

# YUOK TRIBE



## FINAL

### Macroinvertebrate Report: 2007

April 2007 – June 2007

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## **I. Introduction**

This report summarizes the methods and results of macroinvertebrate sampling conducted on the mainstem and selected tributaries of the lower Klamath River within the Yurok Indian Reservation (YIR) boundaries for water year 2007 (WY07). The Yurok Tribe Environmental Program (YTEP) collected macroinvertebrate samples at two sites on the mainstem of the Lower Klamath River in October, and 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

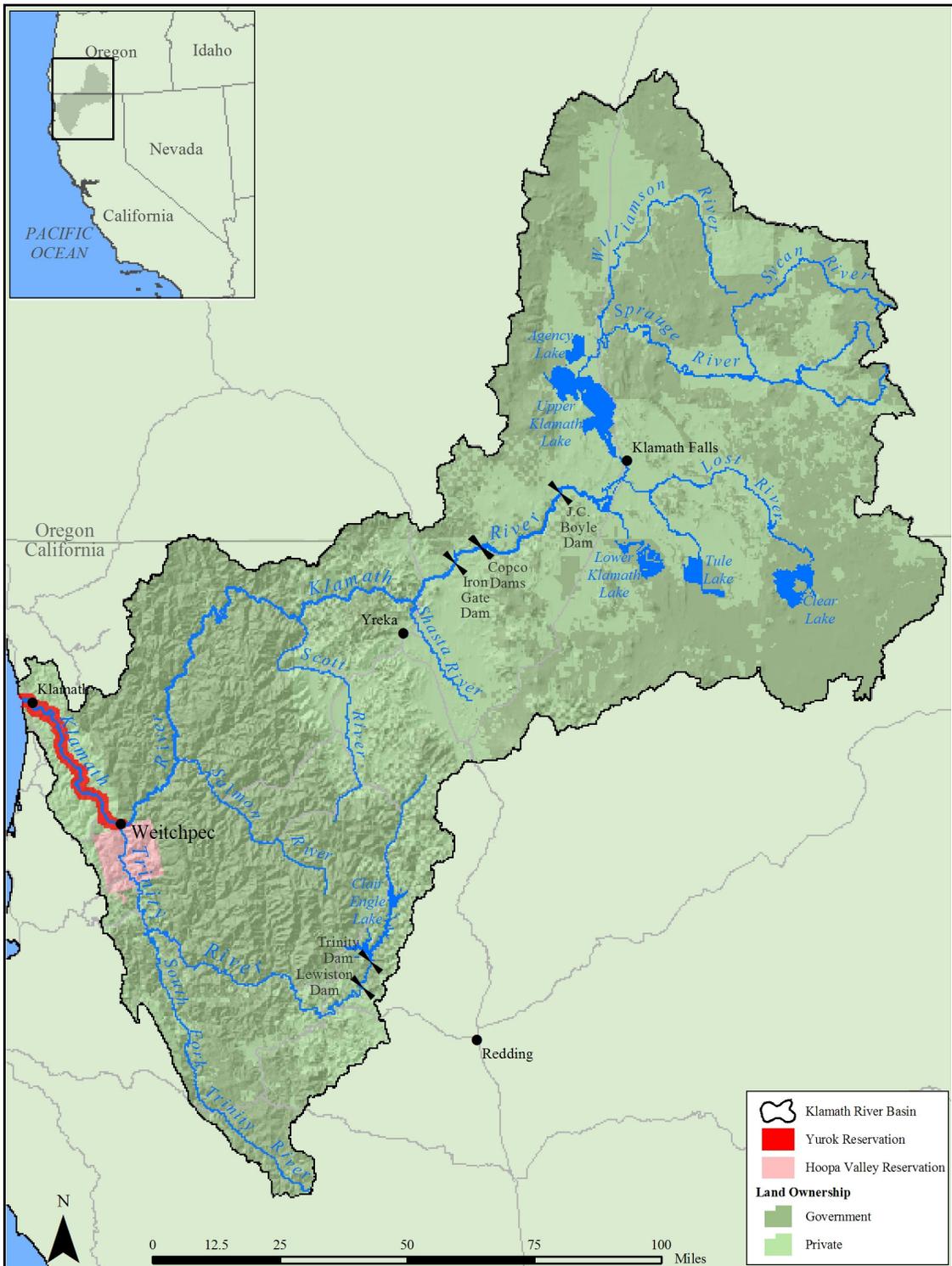


Figure 2-1. Klamath River Basin Map

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.

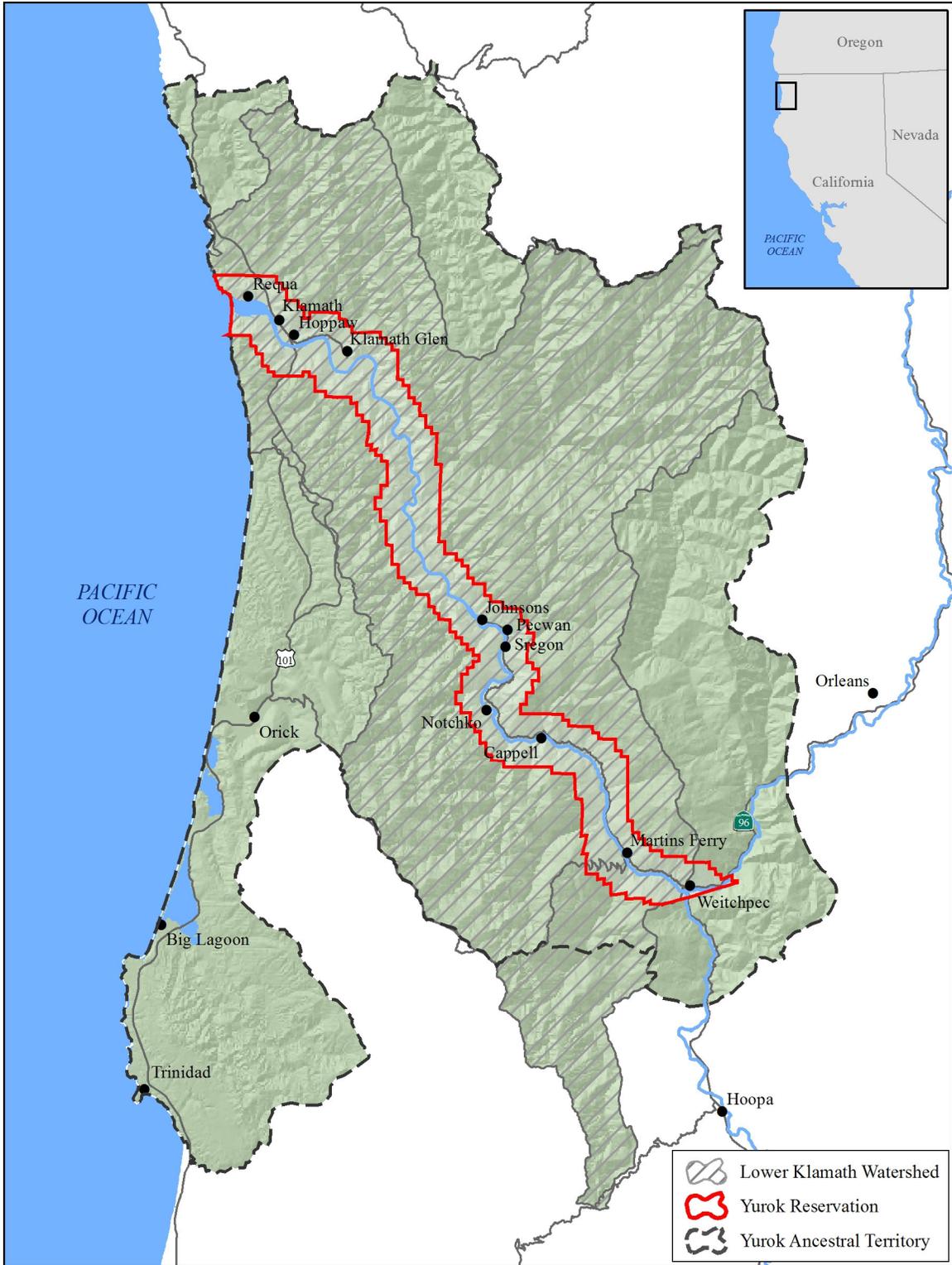
### ***The Klamath River***

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**

#### ***Mainstem***

Site selection criteria for macroinvertebrate sampling in the mainstem Klamath River included collecting additional information to compliment the ongoing water quality sampling. Sites were also selected to represent spatial distribution throughout the YIR. Sampling sites were selected based on the river characteristics that would allow the sampling crew to collect samples in a riffle. Riffles were selected that were safe to wade and allowed the sampling crew to collect kick samples. The following sites met the objectives of this study: Klamath River upstream at Ah Pah riffle (Figure 2-1) and Klamath River at Johnsons (Wautec) (Figure 2-2).

#### ***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.
5. *Klamath Mainstem Water Quality Characterization*- Sites located in the main stem Klamath River in order to compliment the on going water quality studies and characterization.

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), Lower Blue (Figures 3-11, 3-12), Mainstem Tectah (Figures 3-7, 3-8), North Fork Tectah (Figures 3-7, 3-9), South Fork Tectah (Figures 3-7, 3-10), Johnsons (Figures 3-15, 3-16), and Tully (Figures 3-13, 3-14). Two mainstem locations (Table 3-2, Figure 3-1) were also selected based on these parameters. They are Klamath River at Ah Pah (Figures 3-17, 3-18) and Klamath River at Johnson (Figures 3-19, 3-20).

**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	
Lower Blue	Blue	Lower Blue	Lb1	1	3	2
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	
Johnson	Johnson	Johnson	Jo1	2	1	
Tully	Tully	Tully	Ty1	1	4	2

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

**Table 3-2. Selection criteria priority matrix for mainstem macroinvertebrate sampling\***

Site Name	Watershed	Sub watershed	Site ID	Primary Criteria	Secondary Criteria	Other
Klamath River at Ah Pah	Klamath	Lower Klamath	AP1	5	1	
Klamath River at Johnson	Klamath	Lower Klamath	KJ1	5	1	

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

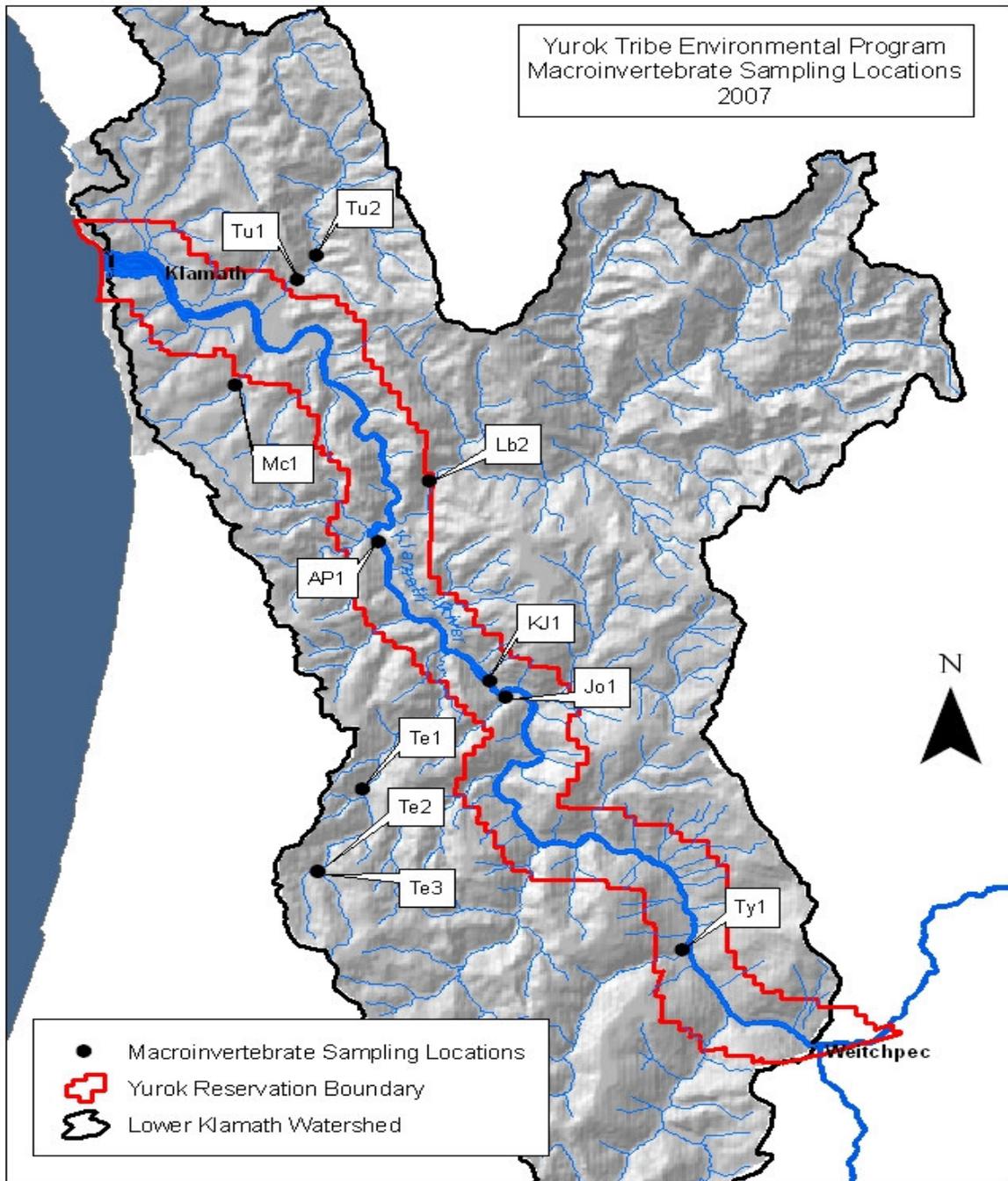


Figure 3-1. Yurok Tribe Environmental Program macroinvertebrate sampling site locations, 2007

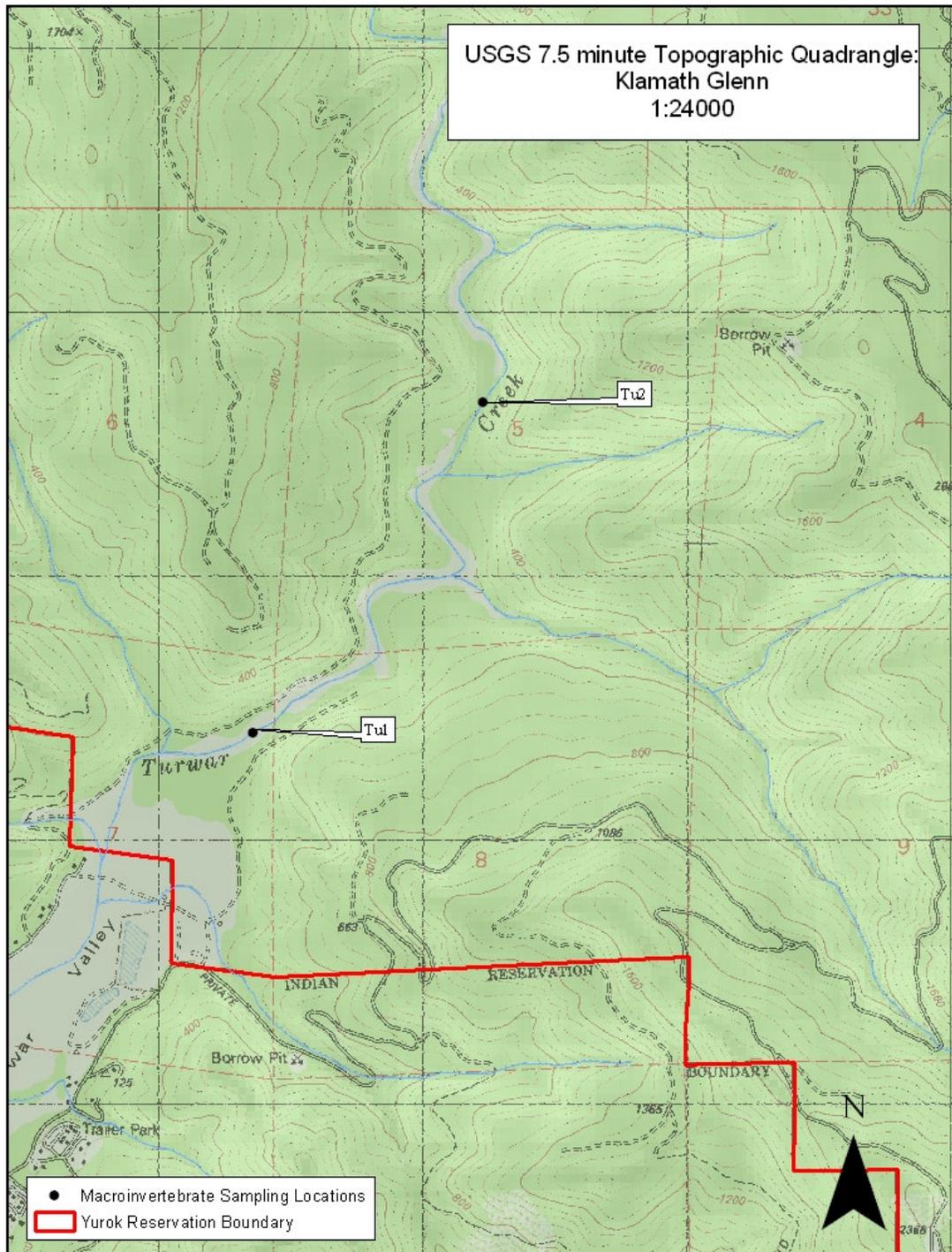


Figure 3-2. Lower (Tu1) and Upper (Tu2) Turwar Sampling Location Map, WY '07



**Figure 3-3. Photo of Lower Turwar (Tu1) Sampling Location, WY '07**



**Figure 3-4. Photo of Upper Turwar (Tu2) Sampling Location, WY '07**

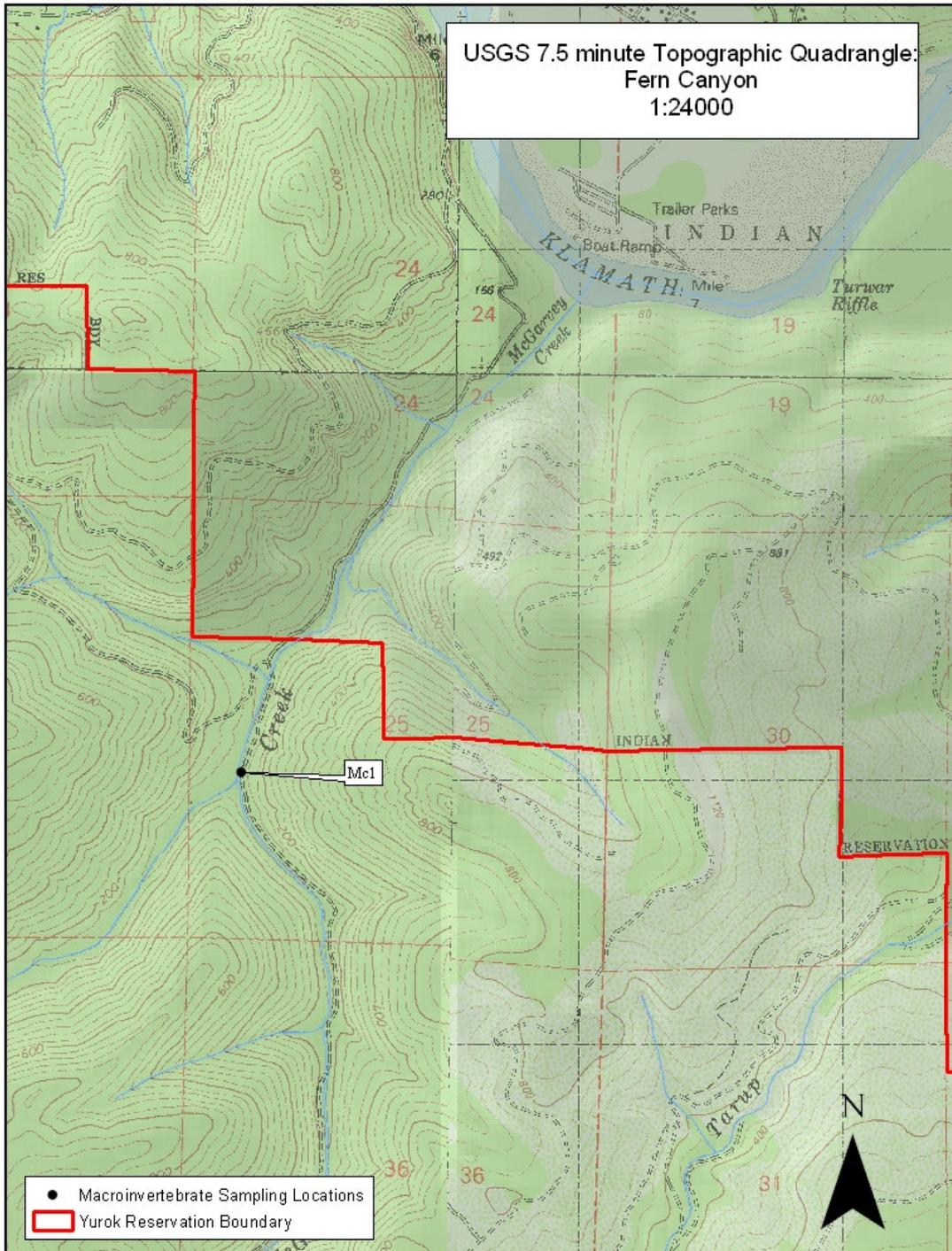


Figure 3-5. McGarvey Creek (Mc1) Sampling Location Map, WY '07



**Figure 3-6. Photo of McGarvey Creek (Mc1) Sampling Location, WY '07**

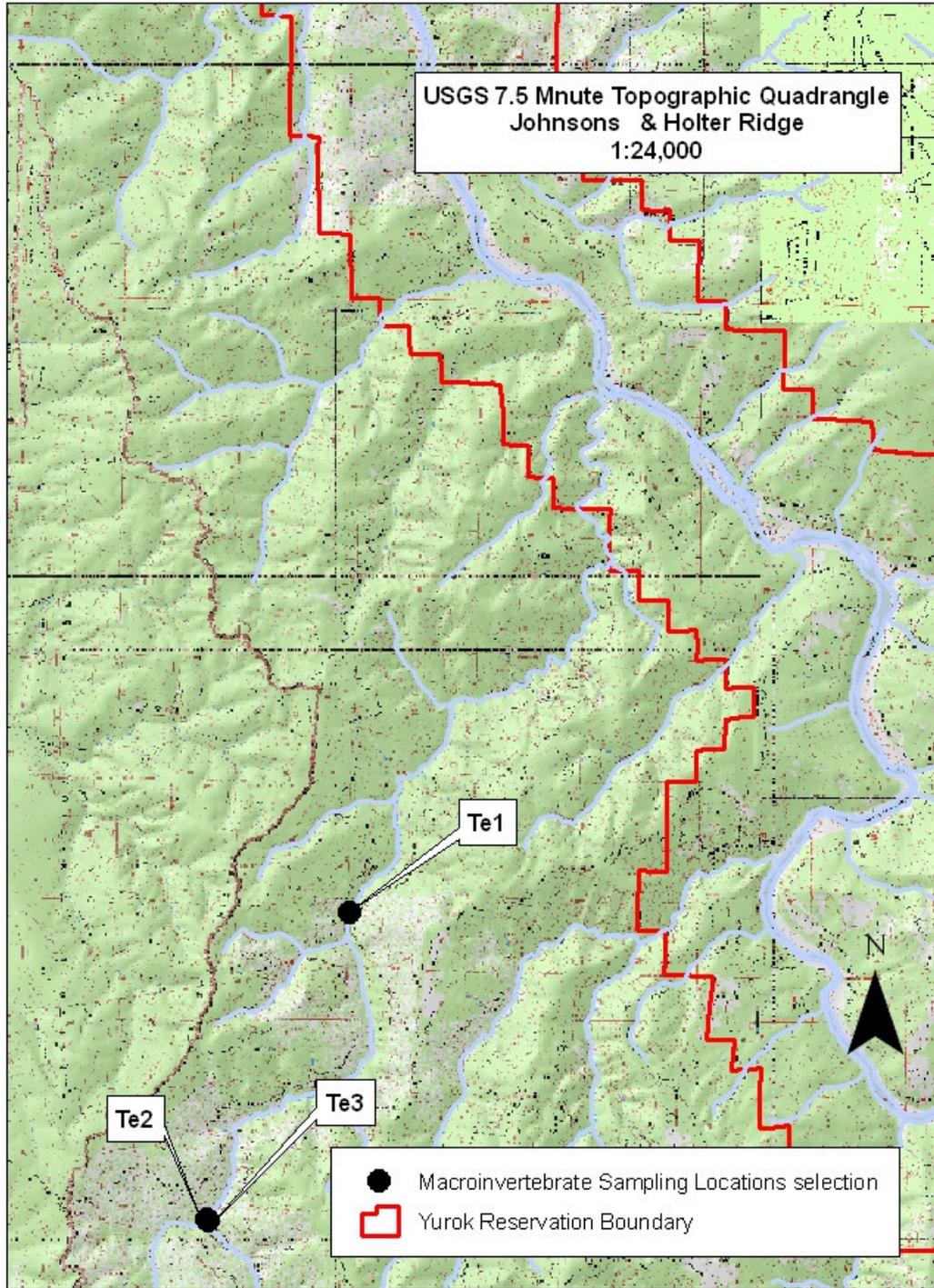


Figure 3-7. Tectah Creek (Te1, Te2, Te3) Sampling Locations Map, WY '07



**Figure 3-8. Photo of Mainstem Tectah Creek (Te1) Sampling Location, WY '07**



**Figure 3-9. Photo of North Fork Tectah Creek (Te2) Sampling Location, WY '07**



**Figure 3-10. Photo of South Fork Tectah Creek (Te3) Sampling Location, WY '07**

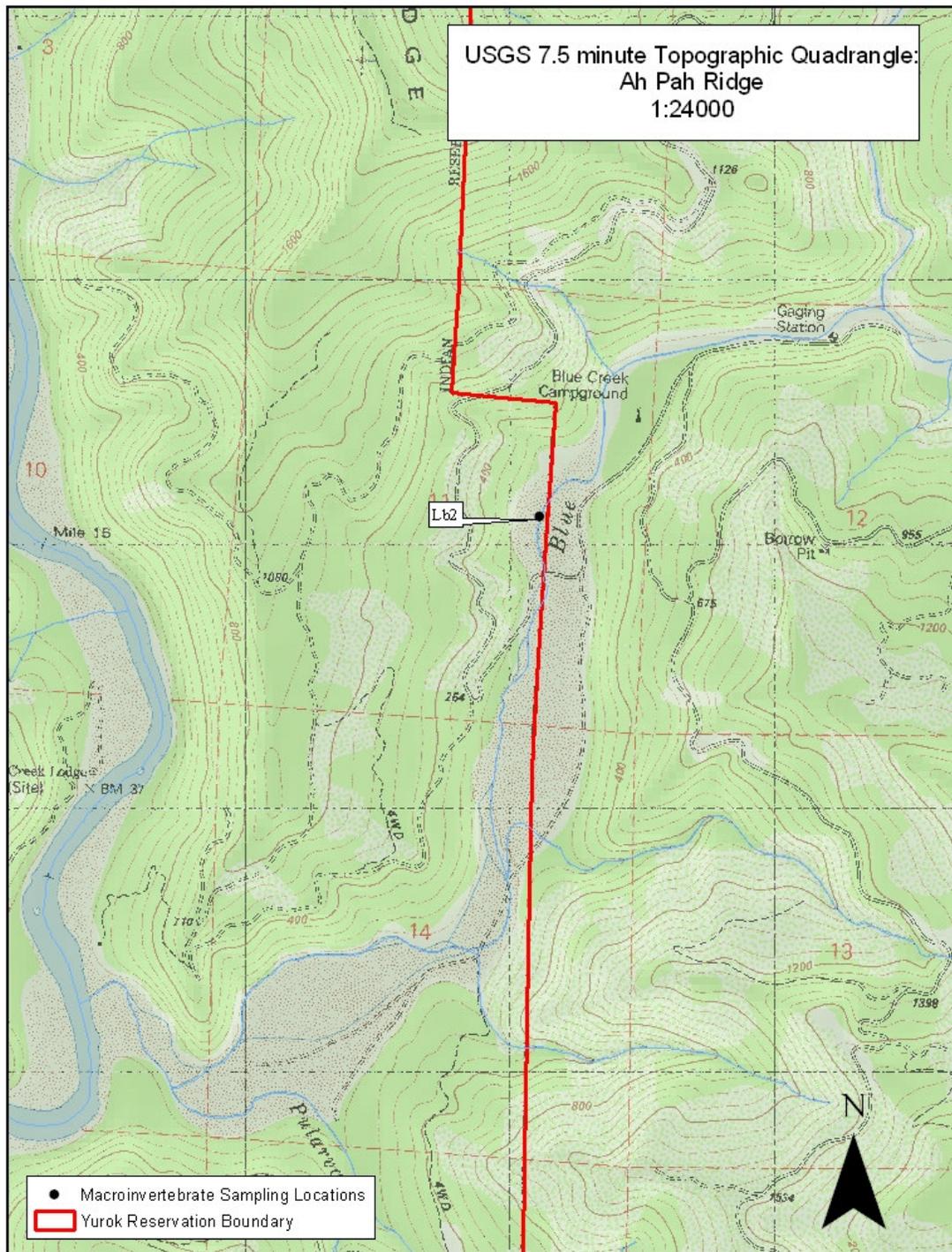


Figure 3-11. Lower Blue Creek (Lb1) Sampling Location Map, WY '07



**Figure 3-12. Photo of Lower Blue Creek (Lb1) Sampling Location, WY '07**

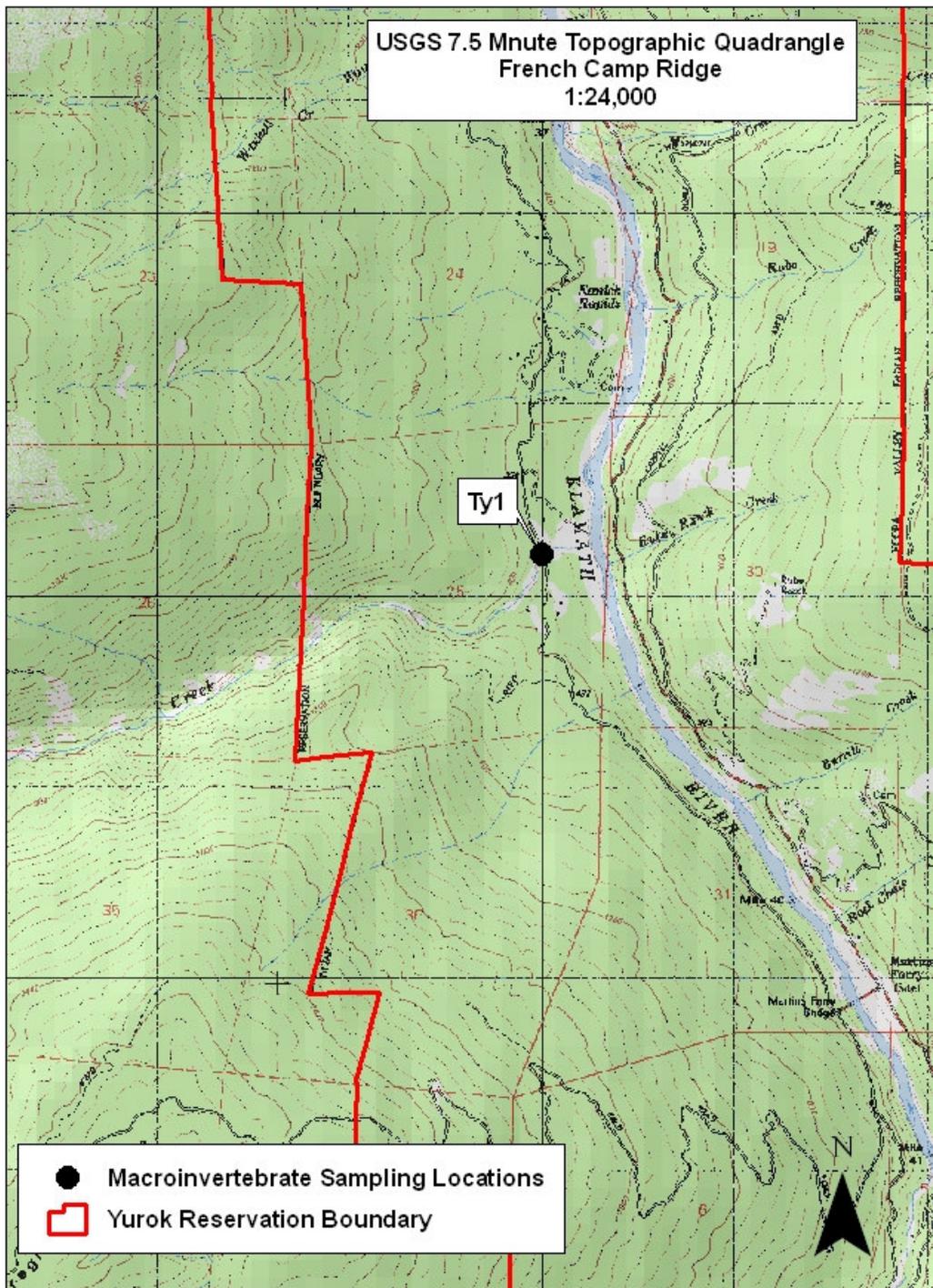


Figure 3-13. Tully Creek (Ty1) Sampling Location Map, WY '07



**Figure 3-14. Photo of Tully Creek (Ty1) Sampling Location, WY '07**

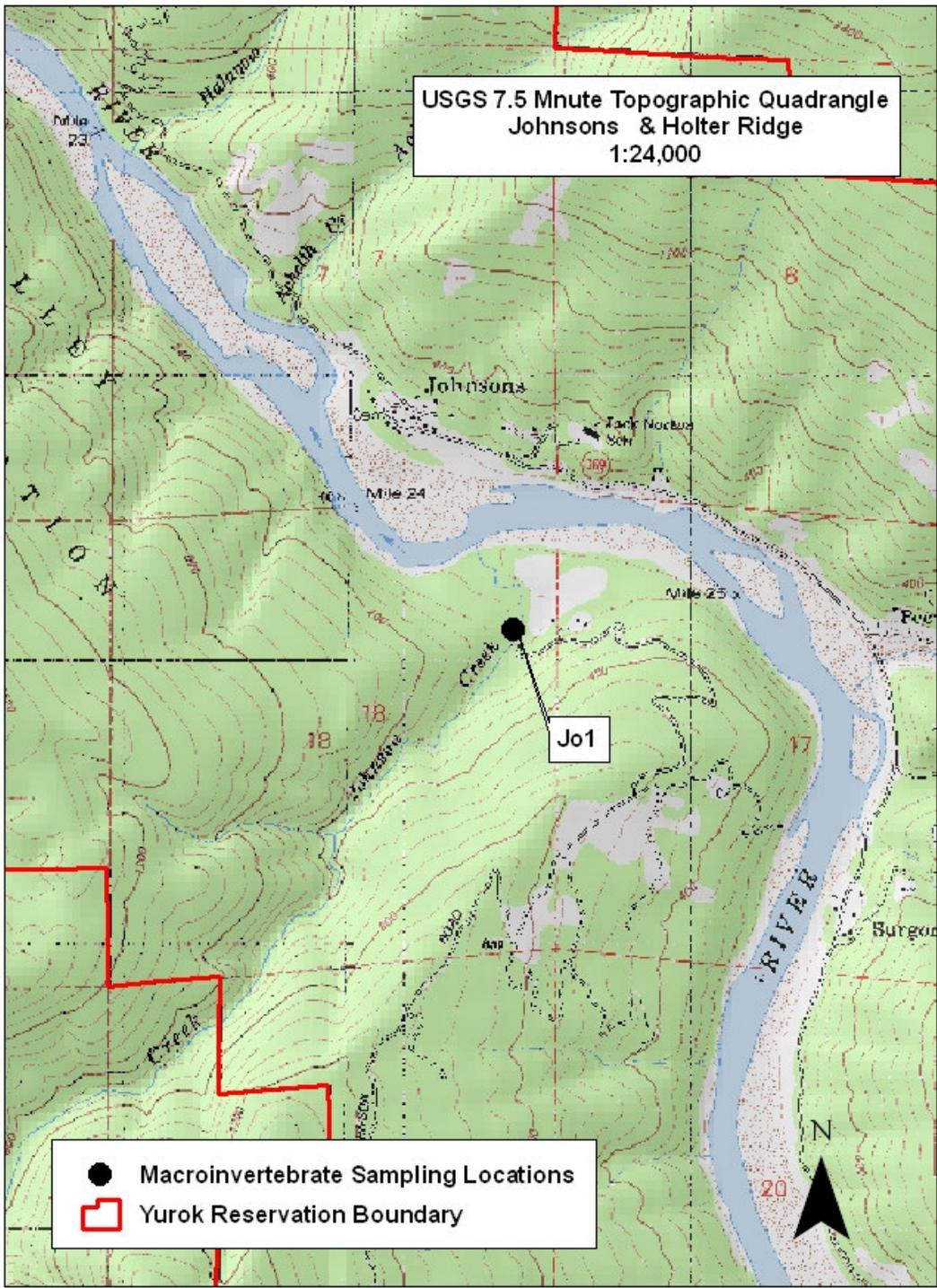


Figure 3-15. Johnson's Creek (Jo1) Sampling Location Map, WY '07



**Figure 3-16. Photo of Johnson's Creek (Jo1) Sampling Location, WY '07**

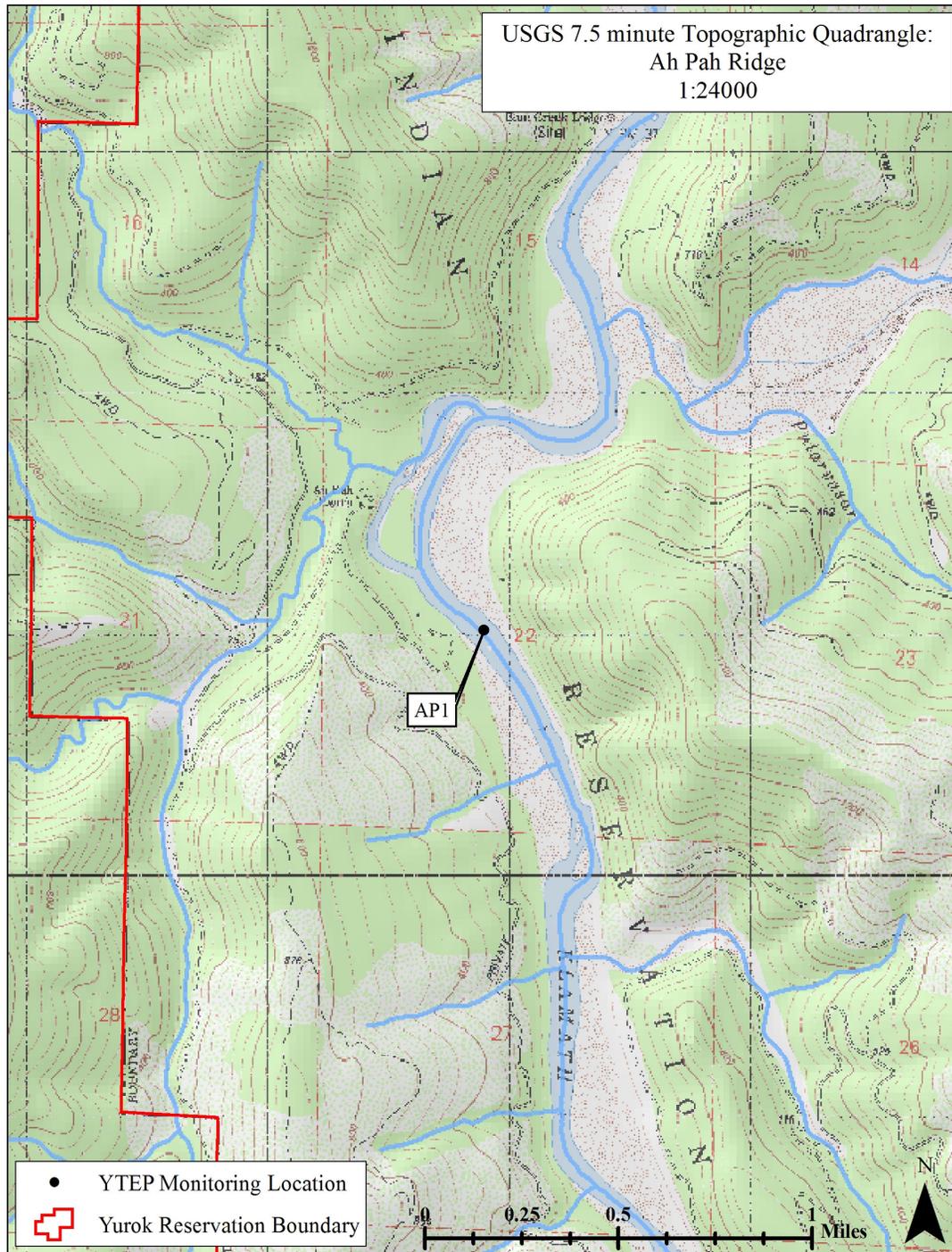


Figure 3-17. Klamath River at Ah Pah Map WY07



**Figure 3-18. Photo of Klamath River at Ah Pah sampling location, WY '07**

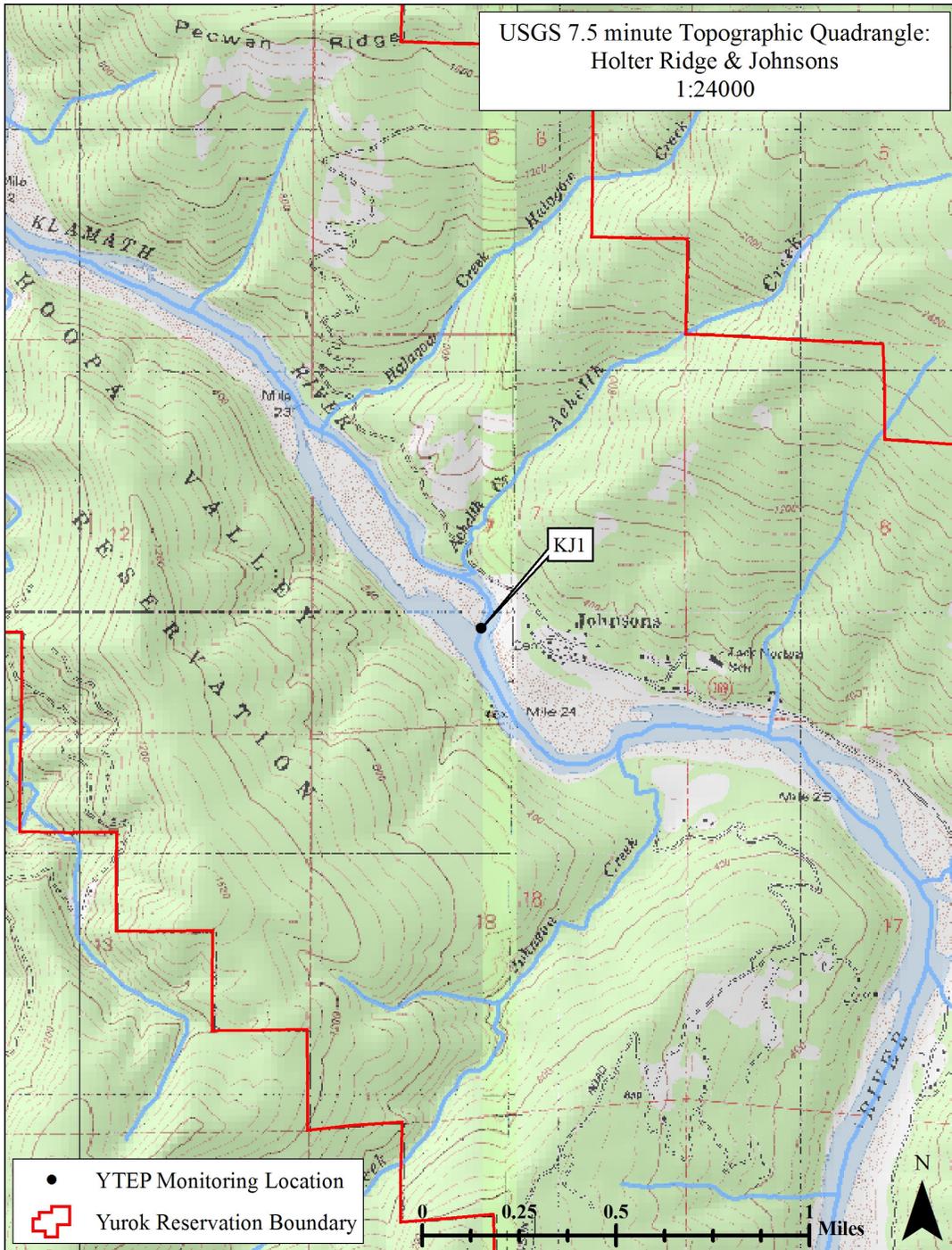


Figure 3-19. Klamath River at Johnson's Map, WY07.



**Figure 3-20. Photo of Klamath River at Johnsons Sampling Location, WY '07.**

#### **IV. Methods**

YTEP sampled benthic macroinvertebrate populations in selected tributaries of the Lower Klamath River and at two locations along the Klamath River 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 2007* 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

The Assistant Director, Program Technician 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 QC 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 and 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, etc. that had come in contact with the sample 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 DFG 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 WY07 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 0-2 and 0-3, Figures 3-1 and 3-2)
- *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 0-2 and 0-3, Figures 3-3 and 3-4)
- *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 0-2 and 0-3, Figures 3-5 and 3-6)
- *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 0-2 and 0-3, Figures 3-7 and 3-8).

- *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 0-2 and 0-3, Figures 3-9 and 3-10).
- *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 0-2 and 0-3, Figures 3-11 and 3-12)

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. Reduced species richness were an artifact of reduced sample size.

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.

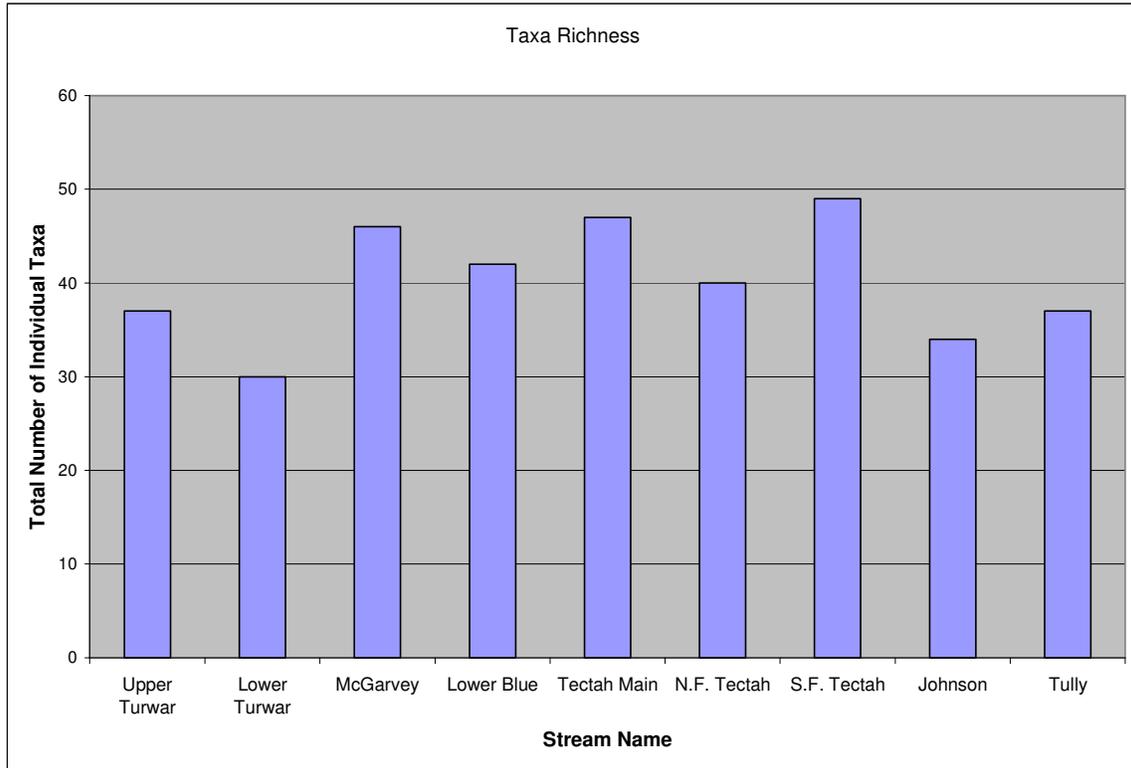
**Table 5-1. Reported macroinvertebrate metrics for lower Klamath tributary sites sampled in WY07**

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
Upper Turwar	1	4/25/2007	506	37	19	37.35	22.53	3.20	2.84	2032
Lower Turwar	1	5/7/2007	505	30	21	39.41	40.79	3.70	2.24	2621
McGarvey	1	4/16/2007	500	46	28	27.00	28.40	3.91	2.66	1012
Lower Blue	1	6/7/2007	503	42	20	21.47	34.79	4.49	2.47	1341
Tectah Main	1	5/10/2007	510	47	26	26.08	21.37	3.89	2.91	1606
N.F. Tectah	1	5/9/2007	510	40	28	65.49	33.73	2.66	2.53	1821
S.F. Tectah	1	5/9/2007	516	49	26	44.38	13.76	3.15	3.04	2136
Johnson	1	5/8/2007	502	34	20	21.71	50.00	4.27	2.18	3792
Tully	1	6/1/2007	368	37	17	22.28	20.38	3.61	2.80	368

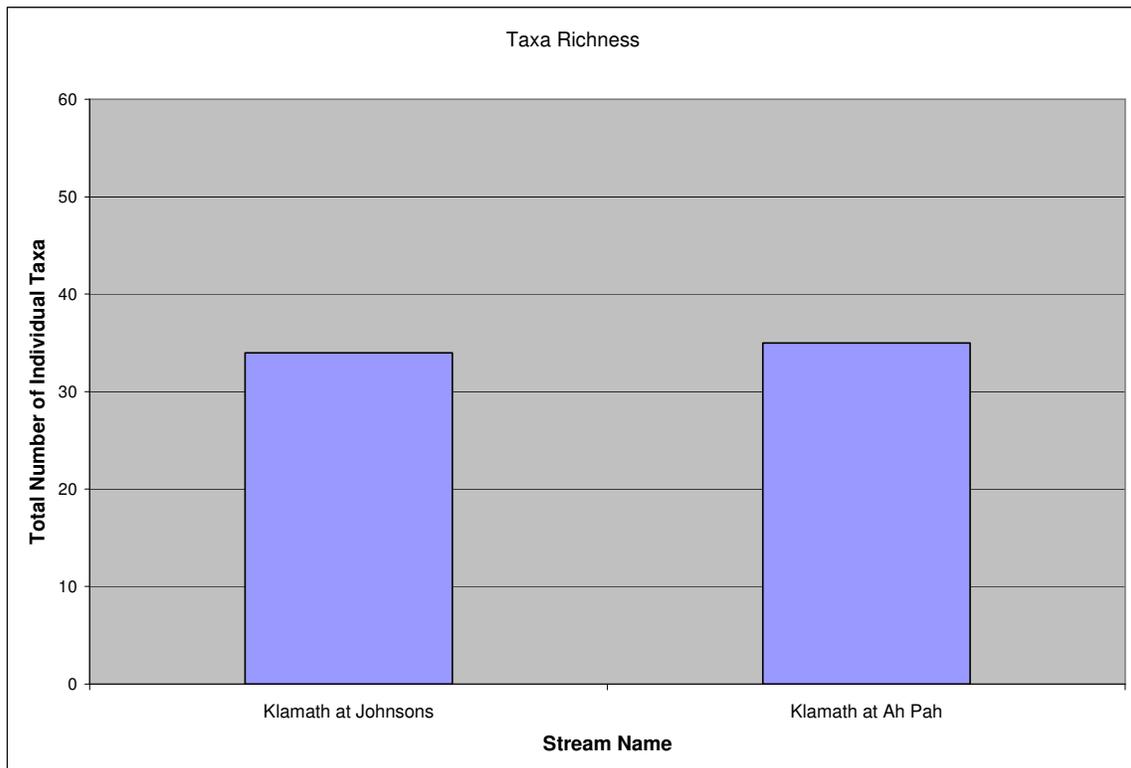
**Table 5-2. Reported macroinvertebrate metrics for lower Klamath mainstem sites sampled in WY07**

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
Klamath at Johnsons	1	10/1/2007	518	34	15	2.12	24.32	4.21	2.51	17376
Klamath at Ah Pah	1	10/1/2007	506	35	16	2.17	24.90	4.42	2.45	13656

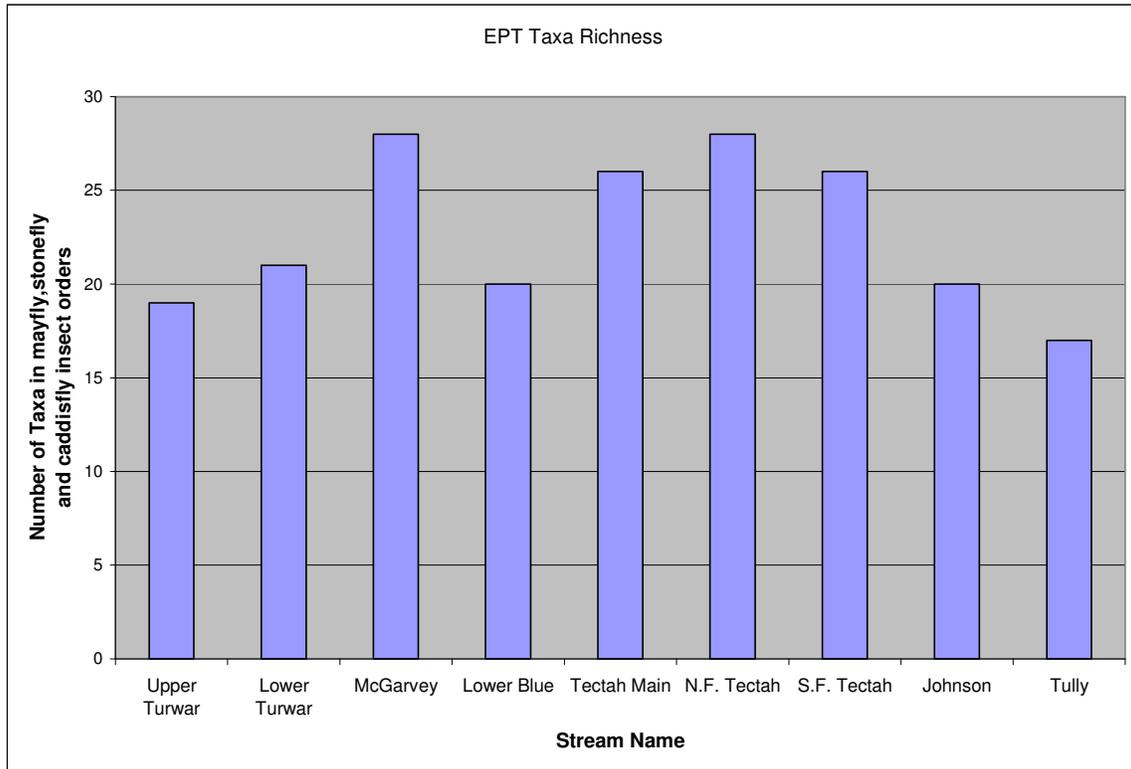
**Figure 5-1. Taxa Richness for Klamath River Tributaries**



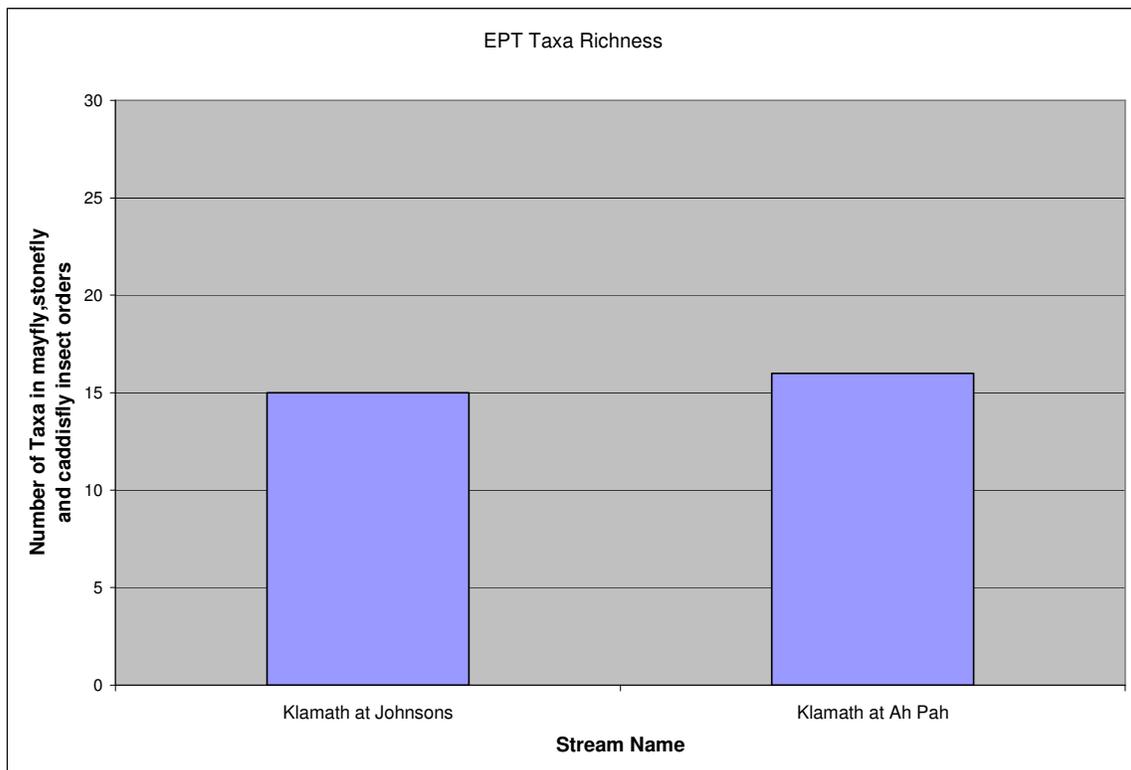
**Figure 5-2. Taxa Richness for Klamath River Mainstem**



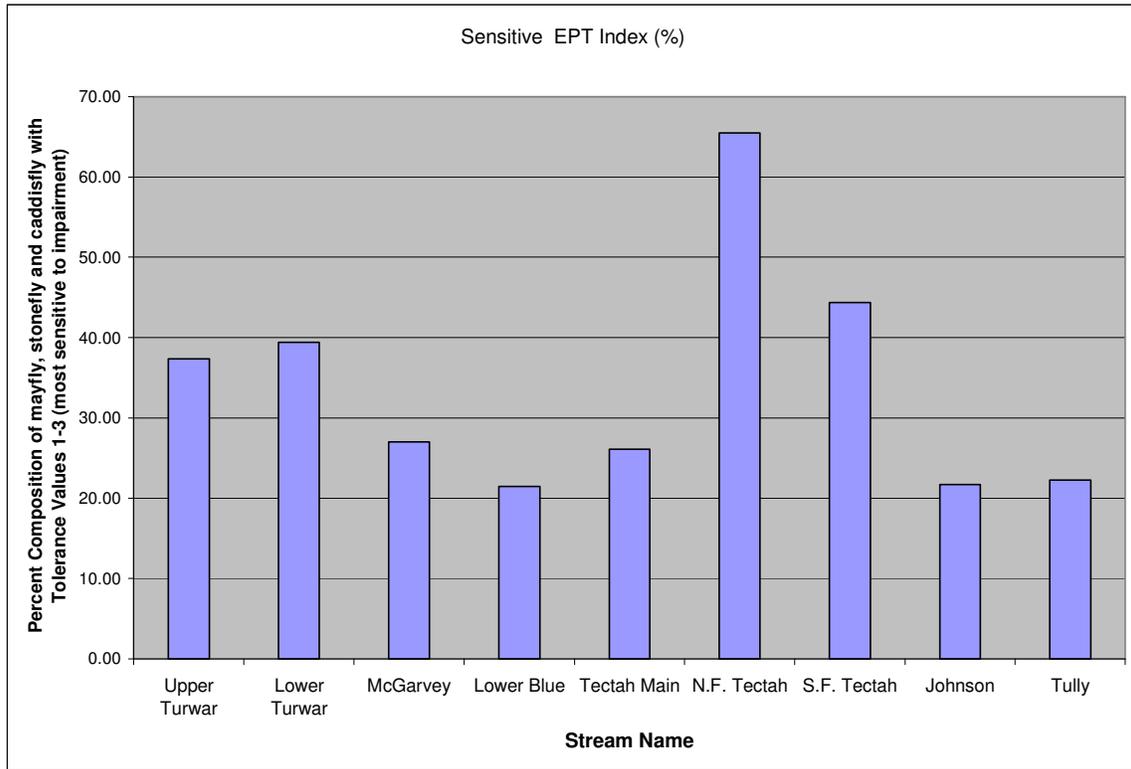
**Figure 5-3. EPT Taxa Richness for Klamath River Tributaries**



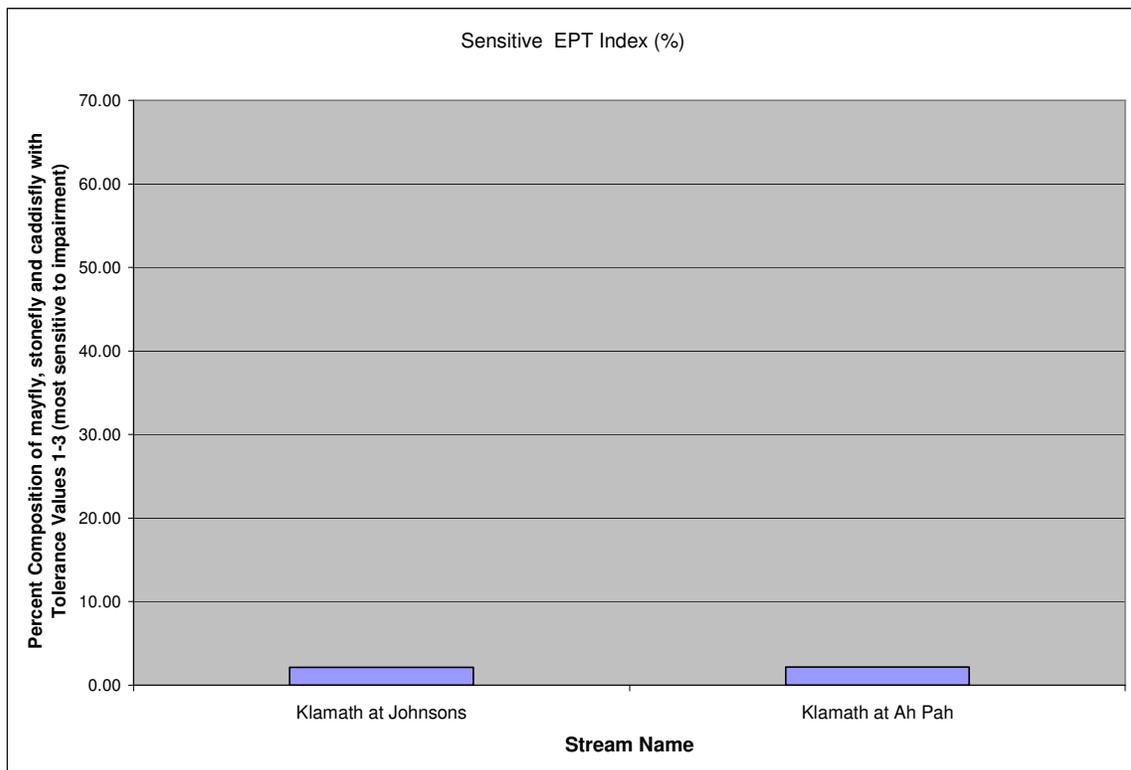
**Figure 5-4. EPT Taxa Richness for Klamath River Mainstem**



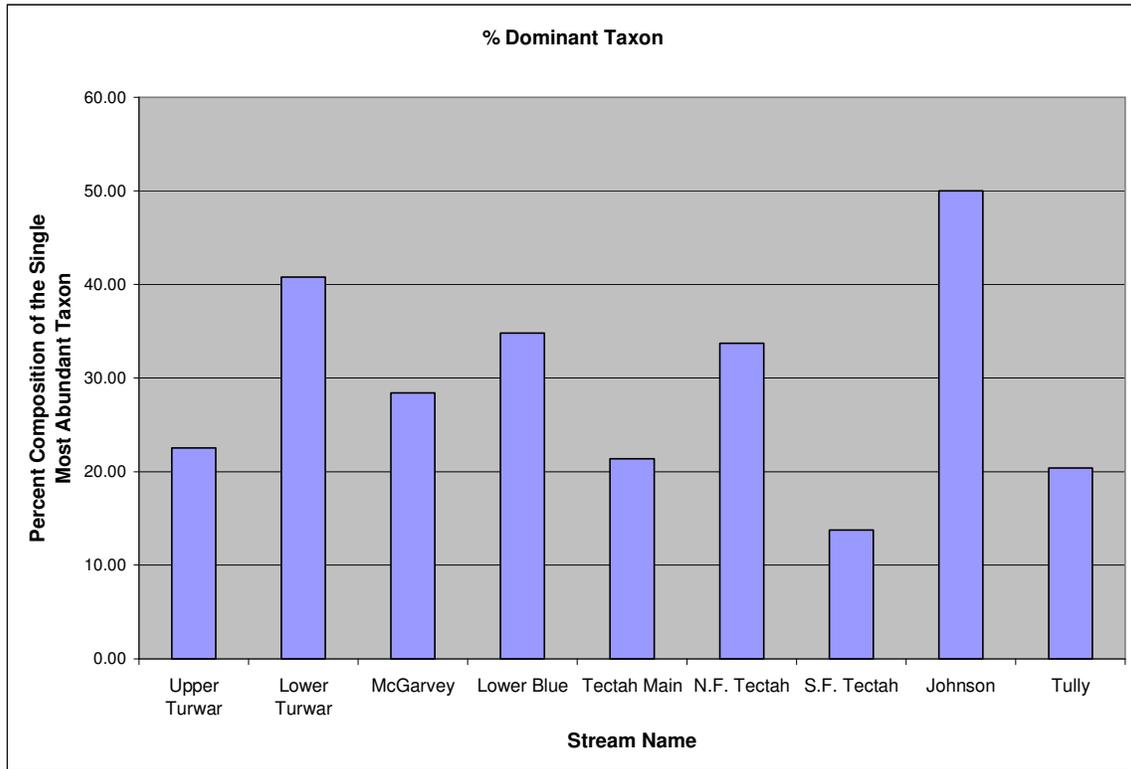
**Figure 5-5. Sensitive EPT Index (%) for Klamath River Tributaries**



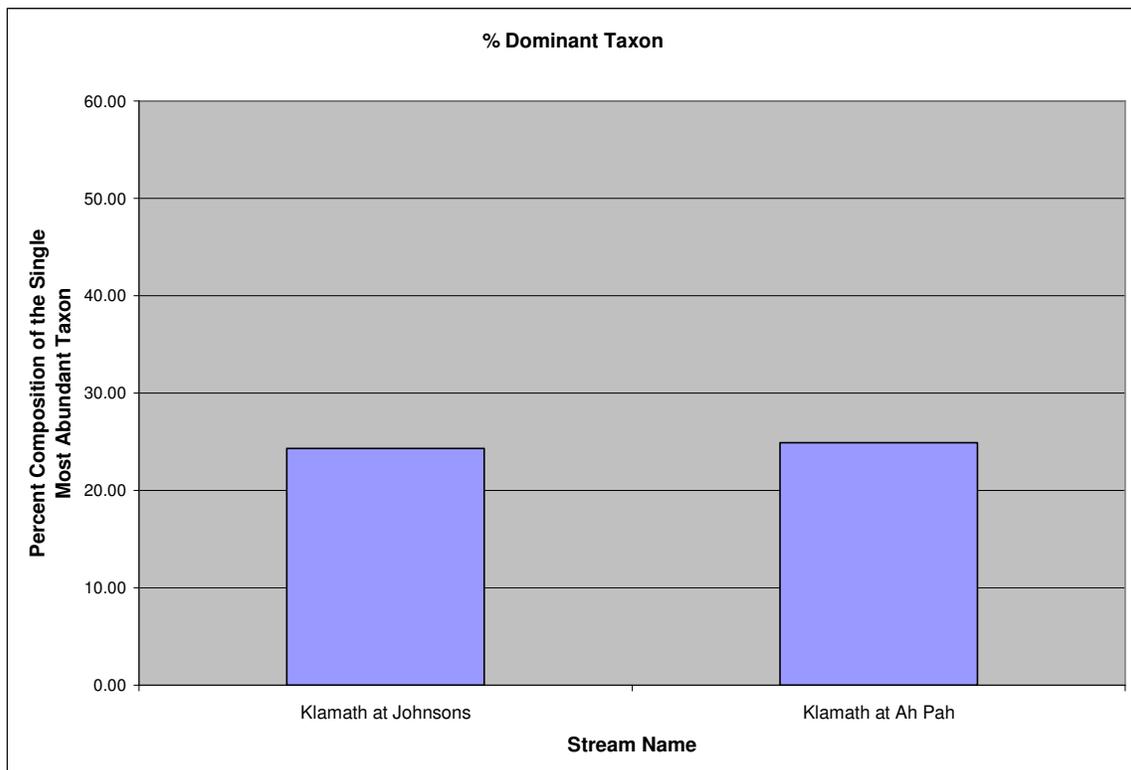
**Figure 5-6. Sensitive EPT Index (%) for Klamath River Mainstem**



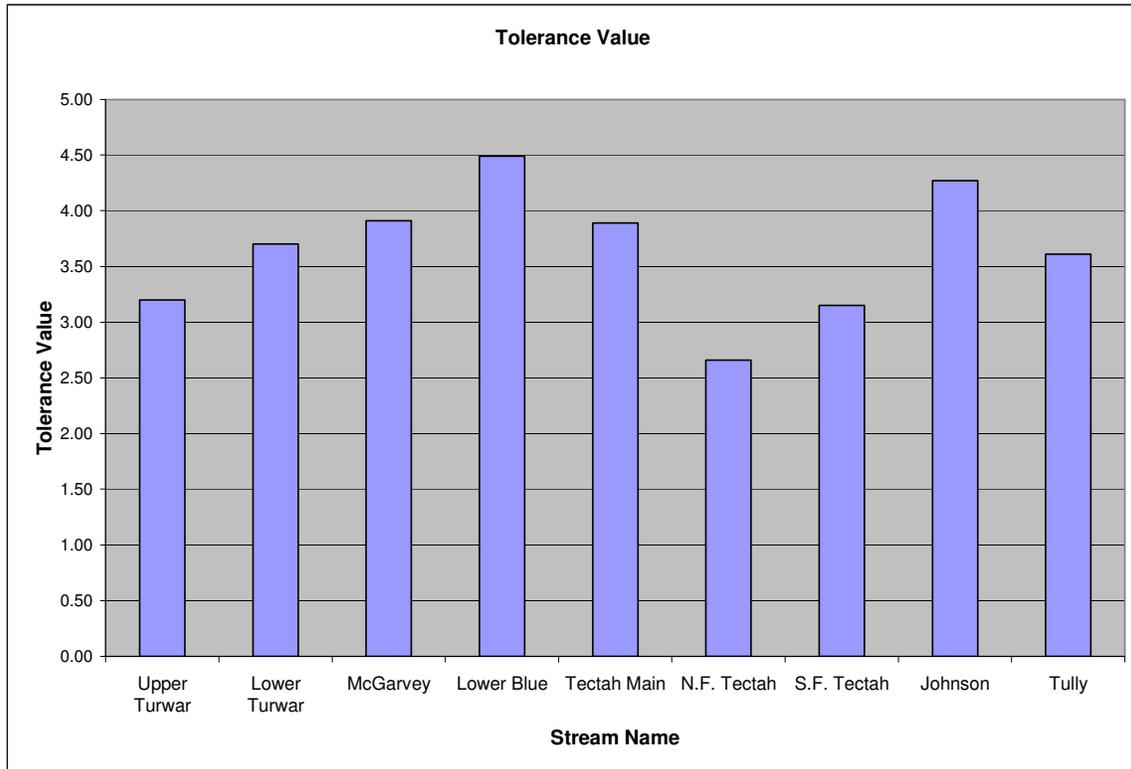
**Figure 5-7. % Dominant Taxon for Klamath River Tributaries**



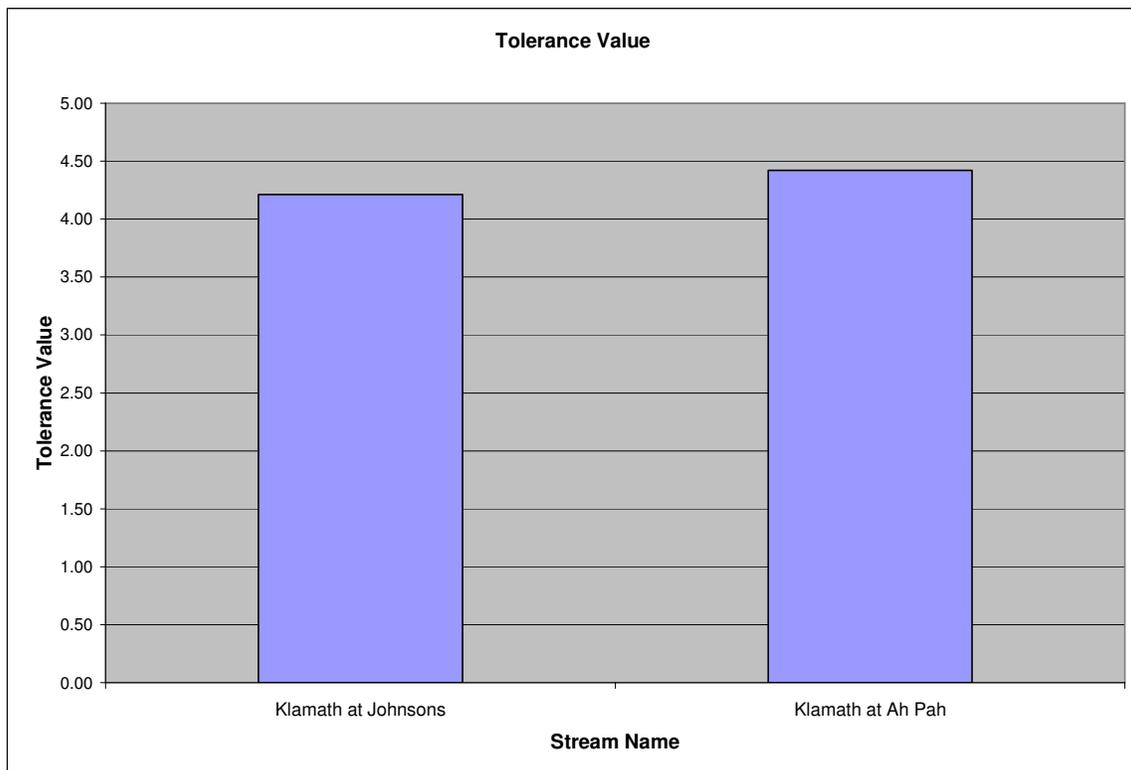
**Figure 5-8. % Dominant Taxon for Klamath River Mainstem**



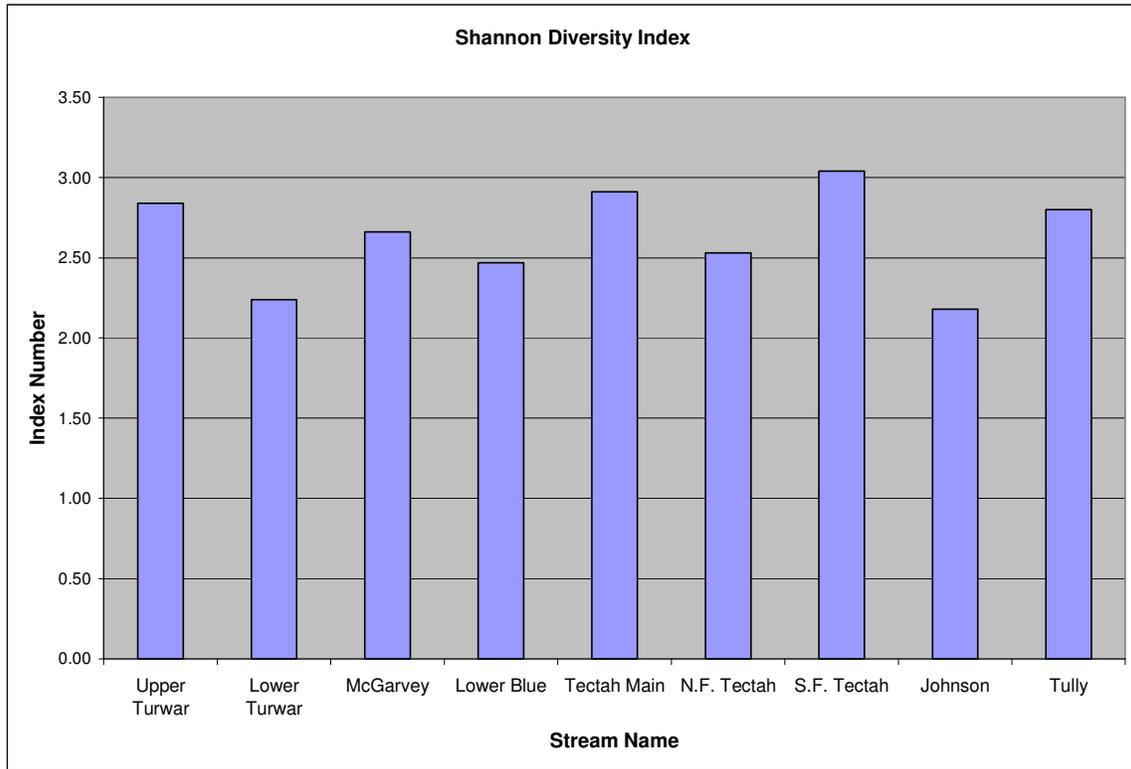
**Figure 5-9. Tolerance Values for Klamath River Tributaries**



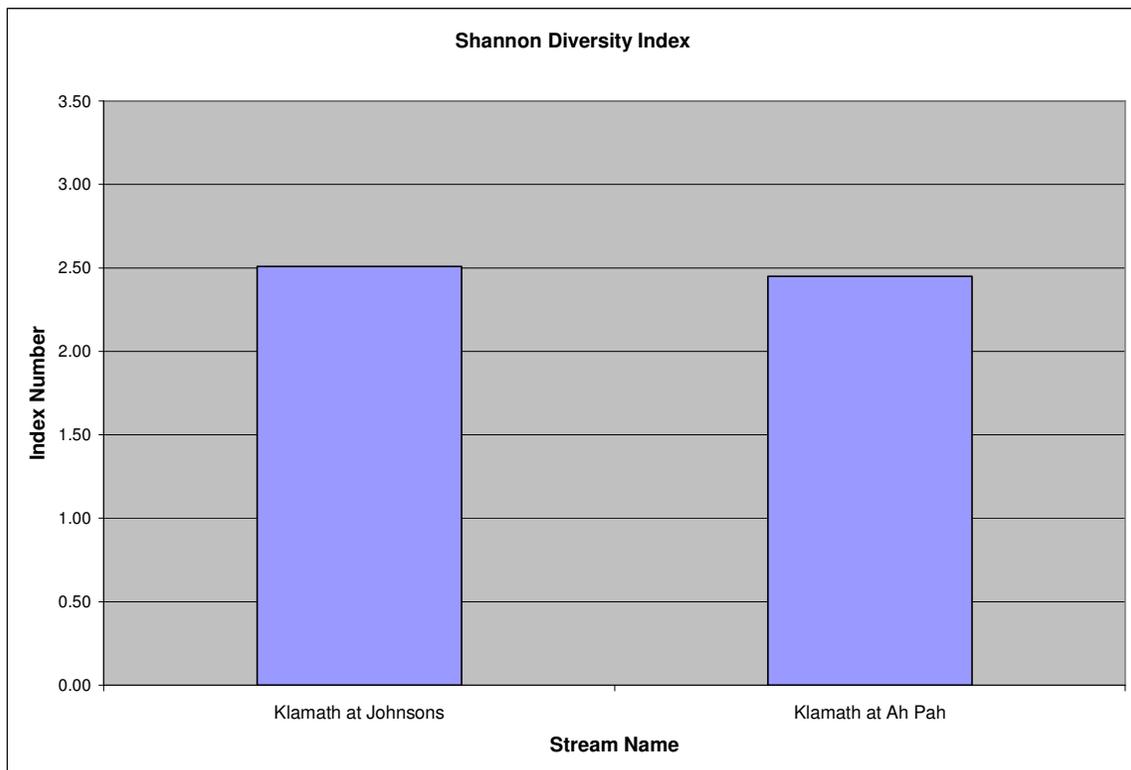
**Figure 5-10. Tolerance Values for Klamath River Mainstem**



**Figure 5-11. Shannon Diversity Index for Klamath River Tributaries**

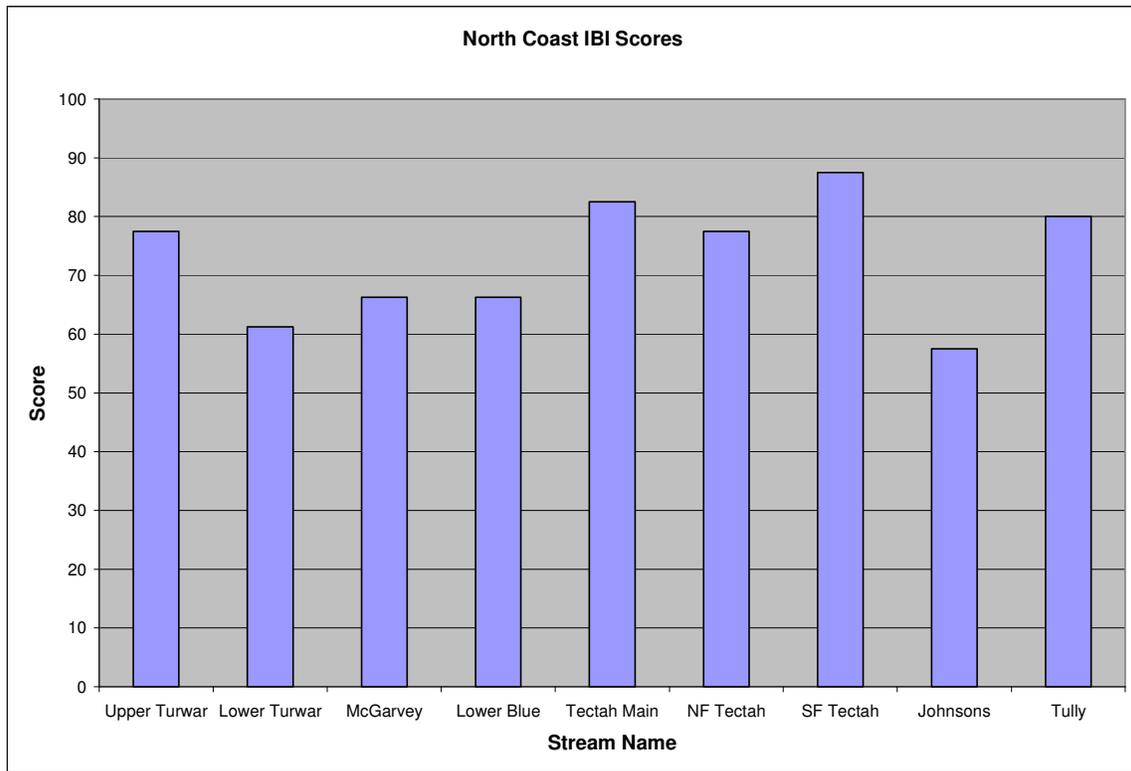


**Figure 5-12. Shannon Diversity Index for Klamath River Mainstem**



Macroinvertebrate results are presented for WY07 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 WY07. The results of this ranking method are as follows, along with the IBI scoring key.

**Figure 5-13. North Coast IBI Scores for Klamath River Tributaries**



**Table 5-3. North Coast IBI Scores for Klamath River Tributaries**

<b>SITE</b>	<b>DATE</b>	<b>EPT Richness</b>	<b>Coleoptera Richness</b>	<b>Diptera Richness</b>	<b>% Intolerant</b>	<b>% non-Gastropod Scraper</b>	<b>% Predator</b>	<b>% Shredder</b>	<b>% non-Insect</b>	<b>Score Total</b>
Upper Turwar	4/25/07	7	10	7	8	10	9	3	8	77.5
Lower Turwar	5/7/07	8	3	4	8	8	5	4	9	61.25
McGarvey	4/16/07	10	9	3	5	8	7	4	7	66.25
Lower Blue	6/7/07	7	9	7	6	8	5	4	7	66.25
Tectah Main	5/10/07	10	10	9	6	10	5	7	9	82.5
NF Tectah	5/9/07	10	7	4	10	6	6	10	9	77.5
SF Tectah	5/9/07	10	10	8	9	10	5	10	8	87.5
Johnsons	5/8/07	7	5	4	4	6	5	8	7	57.5
Tully*	6/1/07	6	10	7	6	10	10	7	8	80

\*Samples with less than 450 organisms were not included in the development of the North Coast IBI

**Table 5-4. IBI Scoring Key**

<b>Total metric score</b>	<b>Value</b>
0-20	very poor
21-40	poor
41-60	fair
61-80	good
81-100	very good

## **VI. Discussion**

It is important to note that one tributary site (Tully Creek) in this sample set was recorded to yield less than 450 total numbers of 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. Tully Creek data is included in this report for comparison to both past and future macroinvertebrate surveys at this site, however, due to statistically unsound data, it will not be compared to other sites for WY07. The mainstem sites of Klamath River at Johnson's and Klamath River at Ah Pah, while also included in this report, are not compared to the tributary sites in the following discussion because the North Coast IBI was developed for wadeable streams.

The data shows Blue Creek to have the lowest percent of intolerant individuals of all streams sampled with an IBI value of 4. Johnson was found to have the most impaired stream health based on the final tallied metric score, with a summed IBI value of 60. All three branches of Tectah, the North and South forks as well as the main stem scored the highest, receiving scores of 77.5, 88.75, and 82.5 respectively. Upper Turwar also scored quite high with a value of 77.5.

All of the nine tributary sites sampled were found to be in the 'un-impaired' range of the IBI index. The index defines impaired as a score of 52 or below. However, only two sites (S.F. Tectah, and Tectah Main) scored in the 'very good' range, while the rest ranged from 'fair' to 'good.' All of these sample sites exist in areas of either historic and or active logging operations.

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## **Appendix**

To view the sampling protocol that YTEP employed in collecting its macroinvertebrate samples in 2007 please view the pdf titled “Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California”.