

Gold Creek Stressor Identification

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Prepared for:

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SUMMARY

TerraGraphics Environmental Engineering, Inc. (TerraGraphics) identified seven potential stressors or causes for fish, macroinvertebrate or habitat scores to be significantly different from established reference sites. The stressors include:

- Low nutrients resulting in low fish and macroinvertebrate abundance;
- Increased flood frequency and maximum stream flows with a concomitant decrease in base flows;
- Increased sediment delivery and percent fines;
- Reduction in riparian cover, shift in riparian plant species, lower quality shade;
- Increased metal concentrations;
- Increased nutrients; and
- Ineffective sampling or inappropriate reference stream reaches for comparison.

High metal concentrations was eliminated as a potential stressor based on available information from investigation of current and historic land use practices. We concluded that the likely causes of impairment are high percent fines and thermal modification.

We recommend that sediment and temperature Total Maximum Daily Loads (TMDLs) be developed for the watershed and that monitoring for determination of the nutrient status be undertaken to determine existing nutrient loading to the system.



SECTION 1.0 SCOPE OF THE INVESTIGATION

Gold Creek is a tributary stream to the Pack River. The Gold Creek catchment is approximately 3,024 hectares. The following was taken from the Idaho Department of Lands (IDL) Cumulative Watershed Effects (CWE) investigation.

“Gold Creek flows into the Pack River approximately four miles upstream from where State Highway 200 crosses the Pack River, in Bonner County, Idaho. The drainage can be accessed along Gold Creek Road (County Road 56 C). The Gold Creek drainage contains 7,472 acres of which 6,503 acres are used for forestry. Land ownership is predominantly private companies and individuals, with smaller ownerships by the Panhandle National Forest and the Idaho Department of Lands (IDL). A few small private mines exist in the headwaters.

The Gold Creek watershed is a mixture of geologic types. The higher elevations are dominated by Cretaceous granitics associated with the Kaniksu Batholith. Along the lower and middle reaches are Pleistocene glacial outwash, fanglomerates, flood and terrace gravels intermixed with unconsolidated alluvium. Just above the confluence with the Pack River are areas of lacustrine sediments associated with Lake Pend Oreille and the Pack River flood plain.

Gold Creek is a third order tributary to the Pack River. The drainage is oriented in a southwesterly direction from the headwaters to the Pack River. Elevation ranges from 2,080 feet at the confluence with the Pack River to 3,785 feet at the headwaters on Gold Ridge.

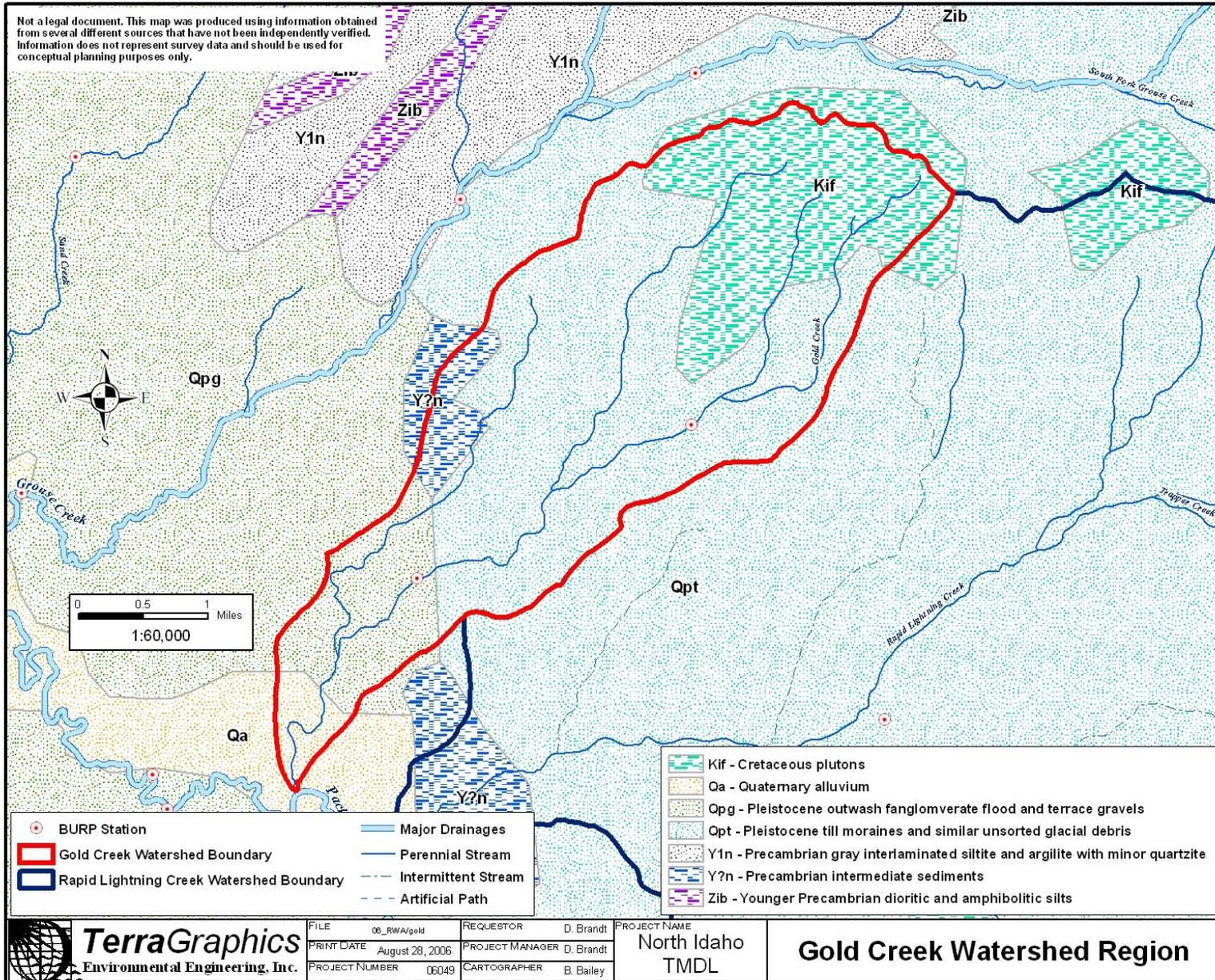
Cool, dry summers and moderately cold winters characterize the area. Average annual precipitation ranges from 30 inches at the lower elevations to 60 inches in the headwaters. The majority of precipitation occurs as winter snowfall and spring rain. High-volume runoff occurs during spring snowmelt and major rain-on-snow events.

Vegetation varies with elevation and aspect. Lower elevations generally support Cedar-Hemlock habitat types. Uplands support a mixed conifer forest of Douglas fir, grand fir, red cedar, larch, hemlock, ponderosa pine, lodgepole pine and western white pine, with more xeric species dominating south to west facing aspects. Very wet areas especially along riparian zones support alder, willow, and other water loving species” (IDL 2003).

The Stressor Identification was completed using existing biological data, water chemistry data, aerial photos, field notes from previous investigations, Idaho Department of Environmental Quality (IDEQ) BURP database and Pend Oreille Sub-basin TMDL, U.S. Forest Service (USFS) reports, interviews, and Geographic Information Systems (GIS) coverages (land use, geology).

A map of the drainage with some distinguishing features can be found in Figure 1.

Figure 1 Gold Creek Site Location Map



SECTION 2.0 DESCRIPTION OF THE IMPAIRMENT

In 1998, the Coeur d'Alene office of IDEQ conducted a rapid bioassessment survey of Gold Creek. The data were analyzed according to the Ecological Assessment Framework (Grafe 2002a) and the Water Body Assessment Guidance (WBAG) document (Grafe et al. 2002b). A status report was created in 2002. The Index Scores for Gold Creek are located in Table 1. IDEQ determined that the Stream Macroinvertebrate Index (SMI) and Stream Habitat Index (SHI) scores for the upper Gold Creek site were significantly lower than expected for a stream within the Northern Rockies Ecoregion (Table 2). The Stream Fish Index (SFI) was also lower than expected for the lower Gold Creek site. The result of the assessment was the determination that Gold Creek was not supporting its beneficial uses of cold water aquatic life and salmonid spawning. The pollutants identified as causing the impairment were “thermal modifications” and “unknown.” This stressor identification process will address the “unknown” pollutant and will not attempt to verify the validity of the “thermal modification” determination.

Table 1 Index Scores for the Gold Creek Watershed

Assessment Unit	Stream	BURP ID	Stream Macroinvertebrate Index (SMI)	Stream Fish Index (SFI)	Stream Habitat Index (SHI)
ID17010214PN034_02	Gold Creek (Lower)	1998SCDAB031	66.293	60.014	63
ID17010214PN034_02	Gold Creek (Upper)	1998SCDAB032	49.817	N/A	41

Table 2 Index Scoring Criteria

Condition Category	SMI (Northern Mountains)	SFI (Forest)	SHI (Northern Rockies)	Condition Rating
Above 25 th percentile of reference condition	≥65	≥81	≥66	3
10 th to 25 th percentile of reference condition	57-64	67-80	58-65	2
Minimum to 10 th percentile of reference condition	39-56	34-66	<58	1
Below minimum of reference condition	<39	<34	N/A	Minimum threshold

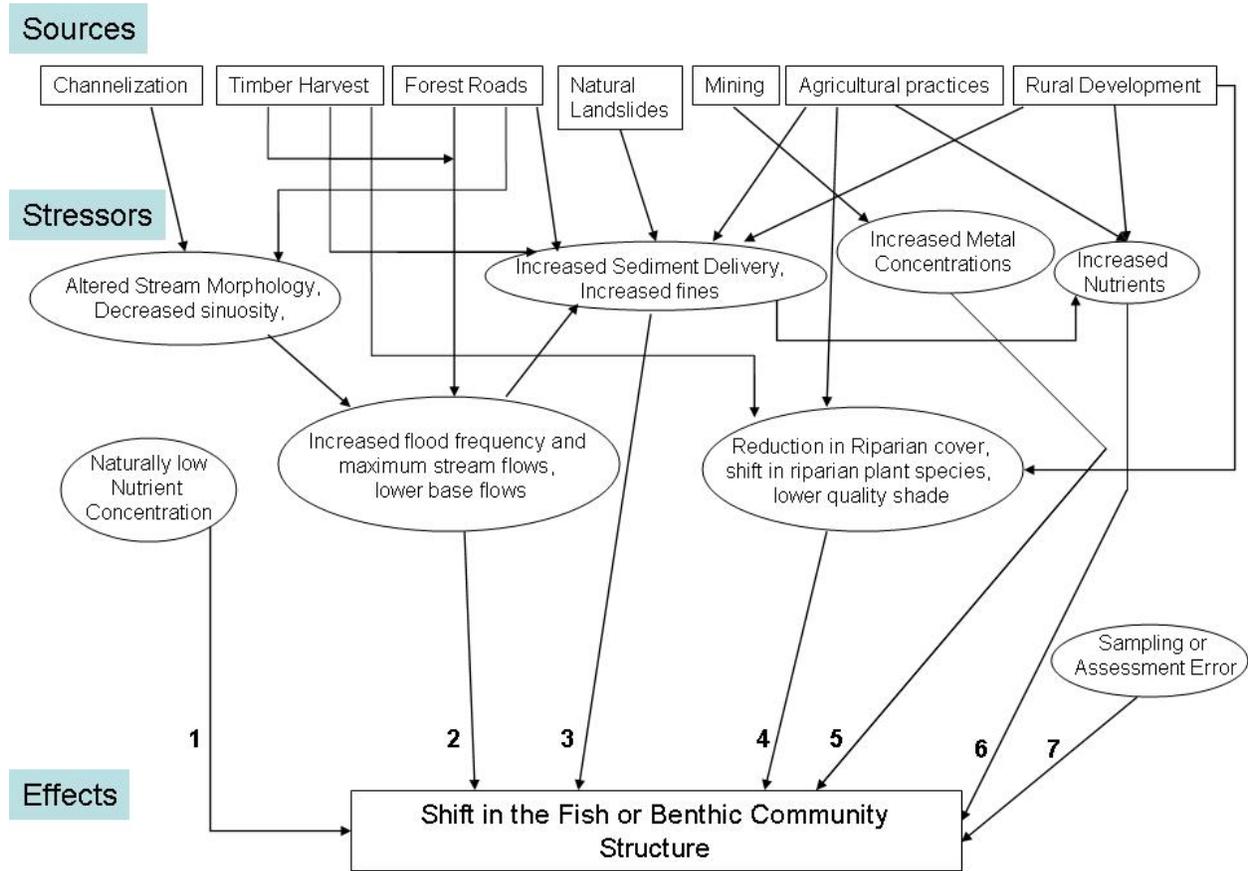
Note: N/A – Not available. SHI does not have a minimum threshold condition rating.

SECTION 3.0 CANDIDATE CAUSES

A conceptual model of candidate causes has been created for the Gold Creek Watershed (Figure 2). The conceptual model indicates seven potential causes for the low SMI and SFI scores for Gold Creek. These seven causes include:

1. **Low nutrients resulting in low fish and macroinvertebrate abundance.** If low nutrients are the cause, one would expect low macroinvertebrate abundance and low species diversity due to limited periphyton biomass for the grazer and scraper guilds, low levels of detritus for shredder guilds and insufficient biomass to support macroinvertebrate predators. The low biomass of macroinvertebrates would result in low food for the fish community, resulting in low fish abundance.
2. **Increased flood frequency and maximum stream flows with a concomitant decrease in base flows.** If these were the causes, the stream flows during the time in which the BURP data were collected would be too low to support a viable aquatic community.
3. **Increased sediment delivery and percent fines.** Increased percent fines decreases both the amount of interstitial space for emerging fish fry as well as intergravel dissolved oxygen. This would result in a decreased survival rate of young of the year fish and a resultant reduction in the total fish abundance within the system. The higher percent fines would also result in a shift in the taxa of macroinvertebrates present in the stream. The sediment intolerant species would be suppressed and the sediment tolerant taxa would have higher abundance.
4. **Reduction in riparian cover, shift in riparian plant species, lower quality shade.** The loss of riparian cover and/or a shift to a lower shade canopy would result in increased stream temperatures. This would cause a shift in the aquatic macroinvertebrate community and the fish community. Fish species that require cold water, particularly for spawning and rearing areas, would have increased year class mortality and lower biomass than areas with more or higher quality shade.
5. **Increased metal concentrations.** Increased metal concentrations would result in a reduction in biomass and taxa richness.
6. **Increased nutrients.** Excessive nutrients would result in nuisance levels of periphyton, and lower scores on the Hillsenhoff Biotic Index (HBI).
7. **Ineffective sampling or inappropriate reference stream reaches for comparison.** The BURP protocol and the WBAG II were developed to assess beneficial use support conditions for a wide variety of streams. There is a sub-set of streams that are outside of the range of conditions used to develop the field protocols and the assessment model. These conditions could include things such as too little water, too large of stream, too large of substrate, or too steep of gradient. The result of applying the field techniques and assessment protocol to those streams outside the range of experience of the model would result in an erroneous assessment of not full support.

Figure 2 Gold Creek Conceptual Model of Candidate Causes



SECTION 4.0 EXISTING DATA

4.1 Physical Habitat Data

Table 3 summarizes the habitat data collected during the BURP sampling. The habitat data collected for upper Gold Creek indicate that the habitat is significantly degraded from similar streams in the sub-basin. The lower Gold Creek site has habitat scores that are slightly degraded when compared to reference sites but deemed acceptable by IDEQ. Both sites have a significant amount of fine sediment in the stream channel. The BURP crew indicated that the riparian zone for both sites was grass with some Alders. Horse and cattle grazing was noted at the lower site.

Table 3 Summary of Selected BURP Habitat Data for Gold Creek

BURP ID	Bank Cover Percentage	Bank Stability Percentage	Percent Canopy	Percent Fines	Embedded Score	Channel Shape Score	Pool/Riffle Ratio	Average Wet Depth (m)	Average Wet Width (m)	Width/Depth Ratio (wetted)	Discharge (cfs)
1998SCDAB031 (Gold Creek, Lower)	95	80	31.5	31	15	3	0.468	0.14	4.11	63.23	1.5
1998SCDAB032 (Gold Creek, Upper)	50	50	60	86	1	8	0.049	0.13	1.88	28.25	0.4

Note: Percent Fines and Average Wet Depth were calculated from BURP field forms. Values in the database were not consistent with the field forms.

IDL conducted a CWE survey on the Gold Creek Watershed. Tables 4 and 5 contain the index scores and summary evaluations of the watershed. The CWE survey indicates that there are low risks of mass failure and total sediment delivery. The primary contributors to this assessment are the mean watershed gradient and the soil type. Since Gold Creek does not have a significant amount of slopes >30% this rating would be expected.

Table 4 Gold Creek CWE Assessment Results

CWE Watersheds	Results	Channel Stability	Canopy Removal	Roads	Mass Failure	Total Sediment Delivery	Hydrologic Risk
Gold Creek (Pack River)	<i>Score</i>	60.5	0.07	18.3	9	29.3	
Acres: 7472 FPA Acres: 6503	<i>Rating</i>	High		Low	Low	Low	Low

Notes: FPA=Forest Practices Act
 Canopy Removal is expressed only as a score.
 Hydrologic Risk is expressed only as a rating.

Table 5 Gold Creek Adverse Conditions

CWE Watersheds	Temperature Adverse Condition	Nutrient Adverse Condition	Fine Sediment Adverse Condition	Hydrologic Adverse Condition
Gold Creek (Pack River)	Yes	N/A	N/A	No

4.2 Biological Data

Table 6 summarizes the individual metric scores that are components to the SMI used in the WBAG process. Figure 3 is a graphical representation of the individual metric scores plotted with the average metric scores of streams assessed to be full-support within the Pend Oreille Sub-basin. The scores presented are not the raw metric scores but a conversion of the raw scores to a similar scale and scoring for this ecoregion. The full explanation of how these scores are derived can be found in the WBAG II document (Grafe et al. 2002b). For most metrics, the upper Gold Creek scores are significantly lower than the full support streams within the Pend Oreille Sub-basin. The only exceptions are HBI and Percent Plecoptera. The lower Gold Creek sample had considerable variability around the sub-basin mean.

Most of these metrics within the SMI are abundance related; therefore, low abundance of macroinvertebrates is the defining characteristic for the low SMI score of upper Gold Creek. The most pronounced metric reduction from reference is in the number of Trichoptera taxa. The basin average for full support streams is 62 whereas Gold Creek scores 8.3.

The BURP crew collected fish data from the lower Gold Creek site. They collected 38 cutthroat trout, 12 brook trout and 139 unidentified young of the year. From visual inspection, it appears that there were 3 to 4 year classes of cutthroat trout and 2 year classes of brook trout.

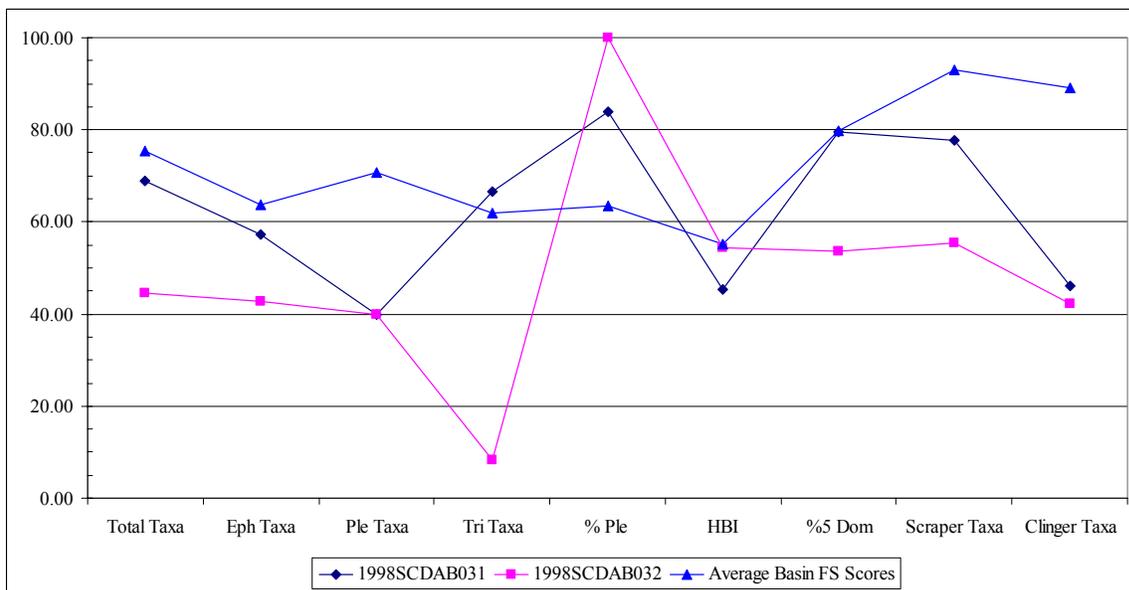
Fish data were not collected at the upper Gold Creek site.

Table 6 Summary of Individual Metric Scores for Gold Creek

BURP ID	Total Taxa	Ephemeroptera Taxa	Plecoptera Taxa	Trichoptera Taxa	% Plecoptera	HBI	% Dominance of top 5 taxa	Scraper Taxa	Clinger Taxa	SMI
1998SCDAB031 (Gold Creek, Lower)	68.89	57.14	40.00	66.67	83.90	45.36	79.63	77.78	46.15	62.84
1998SCDAB032 (Gold Creek, Upper)	44.44	42.86	40.00	8.33	100.00	54.48	53.71	55.56	42.31	49.08
Average Basin Scores for Full Support Sites	75.4	63.8	70.6	62.0	63.4	55.1	79.9	93.1	89.2	72.5

Note: The scores range from 0 to 100 and are compared to reference streams within the Bioregion. They are not the raw metric scores.

Figure 3 Individual Metric Scores of Gold Creek Compared to the Average Score of BURP sites with SMI scores >2 for the Pend Oreille Sub-basin



4.3 Water Chemistry

We were not able to locate any water chemistry data for Gold Creek.

A review of the mine inventory for Gold Creek does not indicate a history of mining activity within the watershed; therefore, it is unlikely that metal loading is a concern.

SECTION 5.0 ANALYSIS

This section investigates each potential cause to determine which ones are supported by the evidence found within the watershed and the current understanding of aquatic ecosystem function.

5.1 Stressor Refinement

Of the seven candidate stressors identified in Section 3.0, we have found sufficient evidence to remove high metal concentrations from the list of potential stressors. This decision was based on the lack of evidence of historical mining operations within the watershed.

5.2 Candidate Cause Elimination

Low nutrients resulting in low fish and macroinvertebrate abundance.

We were not able to locate any nutrient data for Gold Creek; however, based on the land use within the watershed it is unlikely that a lack of nutrients is a contributing factor to the atypical aquatic community in upper Gold Creek. Lower Gold Creek had sufficient nutrients to support a considerable fish community.

We conclude that it is unlikely that low nutrients are stressing the aquatic community within Gold Creek.

Increased nutrients.

We were not able to locate any instream nutrient values for Gold Creek. The HBI scores for lower Gold Creek are lower than the average scores for the sub-basin, indicating the potential for nutrient enrichment to be impacting the system. The BURP crews did not make any observations regarding excessive periphyton or epiphytes growth. The number of cutthroat trout and brook trout found in the lower Gold Creek indicates that diel dissolved oxygen depletion are not a significant problem.

We recommend that nutrient data be collected on Gold Creek to confirm that excessive nutrients are not impairing the beneficial uses.

Increased flood frequency and maximum stream flows with a concomitant decrease in base flows.

There is not sufficient data on this watershed to determine if there have been significant hydrological changes in the Gold Creek watershed. Upper Gold Creek had very little discharge at the time of the BURP sampling. It is likely that in some years, particularly in late August to early September, upper Gold Creek will become dry. This could account for the poor SMI and SHI scores for the upper Gold Creek site.

We conclude that low summer flows can be a significant stressor to the aquatic community within upper Gold Creek. From the available information, we cannot determine if this is a natural or human induced condition. At this time we do not recommend listing this site for hydrological modification.

Increased sediment delivery and percent fines.

The upper Gold Creek stream bed is dominated by fines. It is likely that the high percentage of fines within the stream channel is a significant stressor on the aquatic community. Lower Gold Creek also had a significant amount of fines but they do not appear to be causing significant stress to the aquatic community.

Based on the high amount of fines found in upper Gold Creek, we conclude that fine-grained sediments are a likely stressor to the aquatic community and recommend that a sediment TMDL be developed.

Reduction in riparian cover, shift in riparian plant species, lower quality shade.

The BURP crew recorded that the primary riparian plant community was grasses with some alders and that there was 31% to 60% canopy closure base on concave spherical densiometer readings. Grass offers some shade to a stream but it is a low quality shade. It prevents direct sunlight from reaching the stream but it is not effective in reducing convection of heat to the stream. Additionally, the low discharge levels for Gold Creek makes it very susceptible to changes in thermal loading.

The low canopy closure, poor quality of shade, and minimal discharge of the stream all contribute to increased thermal loading to the stream. Thermal modification is a likely stressor to the aquatic community. We recommend that a temperature TMDL be developed.

Ineffective sampling or inappropriate reference stream reaches for comparison.

The BURP protocol and the WBAG scoring systems were derived to deal with the most common stream types in Idaho. These are typically streams with gradients of 1-4% and a gravel/cobble substrate. Gold Creek is characteristic of the types of streams that BURP and WBAG were developed to assess.

Based on the conditions within Gold Creek, we have determined that the application of the BURP sampling protocol and the WBAG process was appropriate.

SECTION 6.0 CONCLUSIONS

Based on the analysis of existing biological, chemical, habitat, and watershed conditions, we have determined that Gold Creek is being adversely impacted from a number of stressors. The combination of high fines within the stream channel, low discharge, and poor quality shade are all stressing the aquatic community. There is also the potential for excessive nutrients in the system due to the land use practices occurring within the watershed.

We recommend that a sediment and temperature TMDL be developed for Gold Creek and that additional analysis of the nutrient condition within the stream be monitored as well.

SECTION 7.0 REFERENCES

Grafe, C.S. (editor), D. Brandt. 2002a. *Idaho river ecological assessment framework: an integrated approach*. Idaho Department of Environmental Quality. Boise, Idaho. 210 pp.

Grafe, C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandt, and D.T. Mosier. 2002b. *The Idaho Department of Environmental Quality Water Body Assessment Guidance, Second Edition-Final*. Idaho Department of Environmental Quality. Boise, Idaho.

Idaho Department of Lands (IDL). 2003. Gold Creek (Pack River) Cumulative Watershed Effects Assessment.