

YUROK TRIBE



Macroinvertebrate Report: 2009

April 2009 – June 2009

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I. Introduction

This report summarizes the methods and results of macroinvertebrate sampling conducted on tributaries of the lower Klamath River within the Yurok Indian Reservation (YIR) boundaries for water year 2009 (WY09). The Yurok Tribe Environmental Program (YTEP) collected macroinvertebrate samples at nine tributary sites starting in April and ending in June in an effort to assess the physical/habitat and biological conditions on the lower reaches of the Klamath River and selected tributaries during the sampling period. This data was added to previous years' macroinvertebrate data as part of an endeavor to build a multi-year data set 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.

II. Background

The Klamath River Watershed

The Klamath River system drains much of northwestern California and south-central Oregon (Figure 1). Thus, even activities taking place on land hundreds miles off the 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 which may be influenced by 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

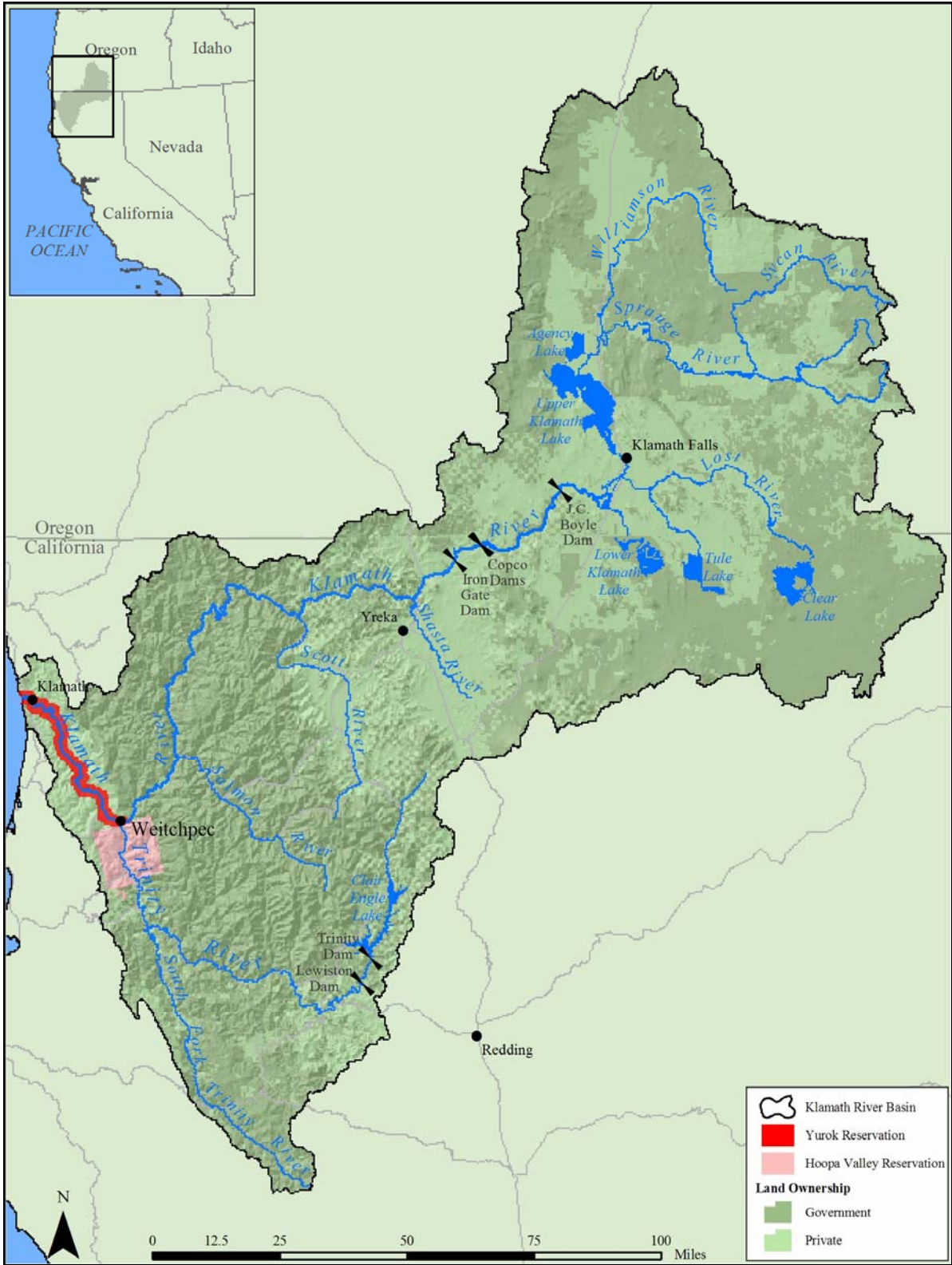


Figure 2-1. Klamath River Basin Map

dissolved oxygen 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.

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 for the last 100 years.

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 56,000-acre corridor extending for one mile from each side of the Klamath River from the Trinity River confluence to the Pacific Ocean, including the channel (Figure 2). There are approximately two dozen major anadromous

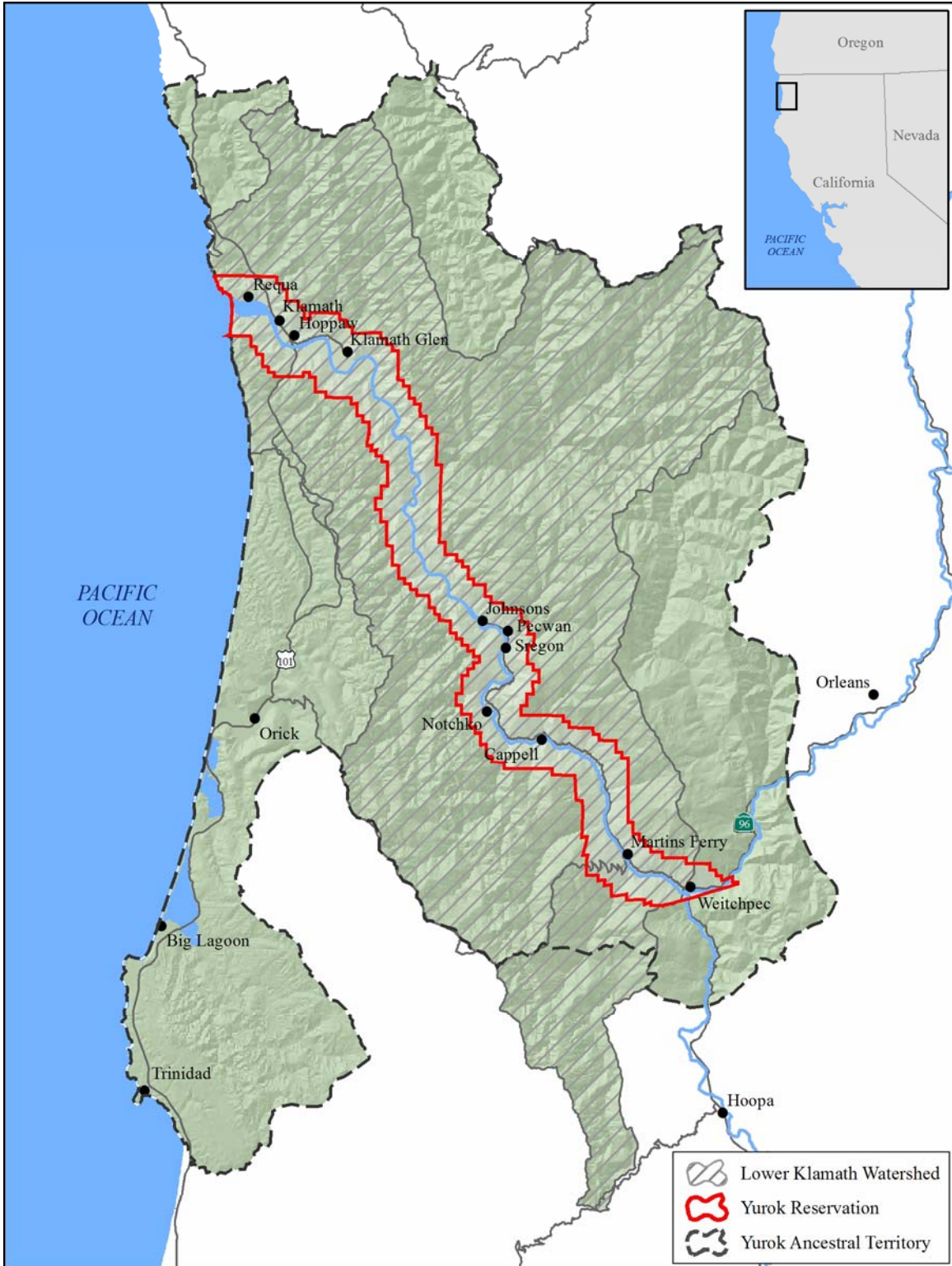


Figure 2-2. Map of Yurok Indian Reservation and Yurok Ancestral Territory

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.

The majority of the lands in the YIR are fee lands, (mostly owned by Green Diamond Resource Company), which are managed intensively for timber products. A small portion of the YIR consists of public lands managed by Redwood National/State Parks (RNSP), the United States Forest Service (USFS) and private landholdings.

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 North Coast Regional Water Quality Control Board (NCRWQCB), and the United States Geological Survey (USGS). Funding allocated under the Clean Water Act Section 106 primarily funds YTEP's water monitoring activities.

Macroinvertebrate Sampling

Evaluating the biological community of a stream or river through assessments of macroinvertebrates provides a sensitive and cost effective means of determining stream condition. Macroinvertebrates, being greater than 0.5mm in size (invertebrates large enough to be seen with the naked eye) are fairly stationary, and are responsive to human disturbances. In addition, the relative sensitivity or tolerances of many macroinvertebrates to stream conditions is well known. Sampling of stream macroinvertebrates for biological assessments is an essential component of any comprehensive stream condition evaluation. The objective of studying macroinvertebrate communities is to monitor the general health and water quality conditions of tributaries to

the Klamath River. According to the California Stream Bioassessment Procedure (CSBP) developed by the California Department of Fish and Game (DFG), benthic macroinvertebrate communities indicate physical and habitat characteristics that determine the stream integrity and ecological health.

III. Site Selection

Klamath River Tributaries

Site selection criteria for macroinvertebrate sampling include spatial distribution, herbicide application activity, watershed restoration activities, proposed future development, and other concurrent water quality monitoring activities. Sites are located in the lower reaches of watersheds that characterize water quality and watershed health condition. YTEP is in the process of developing baseline conditions to document the magnitude and duration of water quality impacts. The following parameters were used as selection criteria for macroinvertebrate sampling:

1. *Spatial Distribution* - Sites located in the lower reaches of watersheds that characterize water quality and watershed health condition. Areas chosen to monitor baseline and long-term trends.
2. *Activity Specific* - Sites located above and/or below herbicide applications and other activities that may potentially impact water quality.
3. *Watershed Restoration Activities* - Sites located in watersheds and sub-watersheds that have active or proposed restoration activities. Sites are selected to monitor the long-term trends by tracking the watershed's recovery.
4. *Proposed Future Development* - Sites near locations of resource and proposed resource development.

Nine tributary locations (Table 3-1, Figure 3-1) were chosen as meeting these requirements. They are: Lower Turwar (Figures 3-2, 3-3), Upper Turwar (Figures 3-2, 3-4), McGarvey (Figures 3-5, 3-6), Mainstem Tectah (Figures 3-7, 3-8), North Fork Tectah (Figures 3-7, 3-9), South Fork Tectah (Figures 3-7, 3-10), Lower Blue (Figures 3-11, 3-12), Tully (Figures 3-13, 3-14), and Johnson (Figures 3-15, 3-16).

Table 3-1. Selection criteria priority matrix for tributary macroinvertebrate sampling*

Creek	Watershed	Sub watershed	Site ID	Primary Criteria	Secondary Criteria	Other
Lower Turwar	Turwar	Turwar	Tu1	1	3	2
Upper Turwar	Turwar	Turwar	Tu2	1	3	2
McGarvey	McGarvey	McGarvey	Mc1	3	1	
Tectah Main	Tectah	Tectah	Te1	3	1	
N.F. Tectah	Tectah	NF Tectah	Te2	3	1	
S. F. Tectah	Tectah	SF Tectah	Te3	3	1	
Lower Blue	Blue	Lower Blue	Lb1	1	3	2
Tully	Tully	Tully	Jo1	2	1	
Johnson	Johnson	Johnson	Ty1	2	1	

*These criteria may change over time, this is an initial criteria designation based on current activities.

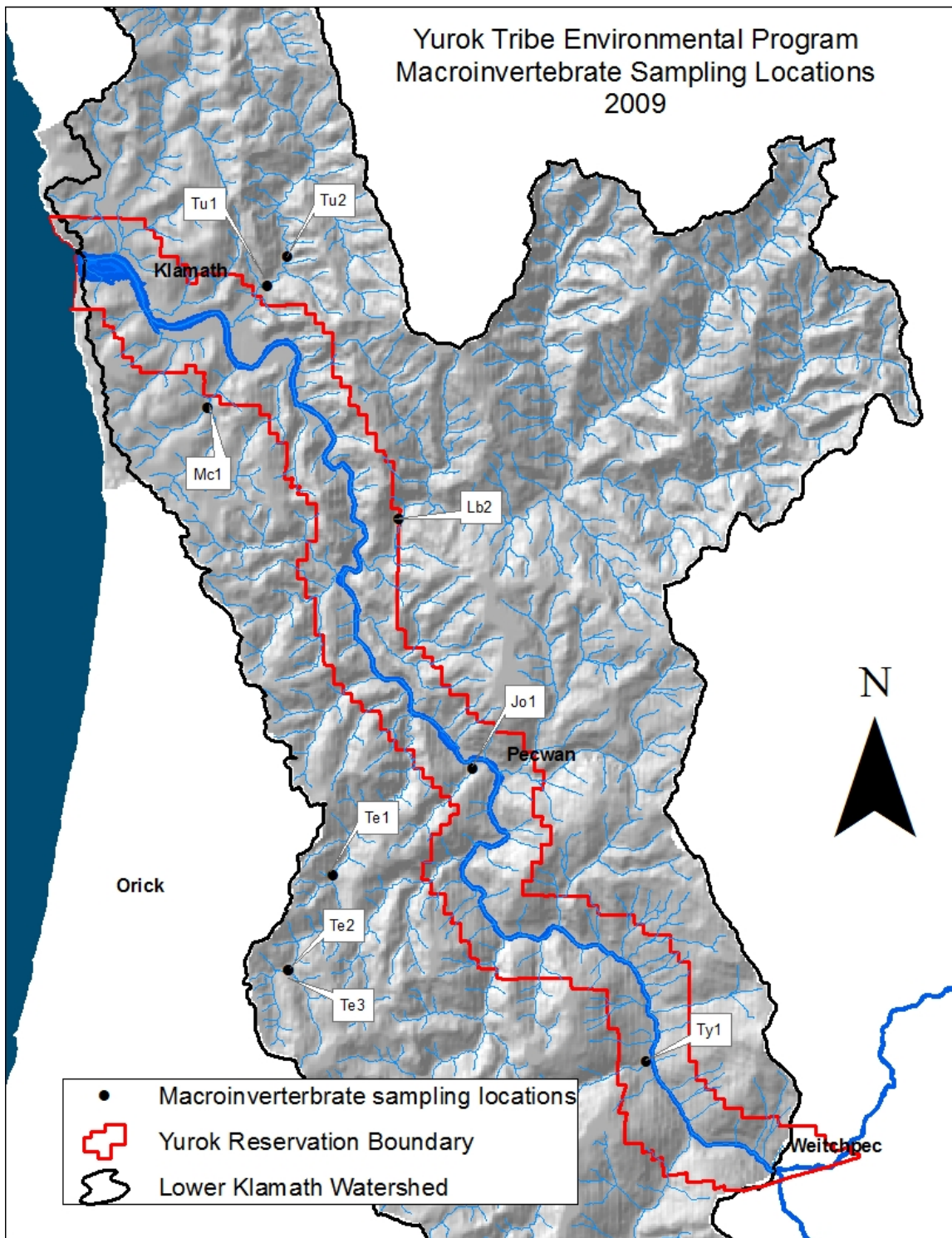


Figure 3-1. Yurok Tribe Environmental Program Macroinvertebrate Sampling Site Locations, 2009

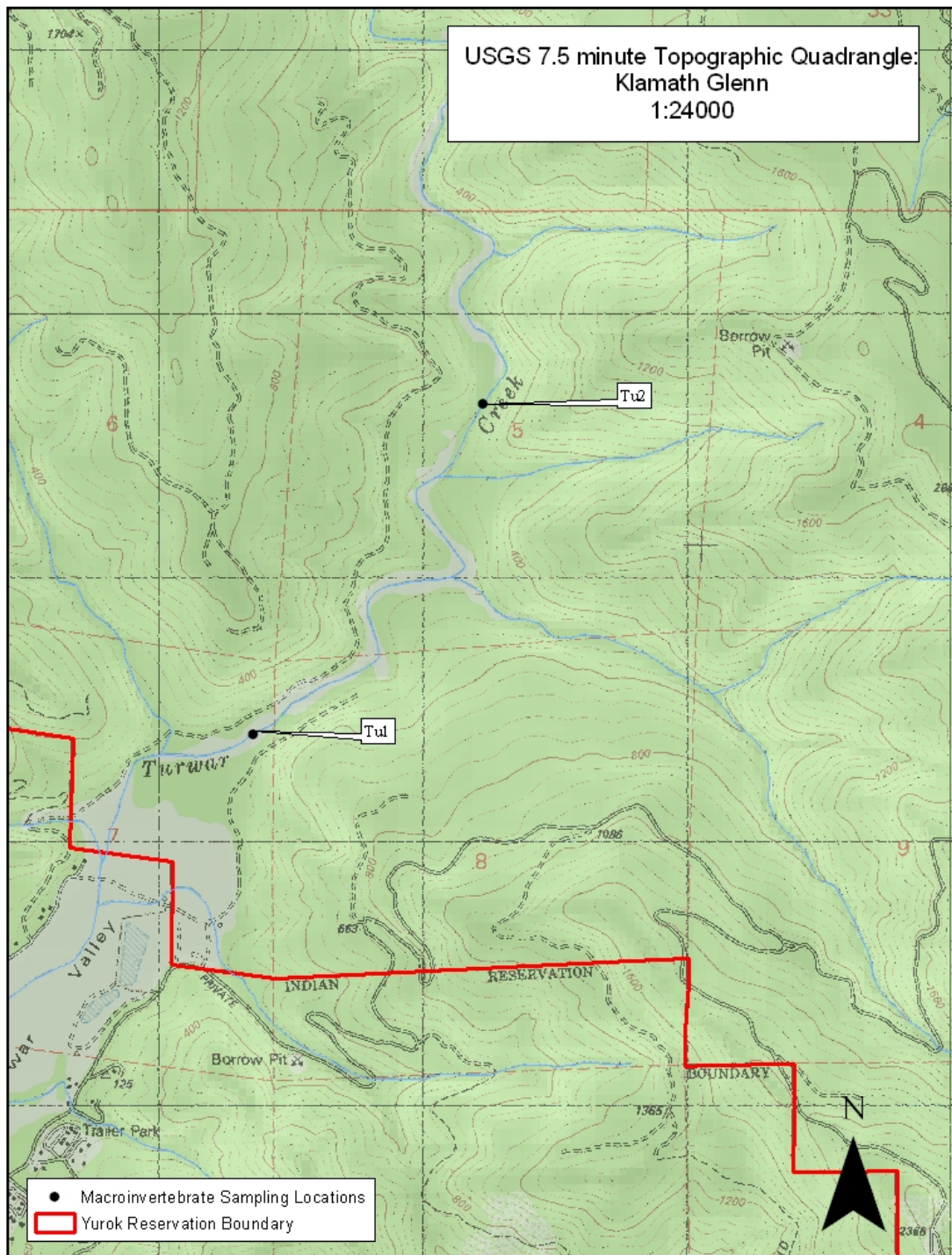


Figure 3-2. Lower (Tu1) and Upper (Tu2) Turwar Sampling Location Map, WY '09



Figure 3-3. Photo of Lower Turwar (Tu1) Sampling Location, WY '09



Figure 3-4. Photo of Upper Turwar (Tu2) Sampling Location, WY '09

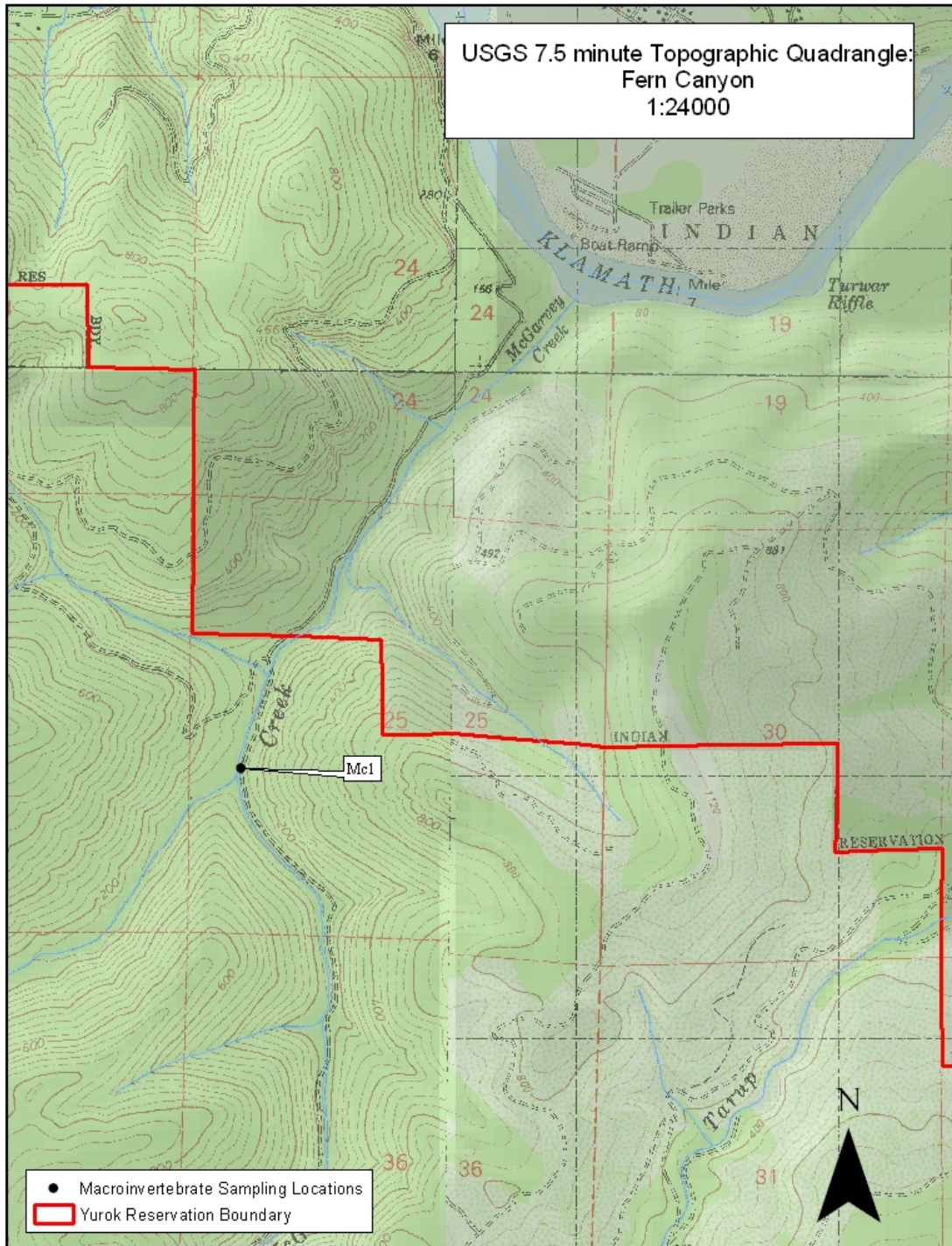


Figure 3-5. McGarvey Creek (Mc1) Sampling Location Map, WY '09



Figure 3-6. Photo of McGarvey Creek (Mc1) Sampling Location, WY '09

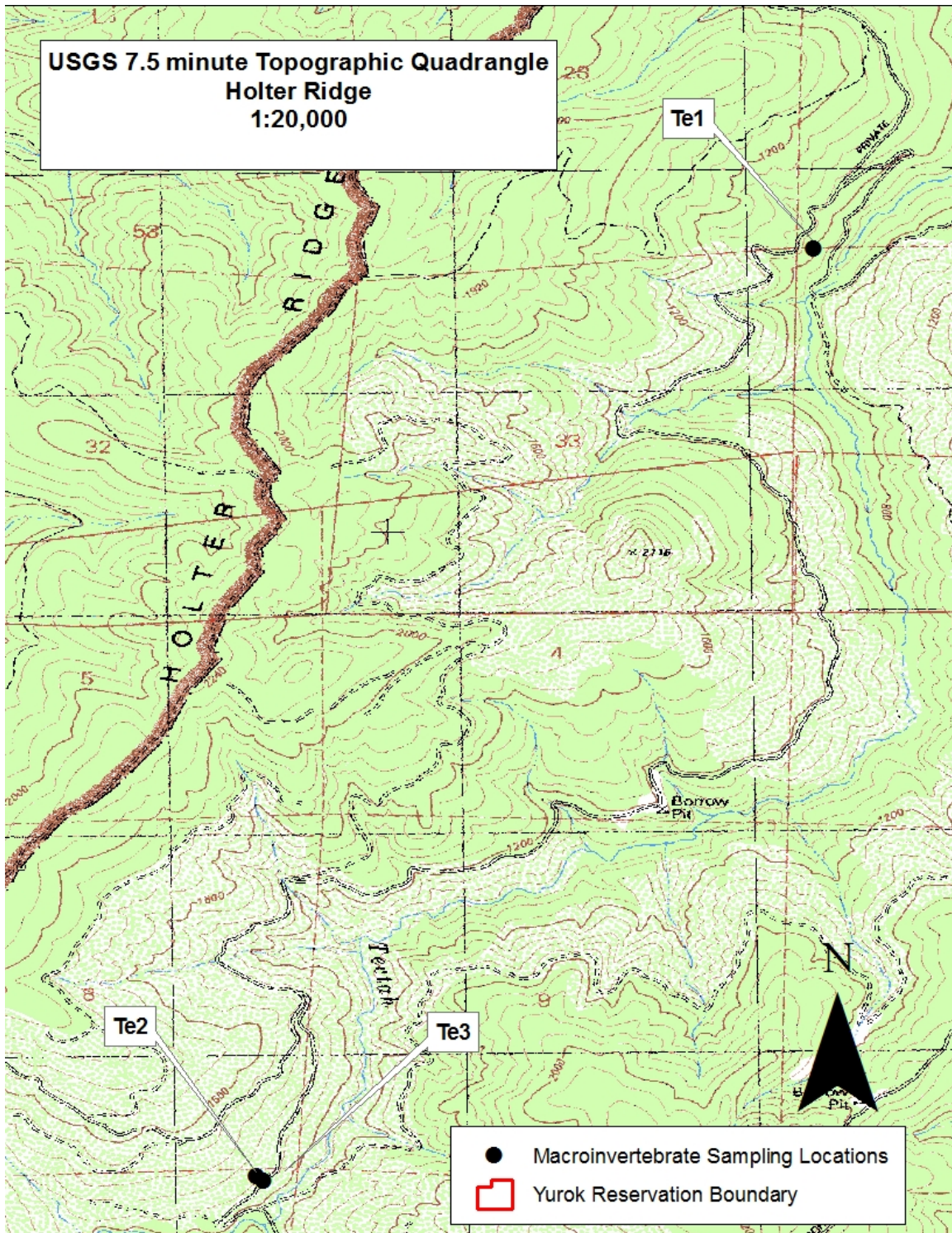


Figure 3-7. Tectah Creek (Te1, Te2, Te3) Sampling Locations Map, WY '09



Figure 3-8. Photo of Mainstem Tectah Creek (Te1) Sampling Location, WY '09



Figure 3-9. Photo of North Fork Tectah Creek (Te2) Sampling Location, WY '09



Figure 3-10. Photo of South Fork Tectah Creek (Te3) Sampling Location, WY '09

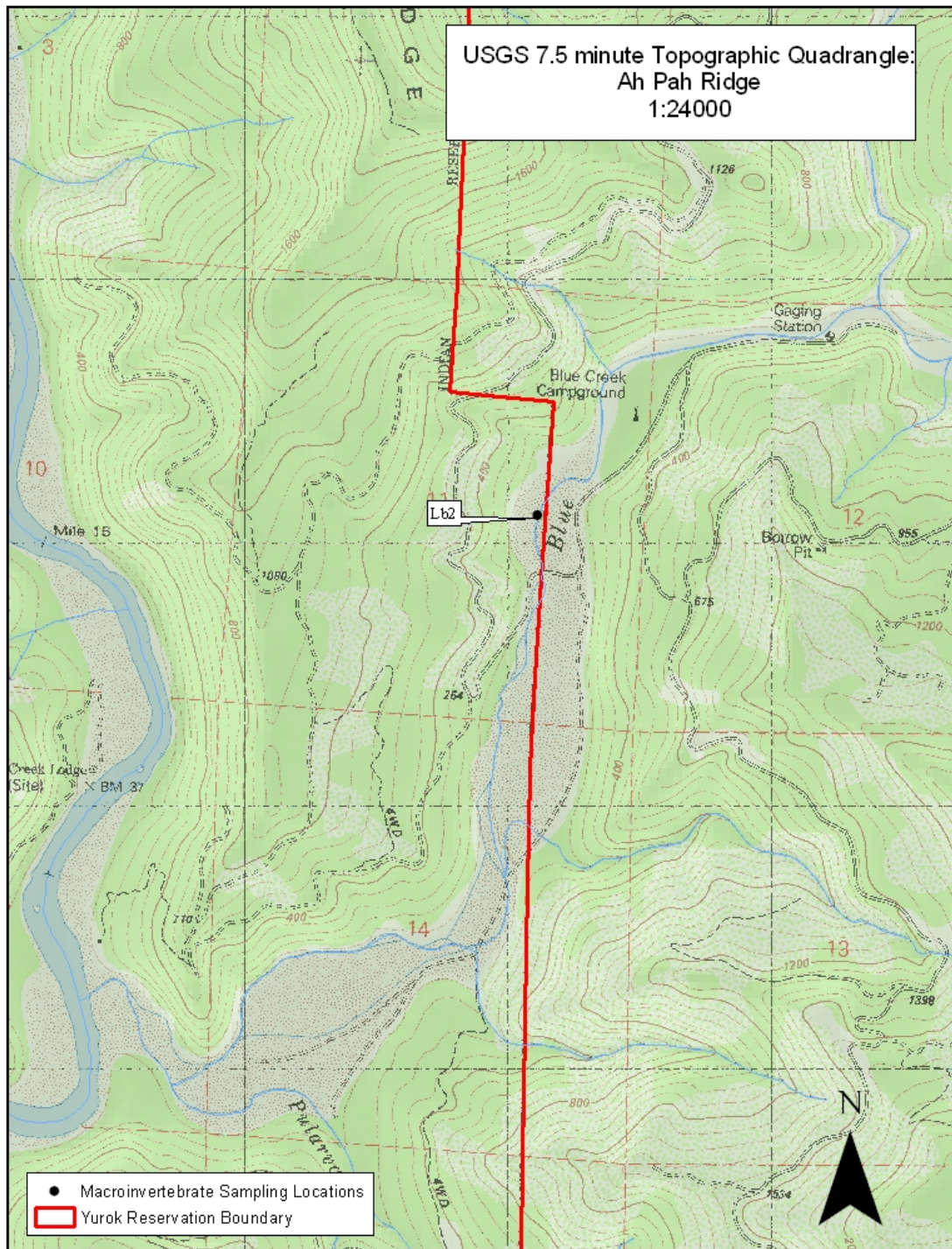


Figure 3-11. Blue Creek (Lb1) Sampling Location Map, WY '09



Figure 3-12. Photo of Lower Blue Creek (Lb1) Sampling Location, WY '09

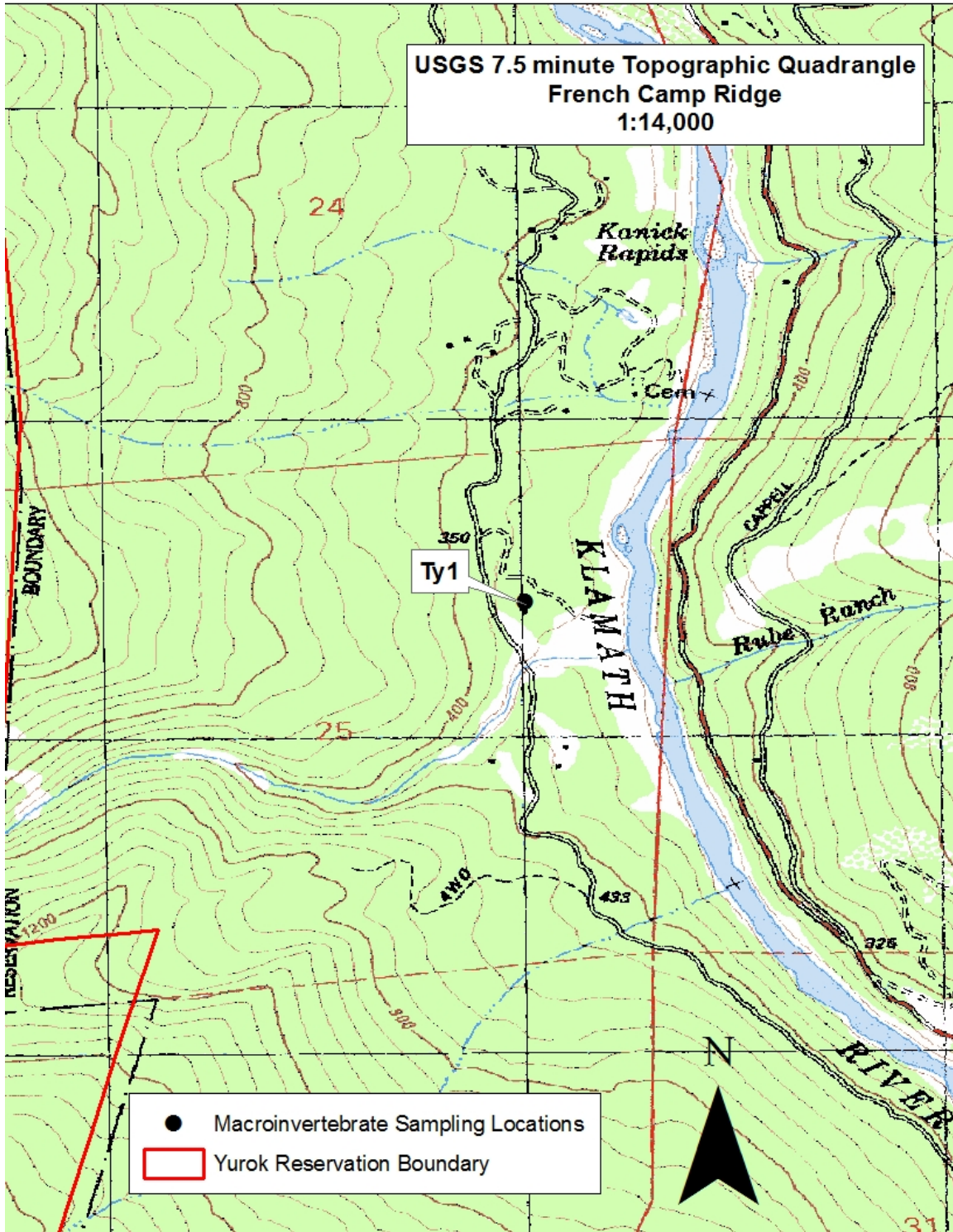


Figure 3-13. Tully Creek (Ty1) Sampling Location Map, WY '09

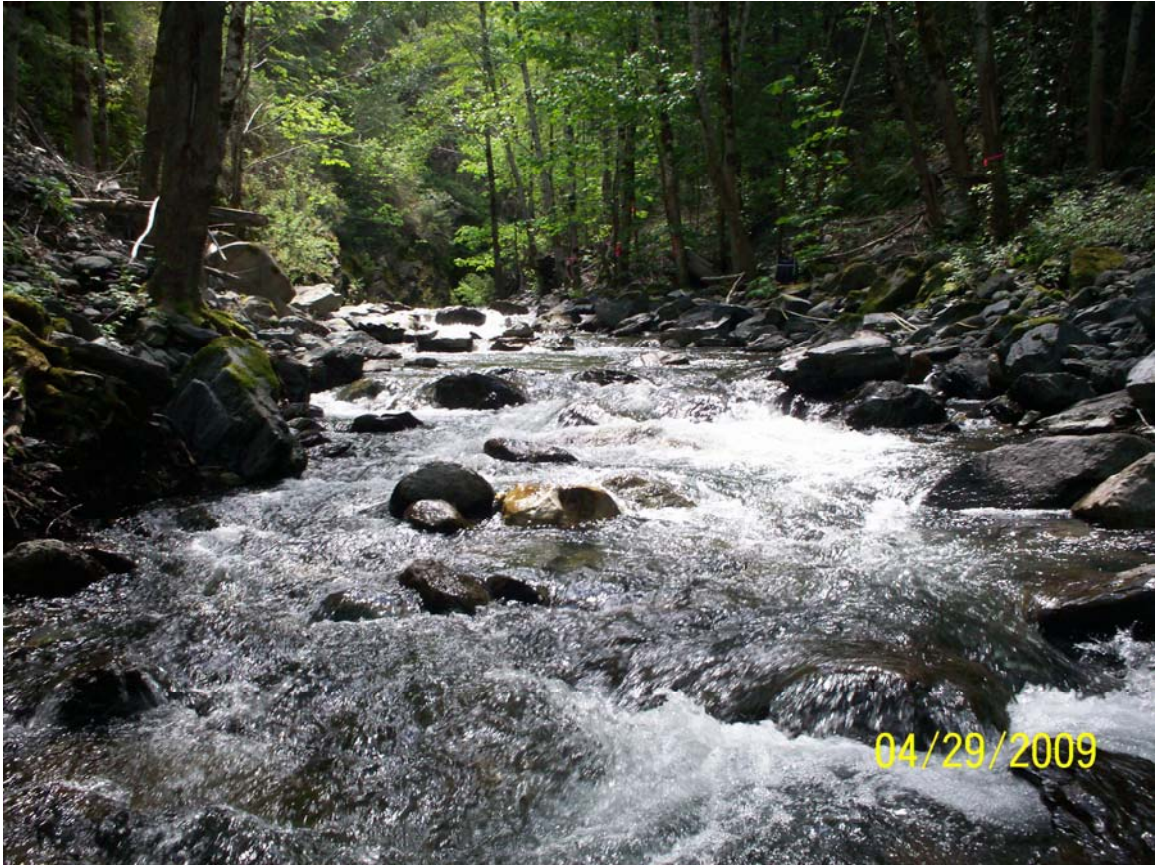


Figure 3-14. Photo of Tully Creek (Ty1) Sampling Location, WY '09

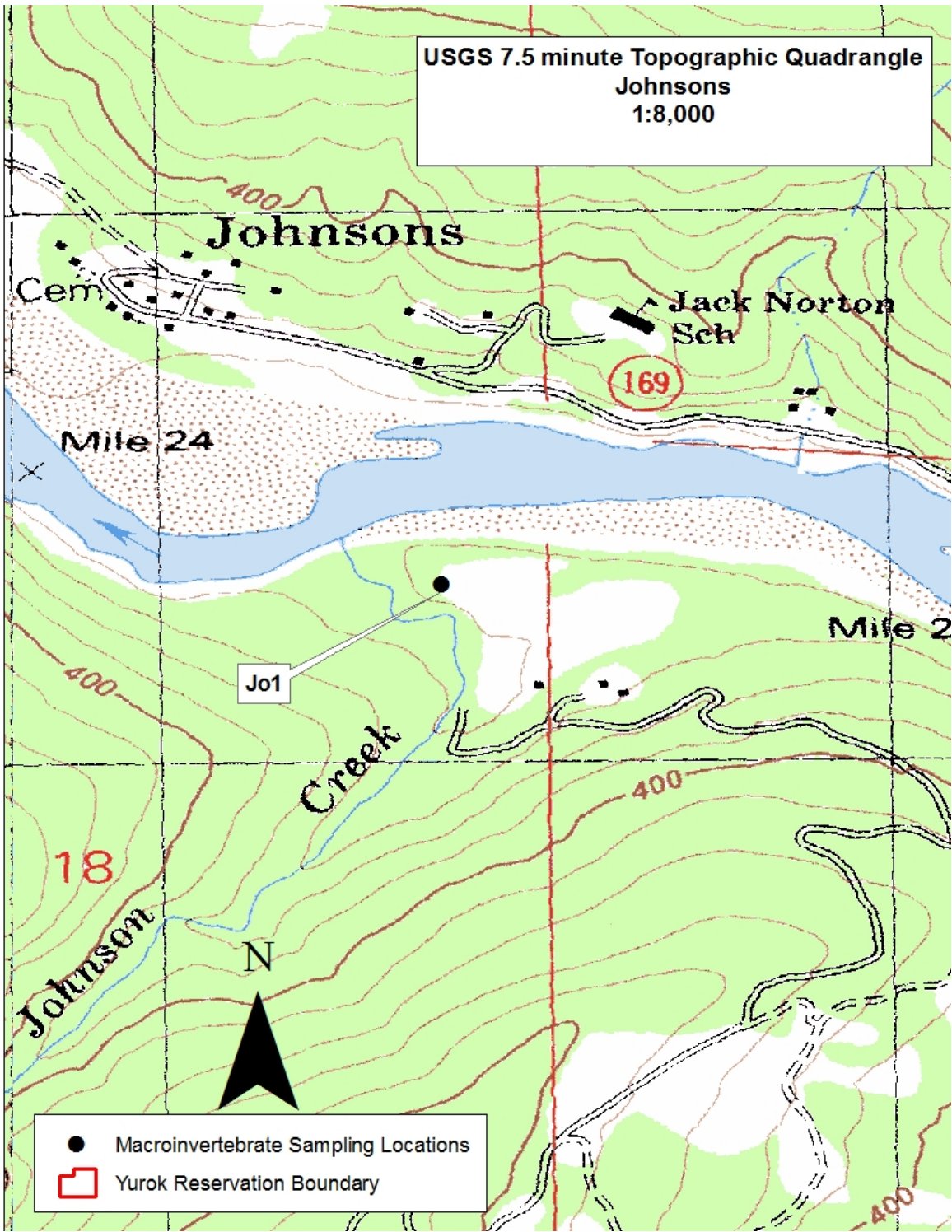


Figure 3-15. Johnson's Creek (Jo1) Sampling Location Map, WY '09



Figure 3-16. Photo of Johnson's Creek (Jo1) Sampling Location, WY 09

IV. Methods

YTEP sampled benthic macroinvertebrate populations in selected tributaries of the Lower Klamath River and during the spring and summer months, respectively. Sampling was performed using the multi-habitat methods located in the State of CA Surface Water Ambient Monitoring Program (SWAMP) *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California February 2009* that the DFG has adapted from the US EPA's "Rapid Bioassessment Protocols of use in Streams and Rivers". This protocol is located in Appendix A. This protocol also includes the collection of water quality parameters and physical habitat conditions in the channel and the riparian zone. This report does not contain this information. The parameters measured include:

- Epifaunal Substrate/Available Cover
- Embeddedness

- Velocity/ Depth Regimes
- Sediment Deposition
- Channel Flow Status
- Channel Alteration
- Frequency of Riffles (or bends)
- Bank Stability
- Vegetative Protection
- Riparian Vegetative Zone Width
- Algae Presence

The Hydrology Specialist, Program Technician, Program Intern, and two AmeriCorps members collected specimens which were sent to a lab where a certified taxonomist identified and calculated the number and types of species.

A variety of Quality Control measures were undertaken in the macroinvertebrate sampling methods. Sample labels were properly completed, including the sample identification code, date, stream name, sampling location, and collector's name, then placed into the sample container. Chain-of-custody forms, when needed, included the same information as the sample container labels. After sampling had been completed at a given site, all nets, pans, and other equipment that had come in contact with the samples were rinsed thoroughly, examined carefully, and picked free of organisms and debris. The equipment was examined again prior to use at the next sampling site.

Data generated in the field and laboratory is reviewed prior to being released internally or to an outside agent. Laboratory processing is contracted to Jonathan Lee, a qualified local CSBP taxonomist and California Bioassessment Laboratories Network (CAMLnet) member. The CSBP has three levels of Benthic Macroinvertebrate (BMI) identification. Level 3 is the professional level equivalent and requires identification of BMIs to a standard level of taxonomy, usually the genus and/or species. If questionable macroinvertebrates are encountered, the CDFG Aquatic Bioassessment Laboratory is used as a reference to verify the specimens. Past review of macroinvertebrate results by CDFG have shown that all identifications and counts are accurate.

After processing the samples, the biological matrices are received from the taxonomist in an Excel spreadsheet format identifying the sample ID and the breakdown of BMI species into standard taxonomic levels.

V. Results

Metric scores calculated using the CSBP can be used to describe macroinvertebrate community structure and determine disturbance status of a stream habitat.

What follows is a brief description of metrics calculated for the YTEP samples which have proven to be useful in the Pacific Northwest (Fore et al. 1996; Karr and Chu 1999) and northern California (Harrington et al. 1999) and the results obtained from WY09 mainstem and tributaries sampling.

- *Taxa Richness*: A richness measure. The total number of distinct taxa in a sample. Reflects health of the community through measurement of the variety of taxa present. Generally increases with increasing water quality, habitat diversity, and/or habitat suitability (Plafkin et al. 1989) (Tables 5-1, Figures 5-1)
- *EPT Taxa Richness*: A richness measure. The total number of Ephemeroptera (Mayfly), Plecoptera (Stonefly), and Trichoptera (Caddisfly) taxa present. These orders are considered generally sensitive to disturbance. Expected to decrease with human induced disturbance (Tables 5-1, Figures 5-2)
- *Percent Sensitive EPT Index*: A composition measure. Proportion of sample composed of Ephemeroptera, Plecoptera and Trichoptera taxa which have been assigned a tolerance value of 0 to 3. Expected to decrease with degraded habitat (Tables 5-1, Figures 5-3)
- *Percent Dominant Taxon*: A Tolerance/Intolerance measure. Percent contribution of the most numerous taxon present in a sample. A community dominated by relatively few taxa would indicate environmental stress (Plafkin et al. 1989). Expected to increase with stress (Tables 5-1, Figures 5-4).
- *Tolerance Value*: A tolerance/intolerance measure. A biotic index which evaluates tolerance of benthic macroinvertebrate to organic enrichment. Taxa tolerant of organic enrichment are also generally tolerant of warm water, fine

sediment, and heavy filamentous algal growth (Wisseman 1996). Scale is 0 through 10, 0 being highly intolerant and 10 being highly tolerant of organic enrichment. The tolerance value is calculated as: $TV = \sum (n_i t_i) / N$, where n_i is the number of individuals in a taxon, t_i is the tolerance value for that taxon, and N is the total number of individuals in the sample. Value expected to increase with stressed environment. Tolerance values are from California Department of Fish and Game (2003) listed values, however are subject to modification as more data is gathered (Tables 5-1, Figures 5-5).

- *Shannons Diversity Index (H)*: A diversity index is a mathematical measure of taxa diversity in a community. Shannons index accounts for both abundance and evenness of the taxa present. The proportion of taxa i relative to the total number of taxa (p_i) is calculated, and then multiplied by the natural log of this proportion ($\ln p_i$). The resulting product is summed across taxa, and multiplied by -1: $H = -\sum p_i \ln p_i$; Diversity is expected to decrease with disturbance (Tables 5-1, Figures 5-6)

Karr and Chu (1999) consider relative abundance to be a poor candidate for use in stream monitoring because of the great natural variation that can occur. Low relative abundance during rapid flow may, in fact, be related to sediment input. The primary disturbance within the study streams is expected to be an increase in fine sediment. Fine sediment reduces the area of substrate available for colonization by macroinvertebrates. Areas of fine sediment in running water are unstable and do not allow a foothold for macroinvertebrates. Fine sediment also fills in areas around cobble substrates reducing usable habitat. Lenat et al. (1981), in North Carolina streams, found that during high flows the addition of sediment simply reduced the available habitat and therefore invertebrate density. Exposed cobble/rubble substrates act as refugia but the number of exposed surfaces is reduced by sediment input.

Lenat et al. (1981) also noted a stable sand community which developed during low flow conditions. This consisted of tolerant small grazers capable of rapid

colonization and reproduction which utilized increased periphyton growing on the stable sand. Relative abundance and tolerance values would increase in stable sand.

Table 5-1. Reported macroinvertebrate metrics for lower Klamath tributary sites sampled in WY09

Sample I.D.	Riffle #	Sample Date	Total # of Specimens	Taxa Richness	EPT Taxa Richness	Sensitive EPT Index (%)	% Dominant Taxon	Tolerance Value	Shannon's DI	Est Relative Abundance
Lower Turwar	1	4/21/2009	515	31	20	14.95	70.1	5.02	1.47	2413
Upper Turwar	1	4/22/2009	514	33	18	25.29	25.88	4.13	2.62	1277
McGarvey	1	4/17/2009	512	42	26	33.79	25.78	3.52	2.79	1786
Blue	1	6/15/2009	503	49	23	10.54	53.08	5.19	2.17	2347
Tully	1	4/29/2009	500	42	21	32.20	24	3.47	2.77	730
Johnsons	1	4/24/2009	504	39	22	19.44	51.59	4.58	2.17	3353
S.F. Tectah	1	6/1/2009	507	41	23	49.7	19.92	3.05	2.81	2540
N.F. Tectah	1	6/1/2009	507	45	24	38.46	31.56	3.67	2.63	1533
Mainstem Tectah	1	6/2/2009	513	44	25	47.56	19.3	3.04	2.84	1331

Table 5-2. North Coast IBI Scores for Klamath River Tributaries

SITE	DATE	EPT Richness	Coleoptera Richness	Diperta Richness	% Intolerant	% non-Gastropod Scraper	% Predator	% Shredder	% non-insect	Score Total
Lower Turwar	4/21/2009	7	5	3	5	6	3	2	8	48.75
Upper Turwar	4/22/2009	7	7	6	7	10	8	2	8	68.75
McGarvey	4/17/2009	10	9	4	7	6	8	9	8	76.25
Blue	6/15/2009	9	9	9	4	3	8	4	7	66.25
Tully	4/29/2009	8	10	10	8	10	5	8	9	85
Johnsons	4/24/2009	8	7	6	4	9	5	8	8	68.75
S.F. Tectah	6/1/2009	9	10	4	10	5	7	8	8	76.25
N.F. Tectah	6/1/2009	9	9	6	8	2	7	10	7	72.5
Mainstem Tectah	6/2/2009	9	10	7	10	10	9	7	8	87.5

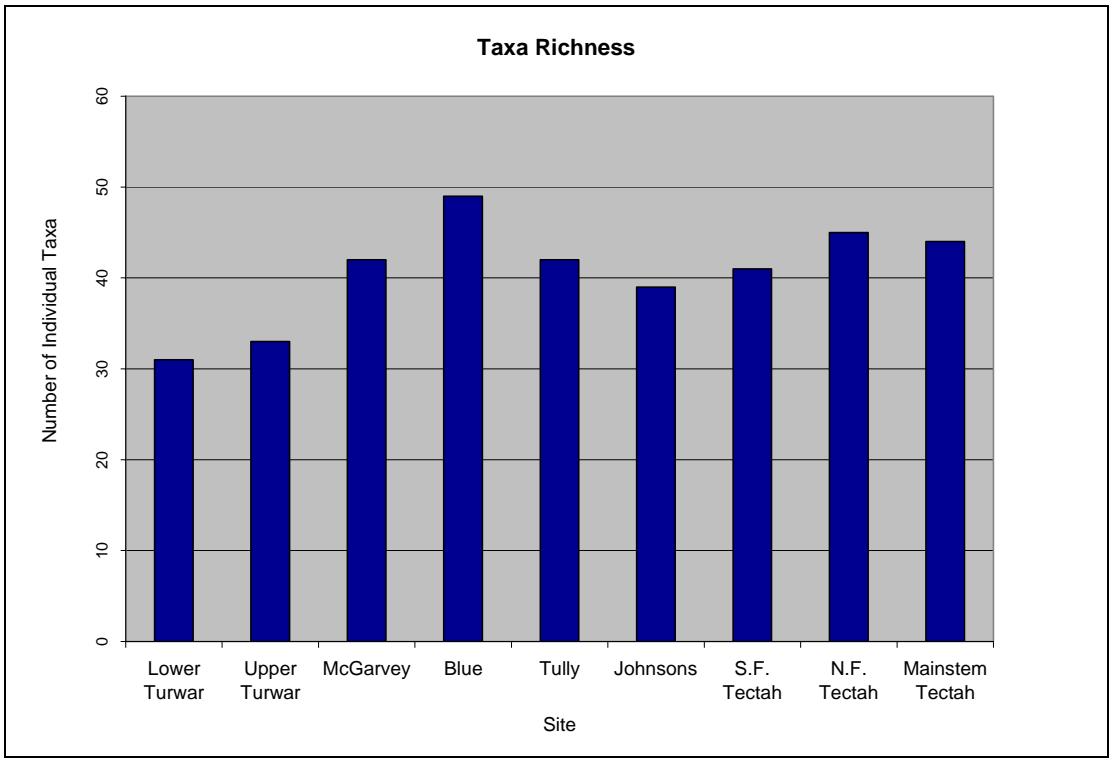


Figure 5-1. Taxa Richness for Klamath River Tributaries.

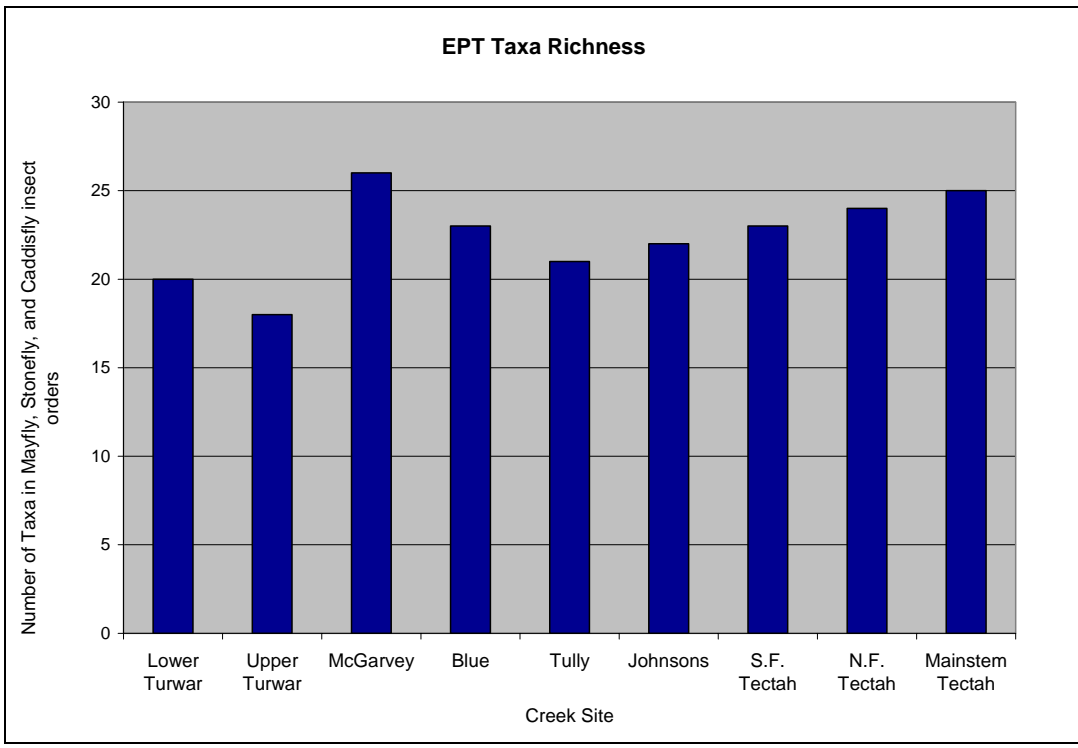


Figure 5-2. EPT Taxa Richness for Klamath River Tributaries.

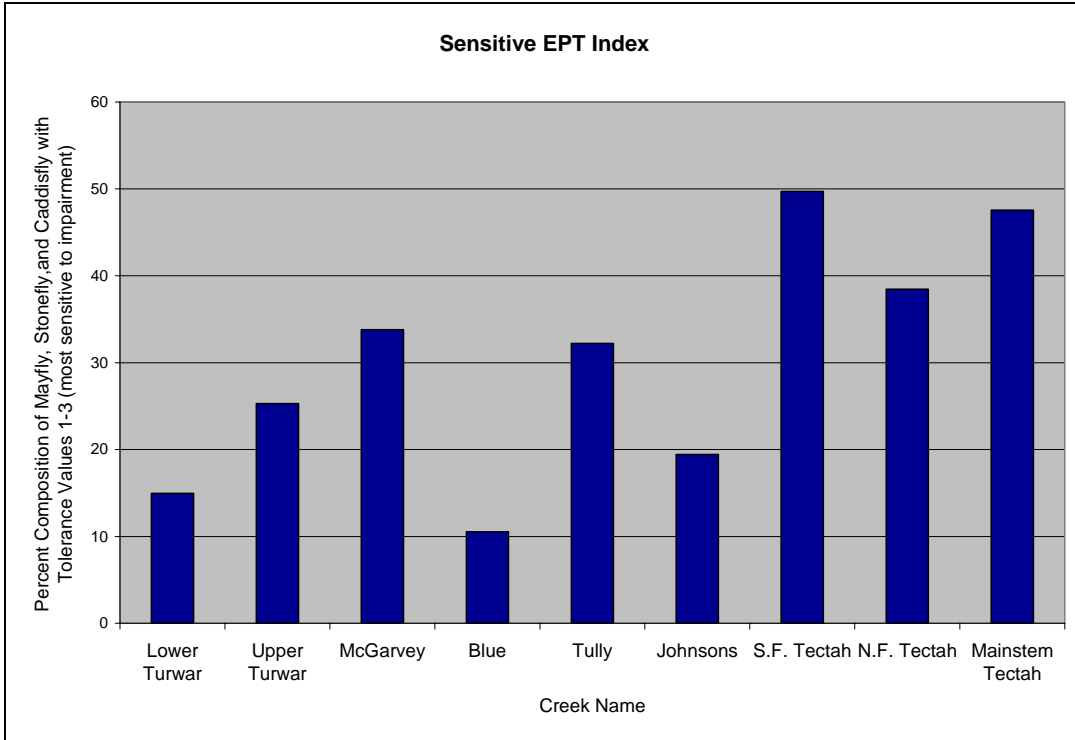


Figure 5-3. Sensitive EPT Index (%) for Klamath River Tributaries.

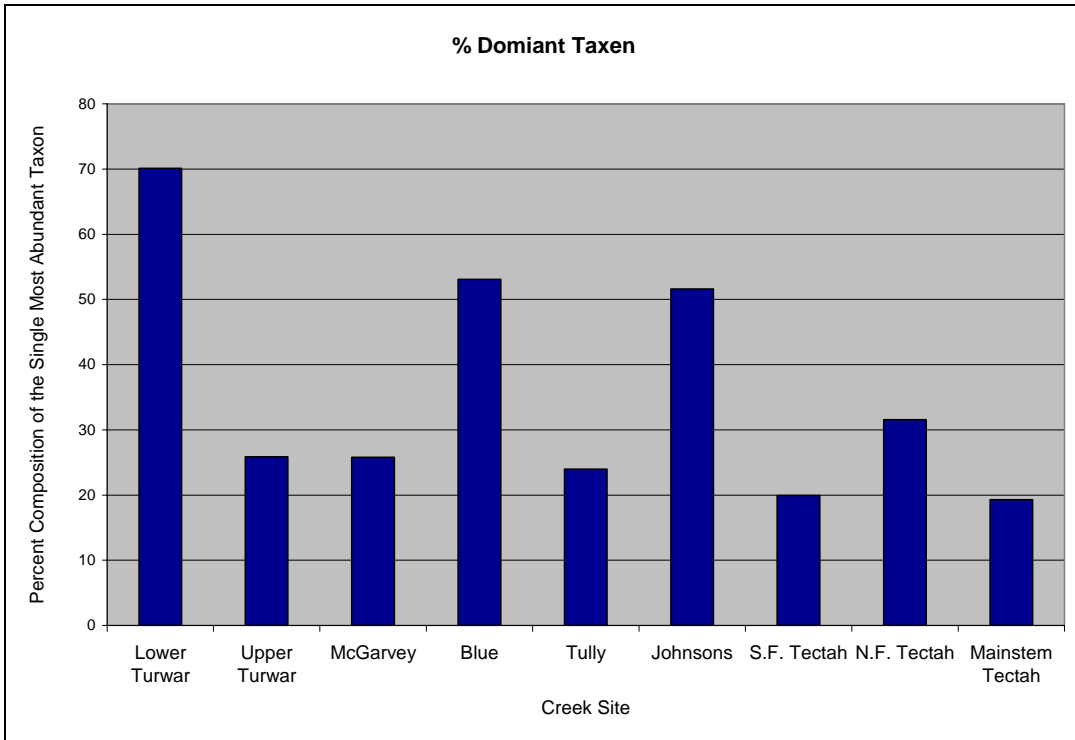


Figure 5-4. % Dominant Taxon for Klamath River Tributaries.

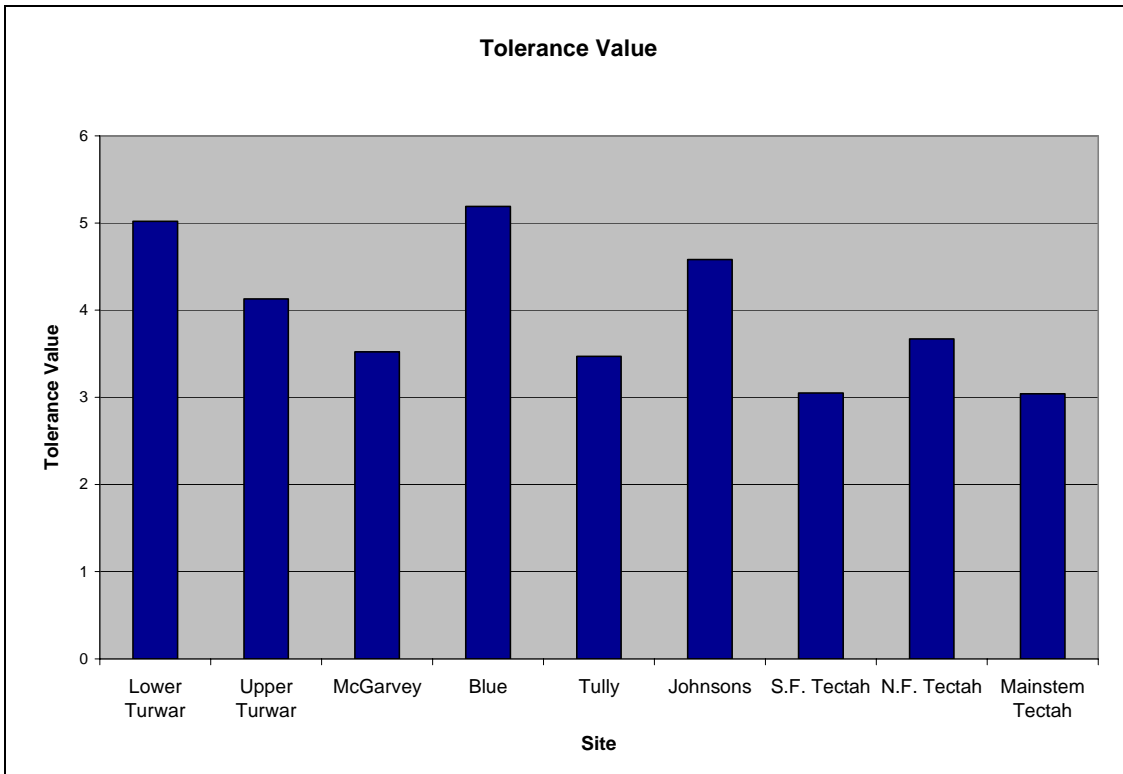


Figure 5-5. Tolerance Values for Klamath River Tributaries.

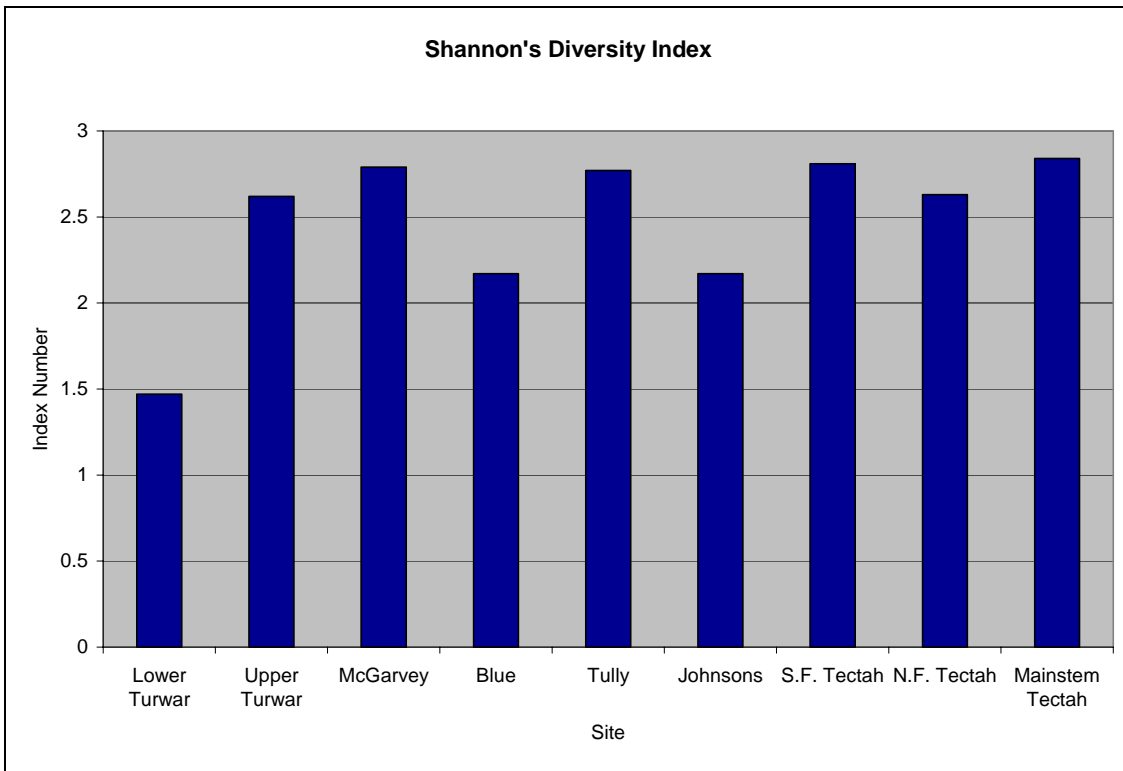


Figure 5-6. Shannon Diversity Index for Klamath River Tributaries.

Macroinvertebrate results are presented for WY09 using the North Coast IBI. DFG developed the North Coast IBI to generate a single value to gauge stream health. Among the metrics used, 6 of the 8 were statistically different than the reference sites in early development of the IBI index for the Klamath region. A separate scoring scale was created to correct these statistical differences. In order to insure the greatest quality control, this separate scoring system was used when generating the metric for WY09. The results of this ranking method are as follows, along with the IBI scoring key.

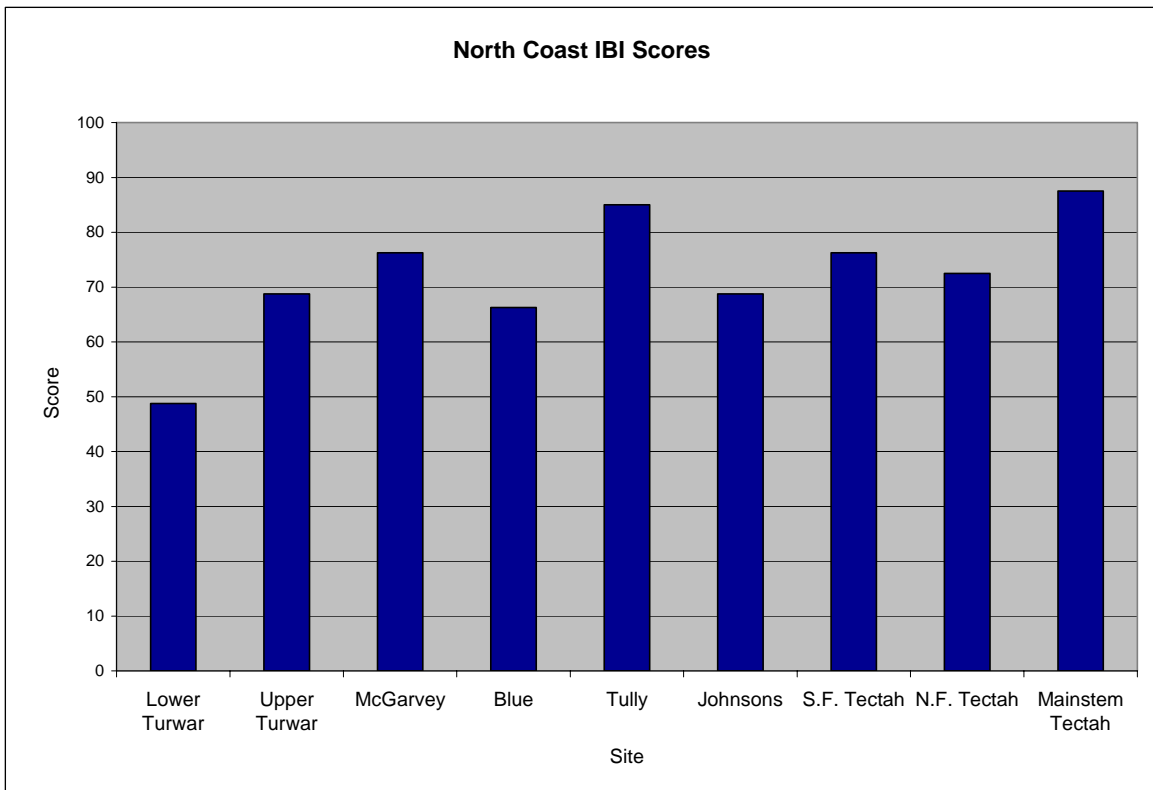


Figure 5-7. North Coast IBI Scores for Klamath River Tributaries.

Table 5-3. IBI Scoring Key

Total Metric Score	Value
0-20	very poor
21-40	poor
41-60	fair
61-80	good
81-100	very good
>52	"unimpaired"

Table 5-4. North Coast IBI Scores for Klamath River Tributaries

SITE	DATE	EPT Richness	Coleoptera Richness	Diperta Richness	% Intolerant	% non-Gastropod Scraper	% Predator	% Shredder	% non-insect	Score Total
Lower Turwar	4/21/2009	7	5	3	5	6	3	2	8	48.75
Upper Turwar	4/22/2009	7	7	6	7	10	8	2	8	68.75
McGarvey	4/17/2009	10	9	4	7	6	8	9	8	76.25
Blue	6/15/2009	9	9	9	4	3	8	4	7	66.25
Tully	4/29/2009	8	10	10	8	10	5	8	9	85
Johnsons	4/24/2009	8	7	6	4	9	5	8	8	68.75
S.F. Tectah	6/1/2009	9	10	4	10	5	7	8	8	76.25
N.F. Tectah	6/1/2009	9	9	6	8	2	7	10	7	72.5
Mainstem Tectah	6/2/2009	9	10	7	10	10	9	7	8	87.5

VI. Discussion

It is important to note all nine sampling sites in this sample set yielded at least 450 total sampled specimens. According to the SWAMP protocol a minimum of 450 total numbers of specimens is required to generate appropriate statistics for the stream, giving us a statistically significant sampling set from which results were generated.

The North Coast IBI index scores provide a single numerical value for accessing stream health using a combination of metric parameters. The IBI single scoring criterion provides an efficient and effective tool for conclusions about each tributary's overall stream health, and will be the primary focus of this discussion.

Eight of the nine tributary sampling sites were found to be in the range of "unimpaired" of the IBI index. Mainstem Tectah and Tully sampling sites were found to have the healthiest stream habitat with IBI scores ranking "very good" of 87.5 and 85, respectively. The other two branches of Tectah, the North and South Forks, both scored in the upper range of "good" with values of 72.5 and 76.25, respectively. In 2007 the three branches of Tectah, the Mainstem, the North and South Fork, had the three highest scores of all sampling sites with values of 82.5, 77.5, and 88.75 respectively, indicating that the greater Tectah watershed has overall maintained healthy aquatic habitats since 2007.

The Lower Turwar sampling site was the only sampling site that generated an "impaired" IBI score of 48.75. This IBI score is significantly lower than the IBI scores of 61.25 in 2007 and 70.0 in 2008, which are both values ranking the stream condition as "good". In addition, there was a significant drop not only in the NC-IBI score but in the overall diversity of the population sampled. Out of a sub sample of 515 specimens 361 were Chironomidae. It is difficult to conclude exactly what events and impacts caused a decreased IBI score and a low population diversity of macroinvertebrates in 2009 at the Lower Turwar sampling site. The report prepared by Micah Gibson, "Lower Turwar Creek Restoration Effectiveness Monitoring Project" hypothesizes that one major contributing factor was a large storm event between March 15th and March 18th. Gibson adds, "This event was the 2nd largest of the year for Lower Turwar. Even though we followed SWAMP protocol and waited 30 days or longer before [macroinvertebrate] sampling, the event may have created optimal conditions for a proliferation of the

Chironomidae. This large number of Chironomidae contributes to the lower numbers of other taxa, and may be misleading to say that the stream habitat and diversity have changed for the worse. Further macroinvertebrate sampling in the next few years will give us a better understanding of the trends occurring in Lower Turwar Creek.”

All other sampling sites ranked “good” in the IBI index. Upper Turwar had an IBI score of 68.75 which was only slightly lower than scores of 77.5 in 2007 and 71.25 in 2008. Interestingly, Upper Turwar was sampled the day after Lower Turwar but did not have a significantly low IBI score or population density in response to the large storm event of March 15th through March 18th. Of the other sites ranking good, McGarvey had an IBI score of 76.25, Blue had an IBI score of 66.25, and Johnsons had an IBI score of 68.75. In summary, of the nine Klamath Tributary sites sampled in 2009 six ranked “good”, two ranked “very good”, and one ranked “fair (impaired)”.

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Appendix

To view the sampling protocol that YTEP employed in collecting its macroinvertebrate samples in 2009 please view the pdf titled “Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California”.