

**FINAL**  
**2010 Klamath River**  
**Continuous Water Quality Monitoring**  
**Summary Report**



**Yurok Tribe Environmental Program:**  
**Water Division**

**March 2011**

Prepared by: Scott Sinnott

## **Acknowledgements**

The Yurok Tribe Environmental Program (YTEP) would like to thank those that contributed to the data collection efforts that occurred during the 2010 monitoring season. AmeriCorps Watershed Stewards Project Members Dan Riddle and Charles Schembre were instrumental in maintaining and calibrating the datasondes. PacifiCorp provided funding under the Klamath Hydroelectric Settlement Agreement (KHSAs) to accomplish a portion of this monitoring. We would also like to thank Yellow Springs Inc. for their prompt responses to any inquiries regarding maintenance and/or equipment operation.

## Table of Contents

<b>I. Introduction .....</b>	<b>1</b>
<b>II. Background .....</b>	<b>1</b>
<b>The Klamath River Watershed.....</b>	<b>1</b>
<b>The Klamath River .....</b>	<b>3</b>
<b>The Yurok Indian Reservation .....</b>	<b>3</b>
<b>Yurok Tribe Water Monitoring Division .....</b>	<b>3</b>
<b>III. Methods.....</b>	<b>5</b>
<b>IV. Site Selection .....</b>	<b>5</b>
<b>V. Quality Assurance.....</b>	<b>6</b>
<b>VI. Results.....</b>	<b>10</b>
<b>Temperature.....</b>	<b>10</b>
<b>All Riverine Sites.....</b>	<b>10</b>
<b>Klamath River above Turwar (KAT) .....</b>	<b>10</b>
<b>Klamath River above Tully Creek (TC) .....</b>	<b>11</b>
<b>Klamath River at Weitchpec (WE) .....</b>	<b>11</b>
<b>Trinity River near Mouth (TR) .....</b>	<b>12</b>
<b>Dissolved Oxygen .....</b>	<b>18</b>
<b>All Riverine Sites.....</b>	<b>18</b>
<b>Klamath River above Turwar (KAT) .....</b>	<b>19</b>
<b>Klamath River above Tully Creek (TC) .....</b>	<b>19</b>
<b>Klamath River at Weitchpec (WE) .....</b>	<b>19</b>
<b>Trinity River near Mouth (TR) .....</b>	<b>20</b>
<b>pH .....</b>	<b>24</b>
<b>All Riverine Sites.....</b>	<b>24</b>
<b>Klamath River above Turwar (KAT) .....</b>	<b>24</b>
<b>Klamath River above Tully Creek (TC) .....</b>	<b>25</b>
<b>Klamath River at Weitchpec (WE) .....</b>	<b>25</b>
<b>Trinity River near Mouth (TR) .....</b>	<b>25</b>
<b>Specific Conductivity .....</b>	<b>28</b>
<b>All Riverine Sites.....</b>	<b>28</b>
<b>Klamath River above Turwar (KAT) .....</b>	<b>28</b>
<b>Klamath River above Tully Creek (TC) .....</b>	<b>28</b>
<b>Klamath River at Weitchpec (WE) .....</b>	<b>28</b>
<b>Trinity River near Mouth (TR) .....</b>	<b>29</b>
<b>VII. Discussion.....</b>	<b>31</b>
<b>Temperature.....</b>	<b>31</b>
<b>All Riverine Sites.....</b>	<b>31</b>
<b>Klamath River above Turwar (KAT) .....</b>	<b>31</b>
<b>Klamath River above Tully Creek (TC) .....</b>	<b>32</b>
<b>Klamath River at Weitchpec (WE) .....</b>	<b>32</b>
<b>Trinity River near Mouth (TR) .....</b>	<b>32</b>
<b>Impacts of the Trinity River on Water Temperature in the Klamath River ....</b>	<b>32</b>

<b>Dissolved Oxygen .....</b>	<b>34</b>
<b>All Riverine Sites.....</b>	<b>34</b>
<b>Klamath River above Turwar (KAT) .....</b>	<b>34</b>
<b>Klamath River above Tully Creek (TC) .....</b>	<b>34</b>
<b>Klamath River at Weitchpec (WE) .....</b>	<b>34</b>
<b>Trinity River near Mouth (TR) .....</b>	<b>34</b>
<b>Impacts of the Trinity River on Dissolved Oxygen in the Klamath River .....</b>	<b>35</b>
<b>pH .....</b>	<b>36</b>
<b>All Riverine Sites.....</b>	<b>36</b>
<b>Klamath River above Turwar (KAT) .....</b>	<b>36</b>
<b>Klamath River above Tully Creek (TC) .....</b>	<b>37</b>
<b>Klamath River at Weitchpec (WE) .....</b>	<b>37</b>
<b>Trinity River near Mouth (TR) .....</b>	<b>37</b>
<b>Impacts of the Trinity River on pH in the Klamath River .....</b>	<b>37</b>
<b>Specific Conductivity .....</b>	<b>39</b>
<b>All Riverine Sites.....</b>	<b>39</b>
<b>Klamath River above Turwar (KAT) .....</b>	<b>39</b>
<b>Klamath River above Tully Creek (TC) .....</b>	<b>39</b>
<b>Klamath River at Weitchpec (WE) .....</b>	<b>39</b>
<b>Trinity River near Mouth (TR) .....</b>	<b>40</b>
<b>Impacts of the Trinity River on Specific Conductivity in the Klamath River ..</b>	<b>40</b>
<b>Works Cited.....</b>	<b>42</b>
<b>Appendix A: YSI Calibration SOP .....</b>	<b>43</b>
<b>Appendix B: Water Quality Grades.....</b>	<b>52</b>

## **Table of Figures**

<b>Figure 2-1. Klamath River Basin Map.....</b>	<b>2</b>
<b>Figure 2-2. Yurok Indian Reservation and Yurok Ancestral Territory Map.....</b>	<b>4</b>
<b>Figure 4-1. Datasonde Locations for 2010 .....</b>	<b>7</b>
<b>Figure 4-2. Klamath Above Turwar (KAT) .....</b>	<b>8</b>
<b>Figure 4-3. Klamath Above Tully Creek (TC) .....</b>	<b>8</b>
<b>Figure 4-4. Klamath River at Weitchpec (WE).....</b>	<b>9</b>
<b>Figure 4-5. Trinity River near Mouth (TR).....</b>	<b>9</b>
<b>Figure 6-1. KAT Maximum/minimum Water Temperatures and Flow: 2010 .....</b>	<b>12</b>
<b>Figure 6-2. KAT 7-Day Moving Averages: 2010.....</b>	<b>13</b>
<b>Figure 6-3. KAT Water Temperature Percent Exceedance: 2010 .....</b>	<b>13</b>
<b>Figure 6-4. TC Maximum/minimum Water Temperature and Flow: 2010 .....</b>	<b>14</b>
<b>Figure 6-5. TC 7-Day Moving Averages: 2010.....</b>	<b>14</b>
<b>Figure 6-6. TC Water Temperature Percent Exceedance: 2010 .....</b>	<b>15</b>
<b>Figure 6-7. WE Maximum/minimum Water Temperature and Flow: 2010.....</b>	<b>15</b>
<b>Figure 6-8. WE 7-Day Moving Averages: 2010.....</b>	<b>16</b>

<b>Figure 6-9. WE Water Temperature Percent Exceedance: 2010 .....</b>	<b>16</b>
<b>Figure 6-10. TR Maximum/minimum Water Temperature and Flow: 2010 .....</b>	<b>17</b>
<b>Figure 6-11. TR 7-Day Moving Averages: 2010 .....</b>	<b>17</b>
<b>Figure 6-12. TR Water Temperature Percent Exceedance: 2010 .....</b>	<b>18</b>
<b>Figure 6-13. KAT Dissolved Oxygen and Flow: 2010.....</b>	<b>20</b>
<b>Figure 6-14. KAT Percent Dissolved Oxygen and Flow: 2010.....</b>	<b>21</b>
<b>Figure 6-15. TC Dissolved Oxygen and Flow: 2010.....</b>	<b>21</b>
<b>Figure 6-16. TC Percent Dissolved Oxygen and Flow: 2010.....</b>	<b>22</b>
<b>Figure 6-17. WE Dissolved Oxygen and Flow: 2010.....</b>	<b>22</b>
<b>Figure 6-18. WE Percent Dissolved Oxygen and Flow: 2010.....</b>	<b>23</b>
<b>Figure 6-19. TR Dissolved Oxygen and Flow: 2010.....</b>	<b>23</b>
<b>Figure 6-20. TR Percent Dissolved Oxygen and Flow: 2010.....</b>	<b>24</b>
<b>Figure 6-21. KAT Maximum/minimum pH and Flow: 2010 .....</b>	<b>26</b>
<b>Figure 6-22. TC Maximum/minimum pH and Flow: 2010 .....</b>	<b>26</b>
<b>Figure 6-23. WE Maximum/minimum pH and Flow: 2010 .....</b>	<b>27</b>
<b>Figure 6-24. TR Maximum/minimum pH and Flow: 2010 .....</b>	<b>27</b>
<b>Figure 6-25. KAT Maximum/minimum Specific Conductivity and Flow: 2010.....</b>	<b>29</b>
<b>Figure 6-26. TC Maximum/minimum Specific Conductivity and Flow: 2010.....</b>	<b>30</b>
<b>Figure 6-27. WE Maximum/minimum Specific Conductivity and Flow: 2010.....</b>	<b>30</b>
<b>Figure 6-28. TR Maximum/minimum Specific Conductivity and Flow: 2010 .....</b>	<b>31</b>
<b>Figure 7-1. Daily Maximum Temperature Across All Sites: 2010 .....</b>	<b>33</b>
<b>Figure 7-2. WE vs. TC Water Temperature: 2010 .....</b>	<b>33</b>
<b>Figure 7-3. Daily Minimum Dissolved Oxygen Across All Sites: 2010 .....</b>	<b>35</b>
<b>Figure 7-4. WE vs. TC Dissolved Oxygen: 2010 .....</b>	<b>36</b>
<b>Figure 7-5. Daily Maximum pH Across All Sites: 2010.....</b>	<b>38</b>
<b>Figure 7-6. WE vs. TC pH: 2010 .....</b>	<b>38</b>
<b>Figure 7-7. Daily Maximum Specific Conductivity Across All Site: 2010.....</b>	<b>40</b>
<b>Figure 7-8. WE vs. TC Specific Conductivity: 2010 .....</b>	<b>41</b>

## Table of Tables

<b>Table B-1. KAT Grades: 2010 .....</b>	<b>53</b>
<b>Table B-2. TC Grades: 2010 .....</b>	<b>53</b>
<b>Table B-3. WE Grades: 2010 .....</b>	<b>54</b>
<b>Table B-4. TR Grades: 2010 .....</b>	<b>54</b>

## **I. Introduction**

This report summarizes the trends in water quality as measured by Yellow Springs Incorporated (YSI) 6600EDS multiparameter datasondes on the Klamath and Trinity Rivers from May through November, 2010. The Yurok Tribe Environmental Program (YTEP) measured water quality at several monitoring sites from Weitchpec to the USGS gaging station at Blake's Riffle at half-hour intervals starting in mid-May and ending in early November. This monitoring was performed in an effort to track both temporal and spatial patterns on the lower reaches of the Klamath River during the sampling period. This data was added to previous years' water quality data as part of an endeavor to build a multi-year database on the Lower Klamath River. This summary is part of YTEP's comprehensive program of monitoring and assessment of the chemical, physical, and biological integrity of the Klamath River and its tributaries in a scientific and defensible manner. Datasonde placement along the mainstem of the Klamath and Trinity Rivers and measured parameters were coordinated with the Karuk Tribe and PacifiCorp to expand our understanding of the water quality dynamics in the Klamath basin.

## **II. Background**

### ***The Klamath River Watershed***

The Klamath River system drains much of northwestern California and south-central Oregon (Figure 2-1). Thus, even activities taking place on land hundreds miles off the Yurok Indian Reservation (YIR) can affect water conditions within YIR boundaries. For example, upriver hydroelectric and diversion projects have altered natural flow conditions for decades. The majority of water flowing through the YIR is derived from scheduled releases of impounded water from the Upper Klamath Basin that is often of poor quality with regards to human needs as well as the needs of fish and wildlife.

Some historically perennial streams now have ephemeral lower reaches and seasonal fish migration blockages because of inadequate dam releases from water diversion projects along the Klamath and Trinity Rivers. The releases contribute to lower mainstem levels and excessive sedimentation which in turn causes subsurface flow and aggraded deltas. Additionally, the lower slough areas of some of the Lower Klamath tributaries that enter the estuary experience eutrophic conditions during periods of low flow. These can create water quality barriers to fish migration when dissolved oxygen and water temperature levels are inadequate for migrating fish. The Klamath River is on California State Water Resource Control Board's (SWRCB) 303(d) List as impaired for temperature, dissolved oxygen, and nutrients and portions of the Klamath River were recently listed as impaired for microcystin and sedimentation in particular reaches.

The basin's fish habitat has also been greatly diminished in area and quality during the past century by accelerated sedimentation from mining, timber harvest practices, and road construction, as stated by Congress in the Klamath River Act of 1986. Management of private lands in the basin (including fee land within Reservation boundaries) has been, and continues to be, dominated by timber harvest.

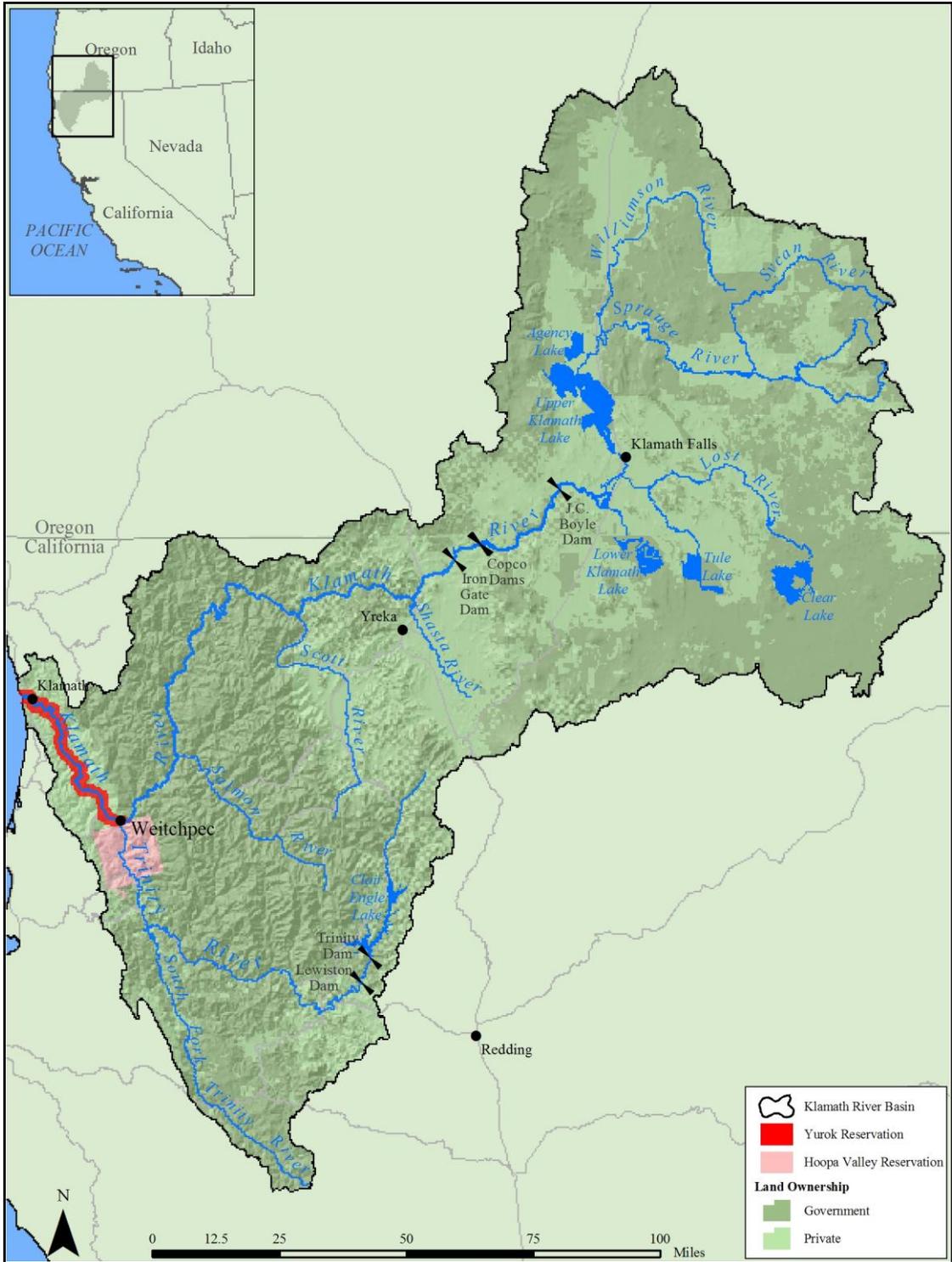


Figure 2-1. Klamath River Basin Map

## ***The Klamath River***

The health of the Klamath River and associated fisheries has been central to the life of the Yurok Tribe since time immemorial fulfilling subsistence, commercial, cultural, and ceremonial needs. Yurok oral tradition reflects this. The Yurok did not use terms for north or east, but rather spoke of direction in terms of the flow of water (Kroeber 1925). The Yurok word for salmon, *nepuy*, refers to “that which is eaten”. Likewise, the local waterways and watershed divides have traditionally defined Yurok aboriginal territories. Yurok ancestral land covers about 360,000 acres and is distinguished by the Klamath and Trinity Rivers, their surrounding lands, and the Pacific Coast extending from Little River to Damnation Creek.

The fisheries resource continues to be vital to the Yurok today. The September 2002 Klamath River fish kill, where a conservative estimate of 33,000 fish died in the lower Klamath before reaching their natal streams to spawn, was a major tragedy for the Yurok people.

## ***The Yurok Indian Reservation***

The current YIR consists of a 59,000-acre corridor extending for one mile from each side of the Klamath River from just upstream of the Trinity River confluence to the Pacific Ocean, including the channel and the bed of the river (Figure 2-2). There are approximately two dozen major anadromous tributaries within that area. The mountains defining the river valley are as much as 3,000 feet high. Along most of the river, the valley is quite narrow with rugged steep slopes. The vegetation is principally redwood and Douglas fir forest with little area available for agricultural development. Historically, prevalent open prairies provided complex and diverse habitat.

## ***Yurok Tribe Water Monitoring Division***

In 1998, YTEP was created to protect and restore tribal natural resources through high quality scientific practices. YTEP is dedicated to improving and protecting the natural and cultural resources of the Yurok Tribe through collaboration and cooperation with local, private, state, tribal, and federal entities such as the Yurok Tribe Fisheries Program (YTFP), US Fish and Wildlife Service (USFWS), the United States Environmental Protection Agency (USEPA), Green Diamond Resource Company, the NCRWQCB, and the United States Geological Survey (USGS). USEPA funding allocated under the Clean Water Act Section 106 and funding from PacifiCorp primarily fund YTEP’s continuous water quality monitoring activities.

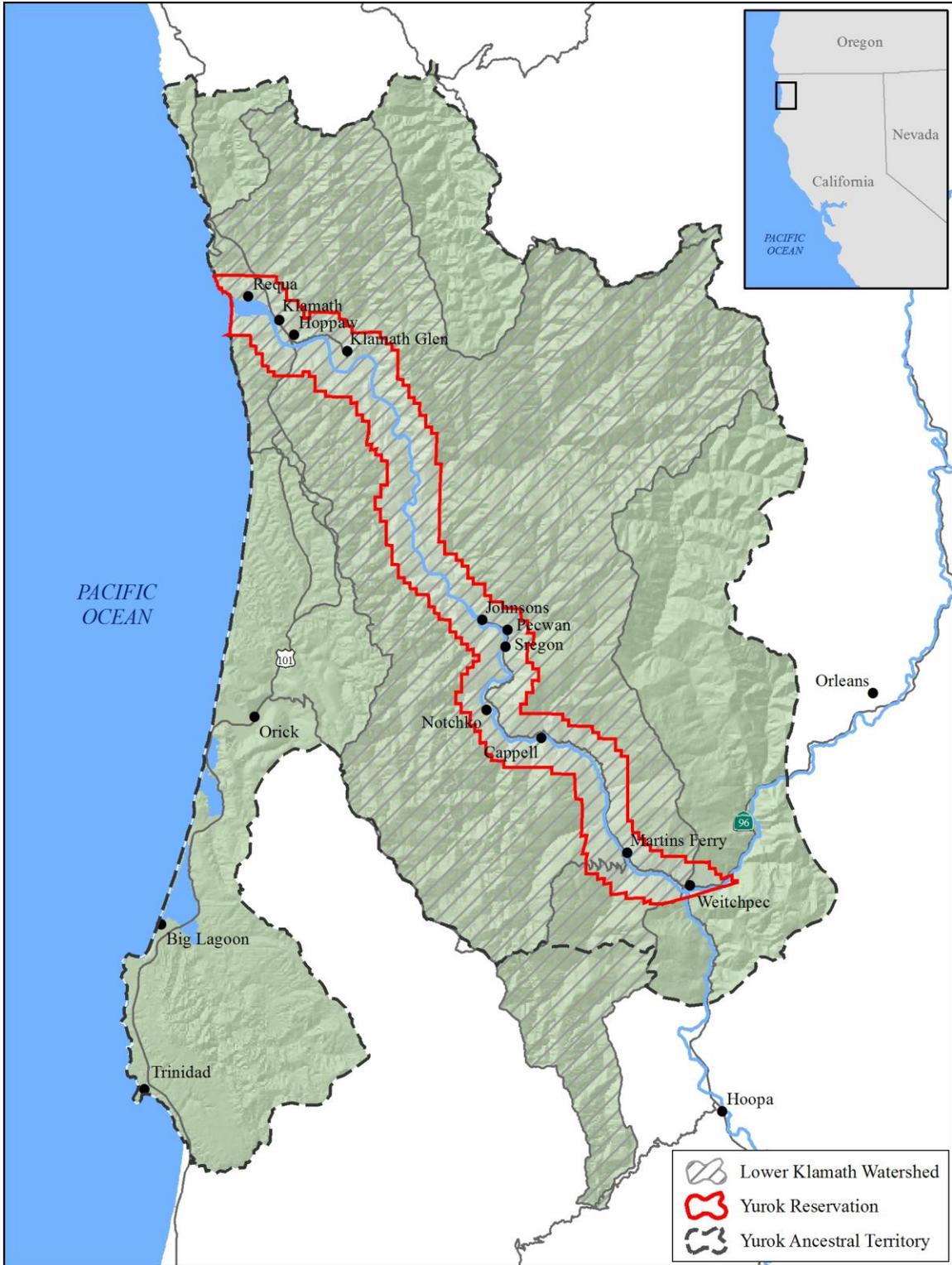


Figure 2-2. Yurok Indian Reservation and Yurok Ancestral Territory Map

### III. Methods

The monitoring study initiated in the middle of May, continued throughout the summer months and ended in early November. Continuous water quality information was collected using YSI 6600EDS multiparameter datasondes equipped with specific conductivity/temperature, pH, DO and phycocyanin probes. ROX DO probes detect concentrations of dissolved oxygen in bodies of water by measuring luminescence as it is affected by the presence of oxygen, while phycocyanin probes are designed to detect the presence of an accessory pigment known to occur in *Microcystis aeruginosa*. These sensors return consistent, high quality measurements.

During this study, many QC measures were undertaken to ensure the data collected with the datasondes were of the highest quality. According to the 2008 datasonde operation protocol (Appendix A), datasondes were pre- and post-calibrated on site every two weeks order to account for electronic drift and bio-fouling. When the datasondes were deployed and extracted, an audit was performed with a freshly calibrated YSI 6600EDS, a portable multi-probe instrument. Effort was made to record the 6600EDS measurements as close as possible to the datasonde and within five minutes of the datasonde recording a measurement.

Once the datasonde was extracted, a pre-clean audit was performed, this time with the site datasonde and reference datasonde in a bucket filled with river water. Once this audit was performed, the site datasonde was cleaned and wiper pads were replaced. Next, a post-clean audit was performed with the site datasonde and reference datasonde in the same bucket of water. After the post clean audit was completed, the dissolved oxygen probe was calibrated using the wet towel method. This protocol requires the user to wrap the datasonde in a wet towel and then place it in a calibration chamber (cylindrical cooler). Dissolved oxygen percent saturation is then calibrated using the current barometric pressure. Barometric pressure was measured using a reliable barometer on site.

Once dissolved oxygen was calibrated, specific conductivity was calibrated, followed by pH with fresh calibration solutions. These were calibrated using the rinse method outlined in the 2008 datasonde operation protocol (Appendix A). Once calibrations were completed the accuracy of the BGA probe was checked by recording readings from DI water, and, during periods of blue-green algae blooms, a solution of rhodamine dye (To view results of continuous blue-green algae data please see the Yurok Tribe's 2010 Blue-green Algae Summary Report).

After all calibrations and audits were completed, the site datasonde was returned to its housing and redeployed.

### IV. Site Selection

The sampling area includes the lower 44 river miles of the mainstem Klamath River on the YIR and the Trinity River above its convergence with the Klamath near the southern boundary of the YIR. In general, the various sampling locations were chosen in order to represent the average ambient water conditions throughout the water column.

The sites listed below in bold indicate established sampling locations for the collection of continuous water quality data from May through November.

YTEP collected continuous water quality data at the following mainstem Klamath River locations (Figure 4-1) (river miles are approximate):

- **KAT - Klamath River above Turwar Boat Ramp – RM 8 (Figure 4-2)**
- **TC - Klamath River above Tully Creek – RM 38.5 (Figure 4-3)**
- **WE - Klamath River at Weitchpec (upstream of Trinity River) – RM 43.5 (Figure 4-4)**

YTEP collected water samples for nutrient analysis at the following major tributary locations:

- **TR - Trinity River near mouth (above Klamath River confluence) – RM 0.5 (Figure 4-5)**

## V. Quality Assurance

During this study, many quality assurance and quality control (QA/QC) measures were undertaken to ensure that the continuous water quality data collected was of the highest quality.

All field personnel that were involved in datasonde maintenance have been trained appropriately by the Water Division Program Manager and are properly supervised to ensure proper protocol is followed consistently throughout the monitoring season. Each field visit requires that staff fill out field data sheets and follow protocols appropriately in the field. Datasonde maintenance is always conducted by at least two staff for safety reasons and to maintain consistency.

Data is thoroughly reviewed once downloaded from the datalogger. YTEP is the primary organization responsible for data review. The data manager will visually inspect all entered data sets to check for inconsistencies with original field data sheets. Where inconsistencies are encountered, data will be re-entered and re-inspected until the entered data is found to be satisfactory or results will be discarded. Any unusual values outside the range of norm will be flagged and all aspects of field data sheets will be reviewed. Outliers will be identified and removed from the dataset if deemed necessary by the QA Officer. The Project Manager will maintain field datasheets and notebooks in the event that the QA Officer needs to review any aspect of sampling for QA/QC purposes. Data is reviewed and finalized once data are merged or entered into a database.

The Yurok Tribe received a grant under the Environmental Information Exchange Network Program and used it to develop the Yurok Tribe Environmental Data Storage System (YEDSS). Continuous water quality data covered in this report have been entered in YEDSS, where each water quality parameter is assigned a grade based on USGS criteria (Appendix B) for each two week deployment, and will be uploaded to USEPA's WQX database. The metadata associated with each data type are also stored within the system and can be easily accessed when questions arise.

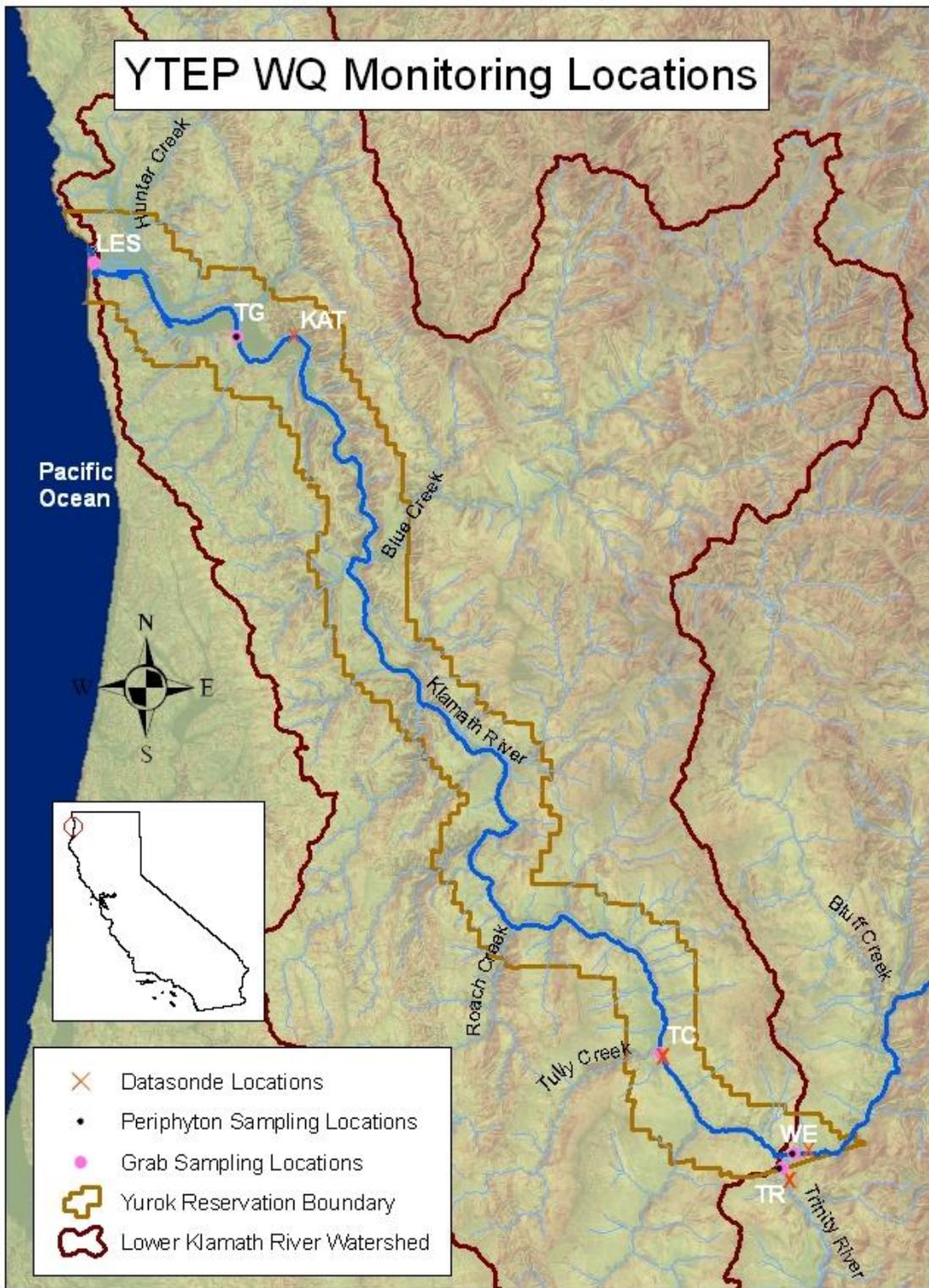


Figure 4-1. Datasonde Locations for 2010 (as indicated by the brown X's)



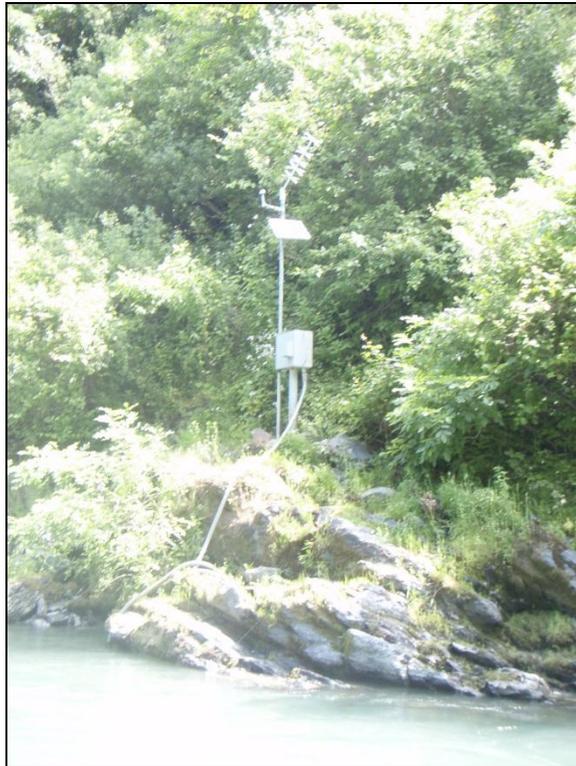
**Figure 4-2. Klamath Above Turwar (KAT)**



**Figure 4-3. Klamath Above Tully Creek (TC)**



**Figure 4- 4. Klamath River at Weitchpec (WE)**



**Figure 4- 5. Trinity River near Mouth (TR)**

## **VI. Results**

### **Temperature**

#### ***All Riverine Sites***

Water temperatures on the Lower Klamath and Trinity River varied greatly during the 2010 monitoring season. The coolest daily water temperature was 8.62°C on May 22 at WE. The warmest daily water temperature was 24.72°C on July 26 at WE. In this discussion, the daily minimum and maximum water temperatures were compared to the Yurok Tribe's water temperature standards in order to assess the water temperatures of the Klamath and Trinity Rivers. The discussion reflects water temperature standards as of November 1, 2005. Temperature standards are under review and will be updated for all salmonid life stages at a later date.

Daily maxima and minima were disregarded when more than five measurements were missing from a 24-hour period and when the daily maximum or minimum was expected to occur during the gap. Gaps in data may occur during service or due to instrument malfunction or vandalism. When gaps occurred in water temperature data, information was filled in using data from U.S. Fish and Wildlife Service (USFWS) HOBO temperature probes. These probes, which are deployed and extracted by YTEP, are placed in close proximity to each datasonde site. These probes record water temperature every hour throughout the entire year, and are switched out twice a year for data upload and probe maintenance and calibration. There is high confidence in the comparability of this temperature data with YTEP's datasonde data since nearly all data for the period of simultaneous deployment is within +/- 0.2 °C. Continuous datasonde water temperature data from the lower Klamath and Trinity River is available from YTEP upon request. For more information regarding HOBO water temperature data on the lower Klamath and Trinity River, contact the Arcata office of the U.S. Fish and Wildlife Service.

#### ***Klamath River above Turwar (KAT)***

Maximum water temperature at KAT increased during the first couple days of deployment in mid-May then decreased until late May. After late May, water temperature generally increased until mid-July, with a small decrease in temperature in early June (Figures 6-1 and 6-2). After mid-July maximum water temperature generally held steady until late August. In late August water temperature gradually decreased until late October, except for small spikes in early and late September. In late October, water temperature decreased sharply, then increased quickly at the very end of the month. Water temperature held steady for about a week in early November, then decreased until the datasonde was removed for the season.

The lowest temperature recorded at KAT during 2010 was 9.38°C on May 23 and the highest temperature recorded was 23.40°C on July 25. The daily maximum water temperature at KAT exceeded 21°C beginning on July 10 and remained above this standard until August 28, exceeding it again from September 2-5 (Figure 6-1).

Daily maximum water temperatures at KAT exceeded 21 °C 30% of the time, or 54 out of 180 days of the monitoring season (Figure 6-3). Water temperature exceeded 21 °C 19.32% of the time, or 1,685 out of 8,721 readings for all half-hour measurements

during the monitoring season (Figure 6-3). The seven-day moving average of the daily maximum exceeded 15.5 °C on June 25 and continued to exceed this standard until October 18 (Figure 6-2).

### ***Klamath River above Tully Creek (TC)***

Maximum water temperature at TC decreased for the first week after initial deployment. After this decrease, water temperature then increased until late July, with small dips in early June and early July (Figures 6-4 and 6-5). After late July, maximum temperature decreased slightly, but generally held steady until late August. After late August water temperature decreased until late October, with small spikes in early and late September.

The lowest temperature recorded at TC during 2010 was 8.87°C on May 22 and the highest temperature recorded was 24.02°C on July 27. The USFWS water temperature probe recorded a slightly higher maximum temperature of 24.07 on July 26, when the datasonde was out of service due to equipment malfunction. The daily maximum water temperature at TC exceeded 21°C beginning on July 10 and remained above this temperature until August 28, exceeding it again from September 2-5 (Figure 6-4).

Daily maximum water temperatures at TC exceeded 21°C 32.53% of the time, or 54 out of 166 days of the monitoring season (Figure 6-6). Water temperatures exceeded 21°C 23.37% of the time, or 1,741 out of 7,450 readings for all half-hour measurements during the 2010 monitoring season (Figure 6-6). The seven-day moving average of the daily maximum exceeded 15.5 °C from June 26 until October 17 (Figure 6-5).

### ***Klamath River at Weitchpec (WE)***

Maximum water temperature at WE increased for the first couple of days after initial deployment, then decreased over the following week (Figures 6-7 and 6-8). After the decrease, water temperature increased until late July, with a dip in early June. After late July, water temperature decreased slightly, then held steady until mid-August. After mid-August temperature gradually decreased until late October, with spikes in early and late September. After late October, water temperature decreased sharply, then increased quickly at the very end of the month. Water temperature held steady for about a week in early November, then decreased until the datasonde was removed on November 9 for the season.

The lowest temperature recorded at WE during 2010 was 8.62 °C on May 22, while the highest recorded temperature was 24.72 °C on July 26. The daily maximum water temperature at WE exceeded 21°C beginning on July 9 and remained above this temperature until August 28, exceeding it again from September 2-5 (Figure 6-7).

Daily maximum water temperature at WE exceeded 21°C 30.22% of the time, or 55 out of 182 days of the monitoring season (Figure 6-9). Water temperatures exceeded 21°C 25.80% of the time, or 2,217 out of 8,594 readings for all half-hour measurements during the 2010 monitoring season (Figure 6-9). The seven-day moving average of the daily maximum exceeded 15.5 °C from June 26 through October 18 (Figure 6-8).

### *Trinity River near Mouth (TR)*

Maximum water temperature at TR increased for the first couple of days after initial deployment, then decreased over the following week (Figures 6-10 and 6-11). Water temperature then generally increased until late July with a very small dip in early June and larger dips in mid-June and early July. After late July, water temperature was fairly steady until mid-August, at which time temperature decreased until late October. During this time there were spikes in early and late September. After late October, water temperature decreased sharply, then increased quickly at the very end of the month. Water temperature then held steady until datasondes were removed on November 9 for the end of the season.

The lowest temperature recorded at TR during 2010 was 9.06°C on May 22, and the highest temperature recorded was 23.72°C on July 26. The daily maximum water temperature at TR exceeded 21°C beginning on July 10 and remained above this temperature until August 28, exceeding it again from September 2-5 (Figure 6-10).

Daily maximum water temperature at TR exceed 21 °C 29.67% of the time, or 54 out of 182 days of the monitoring season (Figure 6-12). Water temperatures exceeded 21°C 20.47% of the time, or 1,794 out of 8,764 readings for all half-hour measurements during the 2010 monitoring season (Figure 6-12). The seven-day moving average of the daily maximum exceeded 15.5 °C from June 26 through October 17 (Figure 6-11).

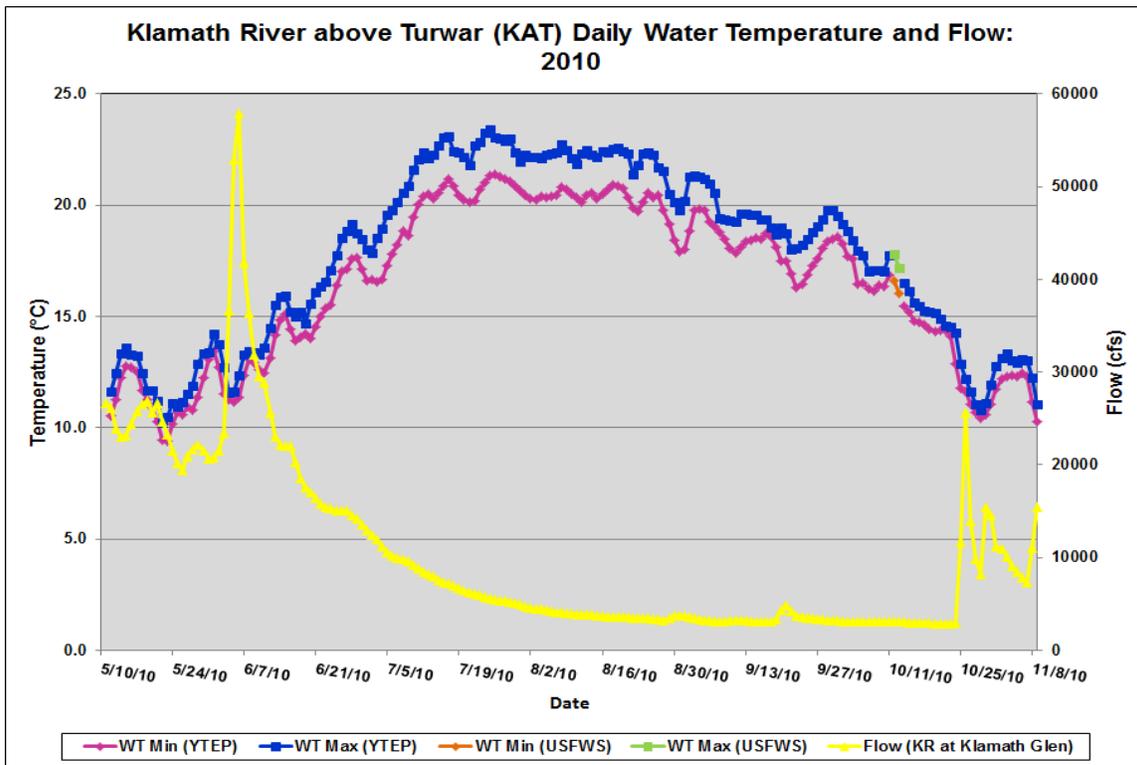


Figure 6-1. KAT Maximum/minimum Water Temperatures and Flow: 2010

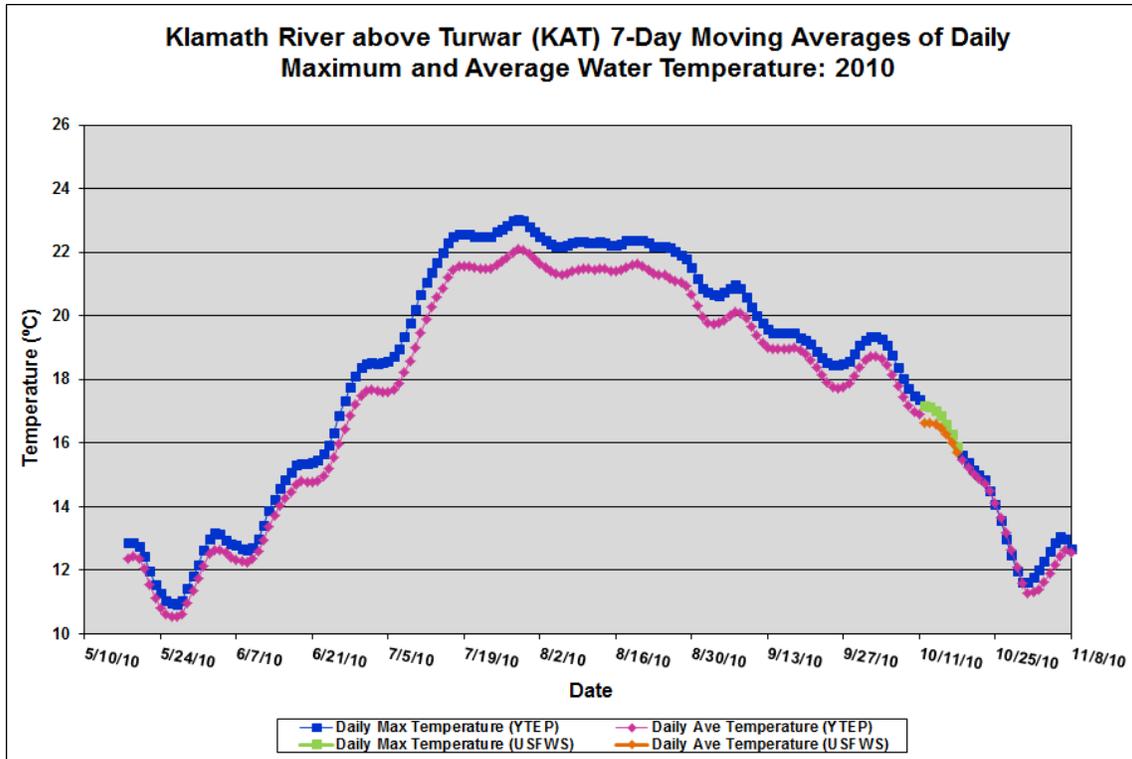


Figure 6-2. KAT 7-Day Moving Averages: 2010

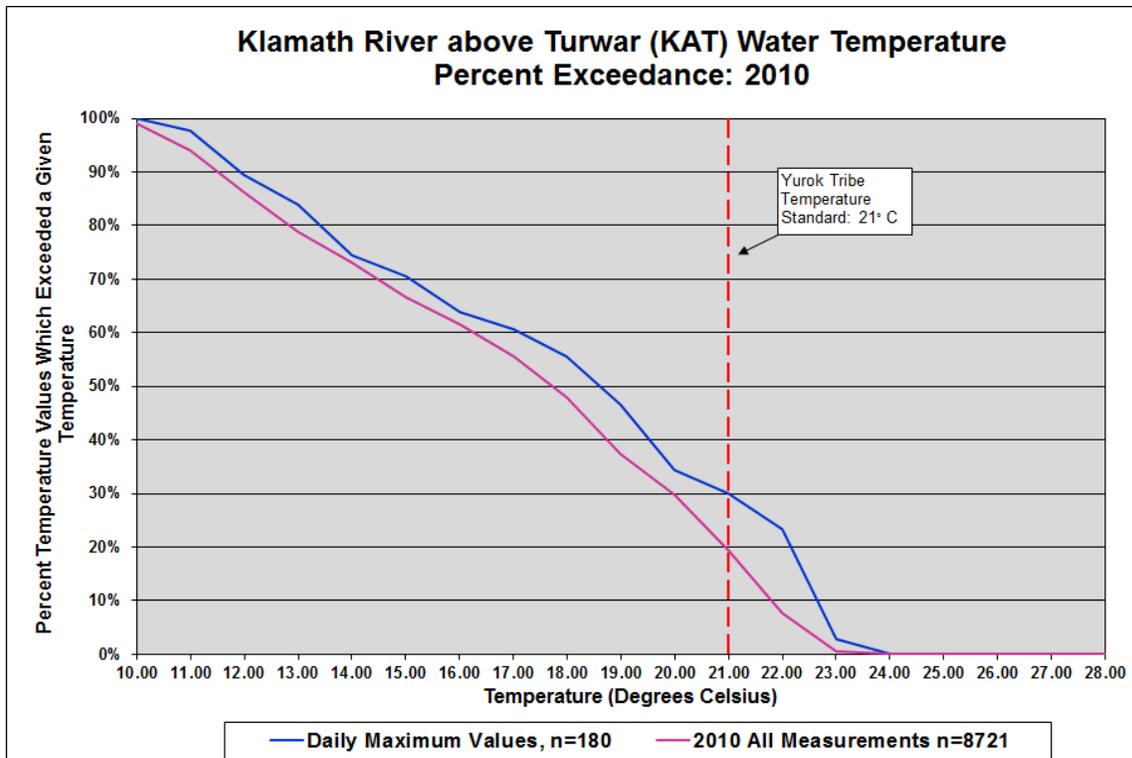


Figure 6-3. KAT Water Temperature Percent Exceedance: 2010

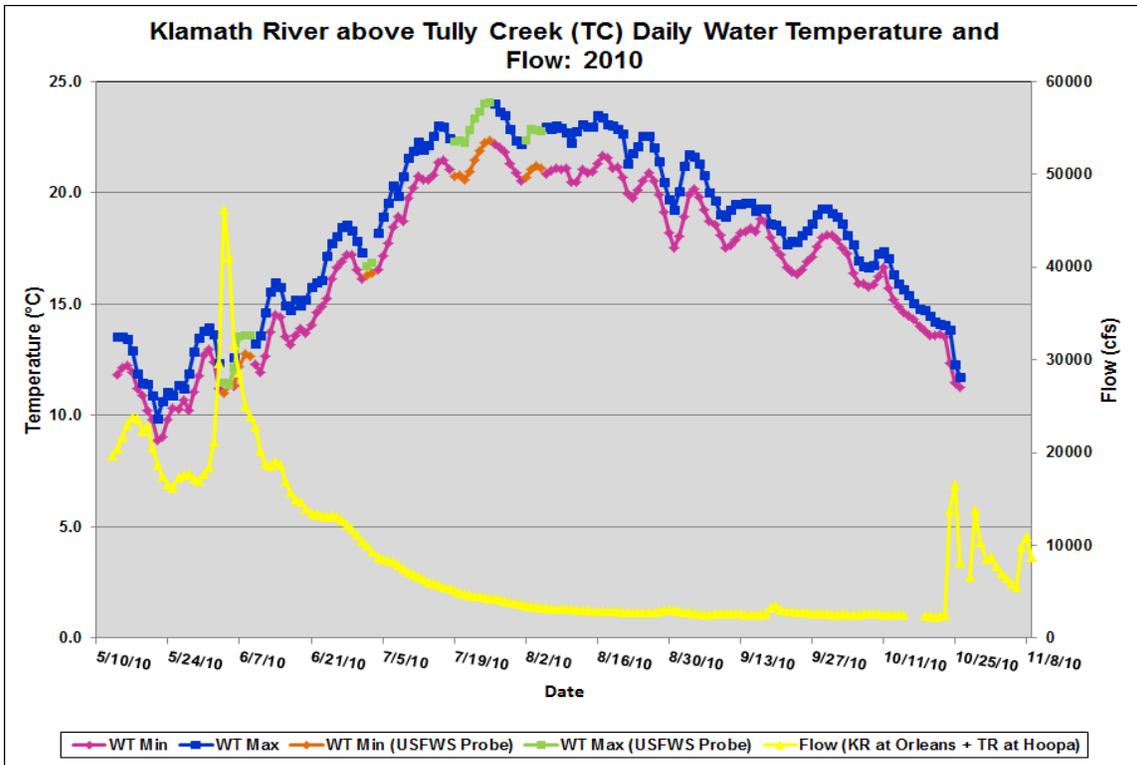


Figure 6-4. TC Maximum/minimum Water Temperature and Flow: 2010

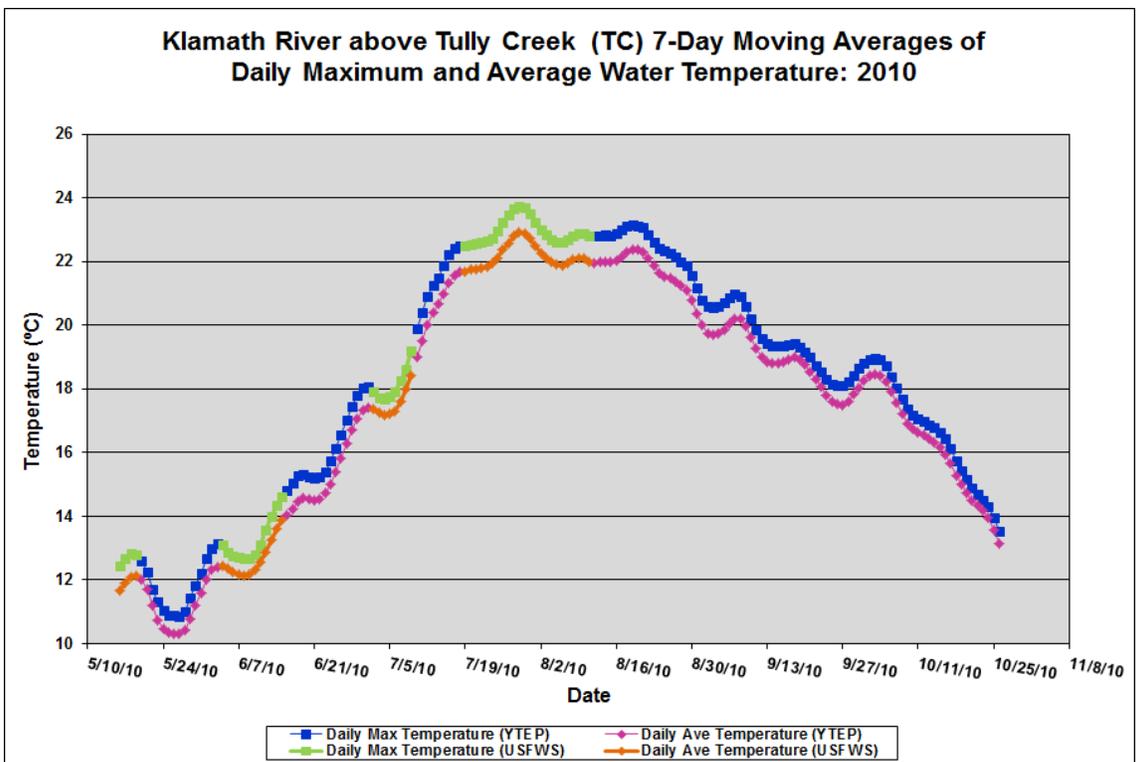


Figure 6-5. TC 7-Day Moving Averages: 2010

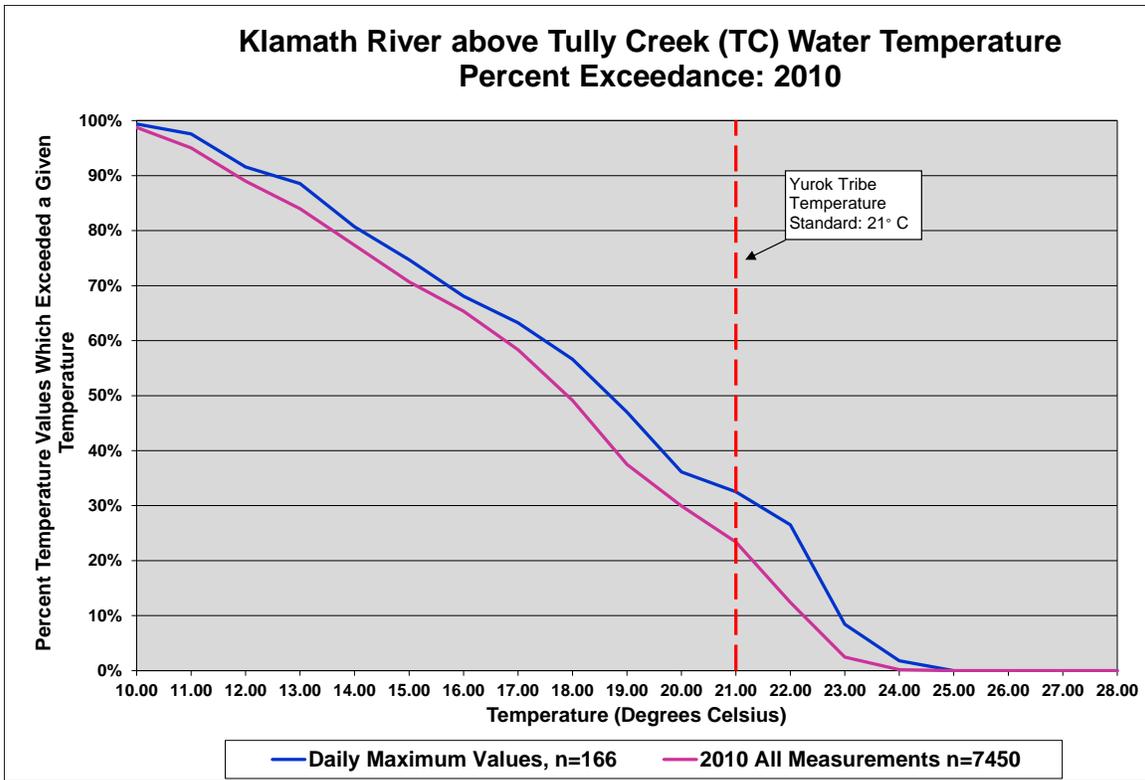


Figure 6-6. TC Water Temperature Percent Exceedance: 2010

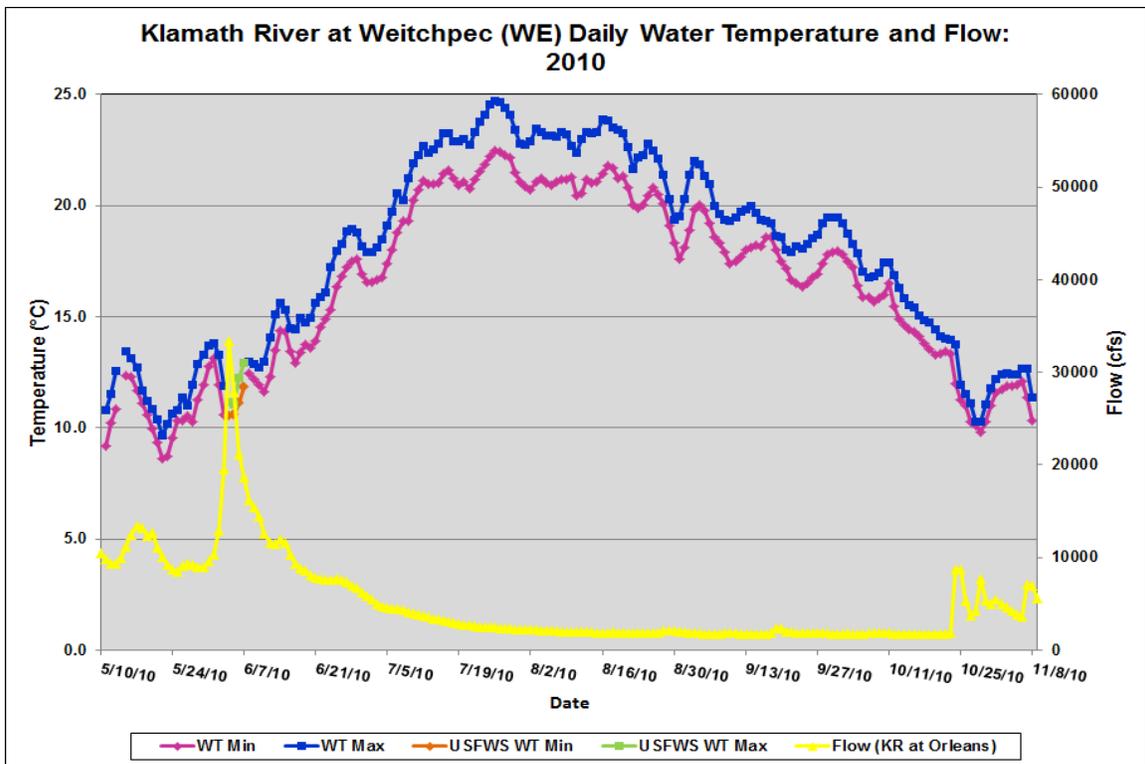


Figure 6-7. WE Maximum/minimum Water Temperature and Flow: 2010

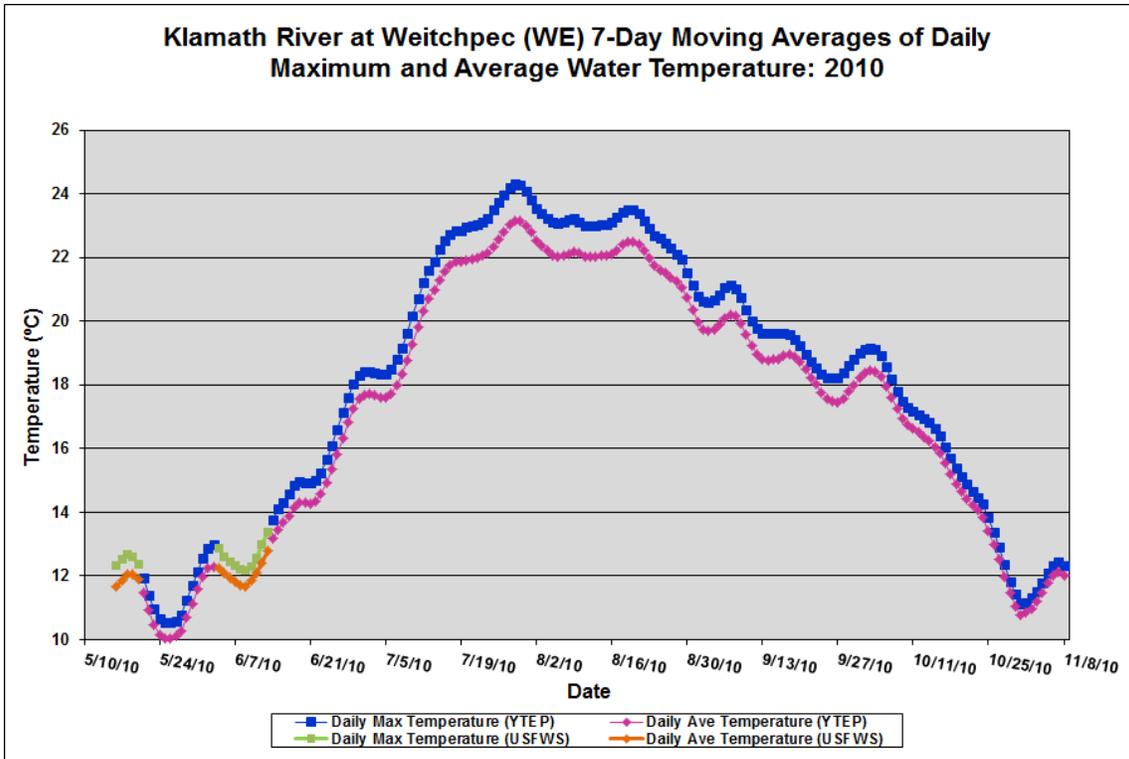


Figure 6-8. WE 7-Day Moving Averages: 2010

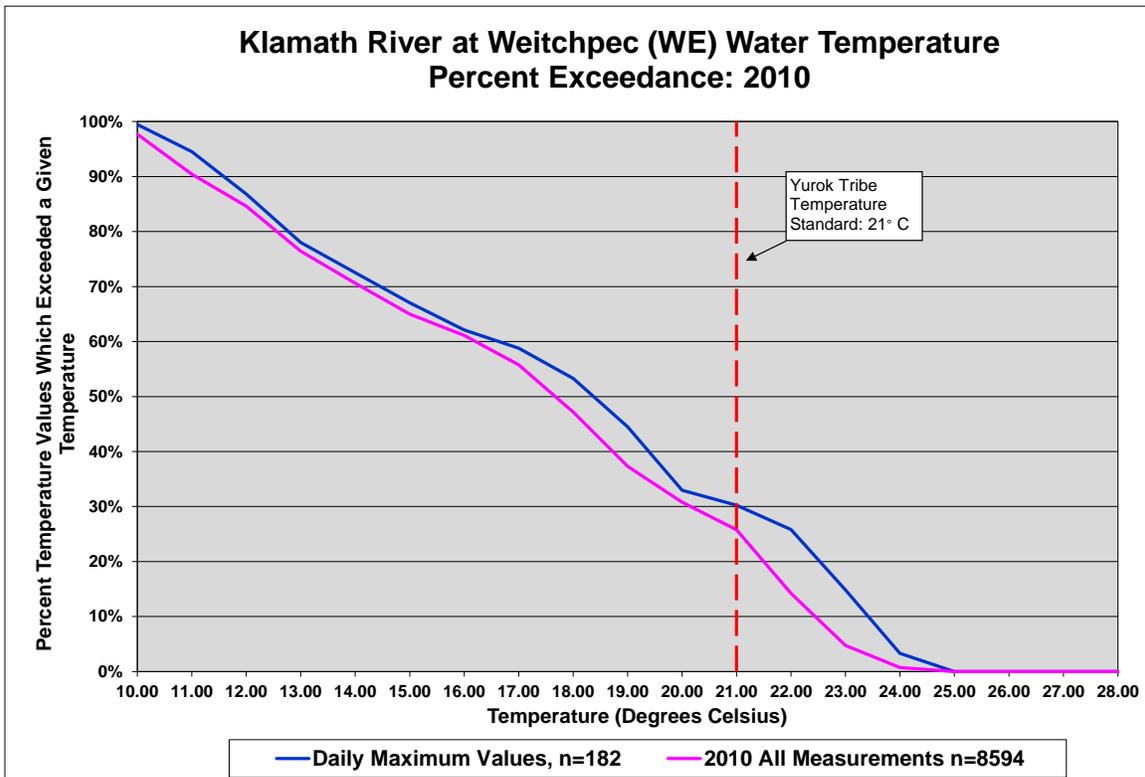


Figure 6-9. WE Water Temperature Percent Exceedance: 2010

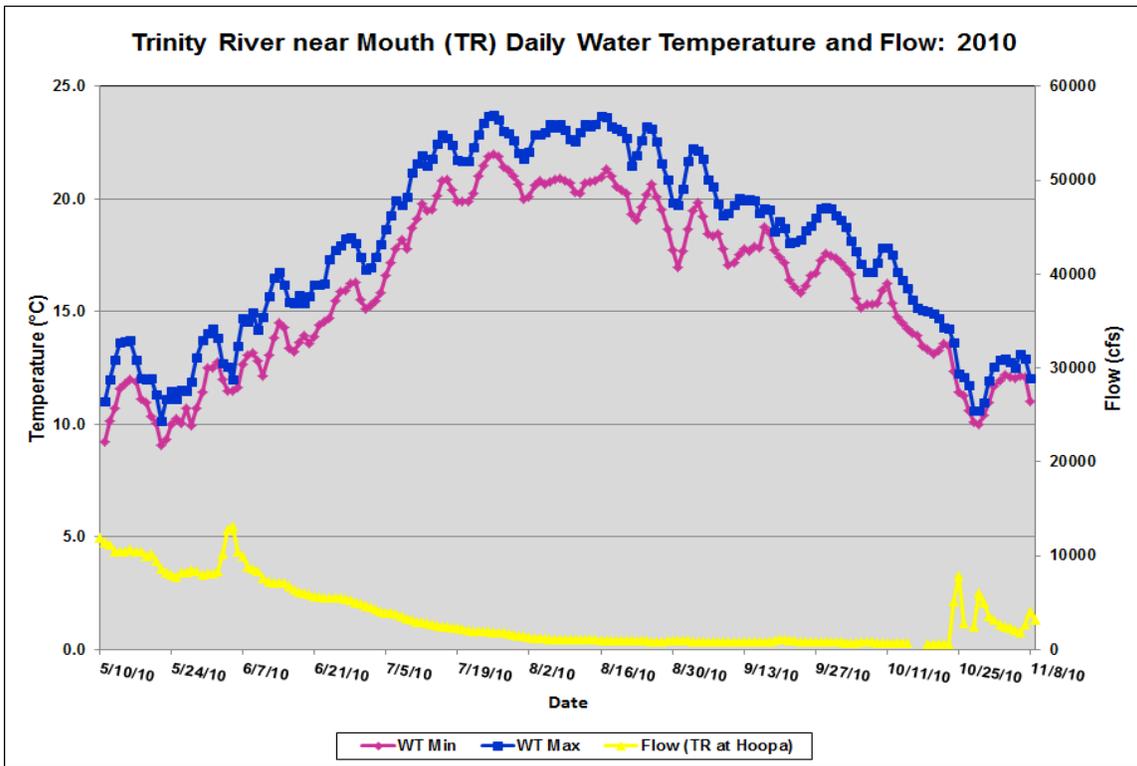


Figure 6-10. TR Maximum/minimum Water Temperature and Flow: 2010

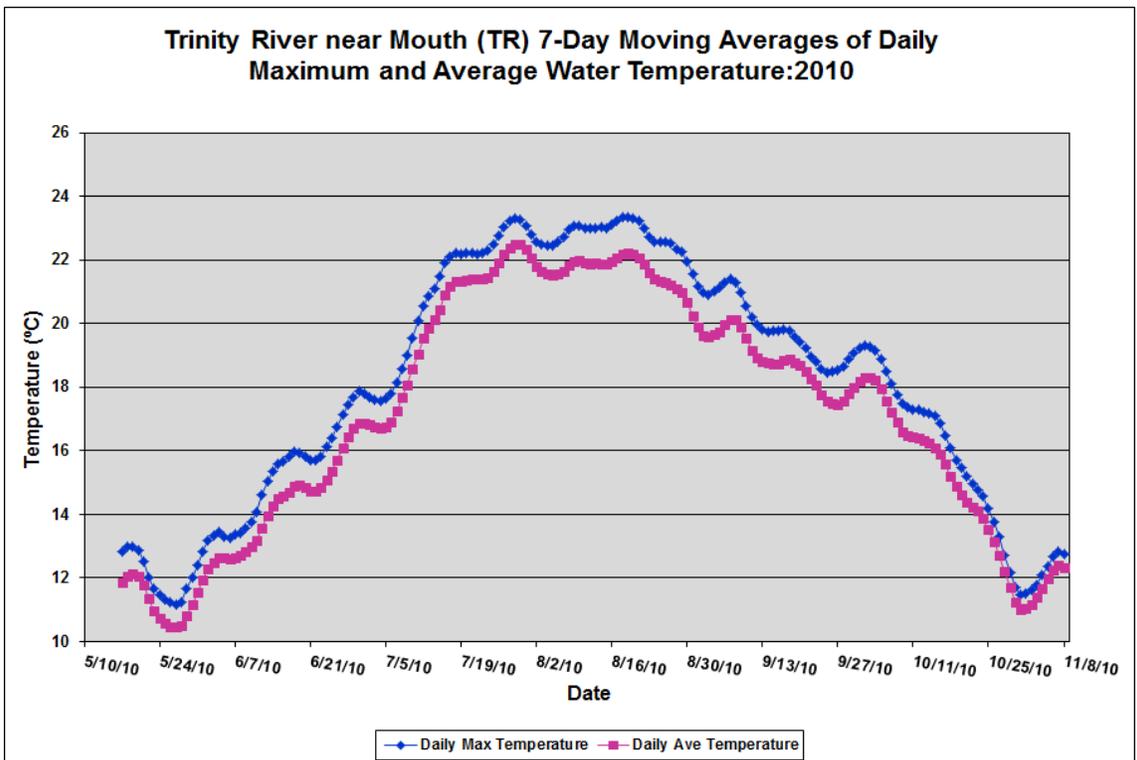


Figure 6-11. TR 7-Day Moving Averages: 2010

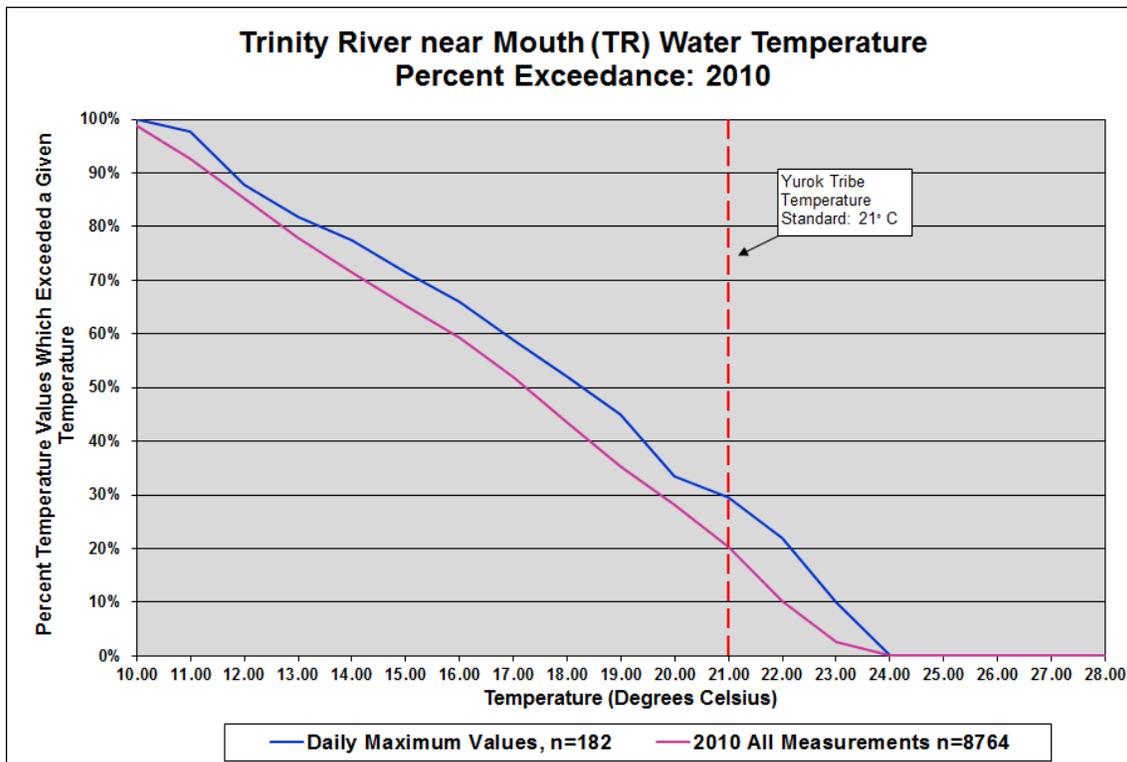


Figure 6-12. TR Water Temperature Percent Exceedance: 2010

## Dissolved Oxygen

### *All Riverine Sites*

Dissolved oxygen (DO) concentrations are reported in milligrams per liter (mg/L). The datasonde calculates this concentration based on the DO sensor's percent saturation reading. Percent saturation is the amount of oxygen dissolved in the water compared to the maximum amount that could be present at the same temperature and barometric pressure. Water is said to be 100% saturated if it contains the maximum amount of oxygen at that temperature and pressure. Sometimes water can become supersaturated with oxygen, returning percent saturations readings above 100%. This happens in two main situations. One is in fast-moving, turbulent water, which encourages more air to mix with the water. The other is in situations with large numbers of aquatic plants. These aquatic plants release oxygen into the water during photosynthesis, which mixes with the water as it rises to the surface.

In general, DO levels of the Lower Klamath and Trinity River follow an inverse relationship compared to water temperature. As water temperature rises, its ability to hold oxygen in solution is decreased, causing DO levels to drop. Therefore, as water temperatures increase throughout the summer, DO levels tend to decrease. There is also a diurnal fluctuation within the system, with minimum DO levels occurring late at night and/or early in the morning when aquatic vegetation is respiring and photosynthesis is not occurring. Conversely, maximum levels occur late in the afternoon and/or early in the evening when aquatic vegetation is at peak photosynthesis. These diurnal fluctuations

can cause large swings in DO throughout the day, which can be harmful to aquatic organisms dependent on DO for respiration.

DO levels at all sites varied greatly during the 2010 monitoring season. The lowest DO concentration recorded was 7.77 mg/L at KAT on August 18. The highest DO concentration recorded was 12.14 mg/L at WE on May 22. The lowest DO% saturation recorded was 86.9% at KAT on August 21. The highest DO% saturation recorded was 119.2% at WE on July 27. Due to its implications for fish health, minimum DO concentrations are focused on in this summary. Optimal DO levels are above 7.00 mg/L and above 80% saturation. At no point in time did minimum DO levels at any of YTEP's real-time continuous water quality monitoring locations fall below these benchmarks during the 2010 monitoring season.

Daily maxima and minima were disregarded when more than five measurements were missing from a 24-hour period and when the daily maximum or minimum was expected to occur during the gap. Gaps in data may occur during service or due to instrument malfunction or vandalism. Continuous DO data from the Lower Klamath and Trinity River is available from YTEP upon request.

### ***Klamath River above Turwar (KAT)***

Minimum DO concentrations at KAT tended to drop from May until mid-August, with spikes in late May and early June (Figure 6-13). DO concentrations then gradually increased until late October, with three short spikes in early, mid, and late September. In late October, there was a sharp increase in DO concentrations, then concentrations fell until early November. DO concentrations were increasing when monitoring was completed for the season on November 10.

The lowest DO concentration recorded at KAT was 7.77 mg/L on August 18, while the highest DO concentration recorded was 11.75 mg/L on May 22 (Figure 6-13). The lowest percent saturation was 86.9% on August 21, and the highest recorded percent saturation was 113.8% on October 11 (Figure 6-14).

### ***Klamath River above Tully Creek (TC)***

Minimum DO concentrations at TC generally dropped from May until mid-August, with spikes in late May, early June, and early July (Figure 6-15). DO concentrations then gradually increased until late October, with small peaks in late August, early September, and late September. In late October, DO concentrations were increasing sharply when the datasonde was removed for the season due to mechanical problems.

The lowest DO concentration recorded at TC was 7.90 mg/L on August 17, while the highest was 11.88 mg/L on May 22 (Figure 6-15). The lowest recorded percent saturation was 91.6% on August 17, and the highest was 111.6% on July 29 (Figure 6-16).

### ***Klamath River at Weitchpec (WE)***

Minimum DO concentrations at WE generally dropped from May mid-August, with small peaks in late May, early June, and early July (Figure 6-17). DO concentrations then gradually increased until late October, with small peaks in late August, early September, and late September. In late October, DO concentrations

increased sharply, then increased until early November. DO concentrations were decreasing when monitoring was completed for the season on November 9.

The lowest DO concentration recorded at WE was 7.92 mg/L on July 27, while the highest was 12.14 mg/L on May 22 (Figure 6-17). The lowest recorded percent saturation was 91.5% on July 27, and the highest was 119.2% on July 27 (Figure 6-18).

***Trinity River near Mouth (TR)***

Minimum DO concentrations at TR generally dropped from May until late July, with small peaks in late May, early June, and early July (Figure 6-19). DO concentrations then increased until late October, with peaks in early and late September. In late October, concentrations increased sharply, then decreased until early November. DO concentrations were increasing when monitoring was suspended on November 9.

The lowest DO concentration recorded at TR was 8.16 mg/L on July 26, while the highest was 11.74 mg/L on May 22 (Figure 6-19). The lowest recorded percent saturation was 94.5% on July 26, and the highest was 105.5% on May 29 (Figure 6-20).

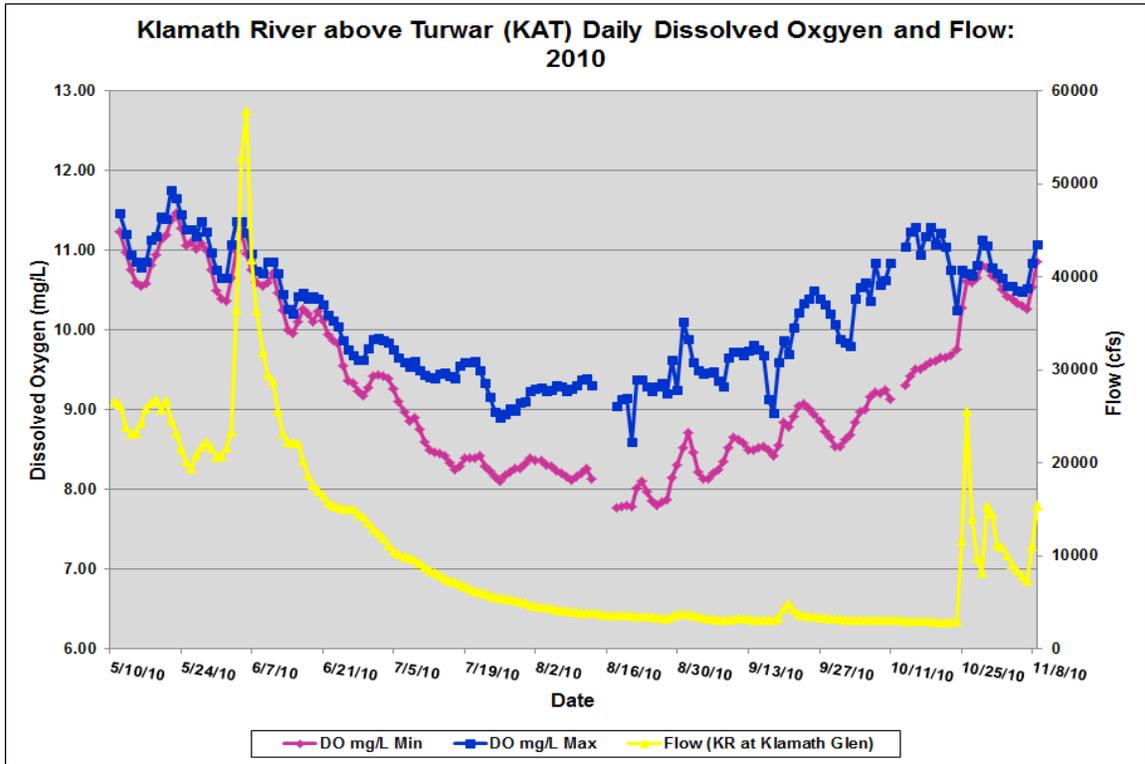


Figure 6-13. KAT Dissolved Oxygen and Flow: 2010

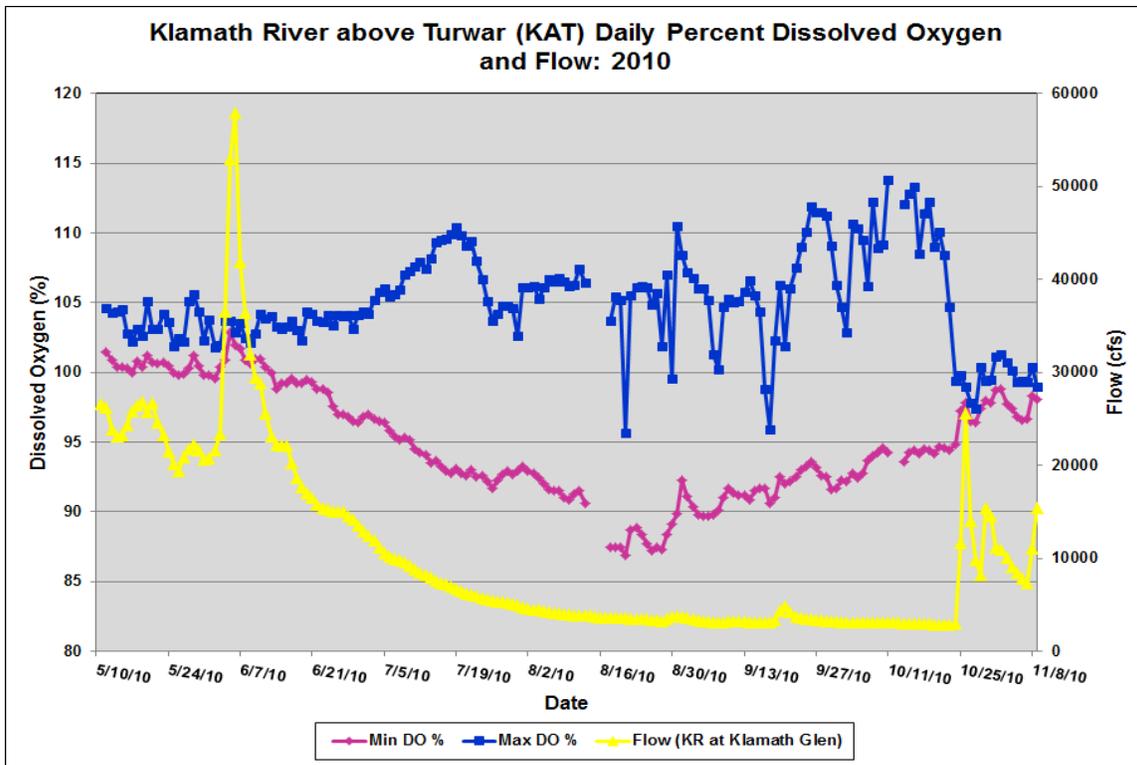


Figure 6-14. KAT Percent Dissolved Oxygen and Flow: 2010

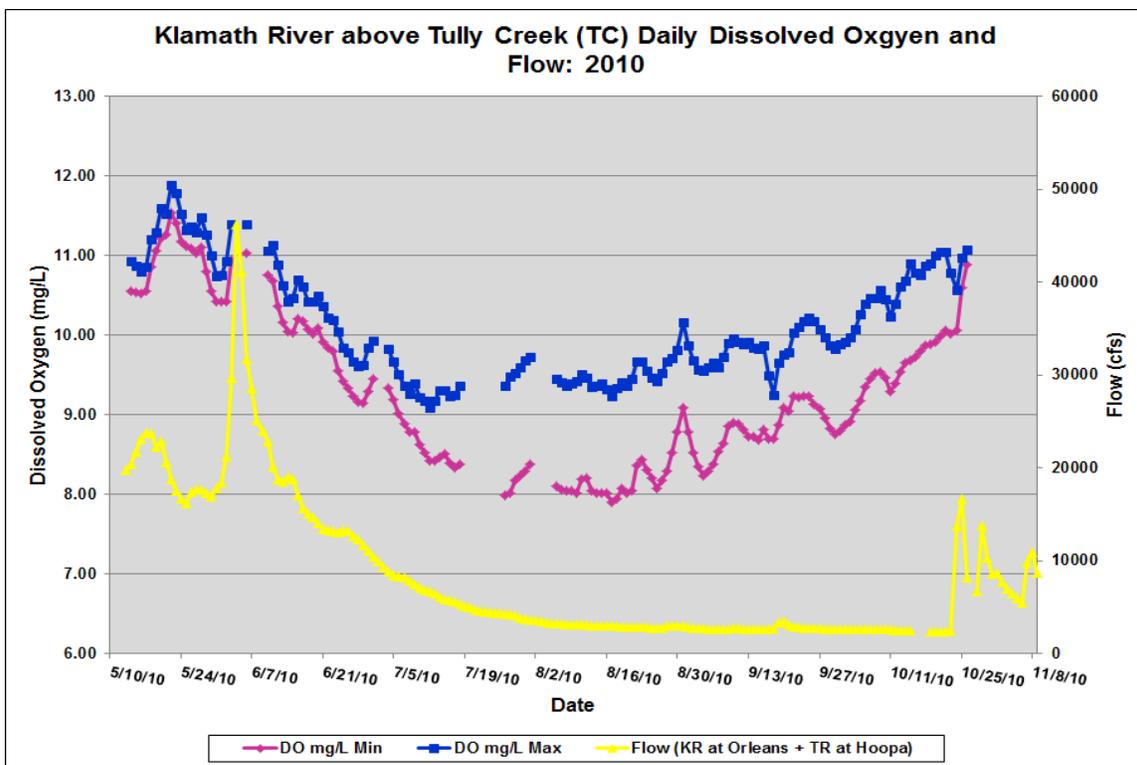


Figure 6-15. TC Dissolved Oxygen and Flow: 2010

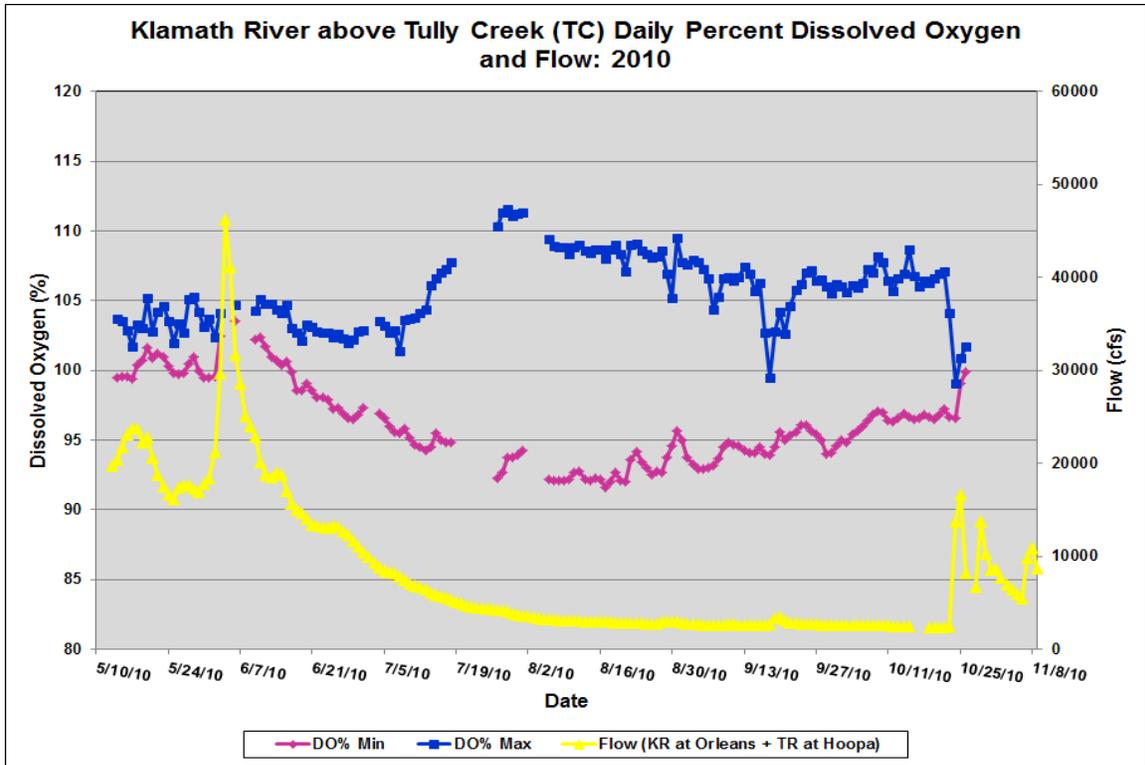


Figure 6-16. TC Percent Dissolved Oxygen and Flow: 2010

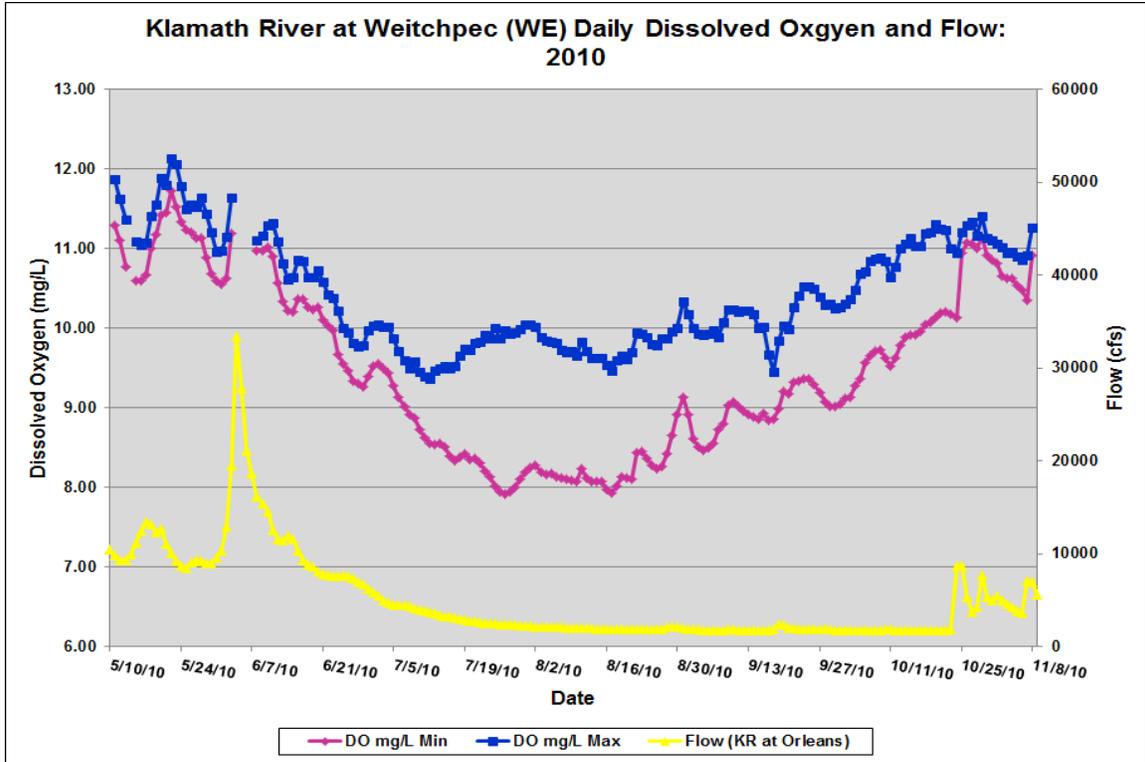


Figure 6-17. WE Dissolved Oxygen and Flow: 2010

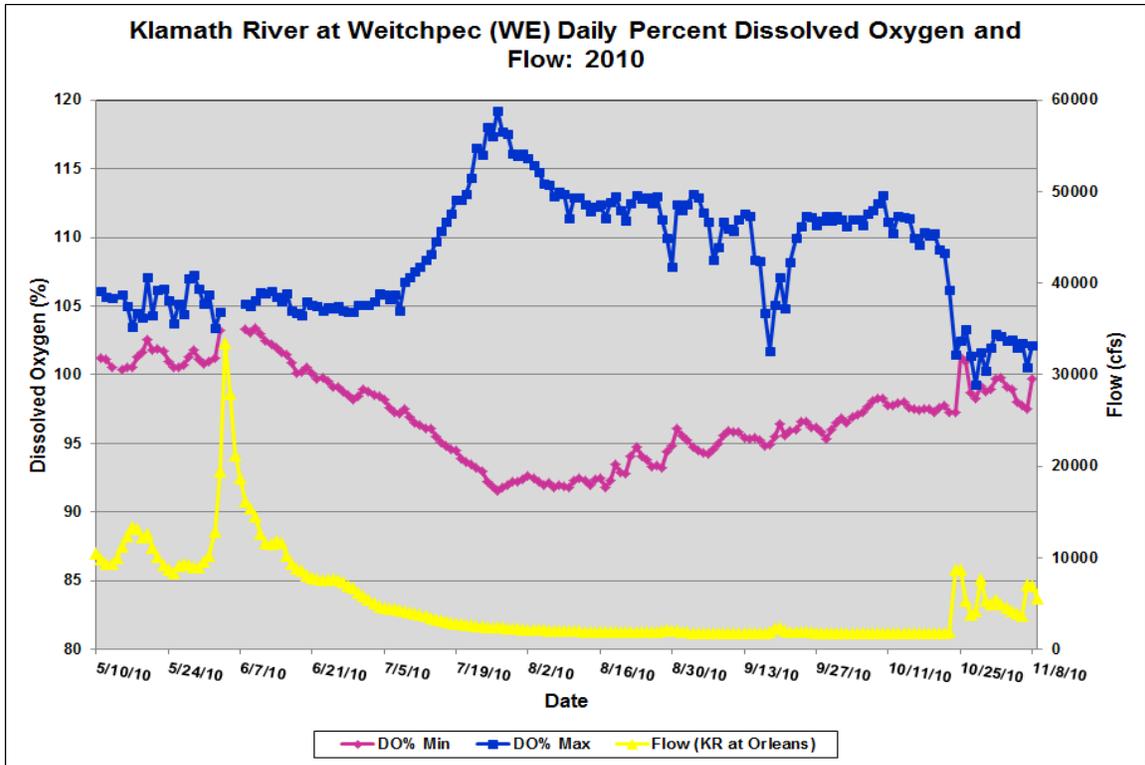


Figure 6-18. WE Percent Dissolved Oxygen and Flow: 2010

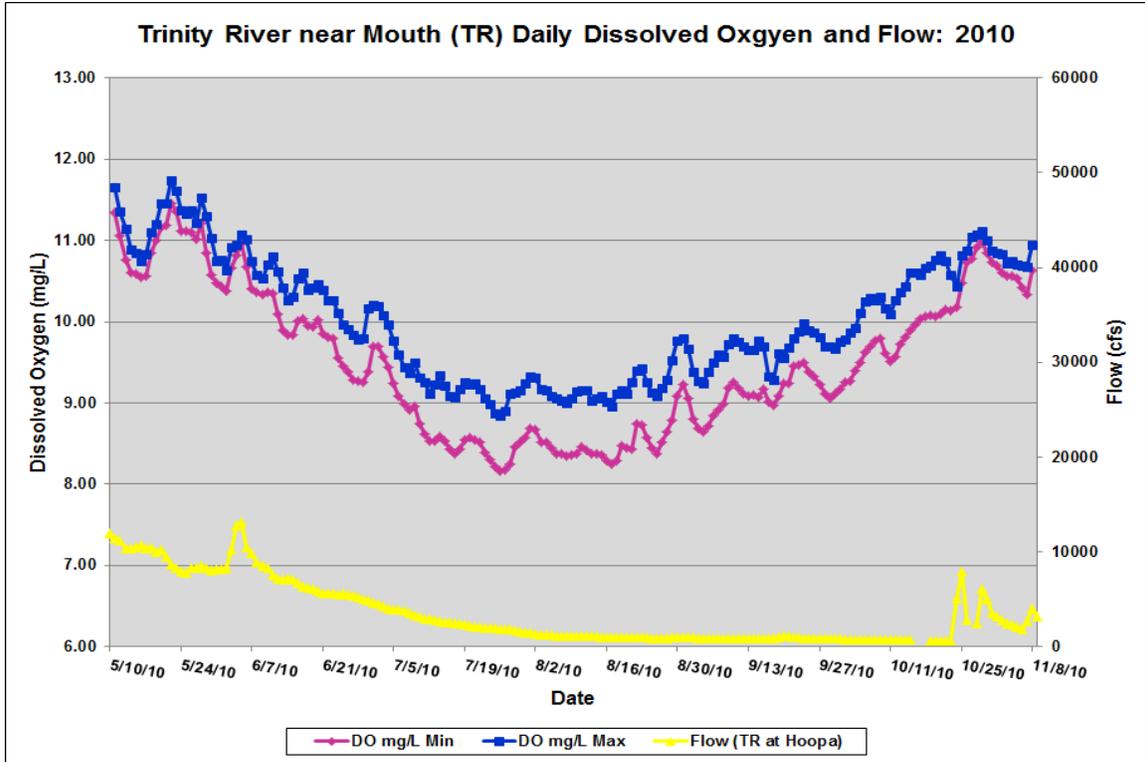


Figure 6-19. TR Dissolved Oxygen and Flow: 2010

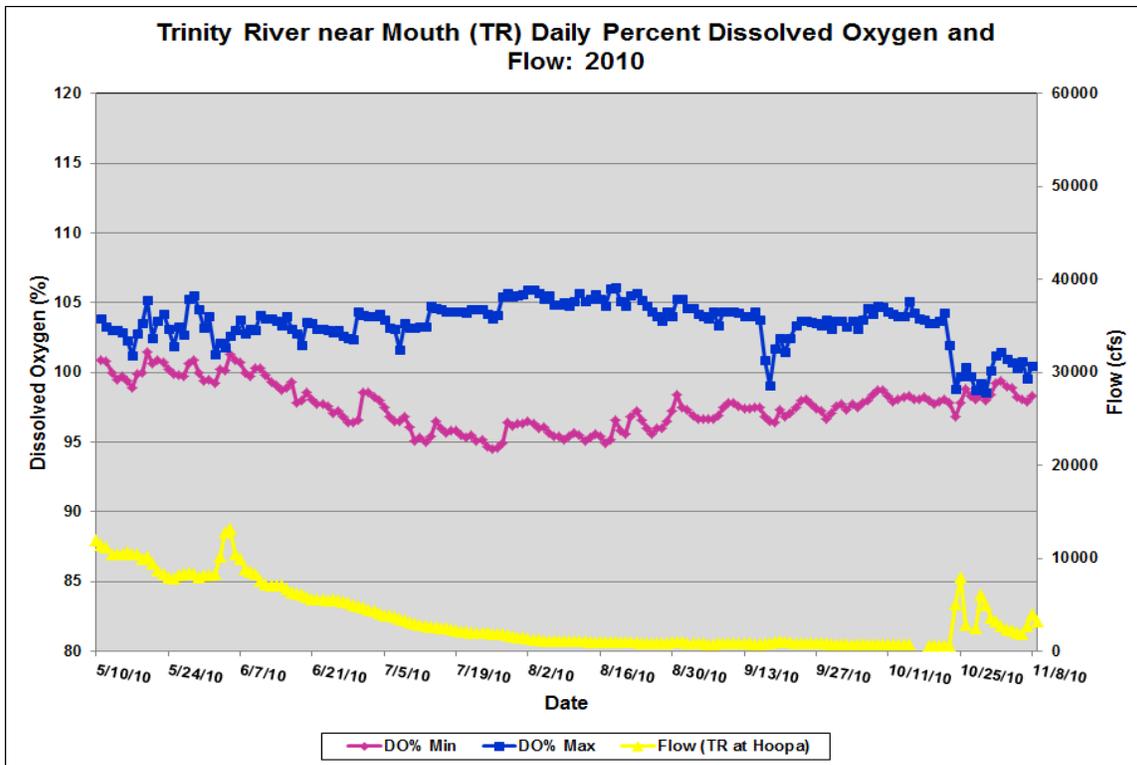


Figure 6-20. TR Percent Dissolved Oxygen and Flow: 2010

## pH

### *All Riverine Sites*

pH values on the lower Klamath and Trinity River varied greatly throughout the 2010 monitoring season. The lowest recorded pH was 7.79 at WE on June 6, while the highest recorded pH was 8.83 at WE on July 27.

Due to its implications for fish health, maximum pH is focused on in this summary. The Yurok Tribe has set a standard of 8.5 for pH on the lower Klamath and Trinity River. pH values above this standard can cause chronic stress and exhaustion to salmonids. Values above 9.6 are often lethal. The combined effects of high pH and high water temperature increases unionized ammonia, which can be highly toxic to salmon and steelhead. For results of nutrient samples collected on the Lower Klamath and Trinity River, see the Yurok Tribe's 2010 Klamath River Nutrient Summary Report.

Daily maxima and minima were disregarded when more than five measurements were missing from a 24-hour period and when the daily maximum or minimum was expected to occur during the gap. Gaps in data may occur during service or due to instrument malfunction or vandalism. Continuous pH data from the Lower Klamath and Trinity River is available from YTEP upon request.

### *Klamath River above Turwar (KAT)*

Maximum pH at KAT initially increased slightly, then decreased sharply in mid-May (Figure 6-21). pH then decreased very sharply again in early June, followed by steadily increasing values until mid-July. After mid-July, pH decreased slightly into late

July, then generally held steady until late October, with a large dip in values in mid-September. In late October, pH decreased drastically, then increased until early November. pH values were decreasing when monitoring was completed for the season on November 10.

The lowest pH recorded at KAT was 7.84 on October 25, while the highest recorded pH was 8.64 on October 16 (Figure 6-21). Daily maximum pH initially exceeded the standard of 8.5 on July 17, then fluctuated around this value until October 23. Daily maximum pH values remained above the standard of 8.5 for 33 out of 180 days.

### ***Klamath River above Tully Creek (TC)***

Maximum pH at TC held steady from mid-May until early June, then dipped sharply in early June (Figure 6-22). After early June, pH values steadily increased until late July. After late July, values decreased slightly, then generally held steady until late October, with a large dip in mid-September. In late October, there was a large decrease in pH values. pH was increasing when monitoring ceased on October 26.

The lowest recorded pH at TC was 7.90 on June 6, while the highest was 8.63 on July 31 (Figure 6-22). Daily maximum pH was initially recorded as exceeding the standard of 8.5 on July 27, then fluctuated around this value until October 23. Daily maximum pH values remained above the standard of 8.5 for 34 out of 141 days.

### ***Klamath River at Weitchpec (WE)***

Maximum pH at WE increased slightly initially, then dropped sharply in early June. After early June, pH values increased steadily until late July. After late July pH decreased slightly, then generally held steady until late October, with a significant dip in mid-September. In late October, pH decreased drastically, then increased until early November. pH values were decreasing when monitoring was suspended on November 9.

The lowest recorded pH at WE was 7.79 on June 3, while the highest was 8.83 on July 27 (Figure 6-23). Daily maximum pH initially exceeded the standard of 8.5 on July 12, and remained above this value until September 16, then exceeded it again from September 22 until October 24. Daily maximum pH values remained above the standard of 8.5 for a majority of the monitoring season (100 out of 169 days).

### ***Trinity River near Mouth (TR)***

Maximum pH values at TR increased slightly from May to early June, then decreased sharply in early June (Figure 6-24). After early June, pH values generally increased until early September. After early September, values decreased slightly, rose for a short period of time in late September, then decreased and held steady until mid-October. In mid-October, pH values increased and held steady until late October, at which time pH values decreased sharply. After late October pH values increased until monitoring was suspended on November 9.

The lowest recorded pH at TR was 7.97 on June 5-6, while the highest pH was 8.59 on September 7-9 (Figure 6-24). Daily maximum pH initially exceeded the standard of 8.5 on August 29, then fluctuated around this value until October 23. Daily maximum pH values remained above the standard of 8.5 for 30 out of 173 days.

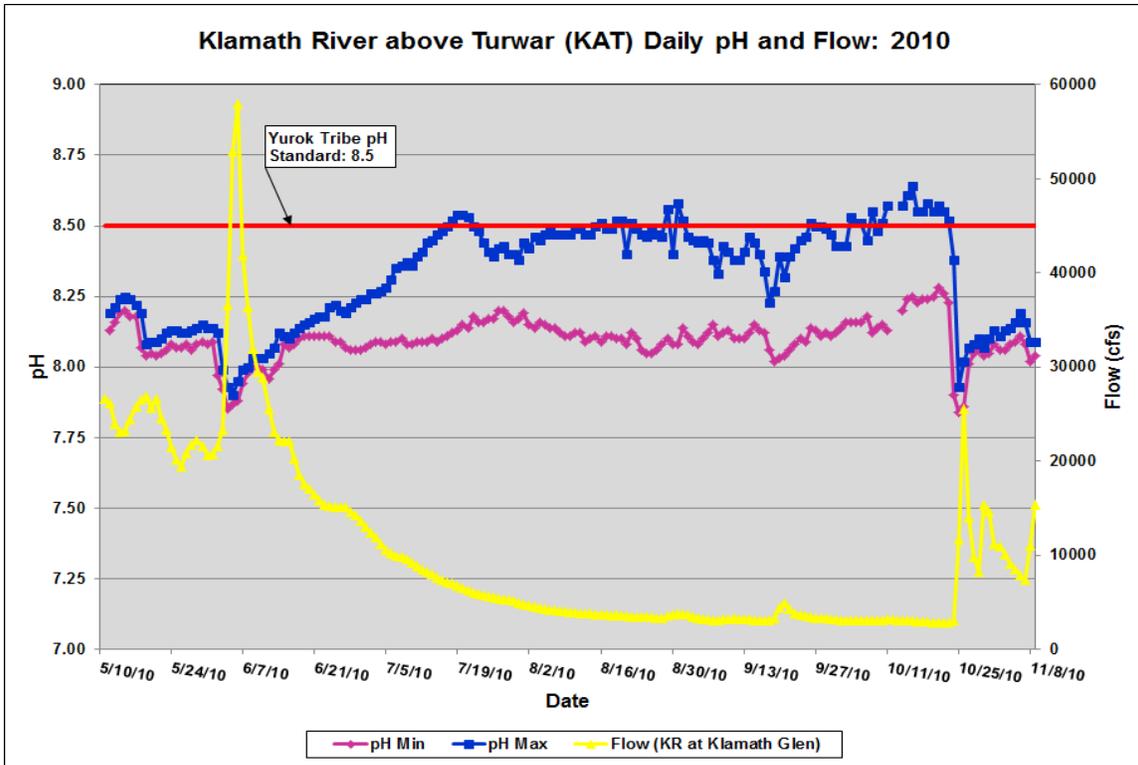


Figure 6-21. KAT Maximum/minimum pH and Flow: 2010

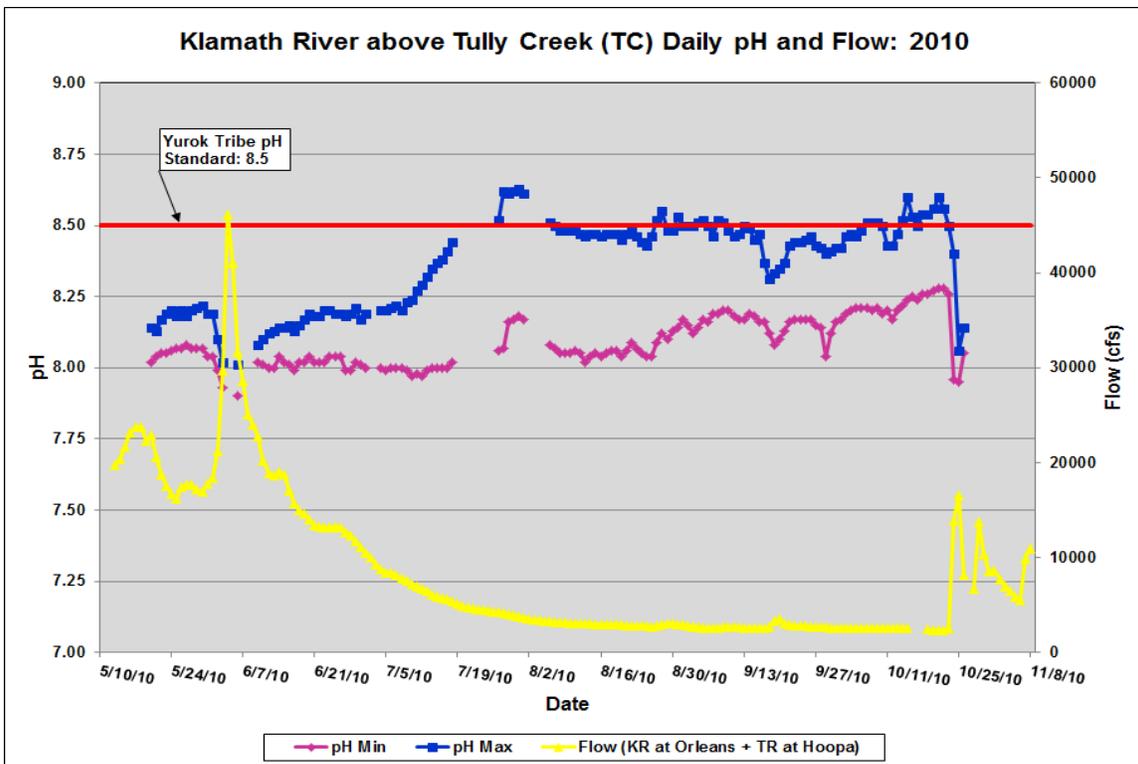


Figure 6-22. TC Maximum/minimum pH and Flow: 2010

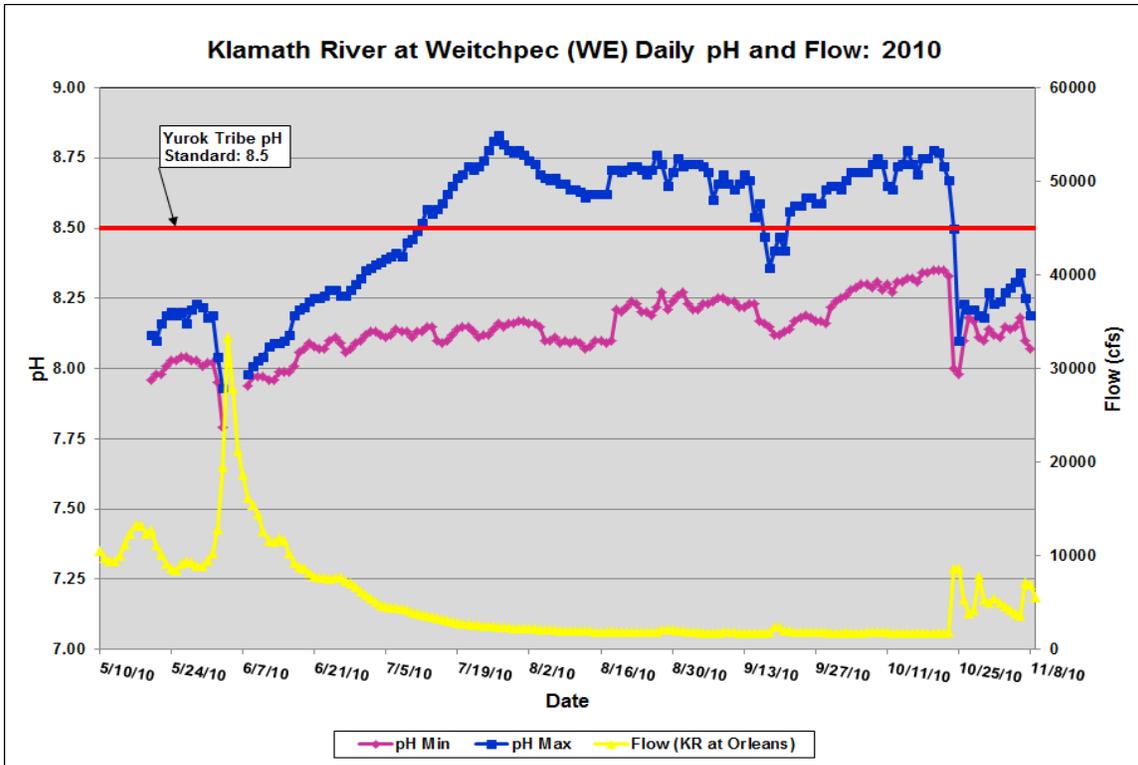


Figure 6-23. WE Maximum/minimum pH and Flow: 2010

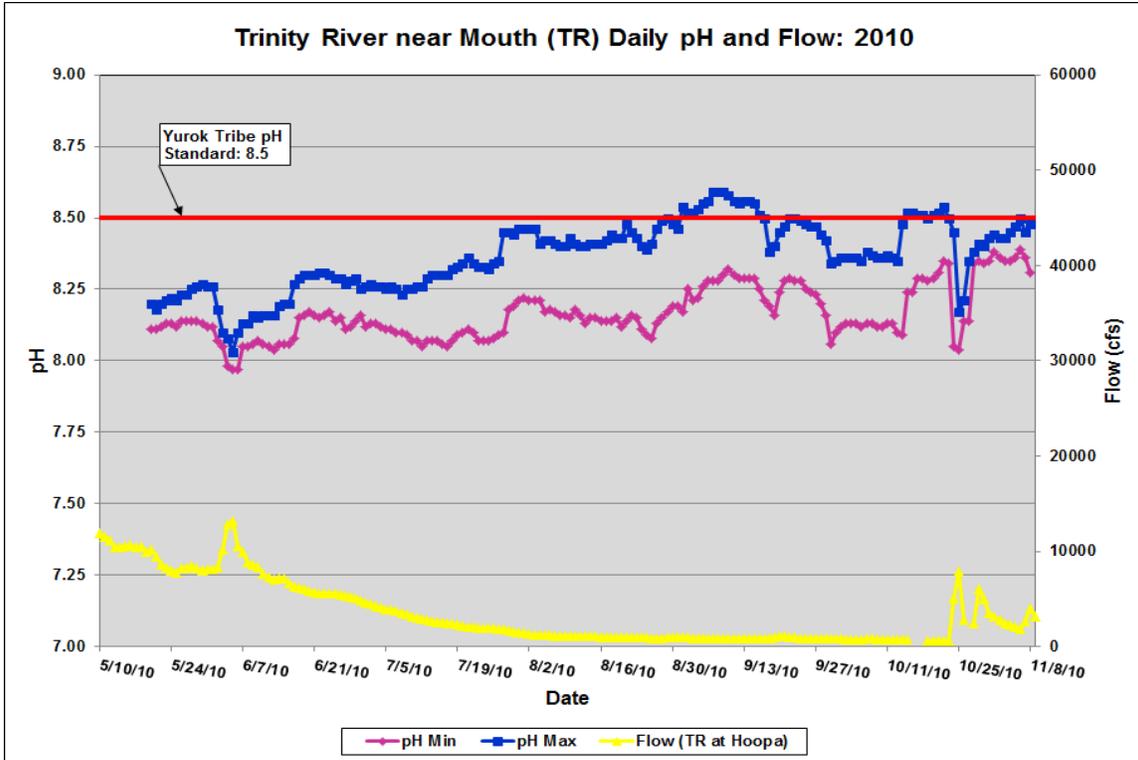


Figure 6-24. TR Maximum/minimum pH and Flow: 2010

## **Specific Conductivity**

### ***All Riverine Sites***

Specific conductivity measures how well an aqueous solution can pass an electric current, which increases with the quantity of dissolved ionic substances in the water column, thus another method to determine the level of dissolved substances present. Specific conductivity is measured in microsiemens per centimeter.

Specific conductivity varied greatly at all sites during the 2010 monitoring season. The highest specific conductivity recorded was 193  $\mu\text{S}/\text{cm}$  at WE from October 21-23, while the lowest specific conductivity recorded was 74  $\mu\text{S}/\text{cm}$  at KAT on June 4 and October 25. At no time did specific conductivity levels exceed the Yurok Tribe's specific conductivity standard, which states that levels shall have a 90% upper limit of 300  $\mu\text{S}/\text{cm}$  at 25 °C, and a 50% upper limit of 200  $\mu\text{S}/\text{cm}$  at 25°C.

Daily maxima and minima were disregarded when more than five measurements were missing from a 24-hour period and when the daily maximum or minimum was expected to occur during the gap. Gaps in data may occur during service or due to instrument malfunction or vandalism. Continuous specific conductivity data from the lower Klamath and Trinity River is available from YTEP upon request.

### ***Klamath River above Turwar (KAT)***

Specific conductivity at KAT increased slightly initially, decreased in mid-May, then increased and held steady until early June (Figure 6-25). In early June specific conductivity decreased sharply. After early June values increased steadily until late October, with a dip in mid-September. In late October, specific conductivity decreased drastically, then generally held steady until early November. Specific conductivity values were decreasing when monitoring was suspended on November 9.

The lowest recorded specific conductivity reading at KAT was 74  $\mu\text{S}/\text{cm}$  on June 4 and October 25, while the highest recorded specific conductivity reading was 183  $\mu\text{S}/\text{cm}$  on October 22-23 (Figure 6-25).

### ***Klamath River above Tully Creek (TC)***

Specific conductivity at TC increased slightly initially, decreased in mid-May, then increased and held steady until early June (Figure 6-26). In early June specific conductivity decreased sharply. After early June values increased steadily until late October, with a dip in mid-September. In late October, specific conductivity decreased drastically. Specific conductivity values were increasing when monitoring ceased on October 26.

The lowest specific conductivity reading at TC was 86  $\mu\text{S}/\text{cm}$  on June 6, while the highest recorded reading was 183  $\mu\text{S}/\text{cm}$  on October 22 (Figure 6-26).

### ***Klamath River at Weitchpec (WE)***

Specific conductivity at WE increased slightly initially, decreased in mid-May, then increased and held steady until early June (Figure 6-27). In early June specific conductivity decreased sharply. After early June values increased steadily until late October, with a dip in early and mid-September. In late October, specific conductivity

decreased drastically. Specific conductivity then increased and generally held steady until early November. Specific conductivity values were dropping when monitoring was suspended on November 9.

The lowest recorded specific conductivity reading at WE was 78  $\mu\text{S}/\text{cm}$  on June 3, while the highest recorded reading was 193  $\mu\text{S}/\text{cm}$  on October 21-23 (Figure 6-27).

***Trinity River near Mouth (TR)***

Specific conductivity at TR increased slightly initially, decreased in mid-May, then increased and held steady until early June (Figure 6-27). In early June specific conductivity decreased sharply. After early June values increased steadily until early August. After early August values generally held steady until late October. In late October specific conductivity decreased and then generally held steady until monitoring was suspended on November 9.

The lowest recorded specific conductivity reading at TR was 82 $\mu\text{S}/\text{cm}$  on June 5, while the highest recorded specific conductivity was 174 $\mu\text{S}/\text{cm}$  on October 22-23 (Figure 6-28).

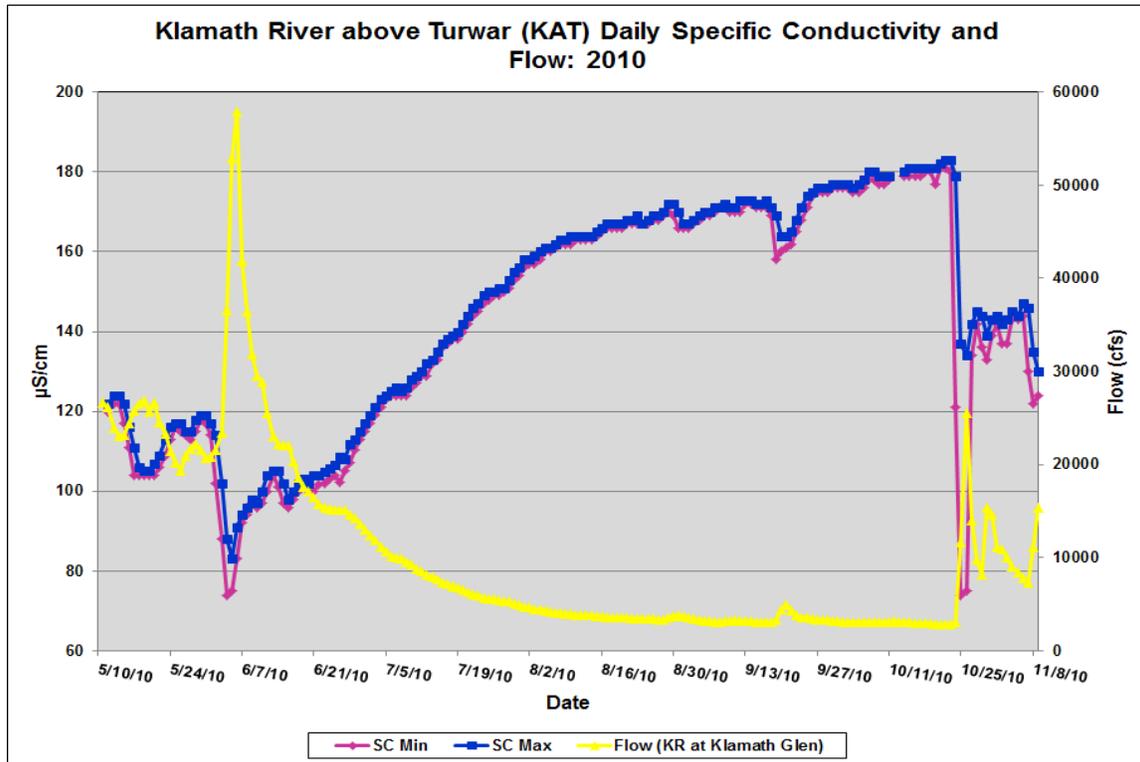


Figure 6-25. KAT Maximum/minimum Specific Conductivity and Flow: 2010

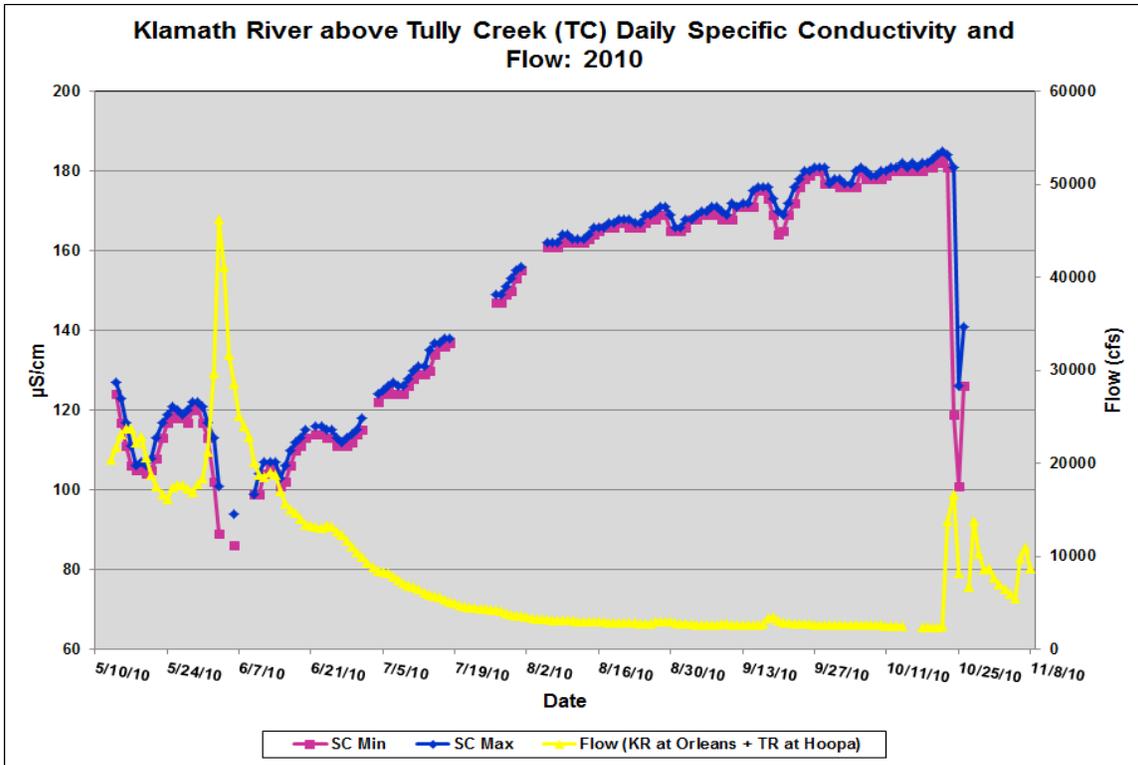


Figure 6-26. TC Maximum/minimum Specific Conductivity and Flow: 2010

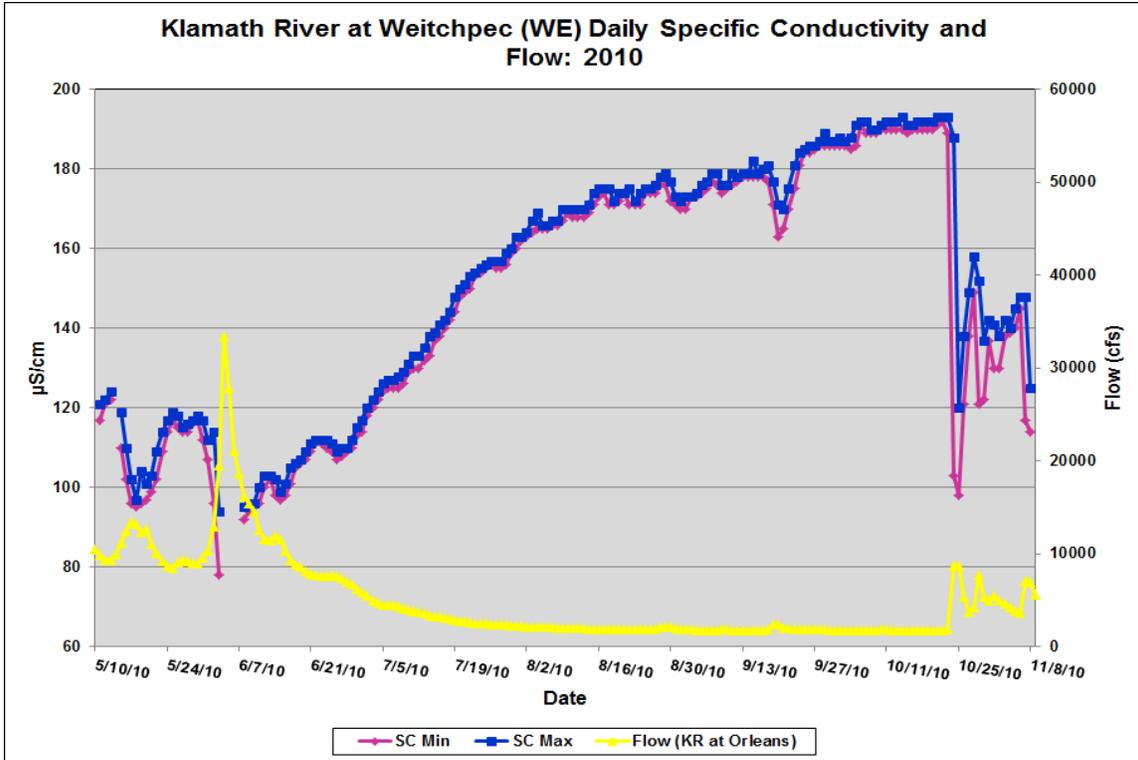


Figure 6-27. WE Maximum/minimum Specific Conductivity and Flow: 2010

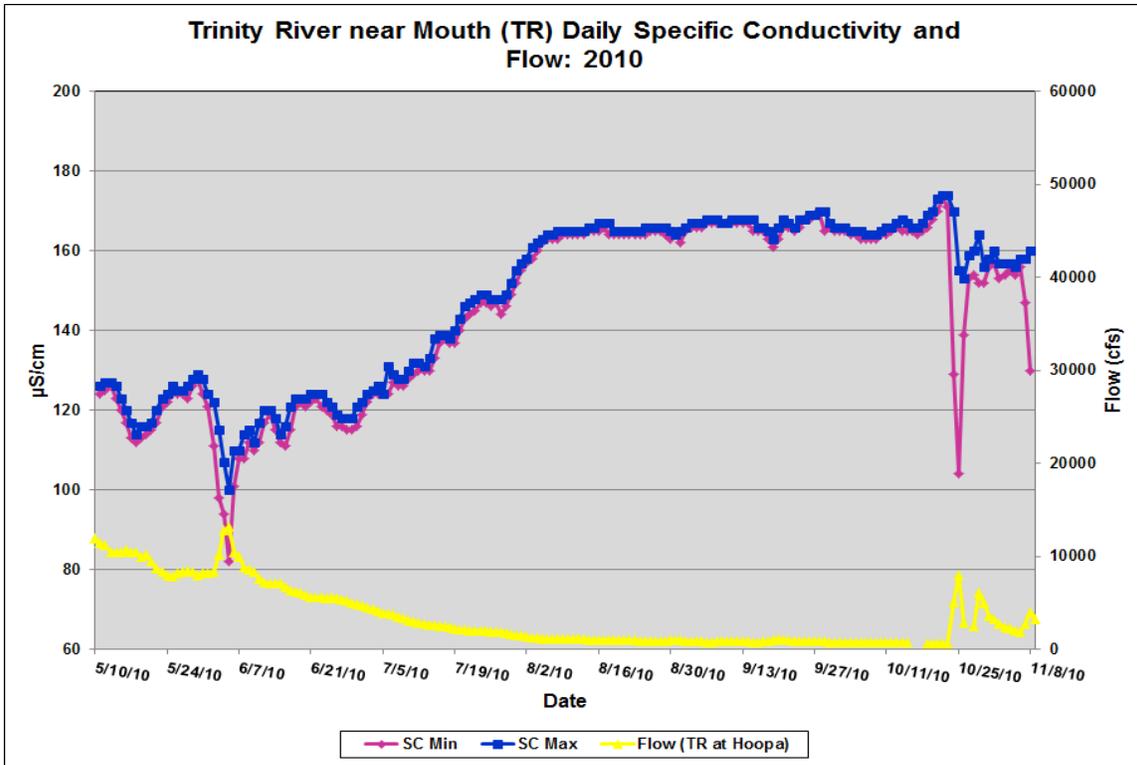


Figure 6-28. TR Maximum/minimum Specific Conductivity and Flow: 2010

## VII. Discussion

### Temperature

#### *All Riverine Sites*

From initial deployment in mid-May until late June, the highest daily maximum water temperatures were recorded at TR (Figure 7-1). From late June to late August, the highest temperatures were recorded at WE. From late August to late September, the highest temperatures were again recorded at TR, and after late September the highest daily maximum temperatures tended to be recorded at KAT.

In the water temperature graphs shown in Section VI, daily average flow was graphed with water temperature to illustrate how water temperatures may have been affected by volume of water present in the river at that time. Flow discharge data used to generate these graphs was downloaded from the USGS website. These graphs provide additional information when trying to determine the impact flow has on water temperature.

#### *Klamath River above Turwar (KAT)*

Rain events seem to have decreased maximum water temperature at KAT for short periods of time (Figures 6-1 and 6-2). During the week leading up to the rain event in early June, maximum water temperature was increasing. On June 4, however, maximum water temperature was 11.59 °C, a reduction of 2.63 °C from June 1. On

October 26 maximum water temperature was 12.18 °C a reduction of 2.07 °C from October 24. This reduction in water temperature was much more rapid than what had been occurring leading up to the late October rain event (Figure 6-1).

### ***Klamath River above Tully Creek (TC)***

Rain events seem to have decreased maximum water temperature at TC for short periods of time (Figures 6-4 and 6-5). During the week leading up to the rain event in early June, maximum water temperature was increasing. Although a portion of datasonde data is missing for early June, USFWS water temperature probes indicate that on June 4 maximum water temperature was 11.03°C, a reduction of 2.95°C from June 1. On October 25, maximum water temperature was 12.03°C a reduction of 1.77°C from October 23. While water temperature had been decreasing leading up to the late October rain event, this reduction in water temperature was much more rapid than what was occurring earlier in the month (Figure 6-4).

### ***Klamath River at Weitchpec (WE)***

Rain events seem to have decreased maximum water temperature at WE for short periods of time (Figures 6-7 and 6-8). During the week leading up to the rain event in early June, maximum water temperature was increasing. Although a portion of datasonde data is missing for early June, USFWS water temperature probes indicate that on June 4 maximum water temperature was 11.15 °C, a reduction of 2.67 °C from June 1. On October 25, maximum water temperature was 11.93°C a reduction of 2.04°C from October 23. This reduction in water temperature was much more rapid than what had been occurring leading up to the late October rain event (Figure 6-7).

### ***Trinity River near Mouth (TR)***

Rain events seem to have decreased maximum water temperature at TR for short periods of time (Figures 6-9 and 6-10). During the week leading up to the rain event in early June, maximum water temperature was increasing. On June 4, however, maximum water temperature was 12.54°C, a reduction of 1.71°C from June 1. On October 25, maximum water temperature was 12.26°C a reduction of 2.01°C from October 23. While water temperature had been decreasing leading up to the late October rain event, this reduction in water temperature was much more rapid than what was occurring earlier in the month (Figure 6-9).

### ***Impacts of the Trinity River on Water Temperature in the Klamath River***

During the 2010 monitoring season the Trinity River had a variable effect on water temperature in the Klamath River. From mid-May to late June, it appears that the Trinity River actually had a slight warming effect on the Klamath River, with daily maximum temperature at TC slightly higher than at WE (Figure 7-2). This warming effect was less than 0.5 °C for most of this time period. From late June on, the daily maximum temperature at TC was usually lower than at WE. Again, this cooling effect was less than 0.5 °C for most of this time period.

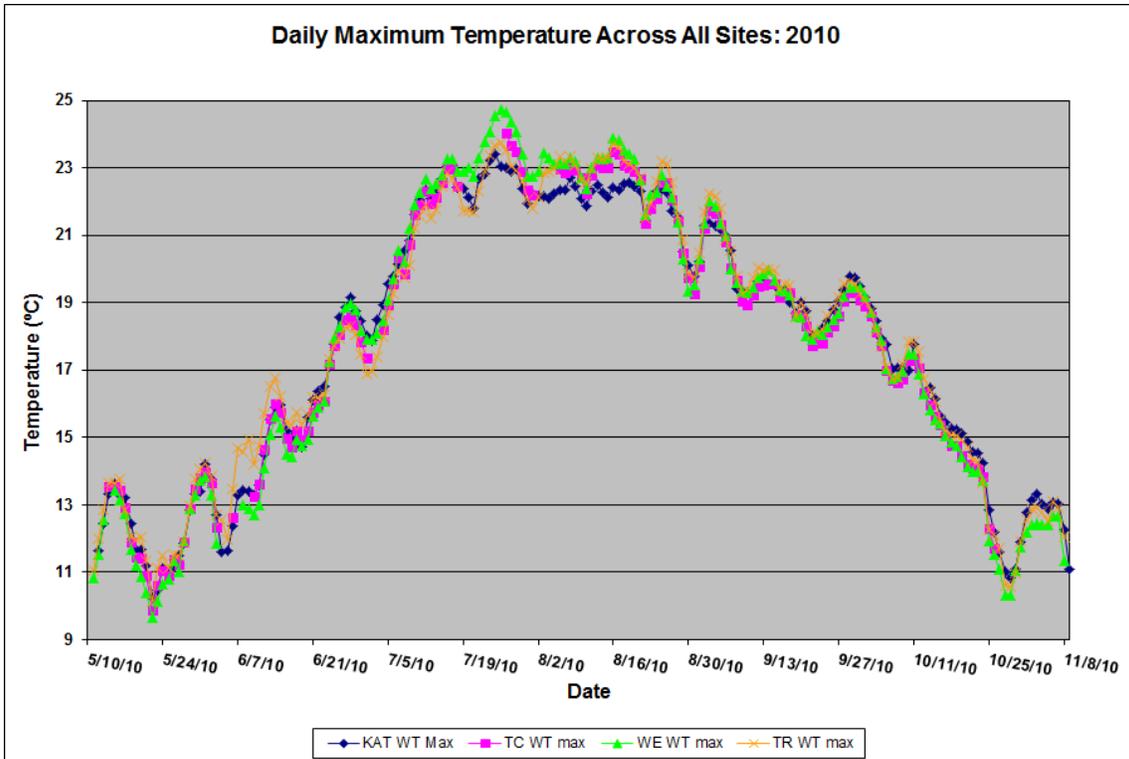


Figure 7-1. Daily Maximum Temperature Across All Sites: 2010

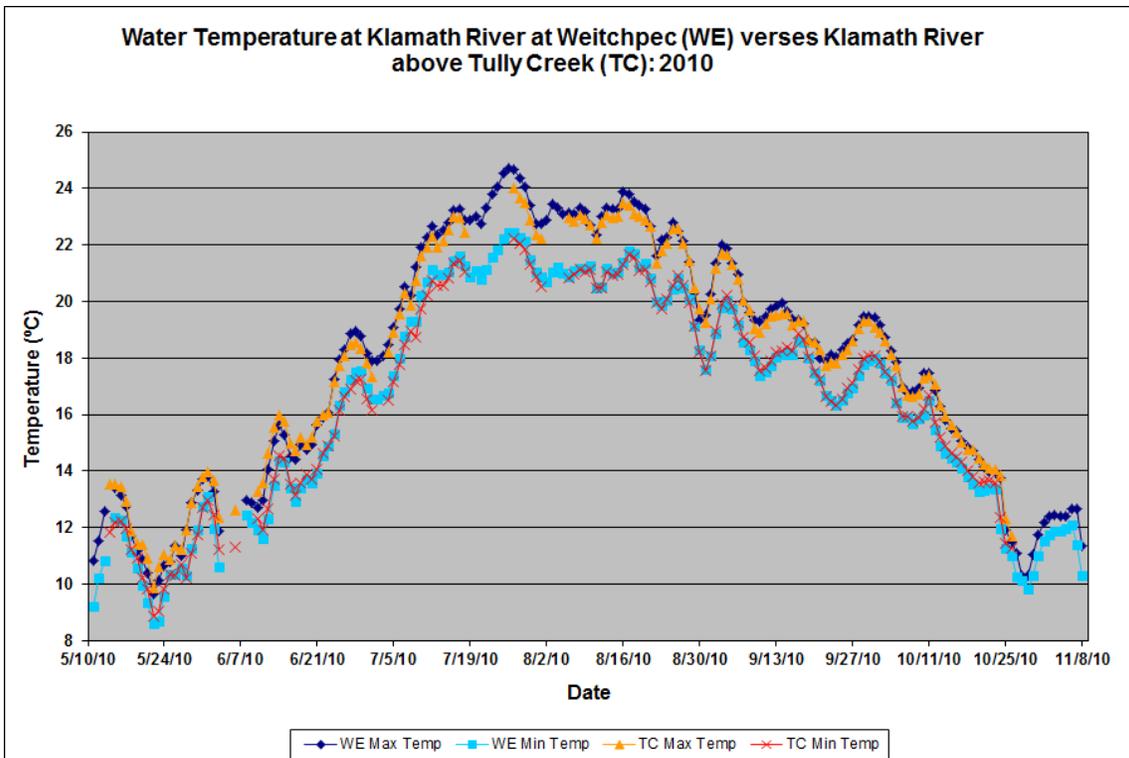


Figure 7-2. WE vs. TC Water Temperature: 2010

## **Dissolved Oxygen**

### ***All Riverine Sites***

From mid-May to the beginning of July, daily minimum DO concentrations were very similar for all sites (7-3). After the beginning of July, TR tended to have the highest daily minimum DO concentrations and after mid-August KAT tended to have the lowest.

In the DO graphs shown in Section VI, daily average flow was graphed with DO to illustrate how DO concentrations may have been affected by volume of water present in the river at that time. Flow discharge data used to generate these graphs was downloaded from the USGS website. These graphs provide additional information when trying to determine the impact flow has on DO concentrations.

### ***Klamath River above Turwar (KAT)***

Rain events seem to have increased minimum DO concentrations at KAT for short periods of time (Figures 6-13 and 6-14). During the time leading up to the rain event in early June, DO concentrations were falling. On June 5, however, minimum DO was 11.23 mg/L, an increase of 0.83 mg/L from June 1. On October 26 minimum DO was 10.61 mg/L, an increase of 0.92 mg/L from October 23. This increase in DO concentrations was much greater than what had been occurring leading up to the late October rain event (Figure 6-13).

### ***Klamath River above Tully Creek (TC)***

Rain events seem to have increased minimum DO concentrations at TC for short periods of time (Figures 6-15 and 6-16). During the time leading up to the rain event in early June, DO concentrations were falling. Although datasonde data is missing during peak flow for this event, on June 6 minimum DO was 11.03 mg/L, an increase of 0.61 mg/L from June 1. On October 25 minimum DO was 10.60 mg/L, an increase of 0.58 mg/L from October 23. Although minimum DO concentrations had been increasing leading up to the late October rain event, this surge in DO was much bigger than what was occurring earlier in the month (Figure 6-15).

### ***Klamath River at Weitchpec (WE)***

Rain events seem to have increased minimum DO concentrations at WE for short periods of time (Figures 6-17 and 6-18). During the time leading up to the rain event in early June, DO concentrations were falling. Although datasonde data is missing during peak flow for this event, on June 3, during which time the flows were increasing, minimum DO was 11.19 mg/L, an increase of 0.64 mg/L from June 1. On October 25 minimum DO was 10.95 mg/L, an increase of 0.78 mg/L from October 23. This increase in DO concentrations was much greater than what had been occurring leading up to the late October rain event (Figure 6-17).

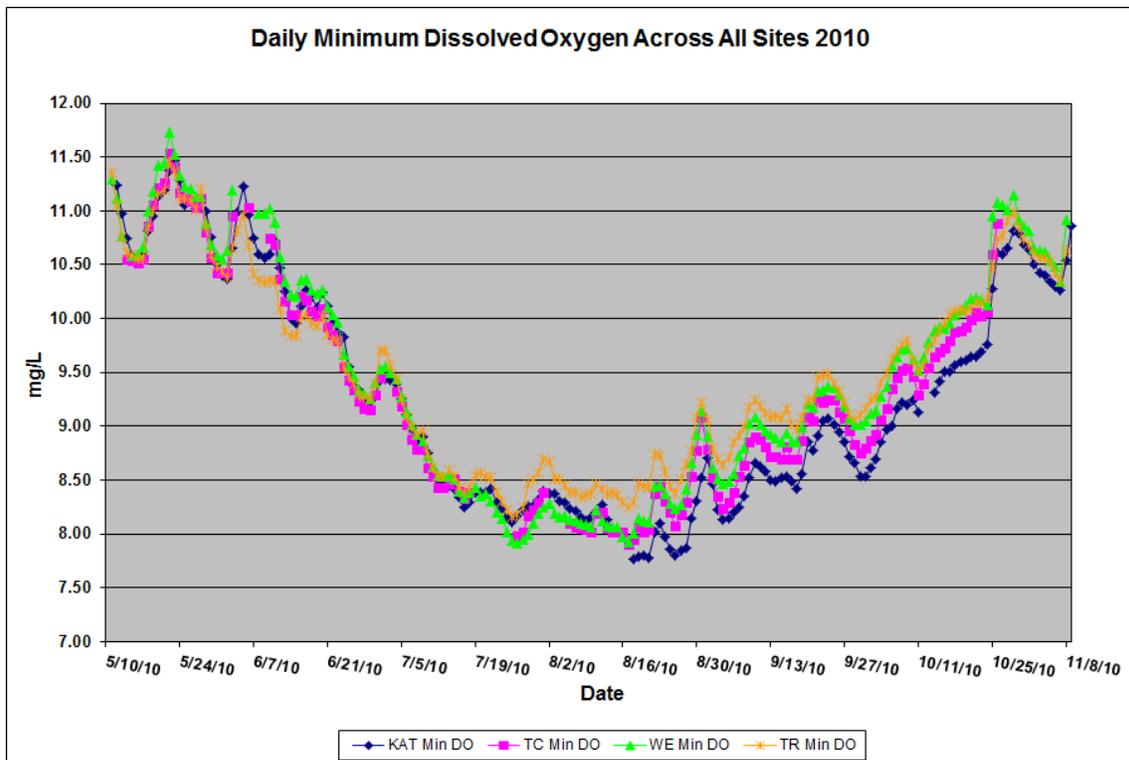
### ***Trinity River near Mouth (TR)***

Rain events seem to have increased minimum DO concentrations at TR for short periods of time (Figures 6-19 and 6-20). During the time leading up to the rain event in early June, DO concentrations were falling. On June 5, however, minimum DO was

10.96 mg/L, an increase of 0.52 mg/L from June 1. On October 25 minimum DO was 10.47 mg/L, an increase of 0.33 mg/L from October 23. Although minimum DO concentrations had been increasing leading up to the late October rain event, this surge in DO was much bigger than what was occurring earlier in the month (Figure 6-19).

***Impacts of the Trinity River on Dissolved Oxygen in the Klamath River***

During the 2010 monitoring season it appears that the Trinity River had little to no effect on DO concentrations in the Klamath River with both minimum and maximum DO concentrations at TC generally lower than minimum and maximum DO concentrations at WE (Figure 7-4).



**Figure 7-3. Daily Minimum Dissolved Oxygen Across All Sites: 2010**

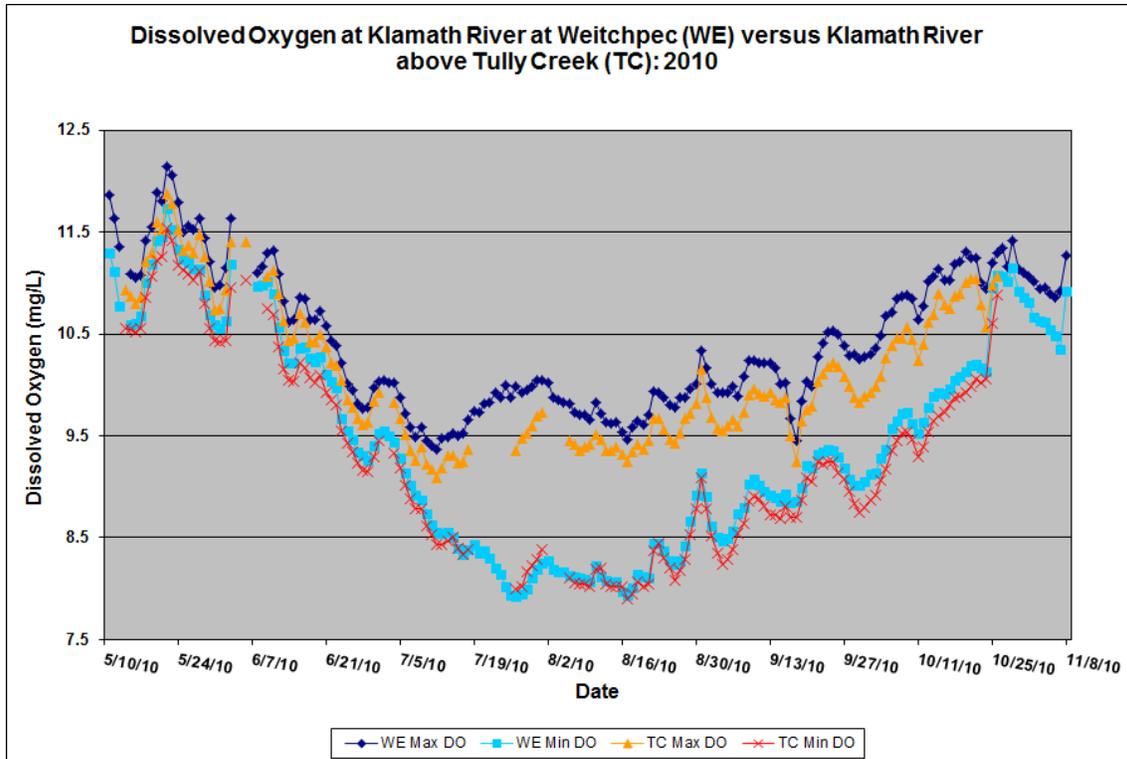


Figure 7-4. WE vs. TC Dissolved Oxygen: 2010

## pH

### *All Riverine Sites*

From mid-May to late June, TR had the highest daily maximum pH values (Figure 7-5). From late June to late October, WE tended to have the highest pH values, and after late October, TR again had the highest pH values.

In the pH graphs shown in Section VI, daily average flow was graphed with pH to illustrate how pH values may have been affected by volume of water present in the river at that time. Flow discharge data used to generate these graphs was downloaded from the USGS website. These graphs provide additional information when trying to determine the impact flow has on pH.

### *Klamath River above Turwar (KAT)*

Rain events seem to have decreased daily maximum pH at KAT for short periods of time (Figure 6-21). During the time leading up to the rain event in early June, pH was holding steady. On June 5, however, maximum pH was 7.90, a decrease of 0.24 from June 1. As in June, pH values leading up to the rain event in late October were holding steady. On October 25 maximum pH was 7.93, a decrease of 0.59 from October 23. Although pH values increased somewhat after the October rain event, this influx of water dropped pH values below the standard of 8.5 for the rest of the monitoring season (Figure 6-21).

### ***Klamath River above Tully Creek (TC)***

Rain events seem to have decreased daily maximum pH at TC for short periods of time (Figure 6-22). During the time leading up to the rain event in early June, pH was holding steady. Although datasonde data is missing during peak flow for this event, on June 6 maximum pH was 8.01, a decrease of 0.18 from June 1. pH values leading up to the rain event in late October were increasing. On October 25, however, maximum pH was 8.06, a decrease of 0.44 from October 23. This influx of water dropped pH values below the standard of 8.5 (Figure 6-22).

### ***Klamath River at Weitchpec (WE)***

Rain events seem to have decreased daily maximum pH at WE for short periods of time (Figure 6-23). During the time leading up to the rain event in early June, pH was holding steady. Although datasonde data is missing during peak flow for this event, on June 3, when flow was increasing, maximum pH was 7.93, a decrease of 0.26 from June 1. pH values leading up to the rain event in late October were increasing. On October 25, however, maximum pH was 8.1, a decrease of 0.57 from October 23. Although pH values increased somewhat after the October rain event, this influx of water dropped pH values below the standard of 8.5 for the rest of the monitoring season (Figure 6-23).

### ***Trinity River near Mouth (TR)***

Rain events seem to have decreased daily maximum pH at TR for short periods of time (Figure 6-24). During the time leading up to the rain event in early June, pH was slowly increasing. On June 5, however, maximum pH was 8.03, a decrease of 0.23 from June 1. pH values leading up to the rain event in late October were holding steady. On October 25 maximum pH was 8.17, a decrease of 0.33 from October 23. This influx of water dropped pH values below the standard of 8.5 until November 6 (Figure 6-24).

### ***Impacts of the Trinity River on pH in the Klamath River***

During the 2010 monitoring season the Trinity River had a variable effect on pH in the Klamath River with no clear trend apparent of the impacts of the Trinity River on pH in the Klamath River (Figures 7-6 and 7-7). Daily maximum pH at TC was lower than daily maximum pH at WE from mid-June to late October. During this time period, however, daily maximum pH at TR was not always lower than TC or WE (mid-June to early July and early September to late September). This indicates there may be factors other than the influx of water from the Trinity River affecting pH in the Klamath River in the reach from the confluence of the Klamath and Trinity Rivers to the Klamath River above Tully Creek.

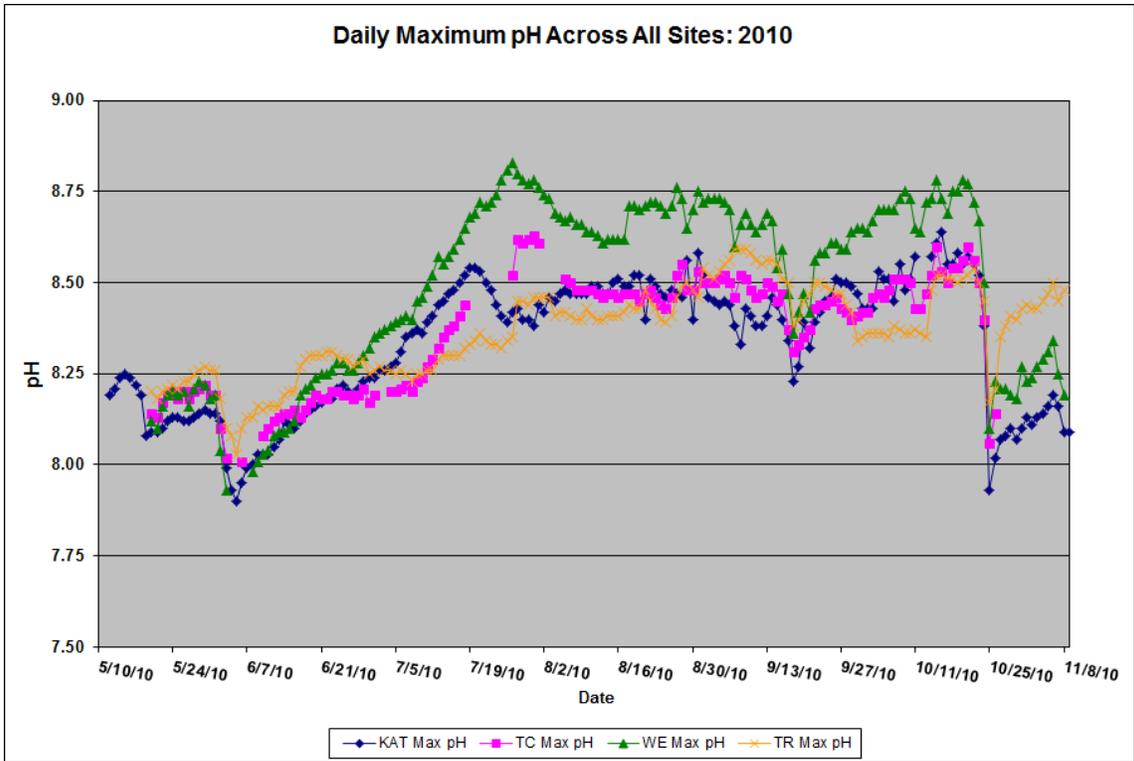


Figure 7-5. Daily Maximum pH Across All Sites: 2010

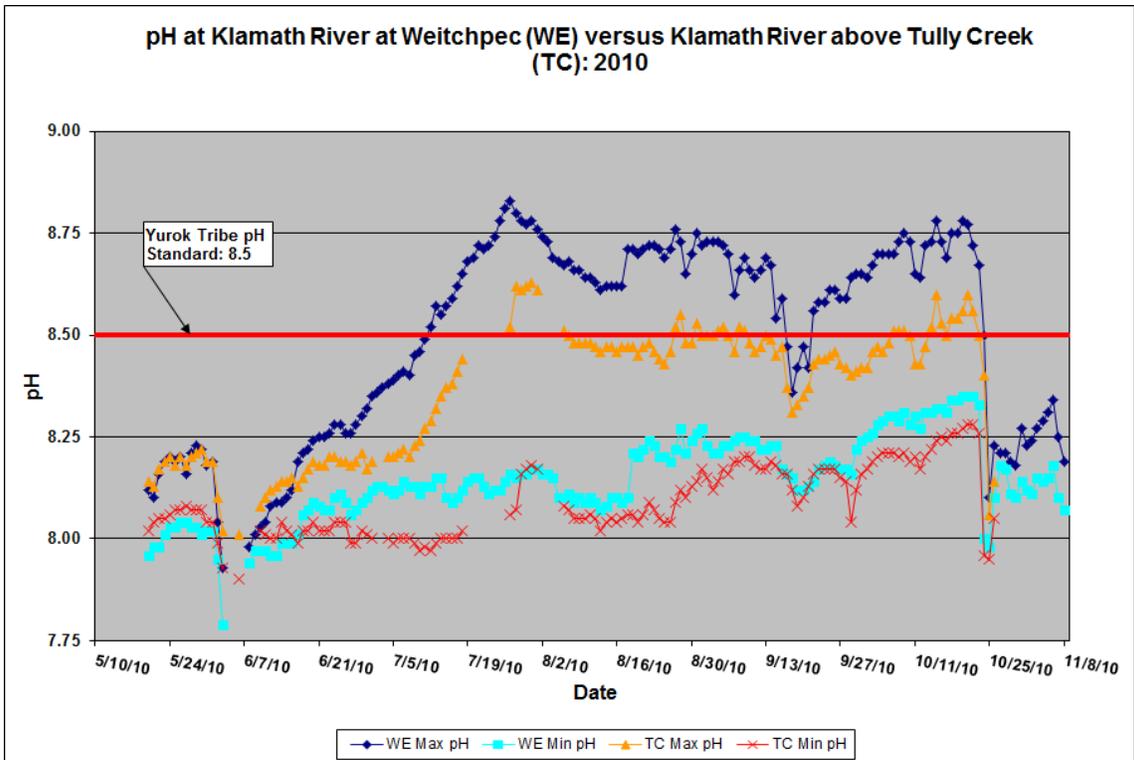


Figure 7-6. WE vs. TC pH: 2010

## **Specific Conductivity**

### ***All Riverine Sites***

From mid-May to early July, the highest daily maximum specific conductivity was recorded at TR (Figure 7-7). From early July to late August the highest readings were recorded at WE, and then from late October until the end of the monitoring season the highest daily maximum specific conductivity readings were recorded at TR. The site with the lowest daily maximum specific conductivity readings was variable throughout the year with all sites recording the lowest daily maximum at some point in the season, however, TR tended to have the lowest daily maximum from mid-August to late October.

In the specific conductivity graphs shown in Section VI, daily average flow was graphed with specific conductivity to illustrate how specific conductivity may have been affected by volume of water present in the river at that time. Flow discharge data used to generate these graphs was downloaded from the USGS website. These graphs provide additional information when trying to determine the impact flow has on specific conductivity.

### ***Klamath River above Turwar (KAT)***

Rain events seem to have decreased daily maximum specific conductivity at KAT for short periods of time (Figure 6-25). During the time leading up to the rain event in early June, specific conductivity was slowly increasing. On June 5, however, maximum specific conductivity was 83 $\mu$ S/cm, a decrease of 34 $\mu$ S/cm from June 1. As in June, specific conductivity leading up to the rain event in late October was slowly increasing. On October 26 maximum specific conductivity was 134  $\mu$ S/cm, a decrease of 49 $\mu$ S/cm from October 23.

### ***Klamath River above Tully Creek (TC)***

Rain events seem to have decreased daily maximum specific conductivity at TC for short periods of time (Figure 6-26). During the time leading up to the rain event in early June, specific conductivity was slowly increasing. Although datasonde data is missing during peak flow for this event, on June 6 maximum specific conductivity was 94 $\mu$ S/cm, a decrease of 23 $\mu$ S/cm from June 1. As in June, specific conductivity leading up to the rain event in late October was slowly increasing. On October 25, however, maximum specific conductivity was 126  $\mu$ S/cm, a decrease of 58 $\mu$ S/cm from October 23.

### ***Klamath River at Weitchpec (WE)***

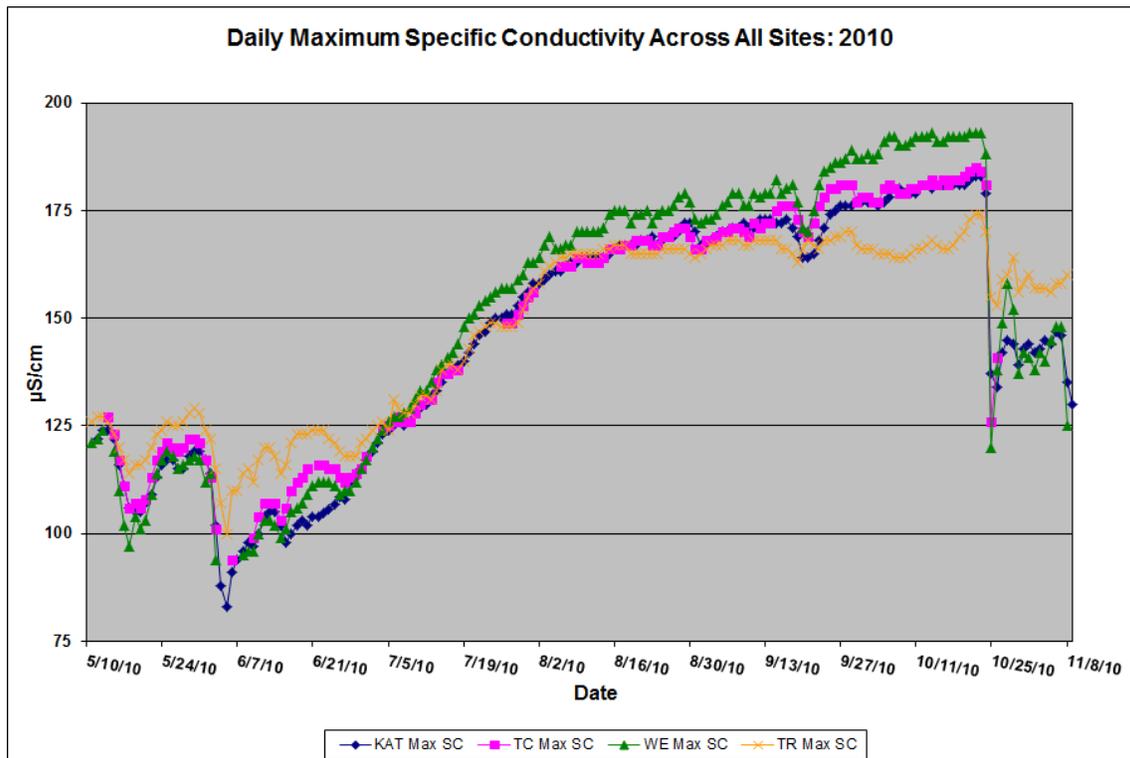
Rain events seem to have decreased daily maximum specific conductivity at WE for short periods of time (Figure 6-27). During the time leading up to the rain event in early June, specific conductivity was holding steady and even decreasing slightly. Although datasonde data is missing during peak flow for this event, on June 3, when flow was increasing, maximum specific conductivity was 94 $\mu$ S/cm, a decrease of 18 $\mu$ S/cm from June 1. As in June, specific conductivity leading up to the rain event in late October was generally holding steady. On October 25, however, maximum specific conductivity was 120 $\mu$ S/cm, a decrease of 73 $\mu$ S/cm from October 23.

### ***Trinity River near Mouth (TR)***

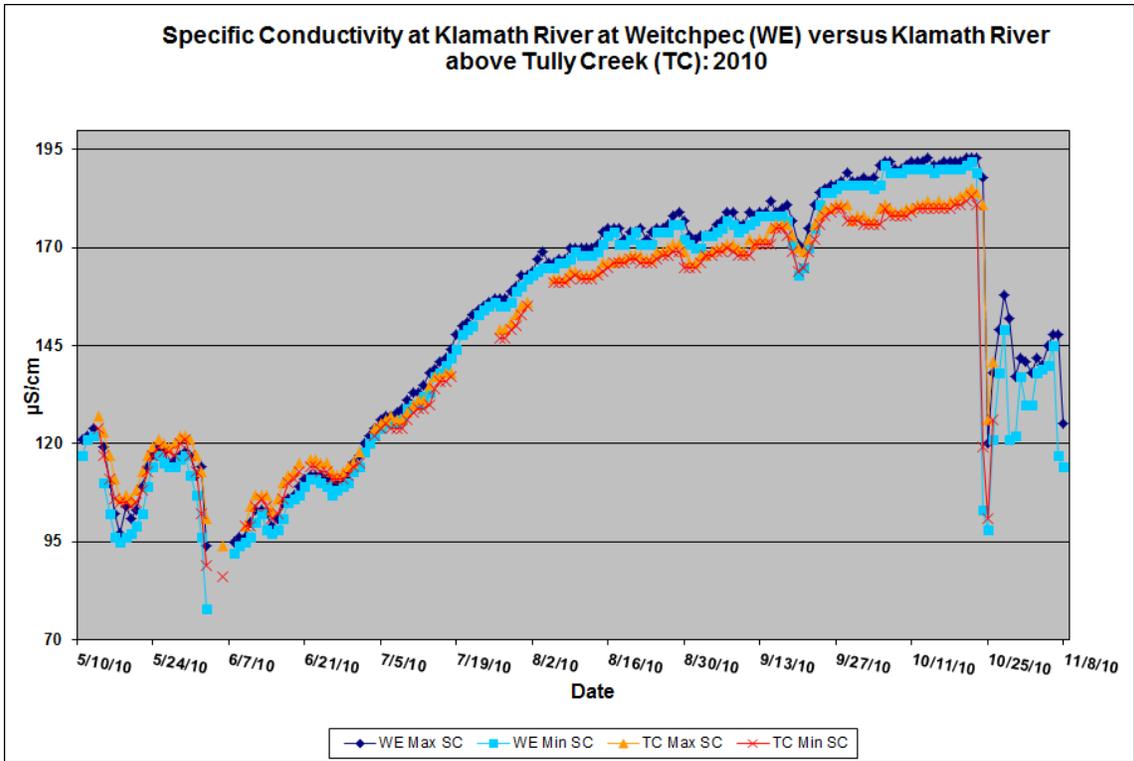
Rain events seem to have decreased daily maximum specific conductivity at TR for short periods of time (Figure 6-28). During the time leading up to the rain event in early June, specific conductivity was slowly increasing. On June 5, however, maximum specific conductivity was 100 $\mu$ S/cm, a decrease of 24 $\mu$ S/cm from June 1. As in June, specific conductivity leading up to the rain event in late October was increasing. On October 25, however, maximum specific conductivity was 155  $\mu$ S/cm, a decrease of 19 $\mu$ S/cm from October 23.

### ***Impacts of the Trinity River on Specific Conductivity in the Klamath River***

From mid-May to early July the Trinity River tended to increase daily maximum specific conductivity in the Klamath River, with higher daily maximum and minimum specific conductivity values at TC than WE (Figure 7-8). In fact, daily minimum specific conductivity at TC was almost always higher than daily maximum specific conductivity at WE during this time period. From early July to late October this trend was reversed with the Trinity River usually lowering daily maximum specific conductivity on the Klamath River. During this time daily maximum specific conductivity at TC tended to be lower than daily minimum specific conductivity at WE (Figure 7-8).



**Figure 7-7. Daily Maximum Specific Conductivity Across All Site: 2010**



**Figure 7-8. WE vs. TC Specific Conductivity: 2010**

## Works Cited

- Kroeber, A.L. *Handbook of the Indians of California*. Bureau of American Ethnology, Smithsonian Institute. 1925
- Lindenberg, M.K., Hoilman, Gene, and Wood, T.M., 2009, *Water Quality Conditions in Upper Klamath and Agency Lakes, Oregon, 2006*. U.S. Geological Survey Scientific Investigations Report 2008-5201, 54 p.
- Mueller, David K., and Spahr, Norman E., 2006, *Nutrients in Streams and Rivers Across the Nation—1992–2001*. U.S. Geological Survey Scientific Investigations Report 2006–5107, 44 p.
- Norton, Ken, Pliny McCovey Jr., Curtis Miller, Louisa McConnell, Mike Orcutt, Nolan Colgegrove, Mark Higley. *Water Quality Control Plan: Hoopa Valley Indian Reservation*. 2008
- Sprague, L.A., Mueller, D.K., Schwarz, G.E., and Lorenz, D.L., 2009, *Nutrient Trends in Streams and Rivers of the United States, 1993–200*. U.S. Geological Survey Scientific Investigations Report 2008–5202, 196 p.

## Appendix A: YSI Calibration SOP

Upon arrival at each monitoring site, numerous tasks must be performed to successfully meet the QA/QC protocol and service the Sonde. Properly filling out the calibration sheet is critical to collecting all the data that is needed for the evaluation of the sonde file. Here is an overview of a typical field tour consisting of extracting the sonde, performing scheduled maintenance and redeploying.

- Arrive on site: Record current barometric pressure and temperature using DeltaCal barometer at the site. Also record other environmental conditions, such as: weather, changing water levels, color of water, water clarity, etc on the datasheet. If at KAT or TC calibrate dissolved oxygen of reference sonde to current barometric pressure onsite.
- Audit the site sonde (datasonde that is dedicated to the site) by placing the reference sonde as close as possible to the lock box that contains the site sonde. As close to the half hour or top of the hour as possible (+/- 2 minutes), record the reference sonde water quality parameters on the datasheet. Remove the lock box containing the site sonde from the water no earlier than 2 minutes after the 30 minute or top of the hour reading. Carefully remove the site sonde from the housing trying not to disturb any fouling on the probes. Inspect the probes and determine if the wiper was properly wiping all of the sondors and make any notes such as extreme biofouling was present or the probes were extremely silted in by sand.
- Fill insulated water jug with river water.
- Connect site sonde to hand held and put in run mode by going to the sonde menu, highlight **Run** and press ENTER, highlight **Discrete Sample** and press ENTER, highlight **Start Sampling** and press ENTER.
- Place the site sonde, reference sonde, and NIST thermistor in the water jug and record pre-cleaning readings after WQ parameters have stabilized (Temp, SpCond, DO %, DO mg/L, pH, BGA) of site sonde in addition to readings of reference sonde and NIST thermistor in bucket.
- Turn off the site sonde. Remove site sonde and thoroughly clean.
- Cleaning site sonde: **Note: only site sonde is cleaned during cleaning process**
- YSI Sonde cleaning Procedure is as follows:
  - Remove sonde guard
  - Use an Alan head wrench to remove the wiper brush and the wiper on the BGA probe.
  - Clean conductance probe with wire brush.

- To clean the probes carefully loosen any built up sediment or algae by brushing sides (**NOT MEMBRANE SURFACES**) with toothbrush. When completed, use squirt bottle with DI water to rinse surfaces of probes.
- Swipe the sides of the probes with a Q-tip moistened with alcohol. **DO NOT APPLY TO MEMBRANE SURFACES**
- Swipe membrane surfaces with Q-tip moistened with DI water.
- Rinse all surfaces once more with squirt bottle of DI water.
- Install wiper brush and wiper (with new wiper pads) back onto probes with the proper gap (width of Rite-In-The-Rain paper).
- Put sonde guard back on.

**WHILE SOMEONE IS CLEANING THE SONDE THE OTHER CAN:**

- Take the big brush and thoroughly clean the inside and outside of the sonde lock box and outside of conduit.
- Get new wiper brush from cleaning kit and apply new wiper pad. Apply new wiper pad to wiper.
- Clean the site sonde sensor guard with a toothbrush and Q-tips.
- Take a Q-tip and clean out the data line connection on the data line ensuring it is free of water and sand.
- Download data from logger.
  - **If you are at the KAT site you do not download data until USGS is present**
  - **If you are at the Weitchpecor Trinity River site then follow the attached SOP to download data off of the H-350 XL data logger using the compact flash card.**
  - **If you are at the TC site then follow the other SOP to swap linear flash cards from the H-350 datalogger.**

---

After site sonde has been cleaned:

- Replace site sonde, reference sonde, and NIST thermistor in bucket and record post-clean readings of YSI site sonde and reference sonde in bucket after WQ parameters have stabilized.
- **Post calibrate site sonde DO probe:** Remove any water from the optical DO probe with Q-tip or Kim wipe (**careful not to push too hard on membrane**). Wrap the wet towel over the sensor guard and entire datasonde to provide insulation. Place the entire sonde with wet towel into the DO calibration chamber (red jug with lid on) and make sure the sonde will not fall over.

- Go to the sonde main menu, highlight **calibrate** and press enter. Select **ODOsat %** and then **1-Point** to access the DO calibration procedure. Enter the current barometric pressure in **mm of Hg**. Press **Enter** and the current values of all enabled sensors will appear on the screen and change with time as they stabilize. Observe the readings under ODO mg/L. **After the DO stabilizes = shows no significant change for approximately 30 seconds**, Record the temp and the initial in DO mg/L and press **ENTER** to calibrate. The screen will indicate that the calibration has been accepted, record the Final DO in mg/L
- **Next: post calibrate the Specific Conductivity Probe**
- Rinse probes two times with DI water.
- Rinse probes two times with specific conductivity standard.
- Fill calibration cup with fresh specific conductivity standard.
- Under the main menu highlight **calibrate** and hit enter
- Highlight **Conductivity** and hit ENTER
- Highlight **SpCond** and hit ENTER
- Enter the value of calibration standard (for 1,000  $\mu\text{S}/\text{cm}$ , enter 1.0) and press ENTER.
- Wait at least 30 seconds until specific conductivity stabilizes and record the temperature and initial specific conductivity value onto data sheet.
- Press ENTER to calibrate the sonde
- Never accept an “Out of Range” message – if this occurs ensure there are no bubbles in the hole where the Sp Cond probe is located and that the standard covers the hole completely
- Record the final value of specific conductivity onto data sheet.
- Press ESCAPE several times to go to the Main Menu and highlight **Advanced** and hit ENTER
- Highlight **Cal constants** and hit ENTER
- Record conductivity cell constant onto data sheet and verify the number ranges between 4.5 to 5.5
- Dump conductivity standard into rinse jar.
- **Next: post calibrate the pH probe**
- Rinse two times with DI water
- Rinse two times with pH 7.0\_ standard.
- Fill calibration cup with fresh pH 7.0\_ standard ensuring that the temp probe is covered with calibration standard
- Press ESCAPE twice to the main menu and highlight **RUN** and hit ENTER
- Highlight **Discrete Sample** and hit ENTER
- Highlight **Start Sampling** and hit ENTER
- Wait until temp stabilizes and record the temperature of the pH 7.0\_ standard and the temperature compensated value for the pH standard, this is done to determine the temperature compensation for the pH standard, for example if the temp is 18 degrees C then determine the value of the pH 7 standard at 20 degrees C on the

look up table on the datasheet and fill it out in the pH standard line on the datasheet

- Press ESCAPE 3 times to go to the Main Menu
- Highlight **Calibrate** and hit ENTER
- Highlight **ISE1 pH** and press ENTER
- Highlight **2 point** and press ENTER
- Enter the temperature compensated value for the pH 7.\_ calibration standard for the first calibration point and hit ENTER.
- Wait at least 30 seconds until pH stabilizes and record the initial pH 7.\_ value onto the data sheet.
- Press ENTER to calibrate the sonde
- **DO NOT press enter or escape!**
- Record the final value of pH onto data sheet.
- Record pH mv onto data sheet and verify that the value ranges between -50 and +50
- Dump pH standard into rinse jar.
- Rinse two times with DI water.
- Rinse two times with pH 10.\_ standard.
- Fill calibration cup with fresh pH 10.\_ standard., ensuring that the pH probe is completely submerged
- Record the temperature of the pH 10.0\_ standard and the temperature compensated value for the pH standard onto the datasheet
- Press ENTER once and enter the temperature compensated pH 10.0\_ value as the second point and hit ENTER.
- Wait until pH stabilizes and record the initial pH 10 value onto data sheet
- Press ENTER to calibrate the sonde
- Record the final value of pH onto data sheet
- Record pH mv onto data sheet and verify that the value ranges between -130 and -230
- calculate the pH slope onto data sheet by subtracting the difference between the two numbers (using absolute value of the two numbers) and enter the value onto the datasheet, ensure the value ranges between 165 and 180
- Dump pH 10.0\_ standard into rinse jar
- Rinse with two times with DI water
  
- **Next: IF YOU ARE AT THE WE, KAT or TC SITES THEN YOU NEED TO DO A 0 CHECK OF THE OPTICAL BGA PROBE.**
- Fill calibration cup  $\frac{3}{4}$  of the way with DI water so that the BGA and temp probe are fully immersed.
- Be sure to engage only one thread on the calibration cup during this procedure to avoid a small interference from the cup bottom
- Highlight **Run** in the main menu and press ENTER, highlight **Discrete Sample** and press ENTER, highlight **Interval** and change it from 0.5 to 4 and highlight **Start Sampling** and press ENTER.

- On the 650 activate the wiper to clean the optics to remove any bubbles that may be present
- **After BGA has stabilized.** Record initial temperature and BGA on data sheet. Do not calibrate
- **Once BGA is present in the Klamath River do a rhodamine dye check for the BGA probes.**
- Rinse two times with DI water
- Rinse two times with rhodamine dye standard that was prepared in the lab.
- Fill calibration cup with fresh rhodamine dye standard ensuring that the temp probe is covered with calibration standard
- Press ESCAPE twice to the main menu and highlight **Run** and hit ENTER
- Highlight **Discrete Sample** and hit ENTER
- Highlight **Start Sampling** and hit ENTER
- Wait until temp stabilizes and record the temperature of the rhodamine dye standard and the temperature compensated value for the rhodamine dye standard, this is done to determine the temperature compensation for the rhodamine dye standard, for example if the temp is 18 degrees C then determine the value of the rhodamine dye standard at 18 degrees C on the look up table on the datasheet and fill it out in the rhodamine dye standard line on the datasheet
- After BGA has stabilized record the BGA number on the datasheet, if BGA number does not stabilize on any one number record the range after you watch it carefully for a couple of minutes
- Dump the rhodamine dye standard into the waste jug and rinse two times with distilled water
- Disconnect the sonde and 650.
- Connect sonde to site data cable, attach carabiner, and insert into aluminum sonde box. Deploy sonde at least 5 minutes before it is set to take a measurement. Record the time of deployment
- Place the reference sonde next to the data sonde at least 5 minutes before it is set to take a measurement and record WQ parameters as close as possible to the half hour or top of the hour (+/- 2 minutes).
- Check logger to ensure that sonde is communicating with logger and logger is recording data.

### H350 XL Datalogger Instructions

Klamath River at Weitchpec(WE) and Trinity River at Weitchpec (TR)

#### To Download Data

- Insert 256 MB Compact Flash Card with PC Card Adapter into Datalogger
- Scroll Down to 'Data Options'
- Press Arrow →
- Scroll Down to 'Copy .NEW to Card?'
- Press Enter
- Wait Until Datalogger reads 'Done, Press Enter to Erase .NEW'
- Press Esc/Cancel to Main Menu
- Remove Data Card by pushing eject button next to card slot

### H350 data download for the TC site

#### **Data Download (Linear Flash card swap out)**

1. Open Gaging Station by unlocking metal box.
2. Disconnect the two metal rings holding lid on display board.
3. Press **ON**.
4. Scroll Down to **<CHANGE DATA CARD>** and hit **ENTER**.
5. Hit **ENTER** for **YES**.
6. Pull card and hit **ENTER**.
7. Install new blank card (from office) and press **ENTER**.
8. Hit **ENTER** for **YES** to format card.
9. On the data logger, scroll down to **<FLASH MEMORY CARD>**, hit **ENTER**.
10. Scroll down to **<VIEW DATA FILE>**, hit **ENTER**. (If the data headings are there, it is accepting data.) Hit **ESCAPE**.
11. Scroll up to **<LOGGING PARAMETER>**, hit **ENTER**. (Screen should say **<LOGGING [ON]>**, if it doesn't, it needs to be turned on.)
12. Close lid on data logger.
13. Lock door on Gaging Station.

### Method to remove and install a probe

- First carefully unscrew the stainless steel probe nut with the provided tool. Carefully dry the base of the probe with a kim wipe. Tilt the probes to be pointing towards the ground. Firmly grasp the probe at its base and pull in a slow downward motion until the o-rings on the probe have cleared the probe port. **Blow out the probe port with compressed air to dry it thoroughly.**
- Prepare the new probe by lightly greasing the o-rings on the probe. Insert the probe into the correct port and gently rotate the probe until you feel the connector engage. Now push the probe in towards the bulkhead until you feel the o-ring seat in its bore. You will experience some resistance as you push the probe inward. Once you feel the o-ring seat, gently rotate the stainless steel probe nut clockwise with your fingers while you are holding the probe in place.
- **DO NOT USE THE TOOL! The nut must be seated by hand, if the nut is difficult to turn STOP back off and attempt again to prevent cross threading the threads on the sonde. The nut will seat flat against the bulkhead and rotate easily when the parts are properly aligned. Use the tool to snug up the nut so it cannot come loose. DO NOT OVER TIGHTEN!!!!!!**
- If you are removing probe from the spare sonde make sure to install a port plug in the same way you install a probe. (grease o-rings and hand screw in first then tighten with the tool)
- Document what you did on the data sheet

Sensor Settings for Datasonde that is used in mainstem monitoring activities  
(does not matter if hooked up to a logger or not)

- **Time is on**
- **Temperature is on**
- **Sp. Conductivity is on**
- **ISE1 pH is on**
- **Dissolved Oxy is OFF**
- **Optic-T – Dissolved Oxy is ON**
- **Battery is OFF**
- **Pressure is OFF**
- **ISE-2 is off**
- **Optic C - BGA is ON (except for TR sonde that has turbidity probe keep it off)**

Report Settings for Datasonde that is Hooked up to a datalogger at WE,TC, KAT and TR:

- **Date and Time is OFF**
- **Temperature is on: °C**
- **Specific Conductivity is on: microsiemens  $\mu$**
- **pH is on**
- **pH mv is on**
- **ODO Sat % and mg/L is on**
- **Turbidity is OFF**
- **BGA is ON (at KR sites only)**

Report Settings for Datasonde that is **NOT** Hooked up to a datalogger:

- **Same as above but Date and Time is turned on**

## To download data and create files on sondes that are not hooked up to a datalogger

Before postcalibrating DO follow the below instructions to download data off of the internal datasonde memory.

- **If the sonde is not hooked up to the datalogger then this is a good time to download the data off of the sonde.**
- Turn the logging off by selecting run, unattended sample, and stop logging
- Download the data (page 55 in the 650 manual) by selecting the sonde menu in the 650 Main Menu
- Highlight File and hit enter
- Highlight Quick Upload and hit enter
- Select PC6000 for the File Type and hit enter
- Do the same process again for the same file but download it as a different data file, a ASCII Text file this time
- Create a file after you do your final calibration of pH or the BGA check
- Create a new file in the Sonde Run Menu unattended sample menu. Make sure the start time is two minutes before the half hour or top of the hour (i.e, 10:28 or 10:58). The interval is 30 minutes. The parameters to log should be date and time, temperature, conductivity, pH, pH mv, and battery voltage, ODO mg/L, ODO % Saturation (and BGA for KR sites). Set the stop time to run for 21 days. Set the file name to site id and start date, example-(TR061606). Scroll down to the bottom of the screen and start logging. To verify that logging is activated go to file status and it will say logging active.

## Appendix B: Water Quality Grades

Water quality data from sondes is entered into the Yurok Environmental Data Storage System (YEDSS) where each water quality parameter is assigned a grade based on USGS criteria for each two week deployment (Table B1). Any grade of 'C' or lower is considered "poor" data and is flagged as such. Low grades can be caused by instrument drift due to biofouling or aging of probes, or damage to datasonde. For more information regarding YEDSS and/or grading of data please contact YTEP.

During the 2010 monitoring year no grade below a 'B' was generated (Tables B2-B5). There was one 'I', which indicates an "Incomplete." This was due to a dissolved oxygen sensor malfunction. In the raw data this malfunction was very apparent and the dissolved oxygen data up until that time was deemed of high enough quality to use in reporting. Data recorded after the malfunction until probe replacement was flagged and removed from the reporting dataset.

**Table B- 1. Water Quality Ratings for Raw Data**

<b>Quality Ratings For Raw Data</b>				
<b>Parameter</b>	<b>A (excellent)</b>	<b>B (Good)</b>	<b>C (Fair)</b>	<b>D (Poor)</b>
Water Temperature	$\leq \pm 0.2 \text{ }^\circ\text{C}$	$> \pm 0.2\text{-}0.5 \text{ }^\circ\text{C}$	$> \pm 0.5\text{-}0.8 \text{ }^\circ\text{C}$	$> \pm 0.8 \text{ }^\circ\text{C}$
Specific Conductivity	$\leq \pm 3\%$	$> \pm 3 \text{ to } 10\%$	$> \pm 10 \text{ to } 15\%$	$> \pm 15\%$
pH	$\leq \pm 0.2 \text{ units}$	$> \pm 0.2 \text{ to } 0.5 \text{ units}$	$> \pm 0.5 \text{ to } 0.8 \text{ units}$	$> \pm 0.8 \text{ units}$
Dissolved Oxygen (% Sat)	$\leq \pm 0.3 \text{ mg/L}$	$> \pm 0.3 \text{ to } 0.5 \text{ mg/L}$	$> \pm 0.5 \text{ to } 0.8 \text{ mg/L}$	$> \pm 0.8 \text{ mg/L}$

Table B-2. KAT Grades: 2010

<b>Table B-1. KAT Grades 2010</b>				
<b>Date</b>	<b>Water Temperature Grade</b>	<b>Specific Conductivity Grade</b>	<b>pH Grade</b>	<b>Dissolved Oxygen Grade</b>
5/11/10	A	A	A	A
5/18/10	A	A	A	A
6/1/10	A	A	A	A
6/14/10	A	A	A	A
6/14/10	A	A	A	A
6/29/10	A	A	A	A
7/13/10	A	A	A	A
7/26/10	B	A	A	A
8/3/10	B	A	A	I
8/17/10	A	A	A	A
8/31/10	A	A	A	A
9/14/10	A	A	A	A
9/28/10	A	A	A	A
10/12/10	A	A	A	A
10/26/10	A	A	B	A

I = Incomplete

Table B-3. TC Grades: 2010

<b>Table B-2. TC Grades 2010</b>				
<b>Date</b>	<b>Water Temperature Grade</b>	<b>Specific Conductivity Grade</b>	<b>pH Grade</b>	<b>Dissolved Oxygen Grade</b>
5/10/2010	A	A	A	A
5/19/2010	A	A	A	A
6/2/2010	A	A	A	A
6/17/2010	A	A	A	A
6/30/2010	A	A	A	A
7/14/2010	A	A	A	A
7/28/2010	A	A	A	A
8/4/2010	A	A	A	A
8/18/2010	A	A	A	A
9/1/2010	A	A	A	A
9/15/2010	A	A	A	A
9/29/2010	A	A	A	A
10/14/2010	A	A	A	B

Table B-4. WE Grades: 2010

<b>Table B-3. WE Grades 2010</b>				
<b>Date</b>	<b>Water Temperature Grade</b>	<b>Specific Conductivity Grade</b>	<b>pH Grade</b>	<b>Dissolved Oxygen Grade</b>
5/10/2010	A	A	A	A
5/19/2010	A	A	A	A
6/2/2010	A	A	A	A
6/17/2010	A	A	A	A
6/30/2010	A	A	A	A
7/14/2010	A	A	A	A
7/28/2010	A	A	A	A
8/4/2010	A	A	A	A
8/18/2010	A	A	B	A
9/1/2010	A	A	A	A
9/15/2010	A	A	A	A
9/29/2010	A	A	A	A
10/14/2010	A	A	A	B
10/27/2010	A	A	A	A

Table B-5. TR Grades: 2010

<b>Table B-4. TR Grades 2010</b>				
<b>Date</b>	<b>Water Temperature Grade</b>	<b>Specific Conductivity Grade</b>	<b>pH Grade</b>	<b>Dissolved Oxygen Grade</b>
5/10/2010	A	A	B	A
5/19/2010	A	A	A	A
6/2/2010	A	B	A	A
6/17/2010	A	A	A	A
6/30/2010	A	A	A	A
7/14/2010	A	A	A	A
7/28/2010	A	A	A	A
8/4/2010	A	A	A	A
8/18/2010	B	A	A	A
9/1/2010	A	A	A	A
9/15/2010	A	A	A	A
9/29/2010	A	A	A	A
10/14/2010	A	A	B	A
10/27/2010	A	A	A	A