

**Stressor Identification for Assessment Unit # ID17010105PN012_02
Moyie River Subbasin**



April 13, 2009

Prepared for:

Idaho Department of Environmental Quality
Coeur d'Alene Regional Office
2110 Ironwood Parkway
Coeur d'Alene, ID 83814

Prepared by:

State Technical Services Office
Idaho Department of Environmental Quality
1410 N. Hilton St.
Boise, ID 83706



Table of Contents

Summary	3
Section 1.0 Scope of Investigation	4
Section 2.0 Description of the Impairment	8
Section 3.0 Candidate Causes	13
Section 4.0 Existing Data	15
4.1 Physical Habitat Data.....	15
4.2 Biological Data	15
4.3 Water Chemistry	16
Section 5.0 Analysis	18
5.1 Stressor Refinement	18
5.2 Candidate Cause Elimination.....	19
Section 6.0 Conclusions	19
Section 7.0 References	21

List of Tables

Table 1. Assessment Scores and Rating for AU #ID17010105PN012_02.....	8
Table 2. Index Rating for Northern Idaho Streams.....	8
Table 3. Habitat Metrics for BURP Sites in AU #ID17010105PN012_02.	15
Table 4. Fish Metrics for BURP Sites in AU #ID17010105PN012_02.	16
Table 5. Macroinvertebrate Metrics for BURP Sites in AU #ID17010105PN012_02.....	16
Table 6. Water Chemistry Data Collected in AU #ID17010105PN012_02.....	16

List of Figures

Figure 1. Land Status Map for Assessment Unit #ID17010105PN012_02.....	6
Figure 2. Aerial View of Assessment Unit #ID17010105PN012_02.....	7
Figure 3. Conceptual Model of Candidate Causes for AU #ID17010105PN012_02.....	14

Summary

Assessment Unit #ID17010105PN012_02 includes the upper Meadow Creek watershed in the southwest corner of the Moyie River subbasin. Stressor identification for Assessment Unit #ID17010105PN012_02 was completed with aid from CADDIS (Causal Analysis/Diagnosis Decision Information System), EPA's *Stressor Identification Guidance Document* (EPA, 2000), and from physical, chemical and biological data collected in the unit.

Assessment Unit #ID17010105PN012_02 (Meadow Creek - source to mouth) was listed in the Idaho DEQ 2002 Integrated Report Section 5 as impaired for reasons associated with temperature. In the Idaho DEQ 2008 Integrated Report Section 5 assessment unit #ID17010105PN012_02 (Meadow Creek – source to mouth) continued to be listed for temperature and benthic macroinvertebrate bio-assessments. This stressor identification analysis was initiated to elucidate the causes of the biological assessment test failure.

Eight candidate causes were identified and were analyzed based on the available data. Those causes that are unlikely to be involved in the habitat/biological impairments of the assessment unit will be eliminated from consideration. This analysis brings forth likely candidate causes for further in depth investigation.

It appears that the lower portion of Meadow Creek in the vicinity of the lowest BURP site in the assessment unit is locally impacted by land use activities resulting in bank instability and sedimentation. Elsewhere in the watershed poor biological scores may result from excess water temperatures and barriers preventing the migration of fish into the system and the movement of water. Heavy metal toxicity is unknown, but remains a possibility.

Section 1.0 Scope of Investigation

Assessment Unit #ID17010105PN012_02 includes the upper portion of Meadow Creek from and including Wall Creek to the headwaters (see Figures 1 & 2). The assessment unit includes Templeman Creek, Fern Creek, Wall Creek, EF Meadow Creek and an unnamed tributary to Meadow Creek. This watershed is predominantly a forested landscape, the majority of which is in the Kaniksu National Forest, although private lands exist along Meadow Creek and the mouths of several tributaries (Figure 1).

The watershed has evidence of forest harvest activities and there are numerous roads (Figure 2). Along Meadow Creek in the lower portion of the assessment unit there appears to be some pasturing and possibly other agricultural activities.

A Cumulative Watershed Effects (CWE) Assessment was conducted in the Meadow Creek watershed in 2003 by the Idaho Department of Lands (IDL, 2003). That report described the watershed as follows:

“Meadow Creek is a 15,949 acre forested watershed in northern Idaho managed for multiple uses. For the purposes of this assessment, Meadow Creek, along with major and minor tributaries, are referred to as Meadow Creek. Meadow Creek flows into the Moyie River near the old town site of Meadow Creek. Land ownership is primarily U.S. Forest Service with smaller portions of private. The watershed is located in Boundary County (Figure 1).

Meadow Creek is a third order tributary with a dendritic stream feeder pattern to the Moyie River. The drainage is oriented in a southeasterly direction with side tributaries flowing southwest. Elevation in the watershed ranges from 2,360 feet above sea level, where Meadow Creek empties into the Moyie River, to 6,112 feet above sea level in the headwaters on Queen Mountain.

The Meadow Creek drainage is underlain by highly and weakly weathered Belt Supergroup Metasediments, Columbia River Basalt, highly and weakly weathered granitics, and glacial drift/till. Typically, the highly weathered material is found along the lower elevations and dominates the main stem flood plain and lower tributary flood plains. The weakly weathered material occupies the uplands and ridgelines.

The area is characterized by warm dry summers and cold wet winters with an average annual precipitation ranging from 25 inches at the lower elevations to 40 inches at the higher elevations. 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. Strong south to west facing slopes at lower elevations support forbs, grasses, and ponderosa pine savannah. On north slopes, and with increasing elevation, forest stands become denser with a greater number of coniferous species. The presence of Douglas-fir, grand fir, western larch, lodgepole pine,

western red cedar and western white pine increases with increasing elevation and effective precipitation.”

Upper portions of watersheds in forested lands can experience impacts from roads and timber harvest activities on slopes (sedimentation from erosion and runoff, road crossings, landslide and slumps, etc.). Whereas lower portion of Meadow Creek can be exposed to a variety of forestry and agricultural related impacts (channelization, diversions, removal of vegetative cover, field runoff, etc.).

Stressor identification for Assessment Unit #ID17010105PN012_02 was completed with aid from the CADDIS (Causal Analysis/Diagnosis Decision Information System) program (<http://cfpub.epa.gov/caddis/>), EPA’s *Stressor Identification Guidance Document* (EPA, 2000), and from physical, chemical and biological data collected by Idaho DEQ, Idaho Department of Lands (IDL), U.S. Forest Service (USFS) and others.

A map and an aerial photo view of the Assessment Unit are found in Figures 1 and 2.

Figure 1. Land Status Map for Assessment Unit #ID17010105PN012_02.

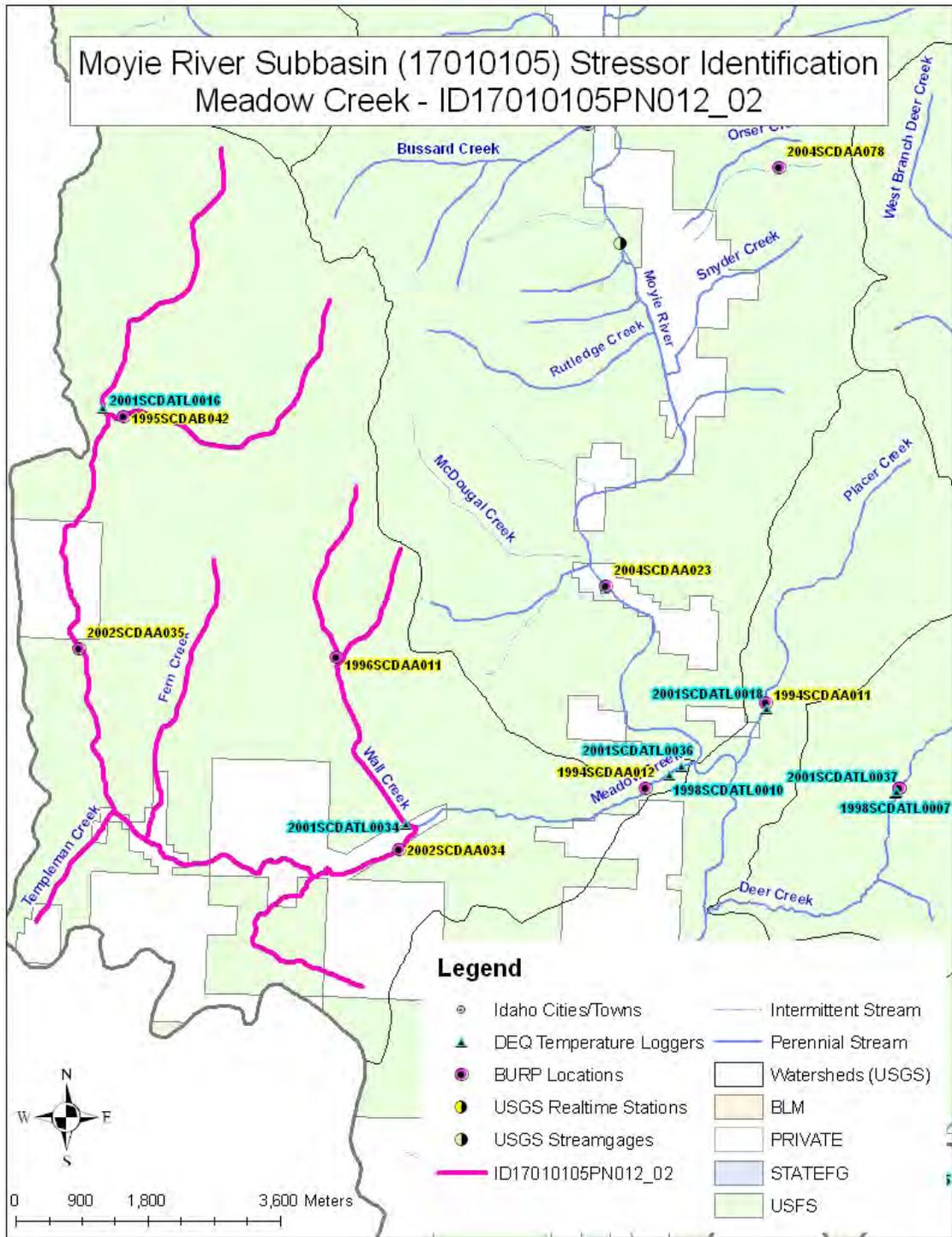
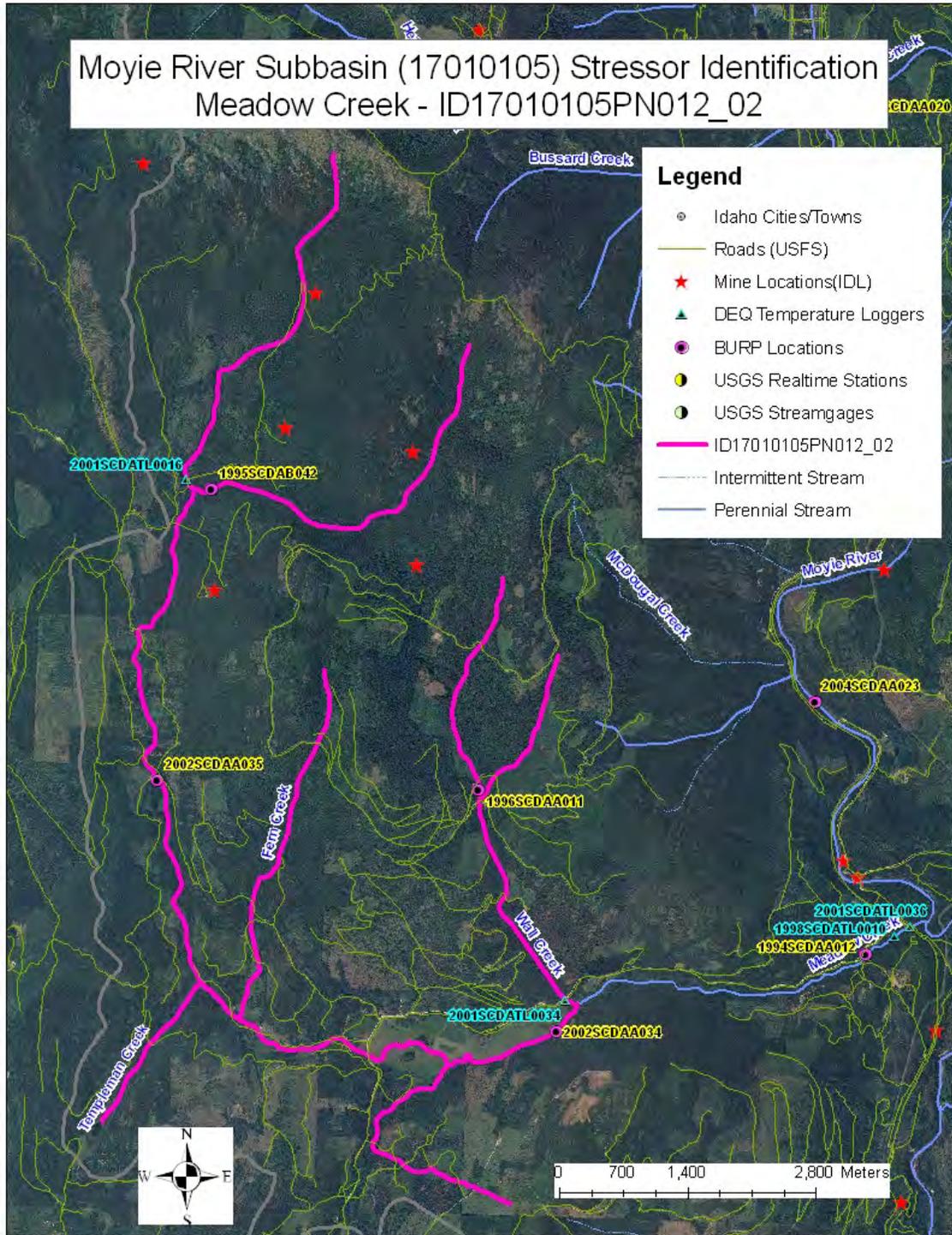


Figure 2. Aerial View of Assessment Unit #ID17010105PN012_02.



Section 2.0 Description of the Impairment

Assessment Unit #ID17010105PN012_02 was listed in the Idaho DEQ 2008 Integrated Report Section 5 as impaired for reasons associated with temperature and benthic macroinvertebrate bio-assessments. Essentially, this second listing indicates that BURP sampling in the assessment unit revealed that streams failed to pass assessment tests conducted on biological data.

Table 1 shows the index scores for the BURP site in the assessment unit. These scores were generated using the Idaho DEQ Water Body Assessment Guidance (WBAG) protocols (Grafe et al., 2002). Multimetric indices were generated from macroinvertebrate, fish and stream habitat data collected at BURP sites. These indices are then rated based on their values relative to bio-regional values calculated for least disturbed sites (Table 2). Ratings (0 to 3) for the macroinvertebrate index (SMI), the fish index (SFI), and the habitat index (SHI) are then combined to form an overall rating (also 0 to 3). In order to pass an assessment test the overall rating needs to be 2 or greater.

Table 1. Assessment Scores and Rating for AU #ID17010105PN012_02.

Assessment Unit	Stream	BURP ID	SMI (rating)	SFI (rating)	SHI (rating)	Overall Rating
ID17010105PN012_02	Meadow Creek	2002SCDAA034	50.64 (1)	78.75 (2)	26 (1)	1.33
ID17010105PN012_02	Meadow Creek	2002SCDAA035	55.69 (1)	50 (1)	65 (2)	1.33
ID17010105PN012_02	EF Meadow Cr	1995SCDAB042	67.14 (3)	49.43 (1)	69 (3)	2.33
ID17010105PN012_02	Wall Creek	1996SCDAA011	56.78 (1)	NA	75 (3)	2

Although there are four sites listed in Table 1, the older sites (1995 and 1996) were not used in the latest assessment of this assessment unit. Therefore, the assessment unit's biological/habitat impairment rating is solely based on results obtained from two locations on Meadow Creek. The BURP site on the lower portion of Meadow Creek near Wall Creek (2002SCDAA034, see Photos 1 & 2) failed as a result of poor macroinvertebrate (SMI) and habitat (SHI) scores. The upper site on Meadow Creek (2002SCDAA035, see Photo 3) failed as a result of poor macroinvertebrate (SMI) and fish (SFI) scores.

The older BURP sites were on tributaries higher in the watershed that had slightly better index scores. The EF Meadow Creek site (1995SCDAB042, Photo 4) had good macroinvertebrate and habitat scores, although the fish index was not as good. The Wall Creek site (1996SCDAA011, Photo 5) had good habitat scores that countered poor macroinvertebrate scores.

Table 2. Index Rating for Northern Idaho Streams.

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	0

Photo 1. BURP Site 2002SCDAA034. Looking downstream through sampled reach.



Photo 2. BURP Site 2002SCDAA034. Looking towards bank from sampled reach.



Photo 3. BURP Site 2002SCDAA035. Looking upstream through sampled reach.



Photo 4. BURP Site 1995SCDAB042. Looking downstream from sampled reach.



Photo 5. BURP Site 1996SCDAA011. Looking downstream from sampled reach.



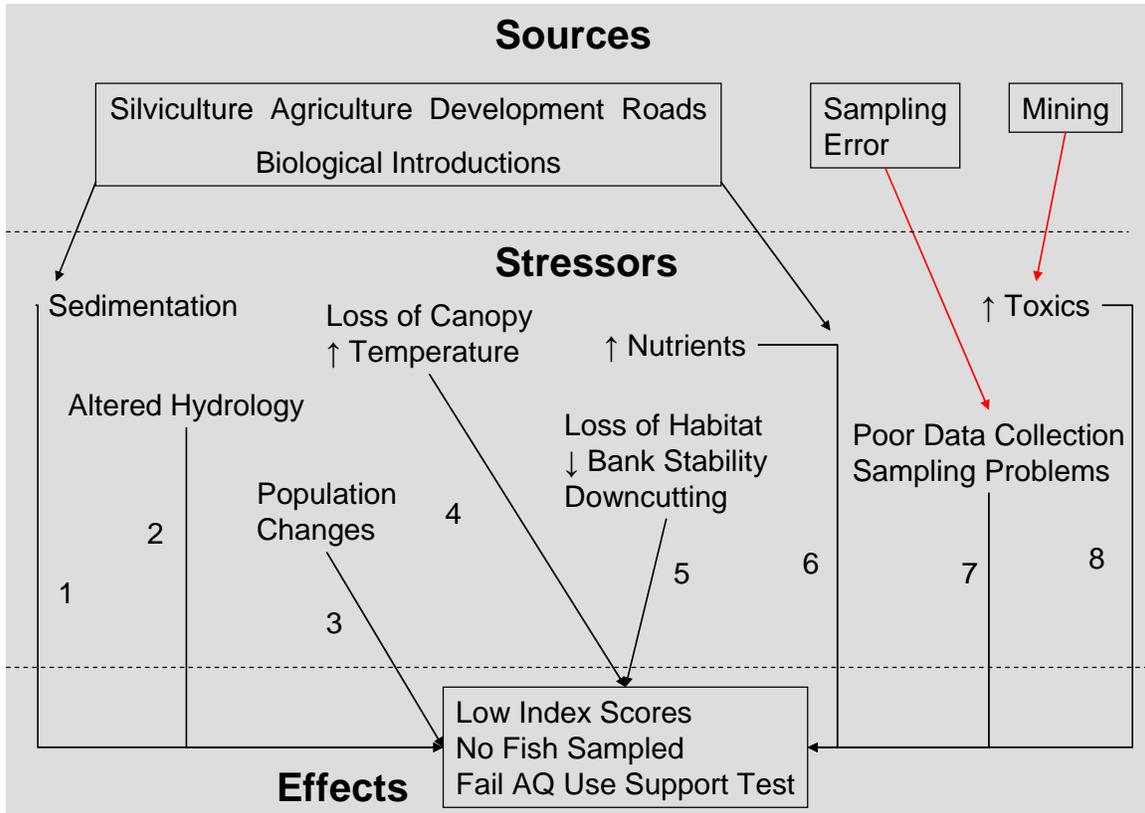
Section 3.0 Candidate Causes

In order to suggest what may affect index scores for the assessment unit in question, a list of possible causes needs to be constructed. Figure 3 presents a simple conceptual model of candidate causes that may lead to poor biological/habitat scoring. The model presents eight candidate causes as stressors that include:

1. Increased **sedimentation** (bedload and suspended) from many of the activities that could occur in the watershed (silviculture, agriculture, rural development, and roads) may result from field and trail runoff, mass failures, road cuts and fills, etc. Excess sediment leads to loss of habitat for macroinvertebrates and fish by the filling of gravel spaces with sand and silt. An over-abundance of sediment can decrease intergravel dissolved oxygen needed for fry development and drive sensitive macroinvertebrates out of the system to be replaced by more tolerant species.
2. Many activities that change the face of the land and increase runoff can alter the hydrology. An **altered hydrology** affects the streams ability to maintain flow and prevent bank erosion and downcutting. Streams can lose baseflow resulting in insufficient water during dry season for aquatic life. Streams can over-widen and increase width/depth ratios resulting in decreased shade and increased water temperatures resulting in loss of cold water species.
3. **Population changes** can result from a variety of interspecies conflicts that result from introductions of alien species including competition, parasitism and predation. Additionally, population changes can result from complications due to small populations (genetic loss, inbreeding, genetic alteration, etc.). Small populations result from habitat loss and loss of connectivity to regional populations.
4. Many activities and natural wildfire can cause a **loss of canopy** shade through direct removal of riparian vegetation. Again, this can result in increased water temperatures that affect biological communities.
5. **Loss of instream habitat** and bank stability can result from modifications to the channel (channelization, trenching and field draining, dikes, berms, instream structures) and changes to the hydrology of the system (see #2). This in turn affects the ability of some species to remain in the system due to loss of habitat, sedimentation, temperature increases, etc.
6. Certain kinds of activities may lead to **increased nutrients** (phosphorus and nitrogen) in the water column. Increased nutrients can cause algae blooms and other un-wanted plant growth instream, the decomposition of which uses up valuable dissolved oxygen, cause warming and can eliminate habitat.
7. Poor macroinvertebrate and fish scores may result from **sampling errors** where field methods are not followed correctly resulting in poor collection events. Sample containers may leak or be inadvertently destroyed resulting in a loss of data.
8. **Toxic pollutants** that are heavy metals may be introduced into the system from mining operations or legacy mine problems should they exist in the watershed. Other toxic pollutants may occur but are unlikely given the rural setting, unless

they are localized introductions of farm chemicals. Increased concentrations of metals and other toxic pollutants can lead to reduction or elimination of sensitive species.

Figure 3. Conceptual Model of Candidate Causes for AU #ID17010105PN012_02.



Section 4.0 Existing Data

Existing data for AU #ID17010105PN012_02 are limited. No data have been acquired from Idaho Fish and Game, USGS or U.S. Forest Service. All the data are from the middle reaches of Meadow Creek collected by DEQ, as well as the IDL CWE analysis on the whole watershed.

The CWE assessment indicated that the watershed had moderate risk in surface erosion and mass failure hazards, low risk in sediment delivery, hydrologic risk, and channel stability and high risk in stream temperature ratings. Within the assessment unit in question, shade levels were not adequate to meet CWE targets and contributed to the high temperature risk rating. Additionally, there were nine road crossings evaluated and all did not meet the criteria for acceptable fish passage. An important observation contained within the CWE report (IDL, 2003) was that “the 2003 CWE assessment determined that little additional sediment is being generated from forest roads, skid trails, and mass failures and delivered to the stream.”

4.1 Physical Habitat Data

The habitat metrics that go into the formulation of the Stream Habitat Index (SHI) are presented in Table 3 for the BURP sites on Meadow Creek. Metric values for the 2002 sites are variable with the lower site (2002SCDAA034) relatively inconsistent with the average of all BURP sites in the Lower Kootenai subbasin with passing SHI scores (Ave Supporting). There were insufficient habitat scores from the Moyie subbasin to calculate a supporting average, so we are comparing results to the Lower Kootenai subbasin average. The lower BURP site (2002SCDAA034) had poor scores for bank cover and stability, canopy, percent fines, and embeddedness. These data suggest that sediment from bank erosion and temperature are likely to be impacting the lower segment of Meadow Creek. The upper site on Meadow Creek (2002SCDAA035) had better scores although canopy cover and percent fines were still somewhat inconsistent with averages. The older (1995-1996) tributary sites had reasonable bank cover and stability scores, although the EF Meadow Creek site (1995SCDAB042) lacked canopy cover.

Table 3. Habitat Metrics for BURP Sites in AU #ID17010105PN012_02.

BURP ID	Bank Cover (%)	Bank Stability (%)	Canopy (%)	Fines (%)	Embedded Score	Channel Shape Score	Pool/Riffle Ratio	Ave Wetted Width (m)	Ave Wetted Depth (m)	Width/Depth Ratio	Discharge (cfs)	SHI
2002SCDAA034	30.5	22	39	21.3	0	3	3.8	2.8	0.11	25.8	0.06	26
2002SCDAA035	96.5	100	51	10.6	0	4	2.2	2.6	0.14	18.6	0.11	65
1995SCDAB042	85	95	0	10	13	12	0.1	2.3	NA	NA	1.3	69
1996SCDAA011	85	87.5	80.5	0	17	9	0.06	2.7	NA	NA	2.5	75
Ave Supporting	98.2	99.3	65.7	5.6	14.6	5.3	0.75	6.6	0.04	18.7	5.9	78.4

4.2 Biological Data

The 2002 BURP sites on Meadow Creek and the 1995 site on EF Meadow Creek produced primarily brook trout when electrofished (Table 4). Brook trout are not considered a cold water native species, nor are they considered sensitive. The lower Meadow Creek site (2002SCDAA034) also had sculpin to improve that site’s fish scores.

The scores for the other two sites were relatively poor compared to the average of all BURP sites in the Moyie subbasin with passing SFI scores (Ave Supporting).

Table 4. Fish Metrics for BURP Sites in AU #ID17010105PN012_02.

BURP ID	CW Native Taxa	% Cold Water	% Sensitive	Sculpin Age Classes	Salmonid Age Classes	CPUE	SFI
2002SCDAA034	1	100	0	3	3	18.5	78.8
2002SCDAA035	0	100	0	0	4	16.8	50
1995SCDAB042	0	100	0	0	3	1.9	49.4
Ave Supporting	1.26	100	65.6	1.2	2.8	4.9	88.1

Macroinvertebrate metrics (Table 5) for the sites on Meadow Creek showed index values that were not as good as the average of all BURP sites in the Moyie subbasin with passing SMI scores (Ave Supporting). The sites lacked species, especially EPT taxa to varying degrees. Thus, mayfly, stonefly and caddisfly numbers of taxa were lower than expected, and percent dominance by the top five taxa increased as a result. The 1995 site on EF Meadow Creek was slightly more consistent with average supporting values than the other sites. The higher HBI score at the lower Meadow Creek site (2002SCDAA034) suggests that more pollution tolerant organisms are dominating that area which could result from increased sedimentation and loss of habitat.

Table 5. Macroinvertebrate Metrics for BURP Sites in AU #ID17010105PN012_02.

BURP ID	Total Taxa	Ephemeroptera Taxa	Plecoptera Taxa	Trichoptera Taxa	% Plecoptera	HBI	% Dominance of top 5 taxa	% Scraper	% Clinger	SMI
2002SCDAA034	27	7	4	3	7.2	6.36	71.9	13.4	67.9	50.6
2002SCDAA035	28	8	7	0	16	5.15	73.8	48.7	81.5	55.7
1995SCDAB042	31	7	8	9	19.4	4.55	72.5	8.1	57.6	67.1
1996SCDAA011	20	5	5	3	30.6	4.27	59.7	22.6	71	56.8
Ave Supporting	36.2	9.4	8.4	7.1	18.3	4.74	62	36.3	69.2	72.4

4.3 Water Chemistry

Water chemistry data for the assessment unit are extremely limited; only temperature data have been discovered. There were two temperature loggers placed in upper Meadow Creek (above East Fork) and at the mouth of Wall Creek in this assessment unit, both in 2001. They recorded identical (15.6 °C) maximum daily maximum temperatures (MDMT). Both loggers showed exceedance of the 13 °C fall salmonid spawning maximum temperature criterion applied to the default time period starting on August 1st. Neither logger showed any exceedances of cold water aquatic life criteria.

Table 6. Water Chemistry Data Collected in AU #ID17010105PN012_02.

Date	Stream	Temperature* (°C)	pH	Dissolved Oxygen (mg/L)	Specific Conductance (µs/cm)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	E. coli (#/100mL)	Total Coliform (#/100mL)	Discharge (cfs)
8/14/2002	Meadow Creek	19.6 (3pm)								0.06
8/14/2002	Meadow Creek	11.9 (9am)								0.11
8/3/2001	Wall Creek	15.6 (MDMT)								
8/14/2001	Meadow Creek	15.6 (MDMT)								
6/18/1996	Wall Creek									2.5
7/27/1995	EF Meadow Cr									1.3

There are several mines and/or prospects in the Meadow Creek watershed according to an IDL database. They are identified as:

- Tommy Moran (lead, silver, gold, zinc, copper, arsenic) in the headwaters area of Meadow Creek,
- Buckskin Prospect (lead, silver, gold) between Meadow Creek and the EF Meadow Creek,
- Klondike Mine (lead, silver, zinc, nickel, gold) in the EF meadow Creek watershed,
- Regal Mine (lead, zinc, silver, gold copper, arsenic) along Meadow Creek below the EF Meadow Creek confluence.
- unknown mine also in the EF Meadow Creek drainage just north of Wall Mountain.

It is unknown whether or not any of these mines have drainage and are creating releases of heavy metals or low pH to the Meadow Creek system. Most workings appear very small or non-existent on the aerial photos. Regal Mine has the largest workings visible on the aerial photos occupying an area about 250m by 400m in size.

Section 5.0 Analysis

The eight candidate causes identified in Section 3.0 are analyzed here based on the available data. Those causes that are unlikely to be involved in the habitat/biological impairments of the assessment unit will be eliminated from consideration. This analysis brings forth likely candidate causes for further in depth investigation.

5.1 Stressor Refinement

1. There is some evidence that sedimentation is occurring in the lower reach of Meadow Creek that are likely to result in poor macroinvertebrate and habitat scores. Habitat metrics such as percent fines, bank cover and bank stability suggest that excess sediment maybe in place and erosion maybe occurring, which would in turn could cause a loss of taxa that are generally sensitive to excess sediment. The 2002 BURP site in the upper part of the watershed did not show the same problems with bank stability and excess fines, although that site did lack some EPT taxa. There is some timber harvest activity within the watershed, however, the CWE assessment indicated that little excess sediment is reaching the stream from these activities. It is more likely that the lower BURP site on Meadow Creek is affected by land uses (primarily agricultural) in its immediate surroundings.
2. Hydrological alteration cannot be ruled out. Although there did not appear to be any evidence of diversion or channelization, there were abundant road crossings with fish barriers which may also act as water barriers during low flow conditions.
3. Although it is a possible cause, there is no evidence of biological invasions that maybe affecting macroinvertebrate populations. However, brook trout, an introduced species, appear to be the only fish in the majority of the watershed. Sculpin were electrofished at the lower site on Meadow Creek in small numbers, but only brook trout were detected elsewhere in the watershed.
4. Water temperature maybe a problem in the Meadow Creek watershed. Habitat metrics suggest that reach lacks adequate canopy cover. The CWE analysis discovered that Meadow Creek was at high risk for stream temperature problems due to a lack of cover. Measured temperature did exceed salmonid spawning criteria in early fall. If it can be demonstrated that early fall spawning does not occur in these waters and is not appropriate to evaluate in August and September, then water temperature in Meadow Creek may not be impairing uses.
5. We have indicated that bank instability is likely occurring in the lower portion of the Meadow Creek watershed. Loss of bank stability and cover may have resulted from livestock impacts as suggested by photographs. These activities can lead to loss of habitat and a reduction in biological communities.
6. There is no evidence that nutrients are in excess in the Meadow Creek watershed. To our knowledge visible slime growth, excess algae and other macrophytes have not been reported for streams in the assessment unit. However, no data have been collected on water chemistry to confirm normal nutrient status.

7. To our knowledge, BURP sampling occurred in an appropriate manner and there were no problems, sample mishandling nor loss of data.
8. There are five potentially current or legacy mining activities in the assessment unit. We have not obtained any water quality data associated with these activities. To our knowledge, no water chemistry sampling has taken place to confirm a lack of toxic pollutants. The introduction of agricultural chemicals or other accidental spills also cannot be ruled out.

5.2 Candidate Cause Elimination

This assessment unit was previously deemed supporting its uses based on data taken on tributaries to Meadow Creek higher in the watershed (Wall Creek and EF Meadow Creek). More sampling on Meadow Creek itself revealed biological/habitat scores suggesting impairment of beneficial uses. There is a lack of data about this assessment unit, so ruling out candidate causes is difficult. We feel somewhat confident that excess nutrients, sampling error, or biological invasion by alien species (other than brook trout) are not causing the problems associated with low biological and habitat scores in Meadow Creek.

Brook trout appear to be the primary fish species in the watershed. This species could have been introduced directly into this system. There are apparently a number of fish passage barriers that may be preventing the movement and replenishment of native fish species. These barriers may also restrict flow resulting in hydrologic alterations within the watershed.

Sediment delivery in general throughout the watershed does not appear to be a concern. However, it is likely that excess sediment and bank instability are causes of low habitat and biological scores in the lower reach of Meadow Creek just above Wall Creek.

Temperature could also play a role in affecting species distributions in Meadow Creek. Habitat data suggest that there is a lack of adequate riparian cover to prevent excess heat loading. There are some fall salmonid spawning criteria issues, however this may result from improper application of spawning time intervals.

Issues associated with toxicity are unknown and may play a hidden role in this watershed. Water quality sampling for heavy metals and pH should take place to rule out this possibility.

Section 6.0 Conclusions

Assessment Unit # ID17010105PN012_02 includes the upper portion of the Meadow Creek watershed in the Moyie River valley. Four BURP sites and an IDL CWE assessment represent the condition and the majority of the data about this watershed.

It appears that the lower portion of Meadow Creek in the vicinity of the lowest BURP site in the assessment unit is locally impacted by land use activities resulting in bank

instability and sedimentation. Elsewhere in the watershed poor biological scores may result from excess water temperatures and barriers preventing the migration of fish into the system and the movement of water. Heavy metal toxicity is unknown, but remains a possibility.

Section 7.0 References

- EPA. 2000. Stressor Identification Guidance Document. Office of Water and Office of Research and Development, U.S. Environmental Protection Agency. Washington, D.C. EPA/822/B-00/025.
- Grafe, C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandt, and D.T. Mosier. 2002. The Idaho Department of Environmental Quality Water Body Assessment Guidance, Second Edition-Final. Idaho Department of Environmental Quality; Boise, Idaho.
- IDL. 2003. Meadow Creek (HUC Nos. 17010105 – 0102) WQLS 3155 Cumulative Watershed Effects Assessment. Idaho Department of Lands, Coeur d'Alene, Idaho. October 27, 2003.