Quartz Valley Indian Reservation
Water Quality Monitoring and Assessment Report
2008

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Special Thanks for making this project possible:

- **US Environmental Protection Agency (US EPA)**
- **North Coast Water Quality Control Board (NCRWQCB)**
- **US Forest Service (USFS) – Salmon/Scott Ranger District**
- **Timber Vest, Mason Bruce & Girard**
- **Quartz Valley, CA landowner participants**
- **Peer Review Team**
- **Klamath Basin Tribal Water Quality Workgroup**

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I. Background

The Quartz Valley Indian Reservation (QVIR) Environmental Protection Department (EPD) began the process of developing a Water Pollution Control Program in accordance with the Clean Water Act (CWA) in 2005. The Tribe set primary goals of ensuring salmonid spawning and rearing habitat, fishing, swimming, other wildlife habitat and cultural needs. The objective is to ensure these goals are met for the future protection and sustained use of valuable Reservation water resources, protection of public health and welfare, and the enhancement of water quality resources. The Tribe intends to protect and improve water resources through water quality monitoring, habitat evaluation, education and community outreach, planning and implementation.

A Quality Assurance Project Plan (QVIR 2006a) for water quality monitoring was developed by the Tribal Environmental Program and approved by the United Sates Environmental Protection Agency (U.S. EPA) in 2006. Current water quality conditions are annually evaluated using the water quality objectives developed from various state, federal and tribal entities. The North Coast Regional Water Quality Control Board (NCRWQCB) *Basin Plan* water quality objectives are determined for the protection of beneficial uses (eg. salmonids, agriculture, and recreation) established for the Scott River and its tributaries. U.S. EPA's (2000a) *Ambient Water Quality Criteria Recommendations for Rivers and Streams in Nutrient Ecoregion II* provides general guidance to analyze nutrient values, but is not intended to be directly translated into standards. The U.S. EPA *2007 Edition of the Drinking Water Standards and Health Advisories* and the *NCRWQCB Basin Plan* were used to analyze groundwater results. For parameters without current water quality objectives established by either state or federal agencies, the QVIR Tribe has adopted an objective based on published research. Table 1 in Section I lists each surface water quality parameter monitored in 2008, the water quality objective used for comparison and their sources. Table 7 in Section IV lists the water quality objectives used for comparison of groundwater results and their sources.

QVIR began collecting data in 2007, and the results of that year's sampling are available in the annual *Quartz Valley Indian Reservation Water Quality Monitoring and Assessment Report* (Bowman, 2008).

Table 1: Water quality objectives used to analyze results.

<table>
<tr><th>Parameter</th><th>Units</th><th colspan="3">Water Quality Objectives</th><th>Source</th></tr>
<tr><td>Temperature</td><td>°C</td><td colspan="2">MWAT</td><td>< 16.8° C</td><td>Sullivan et al., 2000;
Welsh et al., 2001</td></tr>
<tr><td rowspan="2">pH</td><td rowspan="2">pH</td><td colspan="2">Max</td><td>Min</td><td rowspan="2">North Coast Regional Water Quality Control Board (NCRWQCB). 2007 Basin Plan, Scott River Objective</td></tr>
<tr><td colspan="2">8.5</td><td>7</td></tr>
<tr><td rowspan="2">Conductivity</td><td rowspan="2">micromhos</td><td colspan="2">90% Upper Limit</td><td>50% Upper Limit</td><td rowspan="2">North Coast Regional Water Quality Control Board (NCRWQCB). 2007 Basin Plan, Scott River Objective</td></tr>
<tr><td colspan="2">350</td><td>275</td></tr>
<tr><td>Turbidity</td><td>NTU</td><td colspan="3">< 5
above ambient turbidity levels</td><td>Berg, 1982;
Lloyd, 1987</td></tr>
<tr><td rowspan="2">Dissolved Oxygen</td><td rowspan="2">mg/L</td><td>Min</td><td>90% Upper Limit</td><td>50% Upper Limit</td><td rowspan="2">North Coast Regional Water Quality Control Board (NCRWQCB). 2007 Basin Plan, Scott River Objective</td></tr>
<tr><td>7.0</td><td>-</td><td>9.0</td></tr>
<tr><td>Total Phosphorus</td><td>µg/L</td><td colspan="3">10.00</td><td>U.S. Environmental Protection Agency. 2000a. Ambient Water Quality Criteria Recommendations for Rivers and Streams in Nutrient Ecoregion II.</td></tr>
<tr><td>Total Nitrogen</td><td>mg/L</td><td colspan="3">0.12</td><td>U.S. Environmental Protection Agency. 2000a. Ambient Water Quality Criteria Recommendations for Rivers and Streams in Nutrient Ecoregion II.</td></tr>
<tr><td>Escherichia coli</td><td>MPN</td><td colspan="3">a. Single sample < 235

b. Five equally spaced samples over 30 days < 50</td><td>a. US EPA 1986. Ambient Water Quality Criteria for Bacteria.

b. North Coast Regional Water Quality Control Board (NCRWQCB). 2007 Basin Plan which uses the CA Public Health Department draft objectives</td></tr>
<tr><td>Chlorophyll a</td><td>ug/l</td><td colspan="3">10</td><td>Tetra Tech, Inc. 2006. Technical Approach to Develop Nutrient Numeric Endpoints for California. Prepared for U.S. EPA Region IX.</td></tr>
</table>

II. Methods

In accordance with the approved Quality Assurance Project Plan (QAPP), data collection began during the late spring of 2007 and has continued to the present. A multi-channel data recorder (datasonde) was located on the mainstem Scott River at the U.S. Geologic Survey (USGS) flow Gauge below Fort Jones and was maintained for the entire year of 2008 continuously recording the following parameters: temperature, specific conductivity, dissolved oxygen, pH and turbidity. An additional datasonde was deployed on lower Shackleford Creek at one of six selected grab sampling sites. Bi-weekly grab sampling began in June and finished in November. Sampling occurred at one site on Mill Creek, four on Shackleford, one site on the mainstem Scott River below Shackleford Creek and two additional sites were monitored for monitored for bacteria only (Sniktaw Creek and Scott River @ Jones Beach). Sites are located within each land use zone identified in the QVIR QAPP (QVIR 2006a). Grab samples were collected and analyzed for seven water quality parameters: nutrients, bacteria (*E.coli* and total coliform), pH, dissolved oxygen, specific conductivity, turbidity and discharge. Continuous ONSET temperature monitoring probes were deployed at twenty-two sites; five in the mainstem Scott below the Valley, and seventeen in Scott River tributaries, both above and below the Valley.

Figure 1 depicts the 2008 sampling locations. Appendix E contains a spreadsheet of all sites, GPS location and parameters collected for both groundwater and surface water.

Three laboratories were used to analyze nutrient and bacteria samples in 2008. The Quartz Valley Indian Reservation operates its own bacteria lab, which is certified through the State of California, and analyzed all bacteria samples according to CA state lab certification specifications. Basic Laboratory in Redding, CA was utilized as quality control for the duplicate bacteria samples. Nutrient and chlorophyll samples were analyzed by Aquatic Research Inc. in Seattle, WA.

Specific sampling methods and laboratory methods for each parameter are included in the *Quartz Valley Indian Reservation's Quality Assurance Project Plan for Water Quality Sampling and Analysis* (QVIR 2006a). Standardized Operating Procedures (SOP's) for surface water nutrient and bacteria sampling are included in Appendix A. Information on additional protocols or quality assurance procedures (i.e. calibration) is available upon request.

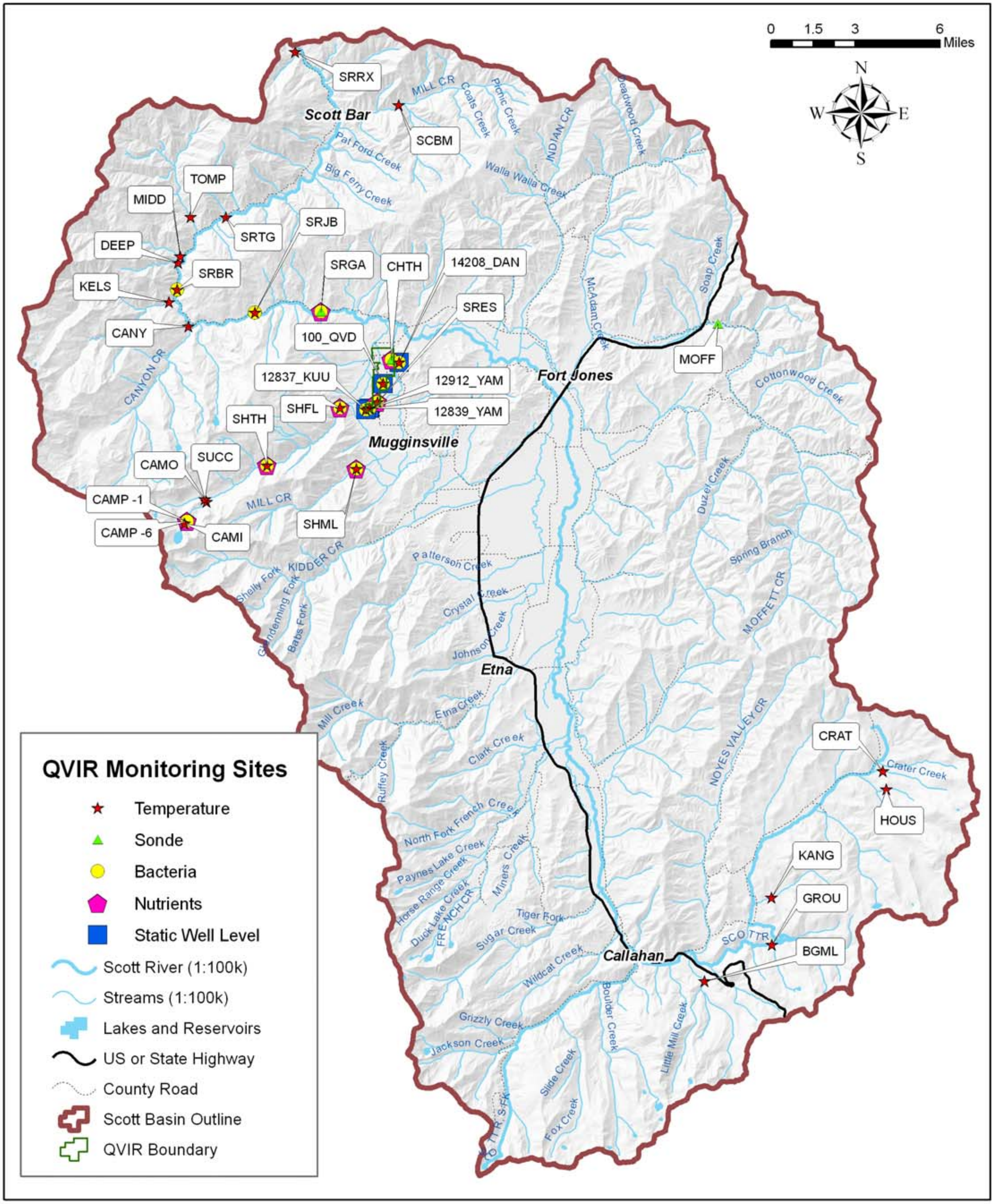


Figure 1: 2008 Sampling Locations, Scott River Basin (map created by Eli Asarian)

Table 2: Sampling site codes for 2008, description of location and property status.

Site Code	Location Description	Property Status
SHTH	Shackleford at wilderness trailhead	Wilderness - USFS
SHFL	Shackleford at Falls	Private
SRES	Shackleford at Quartz Valley Indian Reservation	US Bureau of Indian Affairs
SHML	Mill Creek above Shackleford Confluence	Private
CHTH	Shackleford at Tribal Trust parcel near mouth	US Bureau of Indian Affairs
SRGA	Scott River at the USGS Gauging Station near Fort Jones	Private
12912_YAM	QVIR drinking well – 12912 Yamitch	US Bureau of Indian Affairs
12839_YAM	QVIR drinking well – 12839 Yamitch	US Bureau of Indian Affairs
12837_KUU	QVIR drinking well – 12837 Kuut	US Bureau of Indian Affairs
100_QVD	QVIR abandoned well – 100 Quartz Valley Drive	US Bureau of Indian Affairs
14208_DAN	Drinking well – 14208 Dangle Lane	Private
CAMI	Campbell Lake Inlet	Wilderness - USFS
CAMP -1,6	Campbell Lake – depth (1m, 6m)	Wilderness - USFS
CAMO	Campbell Lake Outlet	Wilderness - USFS
SUCC	Summit Lake Outlet	Wilderness - USFS
SRJB	Scott River @ Jones Beach	USFS
CANY	Canyon Creek	USFS
KELS	Kelsey Creek	USFS
SRBF	Scott River @ Bridge Flat	USFS
DEEP	Deep Creek	USFS
MIDD	Middle Creek	USFS
TOMP	Tompkins Creek	USFS
SRTG	Scott River @ Townsend Gulch	USFS
SCBM	Mill Creek @ Scott Bar	USFS
SRRX	Scott River @ Roxbury Bridge	USFS
CRAT	Crater Creek	USFS
HOUS	Houston Creek	USFS
KANG	Kangaroo Creek	USFS
GROU	Grouse Creek	USFS
BGML	Big Mill Creek	USFS
SNCR	Sniktaw Creek	US Bureau of Indian Affairs

Table 3: Required sample containers, volumes, preservation methods, analysis method and holding times for water samples requiring laboratory analysis.

Analysis	Container Type	Sample Volume	Preservation Method	Maximum Holding Time	Laboratory Detection Limit	Analysis Method	No. of: [1]	
							Dup	MS
Total Phosphorous (PO_4)	HD Polyethylene	1000 ml	H_2SO_4	28 DAYS	0.002 ppm	SM18 4500PF	1 Dup and MS per analytical batch 500 ml	
Total Nitrogen (TN)	HD Polyethylene	1000 ml	None	28 DAYS	0.050 ppm	SM204500NC	N/A	
Ammonium Nitrogen	HD Polyethylene	500 ml	H_2SO_4	28 Days	.010 ppm	SM184500NH3H	1 Dup and MS per analytical batch 1liter	
Phytoplankton	HD Polyethylene	250 ml	1% Lugol solution	1 year or more	0.1 ug/l	SM1810200H	10% of samples for duplication	
Chlorophyll *a*	Amber Glass	1 liter	None	24 Hrs To Filtration	0.1 ug/l	SM1810200H	1 Dup and MS per analytical batch 2 liters	
Total Coliform and *E.coli*	Polystyrene	100 ml	None	8 hours	1 MPN	SM 9223B	1 Dup per every 10 samples	

[1] Include number of associated analytical QC samples if collection of additional sample volume and/or bottles is necessary. If the QC samples listed are part of the analysis but no additional sample volume and/or bottles are needed, include "NAS" (for "no additional sample") in the column. (Note: MS=matrix spike, MSD=matrix spike duplicate, dup=laboratory duplicate/replicate.)

III. Surface Water Results and Assessment Methodology

A. Scott River Water Quality Monitoring at USGS Gauge

The Scott River USGS Gauge near Fort Jones (SFJ) was upgraded in 2007 to include QVIR Environmental Program Department (EPD)'s YSI datasonde (YSI 6600 Series). Data were recorded every 30 minutes from January 1st – December 31st, 2008. Preliminary real-time data are available online at http://cdec.water.ca.gov/cgi-progs/queryF?sfj. Data is finalized each year in the Tribe's water quality report to U.S. EPA the program funder.

Water quality parameters monitored using the YSI datasonde include: temperature, specific conductivity, dissolved oxygen concentration, dissolved oxygen percent saturation, pH and turbidity. Each parameter was compared to state, federal or Tribal water quality objectives based on the specific life stage needs of salmonids. A data grade has been calculated for each parameter following USGS procedures in the document titled *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting*. Figure 8 depicts the USGS data grade assigned to each parameter during the monitoring season. The temperature probe on the datasonde that collected the continuous data was also verified against the NIST thermometer readings and the audit sonde, with a comparison standard of 0.2ºC. The data grade given to the temperature data is consistently "good" due to the difference in the temperature read by each temperature probe used to evaluate the data. The grading system used does not account for this difference based on the known accuracy of the probes (+ or - 0.2C).With the exception of temperature for reasons explained, a minimal amount of data is graded less than excellent indicating that bio-fouling or electronic drift did not affect the probes functionality in 2008. According to the USGS protocol, data correction should be applied to data that received a grade less than excellent. Data correction has not been applied to any of the data (graded less than excellent) published in this report due to software cost limitations. Graphs have been included in this report that indicate visually the data quality for the period of record for each parameter to aid the reader in understanding the periods of time when the data is of a lesser quality.

1. Temperature

The datasonde placed at the Scott River USGS Gauging station (SRGA) recorded temperature data every 30 minutes. For analysis, the maximum weekly average temperature (MWAT) was determined for this location and compared to reference values for lethal and sub-lethal MWAT values affecting salmonids of different life stages. Coho habitat suitability of less than 16.8ºC is used for analysis based on Welsh *et al.* 2001. A salmon risk assessment study approach used by Sullivan *et al.* (2000) found that an MWAT of 19ºC reduces growth of both coho and steelhead by 20%. In addition, the MWAT causing death or elimination from an area can range from 21.0 - 25.0º C for coho and 21.0 - 26.0ºC for steelhead. Elliot (1981) also found these MWAT values can block migration, inhibit smoltification and cause disease problems. (Sullivan *et al.*, 2000; Welsh *et al.*, 2001; U.S. EPA, 2003). Temperatures in 2007 are also graphed for comparison.

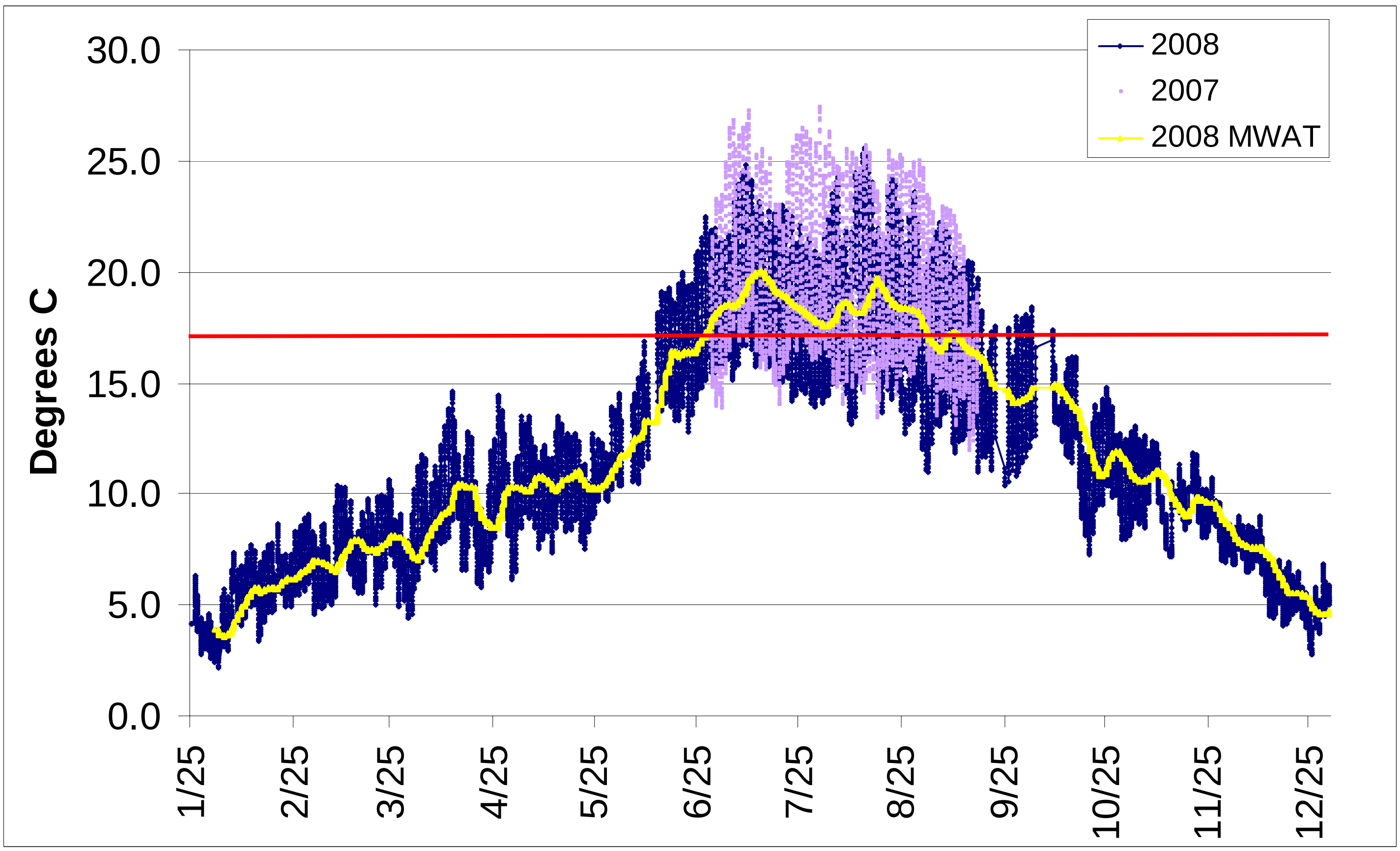


Figure 2 Temperature at the Scott River USGS Gauging Station 2007 and 2008. Coho habitat suitability (red line) is based on 16.8ºC MWAT (Welsh et al., 2001)

2. Specific Conductivity

The datasonde placed at the Scott River USGS Gauging station (SRGA) recorded specific conductivity every 30 minutes. *Basin Plan* (NCRWQCB 2007) water quality objectives for the Scott River are a monthly mean below 350 and 250 micromhos (90% upper limit and 50% lower limit, respectively), these values were used as a reference for analysis, and results are included in the discussion. Figure 3 compares 2007 and 2008 values, Figure 4 depicts the inverse relationship between flow and specific conductance and Figure 5 shows the relationship between temperature and specific conductivity.

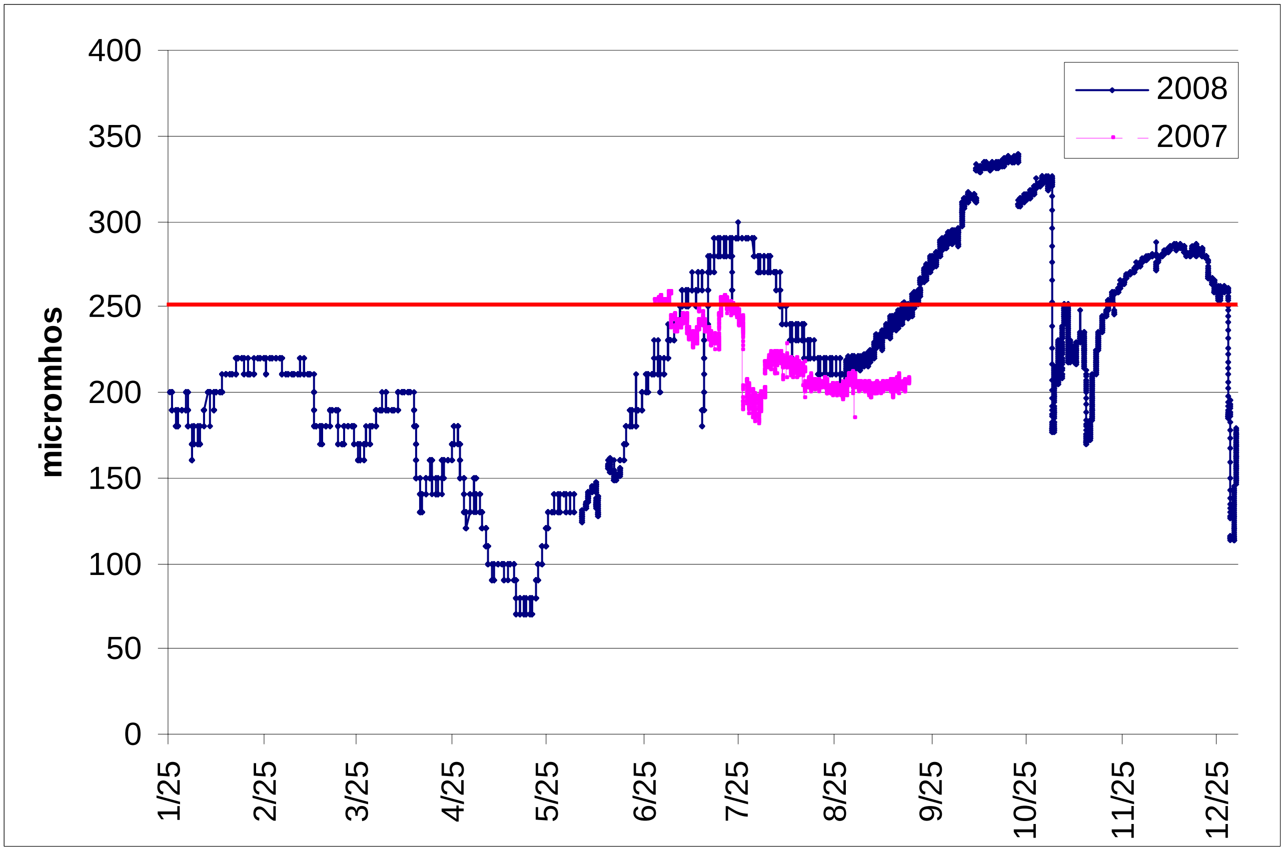


Figure 3 Specific conductivity at the Scott River USGS Gauging Station 2007 and 2008. Fifty percent of the values monthly mean must be less than 250 micromhos (red line).The red line is the *Basin Plan* water quality objective used here for analysis (NCRWQCB 2007).

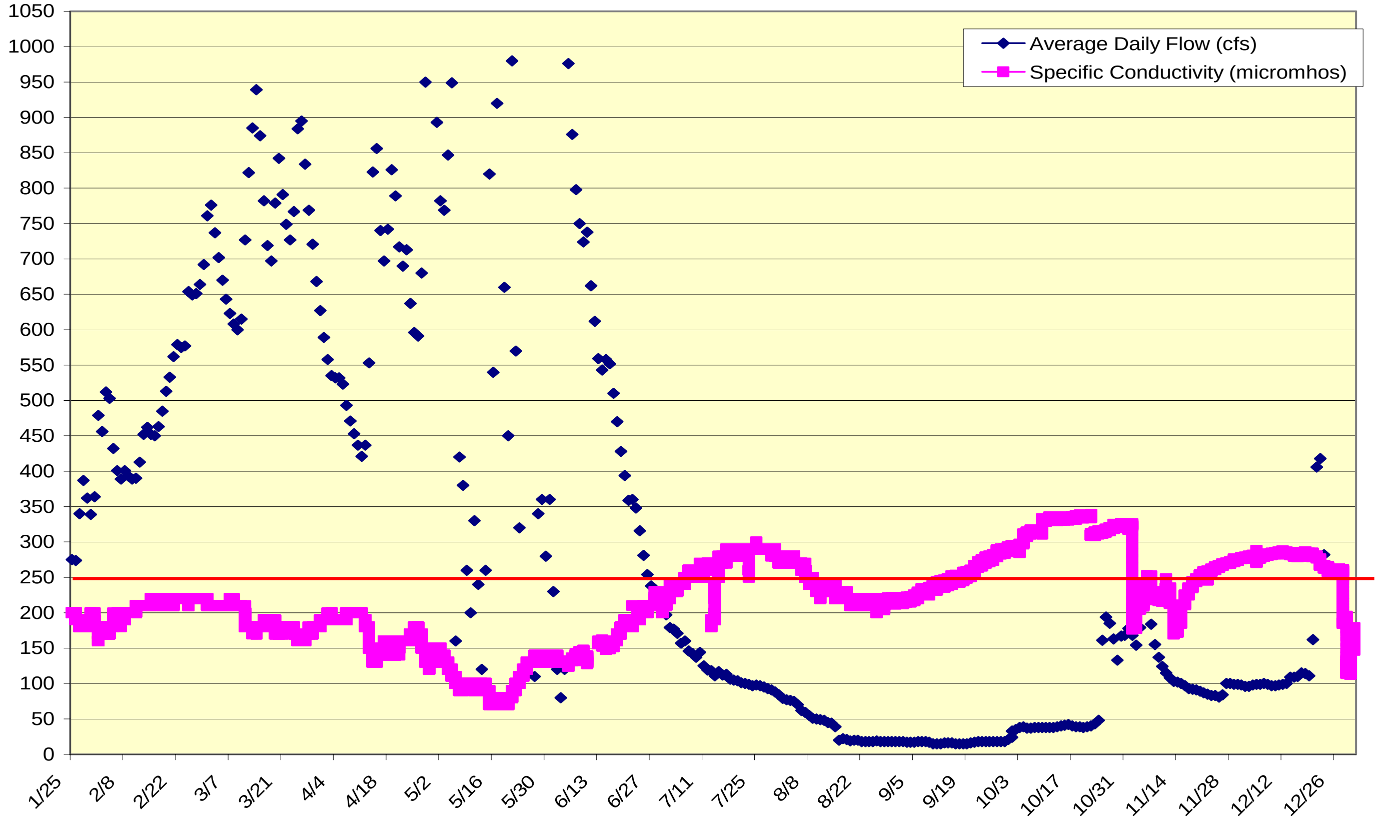


Figure 4: Comparison of specific conductivity and daily average flow in 2008

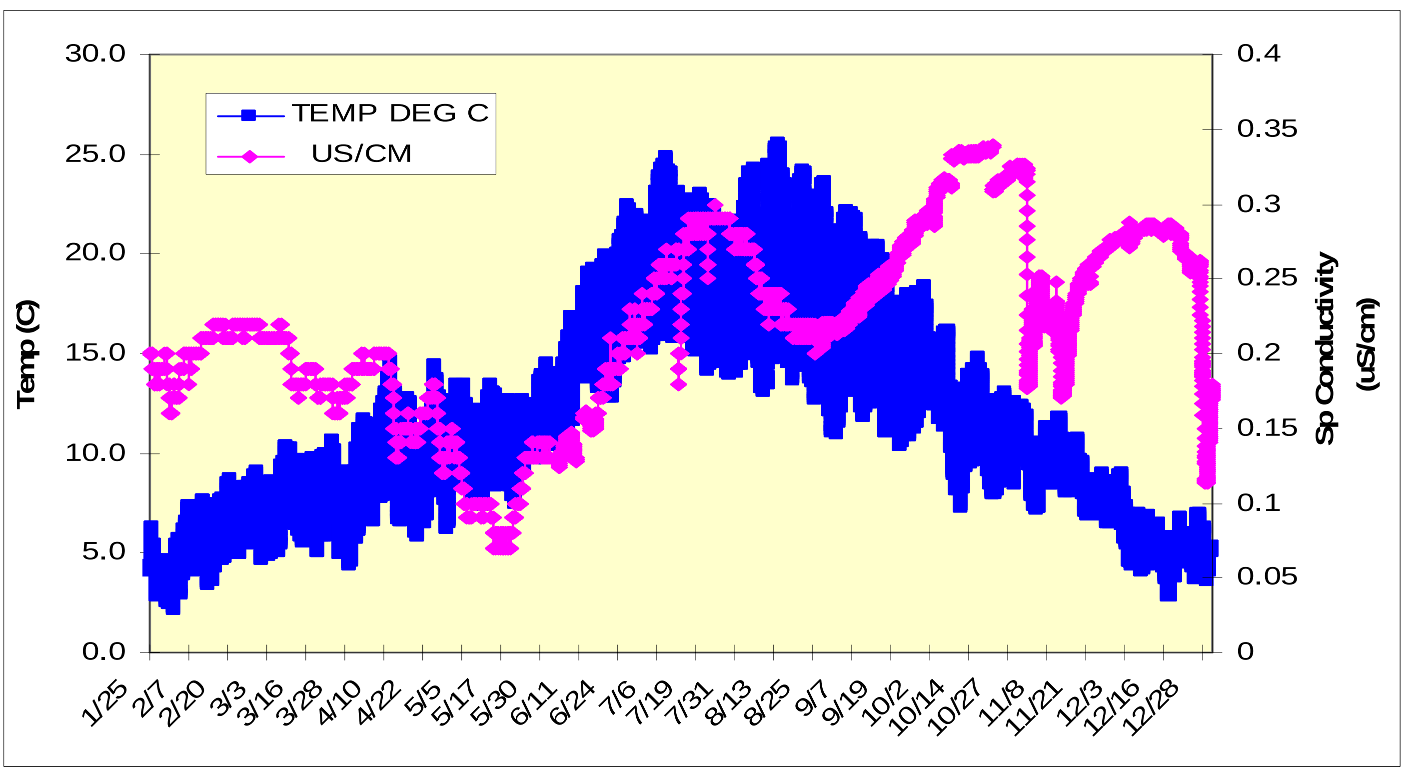


Figure 5: Comparison of specific conductivity and daily temperature in 2008.

3. Dissolved Oxygen

The datasonde placed at the Scott River USGS Gauging station (SRGA) recorded dissolved oxygen (D.O.) every 30 minutes. The *Basin Plan* Scott River objectives were used for comparison (NCRWQCB, 2007), a minimum of 7mg/l and a 50% lower limit of 9mg/l. The minimum value, 7 mg/l, was not met in 2008 from August 3rd – August 31st and September 4th – September 19th.

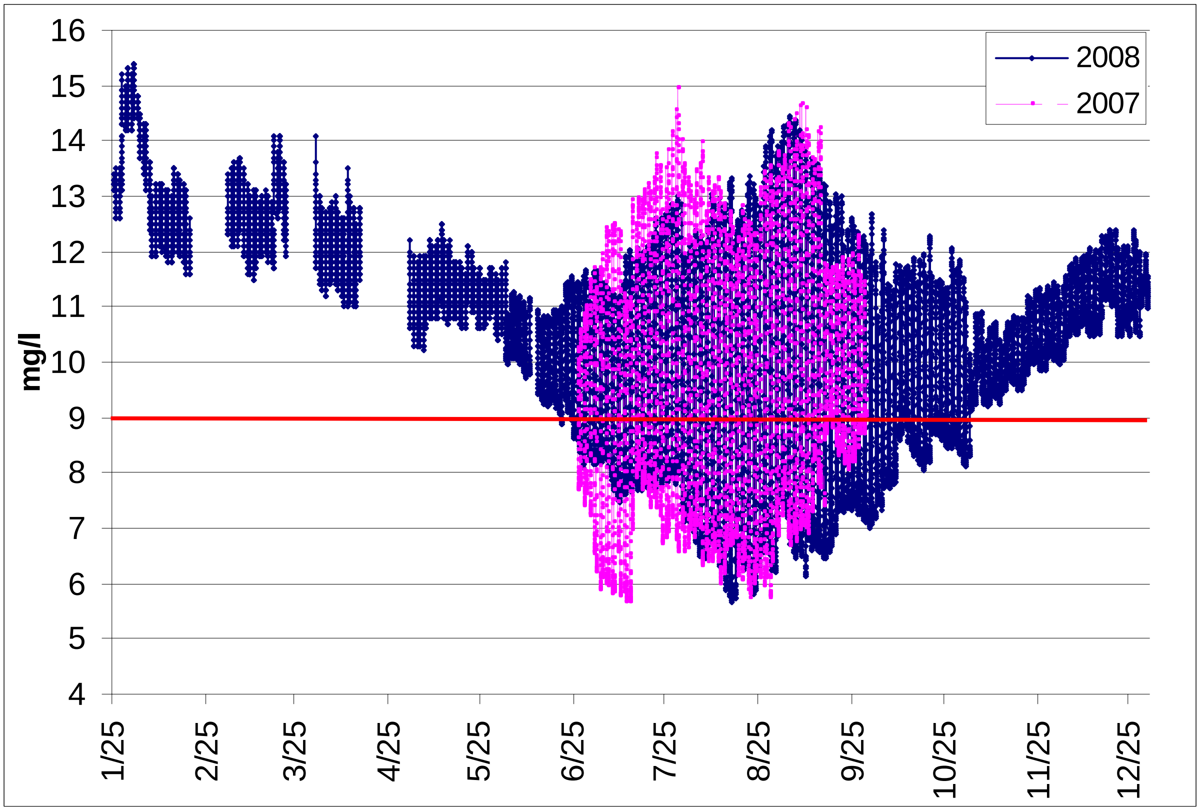


Figure 6 Dissolved Oxygen at the Scott River USGS Gauging Station 2008. The red line is the minimum value, 7mg/l (NCRWQCB 2007).

4. pH

The datasonde placed at the Scott River USGS Gauging station (SRGA) recorded the pH every 30 minutes. The Scott River water quality objectives for pH requires pH values between 7 and 8.5 (NCRWQCB, 2007). The *Basin Plan* maximum value of pH 8.5 was exceeded in 2008 from August 4th – 31st, September 1st-6th, 9th-21st, 23-25th and October 1st.

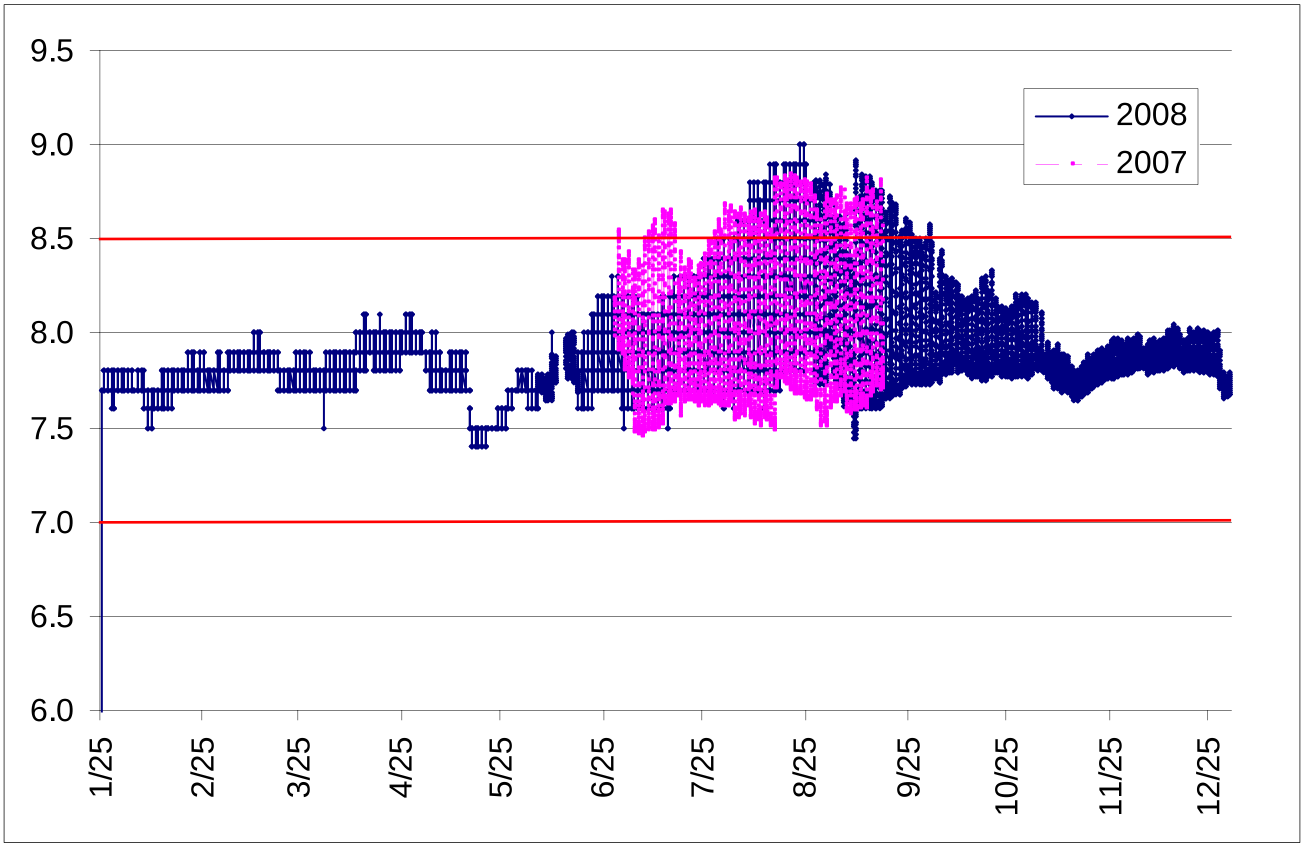


Figure 7 Measured pH values at the Scott River USGS Gauging Station 2007 and 2008. The red lines are indicating the NCRWQCB 2007 *Basin Plan* water quality objectives: minimum (pH 7) and maximum (pH 8.5).

5. Turbidity

Turbidity was collected each half hour at the USGS Gauging station from 3/3/08-12/31/08. Data quality assurance on turbidity is unknown at this time due to the lack of an audit turbidity probe, so no USGS datagrades have been applied for this parameter. The Tribe adopted a water quality objective of <5 NTU above the natural turbidity level (see QVIR QAPP 2006). The action level was determined using coho salmon research results from Berg (1982) and Lloyd (1987). This is the first year we have been able to monitor year-round for turbidity. During the summer of 2007, the low-flow turbidity level was 0 NTU and the turbidity readings ranged between 2-10 NTU in higher flows associated with summer freshets. The summer months of 2008 showed similar patterns to 2007, with average low-flow turbidity levels of 1 NTU and summer time freshet turbidity levels of approximately 2-15 NTU. The greatest turbidity levels observed during 2008 were between April 28th and June 12th corresponding with spring snowmelt and coho salmon outmigration (Chesney, 2007).

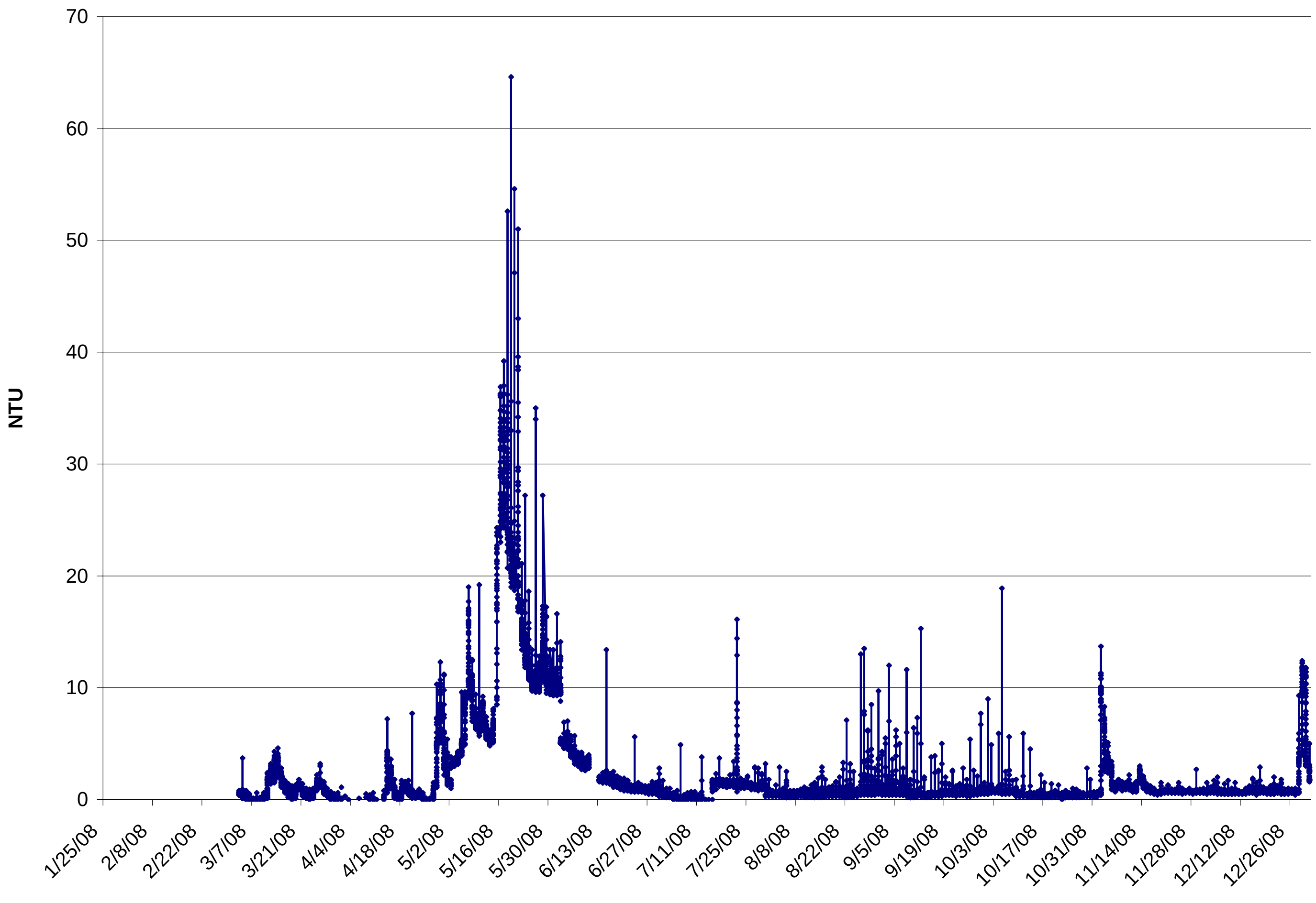


Figure 8. Turbidity at the Scott River USGS Gauging Station 2008.

6. USGS Datagrades

The following graphs, Figure 9, depict data quality based on bi-monthly sonde calibration data. Data graded less than excellent needs a correction factor applied with the exception of temperature, which is discussed in Section III A.

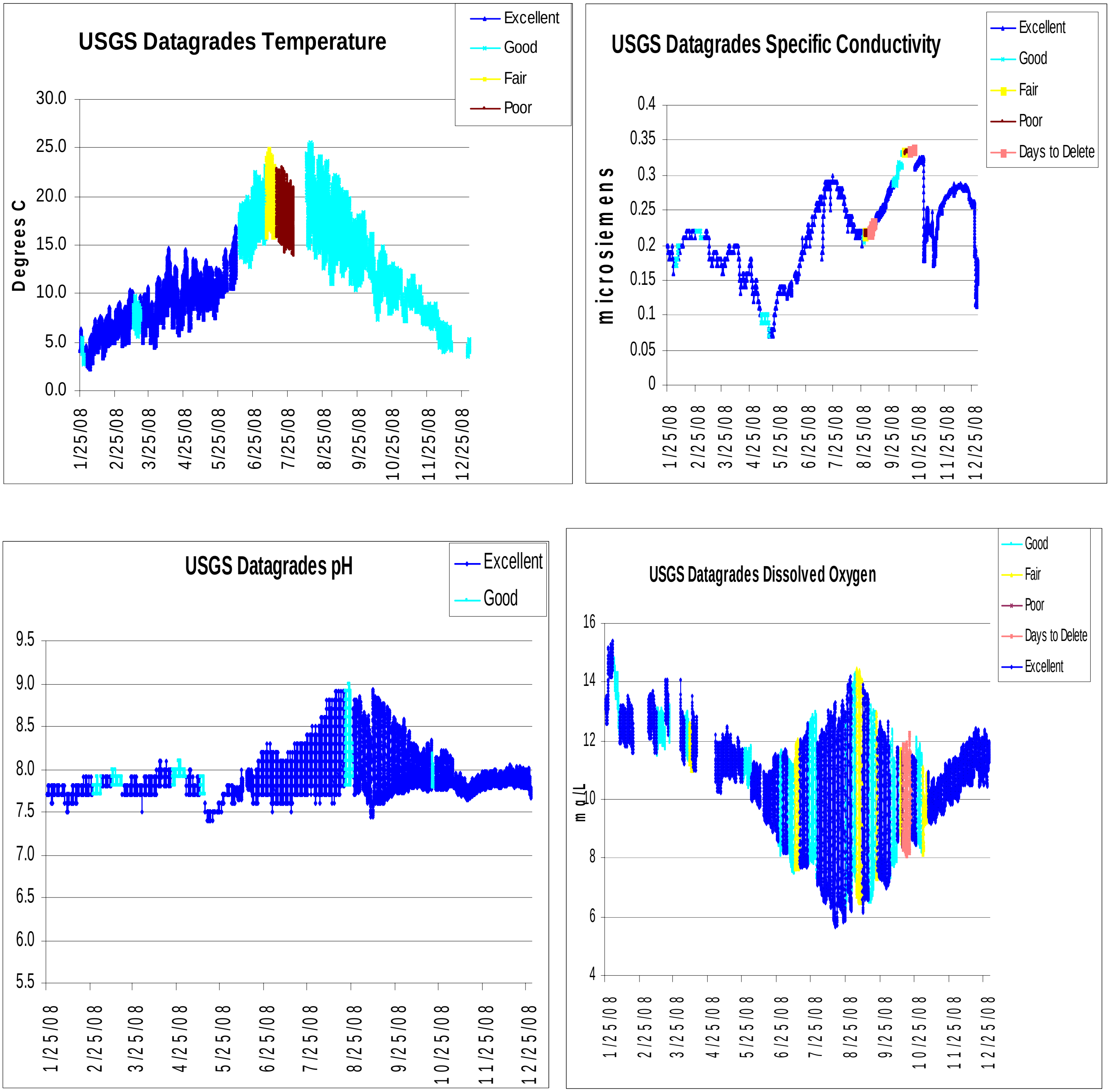


Figure 9: USGS datagrades for Scott River datasonde (site code SRGA) 2008.

B. Shackleford Creek Water Quality Monitoring

A YSI datasonde in 2008 was placed on Shackleford Creek at the Reservation (site code SRES) from May 23rd, 2008 until the creek dried up on July 22, 2008. The sonde was then moved to lower Shackleford (site code CHTH) through the end of the year. Figures 10 and 11 show the results from the two sampling locations. Data were recorded every 30 minutes for temperature, specific conductivity, dissolved oxygen concentration, dissolved oxygen percent saturation, pH and turbidity. Each parameter was compared to state, federal or Tribal water quality objectives based on the specific life stage needs of salmonids. Calibration data were used to calculate correction factors for each parameter following USGS protocol, the SRES site location graded excellent for all parameters (with the exception of dissolved oxygen, discussed below) during the 2008 season (6/1/08-7/22/08). The CHTH location requires correction factors for pH (only 9/26-10/8) and specific conductivity (only 8/22-9/8, 9/26-10/9 and 11/2-11/7). The dissolved oxygen (D.O.) data is uncorrected since the USGS has not published data grading tables for the type of datasonde D.O. probe utilized at this site location.

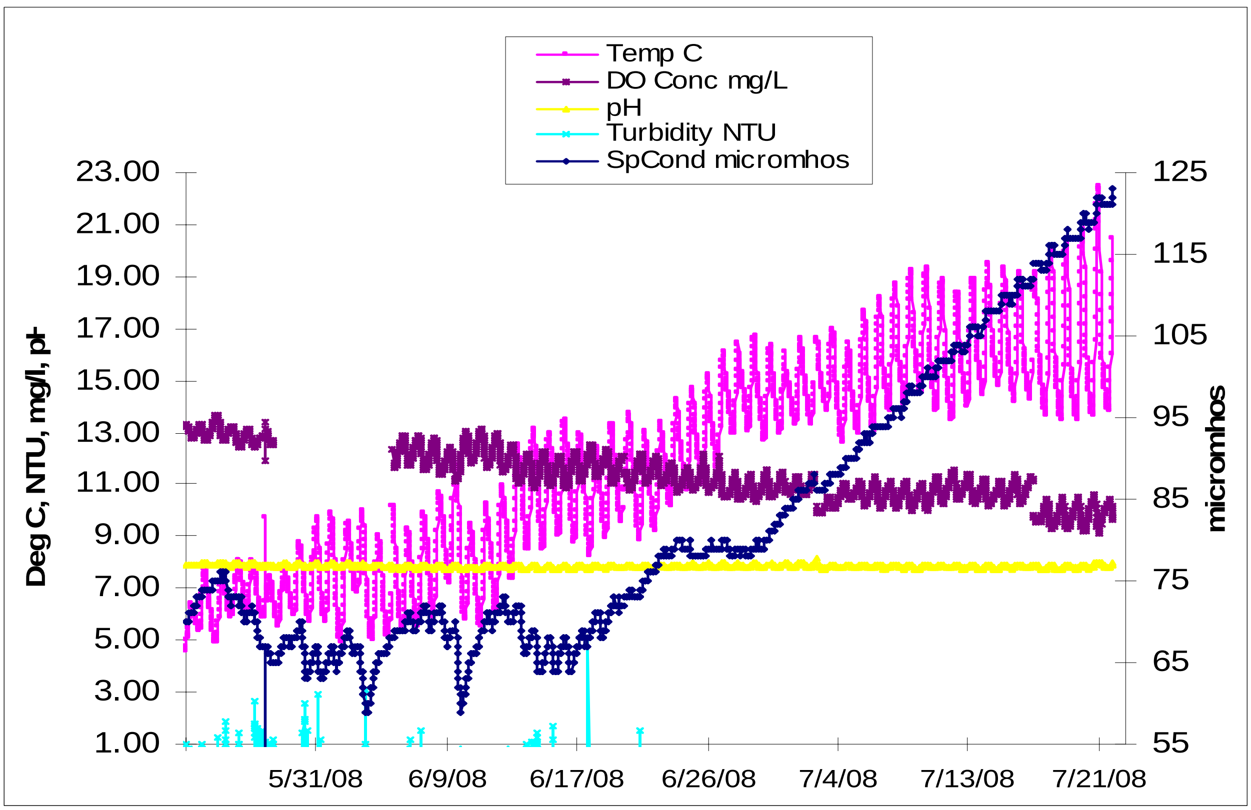


Figure 10: Shackleford Creek Datasonde at Quartz Valley Reservation (site code SRES) May through July 2008 (until the creek dried up).

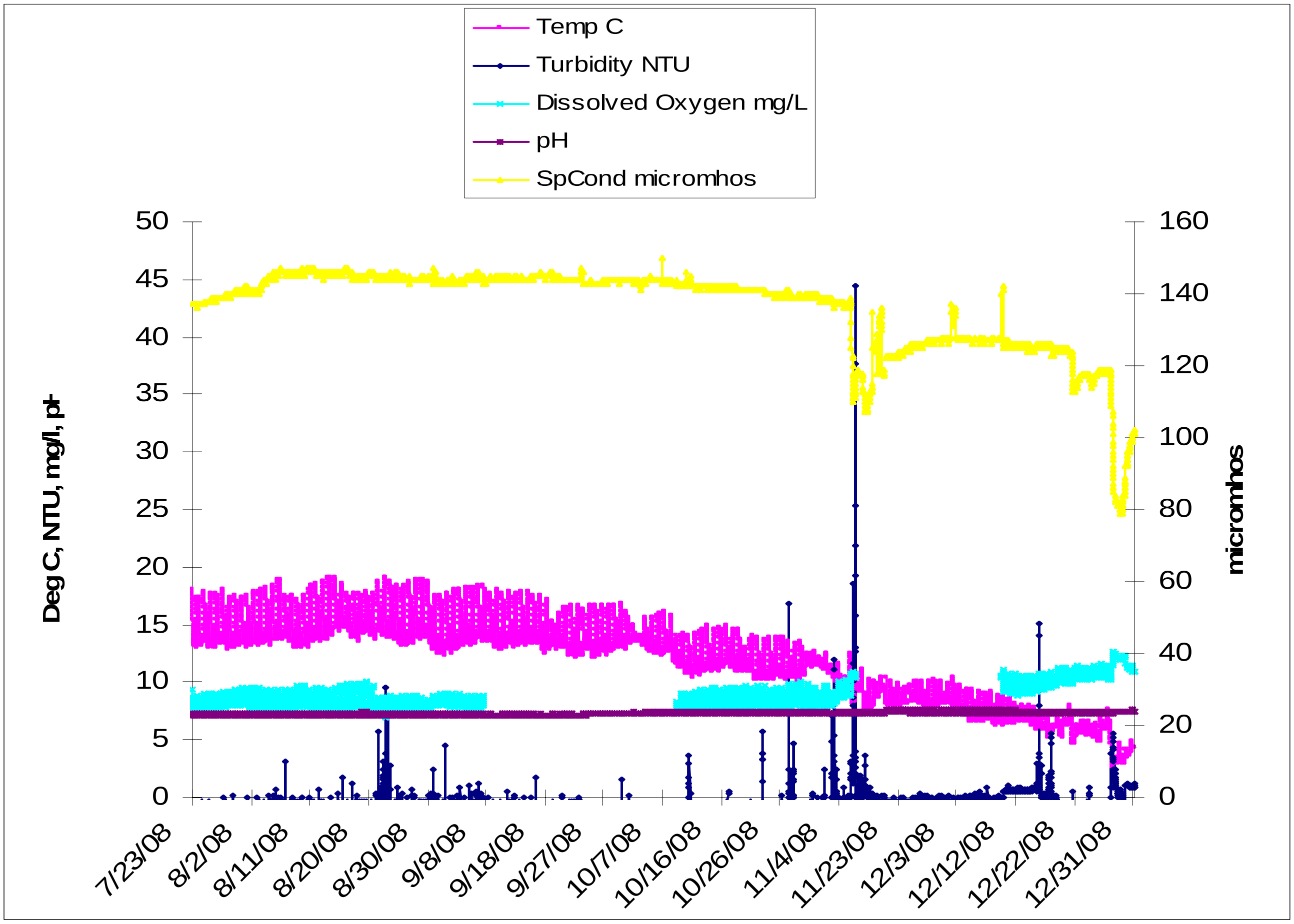


Figure11: Lower Shackleford Creek Datasonde (site code CHTH) July through December 2008.

C. Nutrients

1. Total Nitrogen (Scott, Shackleford and Mill)

The next three Figures (12, 13, and 14) show the concentrations of total nitrogen (TN) at the Scott River Gauging station, Mill Creek and longitudinally on Shackleford Creek. The U.S. EPA (2000a) upper limit recommendation for total nitrogen (0.12 mg/L), this was used as a reference value to compare the data with since there are no *Basin Plan* water quality objectives for total nitrogen. TN was above EPA recommendations in 2008 at the Scott River Gauge, Shackleford at the trailhead and lower Shackleford. The 2007 and 2008 TN trends were similar at both sites, with the exception of the 6/13/08 lower Shackleford sample.

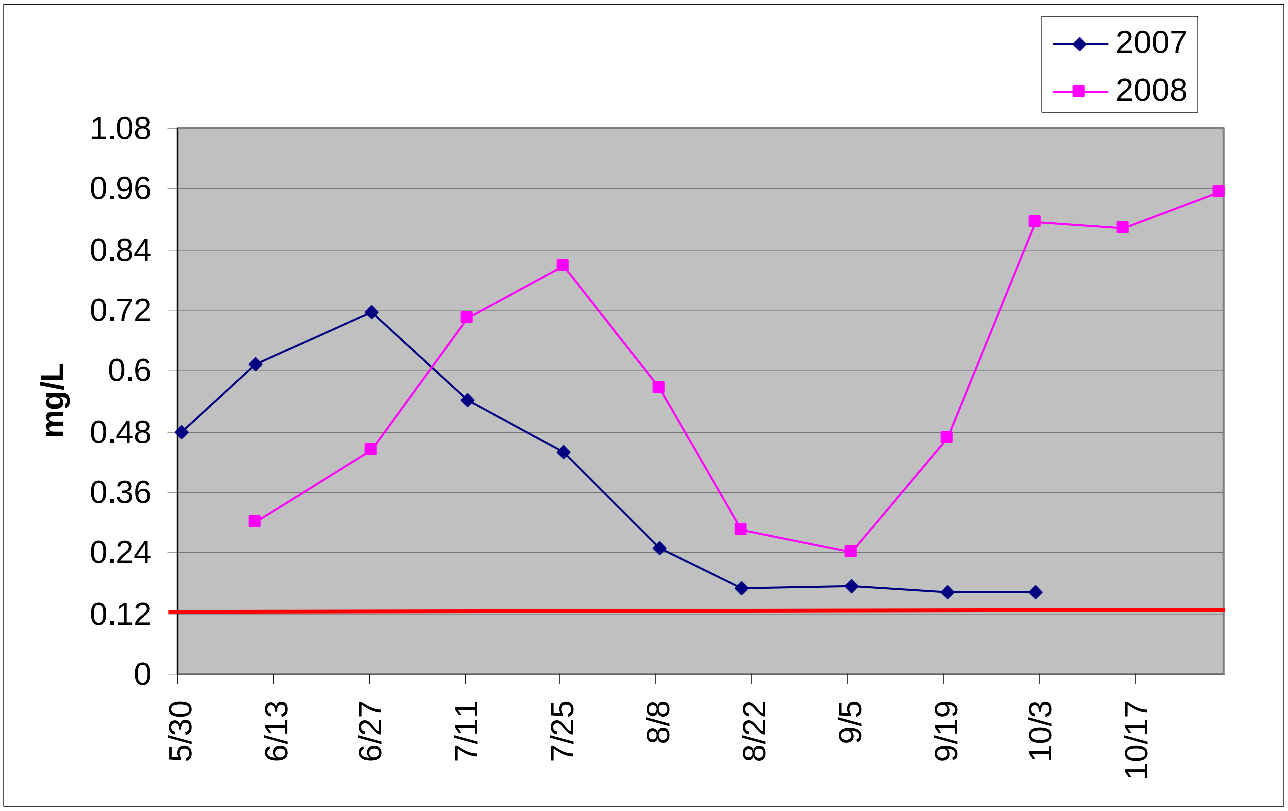


Figure 12 Total Nitrogen (TN) at the Scott River USGS Gauging Station 2007 and 2008 compared to the EPA water quality recommendation, 0.12 mg/L (red line).

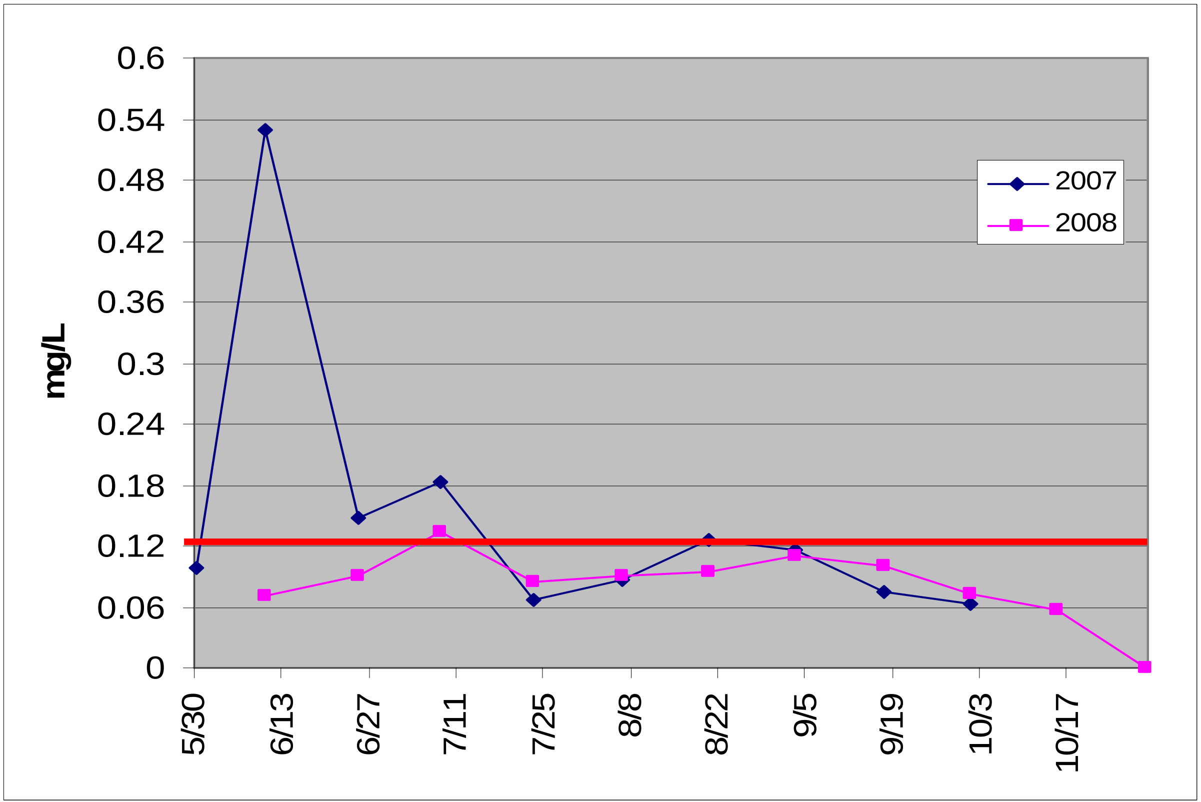


Figure 13 Total nitrogen (TN) on lower Shackleford Creek (site code CHTH) sampled in 2008. U.S. EPA (2000a) upper limit recommendation for total nitrogen was used as a reference value. TN was above EPA recommendations in July of 2008 on lower Shackleford Creek (CHTH).

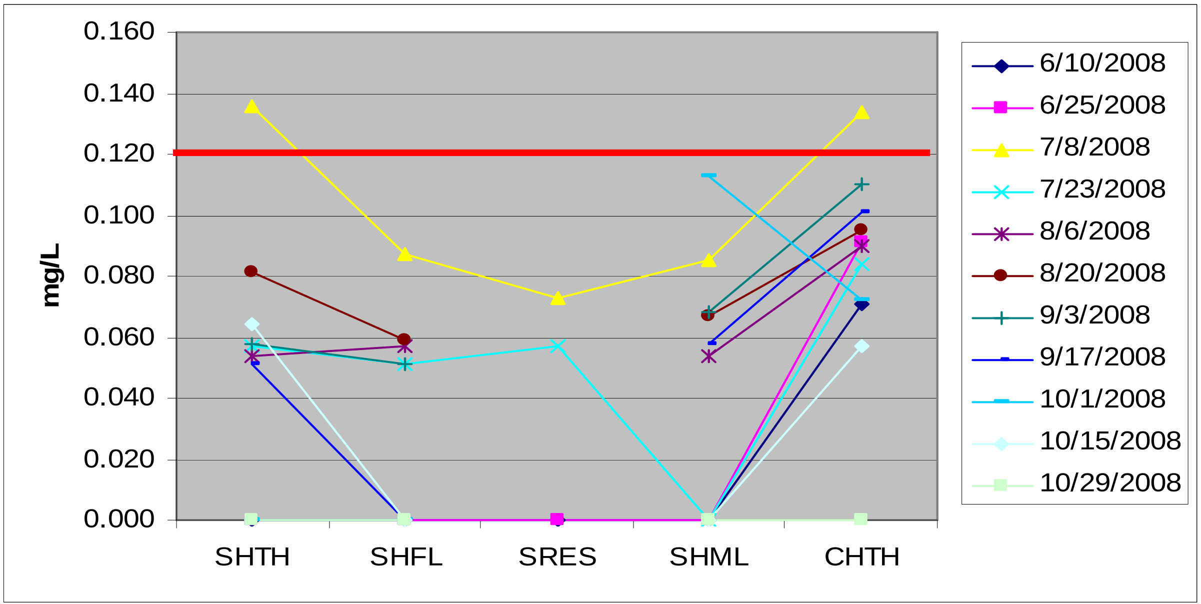


Figure 14 Total Nitrogen (TN) on Shackleford and Mill Creek 2008, compared to the EPA water quality recommendations 0.12 mg/L (red line). SHTH= Shackleford @ trailhead, SHFL = Shackleford @ falls, SRES = Shackleford @ Reservation, SHML = Mill Creek, CHTH = lower Shackleford.

2. Total Phosphorus (Scott Shackleford and Mill)

The next three Figures (15, 16, and 17) show the concentrations of total phosphorus (TP) at the Scott River Gauging station, Mill Creek and longitudinally on Shackleford Creek. The U.S. EPA (2000a) upper limit recommendation for total phosphorus (10µg/L). The 10µg/L criterion was used as a reference value to compare with the Scott River data since there are no water quality objectives in the *Basin Plan* for total phosphorus. TP was above EPA recommendations in 2008 only at the Scott River Gauge. The 2007 and 2008 TP trends were similar at both sites, with the exception of the 6/13/08 lower Shackleford sample.

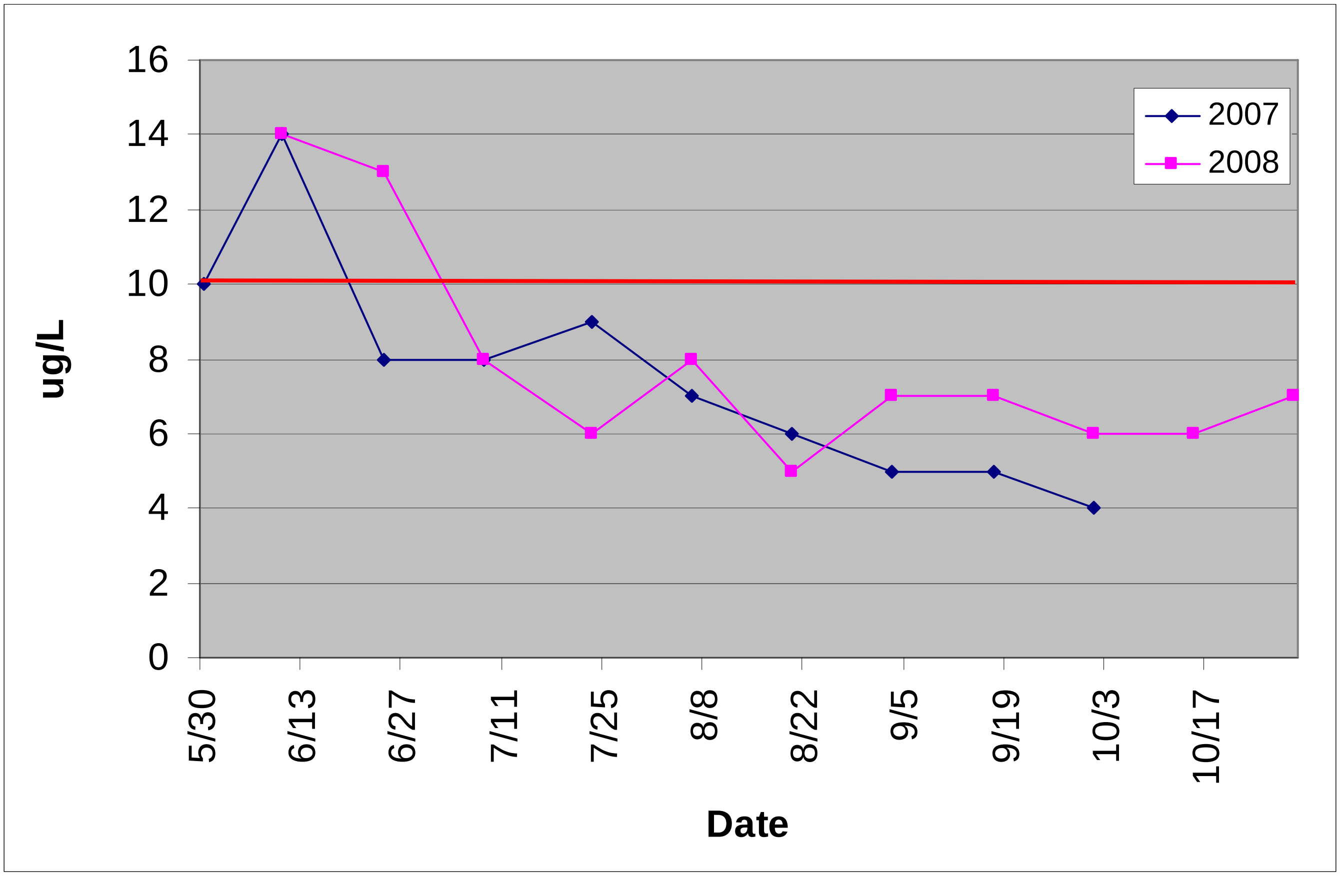


Figure 15 Total Phosphorus (TP) at the Scott River USGS Gauging Station 2007 and 2008 compared to the EPA water quality recommendation, 10 µg/L (red line).

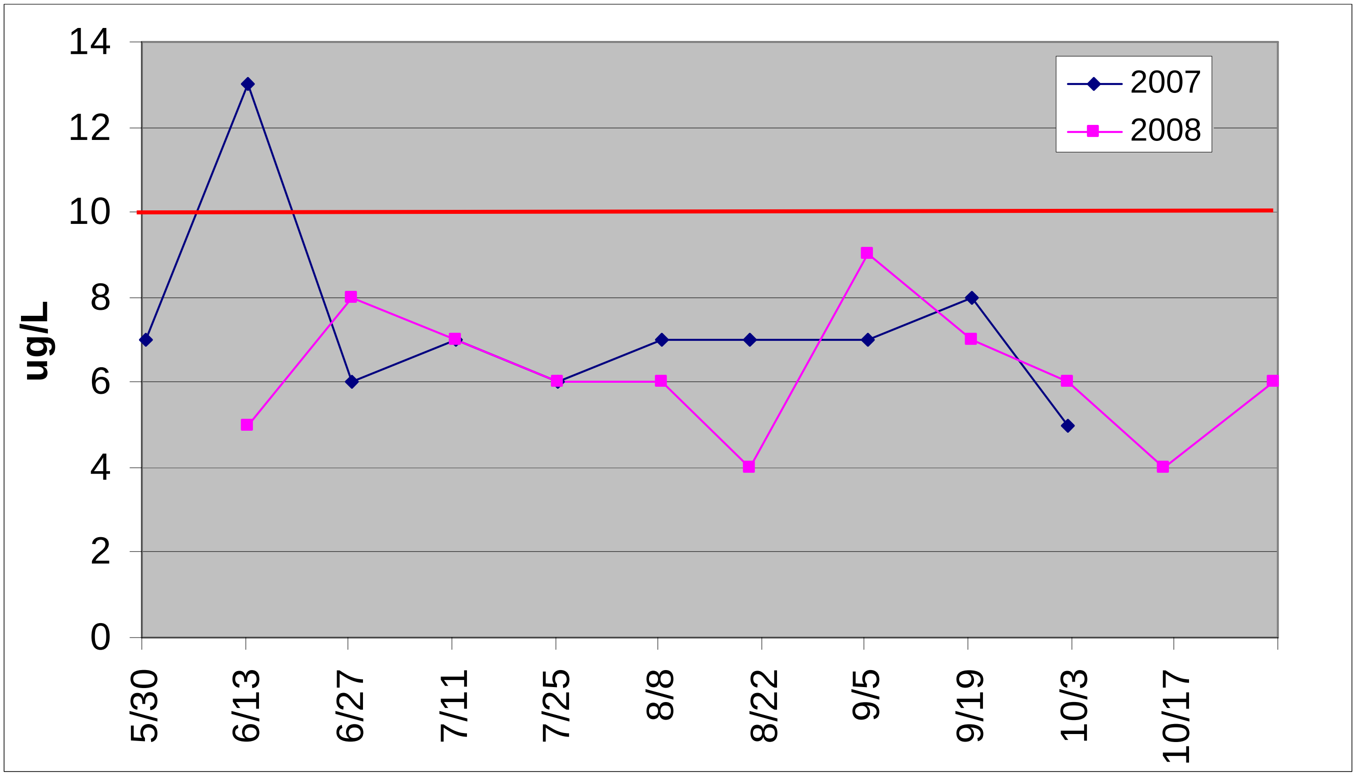


Figure 16 Total phosphorus (TP) on lower Shackleford Creek sampled in 2008. U.S. EPA (2000a) upper limit recommendation for total phosphorus was used as a reference value. TP was not above EPA recommendations on lower Shackleford in 2008.

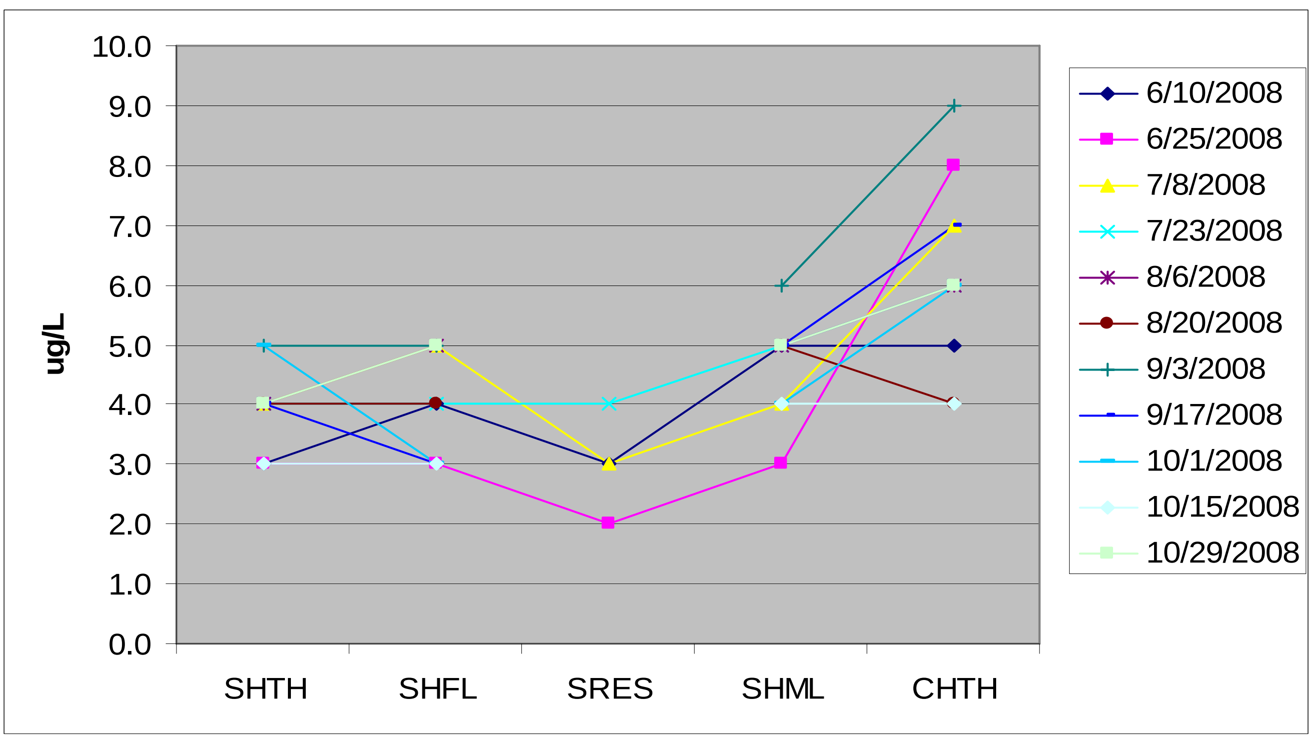


Figure 17 Total Phosphorus (TP) on Shackleford and Mill Creek 2008, compared to the EPA water quality recommendations 10 µg/L. SHTH= Shackleford @ trailhead, SHFL = Shackleford @ falls, SRES = Shackleford @ Reservation, SHML = Mill Creek, CHTH = lower Shackleford.

3.Chlorophyll a and Phaeophytin (Scott, Shackleford and Mill)

The upper limit for chlorophyll-a recommended by U.S. EPA (2000a) is 10 ug/l. The upper limit for phaeophytin (PHAEO) recommended by U.S. EPA (2000a) is 15 ug/l. These values were used as reference to compare with the Scott River data since there are no water quality objectives in the *Basin Plan* for these parameters. Figure 18 shows both chlorophyll-a and phaeophytin below EPA recommendations in 2008. This same trend was observed in 2007 as well.

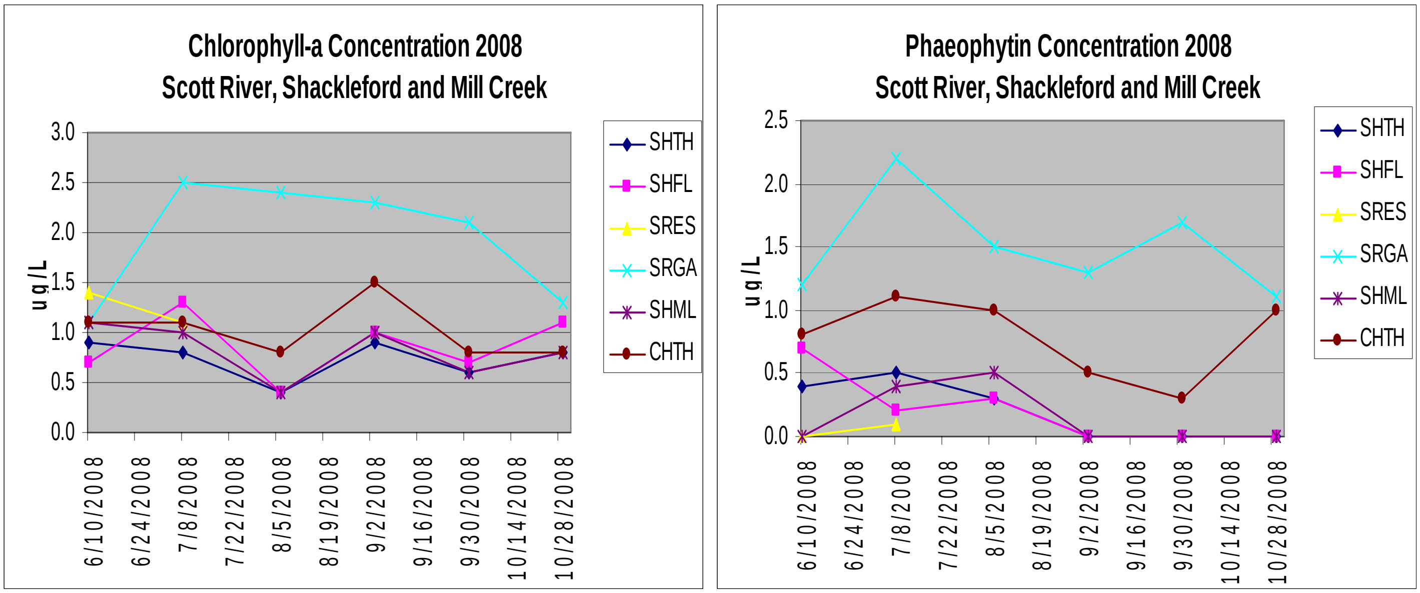


Figure 18 Chlorophyll a and Phaeophytin 2008.

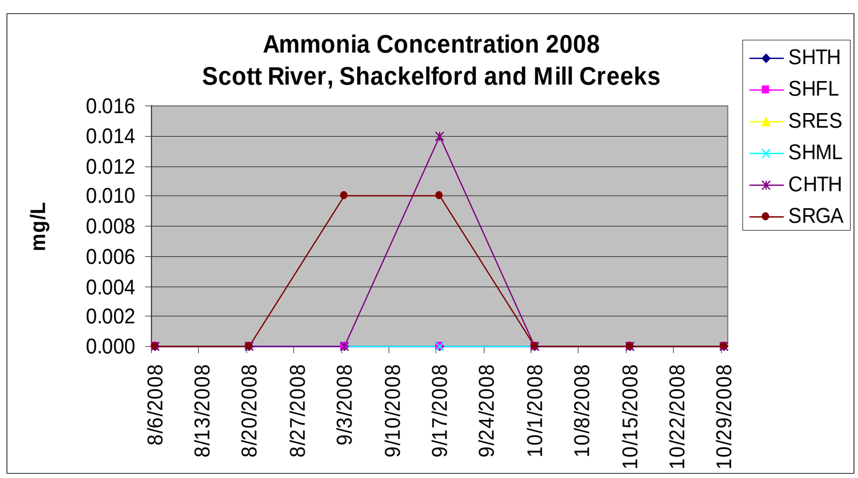
4. Ammonia

Ammonia concentrations were sampled in 2008 on the Scott River, Mill Creek and longitudinally on Shackleford Creek, Figure 19. Values were compared to USEPA (1999b) pH-dependant values of Criterion Maximum Concentration (CMC) of total ammonia as nitrogen (mg/L) in freshwater when salmonids are present. The one-hour concentration of total ammonia (NH3 and NH4+) should not exceed the following values in Table 4 more than once every 3 years. Measured ammonia concentrations at all sites were far below the CMC values.

Table 4: USEPA Acute Criterion for Ammonia

pH	CMC Total NH3 mg/L
8.7	1.47
8.8	1.23
8.9	1.04
9.0	0.885

Figure 19: Ammonia Concentration 2008 all sites.



5. Periphyton Algae Identification

Periphyton was collected in 2008 from cobbles at the Scott River Gauge (SRGA) and lower Shackleford (CHTH) and analyzed for species identification, density (#/cm^2) and biovolume (um^3/cm^2). Table 5 lists the data by site, showing each species' density, relative density, biovolume, and relative biovolume. Color-coding in the chart indicate species that were detected at both sites.

Shackleford Creek (CHTH)					
	Density	Density	Biovolume	Biovolume	
Species	#/cm2	Percent	um3/cm2	Percent	Group
Achnanthes linearis	191,194	35.3	25,237,645	24.7	diatom
Achnanthes minutissima	168,433	31.1	13,474,645	13.2	diatom
Gomphonema angustatum	104,702	19.3	20,730,923	20.3	diatom
Ulothrix sp.	27,313	5.0	10,269,864	10.1	green
Cymbella sinuata	9,104	1.7	1,274,629	1.2	diatom
Rhodomonas minuta	4,552	0.8	91,045	0.1	cryptophyte
Gomphonema subclavatum	4,552	0.8	2,731,347	2.7	diatom
Gomphonema truncatum	4,552	0.8	6,191,053	6.1	diatom
Cymbella affinis	4,552	0.8	8,194,041	8.0	diatom
Ankistrodesmus falcatus	4,552	0.8	113,806	0.1	green
Cymbella tumida	4,552	0.8	11,380,612	11.2	diatom
Achnanthes lanceolata	4,552	0.8	819,404	0.8	diatom
Gomphonema tenellum	4,552	0.8	955,971	0.9	diatom
Rhoicosphenia curvata	4,552	0.8	532,613	0.5	diatom
Scott River (SRGA)					
	Density	Density	Biovolume	Biovolume	
Species	#/cm2	Percent	um3/cm2	Percent	Group
Achnanthes minutissima	12,625	51.5	1,262,489	9.0	diatom
Cymbella affinis	5,584	22.8	10,051,357	71.7	diatom
Scenedesmus quadricauda	1,942	7.9	504,996	3.6	green
Navicula cryptocephala	971	4.0	179,662	1.3	diatom
Cocconeis placentula	971	4.0	446,727	3.2	diatom
Rhodomonas minuta	728	3.0	14,567	0.1	cryptophyte
Cymbella minuta	486	2.0	179,662	1.3	diatom
Chlamydomonas sp.	243	1.0	78,906	0.6	green
Hannaea arcus	243	1.0	424,876	3.0	diatom
Cymbella tumida	243	1.0	606,966	4.3	diatom
Diatoma tenue elongatum	243	1.0	174,806	1.2	diatom
Pediastrum boryanum	243	1.0	97,115	0.7	green

Table 5: Periphyton algae species identification, collected on August 7th, 2008 on lower Shackleford (site code: CHTH) and Scott River mainstem (site code: SRGA).

D. Scott River Mainstem and Tributary Temperature Monitoring

Temperature loggers were deployed in both the mainstem and tributaries throughout the Scott River basin in 2008. Site locations were selected by the USFS for long-term temperature monitoring in the basin. Shackleford and Mill Creek sites were chosen by the Tribe for long-term monitoring of Reservation resources. Table 6 contains the maximum MWAT (Maximum Weekly Average Temperature) recorded for mainstem and tributary sites monitored in 2008.

MWAT's, 7-Day running averages and daily temperatures were graphed for all sites and are included on the data CD. Literature on the effects of temperature on Pacific salmon (Sullivan et al., 2000; Welsh et al., 2001) were used to analyze the Scott River and tributary temperature results where applicable. Coho habitat survivability is based on 16.8ºC MWAT (Welsh et al., 2001).

Table 6. Maximum Weekly Average Temperature (MWAT) for Scott River mainstem and tributary 2008 locations. Coho habitat survivability is based on 16.8ºC MWAT (Welsh et al., 2001).

Maximum Weekly Average Temperature (MWAT) by Site					
MWAT - degrees Celsius	Site	Date	Coho Survivability	Number of Weeks MWAT > 16.8 C	USGS Data Accuracy Rating
Tributary Sites					
13.044	Kangaroo Creek	21-Aug	y		Excellent
13.541	SHTH (Shackelford at Trailhead)	15-Jul	n/a		Excellent
14.174	Crater Creek	19-Aug	y		Excellent
14.688	Canyon Creek	21-Aug	y		Excellent
14.801	SUCC (Shackleford Upstream Campbell Lake Outlet)	18-Aug	n/a		Excellent
14.881	Mill Creek (at Shackleford)	20-Aug	y		Excellent
15.709	CHTH (Lower Shackleford)	20-Aug	y		Excellent
15.770	SHFL (Shackleford at Falls)	19-Aug	y		Excellent
15.775	Tompkins Creek	19-Aug	y		Excellent
16.130	Mill Creek (at Scott Bar)	19-Aug	y		Excellent
16.167	Middle Creek	21-Aug	y		Excellent
16.222	Mule Creek	19-Aug	y		Good
16.443	Kelsey Creek	21-Aug	y		Excellent
16.808	Big Mill Creek	20-Aug	y		Excellent
17.674	Deep Creek	16-Jul	n	5	Excellent
17.734	CAMO (Campbell Lake outlet)	15-Jul	n/a		Excellent
20.198	Grouse Creek	10-Jul	n	8	Excellent
Mainstem Scott River Sites					
20.000	Scott River @ USGS Gauge	14-Jul	n	11	Excellent
21.105	Scott River @ Jones Beach	14-Jul	n	8	Excellent
21.184	Scott River Above Canyon Creek	14-Jul	n	12	Excellent
22.470	Scott River @ Roxbury Bridge	18-Aug	n	13	Excellent
22.489	Scott River @ Bridge Flat	15-Aug	n	12	Excellent

E. Bacteria Sampling (Scott, Shackleford and Mill)

Bi-weekly bacteria sampling occurred in 2008 from January through December at Scott River USGS Gauge Station and the lower Shackleford site. Increased sampling occurred when levels were high on the Scott River at the USGS Gauge, Jones Beach, and the lower portions of tributaries Shackleford and Sniktaw Creeks. The Most Probable Number (MPN) or colony forming units (cfu)/100 ml of *Escherichia coli* (*E. coli*) and total coliform were determined for each sample date. Thirty-three duplicate samples were taken, one for every 10 samples collected. Seven (or 22%) of these samples were sent to Basic Lab in Redding for quality assurance purposes, and six sample results were within 20% of the duplicate sample results preformed at the QVIR lab.

The North Coast *Basin Plan* objective quotes the CA Public Health Department's draft objective:

> "In waters designated for contact recreation (REC-1) the median fecal coliform concentration based on a minimum of not less than 5 samples during a 30-day period, shall not exceed 50/100 ml…….."

The US EPA has a single sample maximum value of 235 MPN/100 ml and/or 5 equally-spaced samples, over a 30-day period, with a geometric mean of 126 MPN/100 ml.

The Tribe has adopted the more protective standard (*QVIR QAPP* 2006a) from the draft state objective of <50 MPN/100 ml over a 30-day period, as detected by at least 5 equally-spaced samples, as well as the EPA single sample maximum value of 235 MPN/100 ml.

The following five Figures (20-24) depict the concentrations sampled on the Scott, Shackleford and Mill Creeks compared to the state, federal and Tribal water quality objectives stated above.

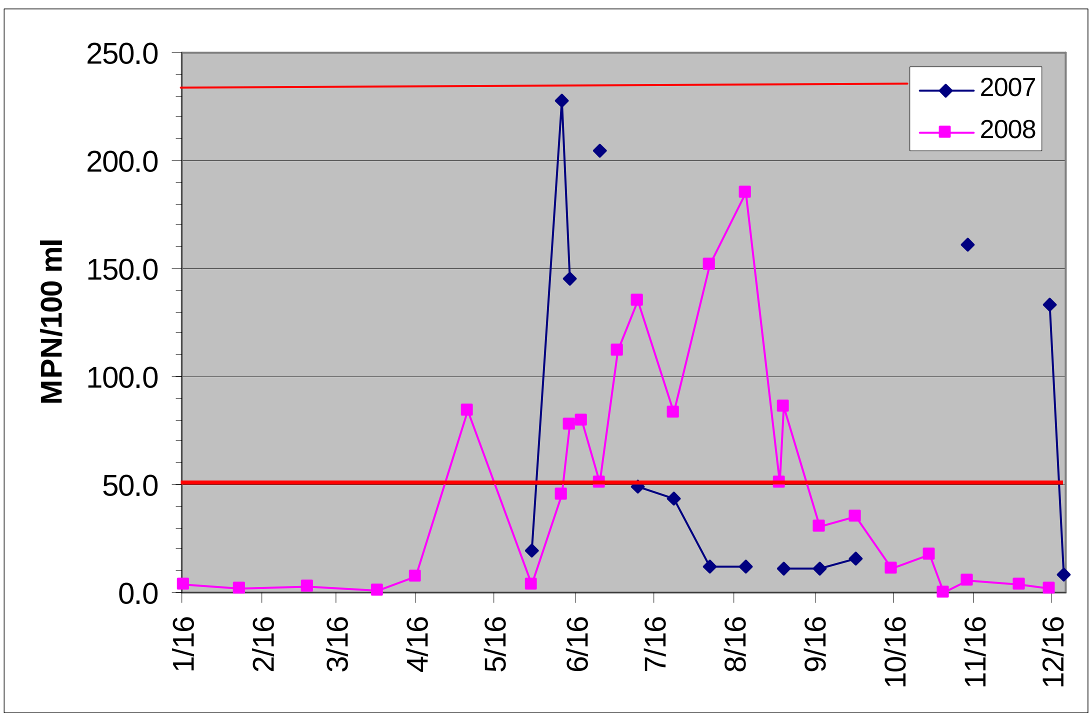


Figure 20 Lower Shackleford Creek (site code CHTH) *E.coli* concentration, January –December 2007 and 2008, compared to the water quality objectives of the Tribe (red line) adopted from the state and federal objectives.

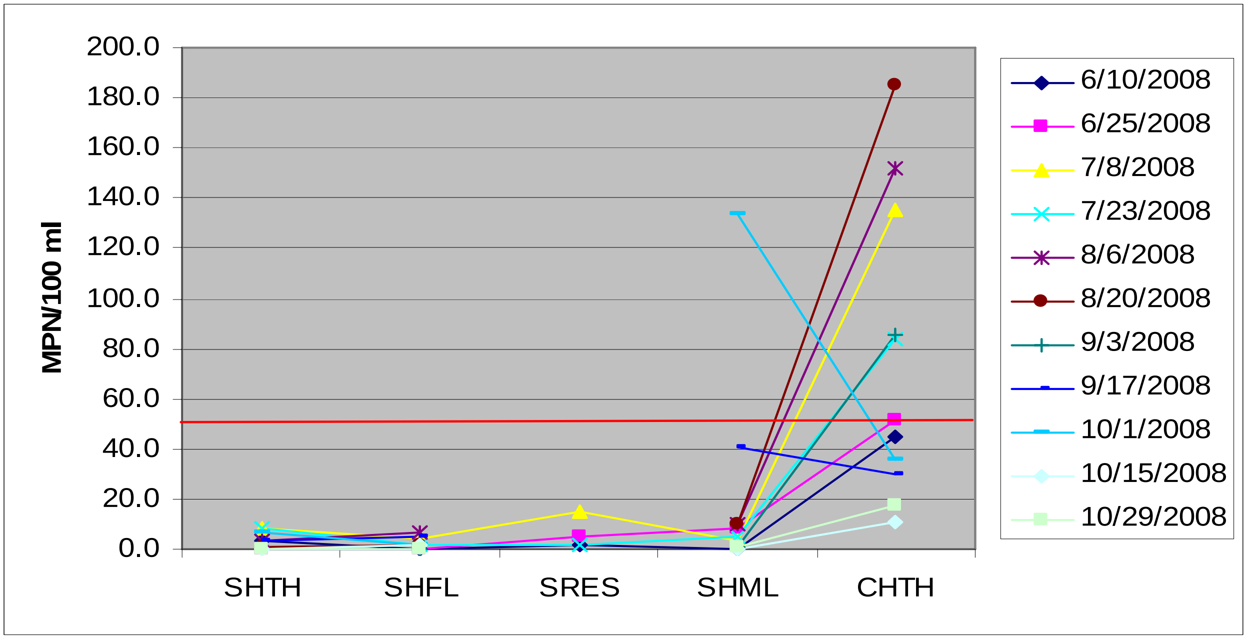


Figure 21: Longitudinal bi-weekly comparison on Shackleford and Mill Creeks from June - October 2008.

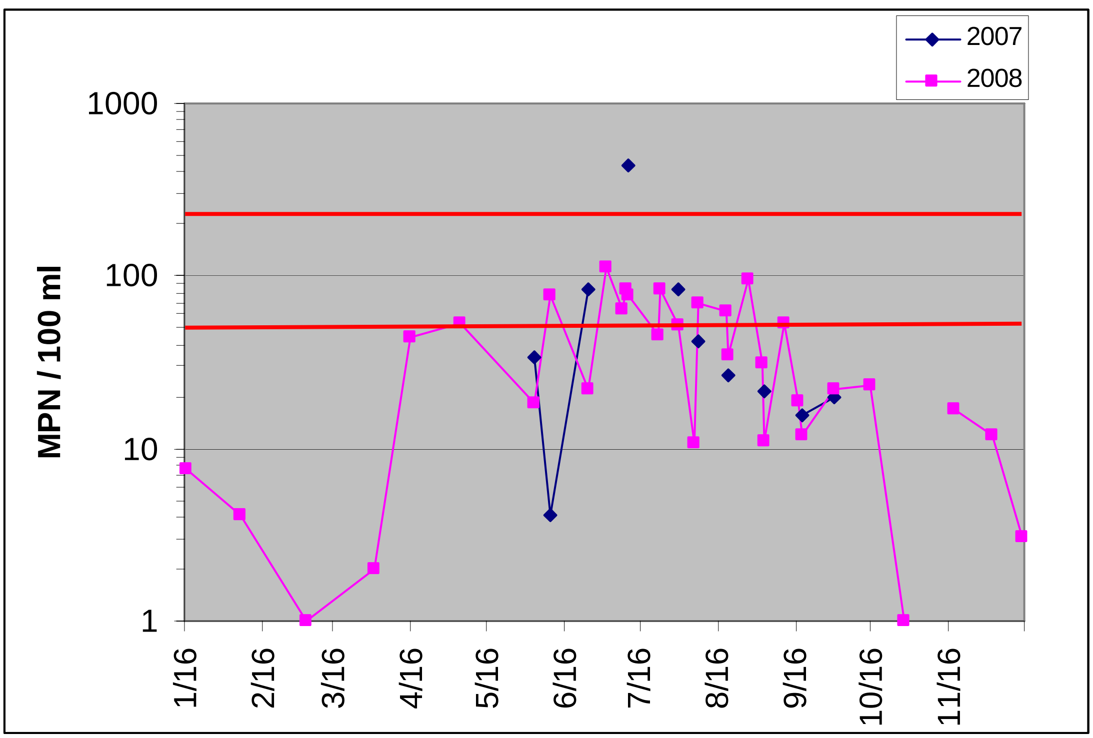


Figure 22 Scott River at USGS Gauging Station *E.coli* concentration, January –December 2007 and 2008, compared to the *Basin Plan* water quality objective (<50 MPN/100 ml over a 30-day period, lower red line) and EPA objective (<235 single sample maximum, upper red line). *Note – logarithmic scale*

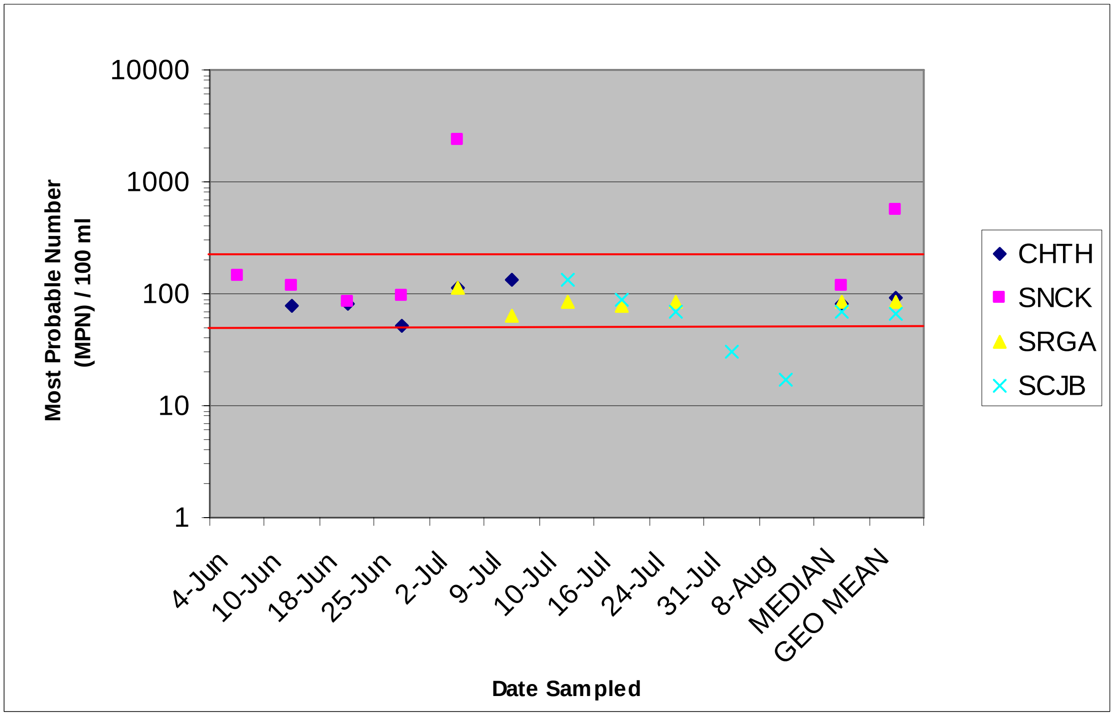


Figure 23: *E.coli* results from five equally spaced samples taken within 30 days, to compare to state, federal and tribal objectives (lower red line – limit for state and tribe, upper red line – federal limit) on lower Shackleford (CHTH), lower Sniktaw (SNCK), Scott River @ USGS Gauge (SRGA), Scott River @ Jones Beach (SRJB). *Note – Median and geometric mean values are graphed on the far right and scale is logarithmic.*

Spatial and temporal sampling occurred on December 17th in order to understand the variability in *E.coli* concentrations. Samples were collected every five minutes for 25 minutes. Collection occurred simultaneously at six points across a channel 112.8 feet wide. Figure 24 depicts the results of this sampling.

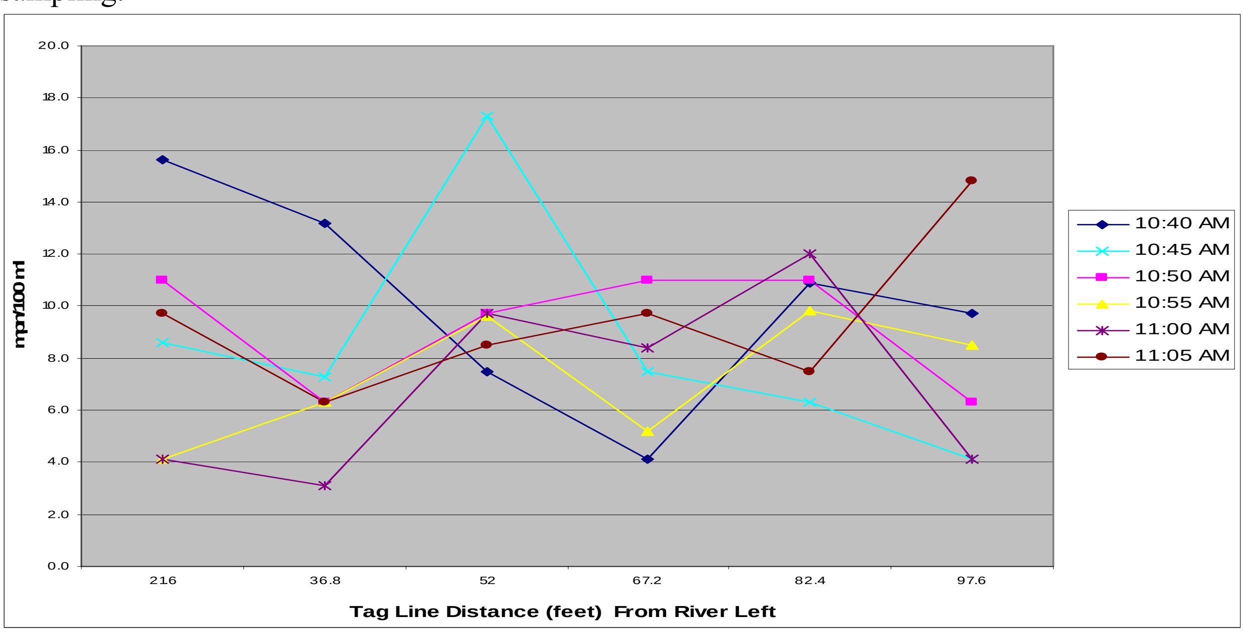


Figure 24: Spatial and temporal sampling for *E.coli* at the Scott River USGS Gauging Station, December 17th, 2008.

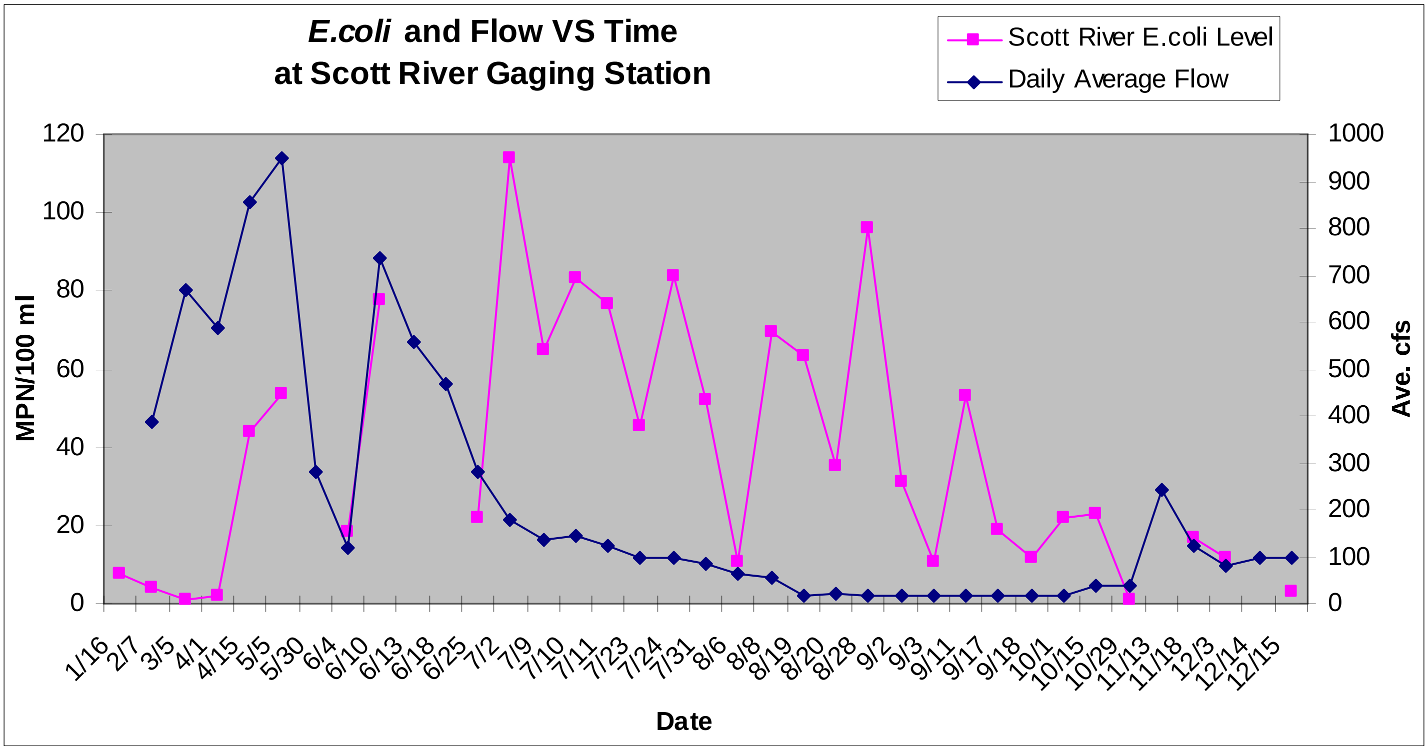


Figure 25: *E.coli* and Flow VS Date at the Scott Mainstem USGS Gauging Station (site code: SRGA) 2008.

IV. Groundwater Sampling Results and Assessment Methodology

Standard Operating Procedures (SOP) and protocols were developed for groundwater data collection based on EPA approved procedures. SOP's for the collection of bacteria (total coliform and *E. coli*) and standard water quality parameters (DO, pH, temp and conductivity) are available upon request. The static water level protocol was developed by the Scott River Watershed Council Community Groundwater Measuring Program (Scott River Watershed Program 2006). Well level measurements were taken using a Keck water level meter. *E. coli* samples were processed and analyzed at the Quartz Valley Indian Reservation bacteria lab, which is certified through the State of California.

Static water well levels were collected the first week of each month, corresponding with well depth data being collected throughout the Scott River basin for the current groundwater model being developed to satisfy TMDL recommendations. The water quality control plan for the north coast region (NCRWQCB, 2007) identifies water quality objectives for groundwater parameters in the Scott Valley. U.S. EPA has set water quality objectives for drinking water. All data results were compared to these state or federal standards. Table 7 lists each groundwater parameter, the water quality objective and its source.

Table 7: *Drinking Water Standards* from US EPA (2006) and groundwater quality objectives from the NCRWQCB (2007) *Basin Plan*.

Parameter	Units	Water Quality Objectives		Source
pH	pH	Max	Min	North Coast Regional Water Quality Control Board (NCRWQCB). 2007 Basin Plan, Scott River Objective
		8	7	
Conductivity	micromhos	90% Upper Limit	50% Upper Limit	North Coast Regional Water Quality Control Board (NCRWQCB). 2007 Basin Plan, Scott River Objective
		500	250	
Escherichia coli	MPN	1 MPN or Presence		US EPA 2006. Edition of the Drinking Water Standards and Health Advisories. Office of Water.

A. Static Water Level

Static water levels were collected on five wells in 2008 located both on and off the Reservation near Shackleford Creek. The wells are depicted in Figure 26 as blue boxes with site codes labeled. Table 8 describes characteristics of each well being monitored for static water level. The 2007 and 2008 data is depicted in Figures 27 and 28.

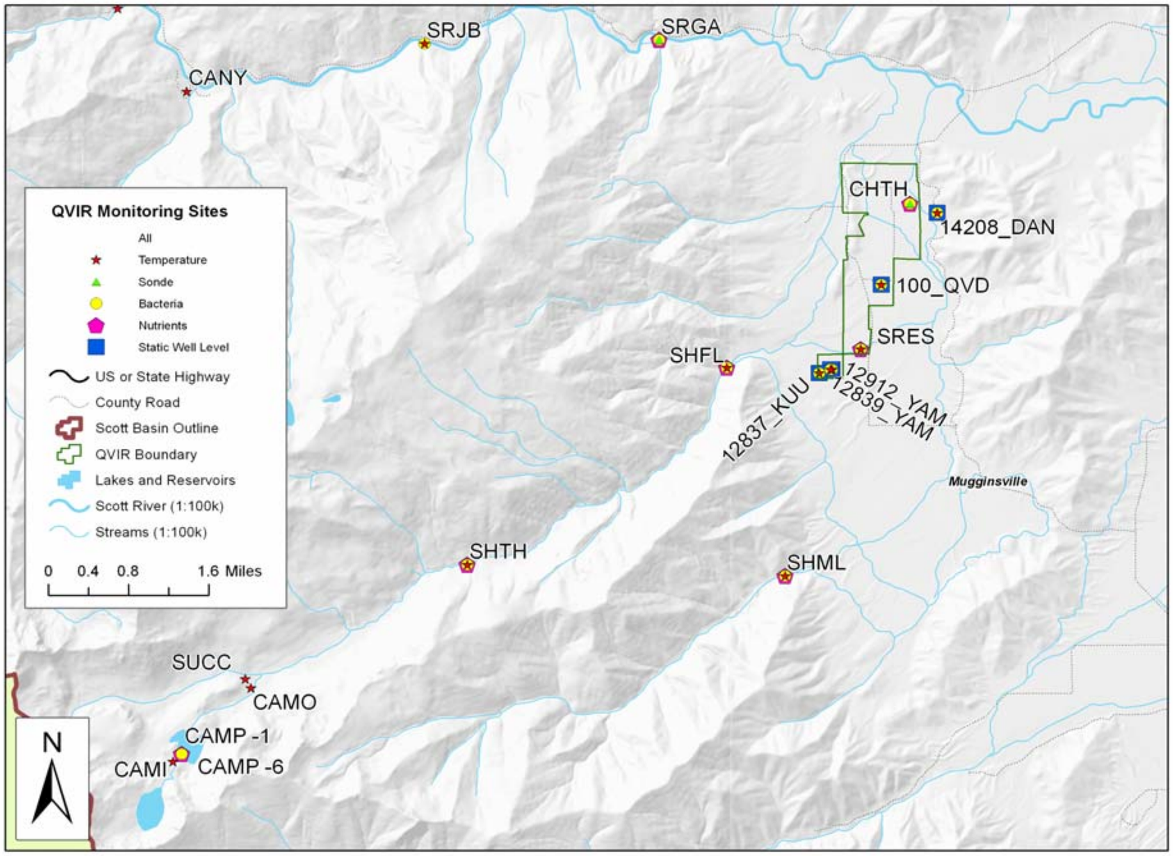


Figure 26 2008 Static water level QVIR well locations. (Map created by E.Asarian)

QVIR Static Water Level Well Attribute Table				
Well ID	**Site Code**	**Date Drilled**	**Total Depth**	**Screened Interval**
12912 Yamitch	12912_YAM	3/3/2004	123	103-123 ft
12839 Yamitch	12839_YAM	3/1/2004	103	83-103
12837 Kuut	12837_KUU	1/13/2004	103	83-103
Abandoned QV Dr.	100_QVD	not available	27.2	not available
Dangle Lane	14208_DAN	not available	42.1	not available

Table 8 Groundwater Well Attribute Table

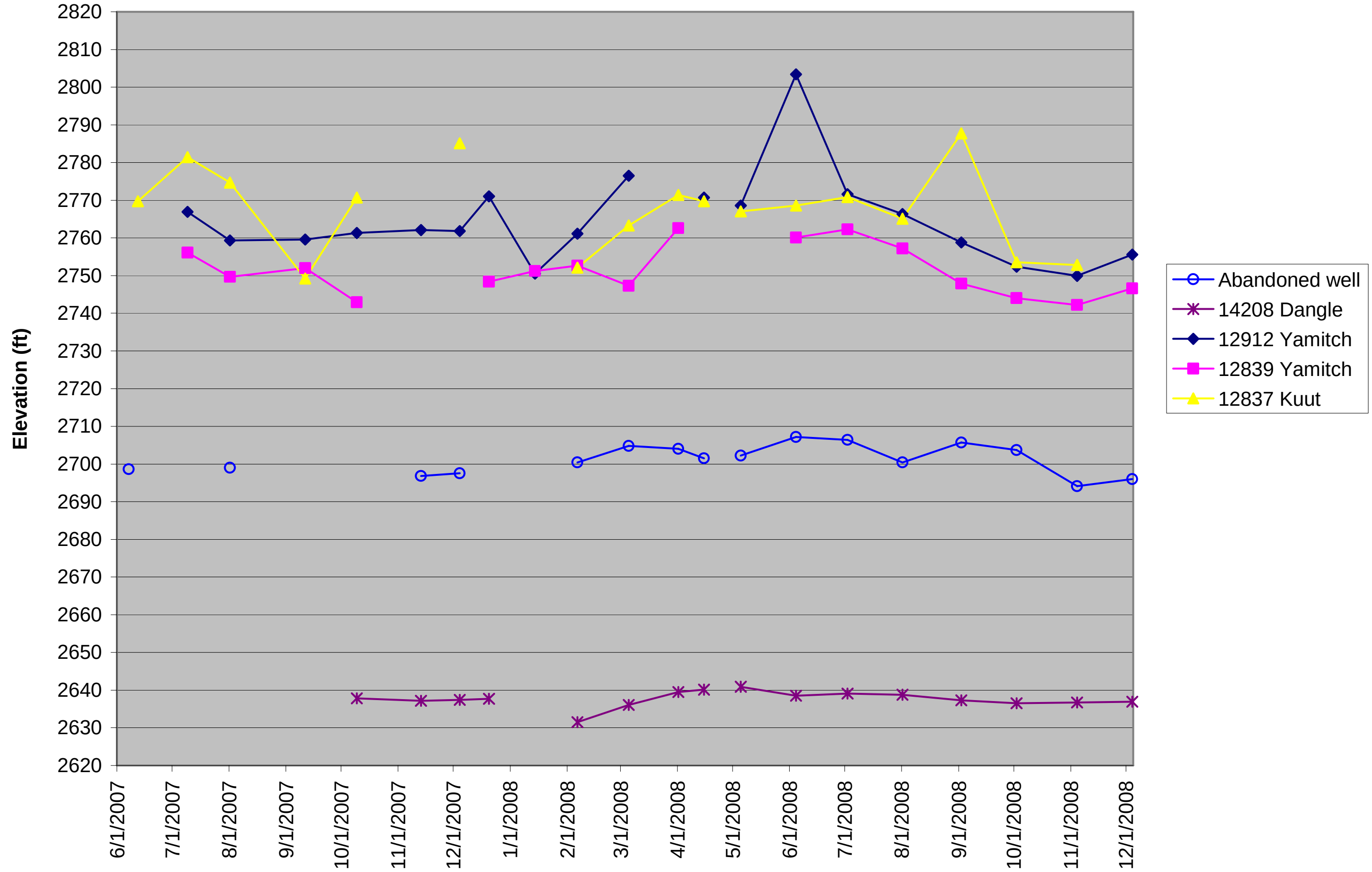
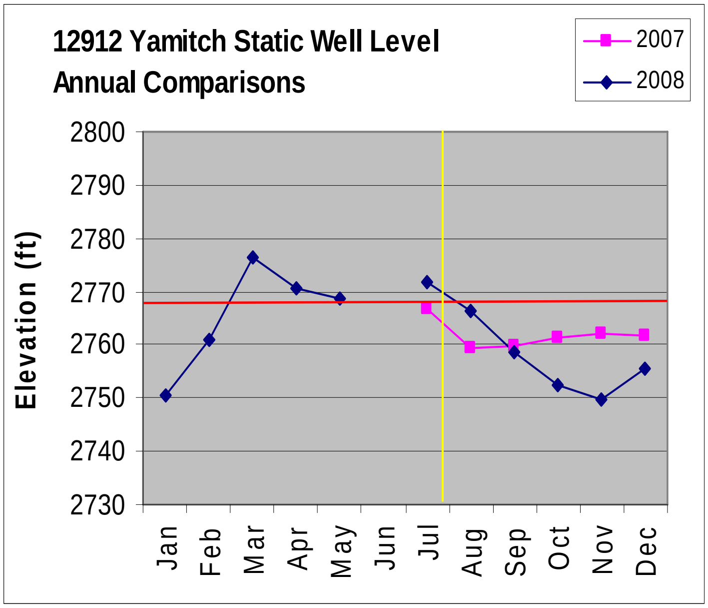
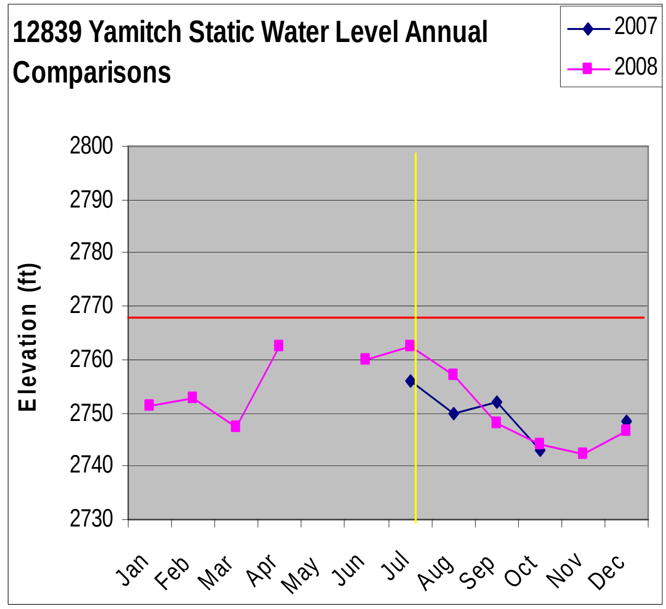
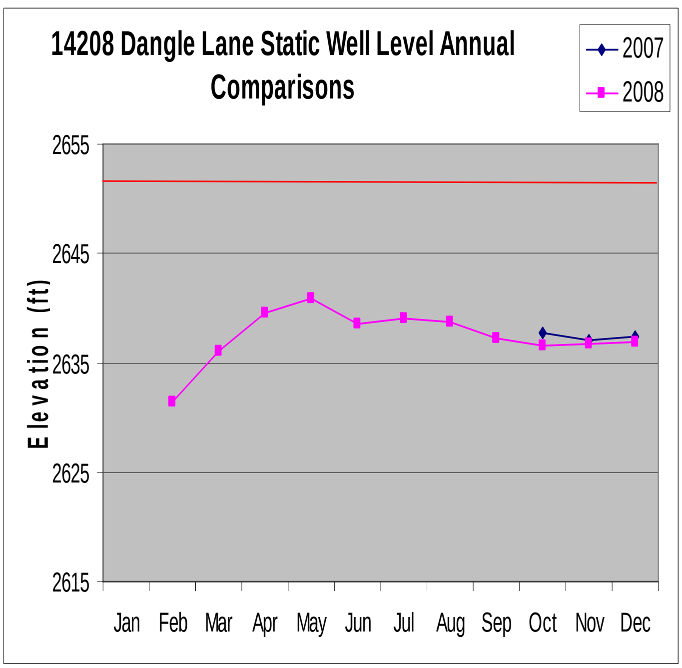
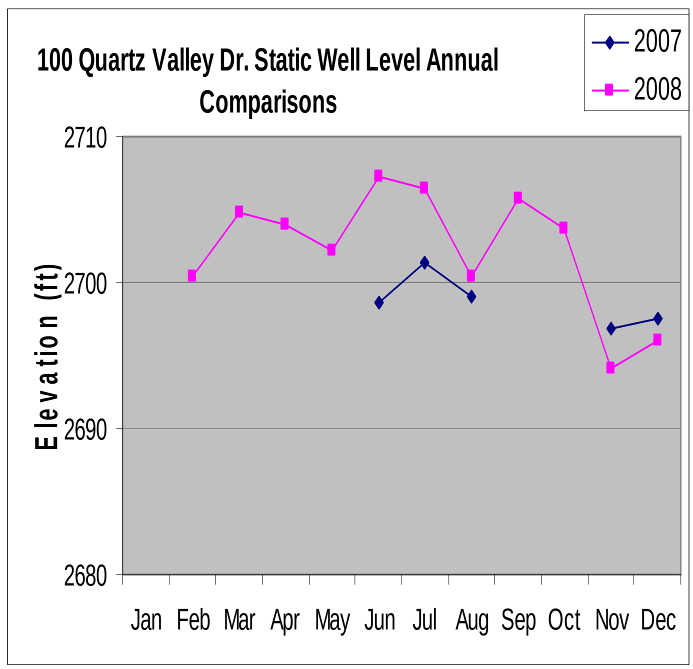


Figure 27 Static well level data in Quartz Valley from June 2007 through December 2008.









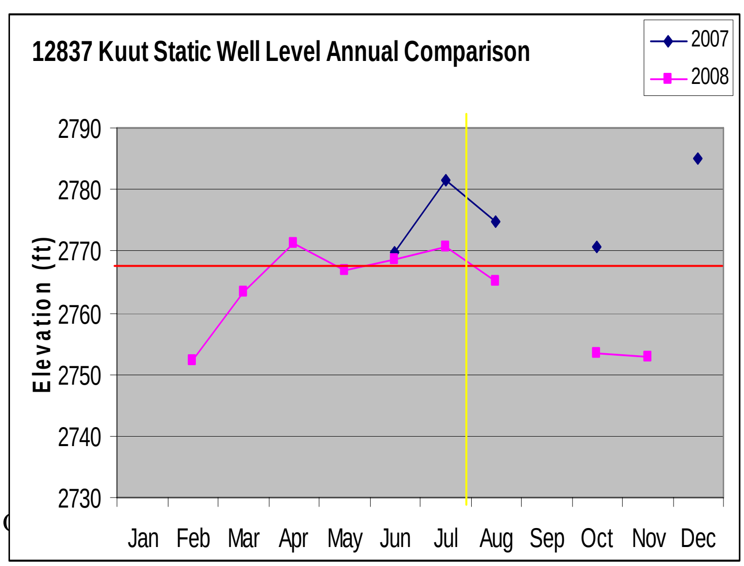


Figure 28: Static Water Level ’07 vs. ’08 Quartz Valley wells, data spikes were cut for annual comparisons. The elevation of the creek (red line) and the date Shackleford disconnects during base flow (yellow line) is added for analysis.

B. Water Quality – dissolved oxygen, pH, temperature, specific conductivity
Water quality data were collected from drinking wells at the same time as the *E. coli* and static water level. The same parameters were collected in Shackleford Creek, directly adjacent to the wells, at the time of groundwater sampling.
The pH values were outside the range of values specified in the Basin plan (NCRWQCB, 2007) at 15 of 17 wells sampled. Groundwater pH values range from 4.42 – 7.8 pH units. Shackleford surface water pH values range from 6.3 – 8.0 pH units.
Groundwater Scott River objectives in the NCRWQCB (2007) *Basin Plan* for specific conductivity was not met on 3 of 17 wells sampled, Figure 29. The 90% upper limit (500 micromhos) was exceeded at 14208 Dangle Lane and the 50% upper limit (250 micromhos) was exceeded on Big Meadows, Ish Pish and Dangle Lane in 2008.

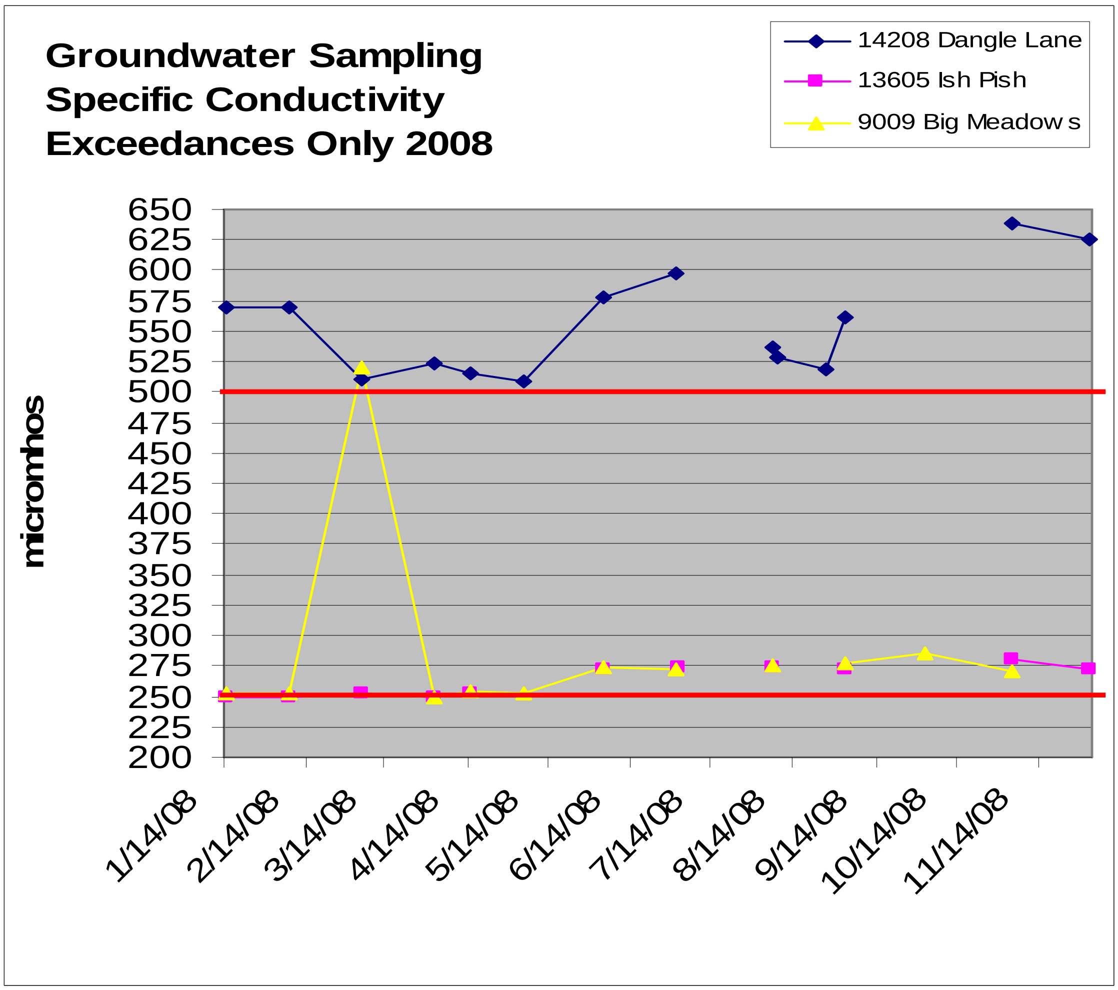


Figure 29: Specific Conductivity Exceedances – Quartz Valley Groundwater 2008

C. Total Coliform and *E. coli*

Monthly well water samples were collected and analyzed for total coliform and *E. coli* throughout 2008. Sampling increased to every two weeks during the winter and spring months (approximately November – April). *E. coli* was detected in one well (#12808 Yamitch) on March 5th, 2008. Total coliform was detected in 13/16, or 81% drinking wells. Figure 30 depicts levels ranging from 1 – 334.8 MPN/100ml sample (note graph is logarithmic scale).

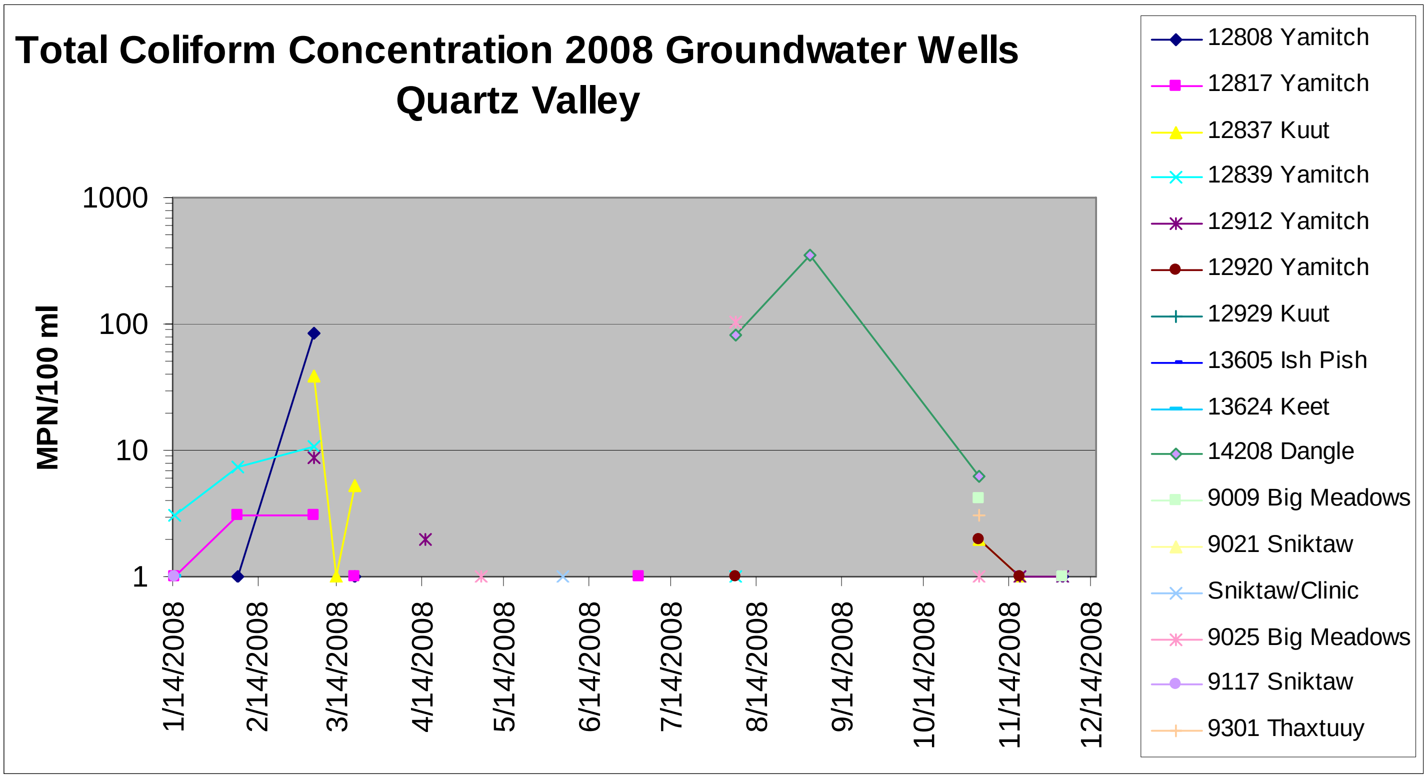


Figure 30: Total coliform levels at all groundwater wells sampled 2008

V. Discussion

A. Scott River Water Quality

Data were most intensively collected on Scott River at the USGS Gauge site below Ft. Jones (site code SRGA), but automated temperature probes were deployed at a number of locations as well. Additionally, nutrient and bacteria grab samples were collected on Scott River, Shackleford and Mill Creek.

The datasonde located at SRGA, revealed significant violations to the NCRWQCB (2007) *Basin Plan* and U.S. EPA (2000a, 1986) water quality recommendations. During the base flow summer sampling period on the Scott River, at SRGA, the water quality created unsuitable aquatic habitat due to violations of pH, dissolved oxygen, temperature, nitrogen and phosphorus. Nocturnal and diurnal fluctuations in dissolved oxygen and pH indicate high rates of algal respiration and photosynthesis. Nutrient enriched conditions that foster these algae blooms may be partially caused by flow depletion and stagnation. High day time temperatures and pH coupled with nighttime dissolved oxygen sags create chronically unsuitable habitat for salmonids. During a portion of the time, the Scott was also unsuitable for human recreation due to high *E. coli* levels. It is important to note that the water quality at this location on the Scott River is at the base of the valley, prior to entering US Forest Service lands that are extensively used for recreation.

Temperature: The lower 21 miles of the Scott River canyon is a migration path to the alluvial valley and tributaries within Scott valley. Salmonids will also use the canyon for spawning and rearing, though it is biologically risky experiencing high confined flows increasing redd scour. Any waterbody used for adult steelhead, coho and Chinook migration should not exceed MWAT 20ºC (USEPA 2003). In 2008, adult steelhead would have been affected by high summer temperatures (July-September) but temperatures cooled for Chinook migration in mid-September and continued to drop through coho migration (November through December). During spawning, egg incubation and fry emergence (October through April), the MWAT was below 13ºC in 2008, a level set by US EPA (2003) to be protective of these lifestages for all three salmonids. However, during summer rearing the mainstem Scott datasonde results show the MWAT was 20.0ºC (week of July 14th, 2008). From June 27th through September 14th, the MWAT exceeded 16.8ºC. This is considered unsuitable for rearing coho (Welsh et al., 2001). Other automated temperature probe data from the mainstem Scott River show MWAT's ranging from 20.0 to 22.5º C, all well into the range of critical stress for salmonids identified by U.S. EPA (2003). Transition between salmonid dominance to dominance of warm water fish species occur between 18ºC and 22ºC (US EPA 1999a). This is approximately the average range of temperatures in the Scott river canyon during the summer of 2008. Compared to MWAT values calculated in 2007 at the same locations, 2008 was on average 1.0 -1.5º C lower than 2007 temperatures. Flows were relatively similar in '07 and '08, the lower MWAT values during the summer of 2008 could be related to the extensive smoke cover in the valley and canyon that year reducing ambient air temperatures and solar radiation on the river.

Dissolved Oxygen: Severe production impairments for juvenile salmonids (coho, Chinook and steelhead) due to dissolved oxygen levels less than 7mg/l (US EPA 1986a), were documented between early August and late September in 2008. This is also the minimum water quality objective from the NCRWQCB *Basin Plan* (2007) for Scott River. From early July through early October, a moderate production impairment was documented, less than 8mg/l (USEPA 1986a). This overlaps with rearing of all three salmonids (coho, steelhead and Chinook); as well as migration of summer/fall steelhead and Chinook salmon. A slight juvenile salmonid production impairment, less than 9 mg/L, was documented between mid-June through early November in 2008. Data comparison of 2007 and 2008 show very similar results with dissolved oxygen levels dipping below 6mg/L during base flow, considered the limit to avoid acute salmonid mortality (USEPA 1986a). The wide range of daily dissolved oxygen during base flows in the Scott River suggests eutrophication is occurring.

Likely sources include: agricultural pollution, waste water treatment plant pollution (Fort Jones) and/or flow depletion/stagnation.

<u>pH</u>: The NCRWQCB (2007) *Basin Plan* maximum value of 8.5 was exceeded in 2008 from early August – late September. This corresponds with the 2007 data exceedances {July 28th – September 16th (end of sampling)}. Algal photosynthesis is the likely cause of these elevated pH values. High nutrient concentrations from agricultural return water in combination with depleted low flows provide ideal conditions for algae blooms. High pH is a substantial concern for salmonid health because pH over 8.5 at temperatures over 25º C converts ammonium ions to highly lethal unionized ammonia (Goldman and Horn, 1983).

<u>Nutrients</u>: Aside from ammonia, nutrients do not directly affect salmonids, but can impact them indirectly by stimulating the growth of algae and aquatic macrophytes to nuisance levels that can adversely impact water quality (diurnal swings in dissolved oxygen and pH as seen during base flow in the Scott). The concentration of nutrients required to cause nuisance levels of periphyton varies widely from one stream to another (U.S. EPA, 2000b; Tetra Tech, 2004, 2006), and detailed data analyses are required to determine relationships. In the absence of such analyses for the Scott River, we use the U.S. EPA's (2000a) *Ambient Water Quality Criteria Recommendations for Rivers and Streams in Nutrient Ecoregion II*. U.S. EPA provided the document as general guidance, but did not intend for these values to be directly translated into standards. The U.S. EPA's recommendations of 0.12 mg/L total nitrogen (TN) and 10 μg/L total phosphorus (TP) were used as preliminary reference values to compare our data with, understanding that these values are subject to uncertainty.

Total nitrogen samples at SRGA in 2008 (and 2007) were above U.S. EPA's (2000a) 0.12 mg/L recommendation in every sample. There was a bimodal peak in nitrogen concentrations in 2008, the first peak level recorded was 0.81 mg/l on July 25th, 2008. The second peak was the highest sample recorded, 0.96 mg/L, was on October 31st, 2008. The most probable cause for the fall peak is the release of nutrients from riparian and aquatic plants. During the summer season these plants uptake nutrients that are then released back into the aquatic environment during seasonal vegetative die-back in fall (Kroger, et al. 2007).

Total phosphorus (TP) concentrations were above the recommended level of 10.0 ug/l set by the U.S. EPA (2000a) in 2008. On June 10th 2008 the TP concentration was 14 ug/L, this concentration and date is the same week as the exceedance in 2007. This June peak in phosphorus levels is likely associated with sediment transported during snowmelt-driven seasonally high flows. Phosphorus levels were generally low and thus could potentially be more limiting to algal growth than nitrogen is, but more data collection and analysis are needed to make that determination.

Chlorophyll *a* levels in water column samples were low, suggesting that the free-floating phytoplankton are not driving these diurnal cycles. This is consistent with many other studies suggesting that algal communities in flowing rivers and streams are typically dominated by benthic algae(periphytin), whereas phytoplankton are more abundant in still waters such as lakes and reservoirs (Tetra Tech, 2006).

Periphytin was sampled once on August 7th, 2008 at lower Shackleford and Scott at the USGS Gauging station. Results indicate the two sites had four of the same species. *Achnanthes minutissima* had the highest density in the Scott sample and the second highest density in the Shackleford sample. *Achnanthes linearis* had the highest density in the Shackelford sample. The biovolume percent by group for the Shackleford sample was: 90% diatoms, 10.2% green algae, and 0.1% crytophyte. The biovolume percent by group for the Scott sample was: 95% diatoms, 4.9% green algae, and 0.1% crytophyte.

<u>Specific Conductivity</u>: The NCRWQCB (2007) *Basin Plan* standards were not exceeded for specific conductance or conductivity in 2008. Monthly means were calculated for comparison to the *Basin Plan* standard

(<250 micromhos), Figure 31. The following 30 day averages during 2008 exceeded this standard: July, October and December. Since this is not 50% of the calculated monthly averages, the Scott mainstem complies with the objective for conductivity. Fluctuations in conductivity are likely related to varying quantities of agricultural return water and groundwater recharge with changing diversion and return flow patterns. Comparison to USGS flow Gauge measurements for 2008 at the SRGA site indicate an inverse relationship between flow and specific conductivity; as flows decrease, specific conductivity increases and vice versa.

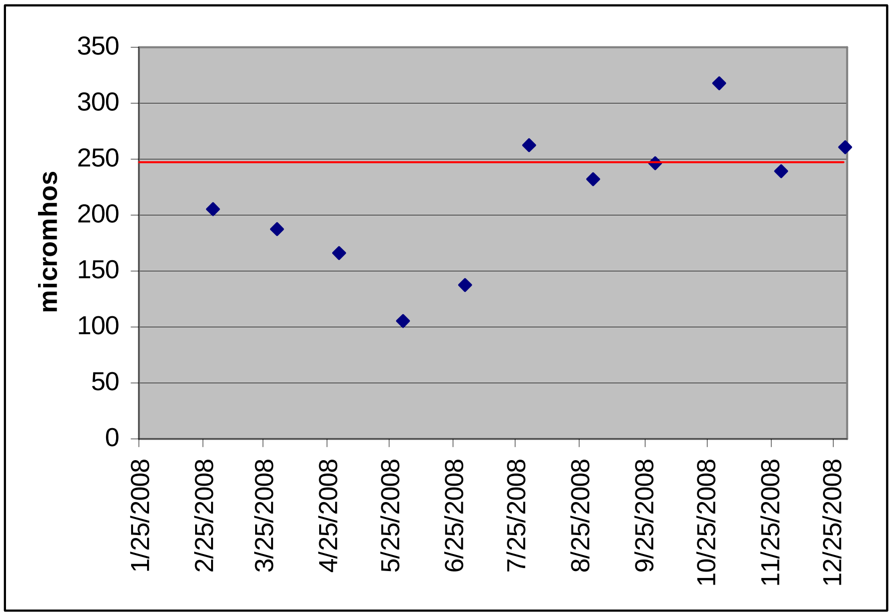


Figure 31: Monthly specific conductivity averages 2008, Scott River (site SRGA), CA

<u>Bacteria</u> (<u>*E. coli*</u>): In 2008 at the Scott River Gauge the U.S. EPA (1986) *Ambient Water Quality Criteria for Bacteria* (235 MPN) was not exceeded. However, the NCRWQCB (2007) *Basin Plan* standard adopted from the draft CA Public Health Department, < 50 MPN for 5 equally spaced samples over a 30-day period, was exceeded from July 7th through July 31st. Jones Beach, a popular summer swimming spot, located approximately 2 miles downstream of SRGA was also in exceedance from July 10th – August 8th. This poses a public health threat and was monitored more intensely in 2008 for the protection of recreating people on the Scott River.

Samples collected from January through December in 2008 at the Scott River Gauge indicated a trend of increasing *E. coli* levels beginning in April and decreasing during the beginning of September. Spatial and temporal sampling occurred in December of 2008 at the USGS Gauging Station. Results indicate that wintertime values across the channel are within an average of 8 MPN/100 ml. Values at each tag distance over time (collected every 5 minutes for 25 minutes) are within an average of 9 MPN/100 ml. Probable sources of *E. coli* contamination in Scott Valley include livestock, wildlife and septic systems. DNA sampling of *E. coli* in 2009 will be aimed at determining which species are the major contributors over different portions of the year.

<u>Turbidity</u>: Turbidity was collected year-round for the first time in 2008 (from 3/3/08-12/31/08). The greatest turbidity levels, average peak ~38 NTU, was observed during 2008 between April 28th and June 12th, which corresponds with the outmigration of 1+ coho smolts. There is not a water quality objective for turbidity established by either, EPA or NCRWQCB. A water quality objective of <5 NTU above the natural turbidity level was adopted by the Tribe (see QVIR QAPP 2006) using coho salmon research results from Berg (1982) and Lloyd (1987). The turbidity levels compared in 2007 and 2008 indicate a base flow level of 0 NTU for the Scott mainstem, but ambient levels at other times of year are not determinable at this time..

Ammonia: Ammonia concentrations were low in the mainstem Scott in 2008, well within EPA criteria, and thus are not likely to pose a toxicity threat to fish.

B. Scott River Tributary Water Temperatures

Results from Table X show that there are several Scott River tributaries that maintain optimal temperatures for salmonids (Sullivan et al., 2000; U.S. EPA, 2003) including suitability for coho salmon. Those with optimal temperatures include Crater, Canyon, Tompkins, upper reaches of Mill (Scott Bar and Shackleford) and Kangaroo Creek. Tributaries to the Scott River canyon experiencing higher temperatures than expected; such as Kelsey, Middle, and Deep; may have elevated temperatures as a result of lingering cumulative effects damage from the January 1997 storm (QVIC, 2006c).

Shackleford Creek has optimal water temperatures upstream of agricultural diversions, but temperatures warm to levels stressful to salmonids in lower reaches, and often lose surface flows altogether (see section below for more in-depth discussion of Shackleford Creek water temperatures). However, in 2008 long-term monitoring locations revealed MWAT's within suitable ranges in sections that remained flowing on Shackleford.

C. Quartz Valley Surface Water Quality – Shackleford, Sniktaw and Mill Creeks

Shackleford, Sniktaw and Mill Creek sampling in 2008 revealed exceedances for bacteria (*E.coli*). Temperature data showed that temperatures are unsuitable for the needs of salmonids at some sites.

Nutrients: Total nitrogen sampling in 2008 revealed one exceedance (July 8th) of U.S. EPA's (2000a) recommended TN limit of 0.12 mg/L at two sampling locations on Shackleford Creek: the wilderness trailhead and lower Shackleford. Grazing occurs in the wilderness during the summer and occurs year-round in the Scott valley. Sampling occurred bi-monthly from June 10th through October 29th, 2008. The lowest levels were observed at sites between the wilderness trailhead and the QVIC Reservation. Sampling in 2008 for total phosphorus revealed no exceedances of the 10.0 µg/l limit recommended by the U.S. EPA (2000).

Chlorophyll-*a*: Values were all less than the 10 µg/L, which is recommended by TetraTech (2006) as a Nutrient Numeric Endpoint (NNE) to protect the coldwater fisheries in lakes in the state of California. The highest values were observed on lower Shackleford, but were still lower than the NNE. Phaeophytin is the breakdown product of chlorophyll, and concentrations were also low at all sites. High concentrations of phaeophytin can indicate a seasonal crash of algae blooms.

Dissolved oxygen: The site located on upper Shackleford, at the Reservation (SRES, 05/23/08 – 07/22/08), indicates a downward trend in dissolved oxygen levels as flows decrease. However, Shackleford dries up before the dissolved oxygen dips below 7 mg/l (2007 *Basin Plan* water quality objective). Dissolved oxygen levels at the lower Shackleford site (CHTH – 07/23/08-12/31/08) was within *Basin Plan* (2007) water quality objectives throughout the sampling period, therefore suitable for salmonids. Nocturnal and diurnal swings noted in the mainstem Scott for dissolved oxygen did not occur on Shackleford in 2008.

Temperature: The calculated MWAT for lower Shackleford Creek (CHTH) in 2008 was 15.7ºC; this is within the range of suitability for salmonids. During 2007, the MWAT at this location was 17.1ºC, this drop in temperature could be attributed to both natural and unnatural reasons. The 2008 summer season experienced higher levels of smoke cover than usual due to fires in a neighboring watershed (Salmon River), thereby decreasing solar radiation and ambient air temperatures on the Scott and its tributaries. In addition, between the '07 and '08 sampling seasons, a ditch intake used for irrigation on lower Shackleford was relocated from downstream of the sonde site to a new location upstream of the sonde site.

The calculated MWAT for Shackleford at the Reservation (SRES) was 16.5ºC; this is just within the optimal range for coho salmon rearing (16.8ºC). However, large diurnal swings and high daily maximum temperatures were occurring due to rapidly decreasing flows from approximately June 30th – July 21st (dry).

pH: The pH on Shackleford at the Reservation (SRES) and lower Shackleford (CHTH) met water quality objectives in 2008 therefore was suitable salmonids. Nocturnal and diurnal swings noted in the mainstem Scott for pH did not occur on Shackleford in 2008.

Specific Conductance: NCRWQCB (2007) *Basin Plan* objectives for streams (excluding Scott River) in the Scott River watershed are 400 and 275 micromhos, (90% upper limit and 50% lower limit, respectively). No violations to specific conductivity water quality targets occurred on Shackleford or Mill Creek in 2008.

Bacteria *(E. Coli)*: Samples for *E. coli* in 2008 on Shackleford and Sniktaw Creek exceeded 50 MPN median during a 30-day (June –July) equally spaced sampling period (draft CA Public Health Department water quality standard). A single sample exceedance (>235 MPN) set forth by U.S. EPA (1986) was exceeded on Sniktaw Creek, July 2nd, 2008. A longitudinal comparison by site on Shackleford revealed that higher levels are occurring at the lowest site near the mouth of Shackleford (CHTH) where the primary land-use is agriculture. Exceedances occurred June through August 2008, corresponding with recreational and cultural uses of Shackleford and Sniktaw Creeks. Samples collected from January through December show an increasing trend in *E.coli* levels on Shackleford occurring from April through September 2008, this same trend was observed in 2008 at the Scott River Gauge (SRGA).

D. Quartz Valley Groundwater Quality

Static Water Level: Comparisons to the '07 data indicate similar trends are occurring; however, the static levels in '08 were in general lower than '07, likely attributed to differences in overall water year type. For analysis, the nearest creek elevation of Shackleford was included along with the date the creek dries, if applicable. Three wells experience static water levels lower than the creek elevation on the Upper reservation (12912_YAM, 12839_YAM and 12837_KUU). This section of Shackleford is dry about mid-July corresponding to the drop below the creek elevation on 12912 Yamitch and 12837 Kuut; 12839 Yamitch's static level is below this elevation all year. The Dangle Lane well (14208 DAN) is near a section of Shackleford (surface water site CHTH) that continues to flow during base flow as a result of tributary inflows from Mill Creek upstream. The static water level at Dangle Lane is below the creek elevation all year, about 10 feet on average. The abandoned well (100_QVD) static water level was not used for comparison to creek elevations due to the uncertainty as to what creek elevation should be used for comparison since it is located further from the creek and between Sniktaw and Shackleford.

Water Quality: Low pH continues to be noted on the majority of wells sampled in Quartz Valley. It is still suspected to be of natural causes, although this has not been fully investigated yet. Specific conductivity was noted as high on three wells. One of these wells is new and located on the Reservation (13605 Ish Pish). The highest levels were noted on the well located off the Reservation near lower Shackleford (14208_DAN, nearest surface water site CHTH). The third well (9009 Big Meadows) is located on the oldest piece of retained Reservation land near lower Sniktaw and Alder Creeks; this well was drilled in the 1950's.

Bacteria: Total coliform was detected in 13 of 16 domestic drinking water wells in Quartz Valley during 2008. The annual trend indicates increasing groundwater levels of bacteria in groundwater from November through March. The highest groundwater levels of total coliform were observed at 14208_DAN, nearest surface water site CHTH, in August and September 2008. This corresponds with the surface water peak of total coliform and *E.coli* levels observed at CHTH. Two of these thirteen wells are also exceeding in specific conductivity

(14208_DAN and 9009 Big Meadows). *E.coli* was detected in only one well during the 2008 sampling period, 12808_YAM. This well is located on the Upper Reservation near Shackleford Creek (surface water sampling site code SRES).

E. Overall Integrated Summary

Water quality on Shackleford Creek in 2008 was relatively good for fish from the wilderness trailhead to lower Shackleford, in sections that retain surface flows. Shackleford falls, located approximately one mile upstream of the reservation, creates a natural barrier to anadromous fish. However, trout are present throughout all of Shackleford Creek, except lower sections of the creek where it ceases to flow during summer months. Flow monitoring data shows that after July 22nd, 2008 the creek no longer has water to support this ecology and the habitat is dry downstream of the falls until the confluence with Mill Creek (~1mile). This same event occurred on July 16th in 2007. *E.coli* surface water samples revealed violations are occurring during times of high cultural and recreational use on lower Shackleford. There are multiple sweat lodges used by tribal people for ceremonial use on and near this section of the creek and water from the creek is used during this tribal practice creating a concern from the tribal community. Groundwater continues to experience total coliform and *E. coli* contamination as documented by the Tribe in previous years (*QVIR EPD Tech Memo*, 2007). This is an increased concern because groundwater wells are the Tribe's primary drinking water source. The contamination observed in groundwater wells could be linked to the increased surface water levels of *E. coli*, particularly since the timing of the highest levels of total coliform observed in the 14208_DAN well matched the maximum levels observed in surface water. A high level of conductivity in the groundwater is most likely indicating the presence of these bacteria. Static water level comparisons of 2007 and 2008 indicate similar trends are occurring and the water table is annually dropping below Shackleford Creek elevation at all wells sampled both on and off the Reservation in Quartz Valley. This is of concern to the Tribe for loss of surface flows is stressful on fish, diminishes suitable habitat and increases temperature and conductivity as seen on the 2008 sonde data for Shackleford at the Reservation. The need for the development of a groundwater management plan in Quartz Valley is imminent.

The Scott River datasonde was deployed throughout the entire year at the USGS Gauging Station, for the first time. Water quality comparisons were only possible during base flow; data showed that 2008 exhibited the same impairments as noted in 2007 with similar magnitude and timing. The pH and dissolved oxygen levels are impaired and fish are experiencing decreasing flows and increasing temperatures as well. Periphyton, stimulated by nutrients and warm water, continue to be the primary driver of the pH and dissolved oxygen diurnal swing impairments through their process of photosynthesis and respiration. Tributary surface flow temperatures in the Scott river canyon are not suitable for salmonids but this habitat continues to be utilized as a refuge during base flows. Turbidity data collected for the entire year revealed high levels of turbidity occurring between April and June. This corresponds with the outmigration of coho 1+ salmon and could be a considerable limiting factor to their survival and outmigration success. *E.coli* sampling in the mainstem revealed exceedances at the USGS Gauge and Jones Beach this poses a risk to human health. Swimmers, rafters and anglers enjoy the Scott River each summer during the time when the exceedances are occurring.

Overall, water quality in the tributaries is much more suitable to salmonids than the mainstem. However, due to decreased flows and reduction of the groundwater table in Quartz Valley, Shackleford is not accessible during base flows when the quality of the Scott degrades. The canyon tributaries are also disconnected or retain such low base flow in the lower reaches during this time, that fish migration to the areas where sufficient surface flow and water quality are available is limited or non-existent. *E.coli* continues to be an issue effecting public health in both Quartz Valley and the mainstem Scott canyon.

Airborne thermal infrared radar (TIR) data collected in 2006 (Watershed Sciences Inc., 2007) and water quality information from 2008 were used to assess the approximate amount of suitable habitat in Shackleford creek, for people and fish (Table 9).

Table 9 Supporting Beneficial Uses for Shackleford Creek 2008

Beneficial Use	Fully supporting	Supporting but threatened	Partially supporting	Not supporting	Not attainable	Un-assessed
Municipal Supply		10 miles				
Agricultural Supply	X					Groundwater pumping
Groundwater Recharge						10 miles
Water Contact Recreation	5.0 miles		1 mile	3 miles		1 mile
Commercial and Sport Fishing	6.5 miles		1 mile	1.5 miles - dry		1 mile
Rare, Threatened, or Endangered Species	0.5 miles – upstream of valley		1 mile	1.5 miles - dry	6 miles	1 mile
Spawning, Reproduction, and /or Early Development	0.5 miles – upstream of valley		1 mile	1.5 miles - dry	6 miles	1 mile
Cultural/ ceremonial	6.5 miles – upstream of	1 mile		1.5 miles - dry		1 mile

F. Future Sampling

Based on our 2008 water quality data, we will continue monitoring to capture data from a variety of water year types. In 2009, will refine our water quality monitoring program at several sites, for various parameters:

<u>Shackleford Creek:</u>

A Microbial Source Tracking Study will be implemented in 2009 to determine the sources of *E.coli*. This will enable us to prioritize restoration efforts to decrease the levels currently observed.

Macroinvertebrate sampling will occur in the spring (April/May) to capture maximum diversity and later in the fall (mid-September/early October) to understand natural seasonal variation.

<u>Scott River:</u>

Eventually, with more funding, periphyton (benthic algae) will be collected more frequently during summer low-flow conditions at the Scott River Gauge. As noted, pH and D.O. levels in the Scott River indicate high levels of periphytin are probably present at the Scott River Gauge and/or in areas upstream. Sampling and analyzing benthic algal levels will help identify factors that contribute to increased algal growth, so that potential restoration efforts can be targeted. Algae sampling protocols from the state SWAMP program will be utilized. Samples should be analyzed for algal species composition and biomass (benthic chlorophyll *a* concentrations in units of mass per area of streambed, not to be confused with water column chlorophyll *a* concentrations in units of mass per water volume). If collected at multiple dates through the low-flow summer season, the data will provide information on the timing and magnitude of peak algal biomass.

A Microbial Source Tracking Study will be implemented in 2009 to determine the sources of *E.coli*. This will enable us to prioritize restoration efforts to decrease the levels currently observed.

<u>Groundwater:</u>

Groundwater sampling in 2009 will include collection of nutrients, four times a year to represent concentrations of each season. This will expand the protection of our drinking water program. We will also be deploying a continuous static water level logger into one well.

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VII. Appendix

A. Standard Operation Procedures for Surface Water Sampling

B. Sample Datasonde Calibration datasheet

C. 2008 Sampling Locations and Parameters collected

DOCUMENT TYPE: Standard Operating Procedure

TITLE: Surface Water Sampling

PREPARED BY: Crystal Bowman, QVIR Environmental Director ______________________

APPROVED BY: Janis Gomes, USEPA Project Officer ______________________

IMPLEMENTED BY: Tami Clayton, QVIR Water Quality Coordinator ______________________

Scope and Application

1.1 This standard operating procedure must be followed when collecting and storing surface water samples for laboratory analysis.

1.2 Samples must be collected in such a way that no foreign material is introduced into the sample and no material of interest escapes from the sample prior to analysis.

2.0 Personnel Qualifications

2.1 All field samplers will be pre-trained in all sampling and equipment procedures by an experienced sampler before beginning the sampling procedure.

2.2 All personnel will be responsible for complying will all quality assurance/quality control requirements as outlined in the QVIR QAPP.

3.0 Summary of Sample Collection Procedure

3.1 Acquire certified sample containers from Laboratory.
 3.1.1 Order 100 ml bottles from IDEXX and perform quality control (see QVIR Lab Manual)
 3.1.2 Call lab and order sample bottles

3.2 Do all necessary preparation prior to sampling.
3.3 Assemble all equipment (See 6. Equipment and Supplies Checklist).
3.4 Collect all QA samples.
3.5 Perform field analyses.
3.6 Obtain samples using dip sampler if necessary and certified clean collection bottle.
3.7 Store nutrient samples at 4ºC and bacteria samples at 10ºC
3.8 Submit samples to laboratory (Refer to Sample Submission SOP).

4.0 Grab Sampling Procedure – Nutrients, Chlorophyll a and Phaeophytin a

4.1 Streams are always sampled upstream from any manmade structure such as a bridge.

4.2 Lakes are sampled at their outlet.

4.3 Collect from the same sampling site each time.

4.4 Check last year's field notes or GPS log for exact sampling location.

4.5 Immerse the thermometer or YSI handheld in the water and leave immersed five minutes before reading temperature. Avoid disturbing the bottom with the thermometer at the sample site.

4.6 Label bottle with a unique site code (geographic area name and stream or lake name), date, time, water temperature and sampler's initials. Include whether it is a grab or composite sample. Label bottle before immersion using a black permanent marker or pre-printed labels. If using pre-printed labels affix with clear plastic packaging tape to avoid them getting wet. Aquatic Research Inc., contracted lab, provides only certified clean containers.

4.7 Use latex gloves when handling bottles during sampling. Fingers contain contaminants such as nitrates. Bug repellents or sunscreen is particularly troublesome as contaminants. Once the gloves are on, be careful not to touch your face, the ground, or anything but the bottles.

4.8 The sample should be taken from flowing, not stagnant water, facing upstream positioned in the thalwag.

4.9 Be sure to immerse the bottle completely, 10 cm (4 inches) deep, with mouth of bottle pointing upstream, so no water flows over your hand into the bottle. Remove the cap under water. Be sure the bottle does not get near the bottom of the stream where sediments can be disturbed. Water samples should be collected 6-12 inches below the water surface. Fill bottle at least half full, replace cap loosely, remove from water and shake. Pour out rinse water downstream of sample point. Pour some rinse water over inside of cap. Do not touch bottle mouth or inside of cap. Partially fill the bottle, cap, shake, and rinse three times.

4.10 Collect the sample on the fourth immersion. Use the same procedure as before but fill bottle completely. Be careful not to contaminate the sample with surface film, contact with human skin, breathing in/on the bottle or cap, etc. If necessary, squeeze the bottle slightly as the cap is tightened so no air remains in bottle. If stream is too shallow to immerse bottle fully, collect as much as possible, being very careful not to touch the bottom. Note depth on field notes.

4.11 Collect one "duplicate" sample every two weeks (sampling frequency). Sample sites chosen for duplicate sampling are selected at random among sites sampled. When a duplicate sample is selected for the site, repeat procedures as with normal stream samples. The duplicate is the second sample when two samples are collected. Duplicates document repeatability of individual sample collections and reproducibility of laboratory results.

4.12 Place sample immediately in a Ziplock bag in the cooler after collection. Do not expose sample bottles to the sun. Fill out the field data sheet, noting any unusual conditions such as wind or rain. Measure air temperature (shaded) and record. Dispose of latex gloves.

4.13 Samples are analyzed in the lab. Keep samples cool while transporting. Ziplock bags (double bagged) filled with snow work well if frozen icepacks are unavailable for transport from the field. Store at 4 ºC but do not freeze. Include a separate Ziploc bag containing the completed Chain of Custody form. Ship to the lab in a picnic cooler with frozen icepacks via FedEx or UPS overnight. Do not ship so the sample arrives on a weekend. If necessary, keep samples refrigerated for arrival weekdays. Hand delivery to the lab is preferred; or arrange for a contact to pick up the samples.

5.0 Grab Sampling Procedure – Total Coliforms and *E. coli*

4.1 Streams are always sampled upstream from any manmade structure such as a bridge.

4.2 Lakes are sampled at their outlet.

4.3 Collect from the same sampling site each time.

4.4 Check last year's field notes or GPS log for exact sampling location.

4.5 Immerse the thermometer or YSI handheld in the water and leave immersed five minutes before reading temperature. Avoid disturbing the bottom with the thermometer at the sample site.

4.6 Label bottle with location (geographic area name and stream or lake name), date, time, water temperature and sampler's initials. Label bottle before immersion using a black permanent marker or pre-printed labels. QVIR Bacteria Lab, State Certified Lab, purchases only certified sterile, 100 ml, sealed containers from IDEXX.

4.7 Use latex gloves when handling bottles during sampling. Fingers contain contaminants such as nitrates. Bug repellents or sunscreen are particularly troublesome as contaminants. Once the gloves are on, be careful not to touch your face, the ground, or anything but the bottles.

4.8 The sample should be taken from flowing, not stagnant water, facing upstream positioned in the thalwag.

4.9 Be sure to immerse the bottle completely, 10 cm (4 inches) deep, with mouth of bottle pointing upstream, so no water flows over your hand into the bottle. Be sure the bottle does not get near the bottom of the stream where sediments can be disturbed. Water samples should be collected 6-12 inches below the water surface. Fill bottle, to the 100ml line indicated, on **first immersion,** pour off the excess and cap. Do not under fill or over fill, do not redunk. If too much water is poured off, redo sample with new 100 ml container.

4.10 Do not touch bottle mouth or inside of cap. Be careful not to contaminate the sample with surface film, contact with human skin, breathing in/on the bottle or cap, etc. If stream is too shallow to immerse bottle fully, collect as much as possible, being very careful not to touch the bottom. Note depth on field notes.

4.11 Collect one "duplicate" sample every two weeks (sampling frequency). Sample sites chosen for duplicate sampling are selected at random among sites sampled. When a duplicate sample is selected for the site, repeat procedures as with normal stream samples. The duplicate is the second sample when two samples are collected. Duplicates document repeatability of individual sample collections and reproducibility of laboratory results.

4.12 Samples are analyzed in the QVIR Bacteria lab. Keep samples cool while transporting. Store at 10 ºC but do not freeze. Hand deliver to the lab. See Lab SOP.

6. Equipment/Supplies

Equipment that is necessary for the collection of surface water samples includes:

6.1 Wilderness First Aid Pack
6.2 Water Filter
6.3 Camel Packs
6.4 Ice Packs
6.5 Coolers
6.6 Sample Bottles
6.7 Sun Block

6.8 Leatherman
6.9 Waders & Boots
6.10 Camera
6.11 Note Pad & Pencil
6.12 Calculator
6.13 Data Sheets
6.14 Meter Measuring Tape/ 4 Utility Clamps
6.15 YSI Handheld
6.16 Aqua Calc & Rod
6.17 Turbidity Meter
6.18 Tape measure (25 ft.)
6.19 Latex gloves
6.20 Ziploc bags
6.21 GPS Unit
6.22 Field Notebook
6.23 2 Waterproof (Sharpie) pens and 2 black ink-writing pens
6.24 Water or Gatorade
6.25 Air temperature thermometer
6.26 Trash bag

7. Procedure for Nutrients, Chlorophyll a and Phaeophytin a

7.1 Two weeks prior to sampling – order bottles from Aquatic Research Inc. for sampling.
7.2 Create sampling bottle labels, label sample bottles, place in cooler.
7.3 Fill out mailing label.
7.4 Be sure Blue Ice packs are freezing.
7.5 Calibrate YSI handheld according to protocol.
7.6 Fill tatum: write-in-the-rain data sheets (Flow & Surface Water per site), pencils, calculator, field notebook, thermometer (NIST),
7.7 Pack truck, complete gear checklist (See Section 5)
7.8 Arrive at first sampling site, make sure all instrumentation is in shade.
7.9 Collect flow according to USDA protocol, record on flow datasheet.
7.10 Just upstream of flow site, place YSI probe in water to stabilize in the thalwag, where the water samples will be taken (see discharge data sheet to locate thalwag). The probes should be ~ 6-12 inches below water surface. Record results on surface water datasheet.
7.11 Collect nutrient samples according to protocol (Section 4). Place samples in a Ziploc bag in cooler. Record sample collected and time of collection.
7.12 Collect Total Coliforms and *E.coli* samples according to protocol (Section 5). Place samples in cooler. Record sample collected and time of collection.
7.13 Take air temperature inside riparian canopy (if possible), record.
7.14 Wilderness samples will be packed into a Ziploc bag and placed inside another Ziploc filled with Blue Ice. Upon reaching the car, at the trailhead, samples will be placed inside the cooler w/fresh Blue Ice prior to collecting samples at the trailhead.
7.15 Once all samples are collected, return to office, open cooler and replace all ice packs with fresh Blue Ice from office freezer. Put used Blue Ice from sampling day in freezer, to re-freeze. The samples sit overnight in the cooler.
7.16 Arrive to office the next day, replace Blue Ice with fresh from freezer.
7.17 Complete Chain of Custody (COC) Forms as each sites samples are packed into the cooler. Copy COC from, file at QVIR, send original COC in a Ziploc bag in the cooler with the samples.

7.18 Using packing tape secure lid on cooler, place FedEx label on the handle (lugGauge tag style labels). Drop off at Yreka Mail Box and Package Service in Yreka by 1:30 pm.

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Comments:

- If there is no current, create a current artificially by pushing the bottle forward horizontally.
- For shallow waters such as streams springs, seeps or other types of discharges, attempt to sample the water without touching any solids.
- if flows are too deep, wide or fast samples may be taken from a well-mixed area at the water’s edge.

E: Sample datasonde calibration datasheet

CALIBRATION WORKSHEET (Sonde 6-series)

Date of Calibration: _______________ Technicians: ______________________________

SN (data sonde) #_________________ Model_________ Site:______________________

SN (audit sonde) #________________ Model_________ BP (mmHg)________________

SN (audit sonde cable) #____________ Turbidity meter SN # __________________

Old File Name____________________ River Stage (ft.): ____________

New File Name ___________________ Weather: clear - pt. cloudy - rain - snow - smokey

Note: Make sure audit sonde is calibrated and meets all specifications

Audit Sonde	Extract (Audit)	Deploy (Audit)	Extract (Sonde)	Deploy (Sonde)	**Notes**:
Time					
Temp. (°C)					
Sp. Con.					
DO (% sat.)					
DO (mg/L)					
pH					
Turbidity (NTU)					

pH Temp. Table

10	7.06	10.15
15	7.04	10.10
20	7.02	10.05
25	7.00	10.00
30	6.99	9.96

DO % sensor output test:
(Rapid pulse only)

1.
2.
3.
4.
5.
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9.
10.

Pre and Post Cleaning Readings

Status	Instrument	Time	Temp (°C)	Sp. Cond. mS/cm	DO %	DO (mg/L)	DO Charge (rapid pulse)	pH	Turbidity (NTU)
Pre-Clean	Site Sonde								
	Audit Sonde						xxx		
Post-Clean	Site Sonde								
	Audit Sonde						xxx		

Notes:

Calibration:

Dissolved Oxygen wiper changed? Y N Wiper parks ≈ 180° from optics? Y N

Turbidity wiper changed? Y N Wiper parks ≈180° from optics? Y N Note: Change wiper if probe will not park correctly.

Record battery voltage: _______________

Record the diagnostic numbers after/during calibration.

NOTE: Span between pH 4 and 7 and 7 and 10 millivolt numbers should be ≈ 165 to 180 MV **Conductivity probe pass: Y N**

NOTE: Check response time in buffer change & in Tap Water

Old DO SN #________________ New DO SN #_________________ pH span_________ pH probe Pass: Y N

Calibration:	Value of Standard	Temp. of Standard (°C)	Actual Reading	Calibrated Reading	Cal Constant	pH MV/ (DO Charge, rapid pulse)	DO Gain	Excepted Value
DO (mg/L/%) old *10 min. in 100% sat. cup	≈ 91%		% mg/L	% mg/L	X			50 ± 25 (chg)/ 1.0 (.7 - 1.5) gain
DO (mg/L/%) new Note: UNCAL *10 min. in 100% sat. cup	≈ 91%		% mg/L	% mg/L	X			50 ± 25 (chg)/ 1.0 (.7 - 1.5) gain
Sp. Con. (mS/cm)	1.000					X	X	5.0 ± 0.5 (cal constant)
pH 7- check temp.					X		X	range 0 ± 50 MV
pH 10- check temp.					X		X	-177 MV from pH 7
Turbidity	0 NTU				X	X	X	X
Turbidity	**11.2 NTU** 10.0 NTU (6026)				X	X	X	X

optical DOgain (1±0.25)

Rapid Pulse DO membrane changed? Y N

Complete DO sensor output test? Y N DO probe Pass: Y N

****Note: Should wait 6 to 8 hours before final DO calibration, run sensor for 15 minutes in Discrete Run to accelerate burn-in- **BEFORE CAL.**

Notes:

Date entered notes:_________ **Date QC notes:**_________

Initials:_________ **Initials:**_________

DISSOLVED OXYGEN SENSOR OUTPUT TEST (after DO calibration probe in saturated air)

The following tests will confirm the proper operation of your DO sensor. The DO charge and gain must meet spec before proceeding.

610/650– Turn off the 610/650, wait 60 seconds. Power up 610/650 and go to the Run mode, watch the DO % output; it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

PC – Stop discrete and unattended sampling. Confirm that auto-sleep RS-232 is enabled (found in Advanced Menu under Setup). Wait 60 seconds. Start discrete sampling at 4 seconds. Watch the DO % output, it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

The **ACCEPT/REJECT** criteria as follows:
The DO output in % must start at a positive number and decrease during the warm up. Example: 117, 117, 114, 113, 110, 107, 104, 102, 101, 100, 100. Should the output display a negative number or start at a low number and climb up to the cal point, the probe is rejected and must not be deployed.

_____ **ACCEPT** ______ **REJECT**

Notes:

QVIR 2008 Sampling Sites, WQ Parameters and Frequency

			Temp	Nutrients				Macros	YSI handheld				bacteria	YSI Sonde					Discharge	Static Groundwater Level	
Lat (N)	Long (W)	Site Location		TP	TN	Chloro a/PHAEO	Periphytin		pH	temp	DO	sp. Conduc		pH	temp	DO	turbidity	sp conduc			Frequency
Surface Water																					
41º32'32"	123º05'33"	Shackleford @ Campbell Outlet (CAMO)	X																		continuous
41º32'37"	123º05'37"	Shackleford @ Summit Outlet (SUCC)	X																		continuous
41º33'39"	123º03'03"	Shackleford @ Trailhead (SHTH)	X	X	X	X			X	X	X	X	X						X		nutrients bi-weekly, Chloro a /PHAEO monthly, continuous temp

Lat (N)	Long (W)	Site Location	Temp	Nutrients				Macros	YSI handheld				bacteria	YSI Sonde					Discharge	Static Groundwater Level	Frequency
				TP	TN	Chloro a/PHAEO	Periphytin		pH	temp	DO	sp. Conduc		pH	temp	DO	turbidity	sp conduc			
41º35'26"	123º00'03"	Shackleford @ Falls (SHFL)	X	X	X	X		X	X	X	X	X	X						**RCD flow Gauge**		nutrients bi-weekly, Chloro a /PHAEO monthly, continuous temp
41º35'36"	122º58'30"	Shackleford @ QVIR (SRES)	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X		nutrients bi-weekly, Chloro a /PHAEO monthly, continuous temp {SONDE UNTIL DRY)
41º36'55"	122º57'56"	Shackleford near mouth (CHTH)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	**DWR flow Gauge**		nutrients bi-weekly, continuous temp, continuous {sonde while SRES is dry}, cholo a /PHAEO monthly (bi-weekly Aug-end)

		Mill Creek	X	X	X	X		X	X	X	X	X	X						X		nutrients bi-weekly, Chloro a/PHAEO monthly, continuous temp
			Temp	**Nutrients**				**Macros**	**YSI handheld**				**bacteria**	**YSI Sonde**					**Discharge**	**Static Groundwater Level**	
Lat (N)	**Long (W)**	**Site Location**		TP	TN	Chloro a/PHAEO	Periphytin		pH	temp	DO	sp. Conduc		pH	temp	DO	turbidity	sp conduc			**Frequency**
41º17'45"	122º45'06"	Big Mill Creek	X																		continuous
41º18'52"	122º42'21"	Grouse Creek	X																		continuous
41º20'19"	122º42'21"	Kangaroo Creek	X																		continuous
41º17'37"	122º44'03"	Mule Creek	X																		continuous
41º24'12"	122º37'46"	Crater Creek	X																		continuous
41º23'39"	122º37'37"	Little Houston Creek	X																		continuous

41º38'24"	123º00'50"	Scott River @ USGS Gauge (SRGA)	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	**USGS flow Gauge**		continuous sonde, bi-weekly nutrients/bacteria, chloro a /PHAEO monthly (bi-weekly Aug-end)
41º37'56"	123º06'18"	Canyon Creek	X																		continuous
41º39'54"	123º06'44"	Deep Creek	X																		continuous
41º38'41"	123º07'06"	Kelsey Creek	X																		continuous
			Temp	**Nutrients**				**Macros**	**YSI handheld**				**bacteria**	**YSI Sonde**					**Discharge**	**Static Groundwater Level**	
Lat (N)	**Long (W)**	**Site Location**		TP	TN	Chloro a/PHAEO	Periphytin		pH	temp	DO	sp. Conduc		pH	temp	DO	turbidity	sp conduc			**Frequency**
41º40'06"	123º06'38"	Middle Creek	X																		continuous
41º44'46"	122º57'38"	Scott Bar Mill Creek	X																		continuous
41º46'24"	123º01'54"	Scott River @ Roxbury Bridge	X																		continuous
41º41'18"	123º04'45"	Scott River @ Townsend Gulch	X																		continuous

41º39'04"	123º06'46"	Scott River @ Bridge Flat	X																		continuous
41º37'58"	123º06'11"	Scott River Above Canyon Creek	X																		continuous
41º38'22"	123º03'33"	Jones Beach	X																		continuous
41º41'19"	123º06'13"	Tompkins Creek	X																		continuous
			Temp	**Nutrients**				**Macros**	**YSI handheld**				**bacteria**	**YSI Sonde**					**Discharge**	**Static Groundwater Level**	**Frequency**
Lat (N)	**Long (W)**	**Site Location**		TP	TN	Chloro a/PHAEO	Periphytin		pH	temp	DO	sp. Conduc		pH	temp	DO	turbidity	sp conduc			
Groundwater																					
41º35'25"	122º58'50"	#12912 Yamitch							X	X	X	X	X							X	monthly
		#12920 Yamitch							X	X	X	X	X							X	monthly
		#12817 Yamitch							X	X	X	X	X							X	monthly
		#12808 Yamitch							X	X	X	X	X							X	monthly
41º35'25"	122º58'51"	#12839 Yamitch							X	X	X	X	X							X	monthly

			Temp	Nutrients				Macros	YSI handheld				bacteria	YSI Sonde					Discharge	Static Groundwater Level	
Lat (N)	**Long (W)**	**Site Location**		TP	TN	Chloro a/PHAEO	Periphytin		pH	temp	DO	sp. Conduc		pH	temp	DO	turbidity	sp conduc			**Frequency**
41º35'23"	122º58'59"	#12837 Kuut							X	X	X	X	X							X	monthly
		#12929 Kuut							X	X	X	X	X							X	monthly
		#9009 Big Meadows							X	X	X	X	X							X	monthly
		#13605 IshPish							X	X	X	X	X							X	monthly
		#13624 Keet							X	X	X	X	X							X	monthly
		#10503 Cram Gulch							X	X	X	X	X							X	monthly
		#9021 Sniktaw							X	X	X	X	X							X	monthly
		#9117 Sniktaw							X	X	X	X	X							X	monthly, continuous temp
41º36'50"	122º57'37"	#14208 Dangle Lane	X						X	X	X	X	X							X	monthly, continuous temp
41º36'11"	122º58'16"	#100 Quartz Valley Drive							X	X	X	X	X							X	monthly
		Big Meadows							X	X	X	X	X								monthly
		Thaxtuuy							X	X	X	X	X								monthly

		Sniktaw (Clinic)							x	x	x	x	x								monthly
		Quartz Valley Dr.							x	x	x	x	x								monthly
		Quartz Valley							x	x	x	x	x								monthly

F. 2008 Sampling Locations and Parameters Collected