KARUK TRIBE OF CALIFORNIA

DEPARTMENT OF NATURAL RESOURCES
P.O. Box 282 * Orleans, California 95556

2005
WATER QUALITY MONITORING REPORT

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BEAVER CREEK, SCOTT RIVER, INDIAN CREEK, & SALMON RIVER

Karuk Tribe of California

Water Quality Monitoring Report
2005

Prepared by
Karuk Tribe of California
Water Resources
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CONTENTS

FIGURES

KARUK TRIBE OF CALIFORNIA

BEAVER CREEK, SCOTT RIVER, INDIAN CREEK, & SALMON RIVER
WATER QUALITY MONITORING REPORT
MAY - OCTOBER 2005

1.0 BACKGROUND

It is the mission of the Karuk Tribe to protect and improve the quality and quantity of water flowing through ancestral tribal trust lands of the Karuk Tribe of California. The Department of Natural Resources for the Tribe has been monitoring daily water quality conditions in the Klamath River mainstem since January of 2000 and tributaries to the Klamath River since 1998. The Karuk Tribe has also been collaboratively involved in maintaining water quality stations along the Klamath River and tributaries with the United States Fish and Wildlife Service (USFWS), the United States Geological Survey (USGS), and the Yurok Tribe.

During 2005, Karuk tribal members performed all data collection and data input. Quality assurance processes as well as administrative oversight and report writing was performed by the water resources coordinator and the water quality biologist. Funding for this project has come mainly through the Karuk Tribe's EPA 106 Water Pollution Control Program.

2.0 WATER QUALITY STATIONS

The water quality stations are located on tributaries to the Klamath River, which contains ancestral tribal trust lands of the Karuk Tribe of California. The Scott and Salmon Rivers are major tributaries, while Beaver and Indian Creek are smaller tributaries.

2.1 Beaver Creek

The Beaver Creek water quality station is located in Beaver Creek approximately 500 meters upstream of the mouth (Figure 1). The Beaver Creek confluence is near river mile 161, between the Shasta and Scott Rivers. The watershed is approximately 165,000 acres. The Beaver Creek watershed has been impacted by extensive road systems and logging. During flow events in the winter and spring, turbidity can be an issue for salmonids. In the summer, Beaver Creek is the closest cold water refugia to Iron Gate Dam. Even though it can reach 18-20 C in the summer, it still provides some relief for juvenile salmonids from the mainstem Klamath River.

This station is located at:
Latitude: 41^o 52' 31" N
Longitude: 122^o 49' 08" W
Elevation: 550 m

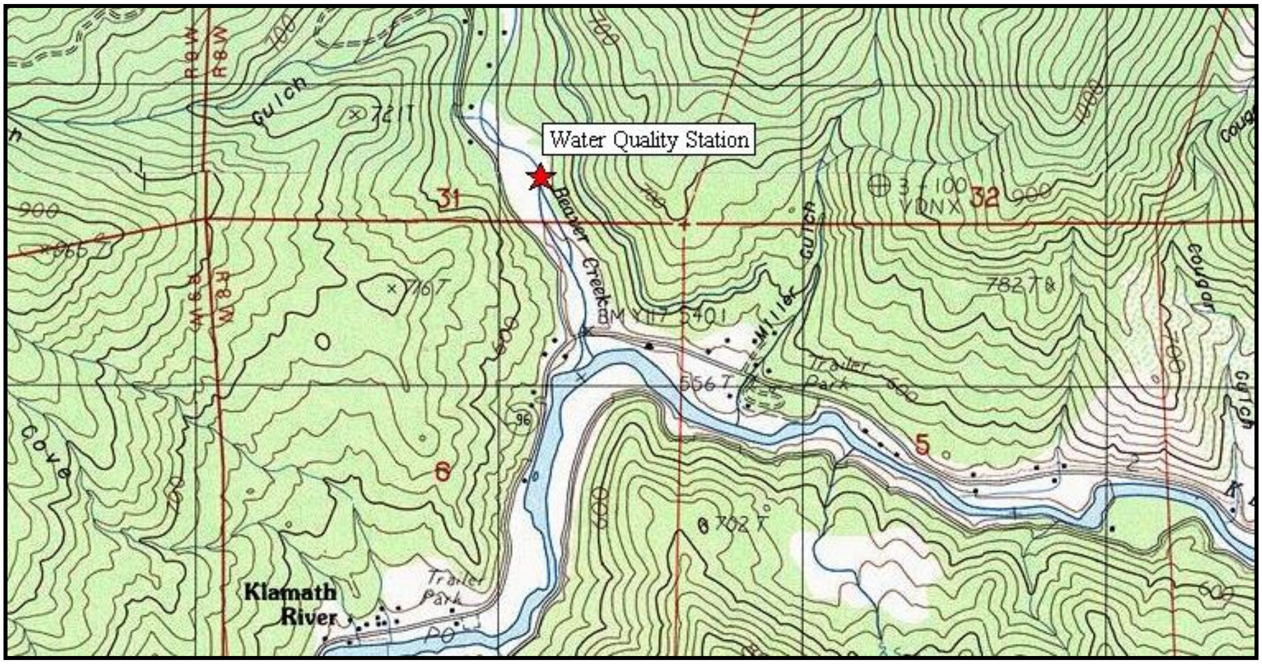

Figure 1. Beaver Creek water quality station.

2.2 Scott River

The Scott River water quality station is located about 2 kilometers from the confluence with the Klamath River (Figure 2). 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 California's 303(d) list for sediment and temperature. Even though the Scott River is a major tributary to the Klamath, it releases minimal poor quality discharge during the summer months. The Scott River used to be one of the predominant rearing locations for coho, fall Chinook, and spring Chinook, so the restoration of this tributary is critical to the future of Karuk Tribal Trust fisheries.

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

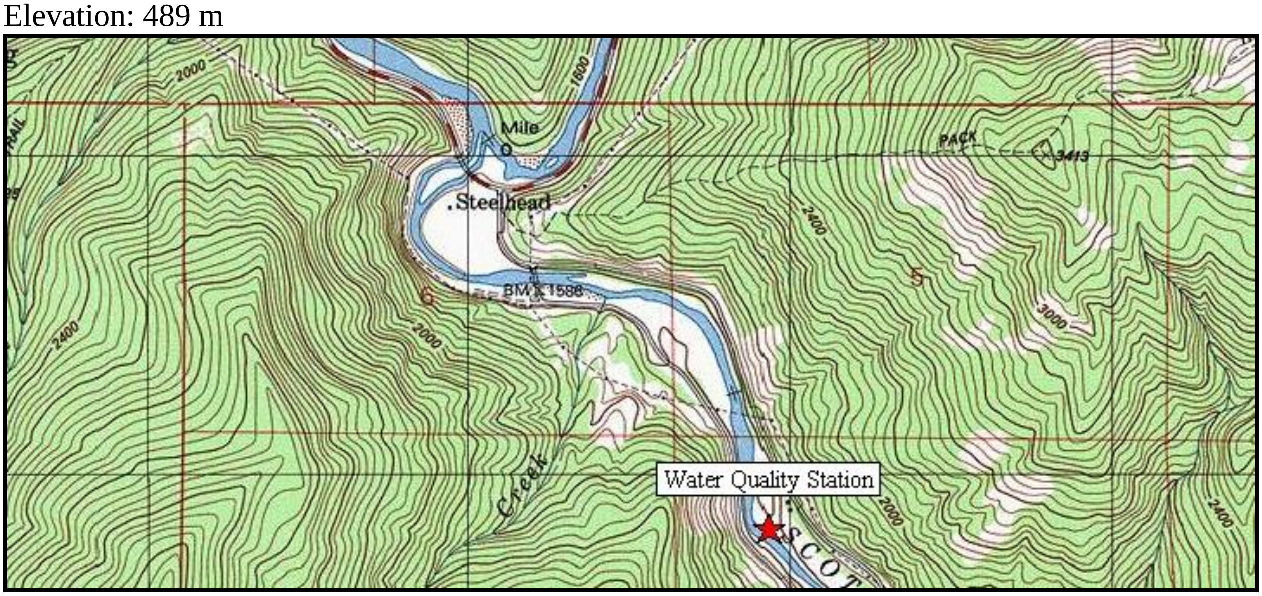

Figure 2. Scott River water quality station.

2.3 Indian Creek

The Indian Creek water quality station is located in the town of Happy Camp adjacent to the Karuk Tribal Administration Building and Karuk Tribal Health Clinic (Figure 3). Indian Creek is a minor tributary to the Klamath River. The drainage area for the Indian Creek water quality station is 76,800 acres. Indian Creek supplies domestic use and has had extensive logging and mining. Indian Creek is not 303(d) listed but is important cold-water refugia for salmonids during the summer.

The exact location of this station is:
Latitude: 41° 47’ 31’’ N
Longitude: 123° 22’ 45’’ W
Elevation: 332 m

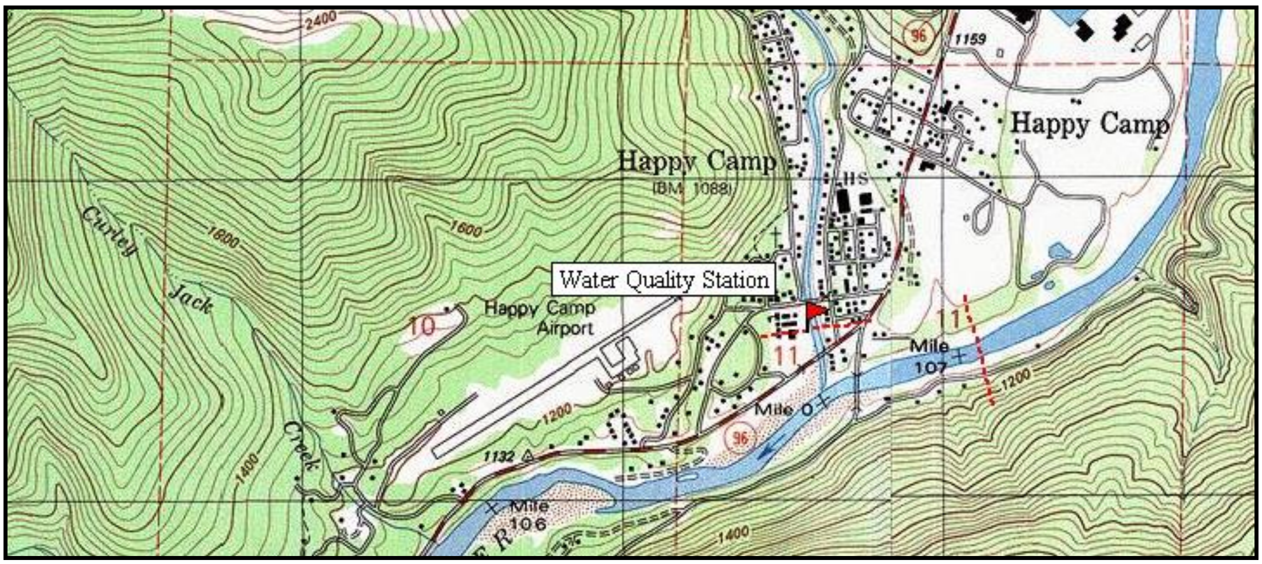

Figure 3. Indian Creek water quality station.

2.4 Salmon River

The water quality station in the Salmon River is located approximately 1.6 kilometers above the confluence with the Klamath River (Figure 4). The drainage area for the Salmon River water quality station is 480,178 acres. The Salmon River is listed in California’s 303(d) list for temperature. The temperature TMDL for the Salmon River was approved by the Regional Board in 2005, however the implementation process is yet to begin. Our data collection will be 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, spring Chinook, lamprey, fall Chinook, and coho.

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

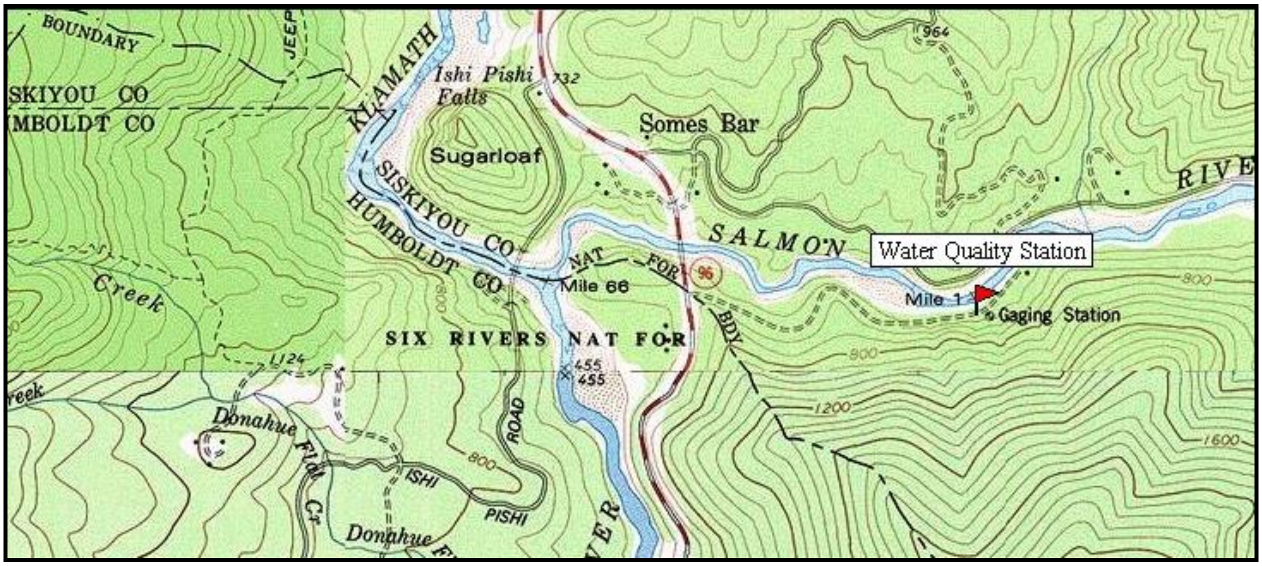

Figure 4. Salmon River water quality station.

3.0 PURPOSE

Historically, the Klamath River system was the third largest salmon producing rivers in the lower forty-eight states on the West Coast. The Karuk fishery once consisted of over one hundred traditional fishing sites that supported over 2500 people. Currently, Karuk people are only legally allowed to fish at one of the traditional sites, Ishi Pishi Falls, which is located upriver of the Salmon and Klamath River confluence. Critically decreasing run sizes and the Klamath River Fish Kill of 2002, presence of toxic algae, and increase of fish disease incidence have demonstrated the effects of anthropogenic changes to the landscape. We believe that if the water quality in the Klamath River Basin is not improved the once great fishery will die, along with the Karuk way of life.

The purpose of this study is to collect essential water quality data, and to monitor the quality of water flowing into and out of Karuk 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 essential in monitoring water quality conditions within the Klamath River. We are building a long-term monitoring data set that lets us track these conditions and monitor for improvement.

This data is important to state and federal processes currently underway for 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 certification for the KHP. The Regional Water Board (NCRWQCB) is developing and/or implementing TMDL's for the Scott, Shasta, Salmon, and Klamath Rivers. Tribes, Counties, and the state of California are working on developing guidance for public health for a toxic blue green algae *Microcystis aeruginosa*. The data the Karuk Tribe collects is essential in providing high quality water quality data to processes that affect the Karuk Tribe.

4.0 WATER QUALITY MONITORING METHODS & QUALITY ASSURANCE

The Karuk Tribe's water quality stations on Beaver Creek, the Scott River, Indian Creek, and the Salmon River collect water temperature, dissolved oxygen (DO), pH, and specific conductance. Datasondes, continuous multi-parameter water quality instruments, were used to collect the data. At all sites, Hydrolab's Datasonde 4*a* were deployed in late May or early June and retrieved in mid-October. The datasonde in the Salmon River was malfunctioning and was replaced by another Hydrolab Datasonde 4*a* on August 1, 2005.

During 2005 water quality monitoring sites were visited at biweekly intervals. At this time audits were performed with a hand-held water quality instrument, Hydrolab's Quanta. 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 reduce the loss of complete daily water quality sets. Regular maintenance of the datasondes helped to minimize lost dissolved oxygen data due to bio-fouling (organic matter building up) on the DO membrane. The DO membrane was allowed to relax for one day before the DO data was included in the data set. During these regular visits, data was downloaded from the datasondes and bought back to the office. This procedure helped locate failed probes or other malfunctions in a timely manner.

The Karuk Tribe has a Quality Assurance Project Plan (QAPP) for monitoring water quality conditions throughout the Karuk Tribe's Ancestral Waters. The QAPP documents the best available scientific methods for testing water quality and is based on past experience working with both the USGS and USFWS water quality staff. During 2005, 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*** for the specific probe.

5.0 WATER QUALITY PARAMETERS

Water quality data collected included water temperature, dissolved oxygen, pH, and specific conductivity.

5.1 Water Temperature

Water temperature varies through space and time, 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 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.

The most common method to assess water temperature for streams that support salmonids populations is to compare the temperature to an acute (lethal) and chronic (sub-lethal) temperature standard. The acute standard represents the temperature at which life cannot continue for the salmonids. The chronic temperature standard represents the maximum weekly average (mean) temperature (MWAT), which is the upper limit for optimum growth for salmonids. The Karuk Tribe's interim water quality objectives have set chronic and acute temperatures at 15.5°C and 21°C respectively. The NCRWQCB is currently working on adding numeric temperature objectives for the Basin Plan. This would affect all of the Klamath TMDL's.

The following Figures are maximum, mean, and minimum temperatures for Beaver Creek, Scott River, Indian Creek, and Salmon River from May to October, 2005 (Figures 5-8). Also included are Figures for MWAT's for the Scott and Salmon Rivers (Figure 9-10).

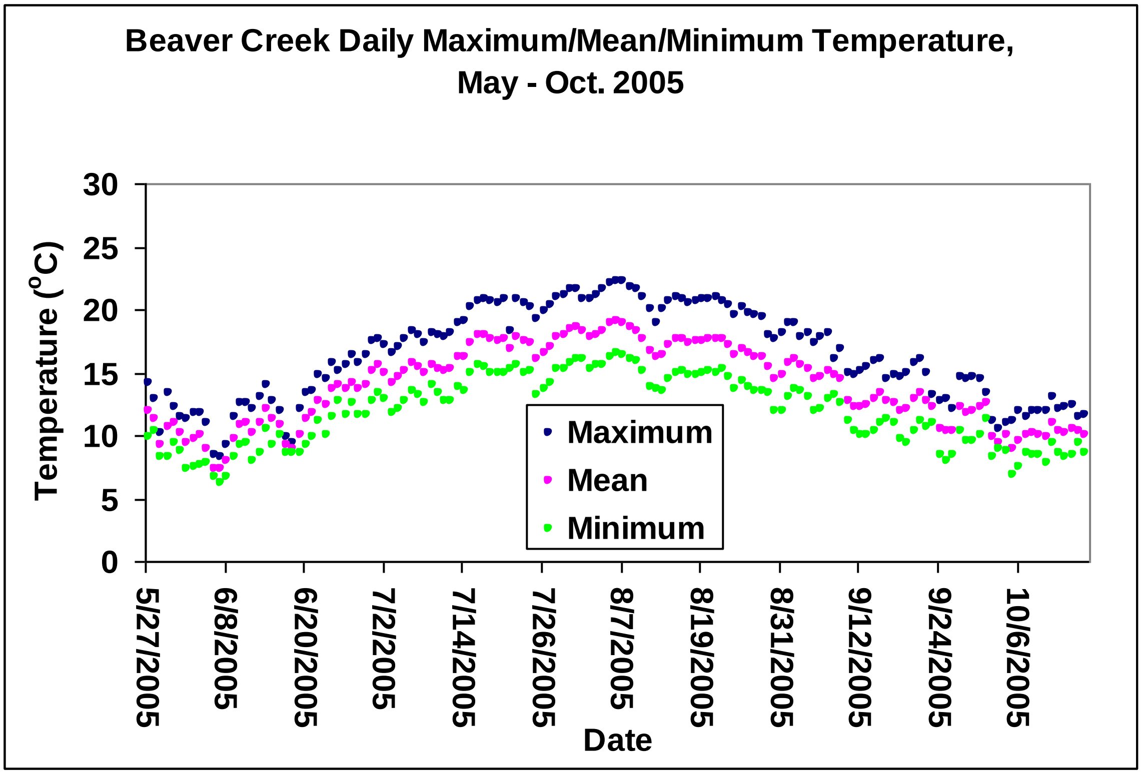

Figure 5. Daily maximum, mean, and minimum water temperature in Beaver Creek from May to October, 2005.

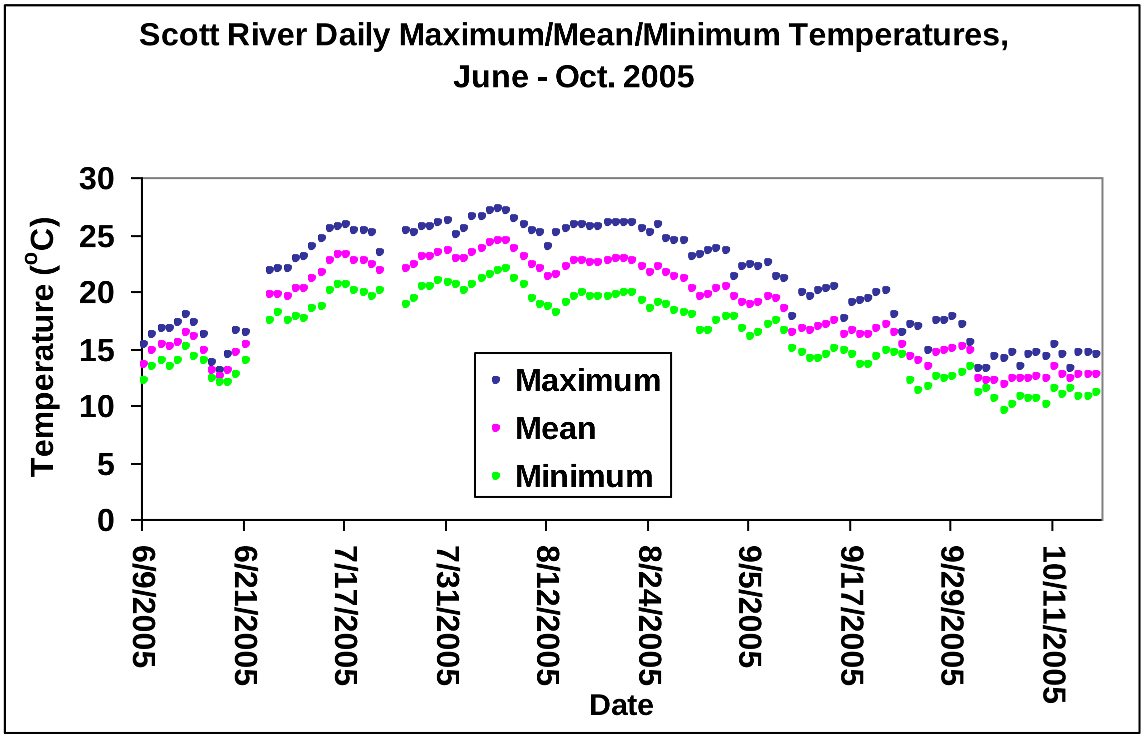

Figure 6. Daily maximum, mean, and minimum water temperature in the Scott River from June to October, 2005.

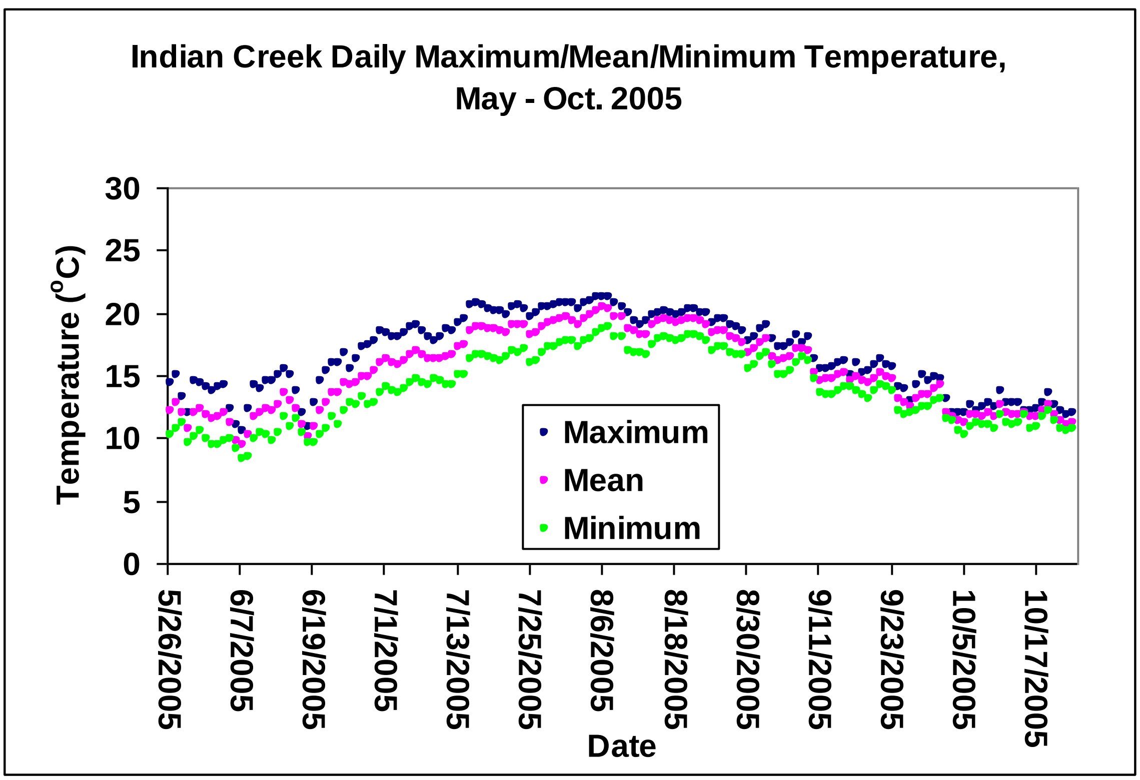

Figure 7. Daily maximum, mean, and minimum water temperature in Indian Creek from May to October, 2005.

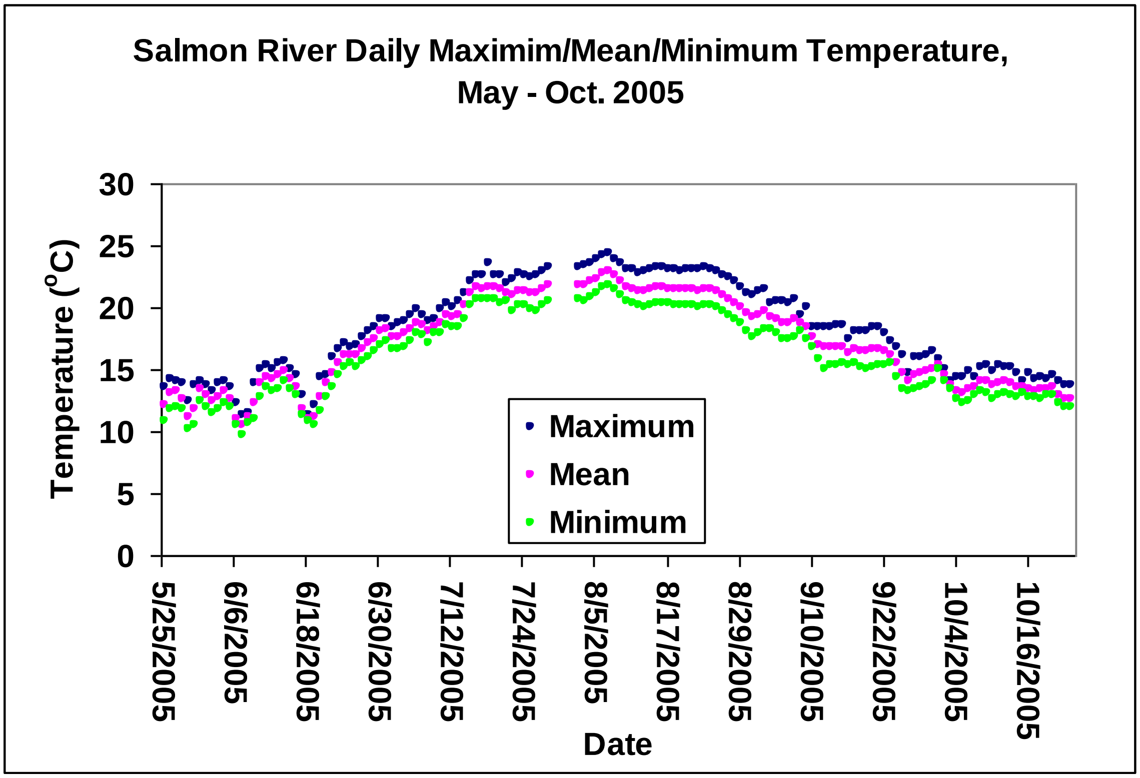

Figure 8. Daily maximum, mean, and minimum water temperature in the Salmon River from May to October, 2005.

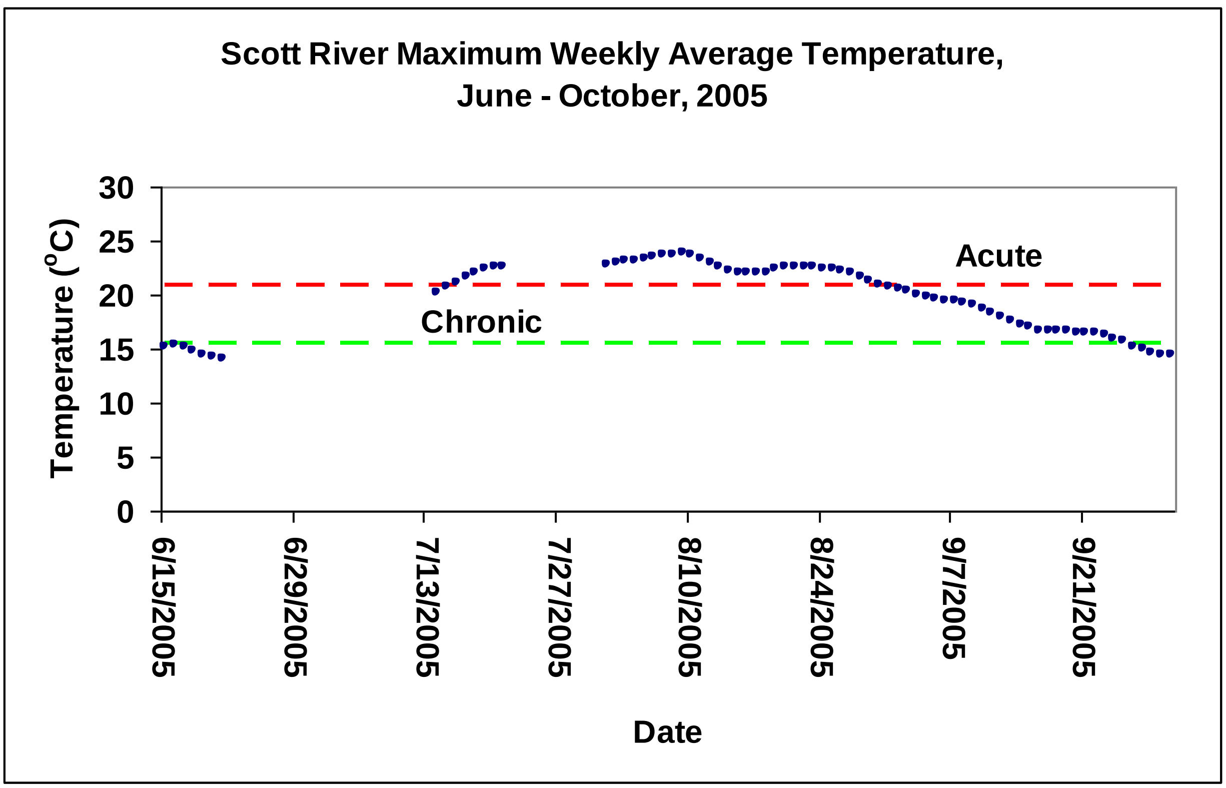

Figure 9. Maximum weekly average temperature for the Scott River from June to October, 2005.

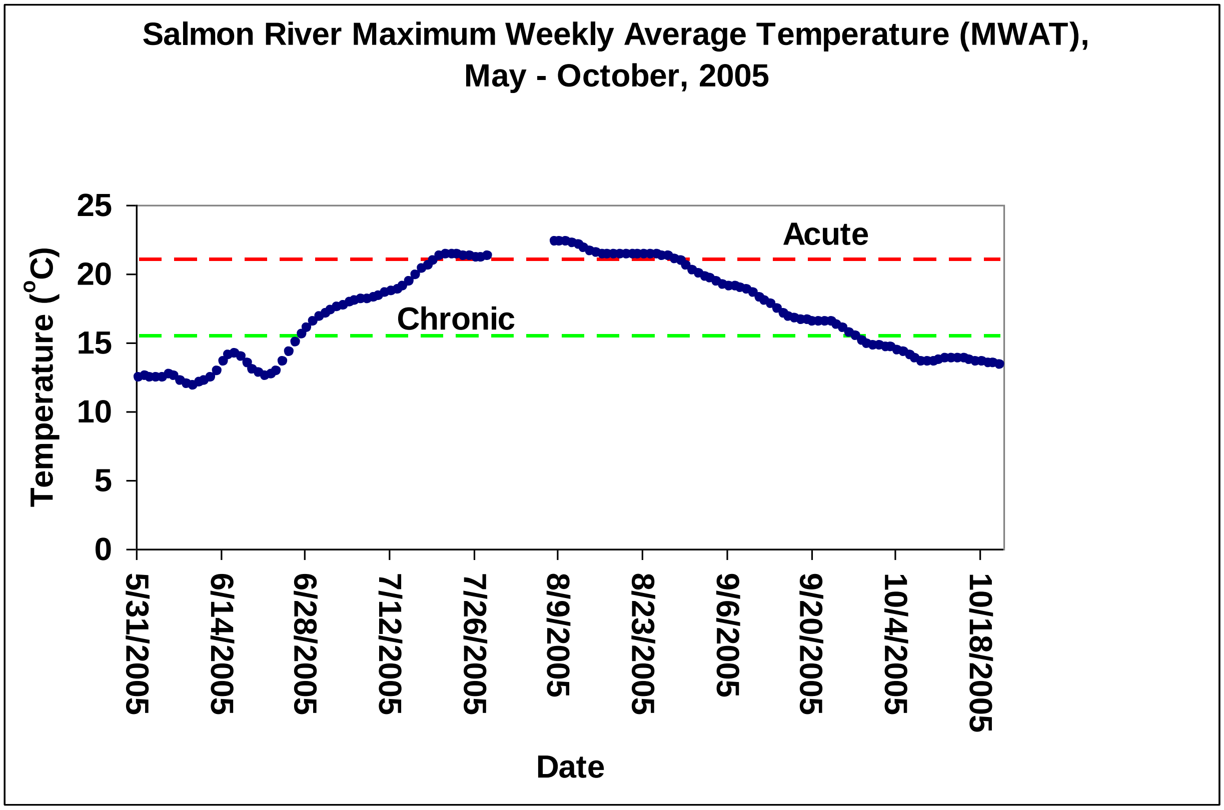

Figure 10. Maximum weekly average temperature for the Salmon River from May to October, 2005.

5.2 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.

The Karuk Tribe's interim water quality objectives have established minimum DO levels for waters designated as COLD Waters to be 6.0 mg/L, and SPWN (spawning) Waters to be 9.0 mg/L during egg incubation of tribal trust aquatic species. The state of California has established a minimum DO level of 8.0 mg/L, and put the Klamath River on their 303(d) list for having DO levels that do not meet their Basin Plan Objectives. Figures of daily dissolved oxygen levels are presented below (Figures 11-14).

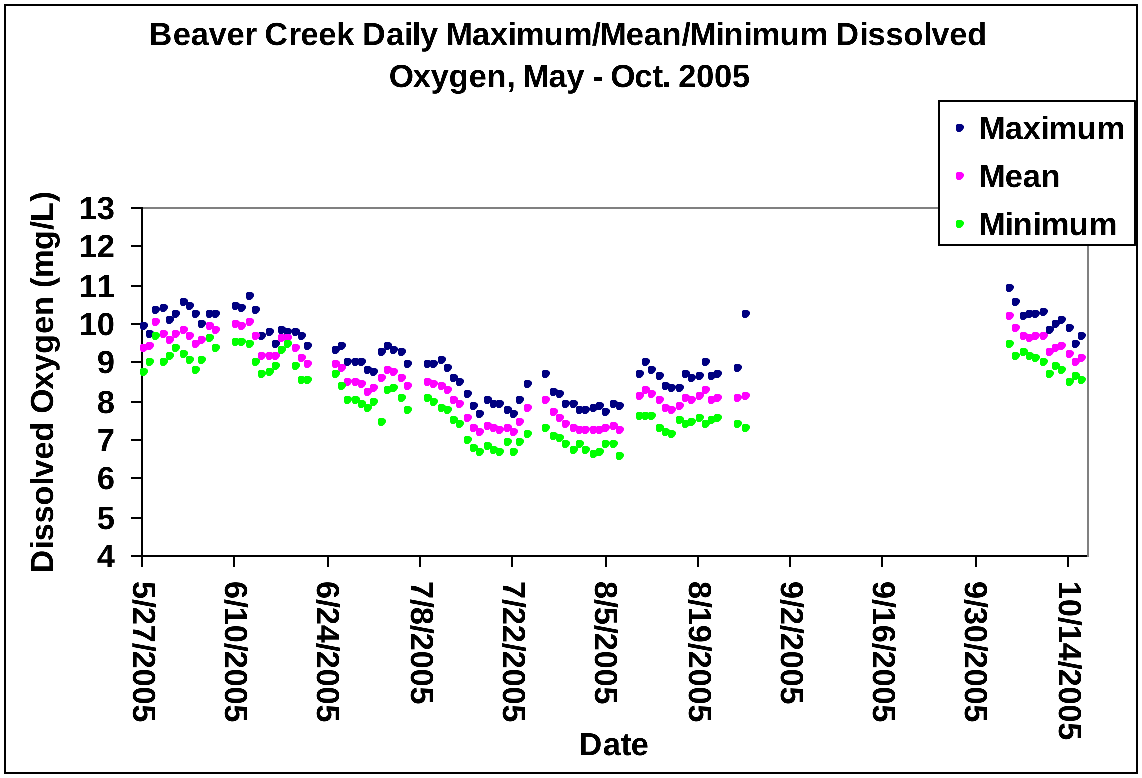

Figure 11. Daily maximum, mean, and minimum dissolved oxygen in Beaver Creek from May to October, 2005.

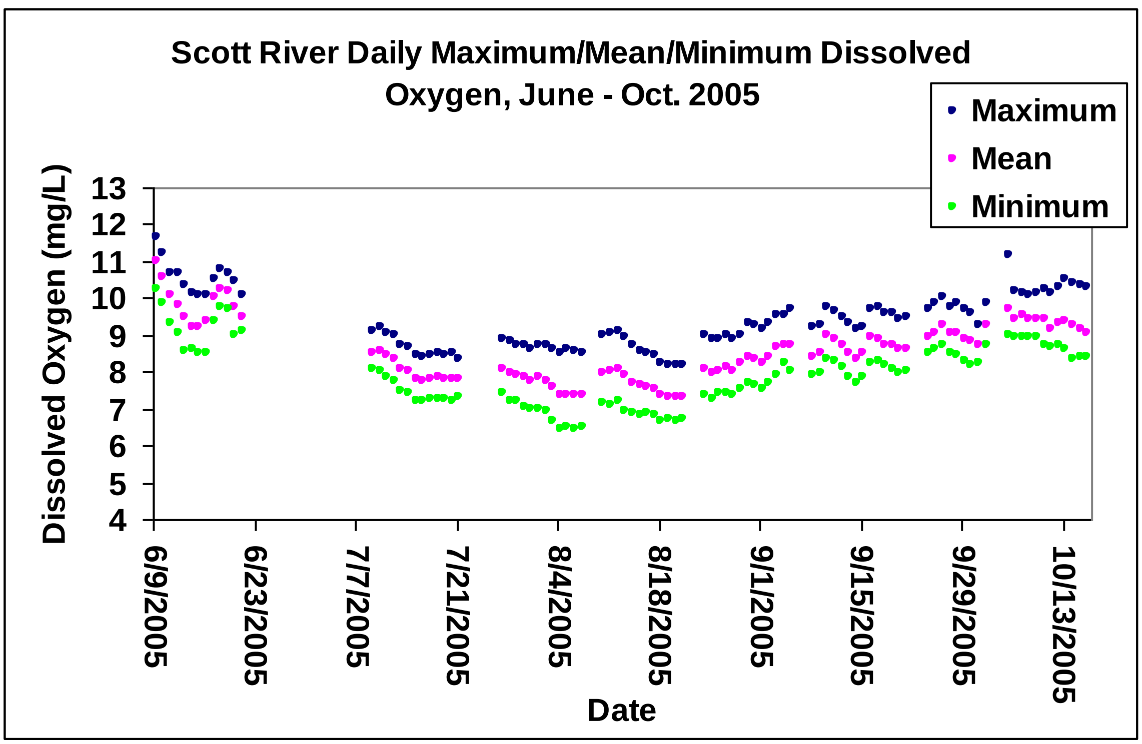

Figure 12. Daily maximum, mean, and minimum dissolved oxygen in the Scott River from June to October, 2005.

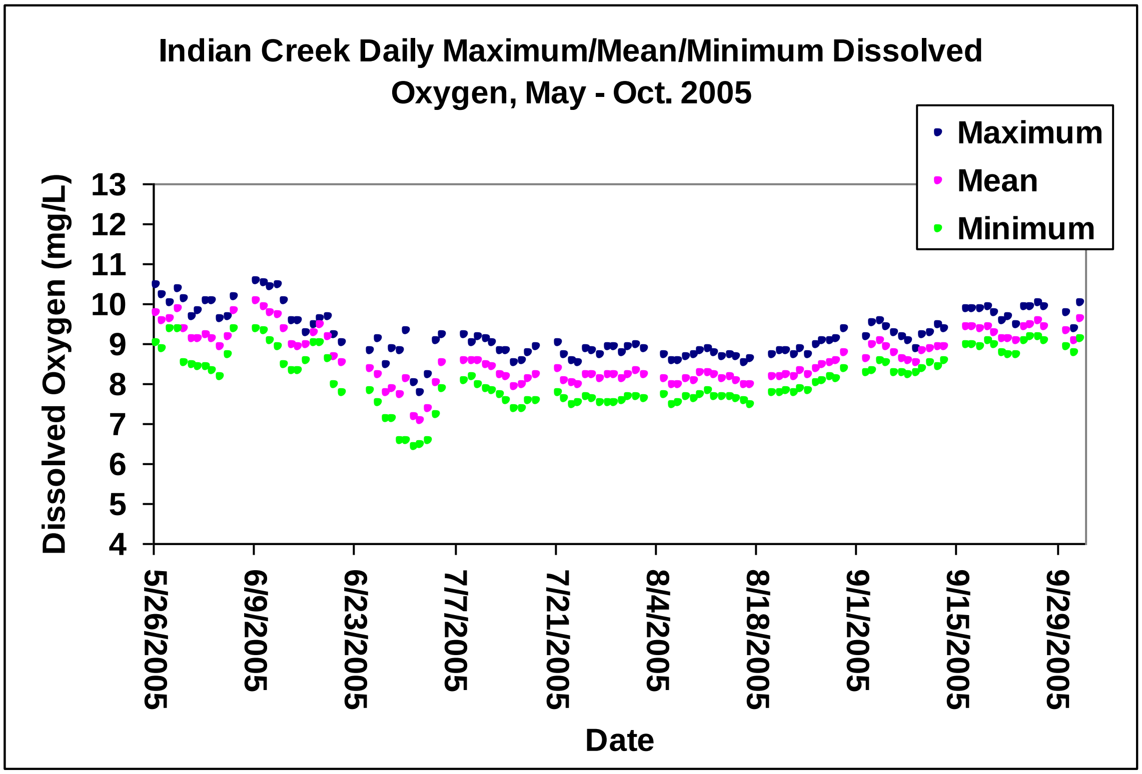

Figure 13. Daily maximum, mean, and minimum of dissolved oxygen in Indian Creek from May to October, 2005.

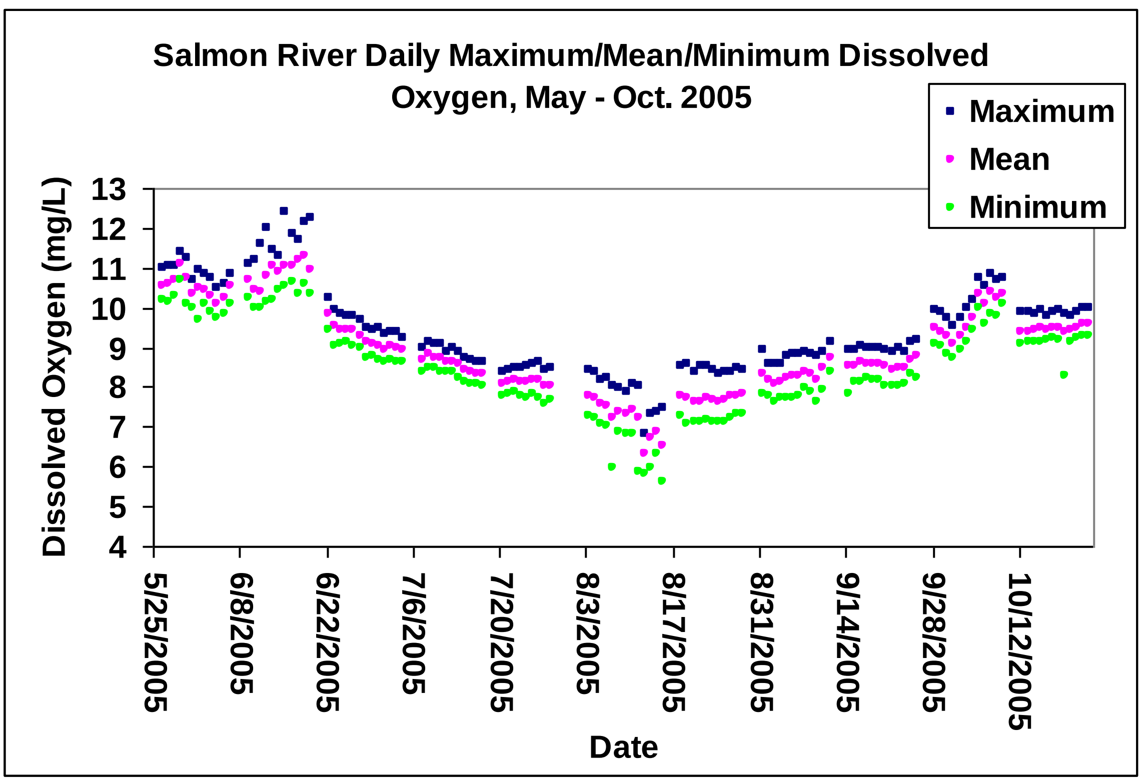

Figure 14. Daily maximum, mean, and minimum of dissolved oxygen in the Salmon River from May to October, 2005.

5.3 pH/Alkalinity

The pH level or alkalinity of water refers to the concentration of H+, hydrogen, and OH-, hydroxide, ions in the water. Water becomes more acidic with higher concentrations of H+ ions and lower concentrations of OH- ions, likewise water will be more basic if there are more OH- ions present than H+ 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 an unionized 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. pH or alkalinity also determine the solubility and biological availability of nutrients and other chemicals in water. In other words, changes in pH can greatly influence how much of a nutrient or chemical is available for use for aquatic organisms. The Karuk Tribe has established a minimum pH objective of 6.5 and a maximum of 8.5. Figures of daily pH are presented below (Figures 15-18).

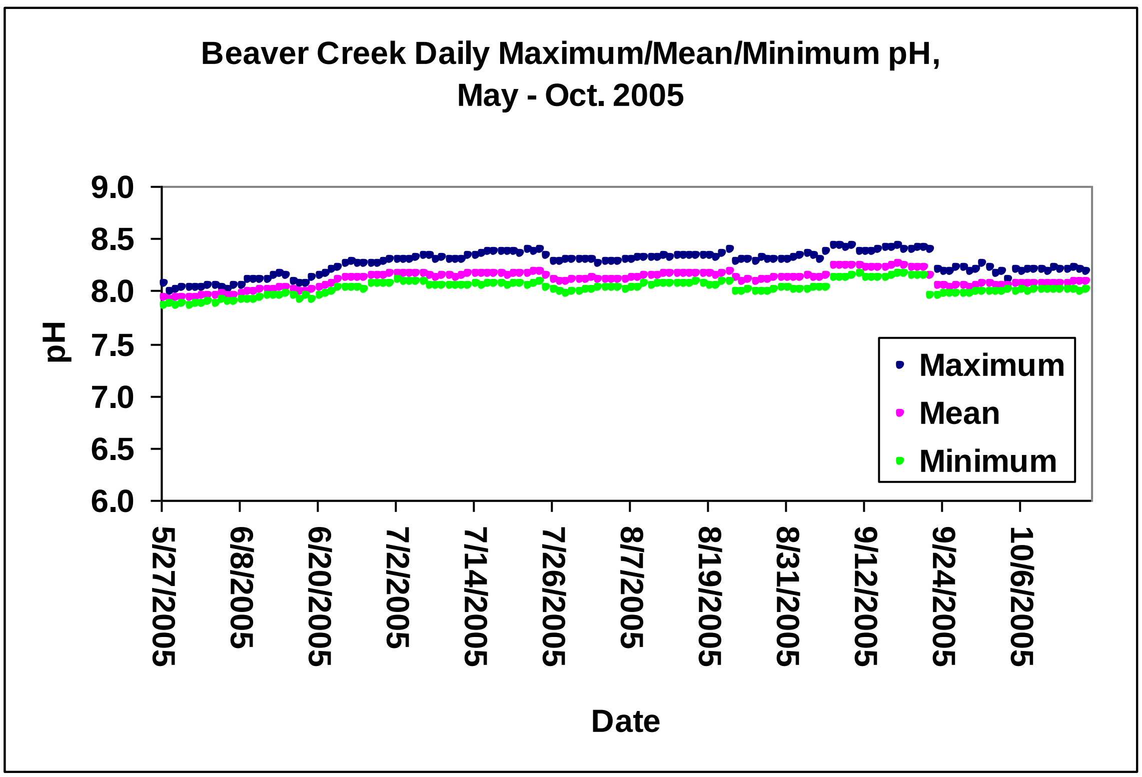

Figure 15. Daily maximum, mean, and minimum pH in Beaver Creek from May to October, 2005.

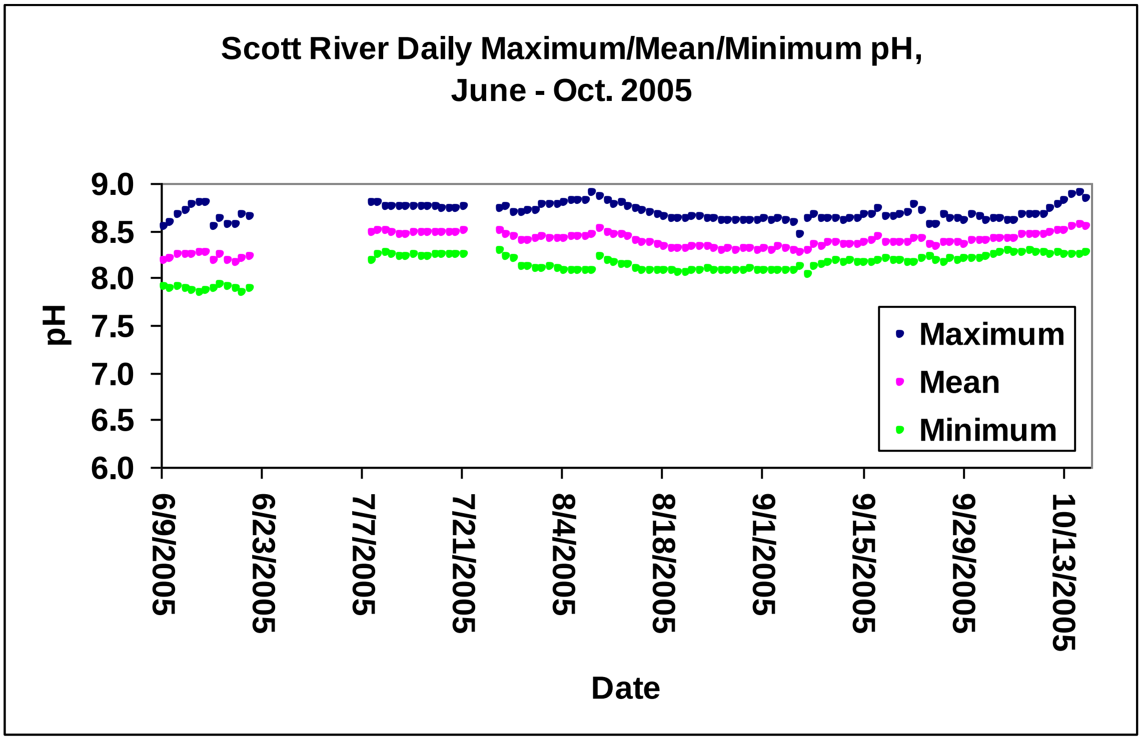

Figure 16. Daily maximum, mean, and minimum pH values on the Scott River from June to October, 2005.

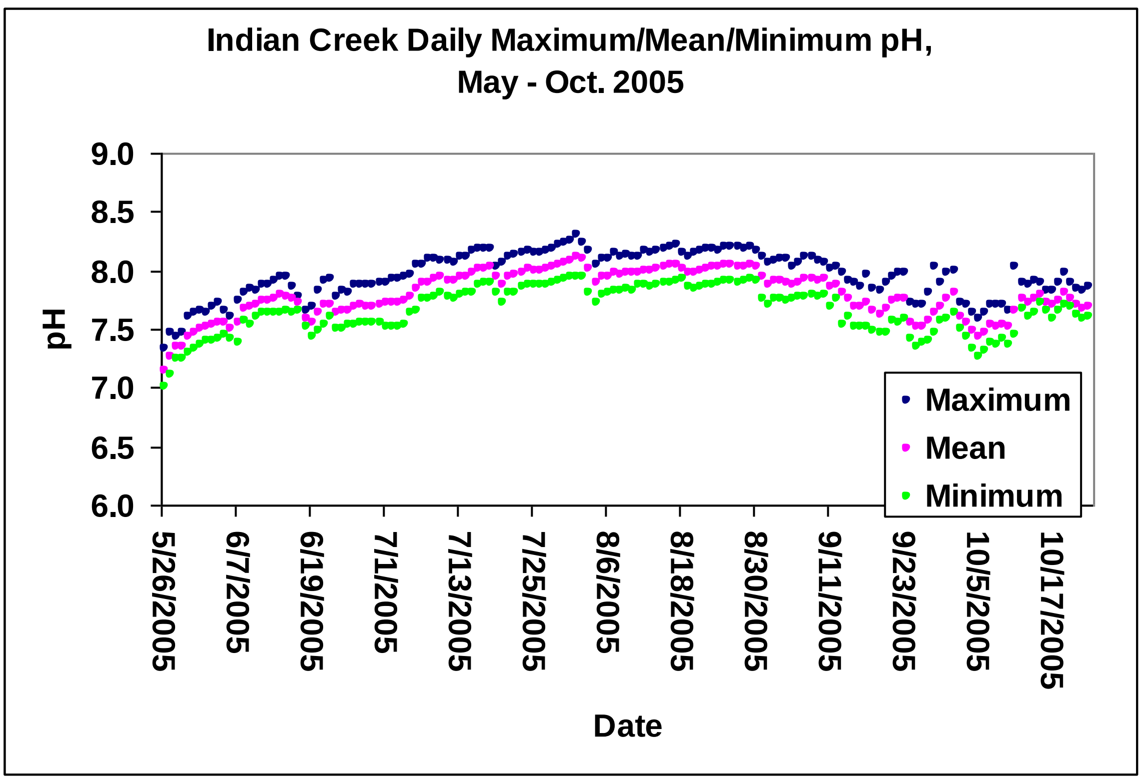

Figure 17. Daily maximum, mean and minimum pH values in Indian Creek from May to October, 2005.

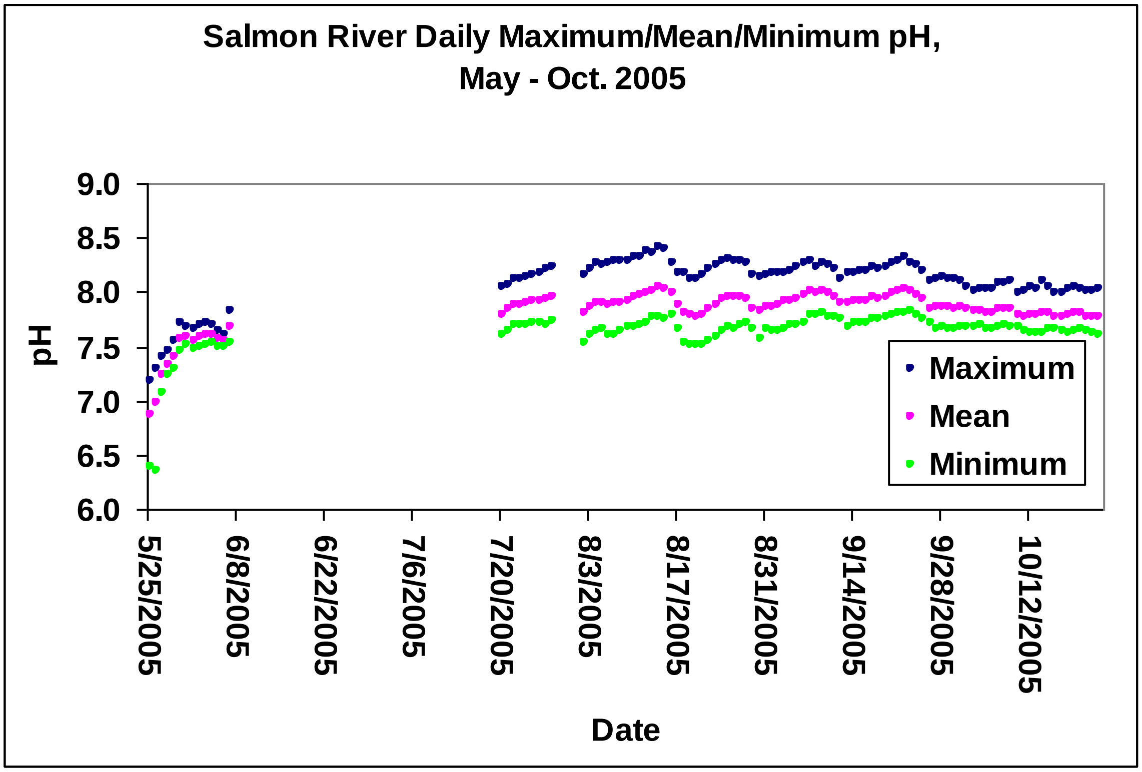

Figure 18. Daily maximum, mean and minimum pH values on the Salmon River from May to October, 2005.

5.4 Specific Conductance

Specific conductance is a measure of the electrical conductance by water at 25°C, and is a function of the concentration of dissolved solids in solution. The higher the concentration of dissolved solids in solution, the higher the specific conductance of the water. Specific conductivity measures how well water can conduct an electrical current across a particular length. Conductivity increases with increasing amount and mobility of 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 state of California's, which is 350 µs/cm for a 90% upper limit and 275µs/cm for a 50% upper limit. The 90% upper and lower limits represent the 90 percentile values for a calendar year. 90% 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 calendar year. 50% 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. Figure of daily specific conductivity are presented below (Figures 19-22).

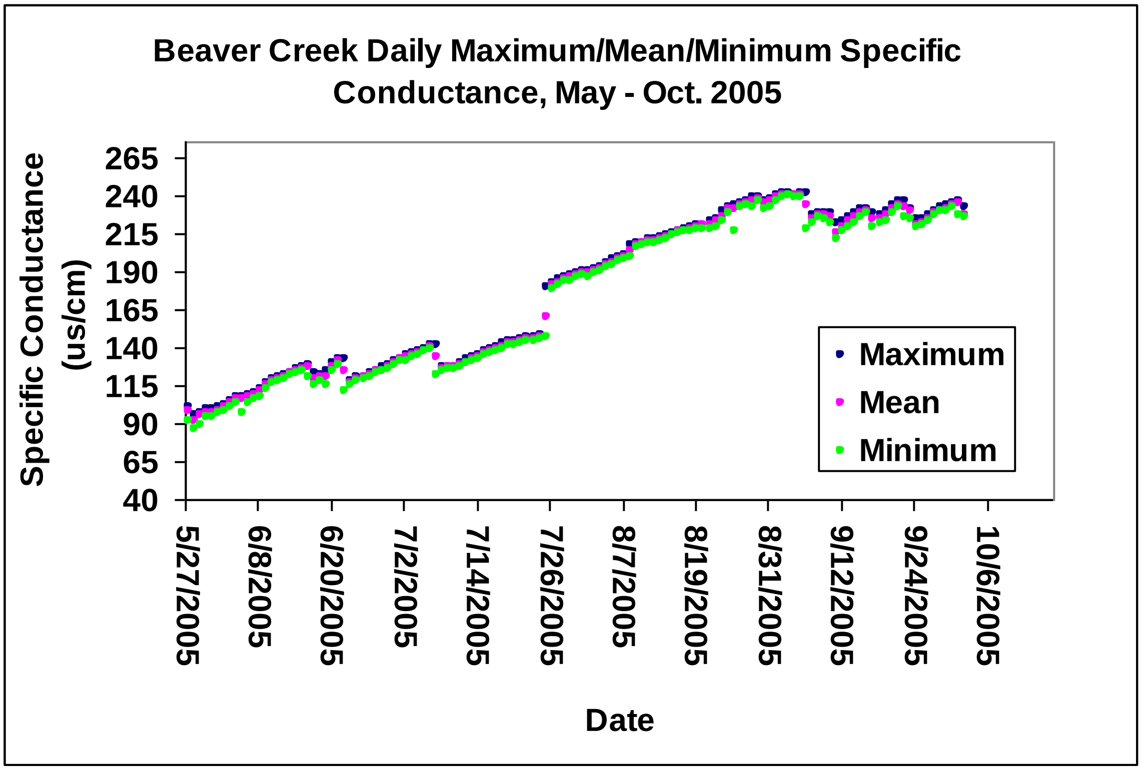

Figure 19. Daily maximum, mean, and minimum specific conductivity values in Beaver Creek from May to October, 2005.

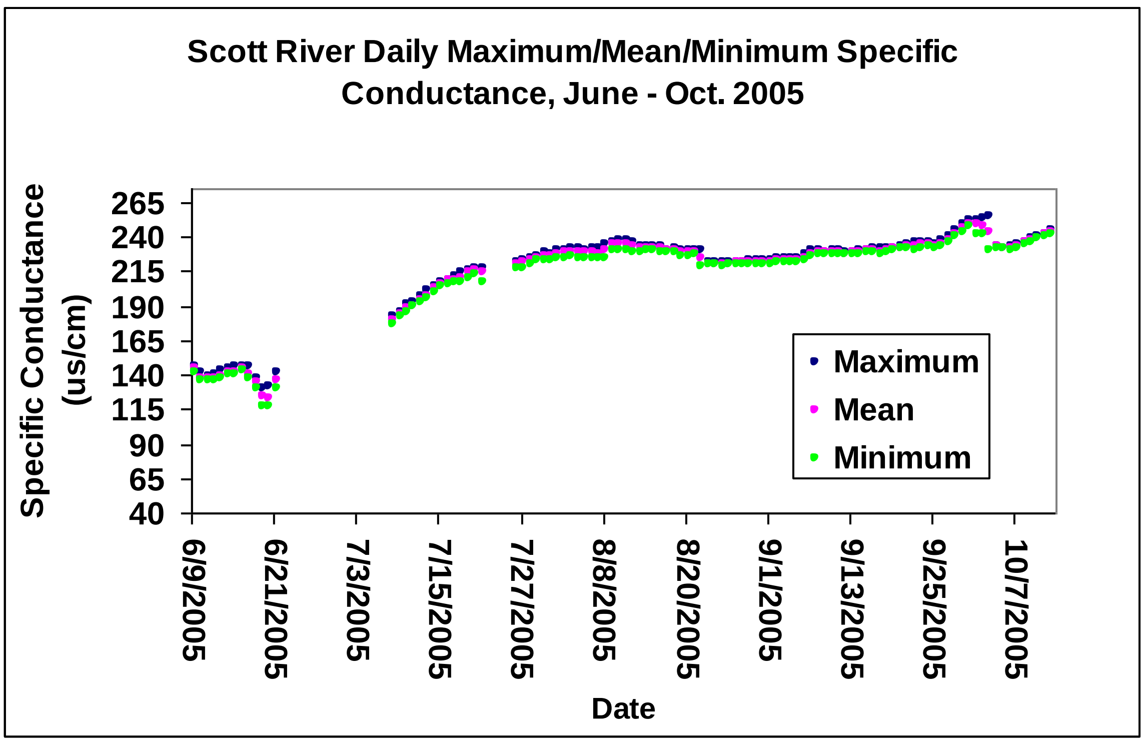

Figure 20. Daily maximum, mean, and minimum specific conductivity in the Scott River from June to October, 2005.

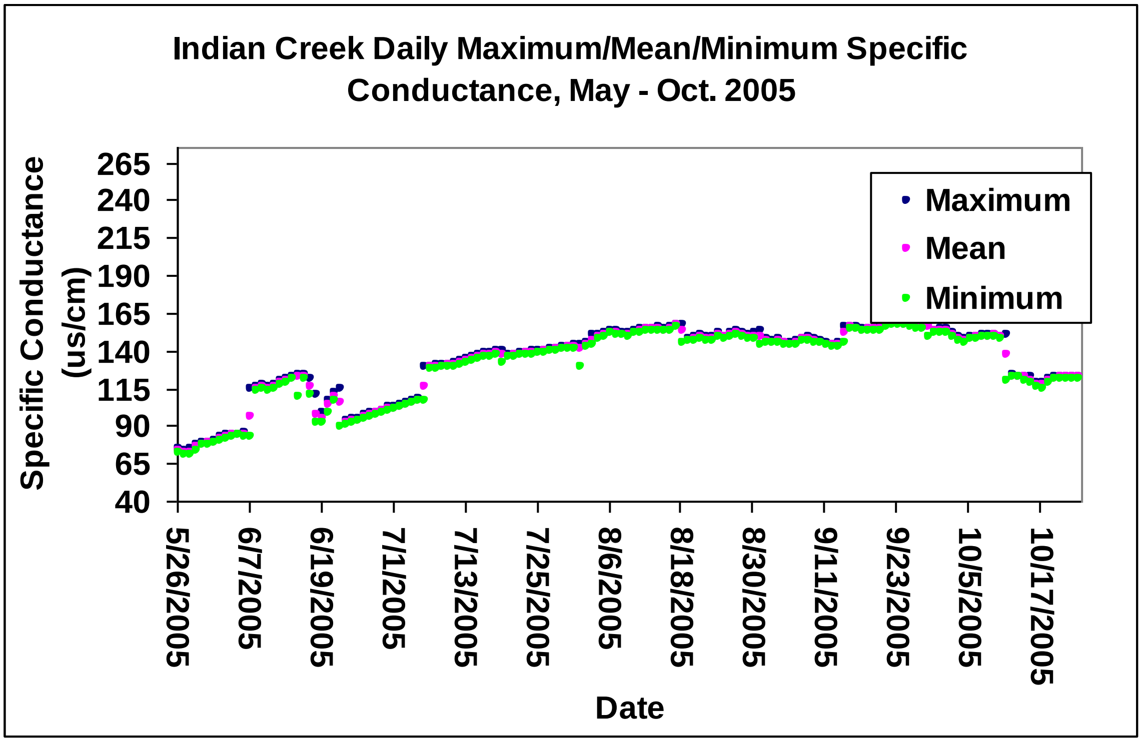

Figure 21. Daily maximum, mean, and minimum specific conductivity values in Indian Creek from May to October, 2005.

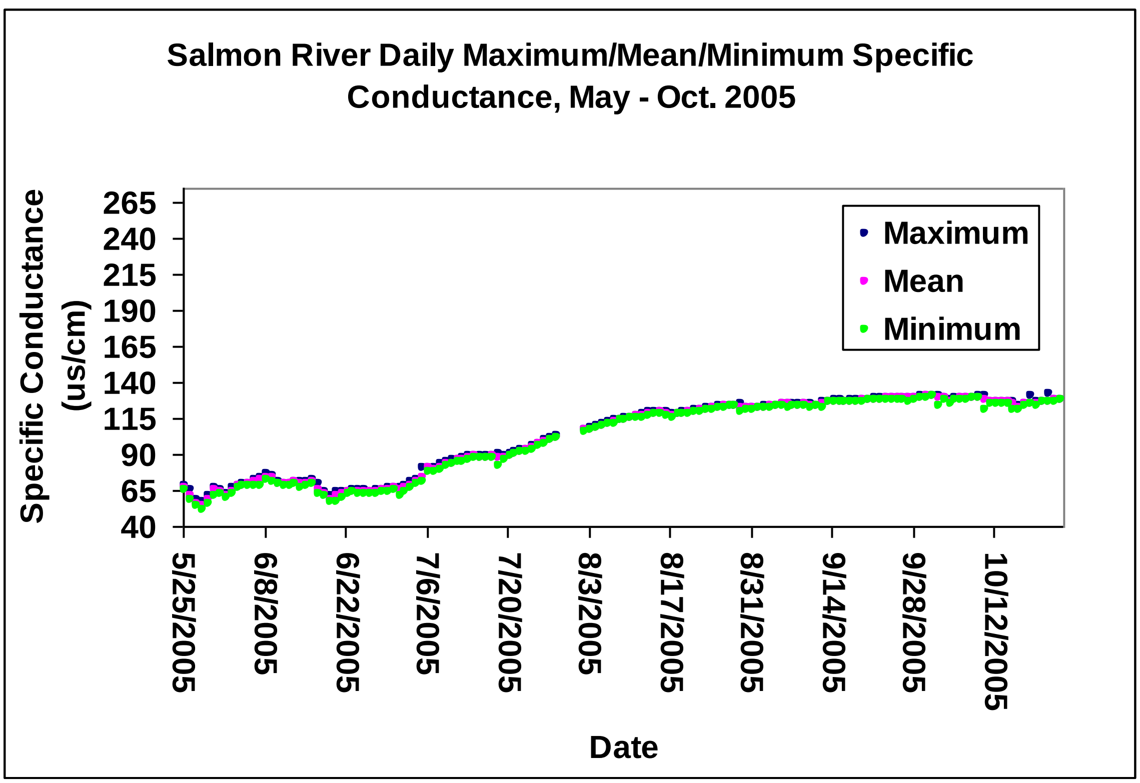

Figure 22. Daily maximum, mean, and minimum specific conductivity values in the Salmon River from May to October, 2005.

5.5 Flow

Provided below are daily mean stream flow (ft^3/sec) from USGS gauging stations located in the Klamath Basin and its tributaries. The Salmon River water quality station is in the same location as the USGS flow gauge (Figure 23). Flows taken from Seiad and Scott River gauges are also presented below, however the water quality stations are not in the same location as the USGS flow gauges (Figures 24-25).

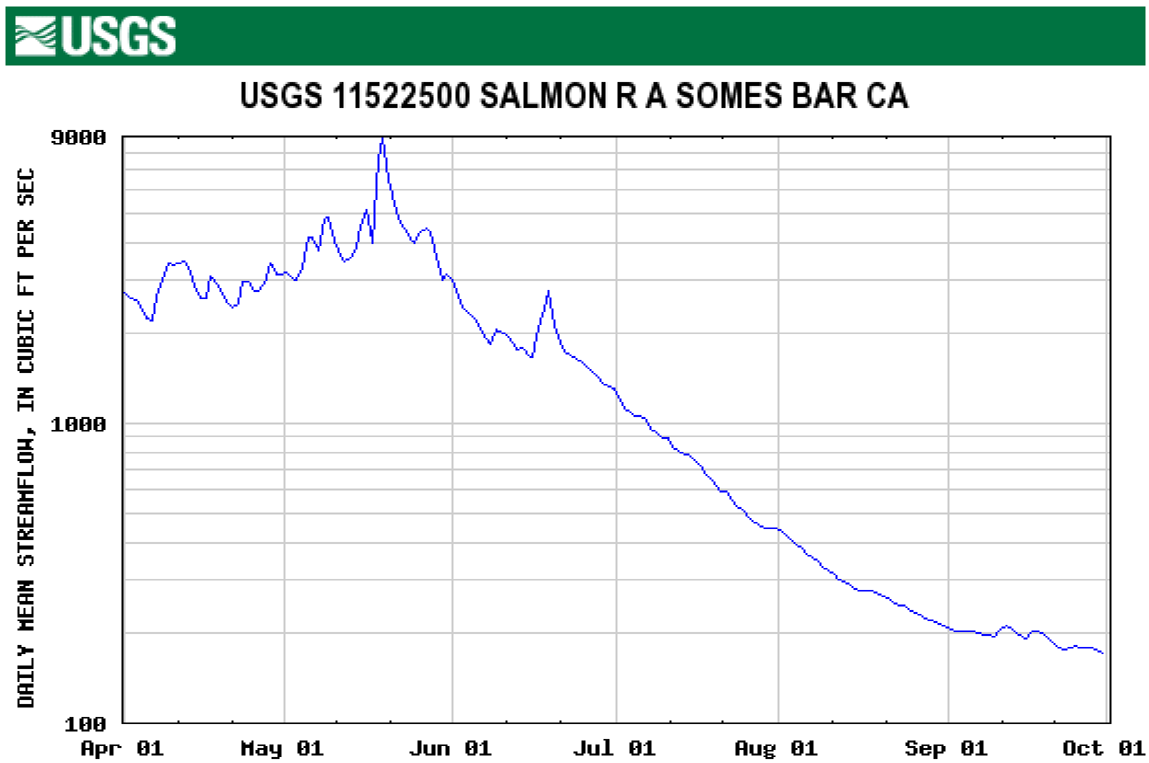

Figure 23. Daily mean stream flow (ft^3/sec) from the Salmon River at the Somes Bar USGS flow gauge from April to October, 2005.

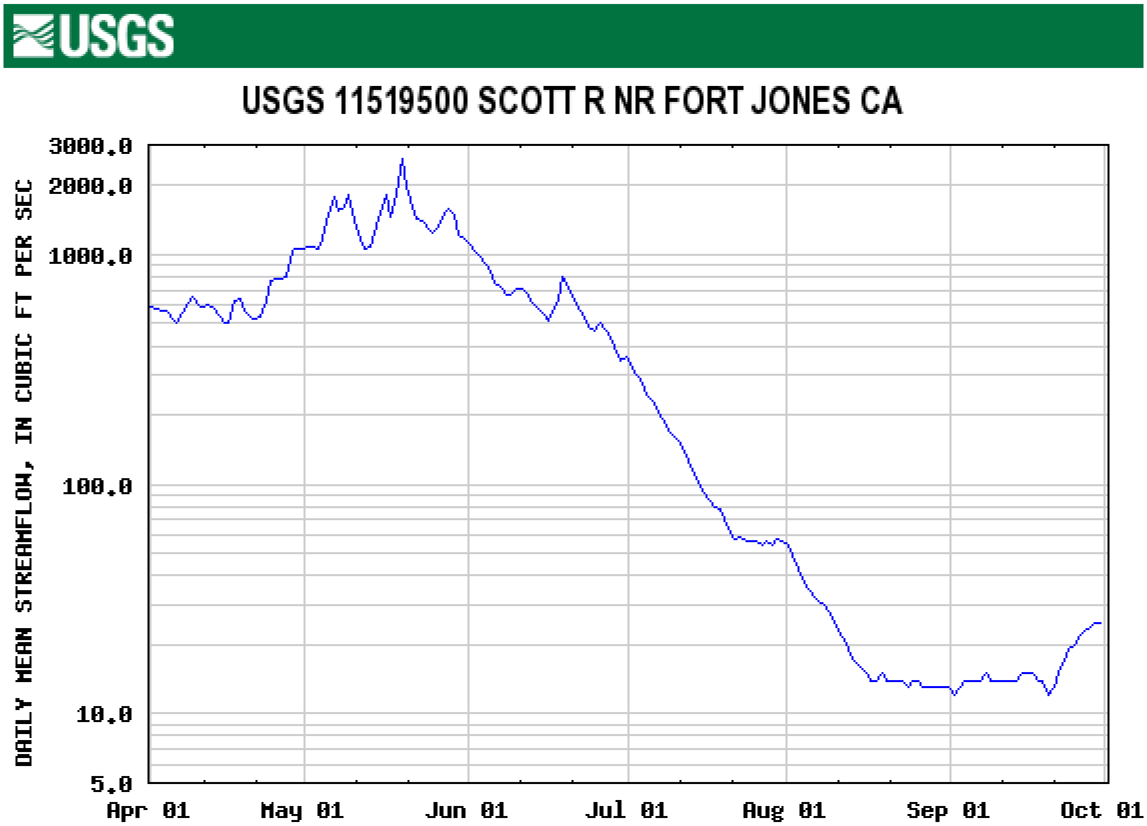

Figure 24. Daily mean stream flow (ft^3/sec) from the Scott River at the Fort Jones USGS flow gauge from April to October, 2005.

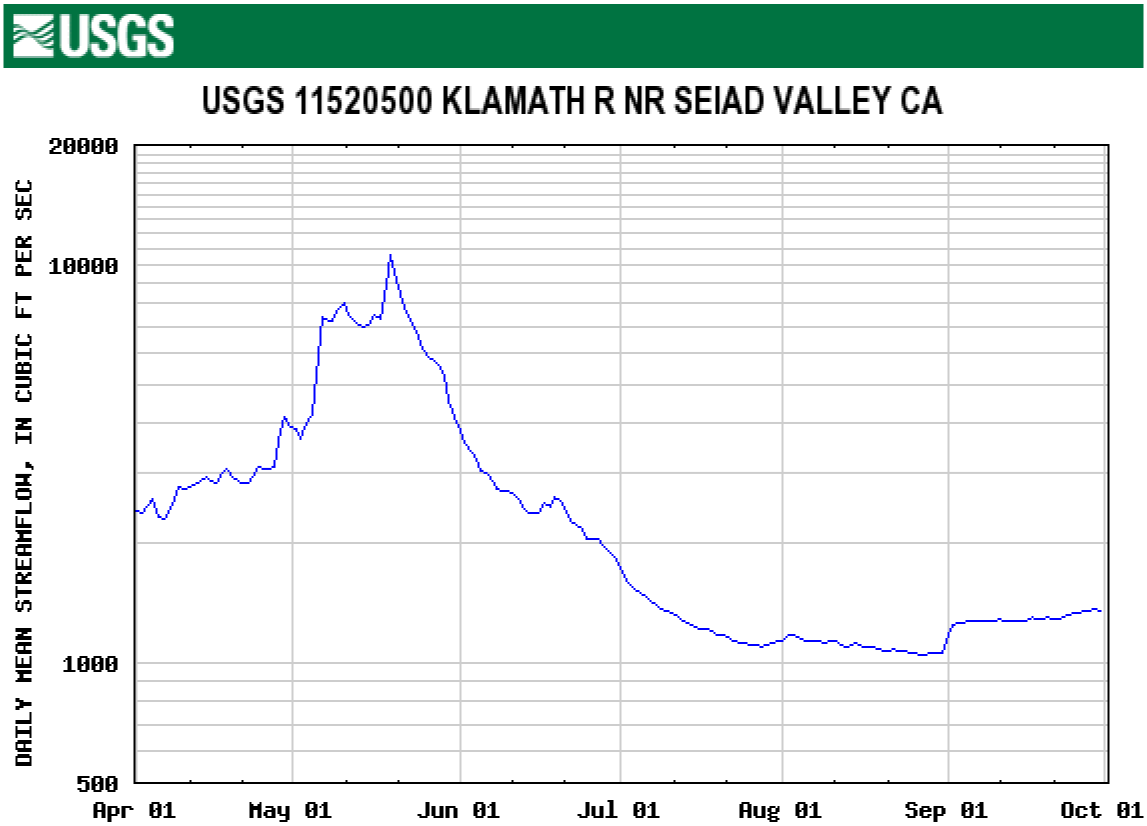

Figure 25. Daily mean stream flow (Ft^3/sec) from the Klamath River at the Seiad USGS flow gauge from April to October, 2005.

6.0 DATA MANAGEMENT

During 2005, the Karuk Tribe of California collected all water quality data during on-site maintenance for each water quality station at biweekly intervals. Data was then downloaded and brought back to the office, where data associated with maintenance activity or malfunctioning probes were omitted. Daily values (based on at least 46 of 48 measurements) were obtained utilizing an Excel spreadsheet. Data was collected in ½ hour intervals. 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.

7.0 SUMMARY

The purpose of this study is to develop baseline information that the Tribe, other agencies, and interested groups, can utilize in assessing the condition of the Klamath River and its tributaries. This report will not extensively analyze the data collected during 2005; however some critical items need to be brought to attention.

Water temperature, for all of the monitoring sites, increased from June to September. This is to be expected as snow melt subsides and air temperatures rise (Figures 1, 2, 3, & 4). However, the Karuk Tribe is concerned about how high the water temperatures are in the Klamath River and its tributaries. Maximum weekly average temperatures, the most common method of assessing water temperatures, calculations require 7 consecutive days of data, thus if one day of data is missing MWAT can not be calculated for the next 6 days. MWAT calculations for the Scott and Salmon Rivers were not consecutive throughout the sampling period due to a couple of days of missing data. However, from the available MWAT's one can visibly see the trend from Figures 9 and 10. For both the Scott and Salmon Rivers, water temperature is 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 high temperatures are due in part to reduction of riparian vegetation, inadequate management of the watershed for fire, and hydraulic mining operations. In the Scott, high temperatures are due in part to agricultural use, groundwater pumping, logging practices, and hydraulic mining operations.

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.

Appendix A

Beaver Creek Water Quality Data
May to October 2005

Beaver Creek Water Quality Station
Water temperature (Temp, ^{o}C), Dissolved Oxygen (DO, mg/L), pH,
Specific Conductivity (SpC, µs/cm)

Appendix B

Scott River Water Quality Data
June to October 2005

Scott River Water Quality Station
Water temperature (Temp, ^{o}C), Dissolved Oxygen (DO, mg/L), pH,
Specific Conductivity (SpC, µs/cm)

Appendix C

Indian Creek Water Quality Data
May to October 2005

Indian Creek Water Quality Station
Water temperature (Temp, ^oC), Dissolved Oxygen (DO, mg/L), pH,
Specific Conductivity (SpC, µs/cm)

Appendix D

Salmon River Water Quality Data
May to October 2005

Salmon River Water Quality Station
Water temperature (Temp, ^{o}C), Dissolved Oxygen (DO, mg/L), pH,
Specific Conductivity (SpC, µs/cm)

Date	Max Temp	Mean Temp	Min Temp	Max DO	Mean DO	Min DO	Max pH	Mean pH	Min pH	Max SpC	Mean SpC	Min SpC
5/25/2005	13.57	12.13	10.81				7.17	6.87	6.39	68	66.6	64.6
5/26/2005	14.17	13.02	11.83	10.99	10.54	10.18	7.28	6.97	6.35	64.6	60.4	58.6
5/27/2005	14.11	13.19	12.01	11.02	10.57	10.15	7.4	7.23	7.07	58.6	55.9	54.1
5/28/2005	13.95	12.65	11.78	11.03	10.70	10.27	7.45	7.33	7.23	56.2	54.0	51.8
5/29/2005	12.39	11.05	10.23	11.4	11.08	10.7	7.54	7.40	7.29	61.4	57.7	55.8
5/30/2005	13.79	11.84	10.45	11.25	10.75	10.09	7.71	7.57	7.45	66.3	64.4	61.5
5/31/2005	14.03	13.34	12.48	10.71	10.34	9.99	7.67	7.58	7.51	65.7	63.1	61.6
6/1/2005	13.69	12.84	11.93	10.93	10.47	9.69	7.65	7.55	7.47	62.4	61.2	59.6
6/2/2005	13.25	12.40	11.38	10.84	10.45	10.09	7.69	7.58	7.49	66	64.1	62.3
6/3/2005	13.82	12.76	11.71	10.76	10.30	9.87	7.72	7.60	7.51	68.2	67.2	65.8
6/4/2005	14.1	13.20	12.29	10.48	10.07	9.72	7.7	7.61	7.53	69.1	68.5	68.1
6/5/2005	13.57	12.53	11.92	10.61	10.25	9.85	7.63	7.57	7.5	69.4	68.7	68
6/6/2005	12.23	10.99	10.48	10.82	10.53	10.1	7.6	7.55	7.5	71.3	70.0	68.5
6/7/2005	11.28	10.47	9.7				7.82	7.67	7.53	73	71.3	68
6/8/2005	11.41	11.10	10.66							75.5	73.8	72.6
6/9/2005	13.86	12.24	10.91	11.09	10.71	10.25				75.2	72.9	70.2
6/10/2005	14.93	13.85	12.81	11.17	10.44	10				70.2	69.5	68.8
6/11/2005	15.25	14.43	13.52	11.61	10.40	9.96				69.6	68.7	67.6
6/12/2005	15.04	14.19	13.25	11.97	10.80	10.12				69.6	68.8	67.7
6/13/2005	15.47	14.47	13.42	11.43	11.02	10.2				70.9	70.0	69
6/14/2005	15.59	14.85	14.09	11.27	10.87	10.44				70.8	69.7	66.8
6/15/2005	14.97	14.22	13.31	12.4	11.04	10.55				70.6	69.7	68.5
6/16/2005	14.48	13.55	12.9	11.83	11.05	10.66				72.4	71.3	69.8
6/17/2005	12.88	11.80	11.3	11.67	11.17	10.34				69.5	65.1	62.9
6/18/2005	11.3	10.99	10.83	12.17	11.28	10.58				63.8	62.1	60.2
6/19/2005	12.06	11.14	10.48	12.25	10.94	10.35				60.4	58.4	56.8
6/20/2005	14.31	12.74	11.55							63.9	60.6	56.6
6/21/2005	14.59	13.82	12.81							63.5	61.7	59.8
6/22/2005	15.9	14.67	13.6	10.21	9.85	9.44				64.3	63.7	62.6
6/23/2005	16.57	15.54	14.47	9.91	9.54	9.01				64.6	63.9	63.2
6/24/2005	17.11	16.16	15.13	9.81	9.41	9.06				64.4	63.5	62.6
6/25/2005	16.79	16.19	15.45	9.78	9.41	9.12				64.7	63.6	62.7
6/26/2005	16.92	16.14	15.19	9.78	9.42	9.02				63.9	63.3	62.6
6/27/2005	17.59	16.63	15.65	9.66	9.27	9				64.7	63.8	62.8
6/28/2005	18.07	17.05	15.98	9.5	9.12	8.71				65.7	64.6	63.6
6/29/2005	18.46	17.48	16.42	9.45	9.08	8.77				66.5	65.3	64.1
6/30/2005	19.08	18.05	16.98	9.5	9.02	8.66				67	65.9	65.1
7/1/2005	19.03	18.22	17.27	9.34	8.92	8.65				66.3	65.1	60.7
7/2/2005	18.4	17.60	16.58	9.4	9.02	8.67				67.3	65.9	63.8
7/3/2005	18.72	17.63	16.57	9.39	8.97	8.61				70.1	68.5	66.4
7/4/2005	18.92	17.86	16.83	9.22	8.91	8.62				71.4	70.5	69.4
7/5/2005	19.4	18.27	17.23							80.8	74.0	70.2
7/6/2005	19.79	18.76	17.84							80.6	79.7	78.2
7/7/2005	19.33	18.54	17.73	8.98	8.65	8.36				80.3	79.1	78
7/8/2005	18.84	18.06	17.11	9.14	8.82	8.5				82.7	80.5	78.5

7/9/2005	19.1	18.45	17.83	9.06	8.74	8.5				84.1	83.0	82.1