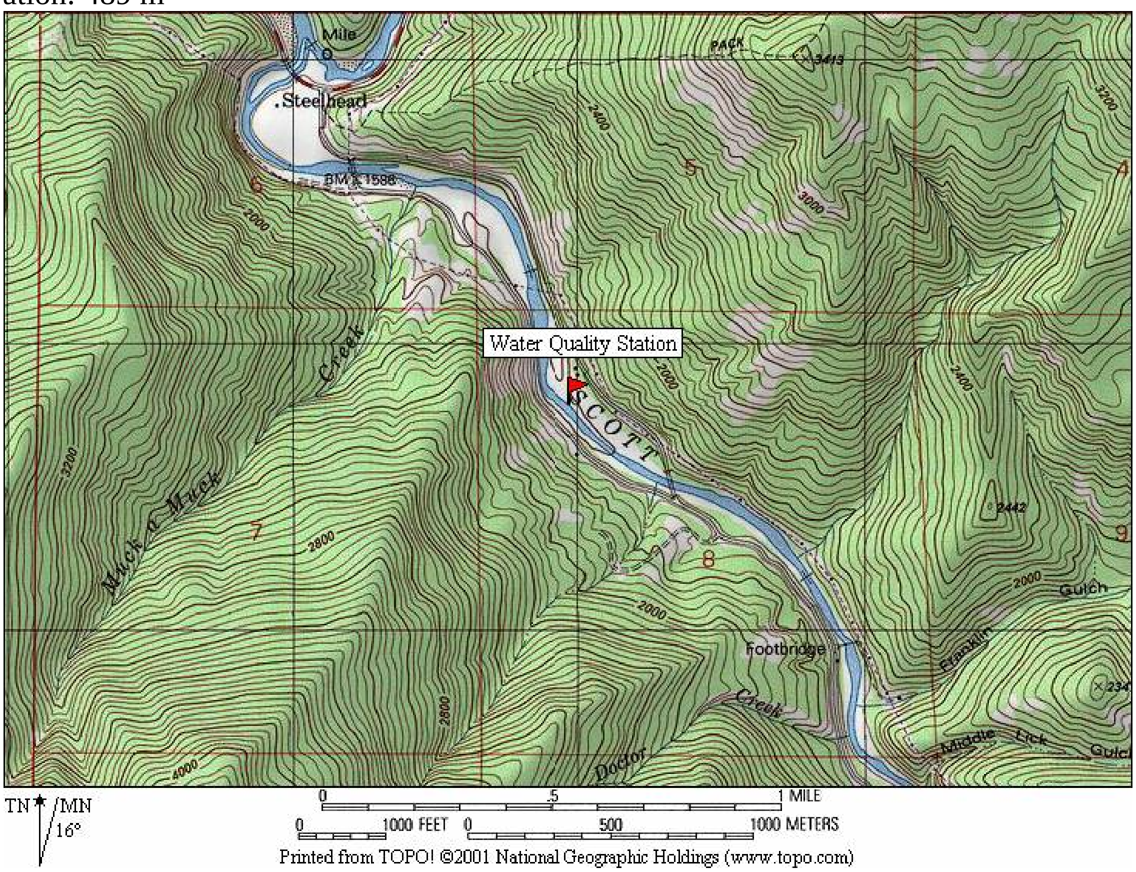

Figure 9 - Scott River water quality station.

Figure 10 - Scott River water quality station looking downstream.

5.2.3 Shasta River

The Shasta River is fed by rain and snowmelt coming down from the Klamath Mountains, in addition to numerous cold water springs. The glacier on Mt. Shasta is one of the few expanding glaciers in the country. Therefore, the Shasta River should be an important source of cold water in the hot summer months and provide excellent rearing habitat for spring Chinook, fall Chinook, Coho, and steelhead. However, the Shasta Valley has been altered by agricultural diversions and the construction of Dwinell Dam, creating Lake Shastina, which blocks fish passage about 40 miles upstream from the mouth of the River. The Shasta River is 303(d) listed for temperature and DO. As part of TMDL implementation, the NCRQCB says there needs to be an additional 45 cfs of cold spring flow in the River to meet temperature requirements. This site monitors a drainage area of approximately 793 square miles. The Shasta River ran under 200cfs throughout the summer months (Figure 39).

The approximate location of this station is:
Latitude: 41° 49' 23" N
Longitude: 122° 35' 40" W NAD 27
Elevation: 2,000.00 feet above sea level

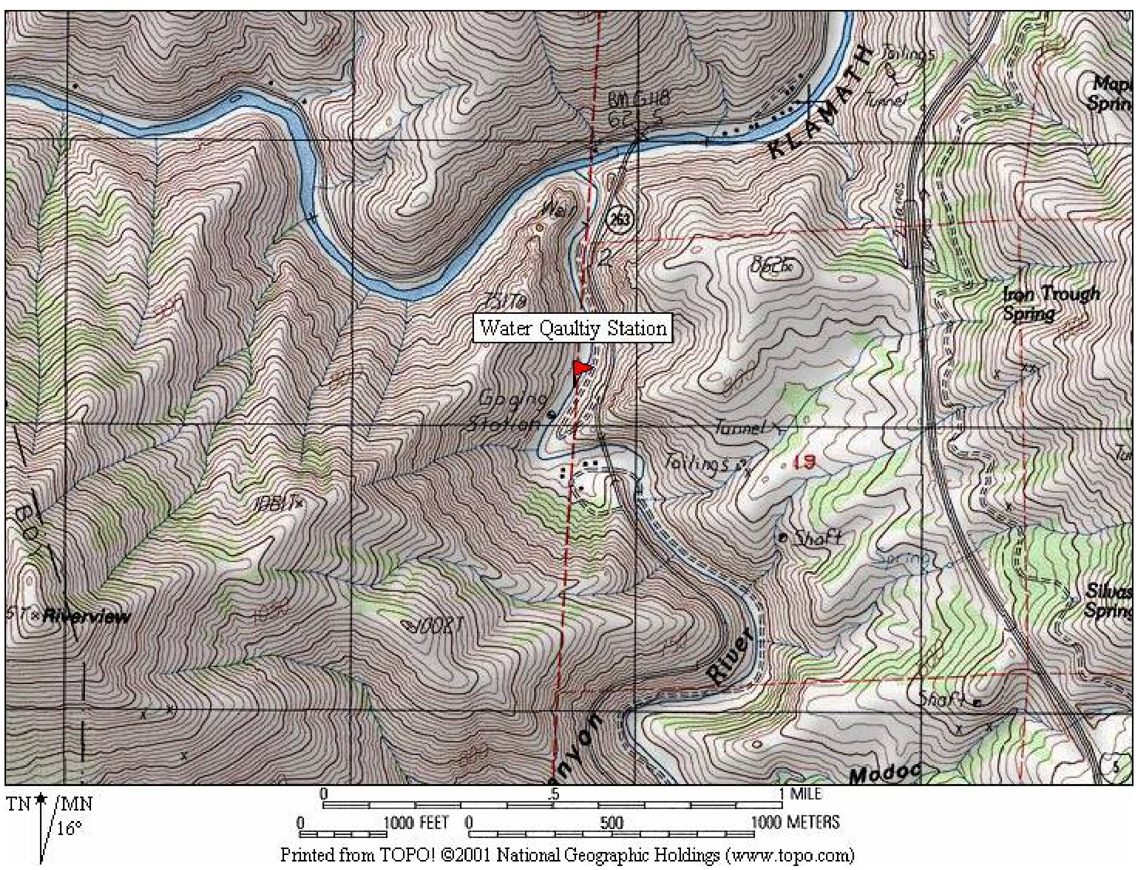

Figure 11 - Shasta River Water Quality Station.

Figure 12 - Shasta River water quality station looking downstream.

6 RESULTS

The following graphs summarize the data collected during the summer of 2006. Temperature, dissolved oxygen, pH, conductivity and flow rates are given for each of the monitoring sites. Graphs depicting accepted Karuk tribal water quality standards as compared to measured water quality conditions are also included.

6.1 Klamath River

6.1.1 Near Iron Gate Dam

6.1.1.1 Water Temperature

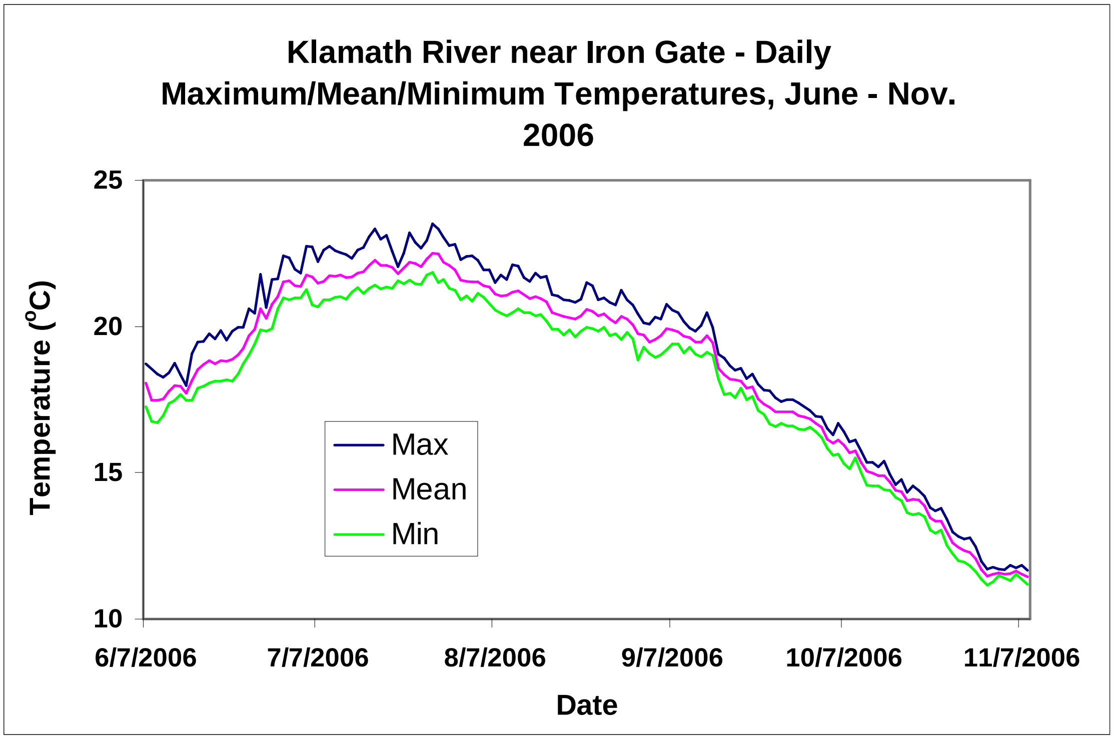

Figure 13 - Daily maximum, mean, and minimum water temperature in the Klamath River near Iron Gate from June to November, 2006

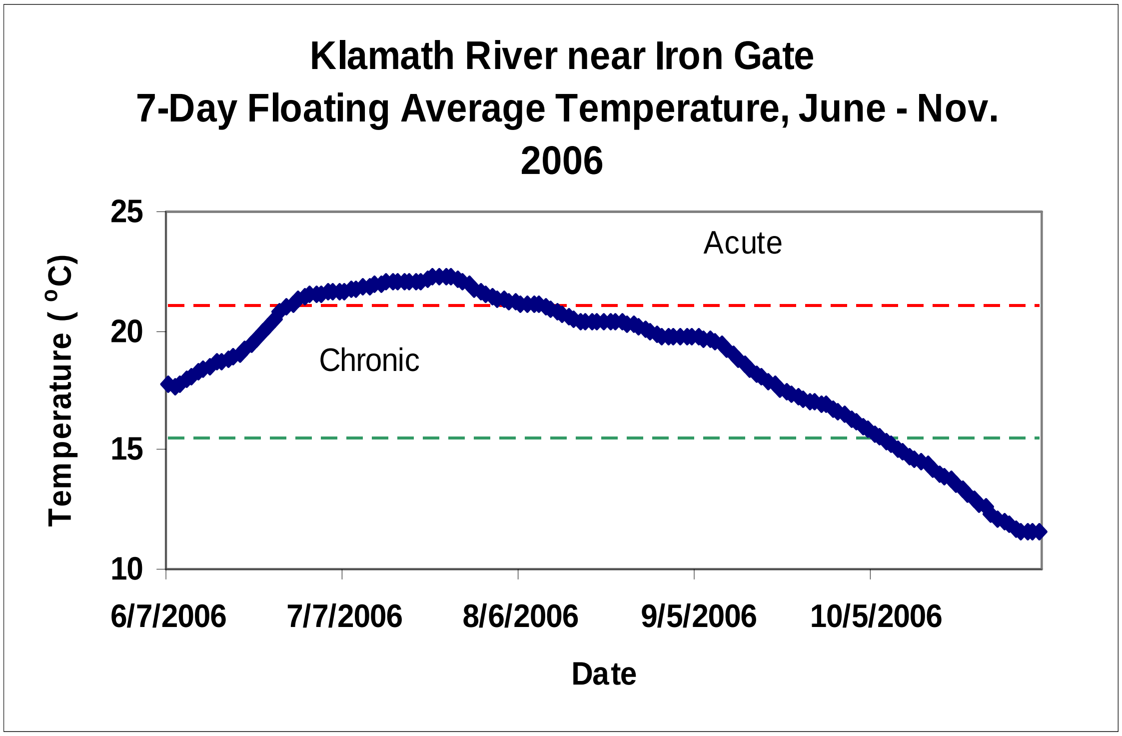

Figure 14 – 7-Day floating average temperature for the Klamath River near Iron Gate dam from June to October, 2006

6.1.1.2 Dissolved Oxygen

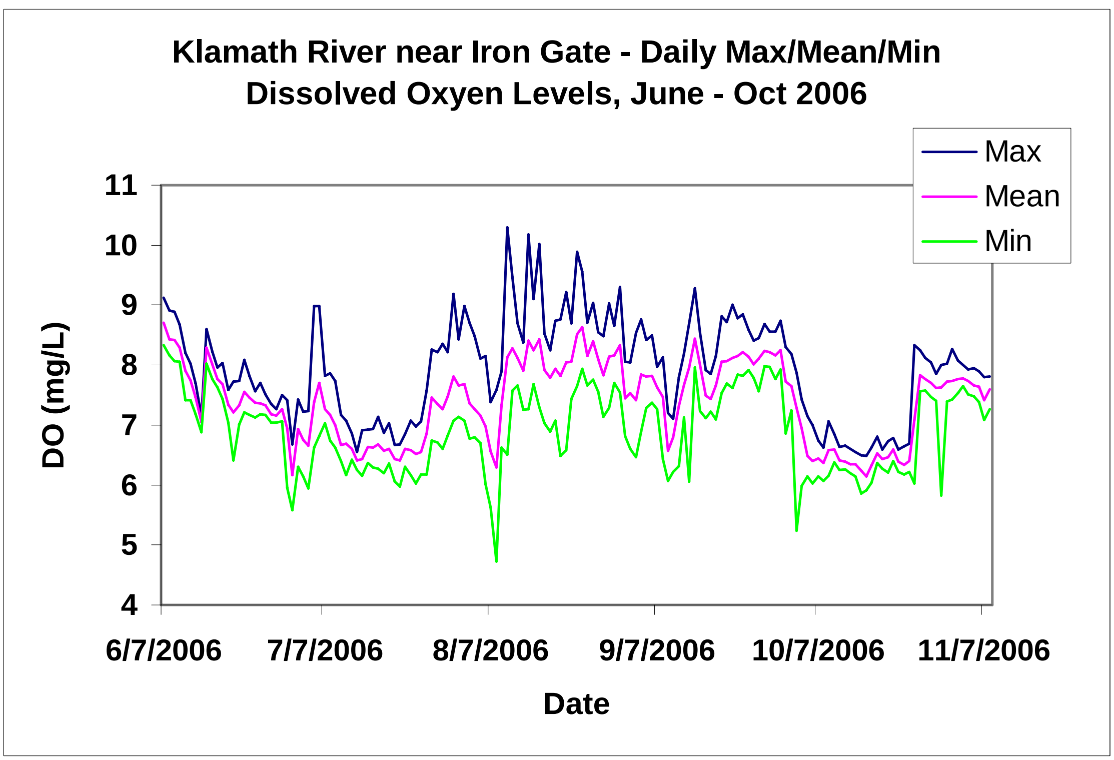

Figure 15 - Daily maximum, mean, and minimum dissolved oxygen in the Klamath River near Iron Gate Dam from June to October, 2006

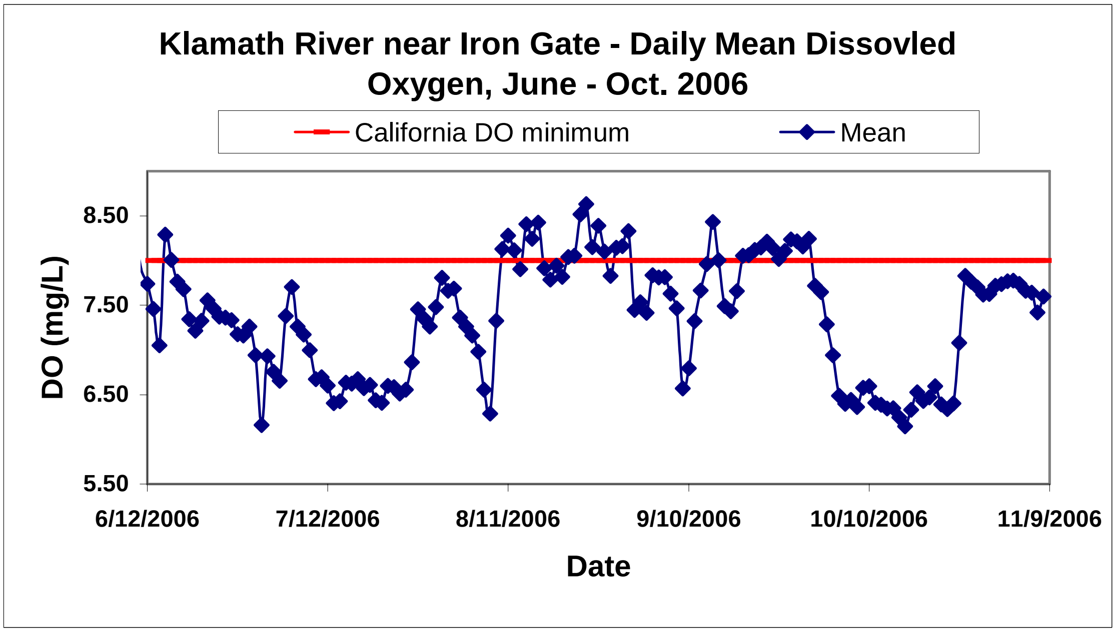

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Figure 16 - Daily mean for dissolved oxygen in the Klamath River near Iron Gate Dam from June to October, 2006

6.1.1.3 pH

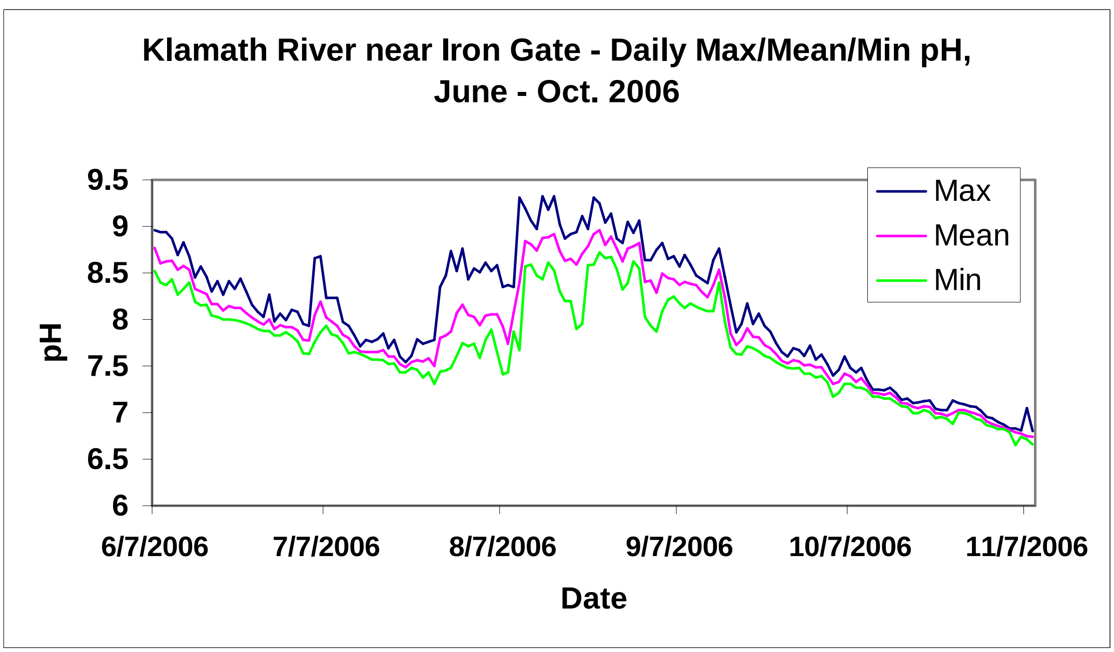

Figure 17 - Daily maximum, mean and minimum pH values on the Klamath River near Iron Gate from June to October, 2006

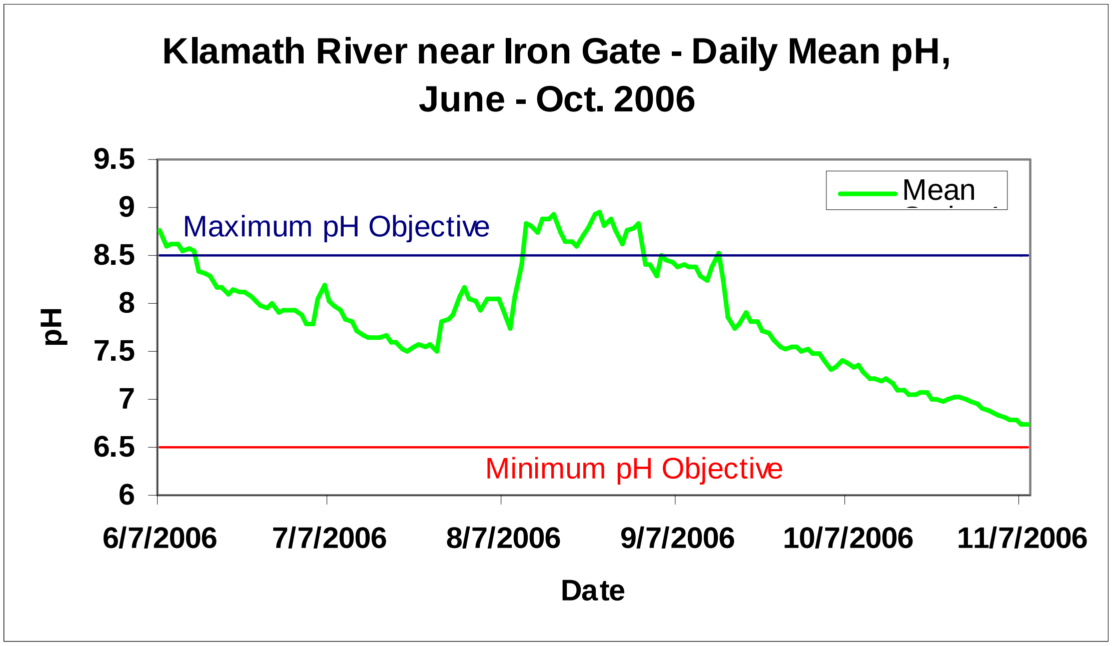

Figure 18 - Daily mean pH values on the Klamath River near Iron Gate from June to October, 2006

6.1.1.4 Specific Conductance

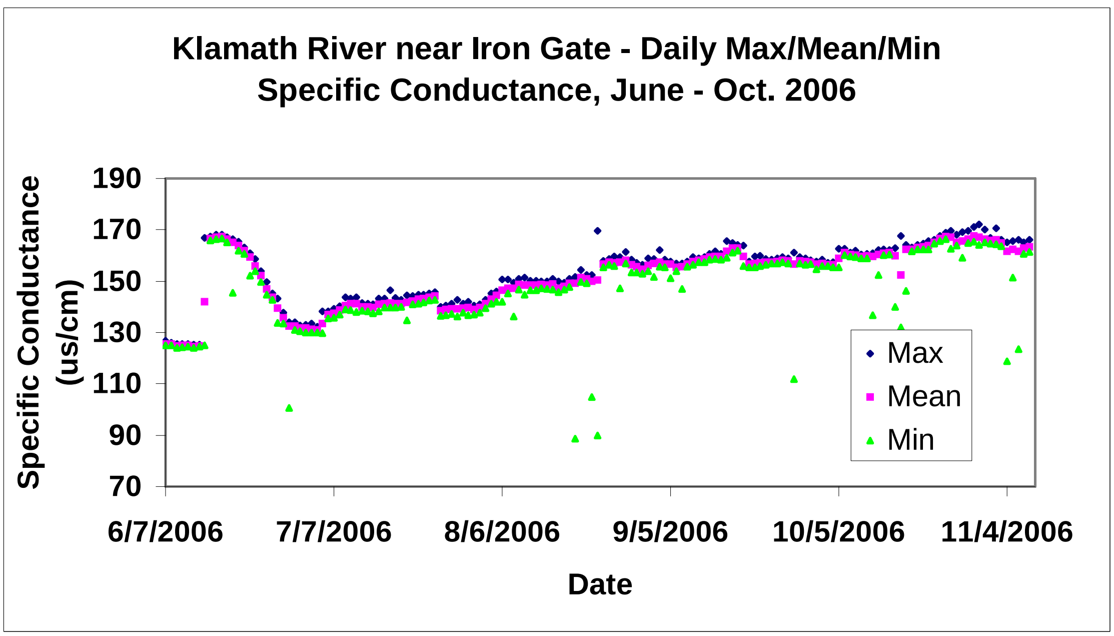

Figure 19 - Daily maximum, mean, and minimum specific conductivity in the Klamath River near Iron Gate from June to October, 2006

6.1.1.5 Flow

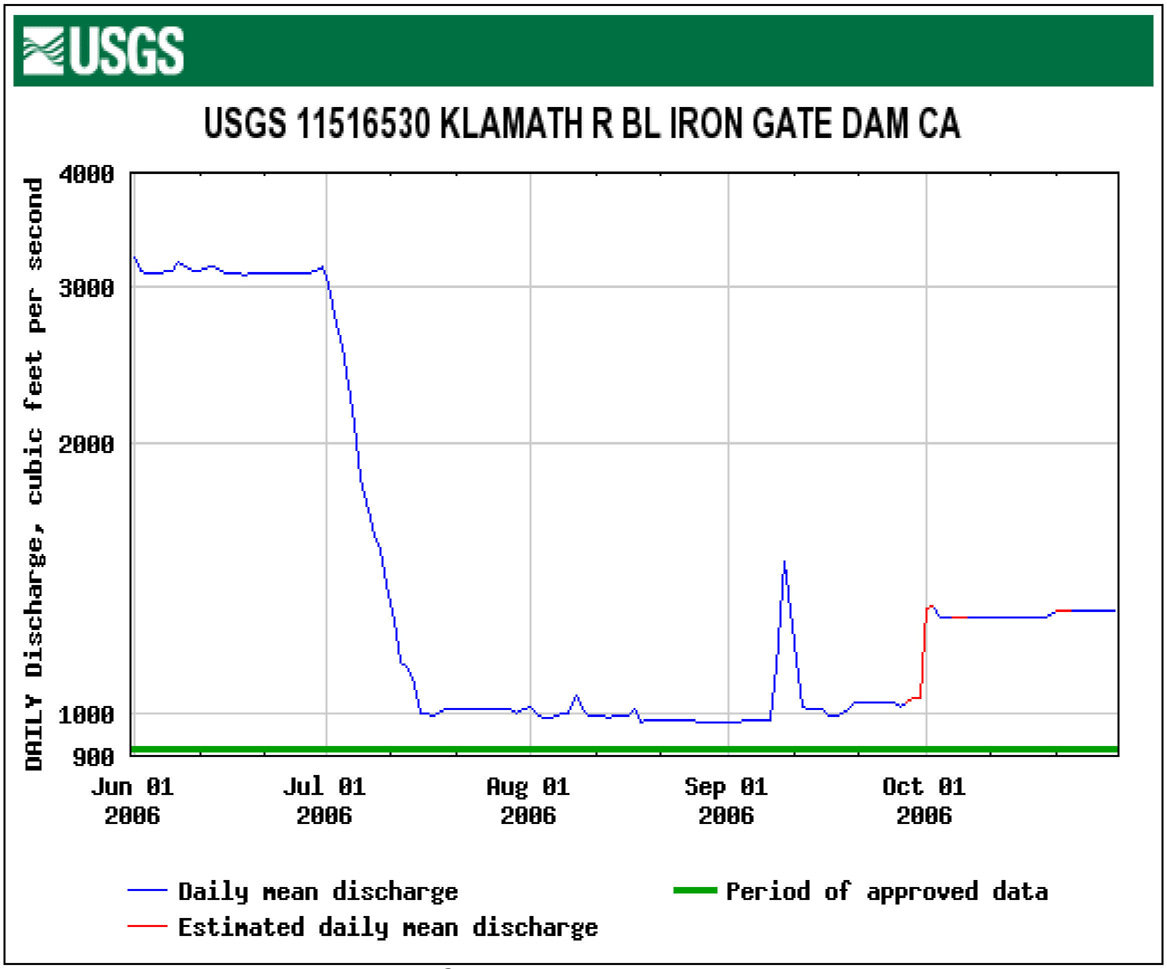

Figure 20 - Daily mean stream flow (Ft^3/sec) from the Klamath River below Iron Gate Dam USGS flow gauge from April to October, 2006

6.1.2 Near Seiad Valley

6.1.2.1 Water Temperature

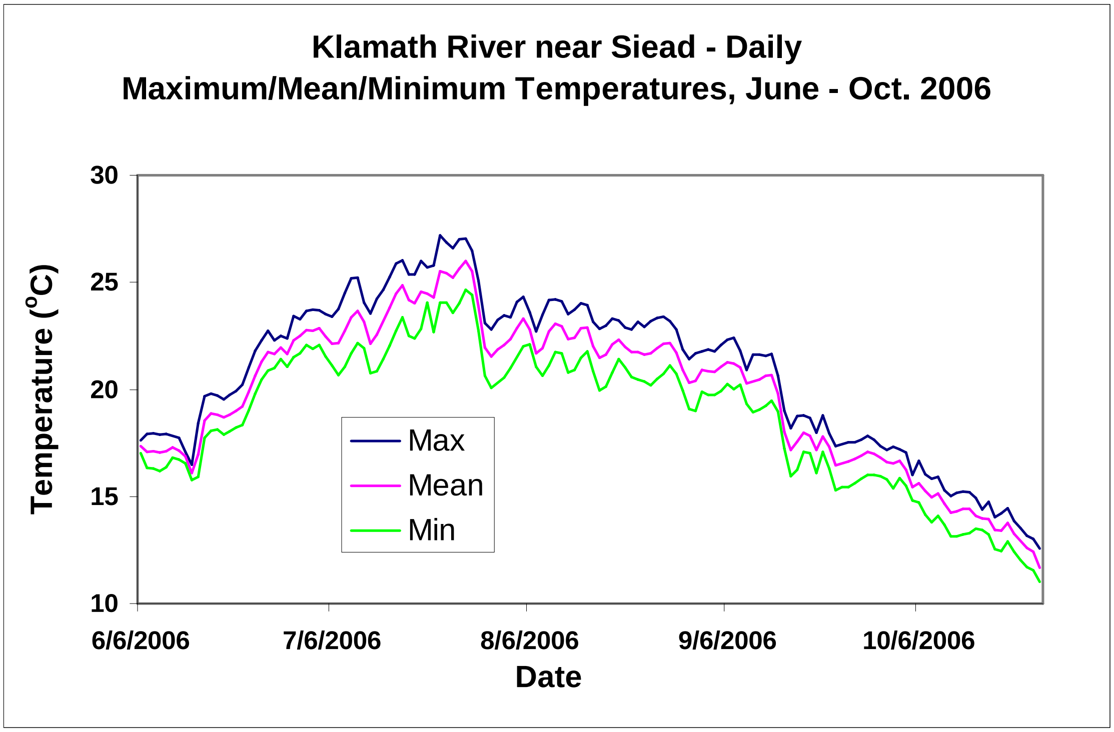

Figure 21 - Daily maximum, mean, and minimum water temperature in the Klamath River near Siead from June to October, 2006

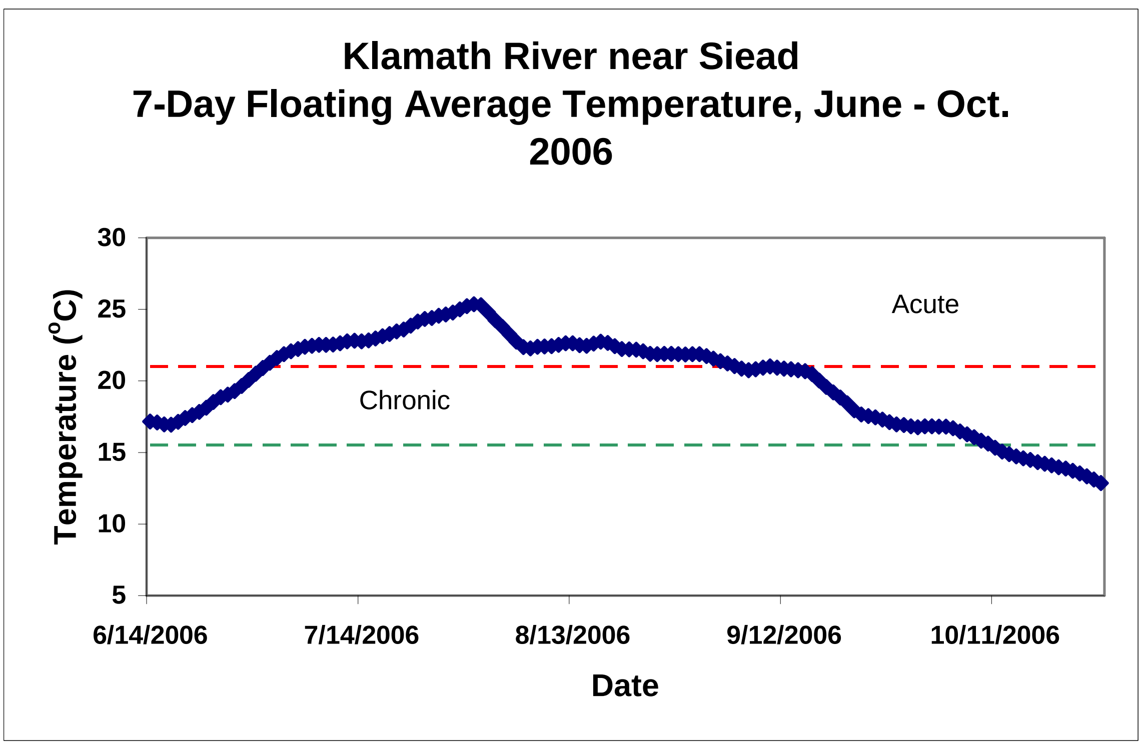

Figure 22 – 7-day floating average temperature for the Klamath River near Siead from June to October, 2006

6.1.2.2 Dissolved Oxygen

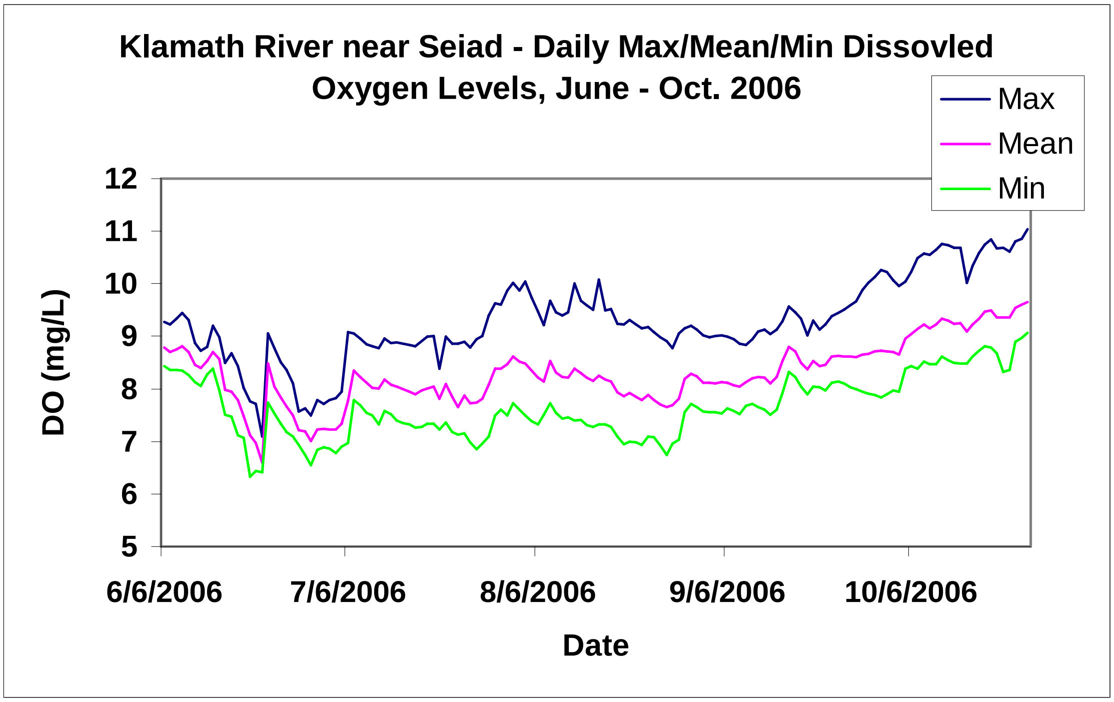

Figure 23 - Daily maximum, mean, and minimum dissolved oxygen in the Klamath River near Seiad from June to October, 2006

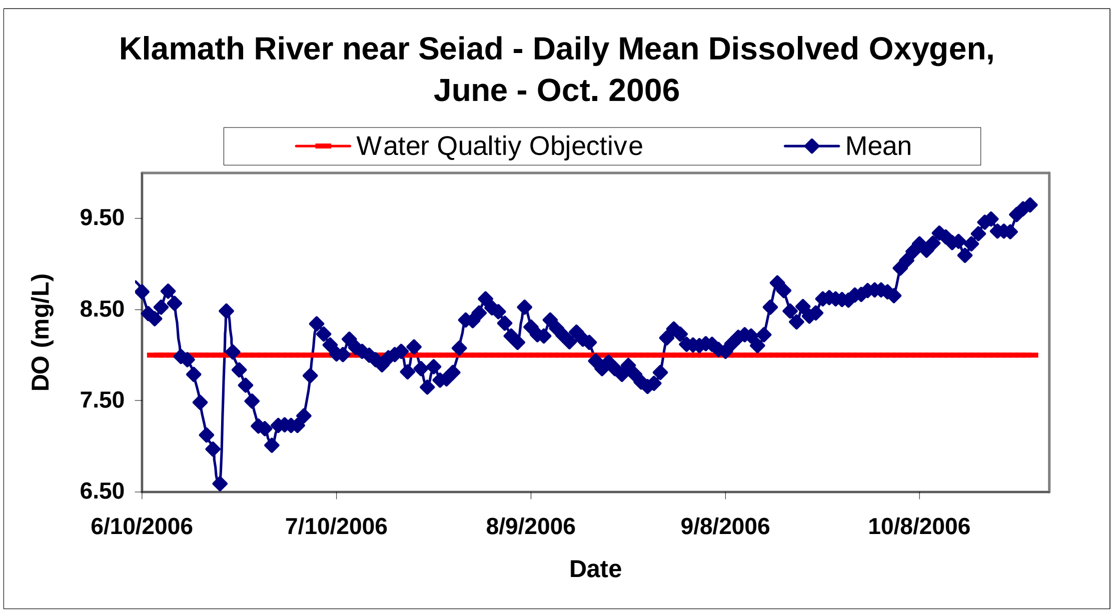

Figure 24 - Daily mean dissolved oxygen in the Klamath River near Seiad from June to October, 2006

6.1.2.3 pH

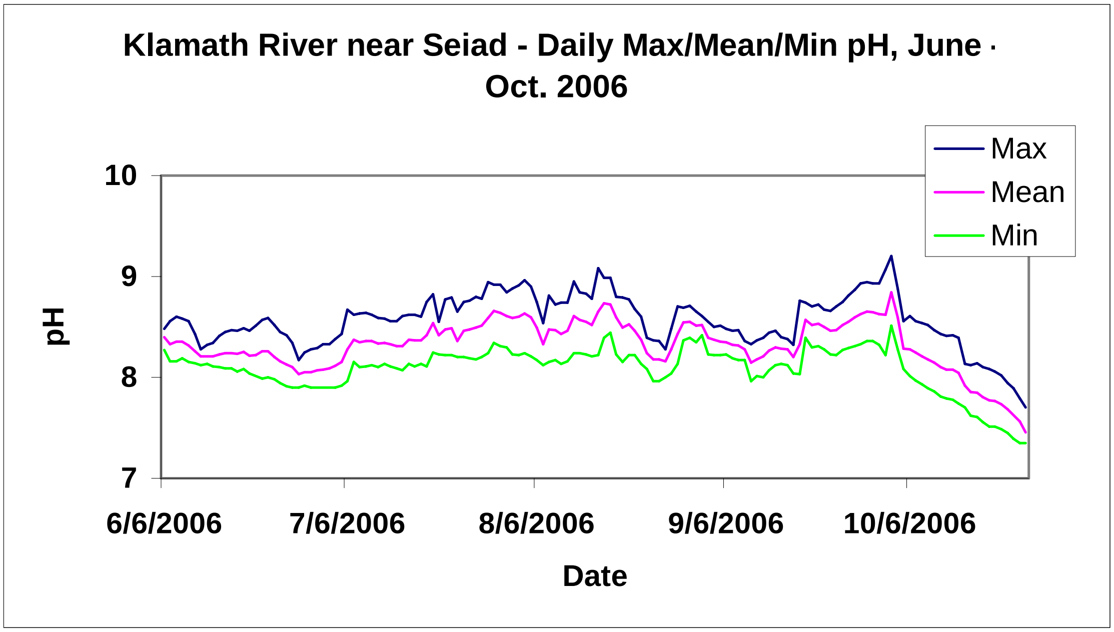

Figure 25 - Daily maximum, mean and minimum pH values on the Klamath River near Seiad from May to October, 2006

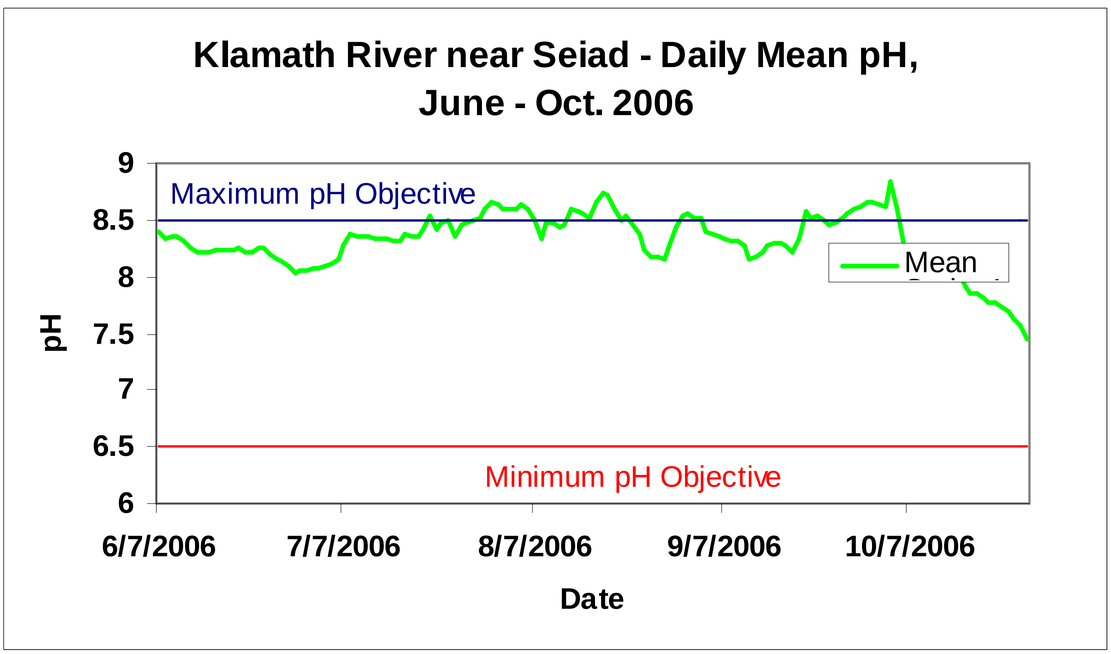

Figure 26 - Daily mean pH values on the Klamath River near Iron Gate from June to October, 2006

6.1.2.4 Specific Conductance

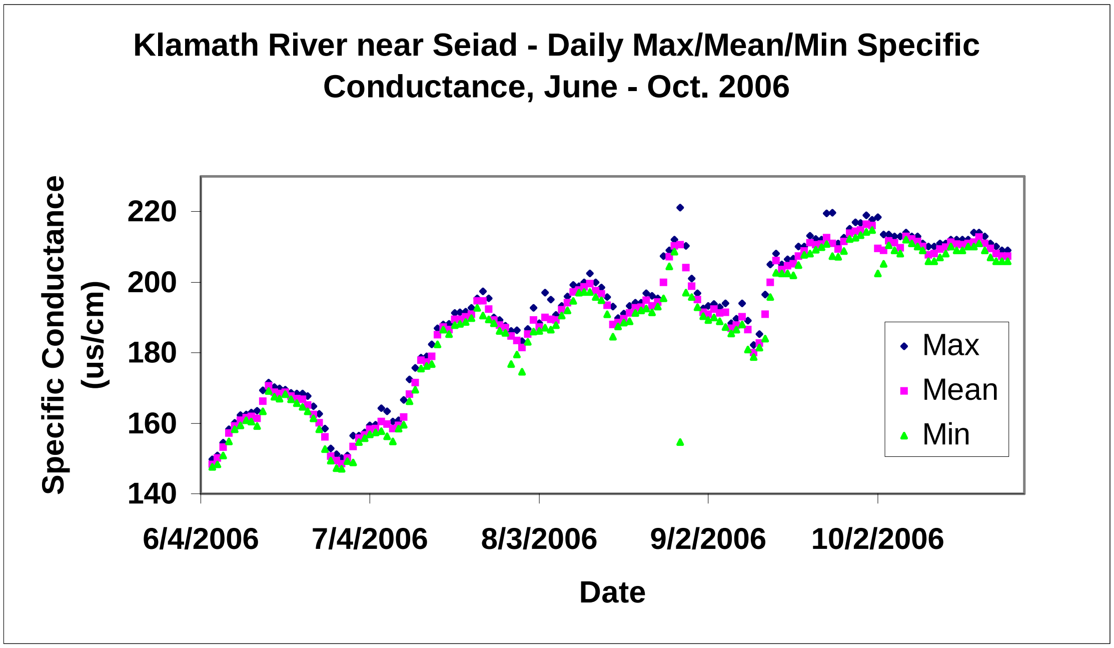

Figure 27 - Daily maximum, mean, and minimum specific conductivity in the Klamath River near Seiad from June to October, 2006

6.1.2.5 Flow

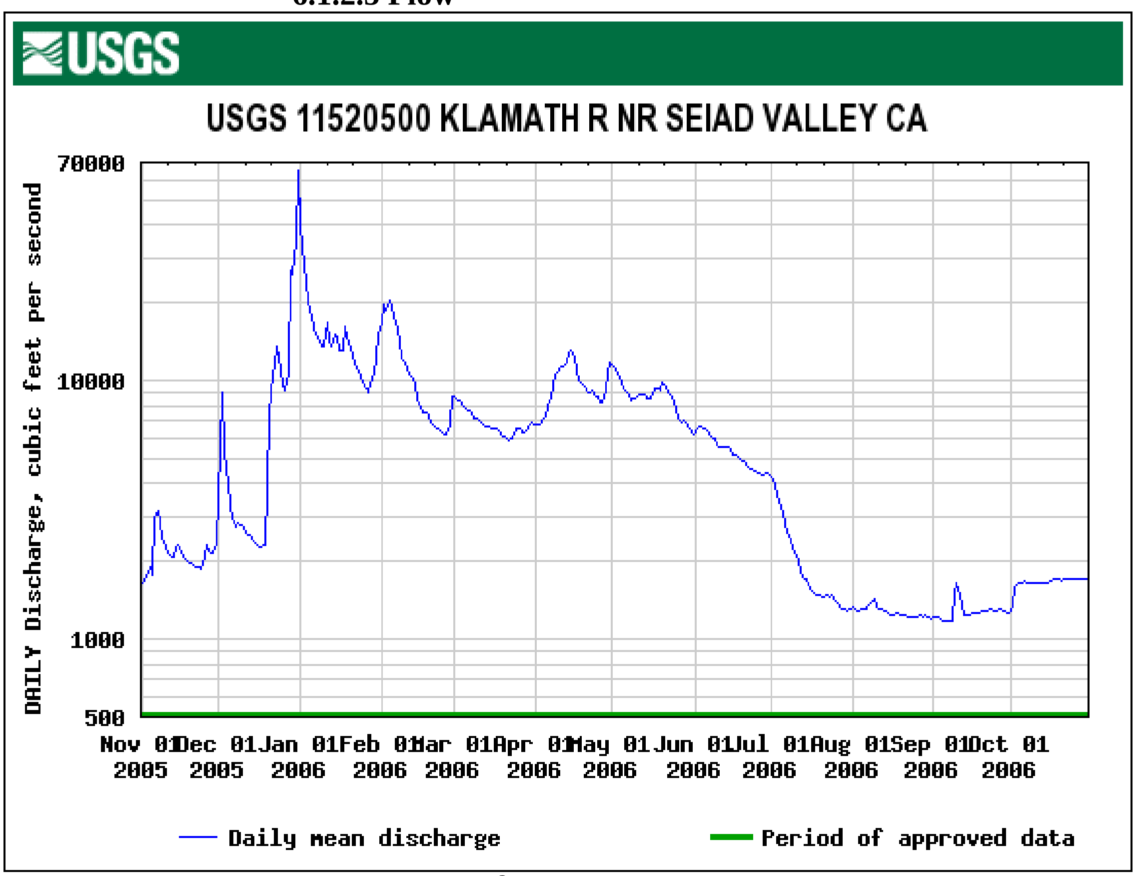

Figure 28- Daily mean stream flow (Ft^3/sec) from the Klamath River at the Seiad USGS flow gauge from April to October, 2006

6.1.3 Near Orleans

6.1.3.1 Water Temperature

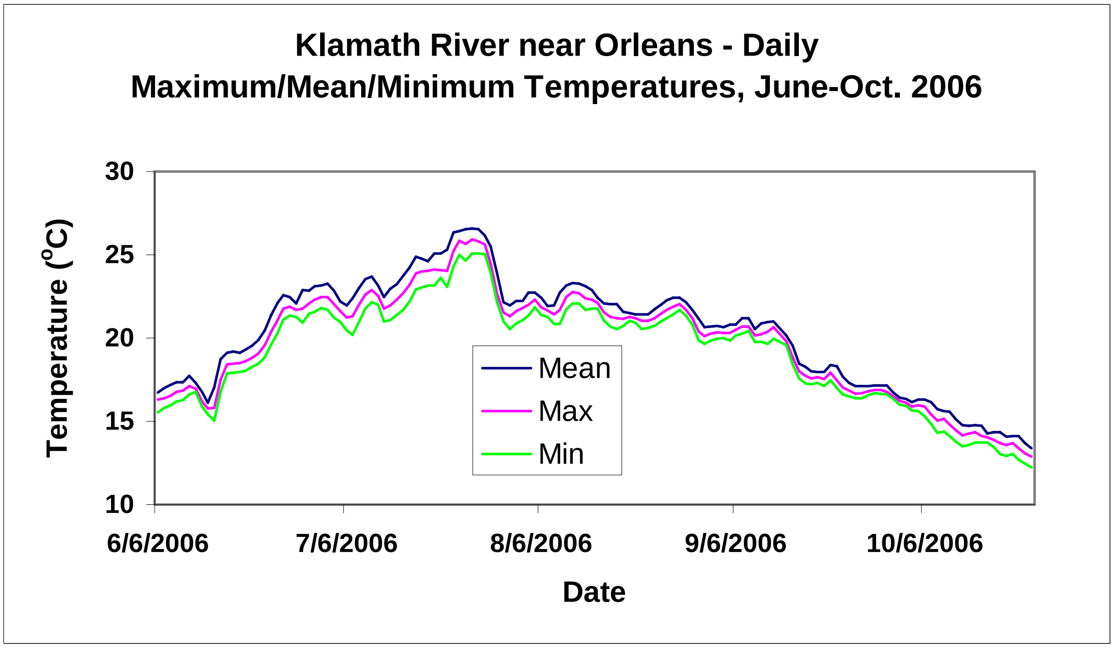

Figure 29 - Daily maximum, mean, and minimum water temperature in the Klamath River near Orleans from June to October, 2006

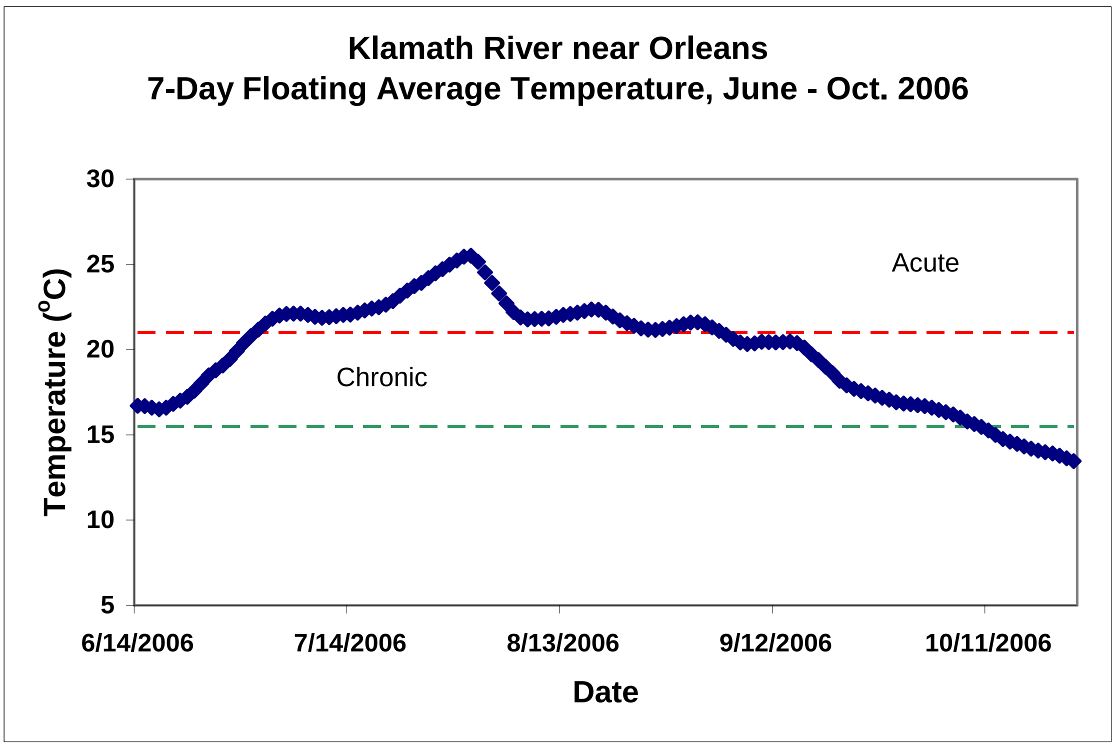

Figure 30 - Maximum weekly average temperature for the Klamath River near Orleans from May to October, 2006

6.1.3.2 Dissolved Oxygen

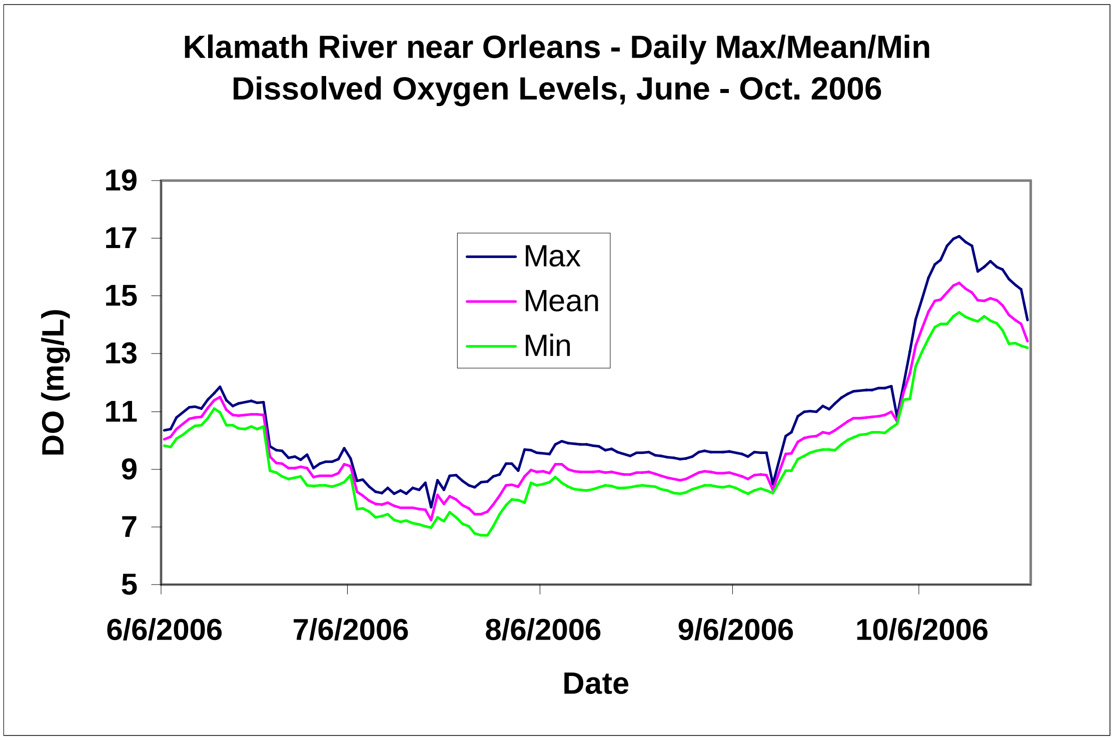

Figure 31 - Daily maximum, mean, and minimum dissolved oxygen in the Klamath River near Orleans from June to October, 2006

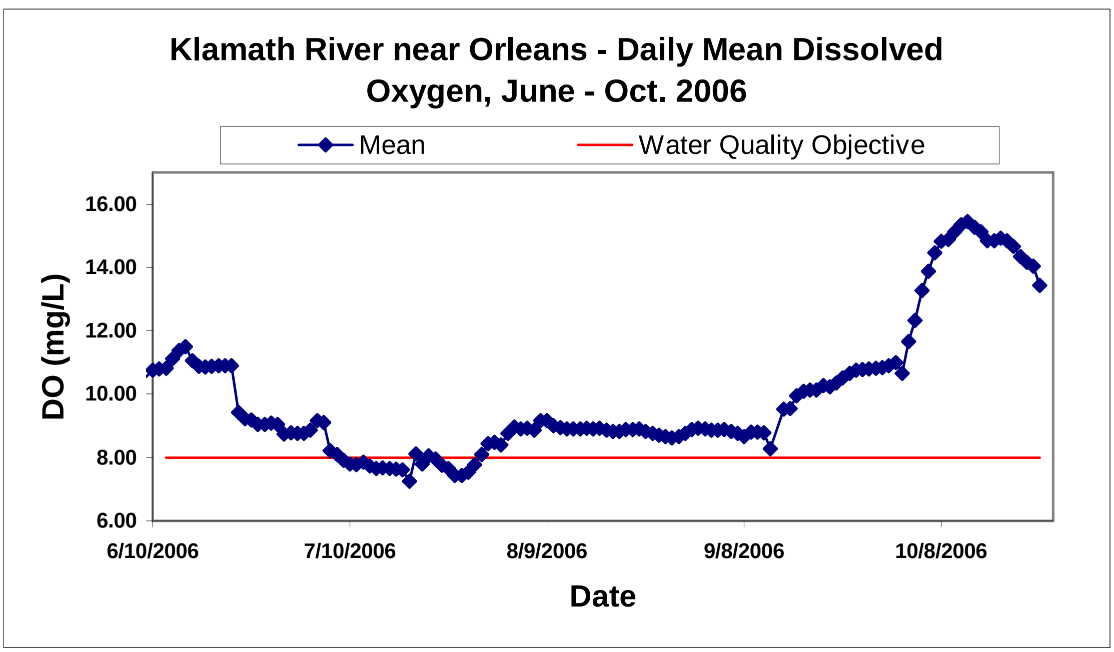

Figure 32 - Daily mean dissolved oxygen in the Klamath River near Orleans from June to October, 2006

6.1.3.3 pH

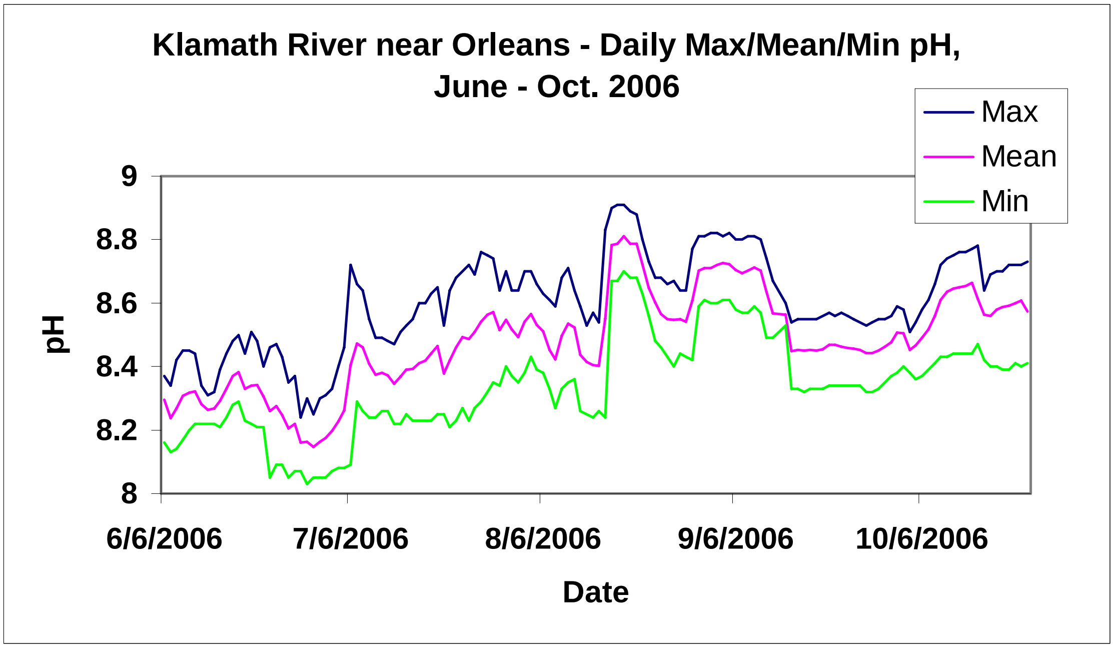

Figure 33 - Daily maximum, mean and minimum pH values on the Klamath River near Orleans from June to October, 2006

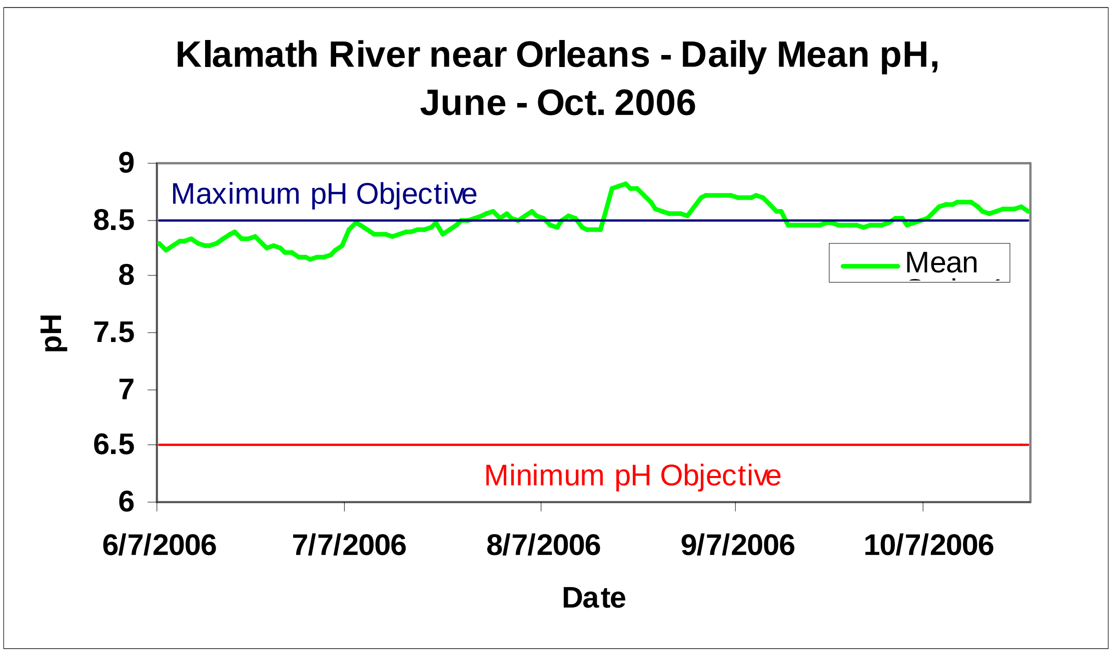

Figure 34 - Daily mean pH values on the Klamath River near Orleans from June to October, 2006

6.1.3.4 Specific Conductance

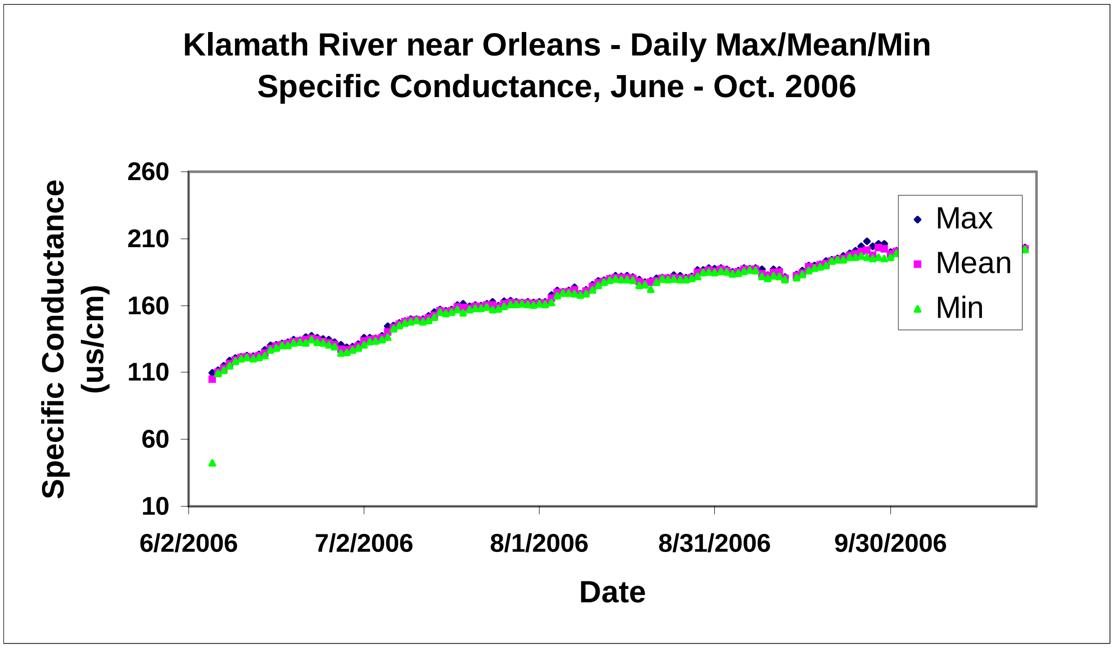

Figure 35 - Daily maximum, mean, and minimum specific conductivity in the Klamath River near Orleans from June to October, 2006

6.1.3.5 Flow

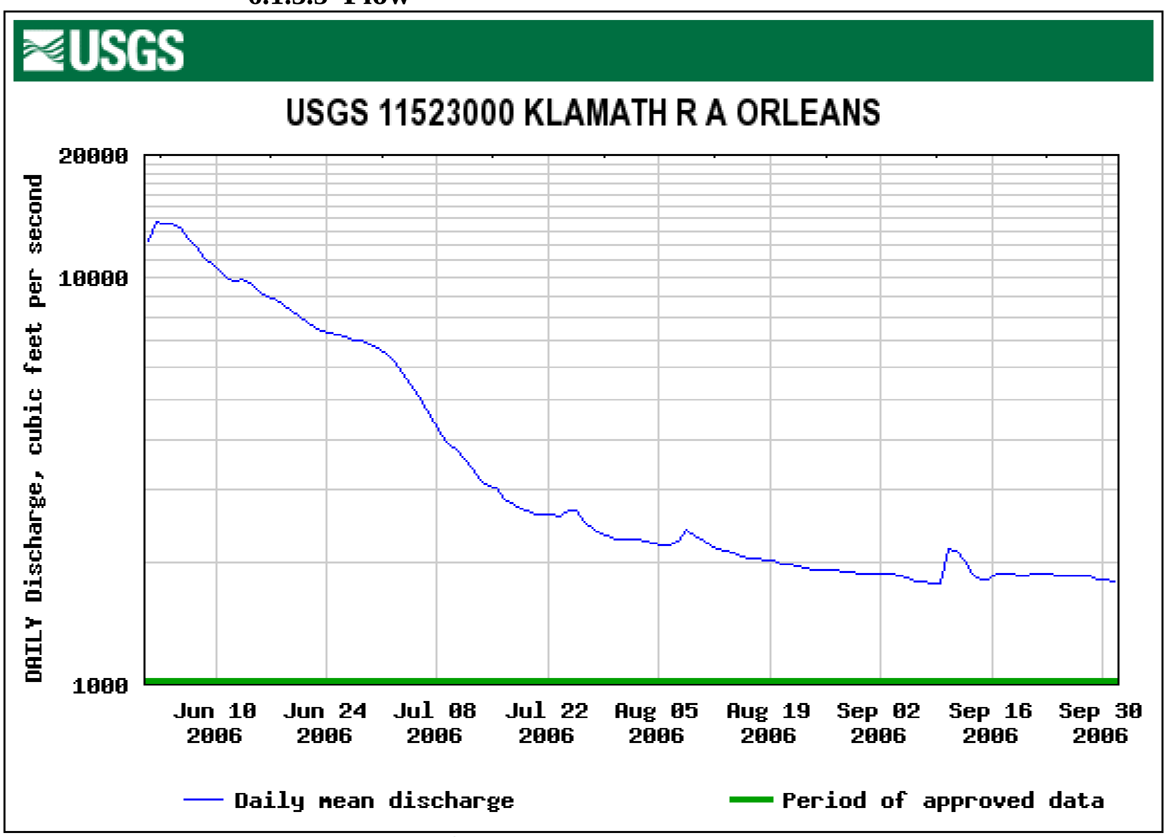

Figure 36 - Daily mean stream flow (Ft^3/sec) from the Klamath River at the Orleans USGS flow gauge from April to October, 2006

6.2 Tributaries

6.2.1 Shasta River

6.2.1.1 Water Temperature

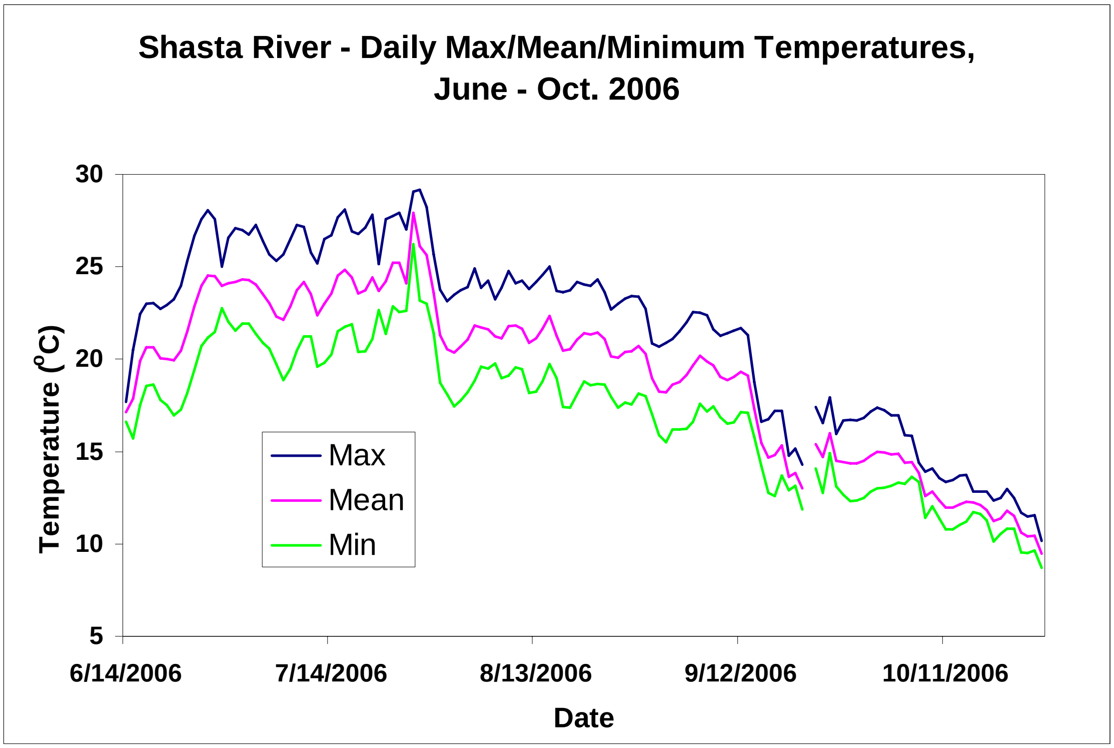

Figure 37- Daily maximum, mean, and minimum water temperature in the Shasta River from June to October, 2006

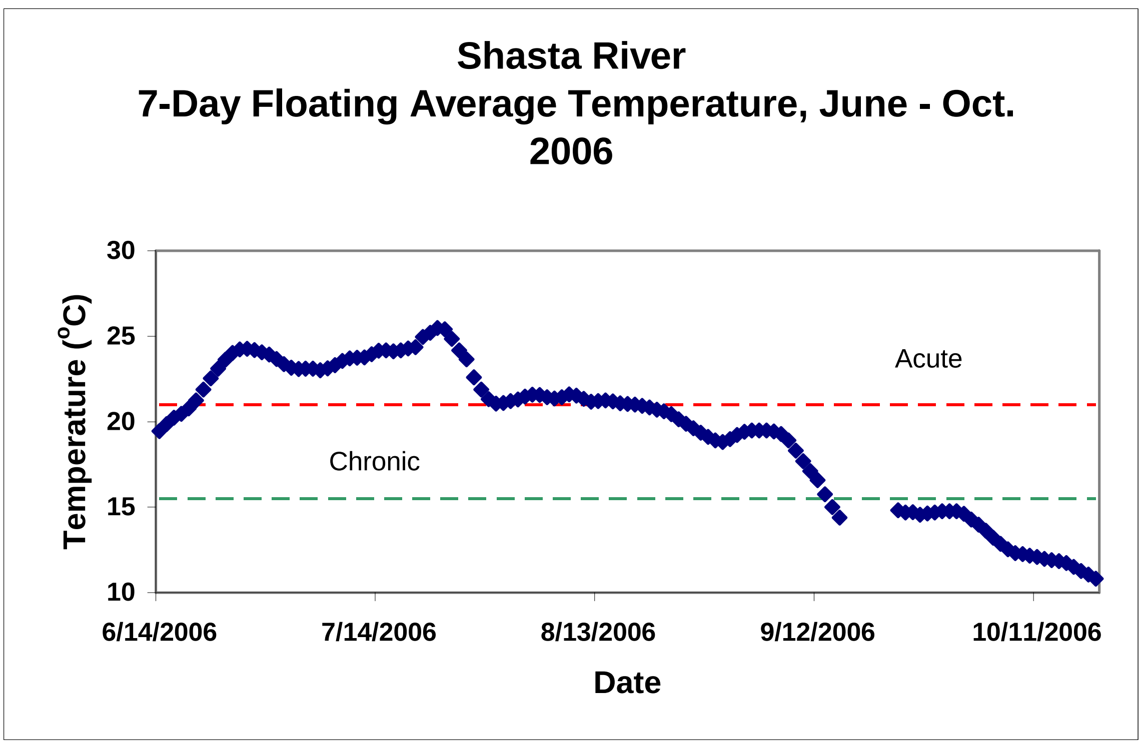

Figure 38 - Maximum weekly average temperature for the Shasta River from June to October, 2006

6.2.1.2 Dissolved Oxygen

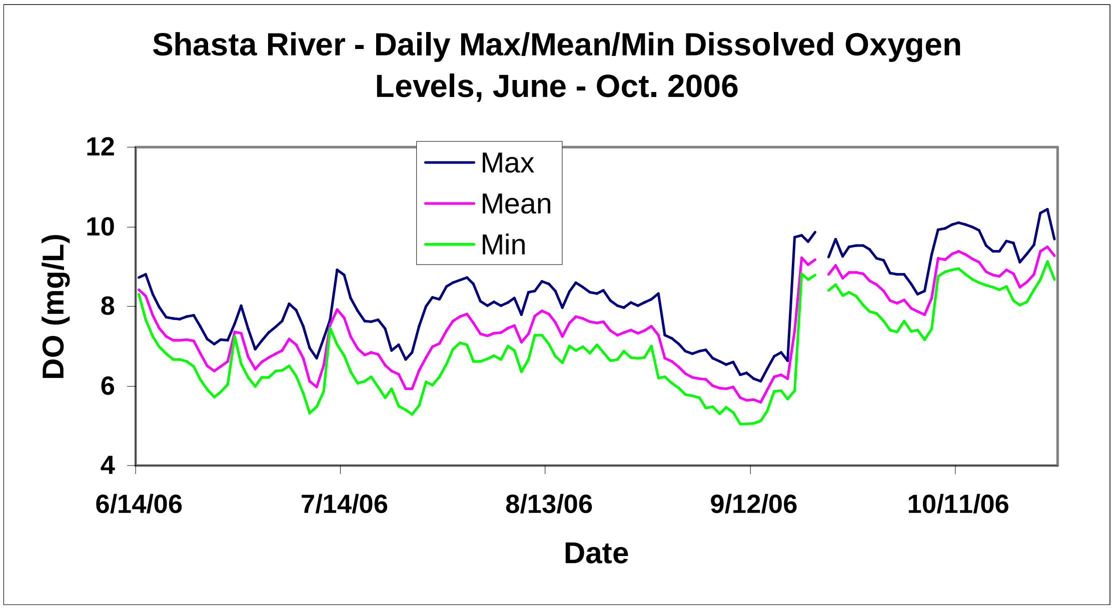

Figure 39 - Daily maximum, mean, and minimum dissolved oxygen in the Shasta River from June to October, 2006

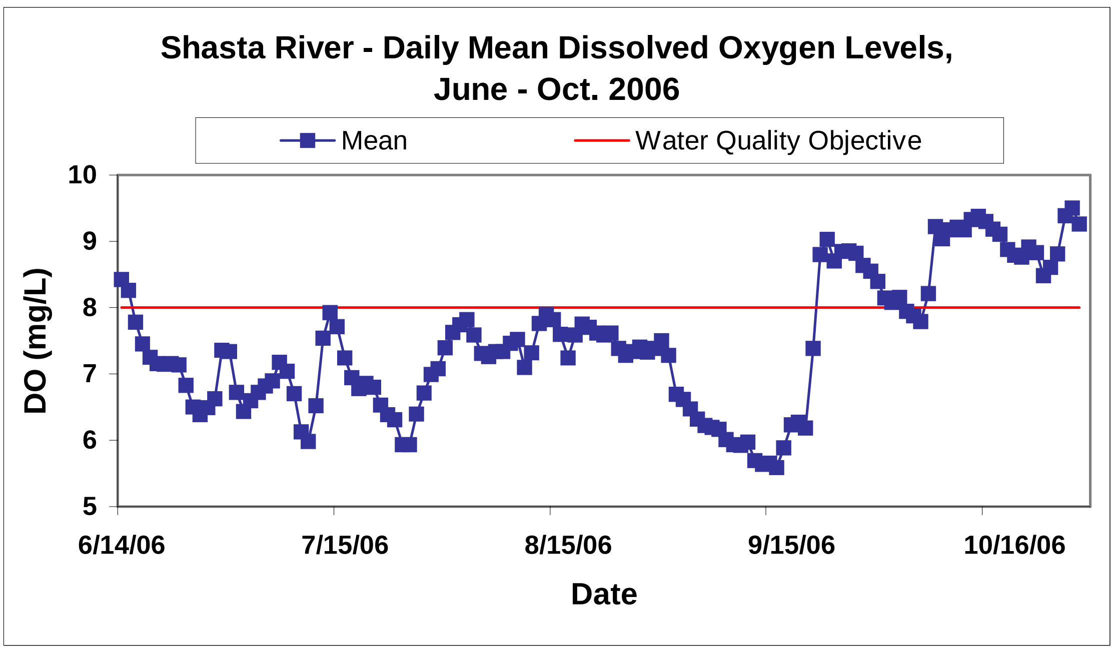

Figure 40 - Daily mean dissolved oxygen in the Shasta River from June to October, 2006

6.2.1.3 pH

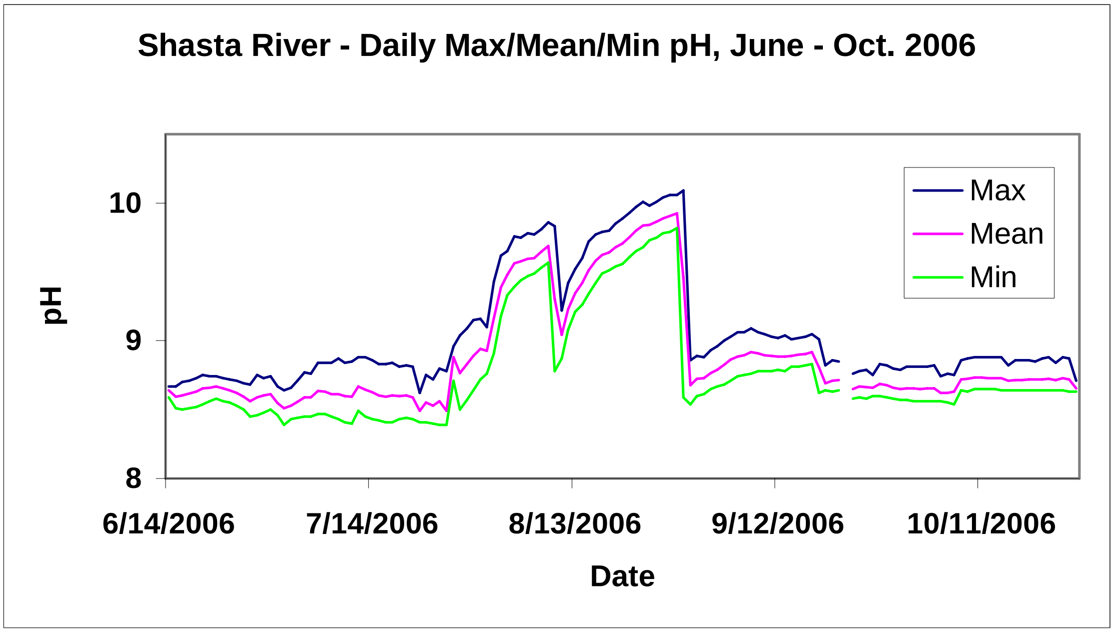

Figure 41 - Daily maximum, mean and minimum pH values on the Shasta River from June to October, 2006

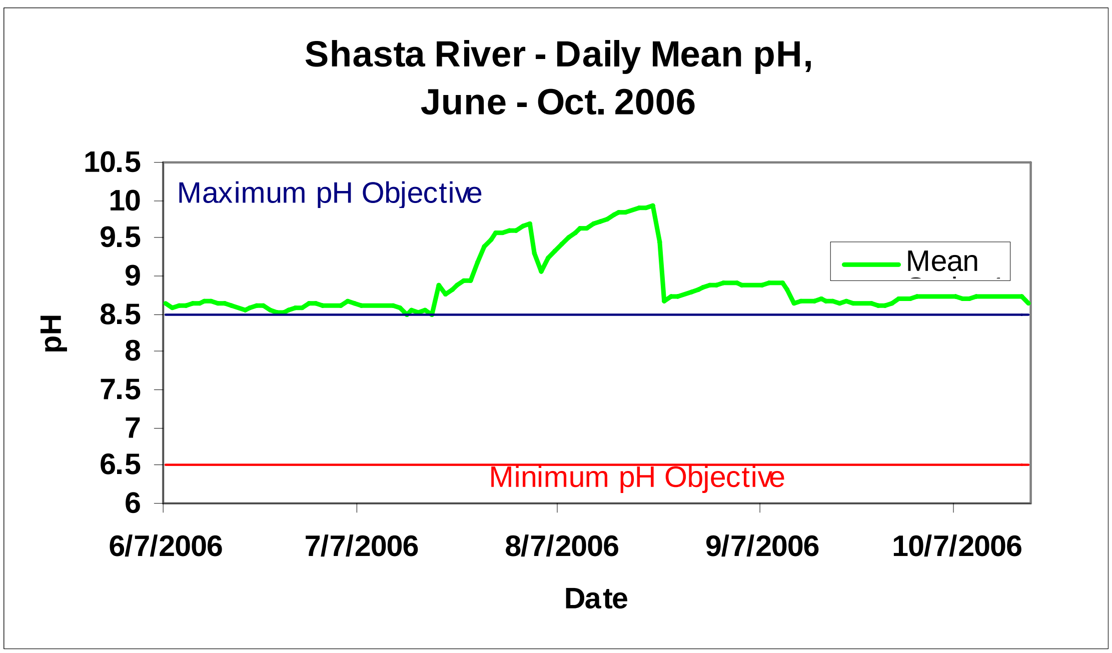

Figure 42 - Daily mean pH values on the Shasta River from June to October, 2006

6.2.1.4 Specific Conductance

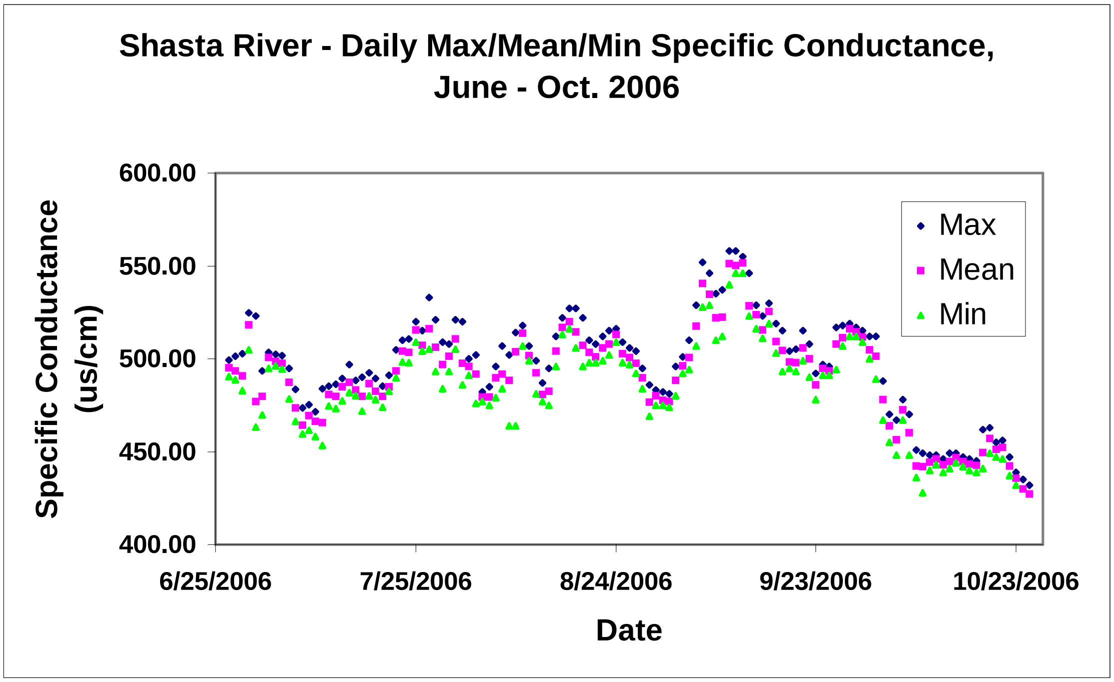

Figure 43 - Daily maximum, mean and minimum specific conductance values on the Shasta River from June to October, 2006

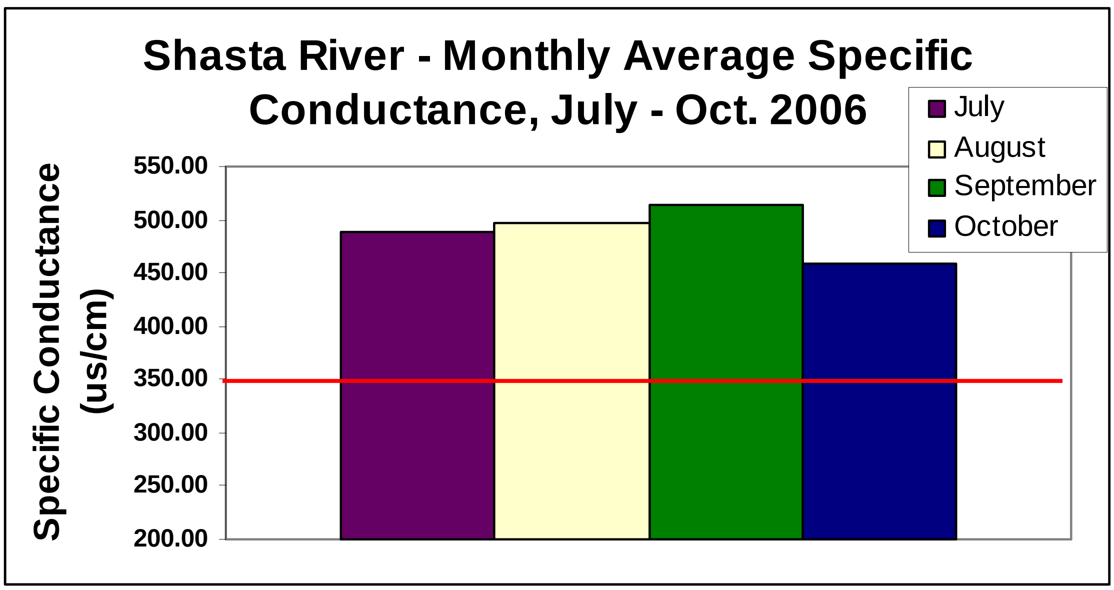

Figure 44 - Monthly average specific conductance from July to October, 2006 with maximum monthly specific conductance objective.

6.2.1.5 Flow

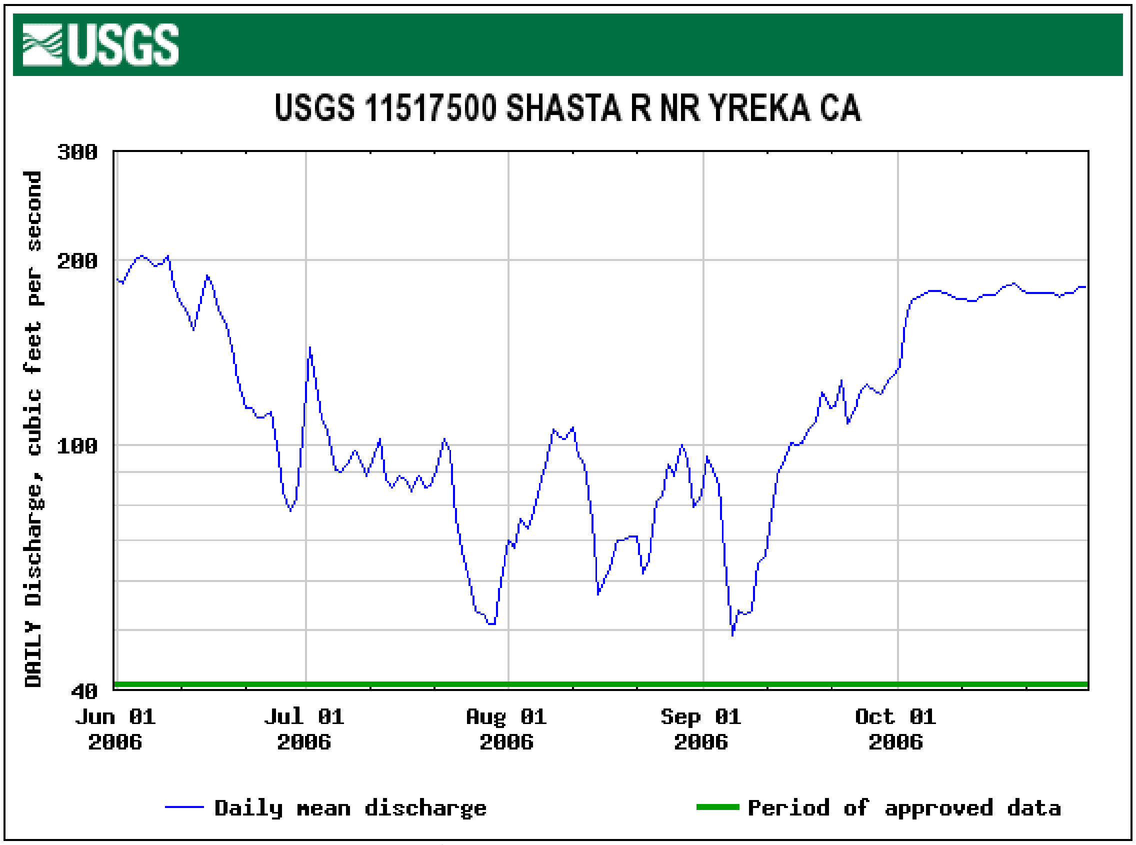

Figure 45 - Daily mean stream flow (Ft^3/sec) from the Shasta River at USGS flow gauge from June to October, 2006

6.2.2 Scott River

6.2.2.1 Water Temperature

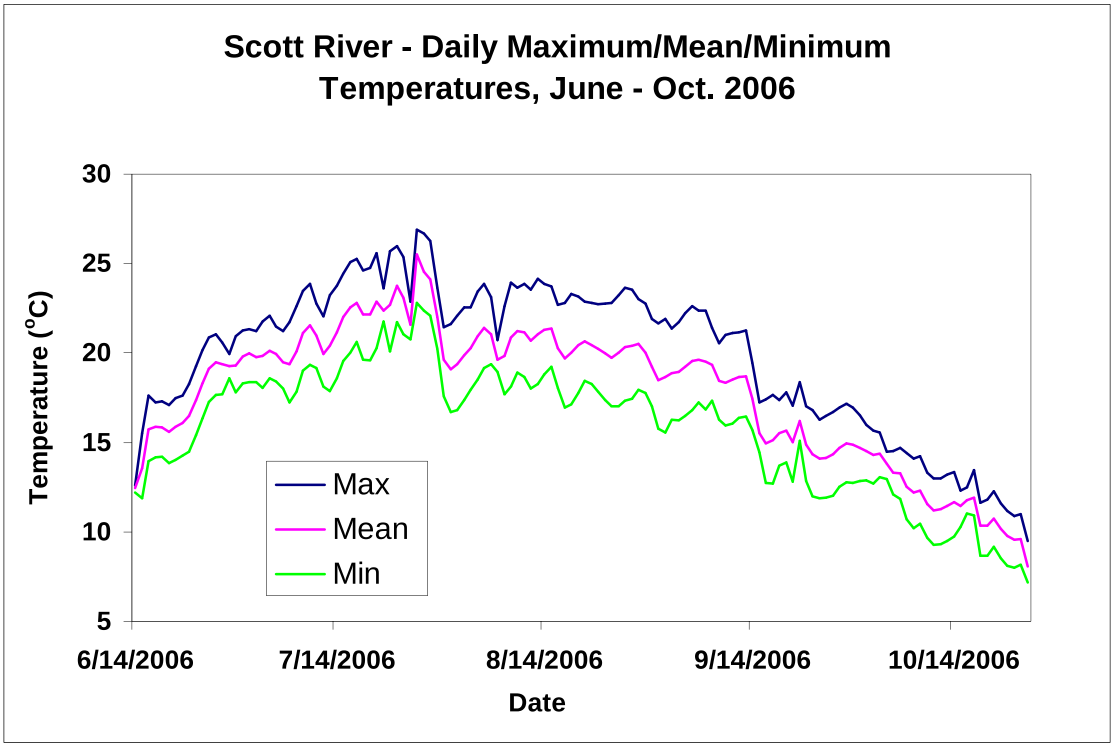

Figure 46 - Daily maximum, mean, and minimum water temperature in the Scott River from June to October, 2006

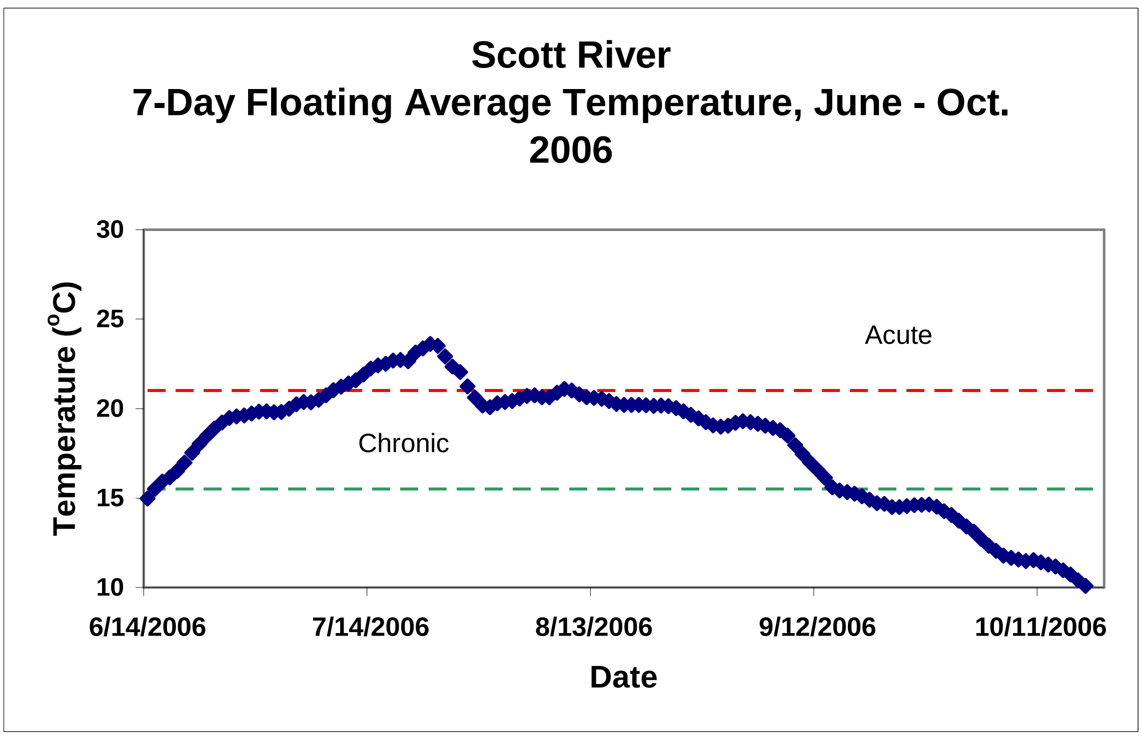

Figure 47 – 7-day floating average temperature for the Scott River from June to October, 2006

6.2.2.2 Dissolved Oxygen

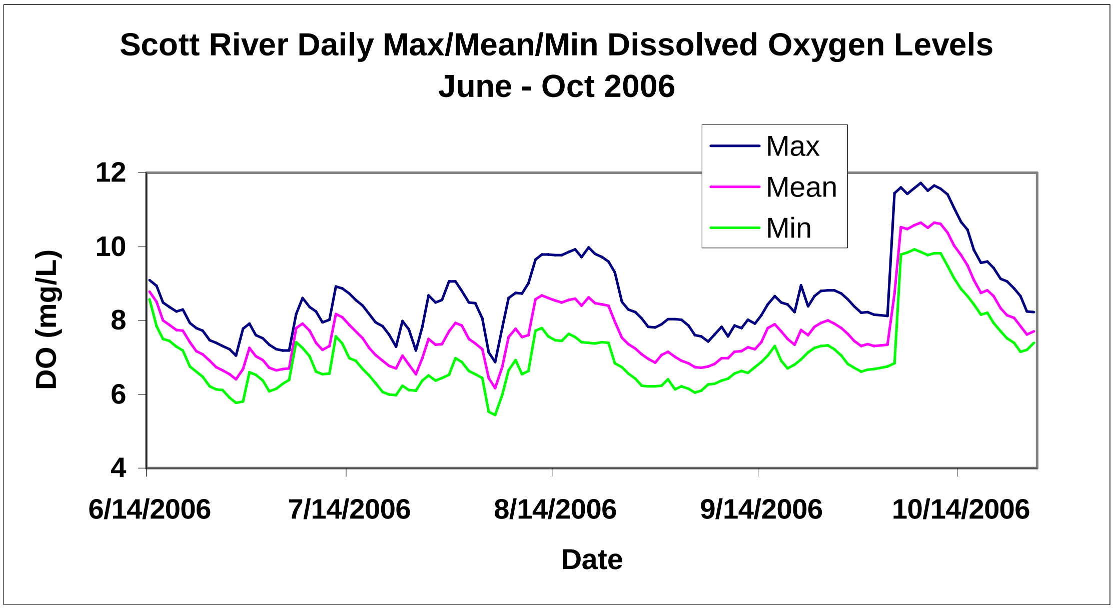

Figure 48 - Daily maximum, mean, and minimum dissolved oxygen in the Scott River from June to October, 2006

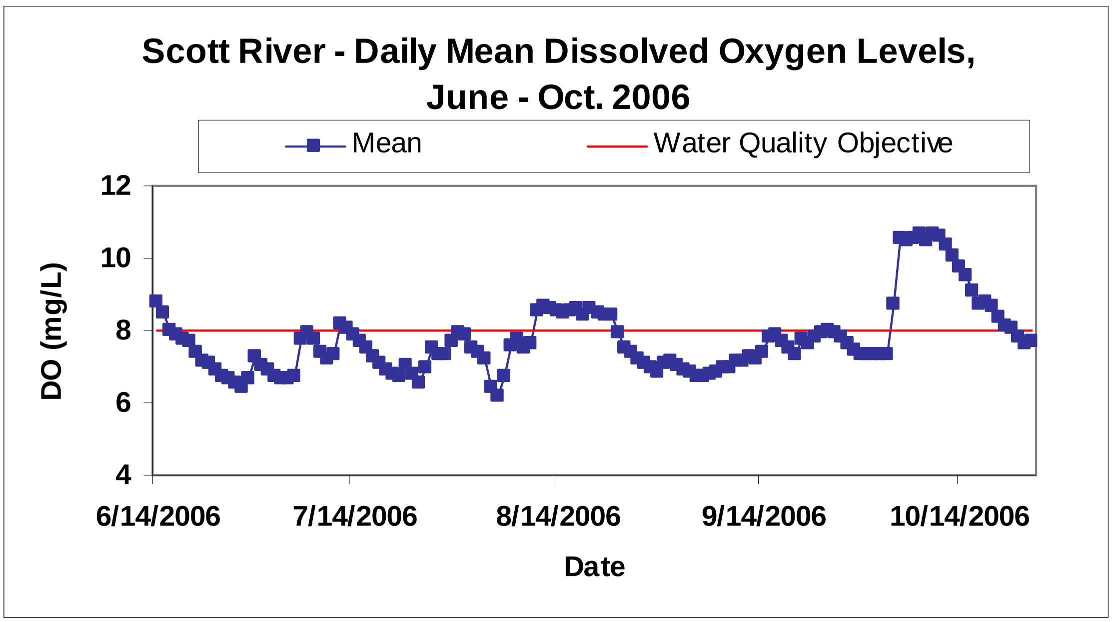

Figure 49 - Daily mean dissolved oxygen in the Scott River from June to October, 2006

6.2.2.3 pH

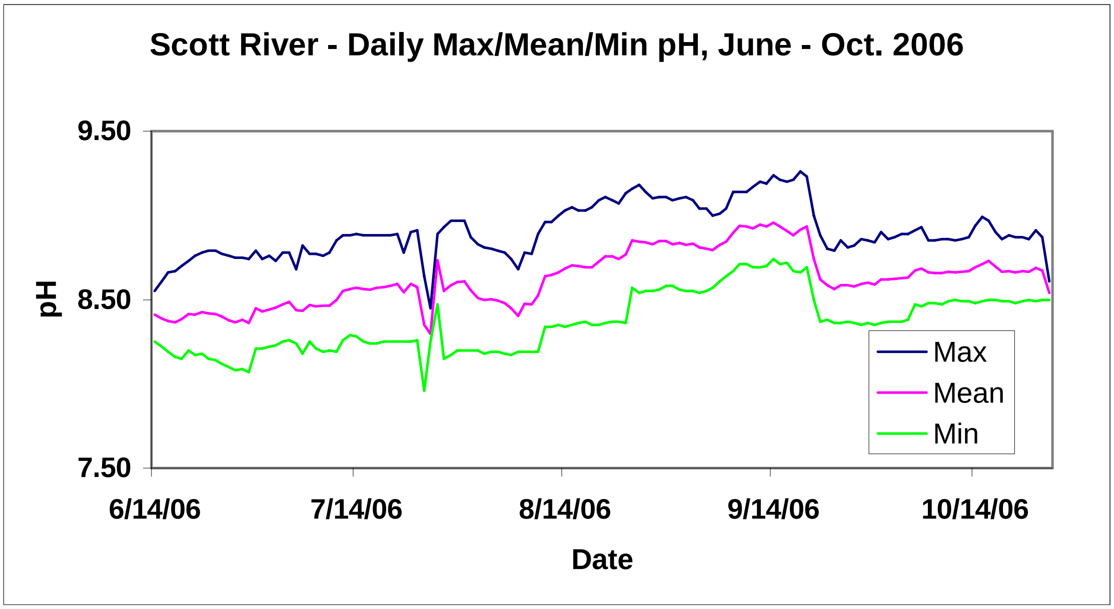

Figure 50 - Daily maximum, mean, and minimum pH values on the Scott River from June to October, 2006

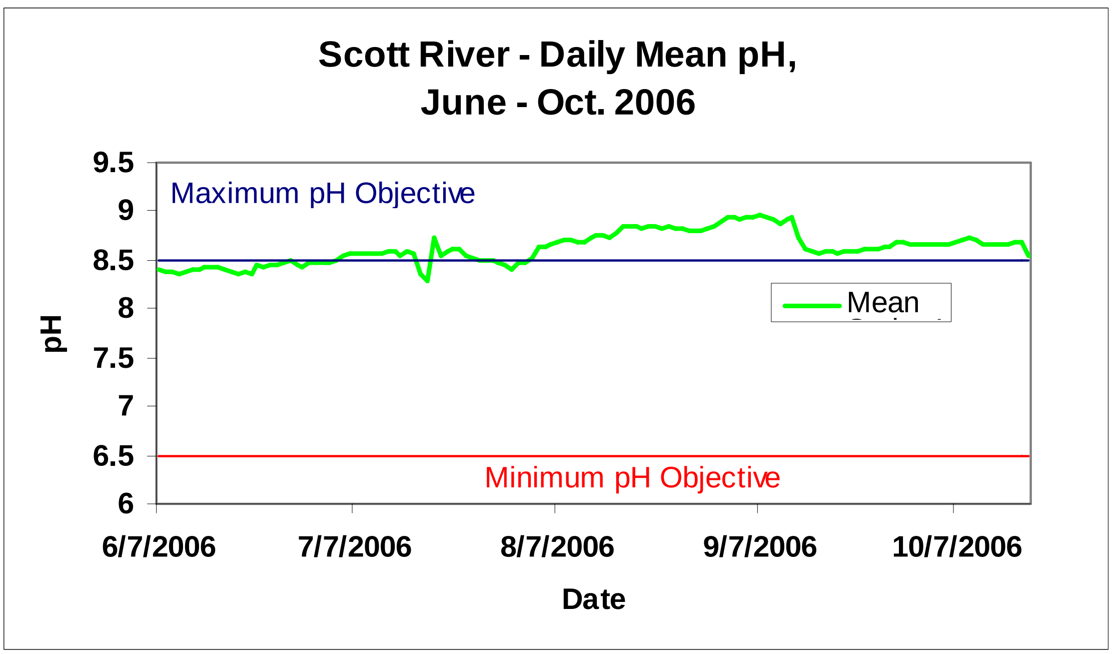

Figure 51 - Daily mean pH values on the Scott River from June to October, 2006

6.2.2.4 Specific Conductance

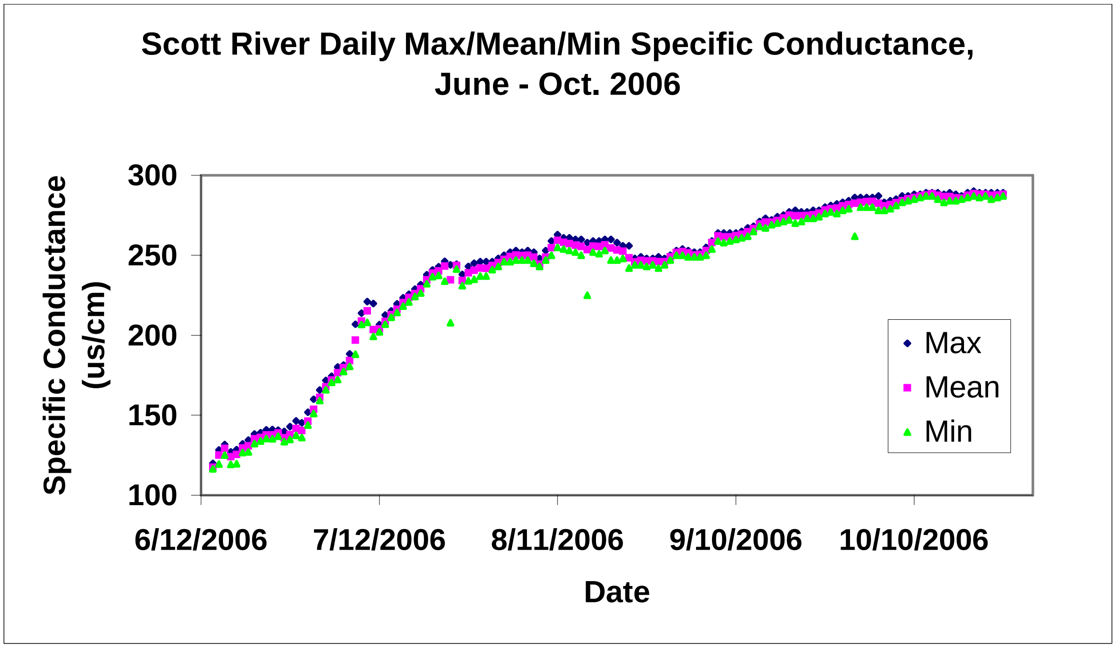

Figure 52 - Daily maximum, mean, and minimum specific conductivity in the Scott River from June to October, 2006

6.2.2.5 Flow

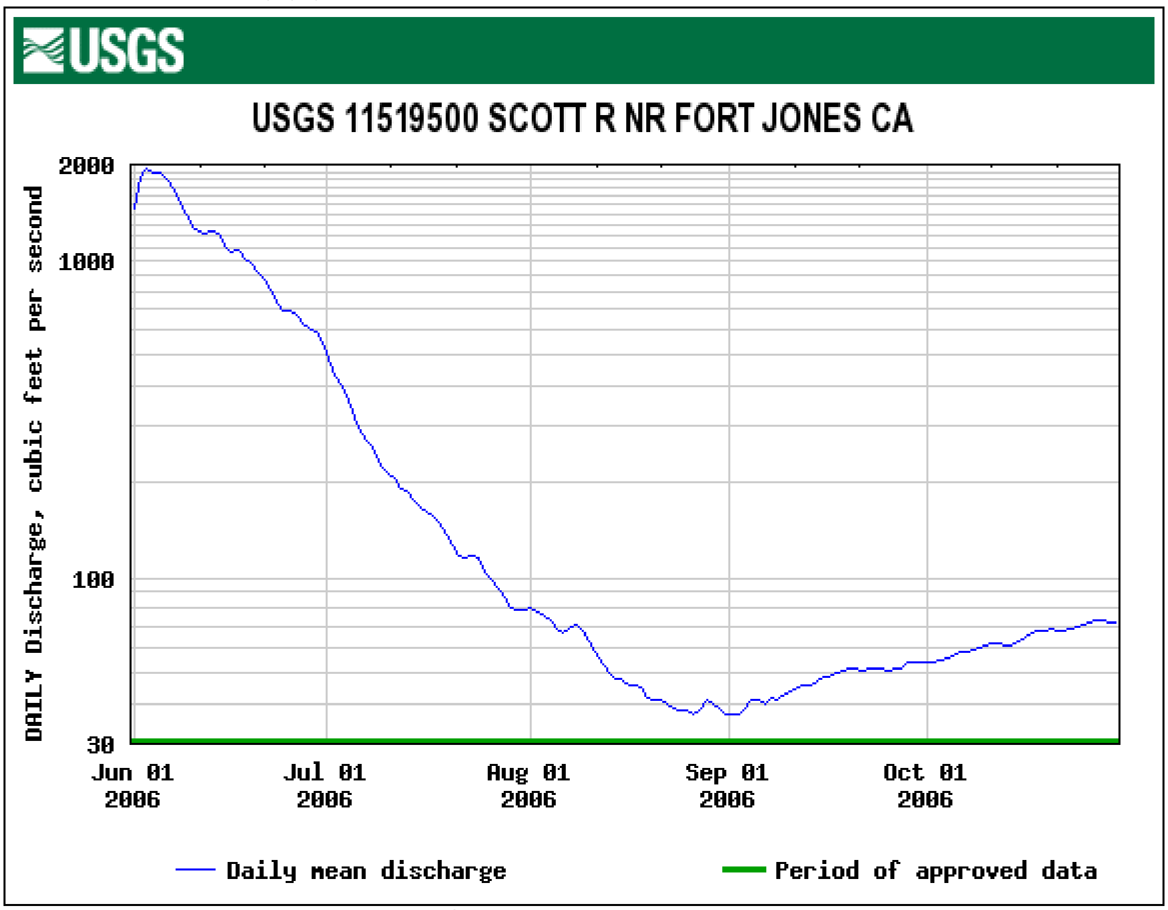

Figure 53 - Daily mean stream flow (ft^3/sec) from the Scott River at the Fort Jones USGS flow gauge from April to October, 2006

6.2.3 Salmon River

6.2.3.1 Water Temperature

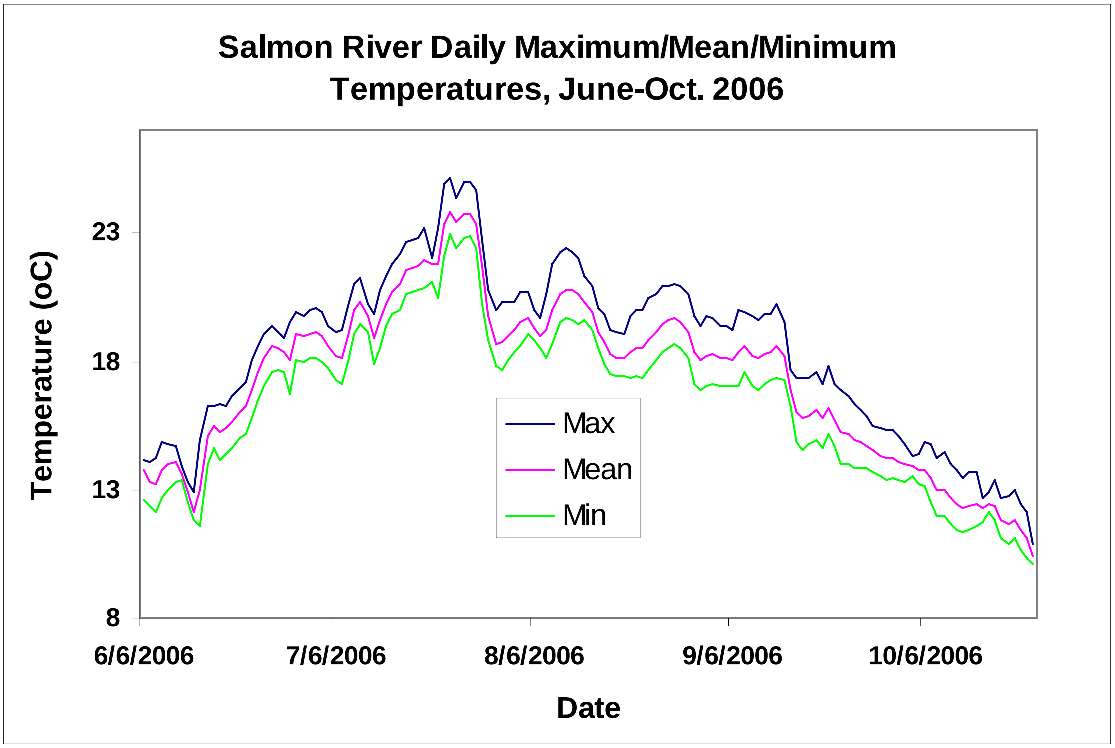

Figure 54 - Daily maximum, mean, and minimum water temperature in the Salmon River from June to October, 2006

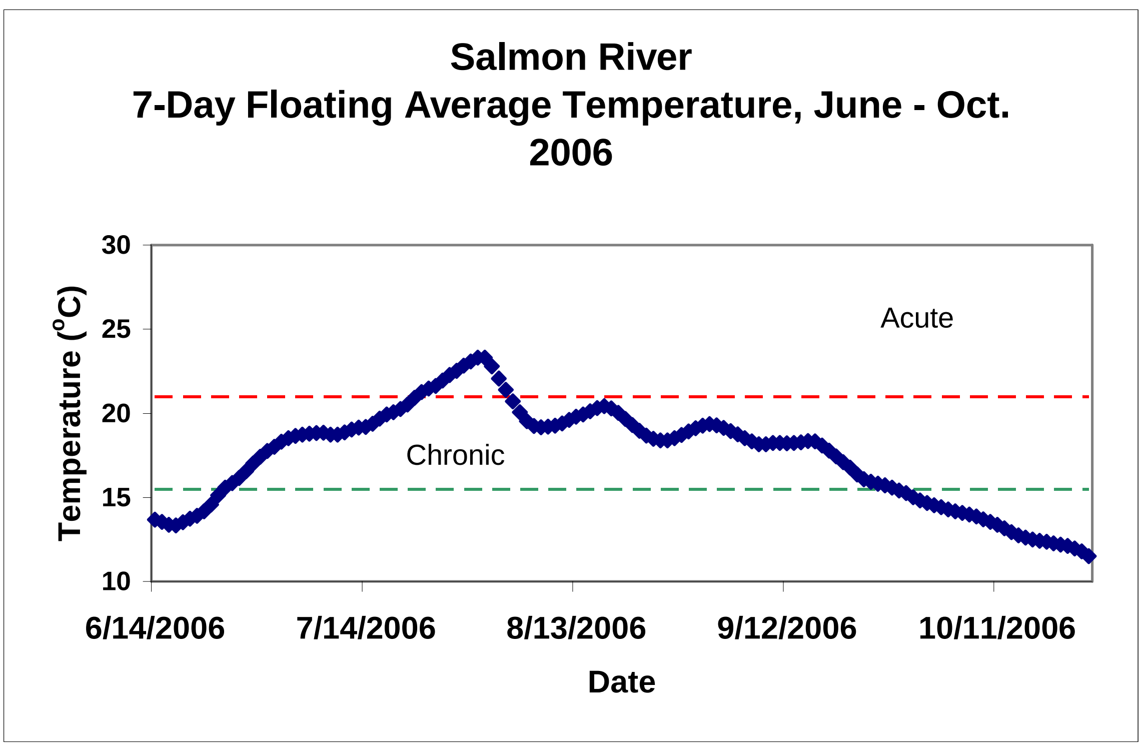

Figure 55 – 7-day floating average temperature for the Salmon River from May to October, 2006

6.2.3.2 Dissolved Oxygen

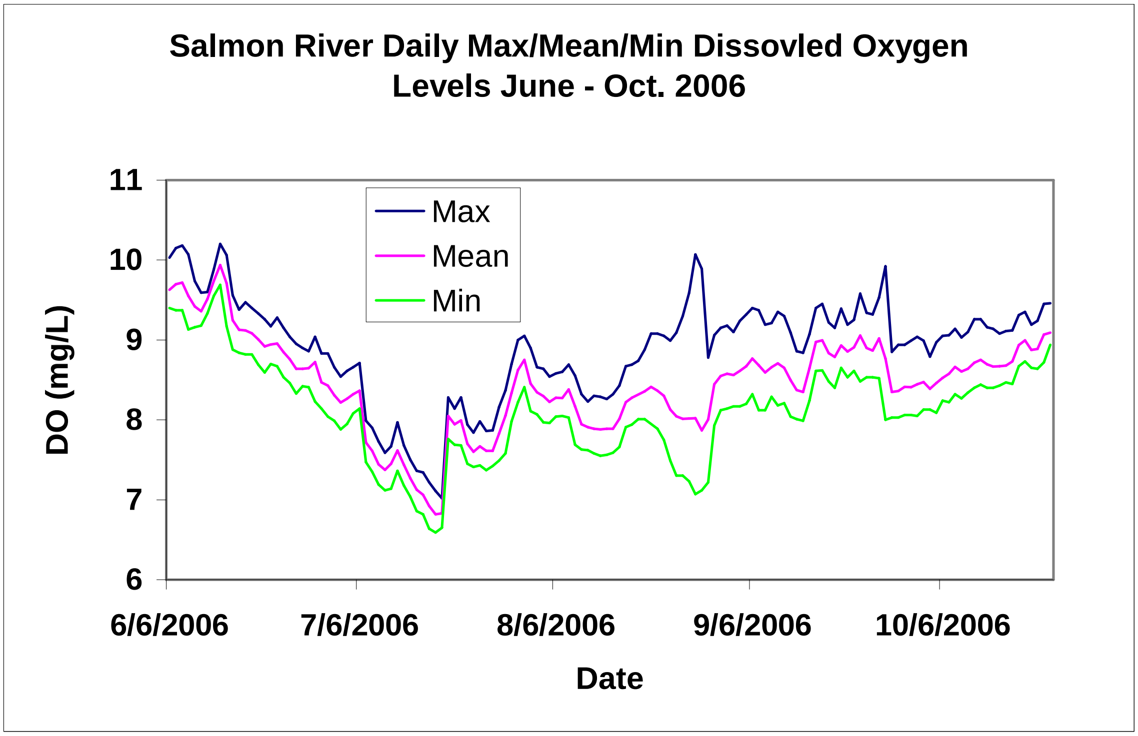

Figure 56 - Daily maximum, mean, and minimum of dissolved oxygen in the Salmon River from May to October, 2006

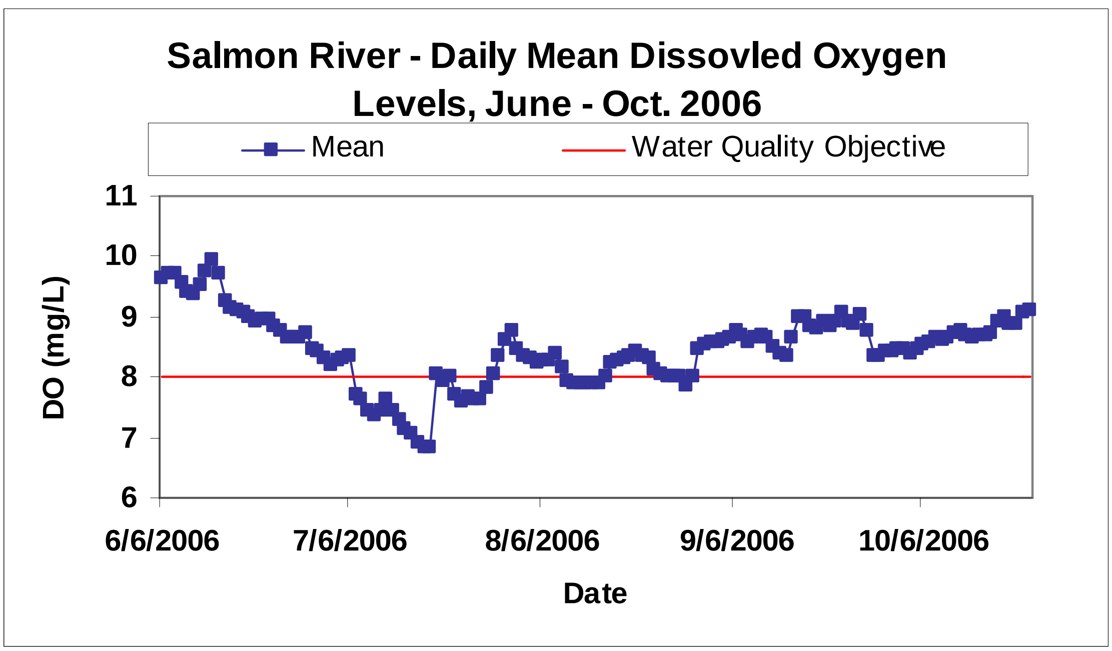

Figure 57 - Daily mean dissolved oxygen in the Salmon River from June to October, 2006

6.2.3.3 pH

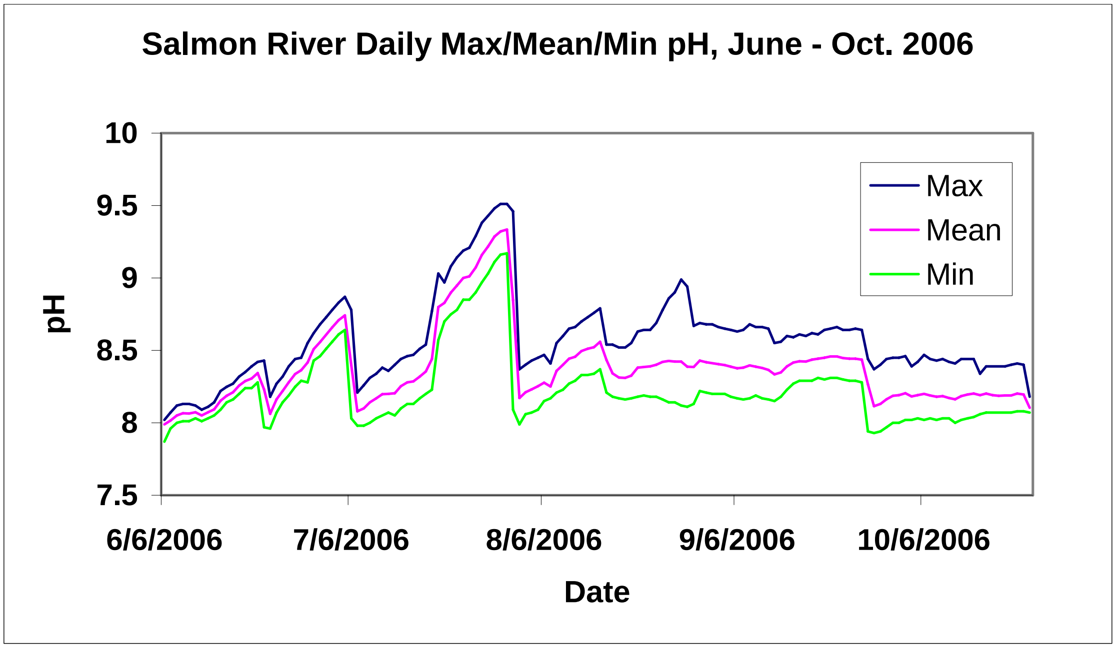

Figure 58 - Daily maximum, mean and minimum pH values on the Salmon River from June to October, 2006

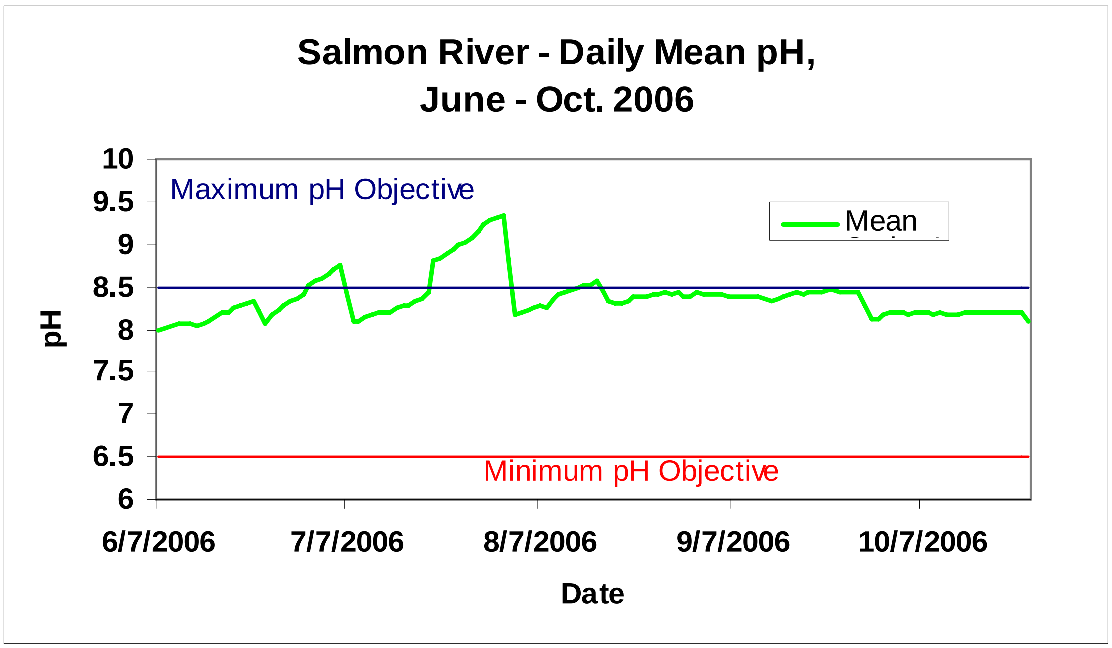

Figure 59 - Daily mean pH values on the Salmon River from June to October, 2006

6.2.3.4 Specific Conductance

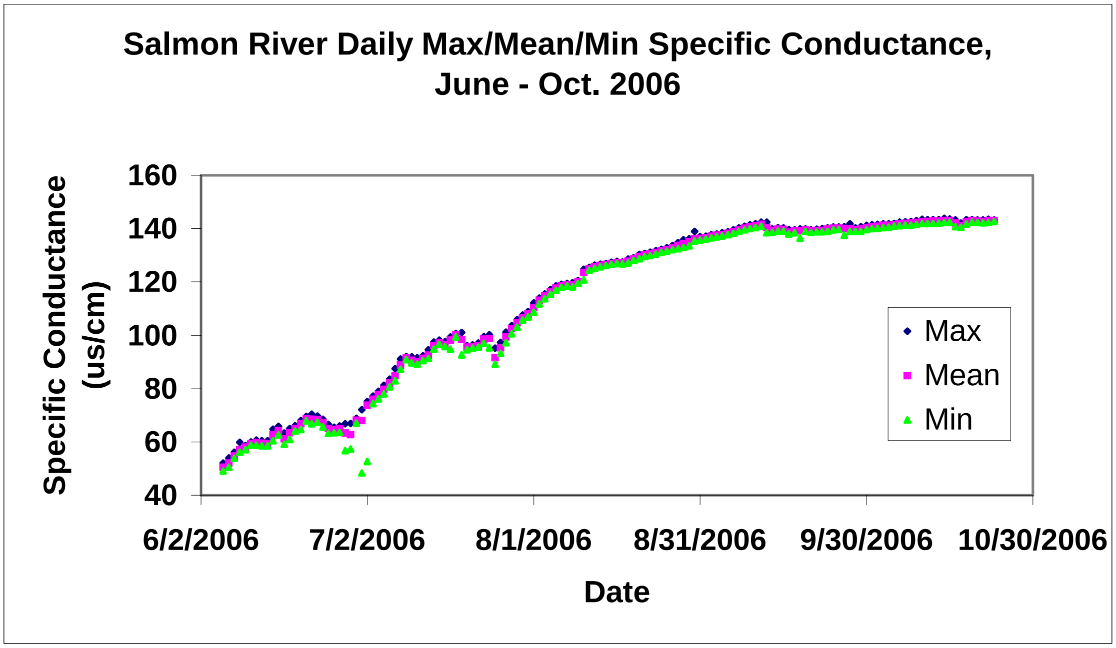

Figure 60 - Daily maximum, mean, and minimum specific conductivity values in the Salmon River from June to October, 2006

6.2.3.5 Flow

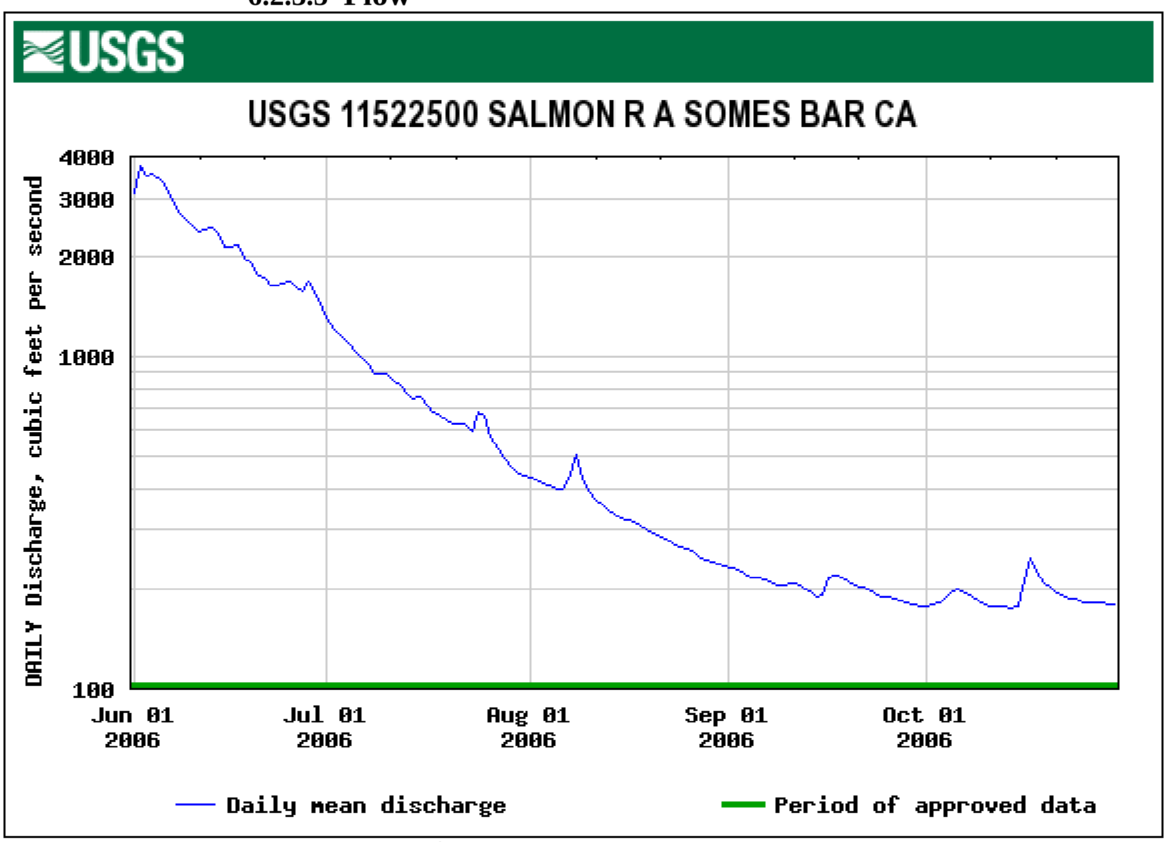

Figure 61 - Daily mean stream flow (ft^3/sec) from the Salmon River at the Somes Bar USGS flow gauge from April to October, 2006

7.0 DISCUSSION

Water temperature, for all of the monitoring sites, increased from June to September. This is to be expected as snow melt subsides, air temperatures rise, and flows drop (Figures 13, 21, 29, 37, 46, 54). The Karuk Tribe is concerned about how high the water temperatures and for how long a duration in the Klamath River and its tributaries.

Floating weekly average temperatures (FWAT) are a common method of assessing water temperatures. These calculations require 7 consecutive days of data, thus if one day of data is missing FWAT can not be calculated for the next 6 days. FWAT calculations for the Shasta River were not consecutive throughout the sampling period due to a data gap. However, this gap occurred after water temperatures dramatically decreased in early fall (Figure 38). For all the monitored waters, water temperatures were continually above the chronic temperature level (upper limit for optimum growth for salmonids) from July to September and above the acute (lethal) level from mid-July to the end of August. In the Salmon River, high temperatures are due in part to reduction of riparian vegetation, inadequate management of the watershed for fire, and historical hydraulic mining operations. In the Scott and Shasta, high temperatures are due in part to agricultural use, groundwater pumping, logging practices, and historical hydraulic mining operations. The Shasta River experienced the highest temperatures for the longest period of time, 61 days above the acute temperature threshold (Table 8). The Klamath River mainstem was in exceedance of the temperature objectives throughout the summer till around October (Figures 14, 22, 30) and showed little variation in duration of chronic and acute temperatures between sites (Table 7).

Looking at Dissolved oxygen levels (DO) in the Klamath we see an increase in days the DO levels meet the water quality objective as one travels downstream (Table 7). This would be expected due to the influence of the reservoir and the increase in volume of water downstream from tributaries. The site below Iron Gate Dam had 119 days out of the summer that the DO objective was not met. As one moves down the system oxygen is re-introduced to the system through mixing, with the Orleans site only having 19 days when DO was below the minimum level. The Scott and Shasta Rivers had low DO levels throughout the summer months.

All the monitoring sites had pH measurements on the basic side. The Shasta and Scott rivers had the most days in non compliance with the pH objective (Table 8). The Klamath River site near Orleans had the greatest number of days in exceedance of the pH water quality standard. The Shasta River was the only site to exceed the objective of specific conductance. The Shasta was not in compliance with this objective throughout the summer months (Figure 44). All other sites were well below the threshold for specific conductivity.

Some of the changes and improvements anticipated for the 2007 monitoring season include switching to new YSI 6600 V2or V4 multi-parameter probes. These probes will be equipped with optical DO sensors. These sensors do not need a 24-hour “rest” time like the Clark’s membranes used in 2006 and drift less over the two week deployment time period. All data will be entered into the YEDSS database, developed by the Yurok tribe to submit data electronically to the EPA. This database will also generate grades based on the USGS criteria to allow for further quality assurance and the examination of drift of instruments during deployment. There are plans for the Klamath River sites at Orleans and Seiad to become “real-time” sites. This will allow monitoring of instrument readings online. This will be done in cooperation with USGS and use USGS gauging stations.

The information collected by the Karuk Tribe and presented in this report will be put to use in land management decisions concerning water quality within the Klamath Basin. The Karuk Water Resources Program wishes to express gratitude to the EPA for their generous grants that make water quality monitoring a reality and the restoration of the native fisheries a possibility.

Number of Days Klamath River Was in Exceedance of Tribal Water Quality Objectives			
Water Quality Objective	**Klamath River near Iron Gate**	**Klamath River near Seiad**	**Klamath River near Orleans**
Temperature Chronic (Daily Average >15.5C)	122	120	119
Temperature Acute (Daily Average >21.0C)	45	68	66
Dissolved Oxygen (Daily Average <8 mg/L)	119	41	19
Specific Conductance (Monthly Average >350 us/cm)	0	0	0
pH (Daily Average <6.5 or >8.5)	29	29	61

Table 8 – Temperature based on 7-day floating average temperature. DO and pH use daily average.

Number of Days Tributaries Were in Exceedance of Tribal Water Quality Objectives			
Water Quality Objective	**Shasta River**	**Scott River**	**Salmon River**
Temperature Chronic (Daily Average >15.5C)	92	92	96
Temperature Acute (Daily Average >21.0C)	61	21	13
Dissolved Oxygen (Daily Average <8 mg/L)	98	97	28
Specific Conductance (Monthly Average >350 us/cm)	4	0	0
pH (Daily Average <6.5 or >8.5)	132	97	22

Table 9 - Temperature based on 7-day floating average temperature. DO and pH use daily average.