BENEFICIAL USE RECONNAISSANCE
MONITORING AND ASSESSMENT REPORT

Waterbody: Giraffe Creek Watershed: Bear River

Hydrologic Unit Code: WYBR16010102 Segment: 010

Investigators: Tavis Eddy (WDEQ/WQD) and Jules Feck (WDEQ/WQD Intern). Also present, Bruce Bauman, surface landowner.

INTRODUCTION

The entire reach of Giraffe Creek is classified by Chapter 1, Appendix A of the Water Quality Rules and Regulations (Unlisted Waters section) as a Class 2, coldwater stream (WDEQ/WQD, 2000). Designated uses for Giraffe Creek include: Agriculture, Protection and propagation of fish (coldwater game fish) and wildlife, Industry, Human Consumption, Recreation, and Scenic value. Giraffe Creek originates on Table Mountain in the Gannett Hills of eastern Idaho and flows into the Bridger-Teton National Forest. Once in Wyoming the creek flows south-southeast before joining Salt Creek (Class 2), a tributary to the Thomas Fork of the Bear River system.

Giraffe Creek was included in the WDEQ/WQD Monitoring Program because the Idaho DEQ had conducted assessments on the upper reaches of this system, which are located within Idaho. That agency had indicated some limitations on the system's integrity and expressed concerns regarding nutrient loading (Idaho DEQ, 1999). The prominent landuse influences may be wetlands manipulation, removal of riparian vegetation and/or pastureland grazing. The Idaho Department of Environmental Quality is involved with data and decisions pertaining to the integrity of the upper Thomas Fork tributaries. As a system that originates in Idaho and then joins the Salt Creek system in Wyoming prior to its return into Idaho, data sharing is vital in assessment. The state of Idaho has expressed concerns regarding the influences such tributaries have upon the waters and designated uses within Idaho. For Giraffe Creek the related issues of habitat stability, sediment, Total Phosphorus and Nitrogen have been the central aspects of focus and are presented in the 'Historical and Ancillary Information' section.

One bioassessment station was established on this segment on October 8, 1998. Within the same day bioassessment work was conducted on the receiving waters of Salt Creek. A separate assessment report discussing the assessment of Salt Creek is available. Water chemistry, biological (benthic macroinvertebrates), and physical (habitat quality) data were collected at the Giraffe Creek site in accordance with the department's bioassessment sampling and analysis plan (King, 1993a), Nonpoint Source Program Quality Assurance Project Plan (WDEQ/WQD, 1993), and Surface Water Quality Assurance Project Plan (WDEQ/WQD, 1989).

The weather at the time of the sampling was clear, dry, and sunny. Local residents observed precipitation in the form of snow and rain at this location 4 days prior to the assessment. It is not felt the precipitation event resulted in a departure from normal base flow water quality at the station.

DESCRIPTION OF BIOASSESSMENT STATIONS

A single bioassessment station was established on Giraffe Creek (Table 1). The station was located approximately 1/4 mile upstream of the confluence of Giraffe Creek with Salt Creek. A single station immediately upstream of the confluence with Salt Creek was deemed adequate to assess the Wyoming portion of the Giraffe Creek watershed.

Table 1. 1998 Bioassessment Station, Giraffe Creek.

Site Name	*Site ID Code*	*Section, Township-Range*	*Latitude*	*Longitude*	*Elevation(ft.)*	*USGS 7.5 Min. Map*
Bauman	MRW83	Sw 1/4 Ne1/4 Section 20 T28N R119W	42 °24' 13.35"	-110° 59' 56.97"	6320	Salt Flat, Wyo

The latitude-longitude coordinates were determined from a corrected GPS reading. The site is within Lincoln County, Wyoming.

RESULTS AND DISCUSSION

Physical Setting

This station was located to assess the integrity of Giraffe Creek and, in addition, to understand the influence it exerts upon the Salt Creek system. This site is within the mountainous landform of the Middle Rockies West ecoregion. The predominant geology in the immediate area of this sample station was determined to be part of the Gannett Group (Kg), which includes red sandy mudstone, chert-pebble conglomerate and thin limestones(Love and Christianson 1985). The soil type (series or association) at these stations has not been mapped and could not be determined. The state wide digital soils map of Wyoming (Munn and Arneson, 1998) lists the general soil taxonomy (order/suborder/great group/subgroup) at this station to be Typic Hapludolls and Typic Hapludalfs, loamy-Skeletal, mixed, frigid. Hapludolls are mollisols (thick, dark mollic epipedon), humid (ud) soils with minimal horizonation (hapl). Hapludalfs are alfisols (moist mineral soils with no mollic horizon) with similar suborder and great group characteristics. These soils occur in foothill valley bottoms along the flank of the higher mountains and represent a transition from the basins to the higher mountains.

Livestock grazing was determined to be the primary land use. As is evident in the photos, the vegetation in the surrounding meadow was vigorous and healthy but the woody species were limited along the riparian edge. Willows, common along Salt Creek immediately downstream, were essentially absent in the assessment reach. No secondary land use was identified. Additional station characteristics are presented in Table 2.

Table 2. Stream Characteristics, Giraffe Creek.

Site Name	*Discharge (C.F.S.)*	*Drainage Area (square miles)*	*Stream Order*	*Rosgen Classification*
Giraffe Creek - Bauman	15.87	22	4	C4

The assessment reach on the Giraffe Creek system, as shown in the table above, was a C4 stream system. This stream type is a slightly entrenched, meandering, gravel-dominated, riffle/pool channel with a well-developed floodplain. The streambanks of this type are commonly composed of unconsolidated, heterogenous, non-cohesive, alluvial materials that are finer than the gravel dominated bed material. Therefore, such systems can be susceptible to accelerated bank erosion. This could be further intensified in that the limited willow cover leaves little for root support along the banks. In a C4 scenario such as this the rates of lateral adjustment are largely a function of the presence and condition of riparian vegetation, coupled with the flow and sediment regimes of the contributing watershed(Rosgen 1996). This system does have the potential for lateral morphological adjustment.

Photographs taken at the sampling station include: upstream, downstream, and panoramic views. These photographs can be found in the Giraffe Creek assessment file. The sample riffle is observable in the photographs, as is the surrounding vegetation.

Water Quality

Water quality samples were taken at the Giraffe Creek sampling locations on October 8, 1998. The data were collected, preserved, transported and analyzed in accordance with procedures outlined in the department's Surface Water Quality Assurance Project Plan (WDEQ/WQD, 1989). All water quality data were evaluated for quality assurance and quality control and met data quality objectives. Water quality parameters and results for the Giraffe Creek station are found in Table 3.

Table 3. Water Quality Parameters and Results, Giraffe Creek, October 8, 1998.

Parameter (units)		**Parameter (units)**	
Time (hours)	11:20	Alkalinity (mg/l)	220
Temperature (°C)	5.2	Chlorides (mg/l)	89.0
pH (Standard Units)	8.47	Sulfate (mg/l)	68
Conductivity (µS/cm)	772	Total Hardness (mg/l)	257
Dissolved Oxygen (mg/l)	10.62	Total Phosphorus (mg/l	<0.1
Turbidity (NTU)	1.05	Nitrate Nitrogen (mg/l)	<0.1
Total Suspended Solids (mg/l)	2.0		

The mid-day water temperature observed in Giraffe Creek on October 8,[th] was 5.2° C and well below the WDEQ/WQD (2000) maximum allowable stream temperature of 25.6° C for cold water fisheries. This reading was taken late in the season, but does not suggest a temperature impairment during base flow conditions.

The pH value observed in Giraffe Creek (8.47 standard units) was basic (greater than 7 standard units) but was below the WDEQ/WQD (2000) upper limit standard of 9.0 standard units.

Dissolved oxygen is the amount of free oxygen available to aquatic organisms. As with temperature and pH, it can exhibit considerable diurnal fluctuation. With an increase in temperature the oxygen content of the water can decrease. In systems with heavy algal growth the dissolved oxygen may fluctuate greatly as photosynthesis increases oxygen concentrations during the day and respiration reduces oxygen concentrations during the night. Dissolved oxygen levels observed in Giraffe Creek (10.62 mg/l) were well above the 4.0 mg/l one day minimum coldwater criteria for non-early life stages and also greater than the 8.0 mg/l for early life stages (WDEQ/WQD, 2000).

Conductivity is a field measurement used to evaluate the level of dissolved constituents in the water. The more dissolved substances present, the higher the conductivity measurement. There are no WDEQ/WQD surface water quality standards for conductivity, however King (1990) reported an aquatic organism negative response when conductivities were greater than 6,900 µS/cm. The conductivity values for the Giraffe Creek sample (772 µS/cm) were relatively high but below threatening levels. This conductivity is not uncommon for waters flowing through a watershed with sedimentary rock geology.

Turbidity is an optical property of water where total suspended solids (TSS) and some dissolved material causes light to be scattered. An increase in turbidity and TSS has been shown to decrease the production and abundance of plant material, decrease abundance of fish food organisms, and decrease production and abundance of fish (Lloyd, 1987). The WDEQ/WQD (2000) numeric standard for turbidity deals with turbidity increases attributable to the activities of man. The WDEQ/WQD (2000) narrative standard for floating and suspended solids states that activities attributable to man shall not cause significant degradation of habitat for aquatic life or adversely affect plant life or wildlife. Lloyd's (1987) literature review of the effects of turbidity on salmonids suggested that turbidities in the 10-25 NTU range and TSS concentrations near 35 mg/l can have deleterious effects on fish. Newcombe and Jensen's (1996) literature review suggest TSS values between 18 and 35 mg/l can result in reduced feeding and abundance, and TSS values in the range of 50 to 66 mg/l can result in reduced rates of weight gain and avoidance behavior in adult rainbow and cutthroat trout. For the Giraffe Creek System the turbidity was a low 1.05 NTU and the TSS values were 2.0 mg/l. These parameters alone do not indicate a significant sedimentation threat to coldwater fish under base flow conditions at the time of sampling.

Alkalinity refers to the capacity of water to neutralize the addition of acid. Alkalinity is also important for primary production (bacteria and algae) in streams, which directly affects the macroinvertebrate community. Generally, as alkalinity increases, stream production increases (King, 1993a). There is no numeric alkalinity standard in Wyoming, but a minimum limit of 20 mg/l has been set by the U.S. Environmental Protection Agency (1986). The Giraffe Creek levels(220 mg/l) were well above this minimum threshold.

Chlorides and sulfates are the two principal dissolved components in water. Increased chloride or sulfate levels can have a negative effect on benthic macroinvertebrates. WDEQ/WQD (2000) water quality standards set aquatic life acute and chronic chloride standards of 860 mg/l and 230 mg/l, respectively. There is no surface water numeric standard for sulfates in Wyoming, however, King's (1993a) review suggests sulfate levels below 150 mg/l were optimal for macroinvertebrates. Acute chloride level was 89 mg/l and the sulfate level was 68 mg/l on Giraffe Creek at the time of sampling. These levels suggest that these parameters were not causing a negative impact to the aquatic life during base flow conditions. The sulfates for the Giraffe Creek station were also below levels which would threaten the macroinvertebrate community.

Total hardness in stream water is related to the concentration of metals (metallic ions). Common metallic ions that contribute to hardness include calcium and magnesium. When the hardness is numerically greater than the sum of carbonate and bicarbonate alkalinity, the excess is called noncarbonate hardness. Metallic ions that contribute to the noncarbonate hardness component may include iron, strontium, and/or manganese. There is no total hardness water quality standard in Wyoming, however, if a large disparity between total hardness concentrations are observed between reference streams and the stream being assessed, sampling for specific metals should be conducted (King, 1993a). The total hardness of Giraffe Creek (280 mg/l) indicates "hard" water. Total hardness values for three reference streams in the "Overthrust" area of the Middle Rockies - West Ecoregion (Hams Fork - Campground, Fontenelle Creek - Upper, and Salt River) ranged from 156 to 213 mg/l with a mean of 178mg/l. The level of hardness in Giraffe Creek was higher than those at the reference sites but is not uncommon for waters flowing through a watershed comprised of sedimentary geology and has not suggested a metallic ion problem.

Phosphorus is an essential element for plant growth and is considered one of two primary nutrients associated with human-induced pollution. Even low levels of phosphorus (>0.2 mg/l) can stimulate growth of algae, periphyton, and bacteria. Naturally occurring phosphorus enters the stream primarily by soil erosion and sediment transport. Additional sources of phosphorus can include municipal and industrial effluents, and runoff from animal feeding areas and fertilized lands (King, 1993a). Wyoming has not established water quality standards for phosphorus, however, King's (1993a) literature review suggests total phosphorus levels should not exceed 0.05 mg/l in a stream that enters a lake or reservoir and suggests a target total phosphorus concentration of $\leq$1.0 mg/l for streams that do not directly enter lakes. The total phosphorus level for Giraffe Creek was <0.1 mg/l and does not suggest a significant phosphorus loading problem during base flow conditions. The channel does not immediately enter a lake or reservoir but does influence the system that contributes to Bear Lake.

Several forms of nitrate nitrogen are present in nature. WDEQ bioassessments sample and analyze nitrate → nitrite nitrogen. Nitrate is considered the other of the two primary nutrients associated with human induced pollution. Sources of human induced nitrate concentrations can be from municipal and industrial effluents, animal feeding operations, fertilizer use, and other human and animal waste runoff (King, 1993). Wyoming does not have a nitrate standard for aquatic life, however, the human health standard for nitrate nitrogen is 10 mg/l (WDEQ/WQD, 1998). Nitrate nitrogen levels for Giraffe Creek were <0.1 mg/l. This low concentration does not indicate a nitrate nitrogen nutrient problem in Giraffe Creek during base flow conditions.

Giraffe Creek exhibited no odors and had a slight brown color at the time of the sampling.

Macroinvertebrates and Biological Condition

Macroinvertebrate samples were taken from a 25-foot riffle habitat. Eight surber samples were randomly located at the site and a composite sample was obtained. Samples were collected and preserved according to WDEQ/WQD bioassessment protocols (King, 1993a). No Idaho DEQ macroinvertbrate data is used in this assessment since they did not collect any macroinvertrabte data on Giraffe Creek in the 1994-1995 data collection period.

Macroinvertebrate samples were sent to WDEQ/WQD's contract laboratory (Aquatic Biology Associates, Corvallis, OR) where they were processed and subsampled according to WDEQ/WQD protocol and standard taxonomic effort (King, 1993a). All biological data were evaluated for quality assurance and quality control and met data quality objectives.

Core metrics have been utilized for assessing the integrity of the stream. These metrics, and their values for Giraffe Creek, are shown on Table 4. The converted 'scores' are simply the value of the given metric placed on a scale from 0-100, with a higher score indicating a more optimal condition. The scores are developed in relation to the given ecoregion of the site. Secondary metrics have been used to augment the bioassessment and further elaborate upon the biologic patterns of the benthic community. The core metrics have been selected through work done by Tetra Tech (Stribling et al., 2000) in their multivariate analyses of Wyoming macroinvertebrate data. These were the metrics that were the most effective, and statistically credible, in indicating the condition of Wyoming stream systems and forms the basis of the Wyoming Stream Integrity Index (WSII). The composition of this suite of metrics is diverse, and relatively non-overlapping, in its ecological characterization.

The WSII score for Giraffe Creek was 64.4, or in the "fair" descriptor. This score is less than the 25th percentile (break between "fair" and "good") score of 70.2. The WSII has a 90% confidence interval (Rockies Bioregion) of $\pm$ 5.4 points. This results in a lower confidence threshold of 65 points. The Giraffe Creek WSII score is only slightly below this 90% confidence threshold.

Table 4. Giraffe Creek (Rockies Bioregion) Core Biometric Values and Scores.

Core Metric	Rockies Bioregion Reference Condition (95th or 5th Percentile)	Giraffe Metric Value	Giraffe Metric Score
Ephemeroptera taxa	12	6	50
Insect taxa	45	38	84.4
Non-insect taxa*	1	3	80
% Ephemeroptera	69.8	13.27	19
% Oligochaeta*	0	0.55	90.1
% 5 dominant*	49.8	62.55	74.6
HBI*	1.4	4.09	68.7
% Scraper	56.1	27.27	48.6
Index Score (∑ /10)			**64.4**
Rating			**fair**

* Metric where the trend increases with increasing stress (positive TwI). Higher values indicate a negative response. Reference Condition 5th percentile is utilized to calculate the score for positive TwI metrics.

Metrics Discussion

The Order Ephemeroptera (mayflies) contains approximately 700 species in North America. Because of the large number of species, mayflies will normally be found in most samples collected in stream riffle habitats during any time of the year. Their presence in riffle habitats is generally associated with good to excellent water quality while their absence from riffle habitats is a strong indicator of poor water quality (King, 1993b). The functional feeding groupings of mayflies are primarily scrapers, collector gatherers, or shredders. The Giraffe Creek station had 6 distinct taxa which is half of the number of taxa for the 95th percentile for the given bioregion and makes for a poor to moderate scoring for this metric. Sedimentation, even in seasonal surges, has been a probable influence on the minimal Ephemeroptera diversity and abundance.

With relatively low tolerance values, numerous mayfly taxa are commonly found in riffle habitats. A limited relative abundance (percentage) of Ephemeroptera taxa typically indicates a predominance of higher tolerance organisms, and therefore, possible stresses upon the aquatic system. The percent Ephemeroptera in Giraffe Creek was 13.27%, resulting in a low score of 19.0. This metric again indicates that depressed Ephemeroptera diversity and abundance in Giraffe Creek lowers the overall average of the net score. A total of six Ephemeroptera taxa were collected. Even though this Order had a significantly lower percent composition than seen in the Rockies bioregion reference sites, the tolerance of the taxa observed was relatively low with 4 of the 6 taxa having an HBI value or 4 or less. A low score for this metric was also documented on the same date for the receiving waters of Salt Creek, possibly suggesting a low percentage of Ephemeroptera taxa may be indicative of conditions in the "Overthrust" portion of the bioregion.

While a predominance of higher tolerant non-insect taxa can be indicative of poorer water quality, a strong representation of different insect taxa within a given sample demonstrates favorable conditions for the more pollution sensitive organisms. The insect taxa were well represented for the Giraffe Creek station (38 taxa) resulting in a score of 84.4. Relative to the Ephemeroptera taxa metric previously discussed, this means a considerable number of non-Ephemeroptera insect taxa were present. Taxa of the Order Coleoptera (beetles) comprise almost 40% of the sample. Riffle beetles (Family Elmidae) of the genus *Optioservus*, were the most common genera of this Order and have an intermediate tolerance.

A high number of non-insect taxa, commonly pollution tolerant members of the Phyla Annelida (segmented worms) and Platyhelminthes (flatworms), generally indicates poor water quality. At the Giraffe Creek station only 3 non-insect taxa were present, resulting in a strong score of 80. Of those 3 non-insect taxa, one was an oligochaete worm of the genus *Nais* (discussed immediately below), one was a fingernail clam (Family Sphaeriidae), and one was an arachnid mite (*Acari*).

Oligochaetes are non-insect aquatic worms which, generally, inhabit areas of lower flow where silts and mud accumulate. The amount and quality of the organic component frequently is a critical factor in determining species distribution (Brinkhurst and Jamieson, 1971) They can be very abundant in contexts where other macroinvertebrates are absent, particularly where decomposition from high amounts of organic material is resulting in minimally oxygenated conditions. The Tubificids in particular may be extremely abundant at stream locations that are receiving animal wastes, sewage, feedlot runoff or other nutrient-rich influences. This makes the Oligochaetes effective organisms in monitoring water quality. Only one Oligocheate taxa was present and its low percentage (0.55%) resulted in a metric score of 90.1. This metric has the highest of the scores in the index suggesting that oxygen content has been sufficient, suggesting severe silt and nutrient loading is not of serious concern in Giraffe Creek.

The percent contribution of the dominant taxa is an indication of community balance. A community dominated by a single taxon or by relatively few taxa indicates environmental stress due to poor water quality or habitat quality (King, 1993a). The percent five dominant taxa (5^{th} percentile) for Basin Bioregion reference condition was 49.8%. Values in excess of this show a lower diversity and higher percentages indicate greater environmental stress. The Giraffe Creek Station had a metric value of 62.55% with a score of 74.6 indicating a reasonable diversity within the macroinvertebrate community. The dominant taxa were riffle beetles (Family Elmidae) of the genus *Optioservus* (see discussion above). The second most dominant taxa were stoneflies (Order Plecoptera) of the genus *Isoperla*, comprised of moderately pollution-intolerant, predator species.

The modified Hilsenhoff Biotic Index (HBI) involves the summation of the pollution tolerances of organisms into a single value. Tolerance values ranging from 0 to 10 are assigned to each organism contained in the sample. Organisms assigned higher values are more tolerant to organic and possibly nutrient and sediment pollutants. A high HBI value indicates that the macroinvertebrate community is comprised of organisms with greater tolerance to pollutants. King (1993a) provides references and additional discussion on this in the index. The reference condition for the Rockies ecoregion (5^{th} percentile) is an HBI of 1.4. The Giraffe Creek metric value for the HBI (4.09) was relatively moderate and the resultant metric score was 68.7.

Scrapers are the functional feeding group of macroinvertebrate taxa that scrape rock, twig, and leaf surfaces for food such as periphyton (King, 1993b). Scrapers increase with an increase in diatoms and decrease as filamentous algae (indicative of organic and nutrient enrichment) increases. Taxa in this functional feeding group tend to be relatively intolerant to stressors such as sediment that reduce or eliminate their feeding areas or food supply. The percent scrapers was quite low for this site (27.27%) when compared to the 95^{th} Percentile for reference condition (56.1%). This individual metric, along with substrate information presented later in this document, suggest possible siltation issues (possibly historical and/or seasonal), or some limitation–such as high turbidity or silted substrate–has impacted the scraper's diatomaceous food source.

Additional Metrics

Additional biological metrics were calculated for the Giraffe Creek bioassessment station. The following metrics are included to further describe the macroinvertebrate community as it pertains to water quality and habitat integrity. These metrics did not have as high discrimination efficiencies as the core metrics previously discussed, however, these data are useful in further understanding the biological community and ecological dynamics in the Giraffe Creek system.

Taxa in the Order Plecoptera (stoneflies) are found in cool, well-oxygenated streams with good to excellent water quality. These taxa are the most sensitive of all aquatic macroinvertebrates to water pollutants and their presence is considered a barometer of good water quality. Because of this, the presence of numerous distinct stonefly taxa and a significant relative stonefly abundance are effective indicators of good to excellent water quality (King, 1993b). Giraffe Creek had 7 distinct Plecoptera taxa and the Plecoptera comprised 15.99% of the sample. The ecological context has been supporting a relatively diverse and healthy Plecoptera population, indicating sound water quality and habitat.

Taxa of the Order Trichoptera (caddisflies) are commonly found in most aquatic habitats. These taxa should be found in all riffle samples with the exception of streams with very poor water quality. Caddisflies either live in cases or are free-living (without cases). It is not unusual to find from 5 to 10 different types of caddisflies in stream riffles with good water quality (King, 1993b). The number of Trichoptera taxa (6) were moderately represented in Giraffe Creek.

A high percentage of non-insects, commonly pollutant tolerant members of the Phyla Annelida (segmented worms) and Platyhelminthes (flatworms), generally indicates poor water quality. The percentage of non-insects in Giraffe Creek was 3.46% and indicates that the water has been of reasonably good quality and of sufficient oxygenation to support this community composition.

Collector - Gatherers are a functional feeding group of macroinvertebrate taxa that eat decomposing fine organic matter such as decayed plants, leaves and materials in stream bottom sediments. A high percentage of collector - gatherer taxa can be indicative of organic enrichment from vegetative material, manure, or sewage. An increase in this functional feeding group may also indicate increased stream sedimentation (King, 1993b). The percentage of collector - gatherer taxa in Giraffe Creek was 33.63% which is not exceedingly high but demonstrates a reasonable representation of Collector-Gatherers.

The EPT Index provides the total number of distinct EPT taxa in the sample. EPT taxa are generally considered to be pollution sensitive. Low numbers of EPT taxa may be a good indicator of high stream sedimentation or toxic substances (King, 1993). Giraffe Creek had an EPT index of 19 (half of total number of taxa), demonstrating a strong capacity for the system to support sensitive taxa.

Percent Hydropsychidae to total Trichoptera is a metric that measures the density of the generally mild pollution tolerant Hydropsychidae family (primarily filtering collectors) to the density of total Trichoptera (relatively sensitive to water pollution)(King, 1993a). King (1993a) assigns the highest biological score to samples where density of Hydropsychidae is less than 20% of the total Trichoptera. The percentage for Giraffe Creek was 50% and demonstrates the relative proliferation of the more tolerant taxa among the Trichoptera.

Community voltinism is a measure of the distribution of taxa with various life cycle requirements. Multivoltine taxa are those that exhibit several life cycles during a single year. Univoltine taxa are those requiring a year to complete a single life cycle, while semivoltine taxa are those that require several years to complete a life cycle. An even distribution of these three assemblages suggests a stable community. The dominance of multivoltine taxa suggest possible seasonal degradation of water quality or periodic pulses of pollutants through the system have limited the survival of univoltine and semivoltine taxa. A strong representation of semi-voltine taxa is a positive indicator that the habitat and water quality is conducive to organisms that need a longer period of time to complete a life-cycle. One can also infer that a greater degree of water quality *consistency* has been maintained. In such a case, their biological and habitat needs are being supported. The Giraffe Creek station exhibited a balance of voltinism in the macroinvertebrate community with 19.64 % multivoltine taxa, 37.91 % univoltine taxa, and 42.46 % semivoltine taxa, respectively; indicating a well-distributed and very stable macroinvertebrate community.

Additional biomonitoring observations collected by the observers at the time of the sampling are presented in Table 5.

Table 5. Biomonitoring Observations, Giraffe Creek, October 8, 1998.

Stream Station	Filamentous Algae	Floating Macrophytes	Rooted Macrophytes	Periphyton	Slimes	Fish
Giraffe Creek	Rare	Rare	Rare	Common	Not Observed	Common

The rare occurrence of filamentous algae and rooted macrophytes suggest that nutrients may not be a significant issue in Giraffe Creek. Additionally, the common occurrence of periphyton suggests that sediment deposition in the main riffle area may not as be significant as the data from the randomly located surber locations indicate (see discussion later in this document).

General Biological Observations

Several general biological observations were noted in the comments section of the data sheet. Fish were commonly observed. The fish seen were 6 inches and smaller. There was minimal willow development along the channel.

Habitat (Physical) Quality

Physical (habitat quality) data were collected and analyzed according to WDEQ/WQD bioassessment protocols (King, 1993a). All data were evaluated for quality assurance and quality control and met data quality objectives.

For each station, substrate composition and silt cover (embeddedness) were recorded at the eight, one square foot sample points within the riffle where macroinvertebrates were collected. Water velocity was also recorded at each of these points. A summary of these data is presented in Table 6.

Table 6. Mean Substrate Composition, Weighted Embeddedness, and Velocity. Giraffe Creek **.**

Mean Percent Substrate (Eight 1 ft.^{2} Quadrats)								
Stream Site	%Cobble (2.5-10")	%Coarse Gravel (1 - 2.5")	%Fine Gravel (0.3 -1")	%Silt* (<0.3", fine)	%Sand (<0.3", gritty)	%Clay (Hard Pack)	%Organic (fine, black)	%Precipitate (Oil, WWTF)
Giraffe Ck..	35.63	10.0	48.75	5.0	0.63	0	0	0

Stream Site	**Weighted Embeddedness - Silt Coverage (Range 20 to 100)** Eight 1 ft.^{2} Quadrats	**Mean Water Velocity (ft./sec.)** Eight Quadrat Locations
Giraffe Ck..	37.75	2.41

* Silt substrate is where the silt covering is greater than 1/4 inch deep

The Giraffe Creek sample riffle was composed primarily of cobble and gravel, particularly fine gravel. Fines were comprised primarily of silt with a small amount of sand substrate being noted. The presence of rock and gravel in flowing streams is generally considered the most desirable habitat (Plafkin et al., 1989). The significant percentage of small gravel may help explain the depressed number and percentage of scraper taxa observed in the benthic community.

The weighted embeddedness rating (weighted embeddedness ranges from 20 to 100 with a rating of 100 being relatively sediment free) of 37.75 indicates the substrate had considerable silt cover. Four of the 8 quadrats had the substrate more than 75% covered by silt. However, it is important to note that for this riffle the random numbers placed the sampling locations mainly along the far shore where the minimal flow provided for greater silt-cover. Few of the samples were in the middle of the channel and therefore many of the readings had a higher silt-cover than they would have had in the central part of the flow. General biomonitoring observations identified the "common" occurrences of periphyton, an indication of relatively silt clean substrate in the central part of the channel.

The qualitative habitat quality assessment for Giraffe Creek covered a segment upstream from the riffle used for macroinvertebrate sampling. The reach length is determined by multiplying the bankfull width by 20. A minimum reach length of 360 feet is used, as was the case with Giraffe Creek. Thirteen parameters (5 primary parameters, 4 secondary parameters, and 4 tertiary parameters) were evaluated. Evaluation of these parameters allow for a total habitat score ranging from zero to 200 points. High total point scores equate to high quality habitat. Specifics of the individual habitat parameters are contained in King (1993) and the department's procedures paper *Beneficial Use Reconnaissance Project - Wadable Stream Monitoring Methodology* (WDEQ/WQD, 1998).

Habitat Scores for Giraffe Creek and three other reference streams located within the "Overthrust" region of the Middle Rockies West Ecoregion are contained in Table 7. The limitations upon the habitat for the Giraffe Creek System were the minimal riparian vegetation, unstable energy dissipation in the channel and silted pools. Willow development is minimal in the system and the streambanks were mainly dependent on upland grasses for root support. Relatively few obligate species were present. The flow in the channel, directing its energy against the outer cutbanks, will likely find little resistance in these unprotected banks, resulting in an increase in sinuosity and sediment contributions. Some collapsing, partly separated, banks were demonstrating that this process has been occurring and will continue to do so. The bank material has been the probable source of the heavy siltation in the pools. Such siltation threatens the spawning, foodbase, and feeding habits for trout species within the Giraffe Creek system and the waters downstream.

Giraffe Creek had a total habitat score of 126.5 points. This score is 89% the mean score for the three reference streams and 86% of the highest scoring "Overthrust" reference stream(Salt River). King (1993a) suggests streams with $\geq$ 90% comparability with reference streams are assessed as comparable and fully supporting.

Table 7. Habitat Assessment Values for Giraffe Creek and compared with three "overthrust" region reference sites.

Parameter	Giraffe Creek	Hams Fork - Campground	Fontenelle Cr. - Upper	Salt River
Total Primary	68			
Total Secondary	39			
Total Tertiary	19.5			
Total Score	126.5	143	136	147

Habitat parameters that scored high in the Giraffe Creek assessment included: Bottom Substrate; Instream Cover for Fish; and, Channelization/Alteration. Habitat parameters that scored low in the Giraffe Creek assessment included: Silt Cover (Embeddedness); Width to Depth Ration; and, Riparian Vegetative Zone Width.

Pool Quality Information

Pool quality data were collected at the first four pools immediately upstream of the sample riffle in the Giraffe Creek assessment reach. Total pool scores can range from "0" to "10", with a score of "10" exhibiting optimal fish habitat. Three of the four pools had a total pool quality score of "5", with the remaining pool having a total pool quality score of "2." Pool characteristics that kept pool quality scores relatively low include a predominance of gravel or finer substrate (generally silt) in the pools, somewhat limited subsurface cover (lack of boulders and submerged woody debris), and very little overhead cover (lack of willows and other overhanging woody vegetation).

HISTORICAL AND ANCILLARY INFORMATION

Water Quality Data from the Idaho Department of Environmental Quality

The Idaho DEQ has been monitoring various tributaries to the Thomas Fork system within both the states of Idaho and Wyoming (Idaho DEQ, 1999). The Salt Creek becomes the Thomas Fork near the Wyoming-Idaho border. As contributing waters to the Bear River, these stream systems influence Bear Lake and therefore nutrient contributions are of concern. The Idaho information contains water chemistry data collected from two Salt Creek locations in 1994 , 1995 and 1998. Idaho's S1 station was located upstream from Coal Creek and their S2 station was between the Coal Creek confluence and the Giraffe Creek confluence. The 1998 Salt Creek sampling location is below the confluence with Giraffe Creek. The Idaho data have been collected at various time throughout the year and reflect seasonal variations The parameters of particular interest have been nitrogen, phosphorus and total suspended solids(Idaho DEQ, 1999).

The total suspended solids (TSS) readings, in mg/l, demonstrates that the predominance of sediment transport occurs through the months of April and May. An increase in sediment delivery, as released from banks or upland sources, will commonly result in an increase in phosphorus. The TSS values demonstrate a degree of positive correlation with the total phosphorus samples. The high flow season is the time of greatest total phosphorus concentrations for the Giraffe Creek and Salt Creek samples taken by the Idaho DEQ.

Wyoming Game and Fish Data

Wyoming Game and Fish reports state that various types of fish have been found in the Giraffe Creek at different locations. Bonneville Cutthroat, the species that receives management focus, exist in the Giraffe Creek System with a 'fair to good population' (Miller, no date). Table 8. provides information on the type and quantity of the Bonneville that are present. Mountain whitefish, sculpins and mountain suckers also are found in the creek. Brook trout and Cutthroat trout were stocked intermittently between 1939 and 1957, however these species have not been found in recent years. Robinson Creek, a tributary to Giraffe Creek, has historically had Bonneville Cutthroat present.

Table 8. WGF Fish Data for Giraffe Creek (Miller, no date)

Location	Location Descriptor	Date	Distance Sampled (ft.)	Estimated Trout/Mile	Number Bonneville Cutthroat	Ave. Length (in.) Bonneville Cutthroat
Giraffe Creek	Below Robinson Creek	6/11/58	1500	422	120	5.7
Giraffe Creek	Below Robinson Creek	9/2/76	300	458	26	6.0
Robinson Creek	.05 mile above Giraffe confluence	8/15/58	600	387	44	6.0

Binns and Eiserman (1979) collected trout standing crop data at an upper Giraffe Creek and lower Giraffe Creek station as part of a Habitat Quality Index model developed to predict trout standing crop. The actual trout standing crops in Giraffe Creek were 27 and 43 kg/ha, respectively. The trout species present were reported as (Bonneville) cutthroat. These fisheries data indicate that Giraffe Creek has the capacity to support coldwater game(trout) species at various locations through its system.

These Wyoming Game and Fish data support the current Class 2 coldwater classification.

SUMMARY AND CONCLUSIONS

Classification

Giraffe Creek is correctly classified as a Class 2, Coldwater game fish stream. This conclusion is based on this assessment and the ability of the system to support trout. The presence of game fish in Giraffe Creek, as reported in the Wyoming Game and Fish Department's *Stream and Lake Database*, indicate that Giraffe Creek will be classified as Class 2AB, under the Unlisted Waters section of the Wyoming DEQ proposed Chapter 1 Rules and Regulations.

Water Quality

Water quality data collected from Giraffe Creek on October 8th, 1998 does not identify any water quality standard exceedences or conditions that would suggest nutrient, sediment, or toxicant problems under base flow conditions. Phosphorus and TSS values for the periods of high flow (April through June), as collected by the Idaho Department of Environmental Quality, suggest that sediment loads provide the main source of phosphorus and the levels have exceeded 0.1 mg/l in Giraffe Creek. This is a factor to be considered in relation to the compound issue of the Thomas Fork tributaries and nutrient concerns at points downstream. The Idaho DEQ has also expressed nutrient concerns relative to levels of various forms of nitrogen. Load reductions from Giraffe Creek to the Thomas Fork may be factored into an Idaho TMDL designed to achieve water quality standards in that receiving water.

Macroinvertebrates and Biological Condition

The core metrics for Giraffe Creek indicate that the system is functioning in a reasonably healthy manner with its most marked limitation being Ephemeroptera diversity and abundance. The percentage of scraper taxa is also low, due to habitat (large percentage of fine gravel), or food-base, stressors. The relatively high siltation, which may experience a seasonal flux, is a probable cause for such biologic limitations. Additional metrics indicate that various components of the biological community are in functioning condition but that any elevations in silt cover and overall sediment supply could further inhibit the macroinvertebrate community.

Physical and Habitat Quality

The substrate composition, moderate amount of silt coverage (embeddedness) and total habitat scores at the Giraffe Creek site is similar to those at the three "Overthrust" reference sites examined. Habitat parameters taken at the Giraffe Creek sample location indicate the physical habitat is experiencing some instability and may continue to do so in the future. The pools are heavily silted and the riparian zone is characterized by limited woody species, minimal obligate species and marginal potential for bank protection and energy dissipation. Lateral extension, and a resultant increase in sinuosity, bank erosion and sediment contributions, is likely in the foreseeable future.

Pool quality is somewhat restricted due to fines in the pool substrate, a lack of subsurface cover for fish, and a lack of willows and other woody vegetation to provide overhead cover.

FINAL ASSESSMENT AND SIGNATURES

Review of the chemical, biological, and physical data collected on Giraffe Creek on October 8th, 1998 indicates that Giraffe Creek, a tributary of Salt Creek, is a Class 2 (cold water) waterbody and that Giraffe Creek is fully supporting of its designated beneficial uses.

The data collected on October 8th, 1998 do not indicate the exceedence of Wyoming water quality standards. Total phosphorus and total suspended sediments are two parameters of concern during high flow as indicated by the Idaho Department of Environmental Quality. The benthic macroinvertebrate community indicates the system is sustaining itself in a reasonable manner, with siltation being the likely limitation on certain metrics. Pool siltation appears to be relatively high and the bank protection provided by willows was found to be absent. A weight of evidence review of the chemical, biological, physical and historical data indicates that Giraffe Creek is supporting the designated uses of a Class 2 waterbody. This decision is based on the following items (in order of strength):

1. No water quality standard was exceeded;
2. The Benthic Macroinvertebrate community indicates a moderate to good condition; and
3. Trout populations are being supported in Giraffe Creek.

Several items in this assessment indicate the presence of stressors to the Giraffe Creek system. These items, when factored into the Weight of Evidence process are not sufficient to result in an impaired recommendation. These items include:

1. Seasonal or historical sediment movement through the system (as indicated by silt in pools, silt covering in portions of the riffle, and State of Idaho data);
2. Low scoring habitat parameters such as width-to-depth ratio and riparian vegetative zone width, and:
3. The potential for streambank instability due to a lack of willows and other vegetation with root systems to add stability to the banks.

____ ________________

Assessment Report Author (signature and printed name) Date

____ ________________

Reviewed by (signature and printed name) Date

____ ________________

Monitoring Supervisor (signature and printed name) Date

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