

Little Wood River Subbasin Assessment and Total Maximum Daily Load



Department of Environmental Quality

Final, August 2005

Little Wood River Subbasin Assessment and TMDL

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Acknowledgments

Samples for the Little Wood River Subbasin Assessment and Total Maximum Daily Load were collected by Jennifer Claire and environmental consulting firms. Reservoir data was collected by Clyde Lay and Jennifer Claire. Habitat data was collected by Jennifer Claire, Alan Monek, and Sean Woodhead. ArcView figures were compiled by Rob Sharpnack. Clyde Lay and Sonny Buhidar reviewed the document throughout the process. Sean Woodhead and many of the Beneficial Use Reconnaissance Program crews collected the biological data. Mark Shumar provided aerial interpretation of canopy cover for temperature TMDLs. Dennis Meier provided technical edit suggestions for the document. The Wood River WAG provided public feedback and input throughout the process. Cover photo of the Little Wood River near Gooding taken by Jennifer Claire.

Table of Contents

Acknowledgments	i
Table of Contents.....	iii
List of Tables.....	viii
List of Figures	x
List of Appendices.....	xi
Abbreviations, Acronyms, and Symbols	xii
Executive Summary	xv
Subbasin at a Glance	xv
Key Findings.....	xix
1. Subbasin Assessment – Watershed Characterization	1
1.1 Introduction.....	1
Background	1
Idaho’s Role.....	2
1.2 Physical and Biological Characteristics.....	3
Climate	3
Precipitation.....	4
Air Temperature and Available Sunlight.....	4
Snow Depth and Snowfall.....	4
Evaporation and Wind Erosion	5
Subbasin Characteristics	5
Hydrography	5
Geology and/or soils	9
Topography.....	13
Vegetation	13
Biological Communities.....	15
Water Chemistry	16
Subwatershed Characteristics.....	19
5 th field Hydrologic Unit Code (HUC)	19
Watershed Area	19
1.3 Cultural Characteristics	23
Land Use.....	23
Land Ownership, Cultural Features, and Population.....	25
History and Economics	28
2. Subbasin Assessment – Water Quality Concerns and Status	33
2.1 Water Quality Limited Segments Occurring in the Subbasin	33
About Assessment Units.....	33
Listed Waters	34
2.2 Applicable Water Quality Standards.....	36
Beneficial Uses	36
Existing Uses	36
Designated Uses.....	36
Presumed Uses.....	36
Surface Water Quality Criteria	39
2.3 Pollutant/Beneficial Use Support Status Relationships.....	39

Temperature.....	39
Dissolved Oxygen	40
Sediment	41
Bacteria	42
Nutrients.....	42
Sediment – Nutrient Relationship	43
Floating, Suspended, or Submerged Matter (Nuisance Algae)	44
2. 4 Summary and Analysis of Existing Water Quality Data	45
Analysis Process.....	45
Bioassessment Data.....	45
Hydrology	46
Water Chemistry	47
Numerical Criteria.....	47
Narrative Criteria.....	48
Nutrient Criteria.....	48
Sediment Criteria	50
Muldoon Creek	51
Biological and Other Data	52
Hydrology	55
Water Column Data.....	56
Conclusions	61
Loving Creek.....	62
Biological and Other Data	62
Hydrology	63
Water Column Data.....	64
Conclusions	69
Dry Creek	70
Biological and Other Data	71
Hydrology	72
Water Column Data.....	74
Conclusions	76
Fish Creek.....	76
Fish Creek (Above the Reservoir).....	77
Biological and Other Data	77
Hydrology	79
Water Column Data.....	81
Conclusions	86
Fish Creek (Below the Reservoir)	87
Biological and Other Data	87
Hydrology	88
Water Column Data.....	90
Conclusions	97
Little Wood River	97
Little Wood River Segment 1 (Above the Reservoir).....	99
Biological and Other Data	99
Hydrology	101

Water Column Data.....	102
Conclusions	107
Little Wood River Segment 2 (Reservoir to Canal Diversions)	108
Biological and Other Data.....	108
Hydrology.....	109
Water Column Data.....	110
Conclusions	113
Little Wood River Segment 3 (Canal Diversions to Silver Creek)	114
Biological and Other Data.....	114
Hydrology	115
Conclusions	115
Little Wood River Segment 4 (Silver Creek to Big Wood River)	115
Biological and Other Data.....	115
Hydrology	117
Water Column Data.....	120
Conclusions	127
Little Wood River Reservoir	127
Biological and Other Data.....	128
Hydrology	128
Water Column Data.....	129
Conclusions	131
Fish Creek Reservoir	132
Biological and Other Data.....	132
Hydrology	133
Water Column Data.....	133
Conclusions	134
2.5 Data Gaps.....	135
3. Subbasin Assessment – Pollutant Source Inventory	137
3.1 Sources of Pollutants of Concern.....	137
Point Sources.....	137
Nonpoint Sources	137
4. Subbasin Assessment – Summary of Past and Present Pollution Control Efforts	139
5. Total Maximum Daily Loads.....	141
5.1 TMDL Components.....	142
Muldoon Creek	143
Design Conditions	143
Target Selection.....	143
Monitoring Points	144
Load Capacity	144
Estimates of Existing Pollutant Loads.....	144
Load Allocation.....	144
Reasonable Assurance	145
Loving Creek	145
Design Conditions	145
Target Selection.....	146

Monitoring Points	146
Load Capacity	146
Estimates of Existing Pollutant Loads	146
Load Allocation	147
Reasonable Assurance.....	147
Little Wood River #1.....	148
Design Conditions	148
Target Selection.....	148
Monitoring Points	148
Load Capacity	149
Estimates of Existing Pollutant Loads	149
Load Allocation	149
Reasonable Assurance.....	150
Fish Creek (Above the Reservoir).....	150
Design Conditions	150
Target Selection	151
Monitoring Points	152
Load Capacity	153
Estimates of Existing Pollutant Loads	153
Load Allocation	153
Reasonable Assurance.....	155
Fish Creek (Below the Reservoir)	155
Design Conditions	156
Target Selection.....	156
Monitoring Points	157
Load Capacity	157
Estimates of Existing Pollutant Loads	158
Load Allocation	158
Reasonable Assurance.....	159
Dry Creek	160
Design Conditions	160
Target Selection.....	160
Monitoring Points	161
Load Capacity	161
Estimates of Existing Pollutant Loads	161
Load Allocation	161
Reasonable Assurance.....	162
Little Wood River Segment #3 (Canal Diversions to Silver Creek)	163
Little Wood River Segment #4 (Silver Creek to Big Wood River).....	163
Design Conditions	163
Target Selection.....	164
Monitoring Points	164
Load Capacity	165
Estimates of Existing Pollutant Loads	165
Load Allocation	165
Reasonable Assurance.....	169

Little Wood River Segment #4 (Silver Creek to Clover Creek Canal, and Clover Creek Canal to Big Wood River)	169
Design Conditions	170
Target Selection	170
Monitoring Points	170
Load Capacity	170
Estimates of Existing Pollutant Loads	170
Load Allocation	171
Reasonable Assurance	173
Construction Storm Water and TMDL Waste Load Allocations	173
Construction Storm Water	173
The Construction General Permit (CGP)	174
Storm Water Pollution Prevention Plan (SWPPP)	174
Construction Storm Water Requirements	174
Future Growth Potential	174
5.2 Implementation Strategies	175
5.3 Conclusions	175
References Cited	179
Geographic Information System (GIS) Coverages	183
Glossary	185

List of Tables

Table 1. Impaired waters of the Little Wood River Subbasin (1998).	xvii
Table 2. Streams and pollutants for which TMDLs were developed.....	xxi
Table 3. Summary of assessment outcomes.....	xxii
Table 4. Average precipitation (inches) in the Little Wood River Subbasin.....	4
Table 5. Little Wood River Subbasin air temperature.	4
Table 6. USGS Gage stations located in the Little Wood River Subbasin.....	7
Table 7. Geologic formations of the Little Wood River Subbasin.....	11
Table 8. Fisheries of the Little Wood River Subbasin.	15
Table 9. Little Wood River Subbasin 5th field HUC watershed areas.....	20
Table 10. Little Wood River Subbasin watershed attributes.	22
Table 11. Land use of the Little Wood River Subbasin.	23
Table 12. Land ownership in the Little Wood River Subbasin.	25
Table 13. Agricultural statistics in the Little Wood River Subbasin.	28
Table 14. Point source facilities of the Little Wood River Subbasin.....	29
Table 15. 303(d) segments in the Little Wood River Subbasin.....	34
Table 16. Little Wood River Subbasin designated beneficial uses.....	37
Table 17. Little Wood River Subbasin existing/presumed beneficial uses.	37
Table 18. Characteristics of Muldoon Creek.....	54
Table 19. Muldoon Creek fish.....	54
Table 20. Muldoon Creek water chemistry data.....	57
Table 21. Muldoon Creek temperature elevations.....	59
Table 22. Muldoon Creek canopy cover.	61
Table 23. Loving Creek water chemistry data.....	65
Table 24. Loving Creek elevated temperatures.	68
Table 25. Loving Creek canopy cover.	69
Table 26. Characteristics of Dry Creek.....	72
Table 27. Dry Creek water chemistry data.	74
Table 28. Characteristics of Fish Creek (above the reservoir).	78
Table 29. Fish Creek (above the reservoir) fish data.....	79
Table 30. Fish Creek (above the reservoir) water chemistry data.....	81
Table 31. Fish Creek (above the reservoir) elevated temperatures.	84
Table 32. Fish Creek (above the reservoir) canopy cover.	86
Table 33. Characteristics of Fish Creek (below the reservoir).	87
Table 34. Fish Creek (below the reservoir) fish data.....	88
Table 35. Fish Creek (below the reservoir) water chemistry data.....	91
Table 36. Fish Creek (below the reservoir) elevated temperatures.....	95
Table 37. Fish Creek (below the reservoir) canopy cover.	96
Table 38. Characteristics of the Little Wood River (segment 1).	100
Table 39. Little Wood River (segment 1) fish data.....	101
Table 40. Little Wood River (segment 1) water chemistry data.....	103
Table 41. Little Wood River (segment 1) elevated temperatures.....	105
Table 42. Little Wood River (segment 1) canopy cover.	107
Table 43. Little Wood River (segment 2) water chemistry data.....	110
Table 44. Little Wood River (segment 2) elevated temperatures.....	112
Table 45. Characteristics of the Little Wood River (segment 3).	114

Table 46. Characteristics of the Little Wood River (segment 4).....	117
Table 47. Little Wood River (segment 4) fish data.	117
Table 48. Little Wood River (segment 4) water chemistry data.....	121
Table 49. Little Wood River (segment 4) elevated temperatures.	124
Table 50. Little Wood River (segment 4) canopy cover.	126
Table 51. Point sources contributing pollutant to an impacted stream.	137
Table 52. Muldoon Creek load reductions.	145
Table 53. Muldoon Creek load allocations.....	145
Table 54. Loving Creek load reductions.	147
Table 55. Loving Creek load allocations.....	147
Table 56. Little Wood River (segment 1) load reductions.	149
Table 57. Little Wood River (segment 1) load allocations.	150
Table 58. Fish Creek (above the reservoir) load reductions.	154
Table 59. Fish Creek (above the reservoir) load allocations.....	155
Table 60. Fish Creek (above the reservoir) stream bank erosion values.....	155
Table 61. Fish Creek (below the reservoir) load reductions.	159
Table 62. Fish Creek (below the reservoir) load allocations.....	159
Table 63. Fish Creek (below the reservoir) stream bank erosion values.	159
Table 64. Dry Creek load reductions.	162
Table 65. Dry Creek load allocations.....	162
Table 66. Dry Creek stream bank erosion values.....	162
Table 67. Sediment waste load allocations on the Little Wood River.	167
Table 68. Little Wood River (segment 4) load reductions.	167
Table 69. Little Wood River (segment 4) load allocations.....	167
Table 70. Little Wood River (segment 4) stream bank values.....	167
Table 71. City of Gooding allowable effluent temperatures.	168
Table 72. City of Shoshone allowable effluent temperatures.....	168
Table 73. Glanbia-Gooding allowable effluent temperatures.....	169
Table 75. Estimated TP waste load from point sources on Little Wood River.	172
Table 76. Little Wood River (segment 4) load reductions.	173
Table 77. Little Wood River (segment 4) load allocations.....	173
Table 78. Summary of assessment criteria results.....	175
Table 79. Summary of pollutants and TMDLs completed.....	176
Table 80. Flow alteration impacting water quality.....	177
Table 81. Metric – English unit conversions.....	211
Table 82. Threatened, endangered, and sensitive species.	213
Table 83. Surface water criteria.	215
Table 84. Stream bank segments in the Little Wood River Subbasin.	221
Table 85. Canopy cover estimates and targets.	229
Table 86. Aerial versus pathfinder data.	233
Table 87. Data sources for the Little Wood River Subbasin Assessment.	243

List of Figures

Figure 1. Subbasin at a glance.....	xvi
Figure 2. Impaired water bodies of the Little Wood River Subbasin.	xviii
Figure 3. Little Wood River Subbasin average hydrology.	6
Figure 4. Little Wood River Subbasin dams and gauge stations.	8
Figure 5. Geologic formations of the Little Wood River Subbasin.	10
Figure 6. Soil erosivity (K Factors) of the Little Wood River Subbasin.	12
Figure 7. Vegetation coverage of the Little Wood River Subbasin.	14
Figure 8. Average annual TSS in the subbasin.....	17
Figure 9. Average annual TP in the subbasin.....	18
Figure 10. Average annual <i>E. coli</i> in the subbasin.....	19
Figure 11. Little Wood River 5th field watersheds.....	21
Figure 12. Little Wood River Subbasin land use.	24
Figure 13. Little Wood River Subbasin counties.	26
Figure 14. Little Wood River Subbasin cities.....	27
Figure 15. Little Wood River Subbasin point sources.	31
Figure 16. Little Wood River Subbasin 303(d)-listed water bodies.....	35
Figure 17. Bedload sediment in streams meeting beneficial uses.	51
Figure 18. Muldoon Creek flow (cfs) regression analysis.	55
Figure 19. Muldoon Creek predicted hydrograph.....	56
Figure 20. Muldoon Creek CWAL temperatures (2003).....	60
Figure 21. Loving Creek actual hydrograph (2001-2003).	64
Figure 22. Loving Creek SS temperatures.	68
Figure 23. Dry Creek actual hydrograph (2001-2003).....	73
Figure 24. Fish Creek (above the reservoir) flow (cfs) regression analysis.....	80
Figure 25. Fish Creek (above the reservoir) predicted hydrograph.....	80
Figure 26. Fish Creek (above the reservoir) CWAL temperatures.	84
Figure 27. Fish Creek (above the reservoir) SS temperatures.	85
Figure 28. Fish Creek (below the reservoir) flow (cfs) regression analysis.....	89
Figure 29. Fish Creek (below the reservoir) predicted hydrograph.....	90
Figure 30. Fish Creek (below the reservoir) sampling sites.	94
Figure 31. Fish Creek (below the reservoir) CWAL temperatures.....	95
Figure 32. Little Wood River (segment 1) hydrograph.....	102
Figure 33. Little Wood River CWAL temperature data (2001).....	106
Figure 34. Little Wood River SS temperature data (2001).....	106
Figure 35. Little Wood River (segment 2) hydrograph.....	109
Figure 36. Little Wood River (segment 2) CWAL temperatures.....	113
Figure 37. Little Wood River (segment 4) current predicted hydrographs.....	119
Figure 38. Little Wood River (segment 4) historical hydrographs.	119
Figure 39. Little Wood River (segment 4) CWAL maximum temperatures (2003).	125
Figure 40. Little Wood River (segment 4) SS temperatures (2003).	125
Figure 41. Little Wood River Reservoir average hydrograph.	129
Figure 42. Temperature profile for the Little Wood River Reservoir.....	131
Figure 43. Land use in the 5 th Field HUC watersheds of the subbasin.....	138

List of Appendices

Appendix A. Unit Conversion Chart	211
Appendix B. Threatened and Endangered Species.	213
Appendix C. State and Site-Specific Standards and Criteria	215
Appendix D. Geology of Fish Creek Reservoir.....	219
Appendix E. Stream Bank Inventory Information.....	221
Appendix F. Information Related to Temperature.....	229
Appendix G. Implementation Strategies	237
Appendix H. Data Sources	243
Appendix I. Distribution List	245
Appendix J. Public Comments	247

Abbreviations, Acronyms, and Symbols

§303(d)	Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section	DEQ	Department of Environmental Quality
μ	micro, one-one thousandth	DO	dissolved oxygen
§	Section (usually a section of federal or state rules or statutes)	DWS	domestic water supply
ADB	assessment database	EPA	United States Environmental Protection Agency
AU	assessment unit	F	Fahrenheit
AWS	agricultural water supply	GIS	Geographical Information Systems
BAG	Basin Advisory Group	HUC	Hydrologic Unit Code
BLM	United States Bureau of Land Management	IDAPA	Refers to citations of Idaho administrative rules
BMP	best management practice	IDFG	Idaho Department of Fish and Game
BOD	biochemical oxygen demand	IDWR	Idaho Department of Water Resources
BURP	Beneficial Use Reconnaissance Program	km	kilometer
C	Celsius	km²	square kilometer
CFR	Code of Federal Regulations (refers to citations in the federal administrative rules)	kWh/day	kilowatt hour per day
cfs	cubic feet per second	LA	load allocation
cm	centimeters	LC	load capacity
CWA	Clean Water Act	m	meter
CWAL	cold water aquatic life	m³	cubic meter
		mi	mile
		mi²	square miles

MGD	million gallons per day	SMI	DEQ's stream macroinvertebrate index
mg/L	milligrams per liter	SS	salmonid spawning
mm	millimeter	TIN	total inorganic nitrogen
MOS	margin of safety	TMDL	total maximum daily load
n.a.	not applicable	TP	total phosphorus
NA	not assessed	TS	total solids
NB	natural background	TSS	total suspended solids
nd	no data (data not available)	t/y	tons per year
NPDES	National Pollutant Discharge Elimination System	U.S.	United States
NRCS	Natural Resources Conservation Service	U.S.C.	United States Code
NTU	nephelometric turbidity unit	USDA	United States Department of Agriculture
ORV	off-road vehicle	USFS	United States Forest Service
PCR	primary contact recreation	USGS	United States Geological Survey
PFC	proper functioning condition	WAG	Watershed Advisory Group
ppm	part(s) per million	WBAG	<i>Waterbody Assessment Guidance</i>
QA	quality assurance	WBID	water body identification number
QC	quality control	WLA	wasteload allocation
RHCA	riparian habitat conservation area	WQLS	water quality limited segment
SBA	subbasin assessment	WQS	water quality standard
SCR	secondary contact recreation		
SFI	DEQ's stream fish index		
SHI	DEQ's stream habitat index		

Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in the Little Wood River Subbasin that have been placed on what is known as the "§303(d) list."

This subbasin assessment and TMDL analysis has been developed to comply with Idaho's TMDL schedule. This assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Little Wood River Subbasin located in south central Idaho. The first part of this document, the subbasin assessment, is an important first step in leading to the TMDL. The starting point for this assessment was Idaho's current §303(d) list of water quality limited water bodies. Ten segments of the Little Wood River Subbasin were included on this list. The subbasin assessment portion of this document examines the current status of §303(d) listed waters, and defines the extent of impairment and causes of water quality limitation throughout the subbasin. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards.

Subbasin at a Glance

The Little Wood River Subbasin lies in south central Idaho (Figure 1). The Little Wood River is the main water body that drains the subbasin. The headwaters of the river originate in the Pioneer Mountains of the Sawtooth National Forest and discharge in the desert plains at the Big Wood River. The Northern Rockies, Snake River Plain/High Deserts and transitional zones between the two ecoregions represent the ecoregions of the subbasin.

Hydrologically, there is a great deal of activity occurring within the subbasin:

- Runoff events in the spring months and precipitation events in the fall months feed many of the water bodies.
- Ground water also plays a role in that many of the springs of the subbasin provide perennial base flow throughout the region.
- Ground water plays a larger role in the southern part of the subbasin, where the spring-fed system, Silver Creek, contributes a large percentage of the flow to the Little Wood River.

- The land uses of the subbasin also require the diversion of water from their natural channels and/or the use of natural channels as a transport channel for waters from other subbasins. In many cases, segments of water bodies are dewatered for the majority of the year.

Hydrology is, therefore, an important component to consider when determining the impacts to water quality in the Little Wood River Subbasin.

The land of the subbasin is used in a number of ways by a number of entities:

- The majority of the subbasin is privately owned or publicly owned and managed by the Bureau of Land Management (BLM.)
- Overall the vegetation of the subbasin is more conducive to rangeland activities, therefore there is a lot of rangeland use followed by some irrigated agriculture use that occurs in the valleys or flood plains of the water bodies.
- Most activity within the subbasin is nonpoint source activity.
- Point sources within the subbasin include four city wastewater treatment facilities, one aquaculture facility, two food processing facilities, and one industrial facility.

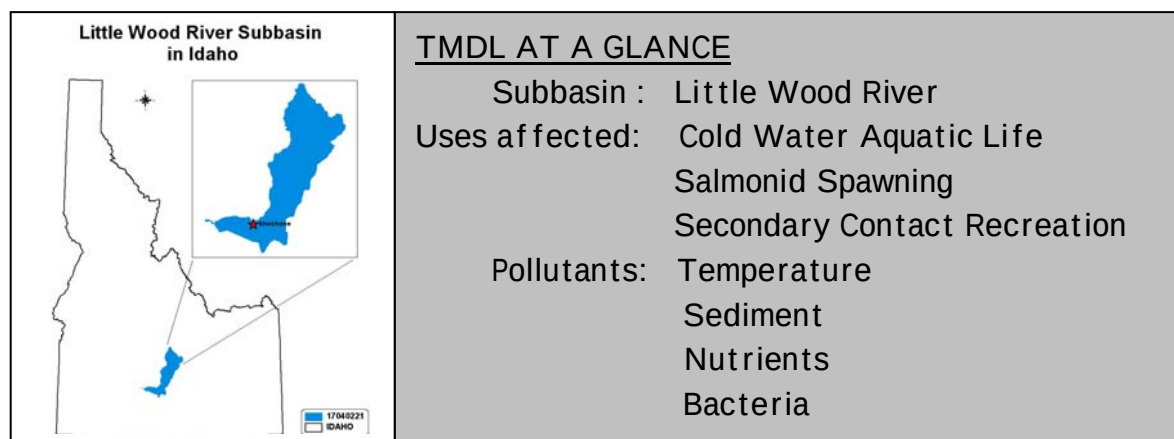


Figure 1. Subbasin at a glance.

There are eleven water body segments of the Little Wood River Subbasin that have been identified as being impaired (Figure 2). Many of these water bodies were identified on the 1998 303(d) list as being impaired by bacteria, dissolved oxygen, nutrients, sediment, flow alteration, or unknown pollutants. EPA also identified Muldoon Creek and segments of the Little Wood River as being impaired by temperature. These pollutants may be impacting the beneficial uses of the subbasin, which includes cold water aquatic life, salmonid spawning, primary contact recreation, and secondary contact recreation. Pollutants were identified in the 1998 303(d) list as impacting water quality (Table 1).

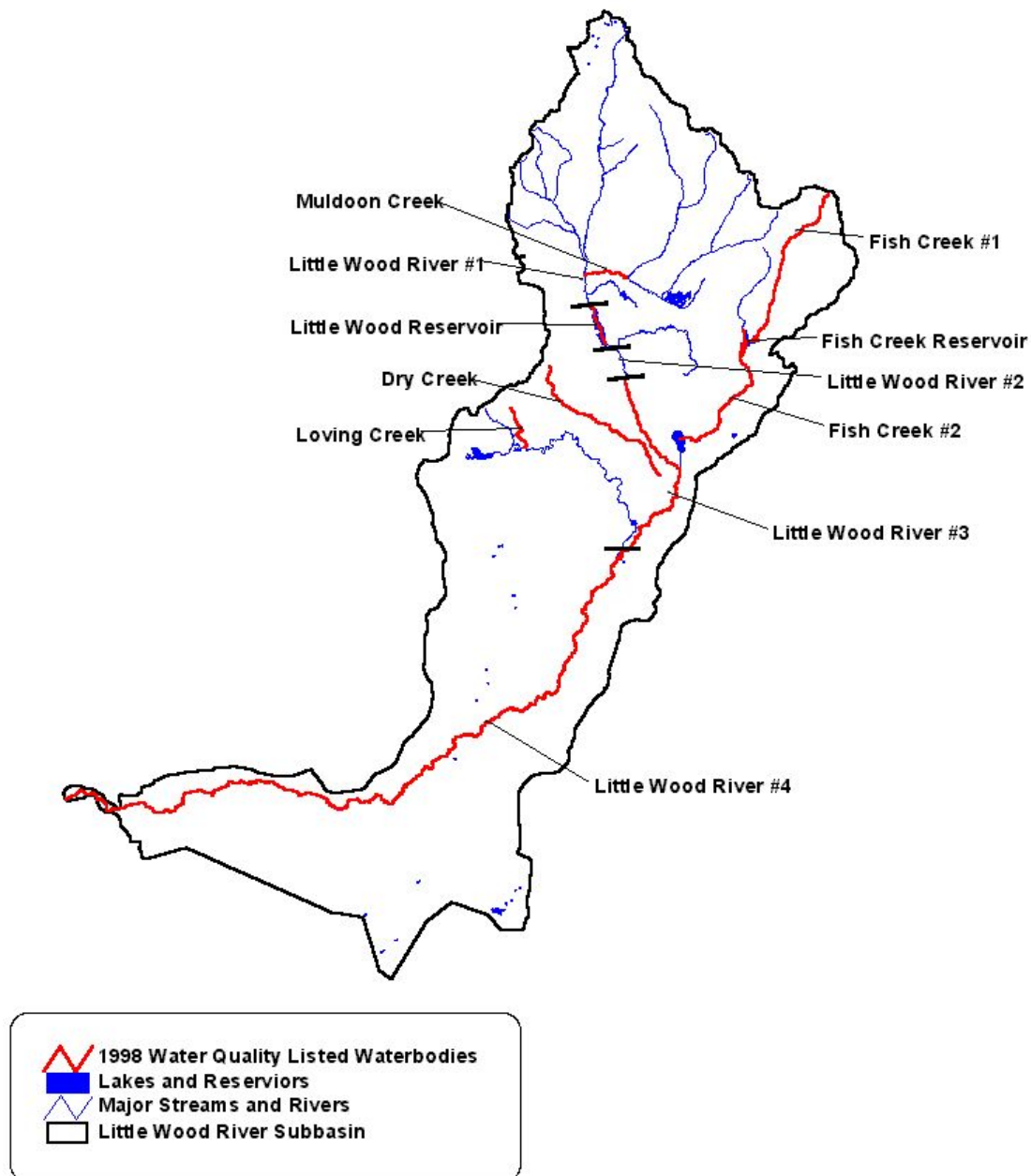
Table 1. Impaired waters of the Little Wood River Subbasin (1998).

Water body Name	Assessment Unit	1998 §303(d) Boundaries	1998 §303(d) listed Pollutants of Concern
Dry Creek	ID17040221SK022_02 ID17040221SK022_03	Headwaters to mouth	BAC, NUT, DO, SED, QALT
Fish Creek (above the reservoir)	ID17040221SK008_02 ID17040221SK008_03 ID17040221SK008_04	Headwaters to Fish Creek Reservoir	BAC, NUT, DO, SED, QALT
Fish Creek (below the reservoir)	ID17040221SK006_03 ID17040221SK006_04	Fish Creek Reservoir Dam to Carey Lake	BAC, NUT, DO, SED, QALT
Little Wood River #3	ID17040221SK010_05a ID17040221SK003_05	East Canal diversion to Silver Creek	NUT, SED, TEMP
Little Wood River #4	ID17040221SK002_05	Silver Creek to Richfield (town)	NUT, SED, TEMP
Little Wood River #4	ID17040221SK001_05 ID17040221SK001_05a ID17040221SK001_05b	Richfield to Big Wood River	BAC, DO, NUT, SED, QALT, TEMP
Muldoon Creek	ID17040221SK014_04	South Fork Muldoon Creek to mouth	UNK
Muldoon Creek	ID17040221SK014_02 ID17040221SK014_03 ID17040221SK014_04	Headwaters to mouth	TEMP
Loving Creek	ID17040221SK023_02	Headwaters to mouth	UNK
Little Wood River Reservoir	ID17040221SK012L_0L		BAC, DO, NUT, SED, QALT
Fish Creek Reservoir	ID17040221SK005L_0L		BAC, DO, NUT, SED, QALT

^a1998 303(d) refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.

^bPollutants : BAC – Bacteria, DO – Dissolved Oxygen, NUT – Nutrients, SED – Sediment, QALT – Flow alteration, UNK – Unknown, TEMP – temperature.

Little Wood River Subbasin 1998 303(d) Listed Waterbodies



Prepared by Rob Sharpnack - October 2000

Figure 2. Impaired water bodies of the Little Wood River Subbasin.

Key Findings

Biological and water chemistry data were used to determine if beneficial uses of the water bodies were fully supported:

- When biological and water chemistry data indicated that beneficial uses were being fully supported, the water bodies were proposed for delisting.
- When biological data indicated that beneficial uses were not fully supported, water chemistry data was used to identify the pollutant impacting beneficial uses.
- If a pollutant was not impacting a water body it was delisted.
- If a pollutant was identified as impacting beneficial uses, load allocations for appropriate point and nonpoint sources were completed.

There were a number of cases in which flow alteration was found to be a source of pollution impacting the water body. When flow has been identified as the pollution, a TMDL is not completed. The water body is identified as being impacted by flow alteration and put on a list of water bodies identified as being impacted by flow alteration.

Temperature elevations occurred in many of the water bodies, and temperature TMDLs were completed. A number of activities contribute to these temperature elevations, including canopy cover deficiencies resulting from land management practices, beaver dam complexes, and geologic formations such as basalt and lava flows that retain heat and may inhibit sufficient riparian development, flow alteration, ground water influences, and desert conditions of south central Idaho.

The pollutants that were impacting beneficial uses of the subbasin were nutrients, sediment, bacteria, and temperature:

- Nutrients were measured in the form of total phosphorus (TP) and total inorganic nitrogen (TIN). The average annual or monthly TP values elevated above 0.100 mg/L may indicate impairment of a water body. For water bodies flowing into a storage system average annual or monthly TP values elevated above 0.050 mg/L may indicate excessive delivery of nutrients to the storage system by the water body. These targets are the targets recommended by EPA in their Quality Criteria for Water 1986, Gold Book. Ideally, the monthly average would be used to determine if impairment was occurring. However, monitoring designs did not allow for a monthly average to be determined. As a result the daily maximum values of 0.160 mg/L or 0.080 mg/L were likely to be elevated in combination with the annual average of 0.100 mg/L or 0.050 mg/L. According to the Idaho water quality status report 1980 and the USFS Salmonid-habitat relationships in the Western United States concentrations of TIN above 0.300 mg/L will allow the development of biological nuisances and accelerate eutrophication (Buhidar 2004). *Therefore, annual averages for TIN greater than 0.300 mg/L, in combination with elevated TP levels, indicate that nutrients could be at levels that are capable of contributing to nuisance aquatic growth in the water body.*

- Sediment was measured in the water column as total suspended solids (TSS) and as percent fines for bed load sediment. The European Inland Fisheries Advisory Commission has suggested limits for TSS; these limits have been used in various south central Idaho TMDLs including the Bruneau and Big Wood River TMDLs. *The annual and monthly average target for TSS is 50 mg/L.* Monthly and annual averages elevated above this value may indicate impairment of the water body. Ideally, the monthly average would be used to determine if impairment was occurring. *However, monitoring designs did not allow for a monthly average to be determined.* As a result, the daily maximum value of 80 mg/L will be used to determine if monthly averages were likely to be elevated in combination with the annual averages of 50 mg/L. *For bedload sediment,* fully supported water bodies within the subbasin indicate that a water body is capable of fully supporting its beneficial uses when percent fines are 35% or less. As a result percent fine data elevated above 35% indicate that impairment of the water body is likely. When it was found that percent fines were elevated, stream bank erosion inventories were completed to determine if stream banks were the source of sediment. *Stream banks with stability less than 80% indicate that stream banks are delivering an excessive source of sediment within the system.*
- Bacteria and temperature are both numeric water quality standards and, as such, have numerical values that have to be met. Bacteria, in the form of *Escherichia coli* (*E. coli*), cannot exceed 406 colony forming units (cfu)/100 ml for primary contact recreation beneficial uses or 576 cfu/100ml for secondary contact beneficial uses. When these values are exceeded, four additional samples must be collected within 30 days. The geometric mean of the five samples are not to exceed a geometric mean of 126 cfu/100 ml.
- Temperature water quality standards differ for cold water aquatic life (CWAL) and salmonid spawning (SS) beneficial uses. Both maximum and average daily temperatures are not to exceed numeric criteria more than 10% of the time during critical time periods. Maximum and average daily temperatures for CWAL are 22 degrees C and 19 degrees C. Maximum and average daily temperatures for SS are 13 degrees C and 9 degrees C. If these temperatures are elevated more than 10% of the time, then temperature is impacting beneficial uses as numeric criteria supersede biological data. However it has been found, in some of the water bodies, that biological data indicates that beneficial uses despite temperature elevations are fully supported. When temperature data was elevated canopy cover of the water body was measured to develop a total maximum daily load (TMDL) for the water body.

Total maximum daily loads have been completed on five of the listed water bodies, addressing the pollutants described in the preceding:

- Nutrient TMDLs have been completed on both segments of Fish Creek, with the reservoir to be included in the implementation plans, and on the two listed segments of the Little Wood River from Silver Creek to the Big Wood River.

- Stream bank erosion TMDLs for sediment have been completed on Dry Creek, both segments of Fish Creek, and the Little Wood River from Silver Creek to the Big Wood River.
- A bacteria TMDL has been completed on the upper segment of Fish Creek from the headwaters to the reservoir.
- Temperature TMDLs have been completed on Loving Creek, Muldoon Creek, both segments of Fish Creek, and segments 1 and 4 of the Little Wood River.

Flow alteration has been identified as pollution for many of the water bodies. Water bodies listed as impacted by flow alteration include segments 3 and 4 of the Little Wood River, Fish Creek from the reservoir to Carey Lake, and Dry Creek. Flow alterations have left a segment of each of these water bodies dry for the majority of the year if not the whole year.

The following tables (Table 2 and Table 3) identify loads and decisions that were made for each of the water bodies.

Table 2. Streams and pollutants for which TMDLs were developed.

Stream	Pollutant(s)
Little Wood River #1 (headwaters to reservoir)	Temperature
Little Wood River #4 (Silver Creek to Big Wood River)	Sediment, Nutrients, Temperature
Fish Creek (above reservoir)	Sediment, Nutrients, Bacteria, Temperature
Fish Creek (below reservoir)	Sediment, Nutrients, Temperature
Dry Creek	Sediment
Muldoon Creek	Temperature
Loving Creek	Temperature

Table 3. Summary of assessment outcomes.

Water Body Segment	Assessment Unit	Pollutant	TMDL Done	Recommended Changes to §303(d) List	Justification
Little Wood River #1	ID17040221SK020_02 ID17040221SK020_03 ID17040221SK020_04 ID17040221SK020_05 ID17040221SK013_05	TEMP	Yes	List TEMP	Temperature violation
Little Wood River #2	ID17040221SK010_05	None	No	None	---
Little Wood River #3	ID17040221SK010_05a ID17040221SK003_05	None	No	List QALT, Delist SED, NUT, TEMP,	Water body dewatered
Little Wood River #4	ID17040221SK002_05 ID17040221SK001_05 ID17040221SK001_05a ID17040221SK001_05b	NUT, SED, TEMP	Yes	Delist BAC, DO	Meeting standards
Little Wood River Reservoir	ID17040221SK012L_0L	None	No	Delist for BAC, DO, NUT, SED	Meeting criteria
Dry Creek	ID17040221SK022_02	SED	Yes	Delist BAC, DO, NUT	Meeting criteria
Fish Creek (above)	ID17040221SK008_02 ID17040221SK008_03 ID17040221SK008_04	SED,NUT, BAC,TEMP	Yes	Delist for DO, QALT	Meeting standards
Fish Creek (below)	ID17040221SK006_03 ID17040221SK006_04	SED,NUT, TEMP	Yes	Delist for BAC,DO	Meeting standards
Fish Creek Reservoir	ID17040221SK005L_0L	None	No	Delist for BAC, DO,NUT,SED	Meeting criteria
Muldoon Creek	ID17040221SK014_02 ID17040221SK014_03 ID17040221SK014_04	TEMP	Yes	Delist for Unknown	Pollutant identified
Loving Creek	ID17040221SK023_02	TEMP	Yes	Delist for Unknown	Pollutant identified

^a1998 303(d) refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.

^b Abbreviations: SED- sediment, NUT- nutrient, BAC- bacteria, TEMP- temperature, DO- dissolved oxygen, QALT- flow alteration.

^c Water body segments: Little Wood River #1- headwaters to reservoir, Little Wood River #2 – reservoir to canal diversions, Little Wood River #3- canal diversions to Silver Creek, Little Wood River #4- Silver Creek to Big Wood River, Fish Creek (above)- headwaters to reservoir, Fish Creek (below)- reservoir to Carey Lake.

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in the Little Wood River Subbasin that have been placed on what is known as the "§303(d) list."

The overall purpose of this subbasin assessment and TMDL is to characterize and document pollutant loads within the Little Wood River Subbasin. The first portion of this document, the subbasin assessment, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Sections 1 – 4). This information will then be used to develop a TMDL for each pollutant of concern for the Little Wood River Subbasin (Section 5).

1.1 Introduction

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Pollution Control Federation 1987). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Background

The federal government, through the U.S. Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. The Department of Environmental Quality (DEQ) implements the CWA in Idaho, while the EPA oversees Idaho and certifies the fulfillment of CWA requirements and responsibilities.

Section 303 of the CWA requires DEQ to adopt, with EPA approval, water quality standards and to review those standards every three years. Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish TMDLs for each pollutant impairing the waters. Further, the agency

must set appropriate controls to restore water quality and allow the water bodies to meet their designated uses. These requirements result in a list of impaired waters, called the “§303(d) list.” This list describes water bodies not meeting water quality standards. Waters identified on this list require further analysis. A subbasin assessment and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the §303(d) list. *Little Wood River Subbasin Assessment and TMDL* provides this summary for the currently listed waters in the Little Wood River Subbasin.

The subbasin assessment section of this report (Chapters 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Little Wood River Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (Water quality planning and management, 40 CFR 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also includes individual pollutant allocations among various sources discharging the pollutant. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutants as “pollution.” TMDLs are not required for water bodies impaired by pollution, but not specific pollutants. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Idaho's Role

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

The state may assign or designate beneficial uses for particular Idaho water bodies to support. These beneficial uses are identified in the Idaho water quality standards and include:

- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning, modified
- Contact recreation – primary (swimming), secondary (boating)
- Water supply – domestic, agricultural, industrial
- Wildlife habitats, aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all water bodies in the state. If a

water body is unclassified, then cold water and primary contact recreation are used as additional default designated uses when water bodies are assessed.

A subbasin assessment entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data to address several objectives:

- Determine the degree of designated beneficial use support of the water body (i.e., attaining or not attaining water quality standards).
- Determine the degree of achievement of biological integrity.
- Compile descriptive information about the water body, particularly the identity and location of pollutant sources.
- When water bodies are not attaining water quality standards, determine the causes and extent of the impairment.

1.2 Physical and Biological Characteristics

The Little Wood River Subbasin runs from the headwaters (in the Pioneer Mountains in Blaine County) of the Little Wood River to its mouth (west of Gooding) where it empties into the Big Wood River. It lies in the western region of the Upper Snake River Basin in Idaho. The Big Wood River, Big Lost River, Lake Walcott, and Upper Snake-Rock Subbasins surround it. The northernmost border is the Blaine County line, just above the headwaters, extending along this line south between the Blizzard and Pioneer Mountains. The eastern border runs to the east of the Little Wood River in a southwest direction south of Richfield. At this point the eastern border runs south to encompass Star Lake. The southern border then runs west to encompass a small portion of upper Jerome and upper Gooding counties to the mouth of the Little Wood River. The western border then runs to the east from the mouth just north of the Little Wood River then north along the Cottonwood Slough. The western border just catches the eastern edge of the Timmerman Hills encompassing Silver Creek drainage and continues running north of Gannet to meet the Blaine County line above the headwaters.

The climate, subbasin characteristics, subwatershed characteristics, and stream characteristics of the Little Wood River Subbasin are described in the following.

Climate

The Little Wood River Subbasin can be characterized into three basic elevation levels. The majority of the subbasin (59.0% of the area) occurs at the lower elevation range, which is less than 5,000 feet. The remainder of the subbasin (34.1% and 6.9% of the area) is found at a middle elevation of 5,000 to 7,000 feet and a higher elevation greater than 7,000 feet (ArcView Coverage 1992-1996).

These three elevation ranges will be used to describe much of the climate of the subbasin, including precipitation, air temperature and available sunlight, snow depth and snowfall, and evaporation and wind erosion. Air temperature, snowfall, and snow depth data have been collected from similar data sources. The low elevation data is an average of data from three sites (Gooding, Shoshone, and Richfield) within the subbasin at this elevation range. The middle elevation is represented by data collected from Picabo, and high elevation data is an average of data collected from Garfield and Swede Peak.

Precipitation

The weighted mean precipitation based on elevation ranges for the Little Wood River Subbasin is 14.66 inches. The majority of the precipitation occurs in the winter and spring months. The following table (Table 4) provides some precipitation data.

Table 4. Average precipitation (inches) in the Little Wood River Subbasin.

Elevation	Winter Average	Spring Average	Summer Average	Fall Average	Total Annual
High	2.81	2.51	1.48	1.19	23.97
Middle	1.62	1.25	0.69	0.46	12.10
Low	1.40	0.95	0.48	0.82	10.97

^aData collected from U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Snotel Site and Western Regional Climate Center.

Air Temperature and Available Sunlight

The estimated midrange temperatures for the low, middle, and high elevations of the subbasin are similar to one another and are described in Table 5.

Table 5. Little Wood River Subbasin air temperature.

Elevation	Midrange Temp (°C)	Midrange Temp (°F)
High	-6.05 to 16.5	21.1 to 61.7
Middle	-5.7 to 20.2	21.6 to 68.4
Low	-4.3 to 22.2	24.2 to 72

^aData collected from Western Regional Climate Center (2001) and the Bureau of Reclamation (USBR) Agrimet site (2001).

The estimated average annual available sunlight for this region is 12.5 hours with the greatest amount of available light occurring in the summer months at 15 hours and the least amount occurring in the winter months at 10.5 hours (USNO 2001).

Snow Depth and Snowfall

The annual average snow depth for the low elevations of the Little Wood River Subbasin is 1.3 inches, while the annual average snow depths for the middle elevation is 2 inches (WRCC 2001). The estimated annual average total snowfall for the low, middle, and high

elevations of the Little Wood River Subbasin is 43.3, 61.4, and 182.8 inches, respectively. The majority of the snowfall in the low elevations occurs from November into March. Snowfall occurs mostly from November to April in the middle elevations and from October to April in the high elevations (WRCC 2001).

Evaporation and Wind Erosion

The annual evaporation for the Little Wood River Subbasin ranges from 6 to 12 mm (0.24 to 0.47 inches) with the majority of evaporation occurring in the months of May through September (CPC 2004). Wind erosion in the Little Wood River Subbasin has been found to be so minimal as to be insignificant in its effect on the water quality of the water bodies. It has been estimated that only 3.85% of the subbasin area exceeds the threshold for wind erosion (NRCS 2001).

Subbasin Characteristics

The Little Wood River Subbasin has its main water body, the Little Wood River, flowing through the high elevations of the Pioneer Mountains, and then on through the lower flat elevation of the Lava Plains, Shoshone, and Gooding. The Little Wood River has many tributaries that originate in both the desert and mountain regions of the subbasin.

Hydrography, geology/soils, topography, vegetation, fisheries, macroinvertebrates, and water chemistry of the subbasin will be described in the following sections. The hydrology, fisheries, macroinvertebrate, and water chemistry discussions will revolve around data that has been collected on the 303(d) listed streams in the subbasin.

Hydrography

There are a number of natural and anthropogenic activities occurring in the Little Wood River Subbasin that impacts the hydrology of the subbasin. Figure 3 depicts the average hydrograph for several of the water bodies. Peak flows tend to occur at the first of the summer in June, followed by smaller runoff events that change the shape of the hydrograph in April, May, July, and August.

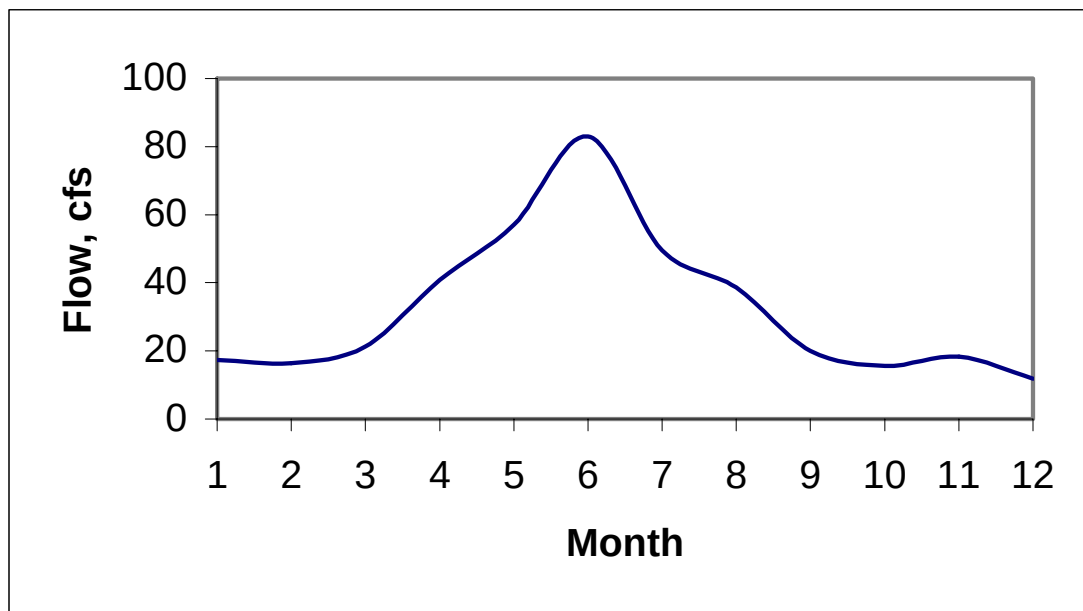


Figure 3. Little Wood River Subbasin average hydrology.

The figure indicates that there may be many natural and anthropogenic activities altering the natural hydrograph of the subbasin. For example, ground water influences portions of the Little Wood River Subbasin substantially. The Silver Creek drainage is a large spring-fed system that lies in the middle portion of the Little Wood River Subbasin. There are also three large reservoirs/lakes and several small alpine lakes that lie within the Little Wood River Subbasin. The reservoirs/lakes include Carey Lake, the Little Wood River Reservoir, and Fish Creek Reservoir:

- Carey Lake is the natural outlet for the Fish Creek drainage and is also fed by surrounding hot springs.
- The Little Wood River Reservoir is the largest reservoir in the subbasin. It lies in the upper third portion of the subbasin and has direct impacts to the hydrology of the remainder of the river located downstream.
- Fish Creek Reservoir is the second largest reservoir in the subbasin and greatly influences the natural hydrology of the Fish Creek system. Additionally there are several other small reservoirs within the subbasin.

The Little Wood River is the natural outlet for all of the water of the Little Wood River Subbasin. The Little Wood River runs from the mountainous headwaters in the north of the subbasin to the flatter agricultural lands at the mouth in the southwest portion of the subbasin. Many snow pack driven creeks feed the upper portion of the river. These creeks contribute to the perennial nature of the river as a whole and to a hydrology that would likely be expected for the subbasin as a whole excluding flow manipulations.

The hydrology of the middle portion of the river is changed substantially by the Little Wood River Reservoir and downstream irrigation water demands. Irrigation water demands within the subbasin leads to peak flows that occur within irrigation months (summer and early fall) rather than during spring runoff. The reservoir storage and irrigation demands also leads to segments of the river that remain dry throughout the year.

Many anthropogenic activities and natural water sources also impact the lower portion of the river. The lower portion of the subbasin contains many natural spring-fed systems, which feed the Little Wood River downstream of the Silver Creek confluence. These systems yield a continuous stable flow for much of the river above Richfield. However, the irrigation demands and the resulting dewatered segment above the spring systems confluence contribute to a pronounced lack of peak flushing flows in the lower segment. Irrigation water transport and use also impacts summer time peak flows in this portion of the river.

The above mentioned hydrologic impacts to the Little Wood River can also be seen in many of the smaller systems of the subbasin. Overall, these impacts yield a subbasin with a non-typical annual hydrograph. The hydrology of the individual water bodies within the subbasin is discussed in Section 2: Subbasin Assessment – Water Quality Concerns and Status.

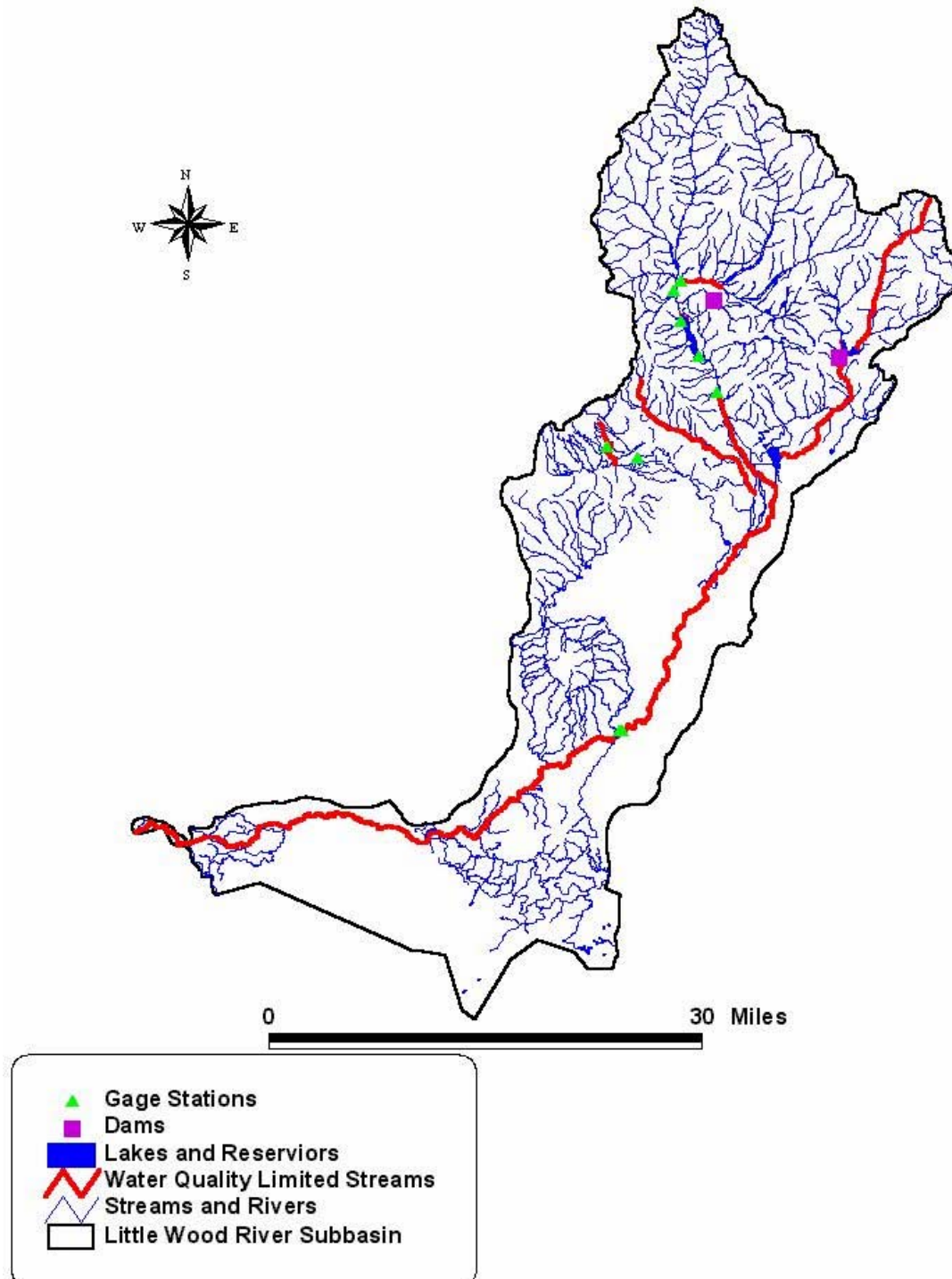
The annual average hydrographs for the Little Wood River and the smaller systems will be developed from U.S. Geological Survey (USGS) gage data and flow records collected by DEQ and other agencies. To date, there have been 11 gage stations in the Little Wood River Subbasin (Figure 4). These gages have been located on the Little Wood River, Silver Creek, Fish Creek, and West Fork Fish Creek. Three of these gage stations have historical and current data, while the remaining gauges have only historical flow data. The current gage stations include two on the Little Wood River and one on Silver Creek. Table 6 identifies the gauging stations in the Little Wood River Subbasin and their period of record.

Table 6. USGS Gage stations located in the Little Wood River Subbasin.

Gage ID	Water Body Name	Gauge Name	Period of Record
13147900	Little Wood River	Little Wood River AB High Five Creek NR Carey ID	1958 - 2002
13148000	Little Wood River	Little Wood River at Campbell Ranch NR Carey ID	1920 - 1958
13148500	Little Wood River	Little Wood River NR Carey ID	1925 - 2002
13149000	Fish Creek	Fish Creek AB Fish Creek Dam NR Carey ID	1920 - 1939
13149500	West Fork Fish Creek	WF Fish Creek NR Carey ID	1920 - 1929
13150000	Fish Creek	Fish Creek NR Carey ID	1919 - 1939
13150430	Silver Creek	Silver Creek at Sportsman Access NR Picabo ID	1974 - 2002
13150500	Silver Creek	Silver Creek at Hwy 20 NR Picabo ID	1920 - 1962
13151000	Little Wood River	Little Wood River NR Richfield ID	1911 – 1972
13151500	Little Wood River	Little Wood River at Shoshone ID	1922 – 1959
13152000	Little Wood River	Little Wood River at Toponis ID	1896 - 1897

^aGage data gathered from U.S. Geological Survey Web site (2004).

Little Wood River Subbasin Dams and Gage Stations



Prepared by Rob Sharpnack - March 2002

Figure 4. Little Wood River Subbasin dams and gauge stations.

Geology and/or soils

The geology and soils of a subbasin can identify areas that may be impacted more by natural events than by anthropogenic activities. This section describes the geologic formations of the subbasin as well as characteristics of the soil of the subbasin.

The Little Wood River Subbasin consists of two ecoregions: the Snake River Basin/High Desert and the Northern Rockies. The Snake River Basin/High Desert covers 76.9% of the area in this subbasin while the Northern Rockies cover the remaining 23.1% in the northern watersheds (ArcView Coverage, 1992-1996). Transitional zones occur within the subbasin where the characteristics of the ecoregions intersect one another, however these transition zones account for a small portion of the subbasin and are not represented in ArcView coverage.

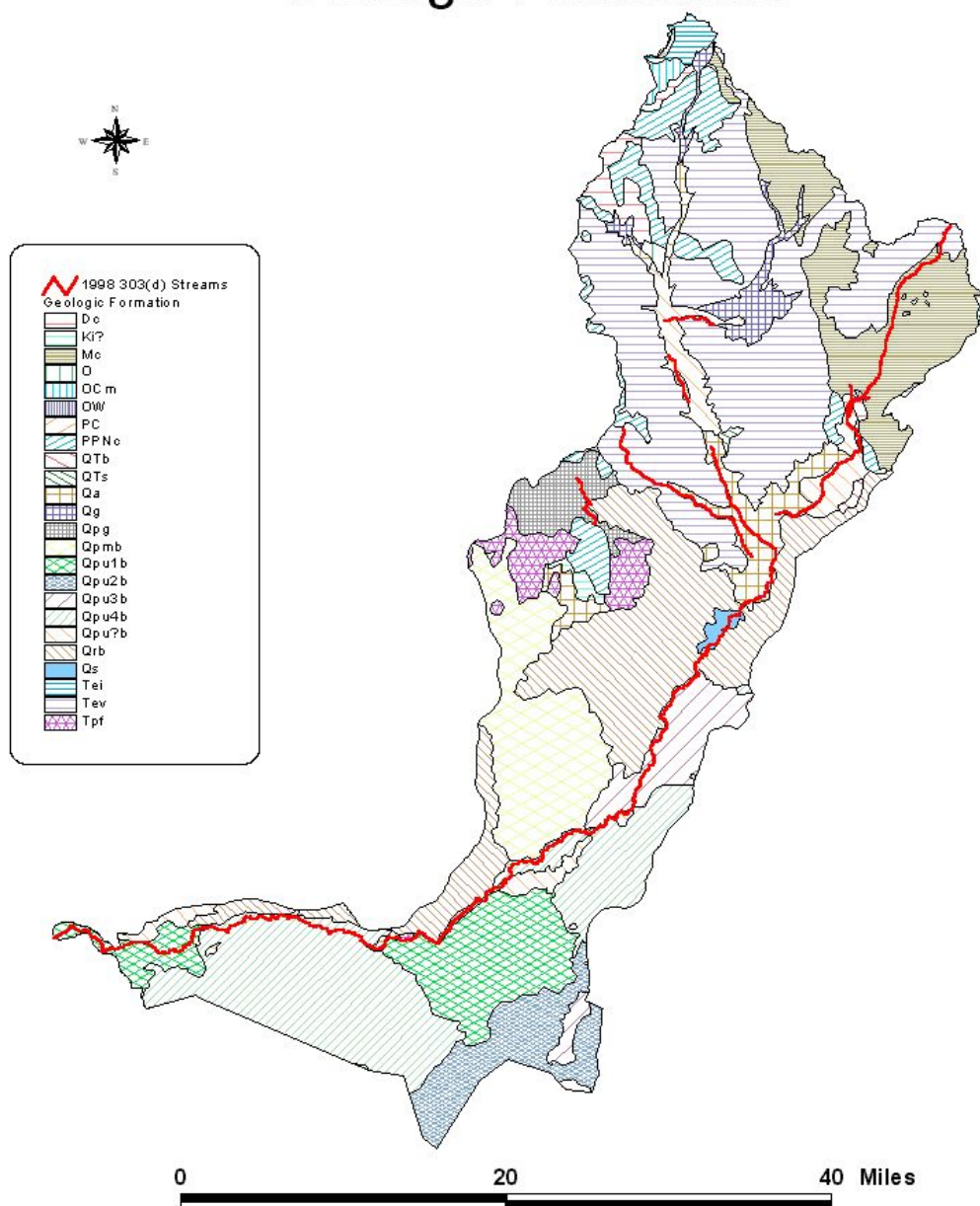
There are three geomorphology types in the Little Wood River Subbasin. The high mountainous elevations are alpine glacial (erosional), while the foothills of the subbasin are fluvial. The lower elevations are plateau and account for slightly over half of the subbasin area (ArcView, 1992-1996).

There are 24 geologic formations occurring in the Little Wood River Subbasin (Figure 5). The three predominate geologic formations within the subbasin are silicic and basaltic volcanic ejecta flows found in the northern portion of the subbasin, basalt flows found in the middle portion, and lava flows found in the southern portion of the subbasin. Table 7 describes the geologic formations within the subbasin.

The K factor of soil is a measure of the susceptibility of soil to erosion and the rate of runoff of the soil. Soils with K factor values of 0.05 to 0.15 are resistant to detachment, soils with K factor values of 0.05 to 0.2 tend to be easily detached but have low runoff. The soils with higher K factors of 0.25 to 0.4 are moderately susceptible to detachment and have moderate runoff. The soils with K factors of 0.4 or greater are easily detached and have high rates of runoff (MSU 2005).

The majority of the subbasin has soil K factors of 0.15 to 0.25 and 0.25 to 0.35 (Figure 6). The upper portion of the subbasin consists mostly of soils with soil K factors of 0.25 to 0.35. There is a small quantity of more erosive soils (0.35 to 0.45) that lie along the valley floor along the Little Wood River above the reservoir, Muldoon Creek, and Fish Creek near the reservoir. The lower portion of the subbasin consists mostly of soils with soil K factors of 0.15 to 0.25 with a small portion of land that has K factors that are more erosive (0.25 to 0.35) upstream of Shoshone.

Little Wood River Subbasin Geologic Formations



Prepared by Rob Sharpnack - December 2001

Figure 5. Geologic formations of the Little Wood River Subbasin.

Table 7. Geologic formations of the Little Wood River Subbasin.

Code	Description	Percent of Subbasin
Dc	Devonian thrust deep-water siliceous argillite and quartzite of central	1.2
Ki?	Cretaceous plutons	0.2
Mc	Mississippian thrust shallow-to-deep marine detrital units of central Id	8.4
O	Ordovician marine dolomite quartzite and limestone	0.1
Ocm	Achist quartzite and other metasediments of probable Lower Ordovician to	0.3
OW	Open Water	0.0
PC	Precambrian high-grade metamorphic rocks	0.0
PPNc	Lower permian to Middle pennsylvanian thrust marine detritus of central	4.5
QTb	Lower Pleistocene to Pliocene basalts with associated tuffs and volcanic det	0.2
QTs	Pleistocene and Pliocene stream and lake deposits	0.1
Qa	Quaternary alluvium	4.0
Qg	Quaternary colluvium fanglomerate and talus	1.7
Qpg	Pleistocene outwash fanglomerate flood and terrace gravels	2.0
Qpmb	Middle Pleistocene plateau and canyon-filling basalt in and near Snake Plai	7.4
Qpu1b	Upper Pleistocene Snake Plain lava flows	6.9
Qpu2b	Upper Pleistocene Snake Plain lava flows	4.1
Qpu3b	Upper Pleistocene Snake Plain lava flows	3.4
Qpu4b	Upper Pleistocene Snake Plain lava flows	13.5
Qpu?b	Upper Pleistocene Snake Plain lava flows	3.4
Qrb	Recent relatively unweathered Snake Plain basalt flows and cinder condes	13.4
Qs	Quaternary surficial cover	0.3
Tei	Eocene intrusions	0.6
Tev	Eocene mixed silicic and basaltic volcanic ejecta flows and reworked depr	22.1
Tpf	Pliocene silicic and welded tuff ash and flow rocks	2.2

^aData from ArcView Coverage, 1992-1996.

Little Wood River Subbasin Soil K Factors

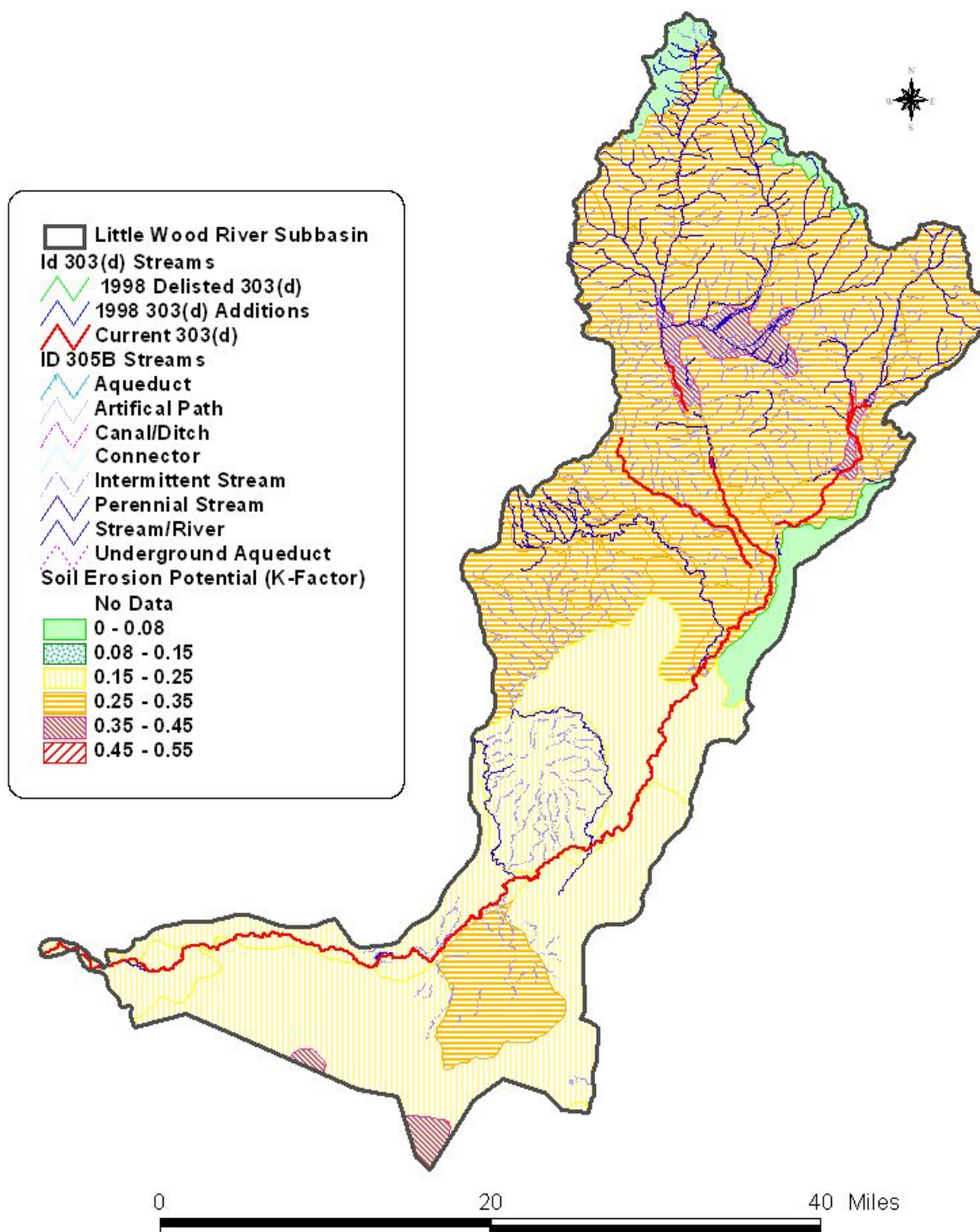


Figure 6. Soil erosivity (K Factors) of the Little Wood River Subbasin.

Topography

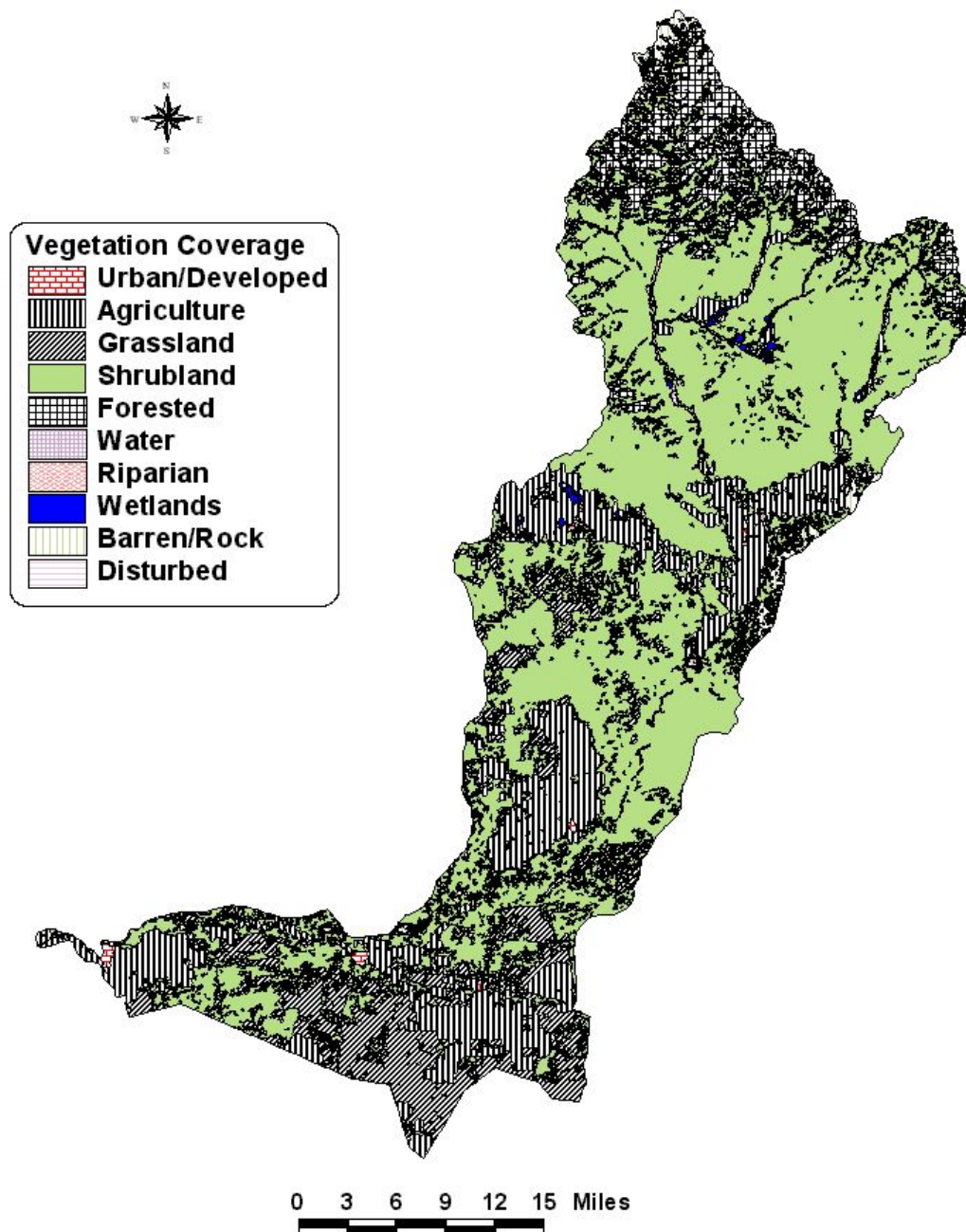
The Little Wood River flows north to south in the upper third of the subbasin, northwest to southwest in the middle portion of the subbasin, and east to west in the lower half of the subbasin. The Little Wood River Subbasin extends from the basin divide line, which is about 0.1 miles beyond the headwaters, to the mouth, which empties into the Big Wood River. The subbasin is about 84.8 miles long and has an elevation difference of 6,430 feet. These characteristics yield a subbasin slope of about 1.44 %.

Three elevation ranges can characterize the Little Wood River Subbasin: low, middle, and high. These ranges were described previously in the climate section. The lowest elevation in the subbasin occurs at the mouth (3,412 ft). Some of the higher elevations occur at Garfield (8,530 ft), Blizzard (8,530 ft), and Elk Mountains (8,040 ft). The highest elevations in the subbasin are at Scorpion Mountain (10,500 ft), Grays Peak (10,560 ft) and unnamed peaks (11,020 ft).

Vegetation

The vegetation coverage of the Little Wood River Subbasin varies and is illustrated in Figure 7. Barren rock, urban/developed, water, riparian, wetlands, and disturbed vegetation account for about 3.9% of the Little Wood River Subbasin area. Shrubland is the largest vegetation cover for the subbasin (57.8% of the area). Agriculture and grassland vegetation cover is similar in coverage (16.4% and 13.8% of the area). Forested vegetation makes up the last vegetation type (7.9% of the area) and occurs in the northernmost areas of the subbasin (ArcView Coverage 1992-1996).

Little Wood River Subbasin Vegetation Coverage



Prepared by Rob Sharpnack - December 2001

Figure 7. Vegetation coverage of the Little Wood River Subbasin.

Biological Communities

The presence of endangered, threatened, or sensitive species can impact the way in which the land of the subbasin is managed. There are a number of endangered, threatened, or sensitive species within the counties of the Little Wood River Subbasin. *These species are a concern within the counties but not necessarily found within the subbasin itself* (Appendix B).

Some of these species are aquatic or depend upon the aquatic environment at some point in their life cycle. The bald eagle winters and nests in the area and feeds on fish within the streams. Some species of concern found within the subbasin are redband trout and Wood River sculpin. Bull trout are listed as a threatened species in Blaine County, however they do not occur within the Little Wood River Drainage. Any bull trout that may be occurring there are non-native (Warren 2001).

Fisheries can be a good indicator of the water quality status of a water body since the thermal requirements of fish have been fairly well studied (Grafe et al 2002). Fish in the northwest are identified as cold, cool, or warm water species and can be classified with overall pollution tolerance values of sensitive, tolerant, or intermediate (Zaroban et al., 1999). There are many species of fish that are found within the waters of the Little Wood River Subbasin. The fish in the subbasin are identified, along with their temperature preference and tolerance values (Table 8).

Table 8. Fisheries of the Little Wood River Subbasin.

Family	Species	Temperature preference	Tolerance value
Salmonidae	Rainbow trout	Cold water	S
	Brook trout	Cold water	I
	Brown trout	Cold water	I
	Mountain whitefish	Cold water	I
Cottidae	Wood River sculpin	Cold water	S
	Sculpin sp		
Catostomidae	Bridgelip sucker	Cool water	T
	Sucker sp	Cool water	
	Utah sucker	Cool water	T
Cyprinidae	Speckled dace	Cool water	I
	Longnose dace	Cool water	I
	Dace sp	Cool water	
	Redside shiner	Cool water	I
	Utah chub	Cool water	T
	Common carp	Warm water	T

^aSpecies accumulated through various collection events.

^bS – Sensitive, I – Intermediate, T – Tolerant.

The Wood River sculpin is a cold water species that is sensitive to pollution and endemic to the Wood River drainage. Idaho Fish and Game (IDFG) considers it to be a species of special concern and the U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM) consider it to be a sensitive species. These classifications are a result of the lack of

knowledge about the range of the species, the land management impacts to the habitat of the Wood River sculpin, and the impacts to the species from competitive species (Zaroban 2003). These characteristics could make this species an excellent indicator of water quality trends within the subbasin if intensive surveys were completed in the Wood River drainage.

Benthic macroinvertebrates have limited migration patterns, which makes them good indicators of environmental conditions (Grafe et al 2002). An analysis of the macroinvertebrates on the 303(d) listed stream was performed, yielding the following results:

- The stream macroinvertebrate index (SMI), the average of nine metric indices, is an overall indicator of the health of a stream. The majority of the sites within the subbasin rated as fair to very poor for the SMI rating.
- Taxa richness is a metric that measures the health of the community by a measure of the variety of taxa present. Generally, as habitat quality increases so too does taxa richness. Taxa richness for the subbasin was low in relation to other studies done in southern Idaho.
- The pollution tolerance value indicates how tolerant a species is to pollution and ranges from 0 to 11. A lower number indicates intolerance. The Little Wood River Subbasin rated as good to fairly poor for pollution tolerance values.
- The numbers of Ephemeroptera and Plecoptera taxa are metrics that can indicate temperature and fine sediment pollution. As the number of these taxa increase so to does water quality. This index score in the subbasin ranged from 0-52%.
- The percent scrapers metric decreases as fine sediment increases within a system. The percent clingers metric decreases as habitat disturbance increases. The number of scraper and clinger taxa within the subbasin was both low.
- Low numbers of cold water taxa indicate that land use and pollutants are impacting a water body. There were few cold water indicator species and counts of each cold water species were very low.

Overall, the macroinvertebrate data in the Little Wood River Subbasin seem to indicate that the water bodies in the subbasin appear to be impacted by sediment and temperature (Clark 2003).

Water Chemistry

Seasonal peaks for sediment, nutrients, and bacteria occur in the Little Wood River Subbasin. Data collected during the 2001-2003 period was used to determine peak discharge of pollutants in the subbasin. Monthly data from all monitoring sites were averaged together to represent the annual graph for the subbasin.

Suspended load constitutes both washload and suspended bed-material load. Washload comes from the banks and upland areas and can remain in suspension during low velocities. Suspended bed-material load is transported with the washload by turbulent water and will

drop out when velocities decrease (Gordon et.al., 1992). Sediment in the subbasin was measured in the form of total suspended solids (TSS). Figure 8 depicts the average discharge of TSS in the Little Wood River Subbasin. *There are two peak discharges of TSS, the first peak occurs during the spring runoff and the second peak occurs in early fall during base flow events.* Higher concentration of TSS would be expected during spring runoff as the stream flows would likely be higher and more washload and suspended bed-material would be transported. A peak in the fall is less likely to be expected as velocities are low and are less likely to be carrying suspended bed-material loads. The peak is likely due to anthropogenic activities occurring in the subbasin, although late season precipitation events could also contribute to sediment loads during base flow events.

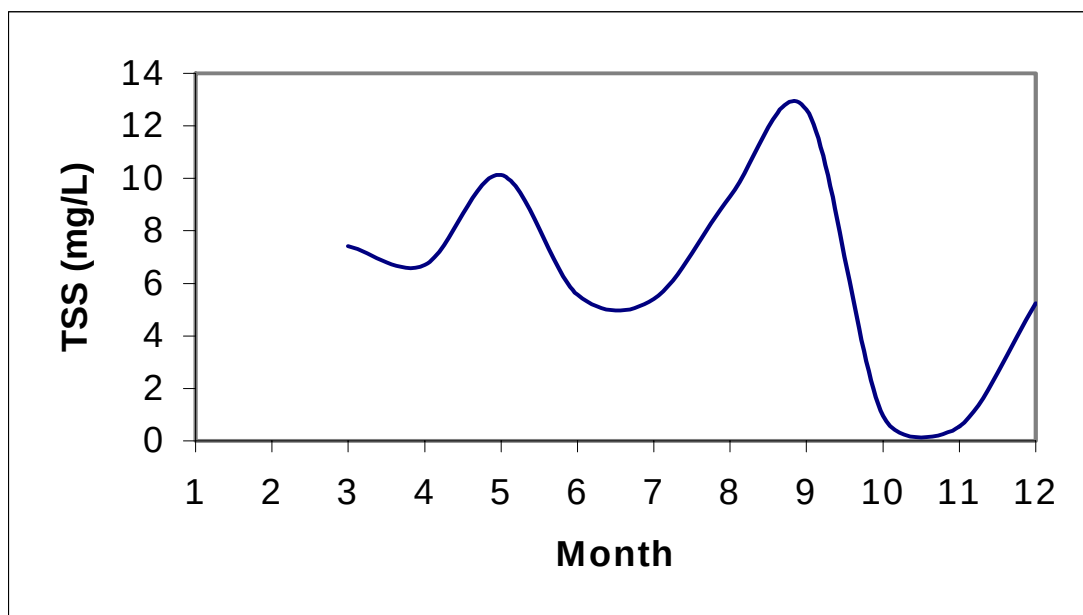


Figure 8. Average annual TSS in the subbasin.

Nitrogen and phosphorous are two components necessary for the growth of aquatic plants within a water body. In most freshwater systems phosphorous is the limiting factor because it has a tendency to bind with other elements or sediment and be taken out of the cycle (Stream corridor restoration, 1998). Nutrients in the Little Wood River Subbasin were measured in the form of total phosphorous (TP). Figure 9 depicts the average annual discharge of TP in the Little Wood River Subbasin. *There are two peak discharges of TP, the first occurs during the spring runoff and the second occurs in early fall during base flow events.* Peak discharges of TP in the runoff period would be expected as sediments are generally transported during high flows. The TP quantity would be elevated because TP has a high tendency to bind with sediments, therefore as sediment is transported so to is TP. The TP peak in the fall is less likely to occur due to low flow conditions therefore this event is likely due to anthropogenic activities, senescence of aquatic plant material, or late season precipitation events.

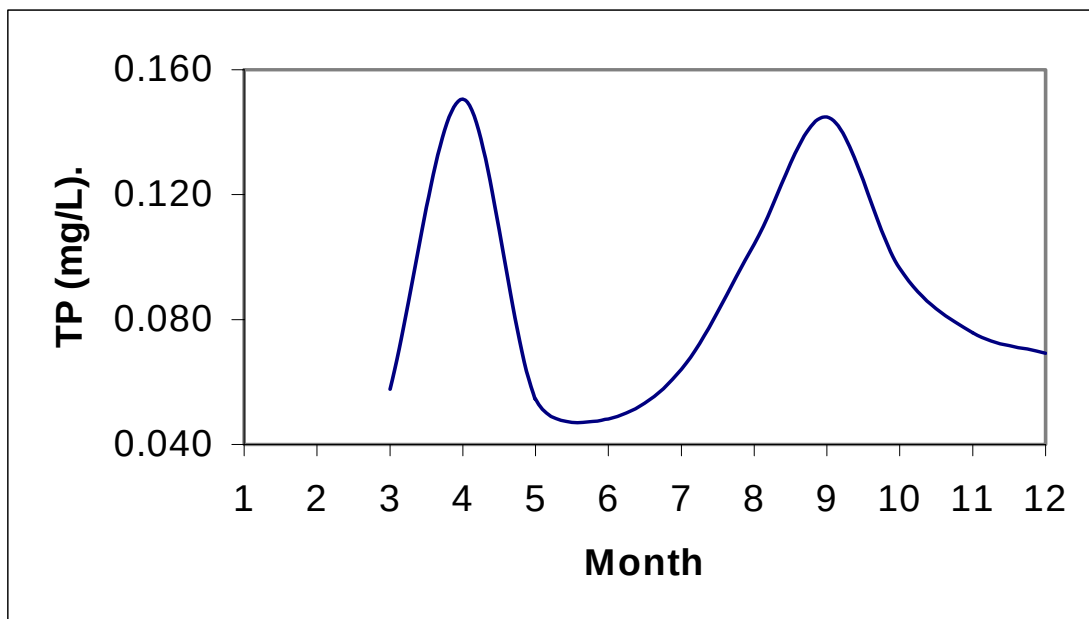


Figure 9. Average annual TP in the subbasin.

There are apt to be fluctuations in the bacteriological content of water in surface waters. These fluctuations tend to occur in the spring and fall when snow melt and rainfall introduce wash from the surrounding lands (Prescott 1931). Bacteria in the Little Wood River Subbasin were measured in the form of *Escherichia coli* (*E. coli*). Figure 10 depicts the average annual discharge of *E. coli* in the subbasin. *There are elevations in E. coli at various times through the spring into the fall.* The elevations seen during the summer are likely due to anthropogenic activities such as grazing. During this time period, instream flows are at base flow conditions. During base flows, direct impacts to the water body from grazing or leaking septic systems are more likely to occur.

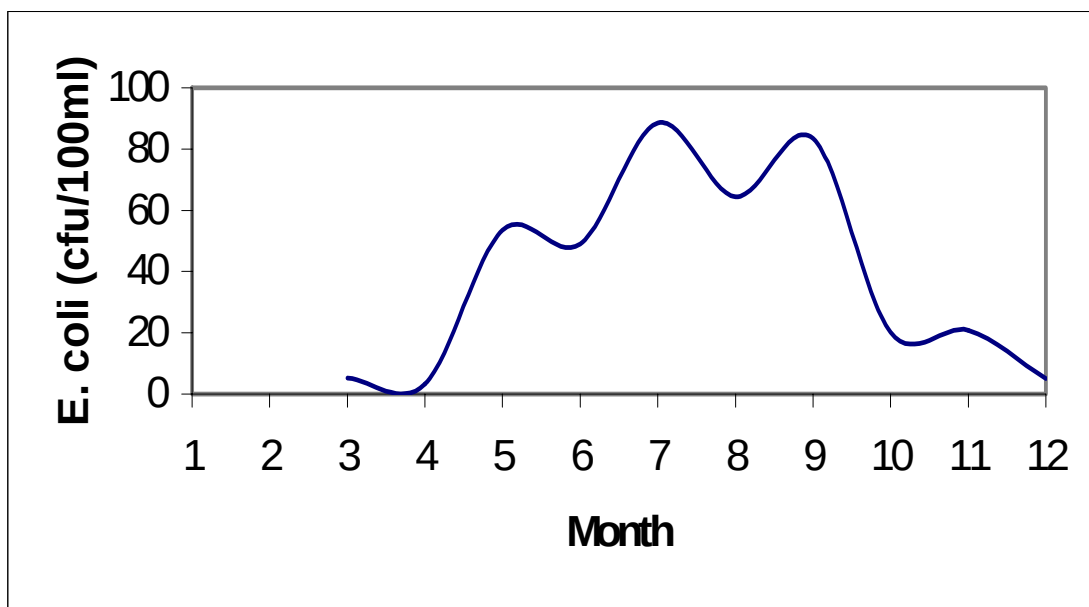


Figure 10. Average annual *E. coli* in the subbasin.

Subwatershed Characteristics

The Little Wood River Subbasin is characterized by ten 5th field Hydrologic Unit Codes (HUCs) referred to as subwatersheds. The subwatersheds of the subbasin and their attributes are described in the following sections.

5th field Hydrologic Unit Code (HUC)

The Little Wood River Subbasin consists of ten watersheds of the 5th field HUC category (ArcView Coverage 1992-1996). Each of these watersheds drains into the tributaries of the Little Wood River or into the Little Wood River itself, with the exception of Dry Creek and its tributaries. Dry Creek currently does not connect with the Little Wood River directly. However, it does flow into the West Canal of the Little Wood River Irrigation District, which does flow into the Little Wood River. These watersheds will be the divisions used to aid in the implementation process to restore beneficial uses of the 303(d) listed streams.

Watershed Area

The watershed areas of the subbasin are described in Table 9 and illustrated in Figure 11.

Table 9. Little Wood River Subbasin 5th field HUC watershed areas.

5th Field HUC	Name	Associated 1998 303(d) Creek	Area (km²)	Subbasin Area (%)
17040221-01	Lower Little Wood River	Little Wood River	118.8	20.8
17040221-02	Main Canal	Little Wood River	412.3	14.1
17040221-03	Middle Little Wood River	Little Wood River	417.8	14.3
17040221-04	Silver Creek	Loving Creek	188.0	6.4
17040221-05	Little Wood River Reservoir	Little Wood River and reservoir, Dry Creek	373.5	12.8
17040221-06	Upper Little Wood River	Muldoon Creek	439.8	15.0
17040221-07	Muldoon Creek	Muldoon Creek	144.5	4.9
17040221-08	Friedman Creek	None	28.5	1.0
17040221-09	Fish Creek Reservoir	Fish Creek and reservoir	197.1	6.7
17040221-10	Fish Creek	Fish Creek	118.4	4.0

^aData from ArcView Coverage, 1992-1996.

^b1998 303(d) refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.

Little Wood River Subbasin Watersheds



Figure 11. Little Wood River 5th field watersheds.

Watershed attributes can help indicate what factors may be influencing water quality in a given watershed. Table 10 provides information on watershed attributes for the various watersheds of the Little Wood River. A brief description of these attributes follows.

Table 10. Little Wood River Subbasin watershed attributes.

5 th Field HUC	Land form	Dominant Aspect	Relief ratio	Mean elevation (m)	Dominant slope	Hydrologic regime	Unit area runoff (ton/acre/yr)
17040221-01	SRB/HD	E to W	0.006	1209	2.2	CON	81.6
17040221-02	SRB/HD	NE to SW	0.018	1404	3.3	ANN + PARA	96.7
17040221-03	SRB/HD	NE to SW	0.018	1400	3.8	NONE	50.3
17040221-04	SRB/HD	NW to SE	0.022	1573	6.2	PARA + CON	81.6
17040221-05	SRB/HD + NR	N to SW	0.026	1742	4.6	DEND	175.9
17040221-06	NR + SRB/HD	N to S	0.061	2157	7.3	DEND	818.4
17040221-07	NR	NW to SW	0.067	2368	10.8	DEND	207.5
17040221-08	NR	NE to SW	0.105	2322	22.4	DEND	14.5
17040221-09	NR + SRB/HD	NE to SW	0.055	2011	9.2	CON	110.7
17040221-10	SRB/HD	N to SW	0.048	1671	10.7	CON	49.9

^a Data from Buhidar 2002.

^b LF – landform, DA-dominant aspect, RR-relief ration, ME-mean elevation (meters), DS-dominant slope (percent), HR-hydrologic regime, UAR- unit area runoff (ton/acre/year) based on RUSLE equation for entire 5th field HUC.

^c SRB/HD – Snake River Basin / High Desert, NR – Northern Rockies, E – East, W – West, N – North , S – South, CON – Contorted, ANN – Annual, PARA – Parallel, DEND – Dendritic.

Landforms are recognizable formations or features of the land that have a characteristic shape and are produced by natural causes (NWOSSP, 2004). The landforms have been identified based on ecoregions. In the case of watersheds of the Northern Rockies (NR), the landforms that are present are sharp-crested, steep sloped high mountains. For those of the Snake River Basin High Desert (SRB/HD) characteristic landforms are tablelands with moderate to high relief plains with hills or low mountains. Both of these landforms are found throughout the watersheds of the Little Wood River Subbasin.

As can be seen, there are many traits that can characterize a region, and these traits are defined as follows.

- *Dominant aspect* of a watershed indicates the direction of the flow of the dominant stream of a watershed.
- *Relief ratio* represents the difference in the elevations of the watershed divided by the watershed length.

- *Dominant slope* is a percentage that indicates the slope of the watershed by dividing the mean elevation by the watershed length.
- *Hydrologic regime* summarizes the drainage patterns of the watershed. In the case of the Little Wood River Subbasin the patterns are contorted, annual, parallel, and dendritic. Contorted drainages are found in coarsely layered metamorphic rocks and annual drainages may form rings around circular underground structures, such as domes and basins. Parallel drainages occur where water bodies flow parallel to one another due to the terrain characteristics and usually indicates moderate to steep slopes, and dendritic branches are drainage with a branch like pattern that occurs in areas with uniform rock with little folding or faulting and gentle regional slopes (Ritter, 1978, ISAS, 2004).
- *Unit area runoff* is an estimate based on RUSLE sediment model of the amount of erosion that occurs within a watershed in a single year.

1.3 Cultural Characteristics

Human activity can affect the water quality of a water body, either by directly influencing the water or by degrading the land around the water body, which, in turn, can affect the water. The following section will describe some of the human activities that may be influencing the water quality in the Little Wood River Subbasin, including land use, land ownership, cultural features, population, history, and economics.

Land Use

Rangeland is the major land use in the Little Wood River Subbasin, accounting for 73.2% of the subbasin area and can be found throughout the entire stretch of the subbasin. There is forestry in the northern portion of the subbasin in the Sawtooth National Forest (5.0%) and rock in the lava plain area (2.2%). Dispersed throughout the subbasin there is irrigated agriculture, gravity flow accounts for 13.8% and sprinkler accounts for 5.8% of the subbasin area (ArcView Coverage, 1992-1996). See Table 11 and Figure 12 for land use within the subbasin.

Table 11. Land use of the Little Wood River Subbasin.

Land use	Area (km ²)	Percent of subbasin
Rangeland	2146.9	73.2
Irrigated-gravity flow	404.7	13.8
Irrigated-sprinkler	170.1	5.8
Forest	146.6	5.0
Rock	64.5	2.2

^a Data from ArcView coverage 1992-1996.

Little Wood River Watershed Land Use

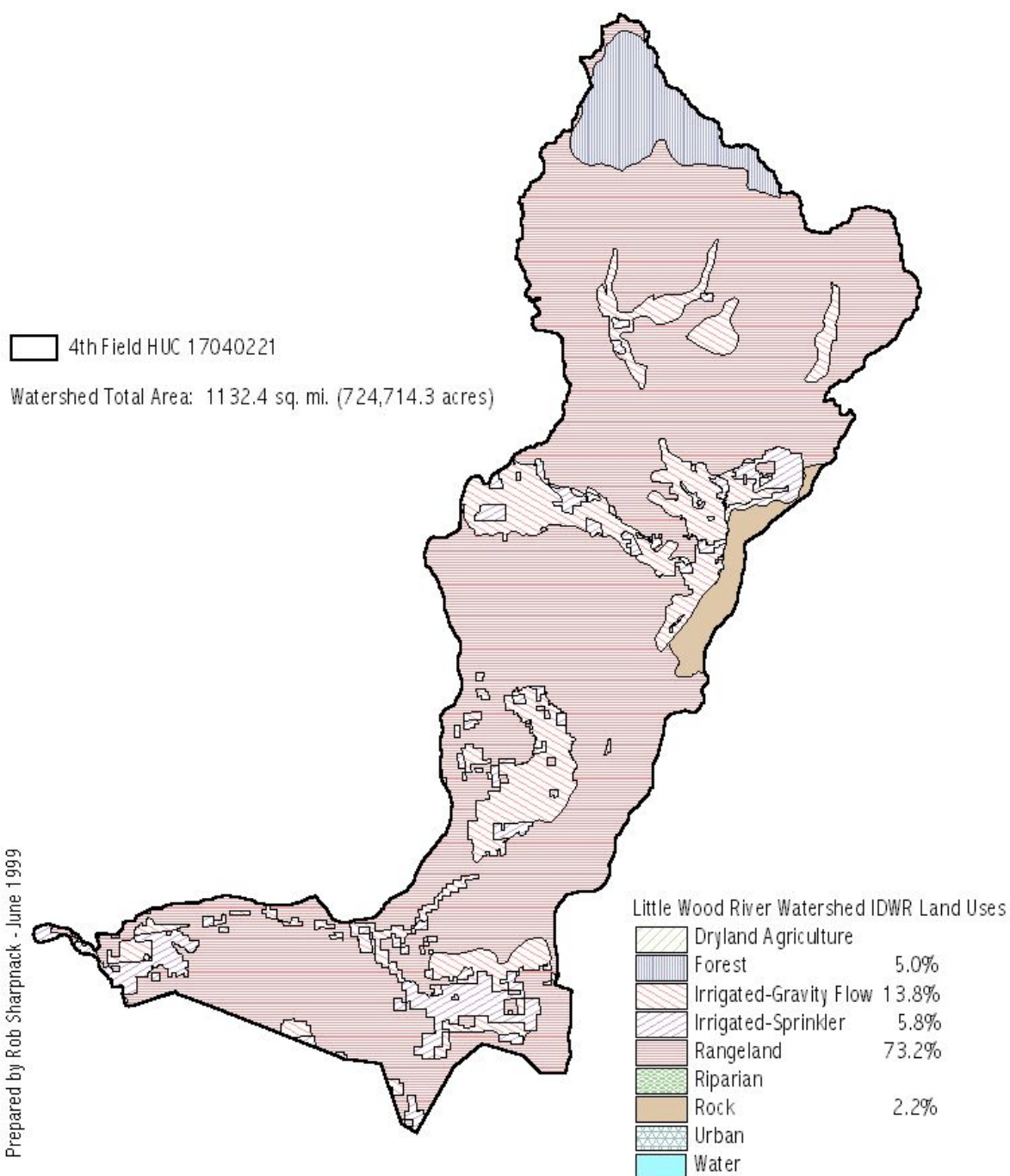


Figure 12. Little Wood River Subbasin land use.

Land Ownership, Cultural Features, and Population

The Little Wood River Subbasin is either privately owned (40.4%) or publicly owned and managed by BLM (43.6%). The remainder is open water (0.2%), publicly owned and managed by the state of Idaho (5.9%), or publicly owned and managed by the USFS (9.9%) (ArcView Coverage, 1992-1996). See Table 12 for a summary of land ownership in this subbasin.

Table 12. Land ownership in the Little Wood River Subbasin.

Land Ownership	Area (km ²)	Percent of subbasin
BLM	1277.4	43.6
Open water	5.7	0.2
Private	1183.1	40.4
State of Idaho	171.2	5.9
U.S. Forest Service	291.1	9.9

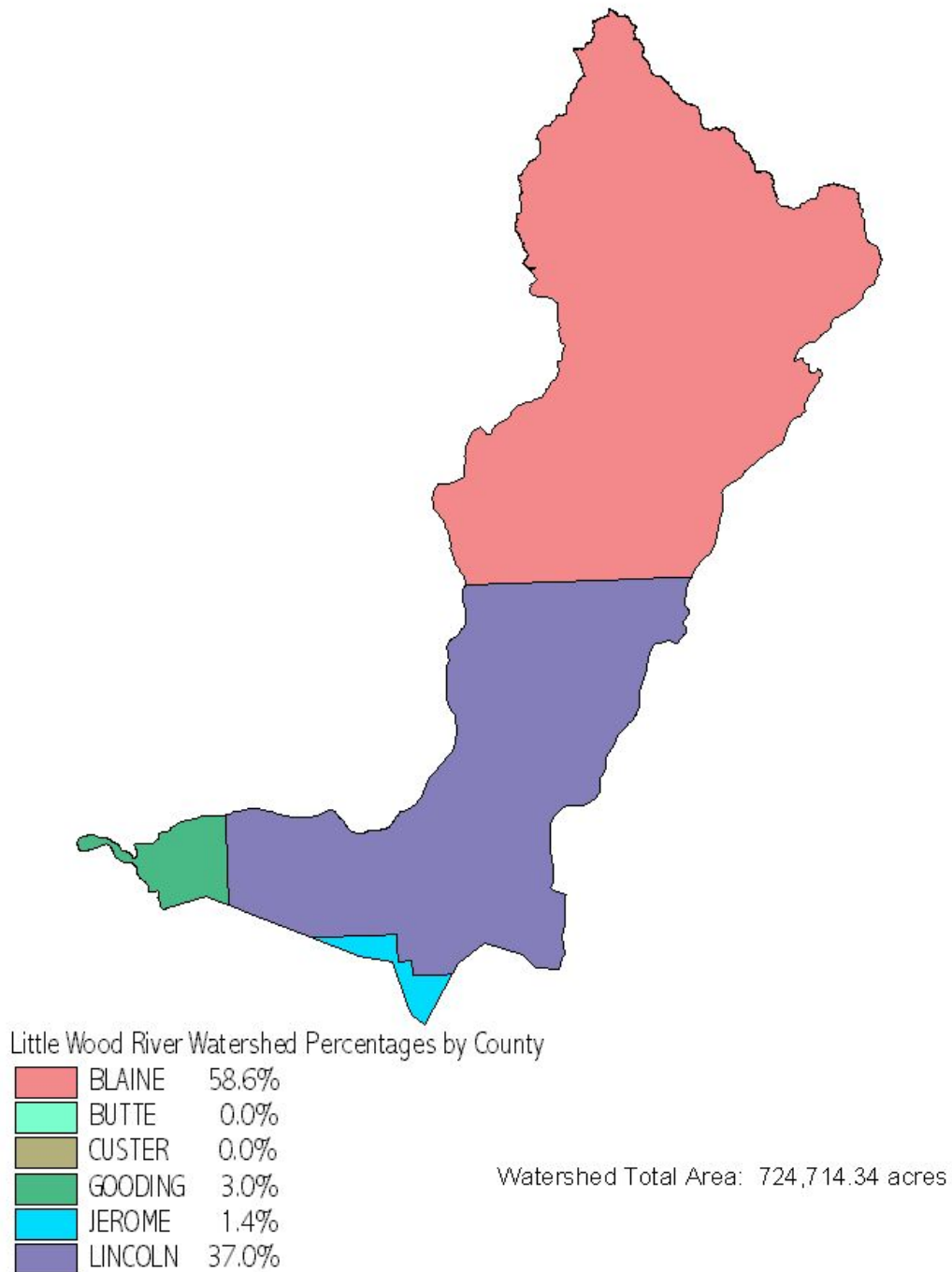
^a Data from ArcView coverage 1992-1996.

^b State of Idaho land is classified into three groups of lands, endowment land (managed by Idaho Department of Lands) accounts for approximately 162.6 km² of state land, lands managed by the Idaho Department of Fish and Game accounts for approximately 4.5 km² of state land, and land managed by the Idaho Department of Parks and Recreation accounts for approximately 1.6 km² of the state land in the subbasin.

The Little Wood River Subbasin lies within four counties (Figure 13). The majority of the subbasin (58.6%) lies in Blaine County (663.1 square miles) and Lincoln County (37.0%—419 square miles). An extremely small portion lies in Jerome County (1.4%—15.4 square miles) and Gooding County (3.0%—34.5 square miles) (ArcView Coverage, 1992-1996).

The Little Wood River runs through three of the seven towns that exist in the Little Wood River Subbasin (Figure 14), including Carey, Shoshone, and Gooding. The remaining towns in the subbasin are Richfield, Picabo, Gannett, and Dietrich. The population for the Little Wood River Subbasin is estimated at 8,669. Thirty two percent of the total population is rural. In the last ten years, the population of the Little Wood River Subbasin has increased 20%. (IDOC, 2001).

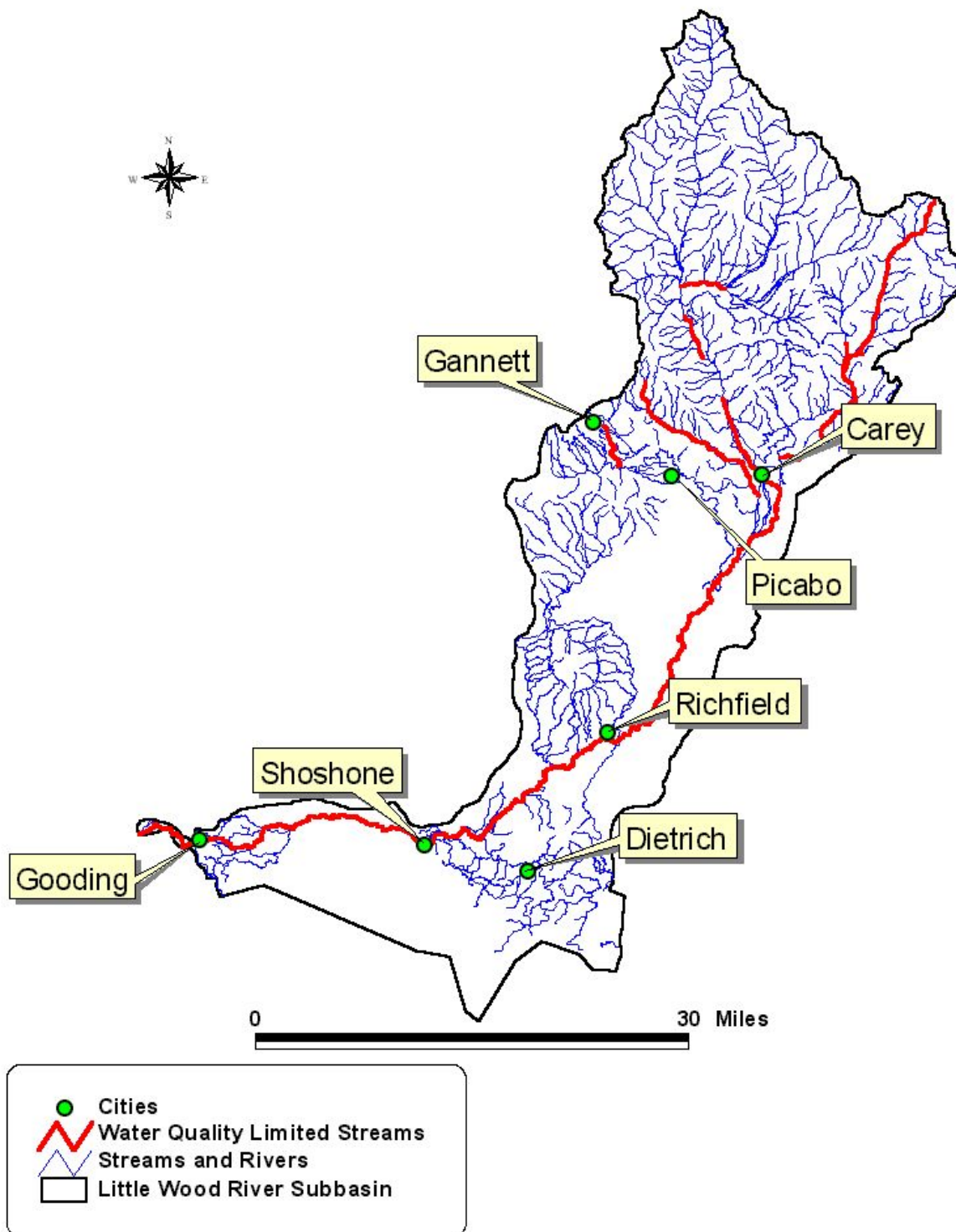
County Areas of the Little Wood River Watershed HUC 17040221



Prepared by Rob Sharpnack - November 1999

Figure 13. Little Wood River Subbasin counties.

Little Wood River Subbasin Cities



Prepared by Rob Sharpnack - March 2002

Figure 14. Little Wood River Subbasin cities.

History and Economics

The Little Wood River Subbasin is predominately an agriculture/rangeland based region, with emphasis in trade, government, and recreation. There are a number of businesses or agencies within the cities of the subbasin that provide employment, yet much of the land is used for agriculture/rangeland. In the last 10 to 20 years, there has been a great change in farming, with a general increase in the number of cattle overall. Table 13 provides a summary of the agriculture statistics of the counties of the Little Wood River Subbasin.

Table 13. Agricultural statistics in the Little Wood River Subbasin.

Year	Total number of Farms	Total Acres Farms	Average farm size (acres)	Total farms in crops	Total acres in crops	Cattle and calves in inventory	Number of irrigated farms	Number of irrigated acres
Blaine County								
1987	221	246,774	1,117	193	75,191	27,474	173	54,441
1992	221	266,293	1,205	182	75,250	29,527	179	64,283
1997	195	214,985	1,102	163	70,233	26,849	160	56,909
Percent change	-11.8	-12.9	-1.3	-15.5	-6.6	-2.3	-7.5	4.5
Lincoln County								
1987	338	145,251	430	295	90,977	32,361	283	64,764
1992	302	132,429	439	278	---	27,535	257	59,694
1997	281	131,473	468	254	---	36,422	255	72,518
Percent change	-16.9	-9.5	8.8	-13.9	---	11.6	9.9	12
Gooding County								
1987	729	239,328	328	644	128,133	83,961	621	107,793
1992	683	227,114	333	585	139,225	113,347	581	115,398
1997	675	220,362	326	529	---	140,974	542	112,665
Percent change	-7.4	-7.9	-0.6	-17.9	8.7	67.9	-12.7	4.5
Jerome County								
1987	909	205,315	226	789	161,672	68,880	768	135,272
1992	815	207,552	255	705	165,898	89,656	695	150,444
1997	683	193,921	284	570	159,852	133,648	582	151,726
Percent change	-24.9	-5.5	25.7	-27.8	-1.1	94	-24.2	12.2

^aData obtained from Idaho Department of Commerce Web site (2001).

The Little Wood River Subbasin has seven point source facilities (Table 14 and Figure 15). Four of these facilities are city municipalities, while the others are trout culturing, food processing or industrial facilities.

Table 14. Point source facilities of the Little Wood River Subbasin.

Facility	NPDES ID	Type	Design flow (mgd)	Existing flow (mgd)	Land application	Discharge period
Carey	ID-002574-7	wastewater	0.10	0.03	May-Aug	Sept-Apr
Richfield	ID-002121-1	wastewater	0.06	0.02	May 1-Oct 31	Nov 1 – Apr 30
Shoshone	ID-022372-8	wastewater	0.20	0.09	---	Year round
Gooding	ID-002002-8	wastewater	1.0	0.18-0.32	Summer months	Year round
Glanbia Gooding	ID-002712-0	food processing	---	0.18	---	Year round
Glanbia Richfield	---	food processing	---	---	---	---
Hayspur hatchery	---	trout culturing	---	---	---	---
Idaho Tire Recovery	---	industrial	---	---	---	---

^aData from DEQ NPDES files (2004).

^bNPDES – National Pollutant Discharge Elimination System, NA – Not applicable (not NPDES permitted)

The City of Carey began discharging effluent into a tributary canal to the Little Wood River in 1986. The facility treats domestic sewage from local residents and commercial establishments, and it used to treat industrial waste from the Kraft Cheese Factory, which shut down in 1991. Waste stabilization ponds are the principal process used, and there is no discharge during the growing season from May 1-August 31. At this time, the waste is land applied. Sewage treatment in this area was previously through individual septic tanks and drain fields. Kraft Cheese was bought out by Wards Cheese in 1987 and then by Avonmore West, Inc. in 1991. Avonmore West applied for an NPDES permit to discharge non-contact cooling water, but the facility closed down shortly thereafter.

The City of Gooding wastewater treatment facility discharges their effluent into the Little Wood River, but also land applies it during the summer months. *However in the last couple of years the facility has been discharging year round.* This facility treats domestic sewage from local residents and commercial establishments. The design flow is for 1 MGD and they average a monthly discharge ranging from 0.18 to 0.32 MGD.

The City of Shoshone wastewater treatment facility discharges their effluent into the Little Wood River at river mile 21. It has a 3 cell lagoon with chlorination, which treats domestic sewage from local residents and commercial establishments. There are no industrial discharges that enter the facility. The design flow is for 0.31 cfs, which is 1.5% of the minimum stream flow of the Little Wood River (20 cfs). This facility began operating in July of 1972. The City of Shoshone land applies the waste when they clean out the lagoons.

The City of Richfield's first NPDES permit was issued November 18, 1974. It allows a two cell aerated lagoon with chlorination to discharge to the Little Wood River. The facility serves a population of 200 with no industrial discharge into the system. This facility discharges during the non growing season.

Glanbia in Richfield, also known historically as Ward's Cheese, Inc. and Avonmore West, at one time, discharged its non contact cooling water through 500 feet of ditch into the Little Wood River. Previously the non-contact cooling water was discharged into their lagoon to be land applied. When the lagoon began to overflow, an NPDES permit for the non-contact cooling water was sought. *However, at this time this facility no longer discharges to the river (Pettinger 2004).*

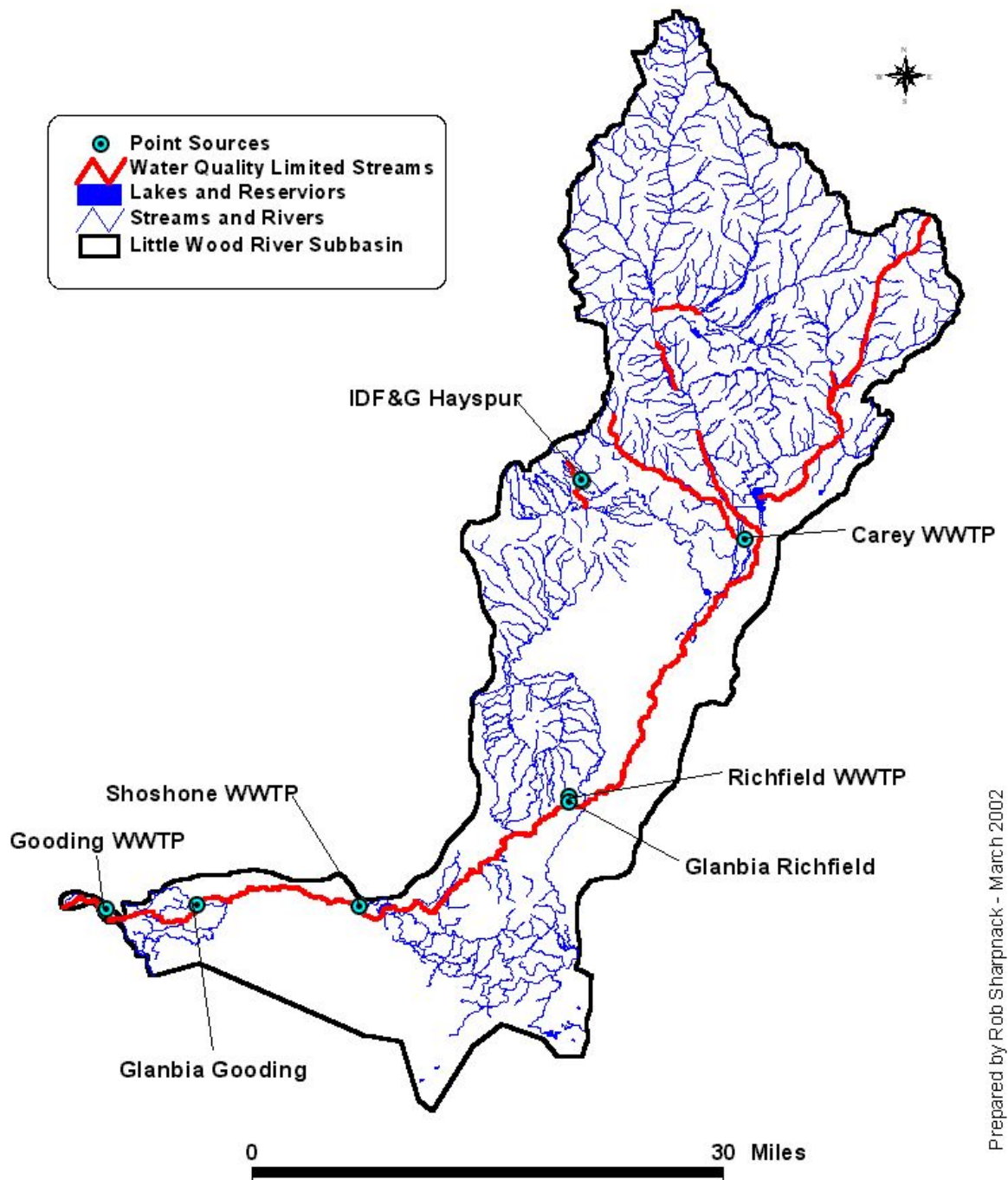
Glanbia in Gooding, a food processing facility located east of Gooding, has recently received a NPDES permit allowing it to discharge non contact cooling water to the Little Wood River. At this time the facility has yet to discharge its non-contact cooling water to the river. Data indicates that the TP levels in their well source are elevated periodically; therefore they may be discharging TP into the river although the facility is not contributing TP to their non-contact cooling water.

Idaho Fish and Game's Hayspur Hatchery, located south of Gannet, discharges into Loving Creek, a tributary to Silver Creek, which is a tributary to the Little Wood River. The NPDES permit for this trout culturing facility became effective on May 1, 1975. In 2001, biomass produced in this facility is 18,000 lbs of fish and 70,000 to 80,000 lbs of feed per year. These numbers allow the facility to not need a NPDES permit, and as a result are classified as a nonpoint source (DEQ 2004).

A letter written in 2001 clarifies further the status of the hatchery as a non point source. "...the hatchery is maintained at approximately 18,000 pounds of fish and feed between 70,000 to 80,000 pounds of feed per year (which is equivalent to less than 7,000 pounds per month). At this low level of production, the Idaho Department of Fish and Game is not required to have a permit from EPA to discharge to the receiving water, and the Hayspur Fish Hatchery is considered a "nonpoint source" of pollution rather than a point source (per regulations 40 CFR 122.24). I hereby notify that the Hayspur Fish Hatchery is no longer authorized to discharge under the previously, administered extended permit and you do not qualify for coverage under the new general NPDES permit. Please be advised that if Idaho Department of Fish and Game wishes to increase production in the future at this facility to more than 20,000 pounds of fish per year, and feed more than 5,000 pounds of feed in any given month, it will be considered a point source and the agency will need to acquire a waste load allocation from IDEQ and a discharge permit from EPA." (EPA 2001)

The Idaho Tire Recovery is a potential point source in the subbasin; however it does not discharge at this time; therefore it does not have a NPDES permit.

Little Wood River Subbasin Point Sources



Prepared by Rob Sharpnack - March 2002

Figure 15. Little Wood River Subbasin point sources.

2. Subbasin Assessment – Water Quality Concerns and Status

This section of the subbasin assessment identifies the water quality limited segments, applicable water quality standards, and provides summary and analysis of existing water quality data. Data gaps are also identified and discussed.

2.1 Water Quality Limited Segments Occurring in the Subbasin

About Assessment Units

Assessment units (AUs) now define all the waters of the state of Idaho. These units and the methodology used to describe them can be found in the Water Body Assessment Guidance (WBAGII) (Grafe et al 2002).

Assessment units are groups of similar streams that have similar land use practices, ownership, or land management. Stream order, however, is the main basis for determining AUs; although ownership and land use can change significantly, the AU remains the same. Using assessment units to describe water bodies offers many benefits, the primary benefit being that all the waters of the state are now defined consistently. In addition, using AUs fulfills the fundamental requirement of EPA's 305(b) report, a component of the Clean Water Act, wherein states report on the condition of all the waters of the state. Because AUs are a subset of water body identification numbers, there is now a direct tie to the water quality standards for each AU, so that beneficial uses defined in the water quality standards are clearly tied to streams on the landscape.

However, the new framework of using AUs for reporting and communicating needs to be reconciled with the legacy of 303 (d) listed streams. Due to the nature of the court-ordered 1994 303(d) listings, and the subsequent 1998 303(d) list, all segments were added with boundaries from "headwater to mouth." In order to deal with the vague boundaries in the listings, and to complete TMDLs at a reasonable pace, DEQ set about writing TMDLs at the watershed scale (HUC), so that all the waters in the drainage are and have been considered for TMDL purposes since 1994.

The boundaries from the 1998 303(d) listed segments have been transferred to the new AU framework, using an approach quite similar to how DEQ has been writing SBAs and TMDLs. All AUs contained in the listed segment were carried forward to the 2002 303(d) listings in Section 5 of the Integrated Report. AUs not wholly contained within a previously listed segment, but partially contained (even minimally), were also included on the 303(d) list. This inclusion was necessary to maintain the integrity of the 1998 303(d) list and to maintain continuity with the TMDL program. These new AUs will lead to better assessment of water quality listing and de-listing.

When assessing new data that indicate full support, only the AU that the monitoring data represents will be removed (de-listed) from the 303(d) list (Section 5 of the Integrated Report.).

Listed Waters

Eleven water quality limited segments listed in the 1998 303(d) list occur in the Little Wood River Subbasin (Table 15, Figure 16). EPA has added temperature as a pollutant to this list for the Little Wood River (mouth to East Canal Diversion) and Muldoon Creek (mouth to headwaters).

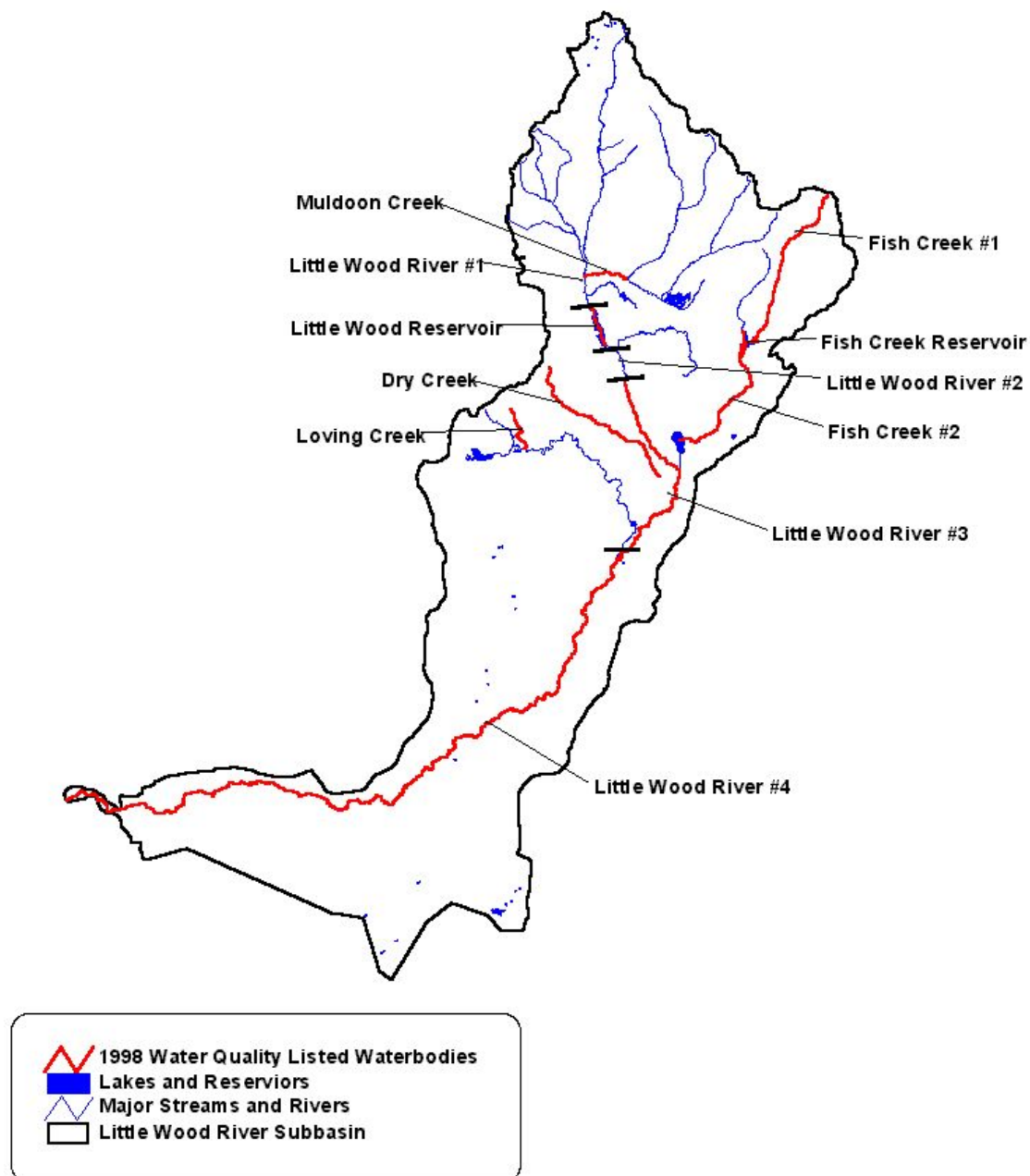
Table 15. 303(d) segments in the Little Wood River Subbasin.

Water body Name	Segment ID Number	Assessment Units	1998 §303(d) Boundaries	Pollutants
Little Wood River #4	2511	ID17040221SK001_05 ID17040221SK001_05a ID17040221SK001_05b	Richfield (town) to Big Wood River	BAC, DO, NUT, SED, QALT, TEMP
Little Wood River #4	2512	ID17040221SK002_05	Silver Creek to Richfield (town)	NUT, SED, TEMP
Little Wood River #3	2513	ID17040221SK010_05a ID17040221SK003_05	East Canal Diversion to Silver Creek	NUT, SED, TEMP
Little Wood River Reservoir	2515	ID17040221SK012L_0L		BAC, DO, NUT, SED, QALT
Dry Creek	2521	ID17040221SK022_02 ID17040221SK022_03	Headwaters to Little Wood River	BAC, DO, NUT, SED, QALT
Fish Creek (below)	2522	ID17040221SK006_03 ID17040221SK006_04	Fish Creek Reservoir to Carey Lake	BAC, DO, NUT, SED, QALT
Fish Creek Reservoir	2523	ID17040221SK005L_0L		BAC, DO, NUT, SED, QALT
Muldoon Creek	5288	ID17040221SK014_04	South Fork Muldoon Creek to Little Wood River	UNK
Muldoon Creek	5288	ID17040221SK014_04 ID17040221SK014_03 ID17040221SK014_02	Headwaters to Little Wood River	TEMP
Loving Creek	5289	ID17040221SK023_02	Headwaters to Silver Creek	UNK
Fish Creek (above)	5650	ID17040221SK008_02 ID17040221SK008_03 ID17040221SK008_04	Headwaters to Fish Creek Reservoir	BAC, DO, NUT, SED, QALT

^a1998 303(d) refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.

^bAbbreviations: BAC - Bacteria, DO - Dissolved oxygen, NUT – Nutrients, SED – Sediment, QALT – Flow alteration, TEMP – Temperature, UNK – Unknown.

Little Wood River Subbasin 1998 303(d) Listed Waterbodies



Prepared by Rob Sharpnack - October 2000

Figure 16. Little Wood River Subbasin 303(d)-listed water bodies.

2.2 Applicable Water Quality Standards

This section discusses the existing, designated, and presumed beneficial uses for the listed water bodies of the Little Wood River Subbasin. Water quality criteria (narrative and numeric) are also discussed for each case.

Beneficial Uses

Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and “presumed” uses as briefly described in the following paragraphs. The *Water Body Assessment Guidance*, second edition (Grafe, et al 2002) gives a more detailed description of beneficial use identification for use assessment purposes.

Existing Uses

Existing uses under the CWA are “those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards.” The existing in stream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.003.35, .050.02, and 051.01 and .053). Existing uses include uses actually occurring, whether or not the level of quality to fully support the uses exists. Practical application of this concept would be when a water could support salmonid spawning, but salmonid spawning is not yet occurring.

Designated Uses

Designated uses (Table 16) under the CWA are “those uses specified in water quality standards for each water body or segment, whether or not they are being attained.” Designated uses are simply uses officially recognized by the state. In Idaho these include things like aquatic life support, recreation in and on the water, domestic water supply, and agricultural use. Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160 in addition to citations for existing uses.)

Presumed Uses

In Idaho, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations. These undesignated uses are to be designated (Table 17). In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called

“presumed uses,” DEQ will apply the numeric criteria for cold water aquatic life and primary or secondary contact recreation to undesignated waters. If in addition to these presumed uses, an additional existing use, (e.g., salmonid spawning) exists, because of the requirement to protect levels of water quality for existing uses, then the additional numeric criteria for salmonid spawning would additionally apply (e.g., intergravel dissolved oxygen, temperature). However, if for example, cold water aquatic life is not found to be an existing use, a use designation to that effect is needed before some other aquatic life criteria (such as seasonal cold) can be applied in lieu of cold water criteria. (IDAPA 58.01.02.101.01).

Table 16. Little Wood River Subbasin designated beneficial uses.

Water body	Designated Uses	1998 §303(d) List
Little Wood River – Richfield to mouth	CW, PCR,	X
Little Wood River – Silver Creek to Richfield	CW, SS, PCR	X
Little Wood River – East Canal Diversion to Silver Creek	CW, SS, PCR	X
Little Wood River – Reservoir to East Canal Diversion	CW, SS, PCR	
Little Wood River – Headwaters to Reservoir	CW, SS, PCR	

^aCW – Cold Water, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply

^b1998 303(d) refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.

Table 17. Little Wood River Subbasin existing/presumed beneficial uses.

Water body	Existing/Presumed Uses	1998 §303(d) List
Fish Creek – Reservoir to mouth	CW, SCR	X
Fish Creek – Headwaters to Reservoir	CW, SS, SCR	X
Dry Creek – Headwaters to mouth	CW, SCR	X
Muldoon Creek – Headwaters to mouth	CW, SS, SCR	X
Loving Creek – Headwaters to mouth	CW, SS, PCR	X

^aCW – Cold Water, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply

^b1998 303(d) refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.

A number of factors were used to determine that cold-water aquatic life is an existing use for the 303(d) listed water bodies in the Little Wood River Subbasin. These factors include cold water macroinvertebrate indicators, cold water fish indicators, water chemistry data, and diel temperature data.

The Water Body Assessment Guidance (WBAG) states that cold water aquatic life uses can be determined by the macroinvertebrate and fish populations of the water body. When there are at least two cold water indicator macroinvertebrate species (identified in the empirically derived cold water taxon list) present in a water body, then the water body has cold water aquatic life as an existing use. For fish, if 50% of the total population or 50% of the total

number of species are cold water adapted species, then the water body is considered to have cold water aquatic life use.

If diel water temperature is collected during the critical time period for cold water aquatic life (June 22 to September 21) temperature data can be used to determine cold water aquatic life use. If the percent of temperature exceedances is no greater than 10% for the maximum water temperature (22 degrees C) or the average water temperature (19 degrees C), then cold water aquatic life use is occurring.

There are also some water chemistry requirements in relation to aquatic life use designations that are found in IDAPA 58.01.02.250. The requirements for cold water aquatic life are that dissolved oxygen concentrations must be greater than six mg/L at all times, ammonia can not exceed calculated criterion more than once in a three year period, and turbidity can not exceed background by more than 50 nephelometric turbidity units (NTUs) for instantaneous measurements.

Because a water body may not be meeting beneficial uses due to impairment, all the above listed factors were considered when determining cold water aquatic life use. Based on these factors, cold water aquatic life was found to be a use on the following water bodies: Little Wood River above and below the reservoir, Fish Creek, Muldoon Creek and Loving Creek. The data available on Dry Creek and the Little Wood River from the East Canal Diversion to the mouth do not strongly indicate that cold water aquatic life use is an existing use. However, since there are data gaps or minimal data pertaining to Dry Creek, DEQ will assume that it does have cold water aquatic life as an existing use—unless future data indicates otherwise. As for the lower segment of the Little Wood River, it is designated for cold water aquatic life uses.

According to the WBAG document, salmonid spawning occurs in a water body if, during the summertime, there are juvenile salmonids that are less than 100 mm in overall length, as long as the water body is a first to fourth order stream. Salmonid spawning occurs in Muldoon Creek, Loving Creek, and Fish Creek above the reservoir. The Little Wood River from headwaters to Richfield town is designated for salmonid spawning beneficial uses. There has been no fish data collected on Dry Creek; *therefore it will be assumed that salmonid spawning does not occur on Dry Creek until future data indicates otherwise.*

The WBAG states that designated recreational facilities, water body size, and accessibility are factors used to determine if primary contact recreation is occurring on a water body rather than secondary contact recreation. In addition, if it was witnessed that swimming occurs in a water body, then it was automatically listed as primary contact recreation. *Based on these factors, primary recreation occurs on the Little Wood River and Loving Creek only, while the remainder of the listed tributaries have secondary contact recreation beneficial uses.*

Domestic water supply is listed as water uses in most of the water rights that have been searched. However, in all domestic water right cases, both domestic water supply and irrigation were listed as water uses for that water right, therefore *domestic water supply is not*

considered an existing beneficial use for any of the water bodies that are 303(d) listed, unless designated as such.

Surface Water Quality Criteria

There are general criteria that apply for all surface waters of the state, and there are other criteria that apply to the surface water based on designated or existing uses of the water body. Appendix C lists the general surface water criteria, surface water quality criteria for aquatic life use designation, surface water quality criteria for recreation use designations, surface water quality criteria for water supply use designation, and surface water quality criteria for wildlife and aesthetic use designations. Also incorporated into the table is natural background conditions language and wastewater treatment requirements as there are point sources in the subbasin.

Temperature elevations within the subbasin may or may not be naturally elevated in the subbasin. However, the influence of beaver dam complexes, geothermal springs, stream banks lined with basalt, and south facing slopes could be influencing water temperatures. As these are natural occurrences within a water body there may be natural background conditions that may be contributing to elevated temperatures. Temperature TMDLs will be completed to restore potential natural vegetation to the riparian zones of the water body. If these conditions are restored and temperature is still elevated above standards then it is likely that natural background conditions are impacting water temperatures. Due to these influences natural background condition language may be applicable and can be further reviewed in Appendix C.

2.3 Pollutant/Beneficial Use Support Status Relationships

Most of the pollutants that impair beneficial uses in streams are naturally occurring stream characteristics that have been altered by humans. That is, streams naturally have sediment, nutrients, and the like, but when anthropogenic sources cause these to reach unnatural levels, they are considered “pollutants” and can impair the beneficial uses of a stream.

Temperature

Temperature is a water quality factor integral to the life cycle of fish and other aquatic species. Different temperature regimes also result in different aquatic community compositions. Water temperature dictates whether a warm, cool, or coldwater aquatic community is present. Many factors, natural and anthropogenic, affect stream temperatures. Natural factors include altitude, aspect, climate, weather, riparian vegetation (shade), and channel morphology (width and depth). Human influenced factors include heated discharges (such as those from point sources), riparian alteration, channel alteration, and flow alteration.

Elevated stream temperatures can be harmful to fish at all life stages, especially if they occur in combination with other habitat limitations such as low dissolved oxygen or poor food supply. Acceptable temperature ranges vary for different species of fish, with cold water species being the least tolerant of high water temperatures. Temperature as a chronic stressor

to adult fish can result in reduced body weight, reduced oxygen exchange, increased susceptibility to disease, and reduced reproductive capacity. Acutely high temperatures can result in death if they persist for an extended length of time. Juvenile fish are even more sensitive to temperature variations than adult fish, and can experience negative impacts at a lower threshold value than the adults, manifesting in retarded growth rates. High temperatures also affect embryonic development of fish before they even emerge from the substrate. Similar kinds of affects may occur to aquatic invertebrates, amphibians and mollusks, although less is known about them.

Dissolved Oxygen

Oxygen is necessary for the survival of most aquatic organisms and essential to stream purification. Dissolved oxygen (DO) is the concentration of free (not chemically combined) molecular oxygen (a gas) dissolved in water, usually expressed in milligrams per liter (mg/L), parts per million, or percent of saturation. While air contains approximately 20.9% oxygen gas by volume, the proportion of oxygen dissolved in water is about 35%, because nitrogen (the remainder) is less soluble in water. Oxygen is considered to be moderately soluble in water. A complex set of physical conditions that include atmospheric and hydrostatic pressure, turbulence, temperature, and salinity affect the solubility.

Dissolved oxygen levels of 6 mg/L and above are considered optimal for aquatic life. When DO levels fall below 6 mg/L, organisms are stressed, and if levels fall below 3 mg/L for a prolonged period, these organisms may die; oxygen levels that remain below 1-2 mg/L for a few hours can result in large fish kills. Dissolved oxygen levels below 1 mg/L are often referred to as hypoxic; anoxic conditions refer to those situations where there is no measurable DO.

Juvenile aquatic organisms are particularly susceptible to the effects of low DO due to their high metabolism and low mobility (they are unable to seek more oxygenated water). In addition, oxygen is necessary to help decompose organic matter in the water and bottom sediments. Dissolved oxygen reflects the health or the balance of the aquatic ecosystem. Oxygen is produced during photosynthesis and consumed during plant and animal respiration and decomposition. Oxygen enters water from photosynthesis and from the atmosphere. Where water is more turbulent (e.g., riffles, cascades), the oxygen exchange is greater due to the greater surface area of water coming into contact with air. The process of oxygen entering the water is called aeration.

Water bodies with significant aquatic plant communities can have significant DO fluctuations throughout the day. An oxygen sag will typically occur once photosynthesis stops at night and respiration/decomposition processes deplete DO concentrations in the water. Oxygen will start to increase again as photosynthesis resumes with the advent of daylight.

Temperature, flow, nutrient loading, and channel alteration all impact the amount of DO in the water. Colder waters hold more DO than warmer waters. As flows decrease, the amount of aeration typically decreases and the instream temperature increases, resulting in decreased

DO. Channels that have been altered to increase the effectiveness of conveying water often have fewer riffles and less aeration. Thus, these systems may show depressed levels of DO in comparison to levels before the alteration. Nutrient enriched waters have a higher biochemical oxygen demand due to the amount of oxygen required for organic matter decomposition and other chemical reactions. This oxygen demand results in lower instream DO levels.

Sediment

Both suspended (floating in the water column) and bedload (moves along the stream bottom) sediment can have negative effects on aquatic life communities. Many fish species can tolerate elevated suspended sediment levels for short periods of time, such as during natural spring runoff, but longer durations of exposure are detrimental. Elevated suspended sediment levels can interfere with feeding behavior (difficulty finding food due to visual impairment), damage gills, reduce growth rates, and in extreme cases eventually lead to death. Newcombe and Jensen (1996) reported the effects of suspended sediment on fish, summarizing 80 published reports on streams and estuaries. For rainbow trout, physiological stress, which includes reduced feeding rate, is evident at suspended sediment concentrations of 50 to 100 mg/L when those concentrations are maintained for 14 to 60 days. Similar effects are observed for other species, although the data sets are less reliable. Adverse effects on habitat, especially spawning and rearing habitat presumably from sediment deposition, were noted at similar concentrations of suspended sediment.

Organic suspended materials can also settle to the bottom and, due to their high carbon content, lead to low intergravel DO through decomposition.

In addition to these direct effects on the habitat and spawning success of fish, detrimental changes to food sources may also occur. Aquatic insects, which serve as a primary food source for fish, are affected by excess sedimentation. Increased sedimentation leads to a macroinvertebrate community that is adapted to burrowing, thereby making the macroinvertebrates less available to fish. Community structure, specifically diversity, of the aquatic macroinvertebrate community is diminished due to the reduction of coarse substrate habitat.

Settleable solids are defined as the volume (milliliters [ml]) or weight (mg) of material that settles out of a liter of water in one hour (Franson et al. 1998). Settleable solids may consist of large silt, sand, and organic matter. Total suspended solids (TSS) are defined as the material collected by filtration through a 0.45 μm (micrometer) filter (Standard Methods 1975, 1995). Settleable solids and TSS both contain nutrients that are essential for aquatic plant growth. Settleable solids are not as nutrient rich as the smaller TSS, but they do affect river depth and substrate nutrient availability for macrophytes. In low flow situations, settleable solids can accumulate on a stream bottom, thus decreasing water depth. This increases the area of substrate that is exposed to light, facilitating additional macrophyte growth.

Bacteria

Escherichia coli or *E. coli*, a species of fecal coliform bacteria, is used by the state of Idaho as the indicator for the presence of pathogenic microorganisms. Pathogens are a small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa), which, if taken into the body through contaminated water or food, can cause sickness or even death. Some pathogens are also able to cause illness by entering the body through the skin or mucous membranes.

Direct measurement of pathogen levels in surface water is difficult because pathogens usually occur in very low numbers and analysis methods are unreliable and expensive. Consequently, indicator bacteria which are often associated with pathogens, but which generally occur in higher concentrations and are thus more easily measured, are assessed.

Coliform bacteria are unicellular organisms found in feces of warm-blooded animals such as humans, domestic pets, livestock, and wildlife. Coliform bacteria are commonly monitored as part of point source discharge permits (National Pollution Discharge Elimination System [NPDES] permits), but may also be monitored in nonpoint source areas. The human health effects from pathogenic coliform bacteria range from nausea, vomiting, and diarrhea to acute respiratory illness, meningitis, ulceration of the intestines, and even death. Coliform bacteria do not have a known effect on aquatic life.

Coliform bacteria from both point and nonpoint sources impact water bodies, although point sources are typically permitted and offer some level of bacteria-reducing treatment prior to discharge. Nonpoint sources of bacteria are diffuse and difficult to characterize.

Unfortunately, nonpoint sources often have the greatest impact on bacteria concentrations in water bodies. This is particularly the case in urban storm water and agricultural areas. *E. coli* is often measured in colony forming units (cfu) per 100 ml.

Nutrients

While nutrients are a natural component of the aquatic ecosystem, natural cycles can be disrupted by increased nutrient inputs from anthropogenic activities. The excess nutrients result in accelerated plant growth and can result in a eutrophic or enriched system.

The first step in identifying a water body's response to nutrient flux is to define which of the critical nutrients is limiting. A limiting nutrient is one that normally is in short supply relative to biological needs. The relative quantity affects the rate of production of aquatic biomass.

Either phosphorus or nitrogen may be the limiting factor for algal growth, although phosphorus is most commonly the limiting nutrient in Idaho waters. Ecologically speaking, a resource is considered limiting if the addition of that resource increases growth.

Total phosphorus (TP) is the measurement of all forms of phosphorus in a water sample, including all inorganic and organic particulate and soluble forms. In freshwater systems, typically greater than 90% of the TP present occurs in organic forms as cellular constituents in the biota or adsorbed to particulate materials (Wetzel 1983). The remainder of phosphorus is mainly soluble orthophosphate, a more biologically available form of phosphorus than TP that consequently leads to a more rapid growth of algae. In impaired systems, a larger

percentage of the TP fraction is comprised of orthophosphate. The relative amount of each form measured can provide information on the potential for algal growth within the system. Nitrogen may be a limiting factor at certain times if there is substantial depletion of nitrogen in sediments due to uptake by rooted macrophyte beds. In systems dominated by blue-green algae, nitrogen is not a limiting nutrient due to the algal ability to fix nitrogen at the water/air interface.

Total nitrogen to TP ratios greater than seven are indicative of a phosphorus-limited system while those ratios less than seven are indicative of a nitrogen-limited system. Only biologically available forms of the nutrients are used in the ratios because these are the forms that are used by the immediate aquatic community.

Nutrients primarily cycle between the water column and sediment through nutrient spiraling. Aquatic plants rapidly assimilate dissolved nutrients, particularly orthophosphate. If sufficient nutrients are available in either the sediments or the water column, aquatic plants will store an abundance of such nutrients in excess of the plants' actual needs, a chemical phenomenon known as luxury consumption. When a plant dies, the tissue decays in the water column and the nutrients stored within the plant biomass are either restored to the water column or the detritus becomes incorporated into the river sediment. As a result of this process, nutrients (including orthophosphate) that are initially released into the water column in a dissolved form will eventually become incorporated into the river bottom sediment. Once these nutrients are incorporated into the river sediment, they are available once again for uptake by yet another life cycle of rooted aquatic macrophytes and other aquatic plants. This cycle is known as nutrient spiraling. Nutrient spiraling results in the availability of nutrients for later plant growth in higher concentrations downstream.

Sediment – Nutrient Relationship

The linkage between sediment and sediment-bound nutrients is important when dealing with nutrient enrichment problems in aquatic systems. Phosphorus is typically bound to particulate matter in aquatic systems and, thus, sediment can be a major source of phosphorus to rooted macrophytes and the water column. While most aquatic plants are able to absorb nutrients over the entire plant surface due to a thin cuticle (Denny 1980), bottom sediments serve as the primary nutrient source for most sub-stratum attached macrophytes. The USDA (1999) determined that other than harvesting and chemical treatment, the best and most efficient method of controlling growth is by reducing surface erosion and sedimentation.

Sediment acts as a nutrient sink under aerobic conditions. However, when conditions become anoxic sediments release phosphorus into the water column. Nitrogen can also be released, but the mechanism by which it happens is different. The exchange of nitrogen between sediment and the water column is for the most part a microbial process controlled by the amount of oxygen in the sediment. When conditions become anaerobic, the oxygenation of ammonia (nitrification) ceases and an abundance of ammonia is produced. This results in a reduction of nitrogen oxides (NO_x) being lost to the atmosphere.

Sediments can play an integral role in reducing the frequency and duration of phytoplankton blooms in standing waters and large rivers. In many cases there is an immediate response in phytoplankton biomass when external sources are reduced. In other cases, the response time is slower, often taking years. Nonetheless, the relationship is important and must be addressed in waters where phytoplankton is in excess.

Floating, Suspended, or Submerged Matter (Nuisance Algae)

Algae are an important part of the aquatic food chain. However, when elevated levels of algae impact beneficial uses, the algae are considered a nuisance aquatic growth. The excess growth of phytoplankton, periphyton, and/or macrophytes can adversely affect both aquatic life and recreational water uses. Algal blooms occur where adequate nutrients (nitrogen and/or phosphorus) are available to support growth. In addition to nutrient availability, flow rates, velocities, water temperatures, and penetration of sunlight in the water column all affect algae (and macrophyte) growth. Low velocity conditions allow algal concentrations to increase because physical removal by scouring and abrasion does not readily occur. Increases in temperature and sunlight penetration also result in increased algal growth. When the aforementioned conditions are appropriate and nutrient concentrations exceed the quantities needed to support normal algal growth, excessive blooms may develop.

Commonly, algae blooms appear as extensive layers or algal mats on the surface of the water. When present at excessive concentrations in the water column, blue-green algae often produce toxins that can result in skin irritation to swimmers and illness or even death in organisms ingesting the water. The toxic effect of blue-green algae is worse when an abundance of organisms die and accumulate in a central area.

Algal blooms also often create objectionable odors and coloration in water used for domestic drinking water and can produce intense coloration of both the water and shorelines as cells accumulate along the banks. In extreme cases, algal blooms can also result in impairment of agricultural water supplies due to toxicity. Water bodies with high nutrient concentrations that could potentially lead to a high level of algal growth are said to be eutrophic. The extent of the effect is dependent on both the type(s) of algae present and the size, extent, and timing of the bloom.

When algae die in low flow velocity areas, they sink slowly through the water column, eventually collecting on the bottom sediments. The biochemical processes that occur as the algae decompose remove oxygen from the surrounding water. Because most of the decomposition occurs within the lower levels of the water column, a large algal bloom can substantially deplete DO concentrations near the bottom. Low DO in these areas can lead to decreased fish habitat as fish will not frequent areas with low DO. Both living and dead (decomposing) algae can also affect the pH of the water due to the release of various acid and base compounds during respiration and photosynthesis. Additionally, low DO levels caused by decomposing organic matter can lead to changes in water chemistry and a release of sorbed phosphorus to the water column at the water/sediment interface.

Excess nutrient loading can be a water quality problem due to the direct relationship of high TP concentrations on excess algal growth within the water column, combined with the direct effect of the algal life cycle on DO and pH within aquatic systems. Therefore, the reduction of TP inputs to the system can act as a mechanism for water quality improvements, particularly in surface-water systems dominated by blue-green algae, which can acquire nitrogen directly from the atmosphere and the water column. Phosphorus management within these systems can potentially result in improvement in nutrients (phosphorus), nuisance algae, DO, and pH.

2. 4 Summary and Analysis of Existing Water Quality Data

This segment of the report describes the analysis process used for each water body as well as existing water quality data that was considered. For most of the water bodies, data collected by DEQ is the only available data; the USGS has collected indicator parameters on some of the water bodies but not consistently for analysis purposes.

Analysis Process

The analysis of the water quality data for the listed water bodies followed these steps:

1. A general description of the water body and the land surrounding the water body was described.
2. Biological data was then analyzed to determine if beneficial uses were fully supported.
3. Hydrology was also described, as this could be a major contributor to the impairment to these water bodies.
4. Water column data was analyzed to develop the conclusions made about the water body.

Bioassessment Data

Biological and habitat data on water bodies are collected through the Beneficial Use Reconnaissance Program (BURP), using the WBAG to interpret data. The data collected is used to determine if a water body is fully supporting beneficial uses. If the data is available, dissolved oxygen, pH, turbidity, total dissolved gas, and temperature are looked at to aid in the determination of whether or not water quality is capable of fully supporting beneficial uses. If the frequency of exceedance is greater than 10%, then the water quality of the water body is considered to be not capable of fully supporting beneficial uses.

The data collected through the BURP protocol includes macroinvertebrate, fish, and habitat data. Multimetric indices are used to determine the health of a water body. Each index has a number of characteristics that are rated and the sum of the ratings provides the stream index of that particular data type. So if macroinvertebrate, fish, and habitat data are all collected at a site, the analysis of the data will provide a macroinvertebrate index (SMI), a fish index (SFI), and a habitat index (SHI). These indices are then given a condition rating score to determine if a water body is fully supporting its beneficial uses.

The index scores were broken down into three ranges of numbers. The number range varies between ecoregions. The range with the highest scores receives a condition rating of 3, the middle range of scores receives a condition rating of 2, and the next lower range of scores receives a condition rating of 1. For the SMI and SFI index there is a fourth range of lower scores, this score is identified as minimum threshold.

At least two of the data groups must have been obtained at the collection event for a water body to be assessed. If the average condition rating scores for the indices that were collected is greater than or equal to 2, then the water body is considered *fully supporting*; if it is less than 2, the water body is considered *not fully supporting*. If either the SMI or SFI score indicates a minimum threshold the water body is automatically considered *not fully supporting*. For more detail on how these index scores are developed, see the WBAG and the *Idaho Small Stream Ecological Assessment Framework* (Grafe, C.S., ed. 2000).

Hydrology

The hydrology sections of this report include a description of the water bodies perennial/intermittent status (defined by ArcView coverage), the water bodies as observed by DEQ during drought years (2001-2003), predicted average stream flows, and water right diversions. When applicable, linear regression models were used to predict average stream flows.

There are three active stream flow stations located within the Little Wood River Subbasin:

- USGS gauge # 13147900 above High Five Creek measures a natural stream flow on the Little Wood River
- USGS gauge # 13148500 near Carey measures flow on Little Wood River that is regulated according to water demand
- USGS gauge #13150430 at sportsman access measures spring-fed flows of Silver Creek.

These gauging stations were used to develop average stream flow models for the other water bodies in the Little Wood River Subbasin.

Flow alteration within a water body can impact beneficial uses, and it can be difficult to identify the degree of impact. In determining if there is an impact due to flow alteration, several things were examined: water rights, diversion maps, and changes in stream flow that did not appear to be due to precipitation events. Canal and ditch systems were identified using ArcView coverage as well as 1:25,000 topoquad maps. Changes in stream flow were identified based on observations and flows measured. Water right searches were performed from the Idaho Department of Water Resources Web site for each of the 303(d) listed water bodies. There are many water rights that list the source as multiple water bodies (usually a main stem and tributaries); therefore it is difficult to distinguish how much water is diverted from which water body. Due to these methods of record, the amount of water diverted from the 303(d) water body itself was a conservative estimate.

Water Chemistry

Water chemistry data is used in the subbasin assessment process to both identify if beneficial uses are fully supported and to identify the pollutants impacting the beneficial uses. The following section describes the available data as well as standards or targets for the constituents.

Water chemistry data for the Little Wood River Subbasin is very limited. Water chemistry data that has been collected in the last five years (1998 – 2003) was used to assess the current status of the water bodies. Due to the lack of data within the subbasin trend analysis cannot be performed. Data that is sporadically collected or older than five years was used to aid in determining the seasonal or monthly fluctuations that occur in the water body.

Recent and historical data in the subbasin has been collected by DEQ and by other agencies. Laboratory and field data were collected by DEQ at various locations during the 2001-2003 periods. During this time temperature loggers were also distributed throughout the subbasin. A private vendor was contracted by DEQ to perform monthly monitoring of the Little Wood River Subbasin from September 2001 to August 2002 for laboratory and field samples. (The data collected by other agencies varies from water body to water body and is extremely limited for most water bodies. In addition, EPA's storage and retrieval (STORET) database was used as a source of data but did not yield data that was not already obtained through the original sources.)

Numerical Criteria

There are numerical water quality standards that apply to surface waters of the state. These standards include bacteria, temperature, ammonia, pH, and turbidity. Ammonia (NH₃), pH, DO, and turbidity data that is elevated beyond standards indicate that there is a pollutant that is impacting the water body, thus the pollutant needs to be identified. On the other hand, bacteria and temperature are pollutants therefore if data for either of these constituents is elevated then they themselves are impacting the water body.

In addition to having numerical criteria in the water quality standards, temperature, pH, DO, and turbidity data is used, in addition to biological data, to indicate if water quality is capable of fully supporting beneficial uses. If the data set for any of these constituents is elevated beyond the water quality standards more than 10% of the time then the data indicates that water quality is not capable of fully supporting beneficial uses. As these constituents are numerical values in the water quality standards exceedance of the 10% policy supersede biological data in determining if water quality is capable of fully supporting beneficial uses.

Numerical standards for the above mentioned constituents are identified in Appendix C, but a brief description of the numerical criteria will be discussed now.

- If NH₃ standards were exceeded more than once in three years, as stated in water quality standards, then NH₃ data could be indicative of a pollutant impacting beneficial uses. The pollutant would then be identified.

- If pH, DO, or turbidity were elevated more than 10% of the time then data indicated that a pollutant was impacting water quality and thus beneficial uses. The pollutant would then be identified. Standards for pH indicate that pH should not fall outside of the range of 6.5 to 9.0 standard units. Standards for DO indicate that DO should be greater than 6.0 mg/L. Standards for turbidity indicate that turbidity should not be elevated more than 50 NTUs above background levels.
- When bacteria values were elevated above the instantaneous criteria (576 or 406 cfu/100mL), then four additional samples collected within 30 days were used to calculate a geometric mean. If the geometric mean value was elevated above the criteria (126 cfu/100mL), then bacteria were impacting contact recreation beneficial uses. A TMDL for bacteria was then completed. If additional samples were not collected within 30 days, then the instantaneous data alone was used to determine if beneficial uses were impacted.
- If temperature data during either CWAL or SS critical periods was elevated more than 10% of the time, then water quality was identified as not being capable of supporting beneficial uses. In this case, canopy cover data was collected from aerial photos (Shumar 2004) as well as from field measurements (solar path finder) to develop loads for a temperature TMDL (Table 85, page 233). The water body was characterized according to vegetation type, bankfull width, and elevation. The Alvord Lake Subbasin Total Maximum Daily Load and Water Quality Management Plan (Hammon, et al. 2003) was used to aid in determining the canopy cover surrogate targets based on these characteristics. The quantity of solar radiation for flat-plate collectors facing south at a fixed tilt was measured at a National Renewable Energy Lab station in Boise, Idaho. These quantities were used to determine an existing and proposed solar radiation load based on the canopy cover of the water body.

Narrative Criteria

The narrative criteria of the water quality standards include nuisance aquatic vegetation and oxygen-demanding materials. These standards were measured with nutrient and sediment numerical surrogates that have been derived from various sources and used throughout many of the south central Idaho TMDLs. The critical value for most of these narrative surrogates in determining if the beneficial uses were impacted by the pollutant is the annual average. However, due to monitoring designs and site inaccessibility the value was not a true annual average but an average of the period of record.

Nutrient Criteria

Nutrient data used in the assessment of the water body includes total phosphorus (TP), total inorganic nitrogen (TIN), and chlorophyll. The surrogate targets for TP are those suggested in the EPA Quality Criteria for Water 1986 (EPA 1986). Surrogate targets for TIN were identified in the Idaho water quality status report 1980 (IDHW 1980) and the Salmonid-habitat relationships in the Western United States (USFS 1990). Nuisance levels of filamentous algae may be occurring when chlorophyll a levels are greater than 15 ug/L (Welch 1987). *The following values have been used in many TMDLs throughout the south central region of Idaho.*

- Chlorophyll values that are elevated above 15µg/L may be indicative of impacted beneficial uses. However, chlorophyll data was not collected simultaneously with TP and TIN data so a relationship between chlorophyll data and nutrient data can not be established in this subbasin.
- The recommended targets of TP to prevent eutrophication of a free flowing stream is 0.100 mg/L and for a stream delivering to a storage system is 0.050 mg/L for the delivering stream (EPA 1986). *For a free flowing water body*, the annual and monthly average target for TP is 0.100 mg/L. Monthly and annual averages elevated above this value may indicate impairment of the water body. Ideally, the monthly average would be used to determine if impairment was occurring. However, monitoring designs did not allow for a monthly average to be determined. As a result, the daily maximum value of 0.160 mg/L will be used to determine if monthly averages were likely to be elevated, in combination with the annual average of 0.100 mg/L. *For a water body flowing into a storage system*, if the TP average for a water body flowing into a storage system was less than 0.100 mg/L but elevated above 0.050 mg/L, then it was concluded that TP was not impacting the beneficial uses of the water body but was likely impacting the water quality of the storage system. (The daily maximum value of 0.080 mg/L would be used in this case to indicate if monthly averages were likely to be elevated.) In a case such as this, a TMDL on the delivering stream was completed to limit the loading to the storage system.
- The Ambient Water Quality Criteria Recommendations for Rivers and Streams in Nutrient Ecoregion III, the Xeric West (EPA 2000) was not used to set nutrient targets for the water bodies in this subbasin. The document identifies suggested targets for reference conditions and states that “reference conditions represent the natural, least impacted conditions or what is considered to be the most attainable conditions (28).” IDAPA states “The existing in stream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.003.35, .050.02, and 051.01 and .053).” The goal is to protect the beneficial uses of the water body, not to restore the water body to reference conditions. As a result, these suggested ecoregional criteria will not be used as a target for TP in this subbasin.
- The limit for development of biological nuisances and eutrophication is considered to be 0.300 mg/L of TIN (IDHW 1980, USFS 1990). If TIN averages were elevated above 0.300 mg/L, it was concluded that nitrogen compounds might be impacting beneficial uses if TP values were also elevated in the system. Well data was then analyzed to determine if elevated TIN was due to groundwater influence.
- Instantaneous TP and TIN values were also examined to better characterize the water body and to identify periods of elevated influence. *Instantaneous data is being used to identify the seasonal fluctuations rather than monthly averages because the monitoring plan for the subbasin did not allow for monthly averages to be determined.* Instantaneous criteria for TIN were 0.480 mg/L while instantaneous criteria for TP were 0.160 mg/L for a free flowing water body and 0.080 mg/L TP for a storage system water body.
- For nutrients to be considered as an impact to a water body, there has to be either nuisance aquatic growth or an elevation of both phosphorous and nitrogen values. Total nitrogen to total phosphorous values was also calculated to find out what the limiting

factor in the water body was. If TN/TP ratios were greater than 7, then the water body was phosphorous limited; if they were 7 or less, then the water body was nitrogen limited.

Sediment Criteria

Sediment data used in the assessment of the water body includes total suspended solids (TSS) and bedload sediment. The surrogate targets for TSS are those suggested by the European Inland Fisheries Advisory Commission (EIFAC 1964). The surrogate targets for bedload sediment (percent fines) are the upper values that are occurring in water bodies of the subbasin that are fully supporting their beneficial uses. Stream bank erosion targets are those that have been identified in numerous plans, the Salmon-Challis Forest Management Plan, the Salmon-Challis Annual Monitoring Plan, and an Inventory of Natural Conditions in the Salmon River Basin by Kerry Overton (Herron 2004). *These targets have been used in many TMDLs throughout the south central region of Idaho.*

- Water column data for sediment was measured in the form of TSS. The European Inland Fisheries Advisory Commission has suggested that targets of 25 mg/L would be highly protective, 80 mg/L would be moderately protective, and targets of 400 mg/L would be least protective. The program management team of DEQ has in the past proposed a target of 50 mg/L (Lay 2000). *The annual and monthly average target for TSS is 50 mg/L. Monthly and annual averages elevated above this value may indicate impairment of the water body. Ideally, the monthly average would be used to determine if impairment was occurring. However, monitoring designs did not allow for a monthly average to be determined. As a result, the daily maximum value of 80 mg/L will be used to determine if monthly averages were likely to be elevated in combination with the annual average of 50 mg/L.*
- Instantaneous TSS values were also examined to better characterize the water body and to identify periods of elevated influence. *Instantaneous data is being used to identify the seasonal fluctuations rather than monthly averages because the monitoring plan for the subbasin did not allow for monthly averages to be determined.* Instantaneous criteria for TSS was 80 mg/L.
- Bedload sediment is measured as percent fines and a target of 35% or less fines indicates that bedload sediment is not impacting beneficial uses. A review of the percent fine data on water bodies that are fully supporting beneficial uses in the Little Wood River Subbasin indicate that beneficial uses are fully supported at percent fines that are 35% or less (Figure 17). When bedload sediment is elevated a stream bank erosion inventory is completed to determine if stream bank erosion is the source of the elevated bedload sediment.
- The NRCS Stream bank Erosion Inventory is a tool used to estimate the amount of stream bank erosion occurring in a water body. Properly managed streams have stream bank stabilities of 80% or greater. This value has been identified in numerous plans that were identified above (Herron, 2004). *Therefore, 80% bank stability is the target for these assessments.* The water body will be divided into segments based on numerous

characteristics of the water body. The stream bank erosion inventories take into account bank stability, bank height, and recession rates of the water body. Stream bank erosion inventories will be completed on each segment, this will aid in developing an overall allocation as well as identifying priority reaches of the water body.

Daily maximum assessment criteria for TP, TIN, and TSS were established by EPA NPDES permit procedures where in daily maximum values are targeted at a 60% increase over monthly average criteria. Seasonal and monthly fluctuations will be described based on the daily maximum assessment criteria although they should really be described based on monthly average fluctuations. *The monitoring plan for the subbasin did not allow for monthly averages to be determined as there was only one sampling event or less per month. Throughout the document when historical data or sporadically taken data was available it was used to aid in determining monthly and seasonally fluctuations however this data would not necessarily be representative of the creek in current conditions or throughout the entire year.*

Some constituents were measured to aid in characterizing the water bodies although they are not found within water quality standards either as numeric or narrative standards. These additional constituents will aid in indicating if water quality is impacting beneficial uses. The assessment criteria for specific conductivity and biochemical oxygen demand (BOD) are 500 uhmos/cm and 10 mg/L, respectively (Buhidar 2001).

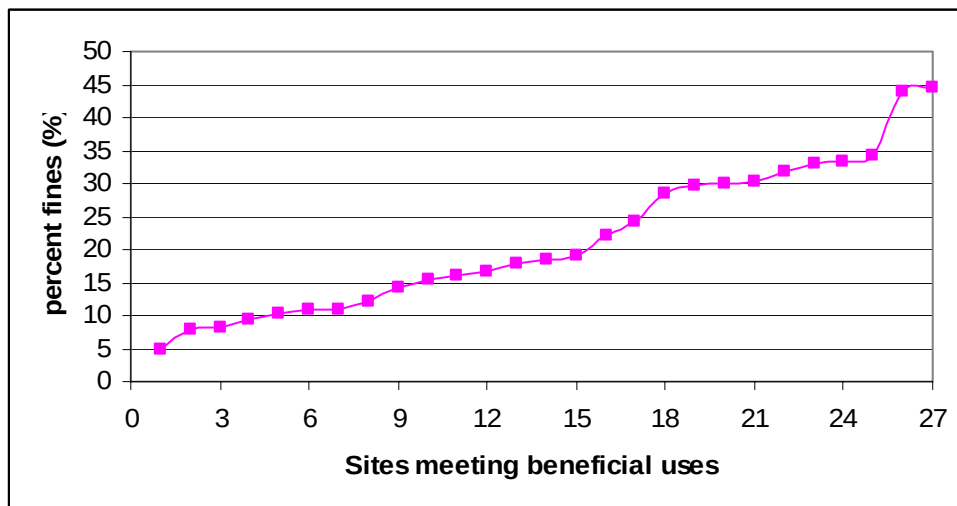


Figure 17. Bedload sediment in streams meeting beneficial uses.

Muldoon Creek

Muldoon Creek is a fourth order perennial stream that lies in the northern part of the Little Wood River Subbasin. Its headwaters begin south of the Pioneer Mountains, and it flows southwesterly into the Little Wood River about 5 miles upstream of the Little Wood River Reservoir. Muldoon Creek is 16.8 miles long while the 303(d)-listed segment is 3.1 miles long. Muldoon Creek originates at an elevation of 9,514 feet and discharges at 5,249 feet.

Muldoon Creek has a bankfull width/depth ratio that averages 22.8, a sinuosity of 1.23, and a gradient of 4.81%, while the 303(d)-listed segment has a gradient of 1%.

Land use, ownership, and vegetation of Muldoon Creek is described based on a 1-mile-stream corridor approach, as was done in the Big Wood River TMDL. Although originating on USFS land (19.7%) and passing through portions of BLM (15.4%) and state land (6.4%), it flows mostly through private land (58.6%). The land use for this stream is irrigated agriculture land with gravity flow (50%) and sprinkler (5.6%) and rangeland (44.5%). The vegetation along Muldoon Creek's stream corridor changes as you move down the creek channel: Muldoon Creek begins in forested vegetation (0.8%) and flows down through agriculture land (17.2%), with scattered riparian and wetlands (8.1%). Shrubland (72.1%) and grassland (1.8%) are distributed upland of the creek, within the mile wide stream corridor (ArcView Coverage, 1992-1996).

The Muldoon Creek stream corridor passes through 4 different geologic formations as well as 4 different soil types. This creek originates in the thrust, shallow-to-deep marine detrital units. Then it flows through colluvium conglomerate and talus until the lower most segment flows through lava flows. The lower two thirds of the creek is surrounded in the uplands by mixed silicic and basaltic volcanic ejecta flows (ArcView Coverage, 1992-1996).

The soils of the Muldoon Creek drainage area have soil erosion potentials (K factors) that increase as you move down the watershed. Headwater streams begin in soils with K factors of 0 to 0.8. This rapidly changes into soils with higher K factors of 0.25 to 0.35. The lower portion of the creek flows through soils that have K factors of 0.35 to 0.45 (ArcView Coverage, 1992-1996).

Biological and Other Data

This section of the document will discuss the fisheries management by IDFG, biological data and information collected through the BURP protocol, and fishery data of the creek.

IDFG manages the fisheries of Muldoon Creek in a general characterization that is attributed to many of the water bodies in the subbasin. Muldoon Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

IDFG surveyed Muldoon Creek in 1986 and found it to have "potential to be a high quality trout fishery with some improvements in land use practices" and "a viable population of Wood River sculpin. (92)" The fisheries collected at three locations are reported in Table 19. The overall condition rating of the stream was good. Spawning habitat and production in the upper reaches were felt to be limited due to rubble substrate and lack of pools and rearing areas. The lower reaches contain good spawning gravels, but fine sediment could be impacting reproductive success. It is believed by IDFG, that grazing, lack of water, and irrigation returns are causing degradation in some areas (IDFG 1987).

Biological data is used by the state of Idaho in determining if beneficial uses of wadeable perennial streams are fully supported. The WBAG document is used as a tool to assess the biological data and thus the beneficial use support status of the creek. This data includes macroinvertebrate data, fishery data, and habitat data. Two of these data groups must be available before the beneficial uses of a water body can be evaluated through the WBAG process.

Biological data is used to indicate support status of beneficial uses, however the WBAG also identifies an exceedance policy for DO, pH, turbidity, and temperature in determining if water quality is capable of fully supporting beneficial uses. As these constituents are numerical criteria in the water quality standards, an elevation above the 10% exceedance policy indicates water quality is incapable of supporting beneficial uses and thus can supersede conclusions supported by biological data. These water chemistry data constituents will be discussed later in the document under the subsection Water Column Data.

Little biological or habitat data has been collected on Muldoon Creek, although at first glance it would appear otherwise. Data has been collected through the BURP protocol in 1996 and 2001. The 1996 sites were reported as being located on Muldoon Creek, but were later identified as the unnamed stream flowing out of Campbell Reservoir and the South Fork of Muldoon Creek. The data from the unnamed stream site led to Muldoon Creek being added to the 1998 303(d) list. This water body is an ephemeral stream that was flowing during the BURP season due to a wet year, therefore little biological or habitat data for Muldoon Creek exists. DEQ assessments will be based on the 2001 BURP sites, which represent upper, middle, and lower segments of the creek.

The BURP files on Muldoon Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel types and activities affecting each reach are reported in Table 18. Additional information provided in the BURP files indicate that in the upper reaches sheep grazing had occurred on the reach, young as well as old willows are present along with alders and other vegetation types, and much of the banks are made up of very large boulders. Middle reach information indicates that sheep and cattle grazing signs were present but stubble height was still 3-4 inches, vegetation included willows, alders, birch, aspen, sage brush, grasses, and some Canada thistle, water was clean, there were signs of very heavy flow in the past, and some channel braiding. Lower reach information indicates that there are large boulders in and along the creek, vegetation includes willows of different age classes, sage, sedge, grasses, rushes, and birch, the site is within a narrow 50-foot deep canyon. There are no signs of grazing, but there are signs of wildlife. The water is clear, macrophytes are found within the channel (DEQ 1993-2001).

Table 18. Characteristics of Muldoon Creek.

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Upper	2	3	B	REC, MIN, RDS, GR
Middle	4	3	B	AG, REC, RDS, DIV
Lower	4	2.5	B	AG, REC, RDS, DIV, GR, BC

^aData from BURP files.

^bREC – Recreation, MIN – Mining, RDS – Roads, GR – Grazing, AG – Agriculture, DIV – Diversions, BC – Beaver Complexes.

According to the preliminary bioassessment of biological data collected in 2001, Muldoon Creek is fully supporting beneficial uses. The SFI, SMI, and SHI condition ratings for all three of the sites were 3 for an average of 3. (A rating of 2 and above indicates that beneficial uses are being fully supported.)

Macroinvertebrate data indicates that macroinvertebrate data in the headwater stretches is better than that data collected downstream. The SMI values for upper segments rated very good (76-100), while the middle and lower segments rated good (51-75). The pollution tolerance values for upper segments rated good (4.51-5.50) while the middle and lower segments rated fair (5.51-6.50).

Sculpin, suckers, brook trout, and rainbow trout have been found to occur in Muldoon Creek. According to stocking records, IDFG has not stocked this water body; however there could be unrecorded stockings that have occurred historically. DEQ fish data indicates that, as a whole, 75% of the fish species of Muldoon Creek were cold water indicators, 95.7% of all the fish collected were cold water indicators, 56.4% of the rainbow trout and 38.2% of the brook trout were young of year.

Table 19. Muldoon Creek fish.

Site	Rainbow trout	Brook trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
2001STWFA052	9	1	36	0	0	0	3	1
2001STWFA080	19	12	68	0	0	0	8	8
2001STWFA081	73	21	25	12	0	0	46	4
1986IDFGMC01	8	2	85	1	10	0	---	---

^aData collected by DEQ and IDFG.

Hydrology

Muldoon Creek is a perennial water body that feeds the Little Wood River. There are 18 water bodies that feed directly into Muldoon Creek. The largest watersheds within the Muldoon Creek drainage are South Fork of Muldoon Creek and Copper Creek. The South Fork of Muldoon Creek has many tributaries that lie in a marshy region.

There is not a gauging station located on Muldoon Creek, currently or historically, therefore flow data collected in 2001-2003 will be used to predict an average stream flow. The site for stream flow measurements occurred at a road crossing approximately three miles upstream of the confluence with the Little Wood River. There are three smaller perennial streams (estimated at less than 3 cubic feet per second [cfs]) and three intermittent streams, likely ephemeral that feed into Muldoon Creek below the sampling location. The ephemeral streams would add to the peak flow but not to the base flows of Muldoon Creek.

The Little Wood River gauging station (13147900 - Little Wood River above High Five Creek near Carey) is a functioning station that was used in predicting Muldoon Creek flow. The Little Wood River and Muldoon Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Little Wood River and Muldoon Creek watersheds was similar, as well as being similar throughout the period of record. Based on this assumption, a linear regression model of Little Wood River flow versus Muldoon Creek flow was performed using data collected on the same day (Figure 18). The statistical values of the regression analysis ($p=0.000$, $r^2=0.825$) indicate that this model can be used to determine a predicted average flow for Muldoon Creek (Figure 19).

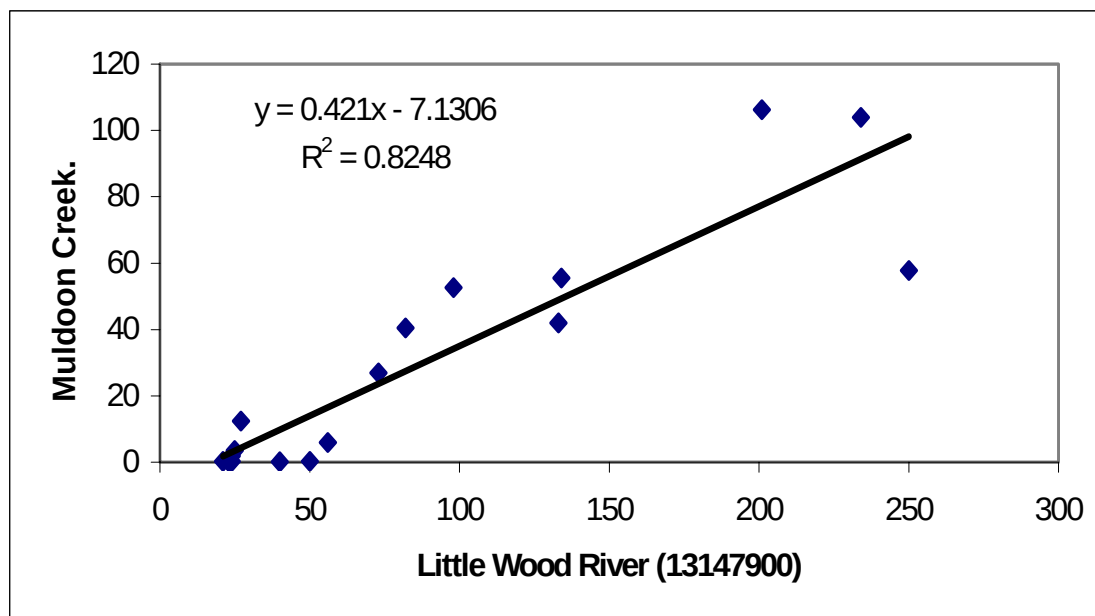


Figure 18. Muldoon Creek flow (cfs) regression analysis.

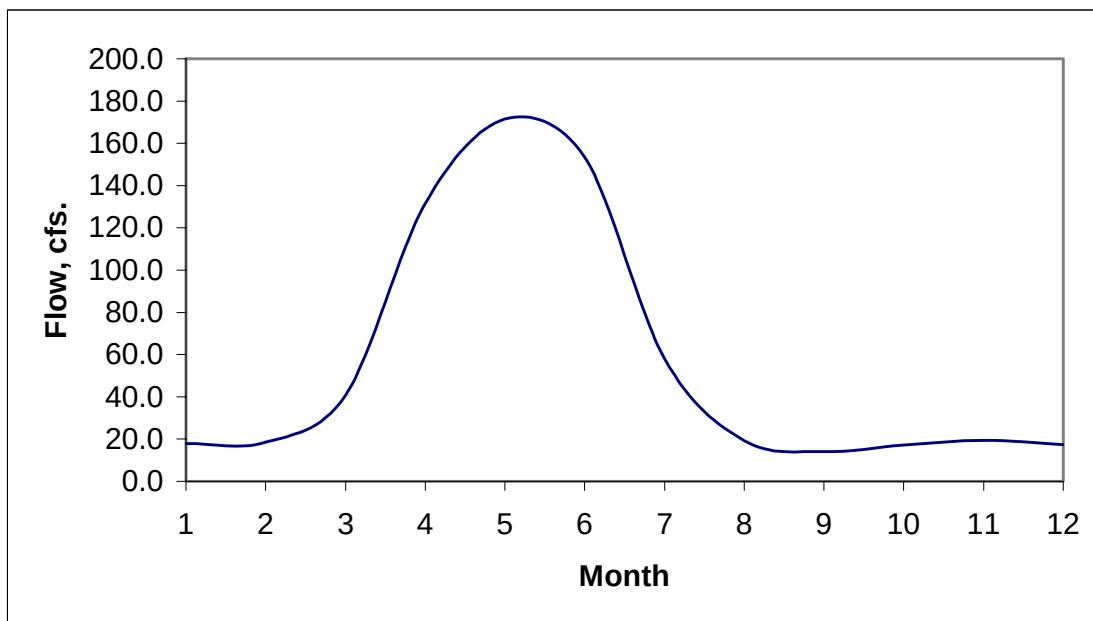


Figure 19. Muldoon Creek predicted hydrograph.

Flows on Muldoon Creek appear to support beneficial uses of the water body. Predicted flows for Muldoon Creek tend to increase in late March and decrease in late June. Average flow for Muldoon Creek is 56.6 cfs. High flow for Muldoon Creek occurs in May and averages 171.6 cfs, with low flows occurring from August to February averaging less than 20 cfs. Muldoon Creek has water year round. However, a decree from 1909 states that the water users can choose to use the water that they have a right to, to the point that Muldoon Creek gets dewatered, despite the water rights that occur downstream (MacMillan 1909).

There are many water rights for the Muldoon Creek drainage area. Diversions from Muldoon Creek itself account for 33.2 cfs of water while diversions from Muldoon Creek tributaries account for 133.3 cfs. This water is used for various purposes: irrigation, stockwater, domestic water supply, and wildlife (IDWR 2002). *Water rights on the creek are not in excess of the average flow conditions of the water body. As there appears to be water present year round in the water body, including during drought years, it is unlikely that flow alteration is directly impacting beneficial uses. However, low flow conditions could contribute to an increase in water temperature.*

Water Column Data

Water chemistry data for Muldoon Creek is very limited. There were three points of sampling performed by the USGS—in 1975, 1976, and 1977—for flow, temperature, and specific conductivity. Bacteria data was collected at three BURP sampling sites by DEQ in the summer/fall of 2001. Monthly monitoring for water chemistry data was completed throughout the 2001-2003 period. Temperature loggers were also distributed at various locations.

Table 20 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 20. Muldoon Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number Elevated	Instantaneous Criteria	Average Criteria
Indicators							
SC	25	258.0	184.0	84.9	0	< 500	---
pH	30	8.65	---	7.11	0	6.5 < x < 9.0	---
TNH3	8	0.110	0.031	0.005	0	Variable	---
Turb	31	107.05	9.00	0.00	1	BG + 50	---
DO	30	12.37	9.24	6.91	0	> 6	---
BOD	6	8.0	4.8	0.5	0	< 10	---
Chl a	7	2.7	1.1	0.0	0	< 15	---
Pollutants							
TSS	11	12.0	2.9	0.5	0	< 80	< 50
TP	11	0.098	0.067	0.045	0	< 0.16	< 0.10
TIN	5	0.281	0.100	0.010	0	< 0.48	< 0.3
<i>E. coli</i>	18	416.0	51.5	2.0	0	< 576	< 126

^aSC – Specific Conductivity (uhmos/cm), pH – Hydrogen Ion Concentration (standard units), TNH3 – Total Ammonia (mg/L), Turb – Turbidity (NTUs), DO – Dissolved oxygen (mg/L), BOD – Biological oxygen demand (mg/L), Chl a – chlorophyll a (ug/L), TSS – Total Suspended Solids (mg/L), TP – Total Phosphorous (mg/L), TIN – Total Inorganic Nitrogen (mg/L), *E. coli* – Escherichia coli (Colony forming units/100ml).

^bThe average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria, except turbidity. Turbidity is elevated above water quality standards one time. This elevation in turbidity accounts for 3.2% of the measurements within the period of record. This percentage is well below the 10% exceedance policy. Historical data also meets assessment criteria.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO. If these parameters are not elevated beyond standards more than 10% of the time than water quality is capable of fully supporting beneficial uses. In the case of Muldoon Creek, neither pH, turbidity, nor DO is elevated more than 10% of the time. *Water quality (DO, pH, and turbidity) appears to support the conclusion made under the biological data assessment, beneficial uses are fully supported.*

The water column data (TSS) and bedload sediment data (percent fines) indicate that sediment is not impacting the beneficial uses of Muldoon Creek. The TSS average values (2.9 mg/L) averaged well below the average assessment criteria of 50 mg/L. The percent fine

data also was not elevated above the assessment criteria (35%). There were six bedload sediment collection events in the water body and the values for percent fines ranged from 7.3% to 19.1%. *A sediment TMDL will not be completed.*

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events. *Seasonally*, TSS values are elevated in March (9 mg/L), April (7.5 mg/L), May (3.8 mg/L) and June (5.6 mg/L) during higher flow periods, but are never elevated above the daily maximum value of 80 mg/L. The TSS values are consistently very low (1 mg/L) during base flow periods.

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the beneficial uses of Muldoon Creek. Chlorophyll data is limited; however, values remain below 15 ug/L indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.067 mg/L) averaged well below the average assessment criteria of 0.100 mg/L. The TIN average values (0.100 mg/L) averaged well below the average assessment criteria of 0.300 mg/L. Neither TIN nor TP components are elevated, *a nutrient TMDL will not be completed.*

The critical period for nuisance aquatic vegetation is typically during the late spring and into the early fall months when primary production is elevated. *Seasonally*, TP values are slightly elevated in April (0.071 mg/L), June (0.072 mg/L), July (0.084 mg/L), October (0.098 mg/L), and November (0.089 mg/L), but never above the 0.16 mg/L daily assessment value. *Seasonally*, TIN values are elevated in April (0.207 mg/L) and December (0.146 mg/L), but never above the 0.48 mg/L daily assessment value. The TN/TP ratios for Muldoon Creek average at 4.84 indicating that the water body is a nitrogen-limited water body; during the period of record the water body was nitrogen limited for seven of the eight events.

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial use of Muldoon Creek. The maximum number of *E. coli* that occurred throughout the period of record was 416, a value that is below the 576 cfu/100ml instantaneous standard. As there were never any instantaneous exceedance, it was not necessary to calculate geometric mean values for the system. *Seasonally*, *E. coli* values are slightly elevated in June (65.5cfu/100ml), July (209.5 cfu/100ml), and August (147.0 cfu/100ml), however they are not elevated above the instantaneous water quality standards. The remainder of the months average 18 cfu/100ml. *A bacteria TMDL will not be completed.*

The existing uses within Muldoon Creek are CWAL and SS; as such maximum daily and average daily temperatures from 24-hour temperature data is analyzed based on critical time periods for these existing uses. The critical time periods for CWAL are June 22 through September 21. As brook trout and rainbow trout are both spawning in Muldoon Creek, the critical time periods for salmonid spawning is from October 1 through July 15. Temperature loggers were placed at various locations on Muldoon Creek for the 2001-2003 periods.

In respect to water quality standards, temperature appears to indicate that water quality is not capable of fully supporting CWAL and SS existing uses (Table 21 and Figure 20), although the biological data and water chemistry data discussed previously indicate otherwise. For the

period of record, the daily average temperatures for CWAL (5.1% exceedance) do not exceed the 10% exceedance policy, however, the daily maximum temperatures (34.5% exceedance) do exceed the exceedance policy. There were 88 days in the period of record where maximum temperatures were elevated above standards. Of these 88 days 40.9% of them had maximum temperatures elevated for less than 10% of the day (2.4 hours). The daily average temperatures (38.5% exceedance) and daily maximum temperatures (39.1% exceedance) for SS were both elevated above the 10% exceedance policy. A temperature logger was also placed in the headwater stretches of the creek. *Data for CWAL and SS indicate that there is no temperature exceedance in the headwater stretches of the creek. Upper stretches of the water body could act as a refuge for aquatic life, if temperatures downstream were indeed impacting aquatic life.*

Table 21. Muldoon Creek temperature elevations.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2001	Lower	92	92	17	18.5%	0	0%
2002	Lower	92	92	29	31.5%	4	4.3%
2003	Lower	92	71	42	59.2%	9	12.7%
2003	Upper	92	71	0	0%	0	0%
SS							
2001	Lower	288	72	69	72%	71	98.6%
2002	Lower	288	131	64	48.9%	60	45.8%
2003	Lower	288	284	62	21.8%	59	20.8%
2003	Upper	288	284	0	0%	0	0%

^a CWAL days missing in the 2003 data include September 1 through September 21.

^b SS days missing in the 2001 data include October 1 through May 4, days missing in the 2002 data include October 1 through March 6, days missing in the 2003 data include October 1 through October 4.

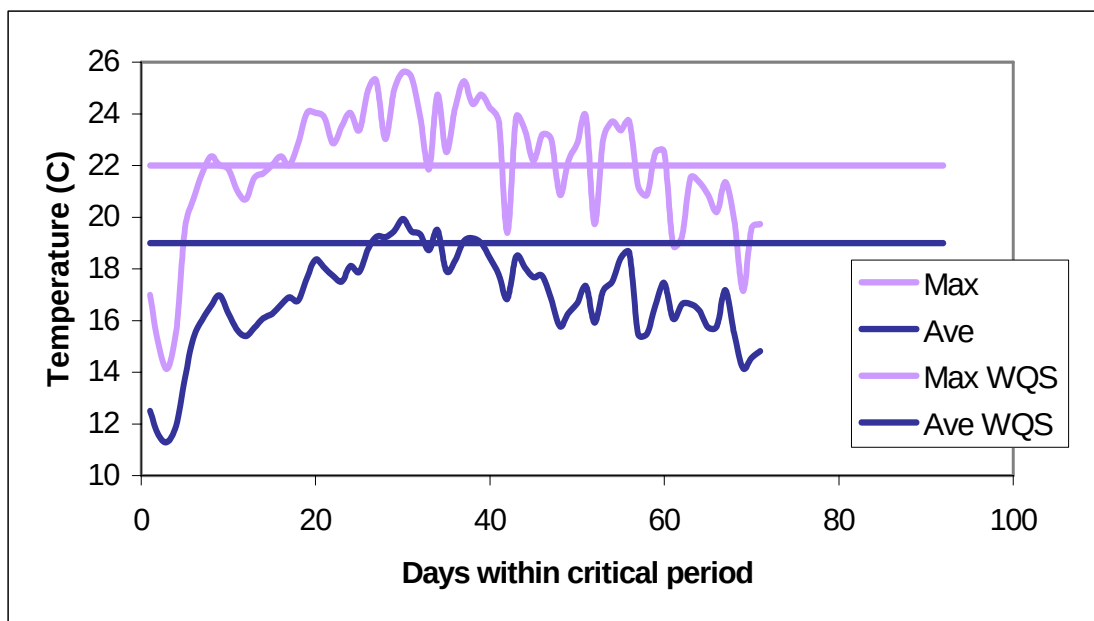


Figure 20. Muldoon Creek CWAL temperatures (2003).

Temperature elevations may be being influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- There are a number of large beaver dam complexes within the watershed that are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases creating a wetland type area and exposing the water to more solar radiation.
- Geologic formations are likely contributing to the temperature elevations as the creek runs through basalt lined box canyon areas. These geologic formations could be contributing to the solar radiation exposure due to the inability of the creek, in some areas, to develop some larger riparian plants as a result of restricted growth area. There are also a great deal of basalt rocks that line the box canyons the water body travels through; these rocks are likely conducting a certain amount of heat that contributes to the increased temperatures of the water body.
- Finally Muldoon Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 22). Muldoon Creek was divided into 19 segment lengths for aerial photo interpretations, the canopy cover ranged from 20% to 60% (Appendix F). The creek was divided into three representative segments to determine the canopy cover targets for each of the 19 segment lengths. Muldoon Creek is dominated by willows and alders therefore the co-dominant willow-alder community shade curve in the Alvord Lake TMDL on page 77

was the best matching shade curve for all three segments. Targets for canopy cover on the creek were as follows: upper portions (65%), middle portions (45%), and lower portions (37%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 22. Muldoon Creek canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Upper (headwater to Copper Creek)	14.4	Willow-alder	50-60	65
Middle (Copper Creek to South Fork of Muldoon Creek)	27.9	Willow-alder-aspen	20-50	45
Lower (South Fork of Muldoon Creek to mouth)	35.1	Willow-alder	30-50	37

^a Bankfull width was determined from BURP data or flow data measurements for each section.

^b Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).

^c The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process the following have been identified about Muldoon Creek:

- Biological data indicates that beneficial uses are fully supported.
- Flow is sufficient to support beneficial uses.
- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.
- Sediment (TSS and bedload sediment) is not impacting beneficial uses.
- Nutrients (TP and TIN) are not impacting beneficial uses.
- Bacteria (*E. coli*) are not impacting secondary contact recreation beneficial uses.
- Temperature is elevated, thus indicating that water quality is not sufficient to support beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for temperature on Muldoon Creek. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Loving Creek

Loving Creek is a second order perennial spring fed stream that lies in the northwestern part of the Little Wood River Subbasin. It is fed by many springs that originate to the east of the town of Gannet, and it drains into Silver Creek. Silver Creek is designated as a special resource water. Loving Creek is 3.7 miles long. The creek originates at an elevation of 4,888 feet and discharges at 4,855 feet. Loving Creek has a bankfull width estimated at 15.8 m, a sinuosity of 1.20, and a gradient of 0.16%. Since this water body is spring fed and has such a small drainage area (3,575.7 acres), it does not normally get a seasonal flushing flow.

Land use, ownership, and vegetation of Loving Creek will be described based on a 1-mile-stream corridor approach. Most of the land surrounding Loving Creek is privately owned (93.2%). There is a small section of state land (2.1%) that the creek flows through, otherwise some of the land at the edges of the stream corridor are managed by BLM (4.7%). The land use for this stream is irrigated-gravity flow (79.0%), irrigated-sprinkler (11.0%) and rangeland (10.0%). There are a variety of vegetation types that occur along the Loving Creek stream corridor. Agriculture vegetation accounts for 68.5% of the corridor. The next largest vegetation type is shrubland (12.3%), with wetlands following (7.6%). Grassland accounts for 5.3% of the area and riparian vegetation for 4.4%. Urban/developed, water, and barren/rock account for the remainder of the stream corridor (1.9%) (ArcView Coverage, 1992-1996).

Loving Creek stream corridor passes through three different geologic formations as well as five different soil types. The majority of the creek and corridor pass through outwash fan conglomerate flood and terrace gravels. A small portion of the creek and corridor passes through unweathered basalt flows and cinder cones. Located right at the mouth of the creek is thrust marine detritus. The soils along the Loving Creek corridor have the same degree of soil erosion potential (K factor). From headwater to mouth, the soil erosion potential for Loving Creek is 0.25 to 0.35 (ArcView Coverage, 1992-1996).

Biological and Other Data

This section of the document will discuss the fisheries management by IDFG, biological data and information collected through the BURP protocol, and fishery data of the creek.

IDFG manages the fisheries of Loving Creek using two different management styles. The entire stretch of the water body has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The Hayspur Hatchery grounds of Loving Creek are managed as a trophy system while the remainder of the creek is managed as a wild trout system (IDFG 2001).

Biological data is used by the state of Idaho in determining if beneficial uses of wadeable perennial streams are fully supported. The WBAG document is used as a tool to assess the biological data and thus the beneficial use support status of the creek. This data includes macroinvertebrate data, fishery data, and habitat data. Two of these data groups must be

available before the beneficial uses of a water body can be evaluated through the WBAG process.

Biological data is used to indicate support status of beneficial uses, however the WBAG also identifies an exceedance policy for DO, pH, turbidity, and temperature in determining if water quality is capable of supporting beneficial uses. As these constituents are numerical criteria in the water quality standards, any elevation above the 10% exceedance policy indicates water quality is not capable of supporting beneficial uses and thus can supersede conclusions supported by biological data. These water chemistry data constituents will be discussed later in the document under the subsection Water Column Data.

No biological and very little habitat data has been collected on Loving Creek, although at first glance it would appear otherwise. Biological and habitat data has been collected through the BURP protocol once in 1996. The 1996 site was reported as being located on Loving Creek near the Hayspur Hatchery grounds in the middle reach of the creek, but was later identified as being located on Butte Creek. *Butte Creek is a first order tributary of Loving Creek and as such does not fit the protocol for assessment under the WBAG process. Loving Creek as a spring fed system also does not fit the protocol for assessment under the WBAG process. Biological data can not be used to assess the support status of these streams until a process is developed to assess spring fed systems.*

Fish data has never been collected on the water body, however, IDFG have performed redd counts on Loving Creek (IDFG, 2003). Redds have been observed during the rainbow trout and brown trout spawning periods (Davidson, 2003).

Hydrology

Loving Creek has high hills to the north of it that potentially could provide some spring runoff to the water body. However, due to the geology and prairie nature of the valley, this does not occur. The hills are south facing slopes that could provide early and rapid spring runoff during the early spring, however ephemeral channels that are providing a drainage system for the hills appear to dissipate at elevations around 5,000 to 4,940 feet. Consequently springs begin to appear and contribute to creek flows at slightly lower elevations than those previously mentioned. The ephemeral channels draining the hillside appear to be feeding the ground water system that provides year round flow for Loving Creek.

There are approximately eight springs within the short four mile stretch of Loving Creek. Seven of these springs contribute to flows in the headwater stretches. There are two larger ditches that deliver the water of Loving Creek to water users in the area. Marshy areas are located just east of Loving Creek.

There is not a gauging station located on Loving Creek, currently or historically, so flow data collected in 2001-2003 was used to predict an average stream flow. The site for stream flow measurements occurred approximately a quarter mile upstream of the confluence. A linear regression analysis was performed on Silver Creek flow from the gauging station (13150430 – Silver Creek at sportsmen access near Picabo, ID) and Loving Creek flow data. The

statistical values of the regression analysis ($p=0.900$, $r^2=0.002$) indicate that this model can not be used to determine a predicted average flow for Loving Creek. As a result, actual flow data collected during the 2001-2003 period was used to develop the hydrograph (Figure 21).

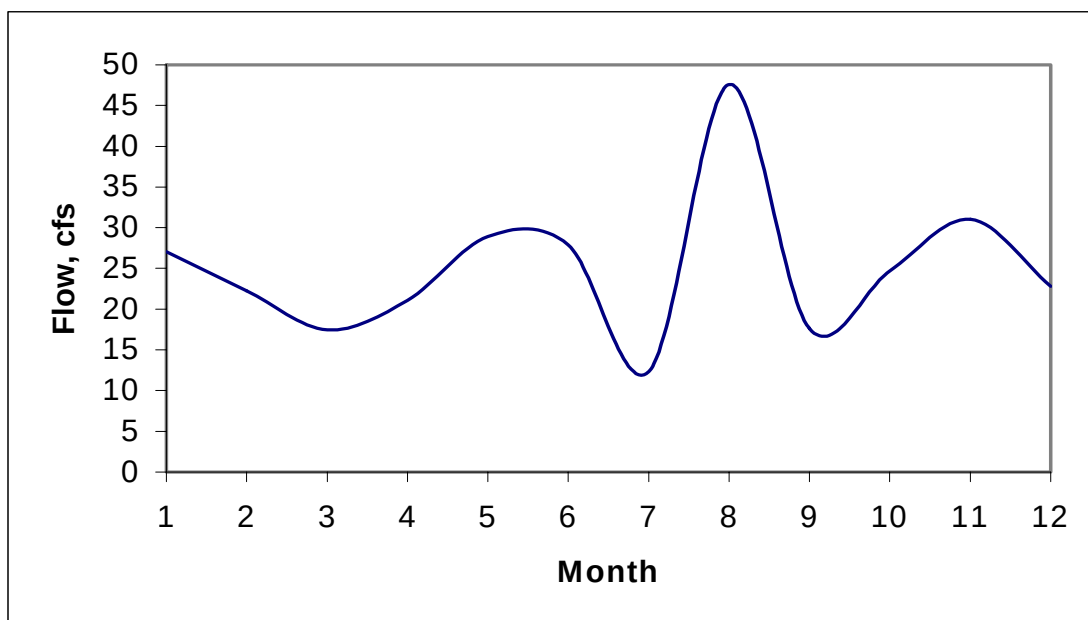


Figure 21. Loving Creek actual hydrograph (2001-2003).

Flow on Loving Creek appears to support beneficial uses of the water body, especially as the creek never went dry during the 2001-2003 drought years. Predicted flows for Loving Creek appear to remain fairly stable throughout the year, with a slight peak in August. The average flow of Loving Creek is 25 cfs. Peak flow occurs in August at 47 cfs with minimum flows occurring in March and September at 17 cfs. The hydrograph of a spring fed creek differs from that of other water bodies where runoff events contribute to peak flows, and thus flushing events.

There are many water rights for the Loving Creek drainage area. Diversions from Loving Creek itself account for 59 cfs of water while diversions from its tributaries account for 177 cfs. This water is used for various purposes: irrigation, stockwater, domestic water supply, recreation storage, aesthetics, fish propagation, aesthetic storage, and wildlife (IDWR 2002). Water rights on the creek are in excess of the average flow conditions of the water body, *but as there was water in the water body throughout the year in severe drought years, it would seem as though flow alteration is not likely to impact beneficial uses.*

Water Column Data

Water chemistry data for Loving Creek is very limited. There were three points of sampling performed by the USGS in 1975, 1977, and 1984 for flow, temperature, and specific conductivity. Loving Creek was sampled seven times by DEQ in 1975 for temperature, DO, SC, pH, turbidity, and TSS. Monthly monitoring for water chemistry data was completed

throughout the 2001-2003 period. Temperature loggers were also distributed throughout the creek.

Table 23 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 23. Loving Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number elevated	Instantaneous Criteria	Average Criteria
Indicators							
SC	21	427.0	384.6	331.0	0	< 500	---
pH	21	8.83	---	8.23	0	$6.5 < x < 9.0$	---
TNH3	7	0.380	0.111	0.005	1	Variable	---
Turb	21	126.7	13.6	0.0	2	BG + 50	---
DO	21	14.94	11.57	6.61	0	> 6	---
BOD	5	9.0	5.3	1.5	0	< 10	---
Chl a	8	34.0	7.1	0.0	1	< 15	---
Pollutants							
TSS	11	18.0	3.9	0.5	0	< 80	< 50
TP	11	0.058	0.027	<0.005	0	< 0.16	< 0.10
TIN	5	1.800	1.264	0.606	5	< 0.48	< 0.3
<i>E. coli</i>	14	96.0	18.7	1.0	0	< 406	< 126

^aSC – Specific Conductivity (uhmos/cm), pH – Hydrogen Ion Concentration (standard units), TNH3 – Total Ammonia (mg/L), Turb – Turbidity (NTUs), DO – Dissolved oxygen (mg/L), BOD – Biological oxygen demand (mg/L), Chl a – chlorophyll a (ug/L), TSS – Total Suspended Solids (mg/L), TP – Total Phosphorous (mg/L), TIN – Total Inorganic Nitrogen (mg/L), *E. coli* – Escherichia coli (Colony forming units/100ml).

^cAverage criteria for *E. coli* is a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. Most indicators meet their criteria, except TNH3, turbidity, and chlorophyll. Chlorophyll was elevated one time during the period of record; as a result an additional measurement was taken to verify the elevation. The value of the additional measurement was 3.8. Ammonia was elevated once during the period of record. One elevation of NH3 is allowed in a three year period. Ammonia and chlorophyll are not indicating impairment by a pollutant. Historical data also falls within assessment criteria.

The following constituents are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO; if these constituents are not elevated beyond standards more than 10% of the time than water quality appears to be capable of fully support beneficial uses. Turbidity is elevated above water quality standards twice. These elevations in turbidity account for 9.5% of the measurements within the period of record. This

percentage is below the 10% exceedance policy. The DO and pH parameters were never elevated during the period of record. In the case of Loving Creek, neither pH, turbidity, nor DO is elevated more than 10% of the time. *Water quality (DO, pH, and turbidity) appears to be capable of supporting beneficial uses of Loving Creek.*

The water column data (TSS) indicates that sediment is not impacting beneficial uses, however bedload sediment data (percent fines) indicates that sediment is impacting beneficial uses of Loving Creek. The TSS average values (3.9 mg/L) averaged well below the average assessment criteria of 50 mg/L. The percent fines data was elevated above the assessment criteria (35%). There is one collection event in the water body and the value for percent fines was 66.4%. *Bedload sediment appears to be impacting beneficial uses, however it may be a natural process.*

The critical period for sediment transport is typically during the spring and early summer, when flow is elevated due to runoff events. *Seasonally* TSS values are elevated in March (5.5 mg/L), May (9.8 mg/L), and December (13 mg/L) during lower flow periods for this creek, but never above daily maximum values of 80 mg/L and are consistently very low (1.4 mg/L) during higher flow periods (June, July, and August). *Historically*, one data collection event in 1975 shows that TSS values were slightly elevated (20.7 mg/L) in October. This event still remained well below daily maximum assessment criteria.

Stream bank erosion inventories were completed to identify the source of the sediment and they indicate that the stream banks are not contributing an excessive load of sediment to the water body. Bank stability of upper, middle, and lower portions of the water body were calculated at 85.3%, 93.4%, and 83.5%. The target for stream bank stability is 80%, these values are meeting the target, and therefore the elevated bedload is not currently being delivered from the stream banks.

Bedload sediment is elevated in the system; however it is likely due to historical land management practices as well as the hydrology of the system. Currently there is very little sediment being transported in the water column and very little erosion occurring from the banks. *The bedload sediments are likely to remain until a large flushing event moves them out of the system, and as this is a spring fed system, flushing events are rare. A sediment TMDL will not be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the beneficial uses of Loving Creek. Chlorophyll data is limited; however, chlorophyll data was elevated once, but a verification of the measurement reported chlorophyll as below criteria. There are a lot of aquatic plants within Loving Creek, but at this time they do not appear to be excessive or a nuisance. The TP average values (0.027 mg/L) are well below the average assessment criteria of 0.100 mg/L. The TIN average values (1.264 mg/L) are elevated above the assessment criteria of 0.300 mg/L. The elevated TIN values at first appear to be a concern, however, in relation to nuisance aquatic vegetation, TIN and TP values together are truly the important values. If both TP and TIN values were elevated then there would likely be a nuisance aquatic plant problem, however TP levels near background levels are limiting the ability of nuisance aquatic plants to grow in the system. *Currently*

pollutants are not a concern as low TP levels are limiting the growth of aquatic plants, however an influx of TP in the future could lead to excessive and nuisance aquatic growth. A nutrient TMDL will not be completed.

The critical period for nuisance aquatic vegetation is typically during the late spring into the early fall months, when primary production is elevated. *Seasonally* TP values are slightly elevated in March (0.032 mg/L), October (0.033 mg/L), November (0.033 mg/L), and December (0.045 mg/L), but never above the 0.16 mg/L daily assessment value. These values correspond with lower flow periods. *Seasonally* TIN values are elevated in April (1.616 mg/L) and October (1.479 mg/L). Elevated TIN values correspond with lower flow periods. The TN/TP ratios for Loving Creek average 52.6, indicating that the water body is a phosphorous limited water body; during the period of record the water body was phosphorous limited for all events.

Well data in this drainage area indicate that TIN values are elevated in the ground water in relation to the assessment criteria. There have been four collection events from two sites in differing years. The values for site one were 0.445 mg/L in 1992 and 0.76 mg/L in 1996. The values for site two were 0.390 mg/L in 1994 and 0.441 mg/L in 1998. Loving Creek is fed by springs (ground water), which appear to be elevated in TIN before they reach the surface water. Once the ground water is contributed to the creek flow it is already elevated above the average assessment criteria.

Bacteria (*E. coli*) are not impacting the primary contact recreation beneficial use of Loving Creek. The maximum number of *E. coli* that occurred throughout the period of record was 96, a value that is well below the 406 cfu/100ml instantaneous standard. As there were never any instantaneous violations, it was not necessary to calculate geometric mean values for the system. *Seasonally* *E. coli* values are slightly elevated in July (96 cfu/100ml) and September (30 cfu/100ml), but never above instantaneous water quality standards. The remainder of the months average 9 cfu/100ml. *A bacteria TMDL will not be completed.*

The existing uses of Loving Creek are CWAL and SS; as such maximum daily and average daily temperatures from 24-hour temperature data is analyzed based on critical time periods for these existing uses. The critical time periods for CWAL are June 22 through September 21. As brown trout and rainbow trout are both spawning in Loving Creek, the critical time periods for salmonid spawning is from October 1 through July 15. Temperature loggers were placed at various locations on Loving Creek for the 2001-2003 period—drought years for the subbasin.

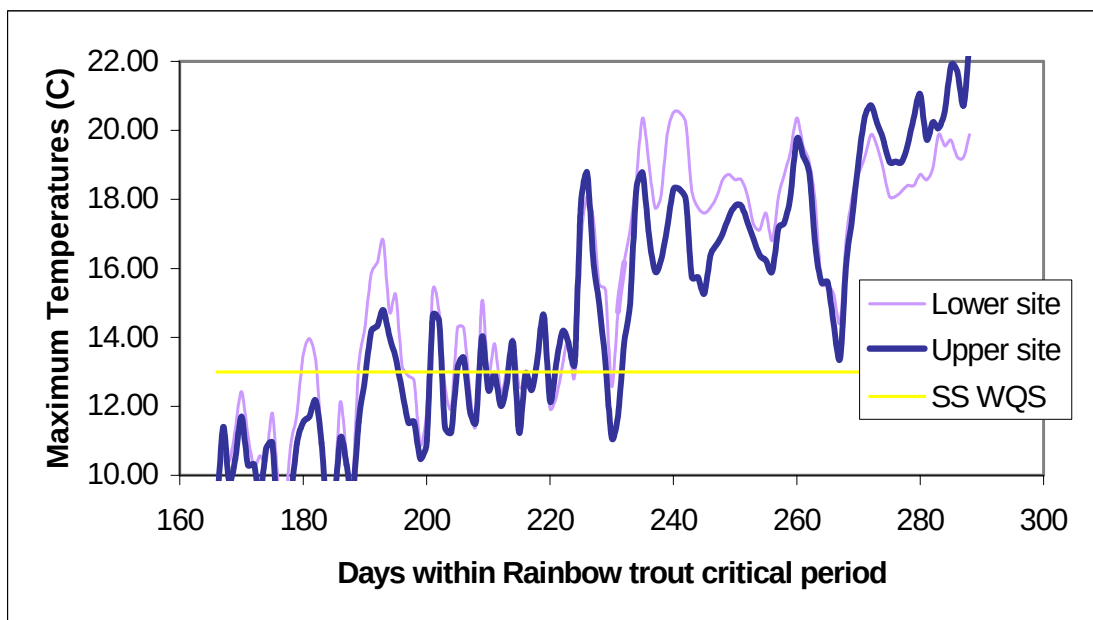
In respect to water quality standards, temperature appears to not be impacting CWAL existing uses, temperature during SS critical time periods is elevated, however it is elevated throughout the entire stretch of the creek (Table 24 and Figure 22). The daily average temperatures for CWAL (1.1% exceedance) do not exceed the 10% exceedance policy nor does the daily maximum temperatures (0.0% exceedance). The daily average temperatures (44.0% exceedance) and daily maximum temperatures (34.4% exceedance) for SS were both elevated above the 10% exceedance policy.

Table 24. Loving Creek elevated temperatures.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2003	Lower	92	92	0	0%	1	1.1%
2003	Upper	92	92	2	2.2%	0	0%
SS							
2003	Lower	288	250	86	34.4%	110	44.0%
2003	Upper	288	251	79	31.5%	105	41.8%

^a SS days missing in the 2003 data include October 1 through November 7.

There is very little difference in water column temperatures throughout the length of this water body (Figure 22). Temperature loggers were placed at the headwaters of the creek and near the mouth of the creek. During the fall the average temperature difference between the two sites was 0.94 degrees C. During the winter, the average temperature difference between the sites was 0.10 degrees C. During the spring months, the average temperature difference between the two sites was 0.64 degrees C. Finally, the greatest difference occurred in the summer months with an average temperature difference of 1.06 degrees C. The drainage area and length of Loving Creek are very small in relation to that of other water bodies in the Little Wood River Subbasin, whereas bankfull width of the creek is wider in most cases. These factors, along with the spring-fed nature of Loving Creek, do not lend themselves to allow for a great deal of temperature fluctuation along the length of the water body.

**Figure 22. Loving Creek SS temperatures.**

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 25). Loving Creek was divided into 12 segment lengths for aerial photo interpretations, the canopy cover ranged from 0% to 40% (Appendix F). The creek was divided into four representative segments to determine the canopy cover targets for each of the 12 segment lengths. Loving Creek is dominated by willows and alders in some areas, but mainly it is dominated by willows and grasses, therefore willow-mix community, willow community, and the co-dominant willow-alder community shade curve in the Alvord Lake TMDL on page 75 and 77 was the best matching shade curves for all of the segments. Targets for canopy cover on the creek were as follows: upper portions (20%), middle portions (45%), upper lower portions (10%) and lower portions (28%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 25. Loving Creek canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Upper (headwaters to Stanfield ditch)	30	Grasses, willows	0	20
Middle (Stanfield ditch to highway)	20	Willow, grasses, cattails	10-40	45
Upper Lower (highway to ditch)	65	Grasses, willows	0	10
Lower (ditch to mouth)	48	Willows, alders, grasses	10-40	28

^a Bankfull width was determined from BURP data or flow data measurements for each section.

^b Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).

^c The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process the following have been identified for Loving Creek:

- Biological data can not be used to determine support status of the beneficial uses on Loving Creek due to its spring fed nature.
- Flow is sufficient to support beneficial uses.
- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.

- Sediment (TSS and bedload sediment) is not impacting beneficial uses. Elevated bedload sediment will not be moved out of the system unless a flushing flow occurs within the watershed.
- Nutrients (TP and TIN) are not impacting beneficial uses. Low levels of TP are limiting nuisance plant growth, therefore an influx of TP in the future would likely lead to nuisance aquatic growth.
- Bacteria (*E. coli*) are not impacting primary contact recreation beneficial uses.
- Temperature is elevated, thus indicating that water quality is not sufficient to support beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for temperature on Loving Creek. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Dry Creek

Dry Creek is a third order intermittent stream that lies in the northwestern part of the Little Wood River Subbasin. Its headwaters begin north of the Jasper Flats and southwest of the Little Wood River Reservoir, and it flows southeasterly where it joins with the West Canal of the Little Wood River Irrigation District. Dry Creek is 9.9 miles long and originates at an elevation of 6,233 feet and discharges at 4,724 feet. Dry Creek has a bankfull width average of 2.99, a sinuosity of 1.06, and a gradient of 2.88%.

Land use, ownership, and vegetation of Dry Creek will be described based on a 1mile-stream corridor approach. Dry Creek originates on BLM land (10.5%) with small sections of state land (7.7%) dispersed throughout the headwaters. Once off of the BLM land it travels through private land (81.9%). Rangeland accounts for 73.2% of the stream corridor land use and occurs in the upper portion of the drainage. In the southern portion, irrigated-gravity flow (23.2%) and irrigated-sprinkler (3.6%) makes up the remainder of the stream corridor. The vegetation coverage along Dry Creek is predominately shrubland at 74.3%. As you move downstream, agriculture vegetation makes up 21.7% of the area and grassland 3.0% of the area. Urban/developed and riparian vegetation together make up 1% of the stream corridor (ArcView Coverage, 1992-1996).

Dry Creeks stream corridor passes through four different geologic formations as well as three soil types. The headwaters of this creek originates in the thrustbed marine detritus, and then travels down through the foothills in the mixed silicic and basaltic volcanic ejecta flows. As the land around the creek flattens out there is a transition to alluvium. The entire stretch of Dry Creek lies within soils that have soil erosion potential K factors of 0.25 to 0.35 (ArcView Coverage, 1992-1996).

Biological and Other Data

This section of the document will discuss the fisheries management by IDFG, biological data and information collected through the BURP protocol, and fishery data of the creek.

IDFG manages fisheries of Dry Creek in a general characterization that is attributed to many of the water bodies in the subbasin. Dry Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

Biological data is used by the state of Idaho in determining if beneficial uses of wadeable perennial streams are fully supported. The WBAG document is used as a tool to assess the biological data and thus the beneficial use support status of the creek. This data includes macroinvertebrate data, fishery data, and habitat data. Two of these data groups must be available before the beneficial uses of a water body can be evaluated through the WBAG process.

Biological data is used to indicate support status of beneficial uses, however the WBAG also identifies an exceedance policy for DO, pH, turbidity, and temperature in determining if water quality is capable of fully supporting beneficial uses. As these constituents are numerical criteria in the water quality standards, any elevation above the 10% exceedance policy indicates water quality is not capable of fully supporting beneficial uses. These water chemistry data constituents will be discussed later in the document under the subsection Water Column Data.

Very little biological or habitat data has been collected on Dry Creek. Data was collected through the BURP protocol in 1995 at two locations: a lower and upper site. The lower site was located near the confluence, while the upper site was on BLM ground near the headwaters. Habitat and macroinvertebrate data were collected at these sites. However fish data has never been collected on Dry Creek. The BLM has also collected habitat data in 2000 on the portion of the creek that is managed by their agency.

Dry Creek has had biological data collected on it, however has never been bioassessed. The WBAG process is to be used on perennial water bodies; the entire length of Dry Creek is intermittent and as such should not be bioassessed through this process. *Therefore, water chemistry data rather than biological data were used to determine if water quality of Dry Creek is impaired.*

The BURP files on Dry Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel types and activities affecting the reach for each reach are reported in Table 26 (DEQ 1993-2001).

Table 26. Characteristics of Dry Creek.

Reach	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Upper	10	A	RDS
Lower	0.8	C	AG, DIV

^a Data from BURP files.

^b RDS – Roads, AG – Agriculture, DIV – Diversions.

The BLM riparian survey appears to indicate that Dry Creek is functional-at risk with no apparent trend. Bank stability and riparian vegetation both rated as fair.

The fisheries of Dry Creek are unknown at this date, as the stream has never been electrofished. According to stocking records, IDFG has not stocked this water body; however there could be unrecorded stockings that have occurred historically. BLM personnel have indicated, in a personal interview, that fish and, more specifically, trout have been observed in the upper portions of the water body (BLM 2002). Hydrology of this water body could be greatly impacting fisheries if they do indeed exist in this water body.

Hydrology

From headwaters to mouth, Dry Creek is an intermittent creek that is fed naturally by eleven intermittent creeks. The tributaries of Dry Creek drain the foothills that are within the Dry Creek watershed. The water from spring runoff is stored in a storage pond that encompasses the creek channel and lies in the lower half of the creek. Water occurring within the channel downstream of this pond is a result of irrigation demands or of flood control. There lies another storage pond within the creek channel, this pond stores water that is delivered during the irrigation season for irrigation demand. Finally Dry Creek feeds the West Canal of the Little Wood River Irrigation District.

There is not a gauging station located on Dry Creek, currently or historically, therefore flow data collected from 2001-2003 will be used to predict an average stream flow. The site for stream flow measurements occurred at the Highway 20 road crossing, approximately one mile upstream of the confluence with the West Canal and in the upper section on BLM land. The lower segment of Dry Creek flow is affected more by agricultural irrigation returns than precipitation events or springs, the upper site is more typical of a water body influenced by precipitation events and base flows. Due to the different natures of the types of flow, two hydrographs were developed to represent flows of both areas.

The Little Wood River gauging station (13147900 - Little Wood River above High Five Creek near Carey and 13148500 - Little Wood River near Carey ID) are functioning stations that were used in predicting Dry Creek flow. The Little Wood River and Dry Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Little Wood River and Dry Creek watersheds was similar, as well as being similar throughout the period of record. Based on this assumption, a linear regression model of Little Wood River flow versus Dry Creek flow was performed using data collected on the same day. The statistical values of the

regression analysis for the upper site ($p=0.992$, $r^2=0.000$) and the lower site ($p=0.038$, $r^2=0.364$) indicate that this model can not be used to determine a predicted annual flow for either of the Dry Creek sites. Actual flow of the creek during the 2001-2003 period are depicted in the following figure (Figure 23).

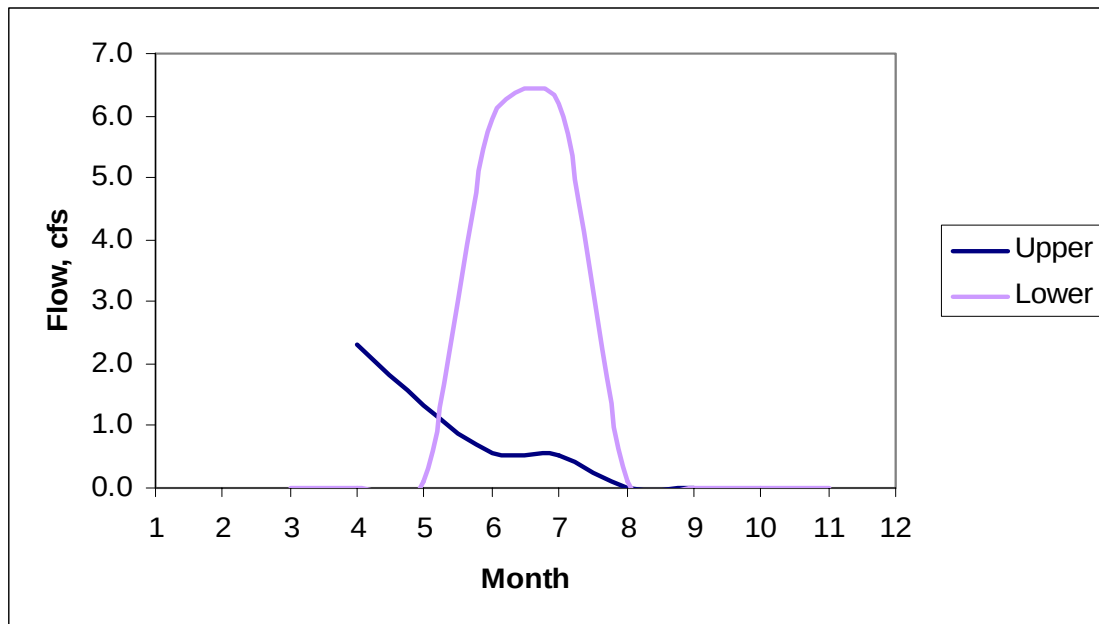


Figure 23. Dry Creek actual hydrograph (2001-2003).

Lack of flow due to both natural events as well as man-made manipulations, are impacting the beneficial uses of the creek. The predicted hydrograph indicates that flows on the upper portion of the water body occur from March to August, then the water body becomes dry. Data collected by BLM support the intermittent status of the upper portion of Dry Creek. Maximum flow is in April at 2.3 cfs. Flows may be higher in March however; site inaccessibility has prevented flow measurements within this month.

Flow measurements on intermittent streams become critical when assessing water quality criteria. For secondary contact recreation beneficial uses, 5 cfs is the critical flow value and 1 cfs is a critical flow value when assessing CWAL beneficial uses. The actual hydrograph indicates that flows in the creek are less than 5 cfs during all months and are less than 1 cfs from June until spring runoff. The actual hydrograph also indicates that flows on the lower portion occur from May to August during irrigation months. The flows during the 2001-2003 period did not appear to get above base flow heights in the creek channel.

A decree from 1909 states that the Dry Creek water users can choose to use the water that they have a right to, to the point that Dry Creek would get dewatered, irrespective of the water rights or uses that occur downstream (Macmillan 1909). Based on conversations with the local canal company, water occurs in Dry Creek during spring runoff from April to May and there is very little water occurring in the water body downstream of BLM land due to diversions. The lower section of Dry Creek is used as a water transport channel for irrigation

demands to downstream water users. The natural waters of Dry Creek are used for irrigation purposes in the middle portion of the water body and the lower portion of the water body receives its waters from the Little Wood River (Simpson 2001).

There are many water rights for the Dry Creek drainage area. Diversions from Dry Creek itself account for 27.3 cfs of water while diversions from its tributaries account for 2.57 cfs. This water is used for various purposes: irrigation, stockwater, domestic water supply, and wildlife (IDWR 2002).

Water Column Data

Water chemistry data for Dry Creek is very limited. Data collected by DEQ was the only available data for this water body. Monthly monitoring for water chemistry data was completed throughout the 2001-2003 period. Table 27 describes the number of samples, maximums, mean, minimums, and number of values elevated above the assessment criteria. *For a description of how the assessment criteria were developed and analyzed see Analysis Process, page 45.*

Table 27. Dry Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number Elevated	Instantaneous Criteria	Average Criteria
Indicators							
SC	6	218.0	164.3	125.1	0	< 500	---
pH	6	8.52	---	7.75	0	$6.5 < x < 9.0$	---
TNH3	3	0.017	0.011	0.005	0	Variable	---
Turb	6	14.2	7.4	0	0	BG + 50	---
DO	6	12.00	9.57	8.22	0	> 6	---
BOD	1	6.0	---	---	0	< 10	---
Chl a	3	4.5	2.1	0	0	< 15	---
Temp	6	17.2	12.38	4.17	0	< 22	---
Pollutants							
TSS	4	4.0	3.6	3.0	0	< 80	< 50
TP	4	0.057	0.041	0.023	0	< 0.16	< 0.10
TIN	3	0.020	0.015	0.010	0	< 0.48	< 0.3
<i>E. coli</i>	2	41.0	27.5	14.0	0	< 576	< 126

^aSC – Specific Conductivity (uhmos/cm), pH – Hydrogen Ion Concentration (standard units), TNH3 – Total Ammonia (mg/L), Turb – Turbidity (NTUs), DO – Dissolved oxygen (mg/L), BOD – Biological oxygen demand (mg/L), Chl a – chlorophyll a (ug/L), TSS – Total Suspended Solids (mg/L), TP – Total Phosphorous (mg/L), TIN – Total Inorganic Nitrogen (mg/L), *E. coli* – Escherichia coli (Colony forming units/100ml).

^cAverage criteria for *E. coli* is a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria with no elevations above the criteria or any policy exceedances.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, temperature, and DO. The 10% exceedance policy is applied to pH, turbidity, temperature, and DO; if these parameters are not elevated beyond standards more than 10% of the time than water quality appears to be capable of fully supporting beneficial uses. In the case of Dry Creek, neither pH, turbidity, temperature nor DO was elevated during the period of record. *Water quality (DO, pH, and turbidity) appears to be capable of supporting beneficial uses of Dry Creek.*

The water column data (TSS) indicates that sediment is not impacting water quality, however bedload sediment data (percent fine) indicates that sediment is likely impacting the water quality of Dry Creek. The TSS average values (3.6 mg/L) averaged well below the average assessment criteria of 50 mg/L. The percent fines data was elevated above the assessment criteria (35%). There were four collection events in the water body and the values for percent fines ranged from 11.9% to 100.0%.

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events. Due to the hydrology of the creek and lack of data it is not possible to determine seasonal fluctuations in this system.

Stream bank inventories were completed on Dry Creek to identify the source of the bedload sediment and they indicate that the stream banks are contributing a larger load of sediment into the creek. Bank stability of upper, middle, and lower portions of the water body were calculated at 52.3%, 60.0%, and 55.8%. The target for stream bank stability is 80%; these targets are not being met. *Sediment erosion from banks is impacting water quality, a sediment TMDL will be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the water quality of Dry Creek. Chlorophyll data is limited; however, values remain below 15 ug/L indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.041 mg/L) averaged well below the average assessment criteria of 0.100 mg/L. The TIN average values (0.015 mg/L) averaged well below the average assessment criteria of 0.300 mg/L. Since there is such a short period of time when water is present in the water body, it is unlikely that nuisance aquatic vegetation has the opportunity to develop or impact water quality. *Nutrients are not a concern at this time in this water body, a nutrient TMDL will not be completed.*

The critical period for nuisance aquatic vegetation is typically during the late spring into the early fall months when primary production is elevated. Due to the hydrology of the creek and lack of data it is not possible to determine seasonal fluctuations in this system. The TN/TP ratios for Dry Creek average at 4.7 indicating that the water body is a nitrogen-limited water body; during the period of record the water body was nitrogen limited for all events.

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial use of Dry Creek. The maximum number of *E. coli* that occurred throughout the period of record was 41, a value that is well below the 576 cfu/100ml instantaneous standard. As there were never

any instantaneous violations, it was not necessary to calculate geometric mean values for the system. Due to the hydrology of the creek and lack of data it is not possible to determine seasonal fluctuations in this system. *Bacteria are not a concern at this time in this water body, a bacteria TMDL will not be completed.*

Conclusions

Through the subbasin assessment process the following have been identified for Dry Creek:

- Dry Creek is an intermittent stream naturally; however flow alteration in the lower half of the creek also greatly alters the hydrology of the water body.
- Biological data at this time is not an accurate way to assess the support status of the water body.
- Water chemistry data (turbidity, DO, pH, and temperature) indicate that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment from stream bank erosion) is impacting the water quality of the creek.
- Nutrients (TP and TIN) are not impacting water quality of the creek.
- Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial uses of the creek.

As a result of the subbasin assessment, a TMDL will be completed for sediment on Dry Creek and the creek will remain listed as impacted by flow alteration. In addition, DO, bacteria, and nutrients will be delisted as pollutants impacting the water quality of Dry Creek.

Fish Creek

Fish Creek is a fourth order perennial stream that lies in the northeastern part of the Little Wood River Subbasin. Its headwaters begin in the Challis National Forest just southeast of the Pioneer Mountains, and it flows southwesterly into Carey Lake. Fish Creek is 23.0 miles long and about 13 miles downstream of the headwaters lies Fish Creek Reservoir. It originates at an elevation of 7,365 feet and discharges at 4,724 feet.

Fish Creek can be divided into two segments: above the reservoir (#1) and below the reservoir (#2). Fish Creek (above the reservoir) has a bankfull width/depth ratio that averages 11.5, a sinuosity of 1.05, and a gradient of 3.22%. Fish Creek (below the reservoir) has a bankfull width/depth ratio that averages at 16.9%, a sinuosity of 1.42, and a gradient of 0.91%.

Land use, ownership, and vegetation of Fish Creek will be described based on a one-mile stream corridor approach. Fish Creek originates on USFS land (7.9%) and then flows through private land (64.9%), with patches of BLM (19.5%) and state land (6.0%) occurring within the stream corridor until it flows into the reservoir. As the creek leaves the reservoir,

it flows through a small canyon for about 2.5 miles that includes private and BLM land. Private land below the reservoir accounts for 66.2% of the stream corridor area while BLM land is 30.4%. The land use for the entire stretch of Fish Creek is 19.3% irrigated-gravity flow, 13.2% irrigated sprinkler, 64.5% rangeland and 3.0% rock. The vegetation along Fish Creek's stream corridor changes as you move down the creek channel. Fish Creek begins in forested vegetation (5.1%) and flows down through agriculture vegetation (22.6%) that is encompassed by shrubland (64%). Grassland, riparian vegetation, wetlands, barren rock, and water make up the remaining 8.3% of the stream corridor (ArcView Coverage, 1992-1996).

Fish Creek stream corridor passes through seven different geologic formations as well as six different soil types. This creek originates in the mixed silicic and basaltic volcanic ejecta flows and travels through thrust shallow to deep marine detrital units until it gets to the reservoir. The geology surrounding the reservoir is thrust deepwater siliceous argillite and quartzite. Below the reservoir the creek travels in and out of lava flows and alluvium. There are small portions of recent relatively unweathered basalt flows and cinder cones and thrust marine detritus that border the stream channel in the segment below the reservoir (ArcView Coverage, 1992-1996).

There are three soil K factors that exist in the Fish Creek drainage area. The majority of Fish Creek lies in soil with K factors of 0.25-0.35. K factors increase as you approach the reservoir to 0.35-0.45. The soils below the reservoir vary between these two K factor ranges. Lava plains to the south of Fish Creek have soil K factors of 0-0.08 (ArcView Coverage, 1992-1996). The NRCS has completed a more thorough study of the geology surrounding Fish Creek Reservoir (Appendix D).

Fish Creek (Above the Reservoir)

Fish Creek land ownership, land use, vegetation, geology, and soils were described in the previous section.

Biological and Other Data

IDFG manages fisheries of Fish Creek in a general characterization that is attributed to many of the water bodies in the subbasin. Fish Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

Biological data is used by the state of Idaho in determining if beneficial uses of wadeable perennial streams are fully supported. The WBAG document is used as a tool to assess the biological data and thus the beneficial use support status of the creek. This data includes macroinvertebrate data, fishery data, and habitat data. Two of these data groups must be available before the beneficial uses of a water body can be evaluated through the WBAG process.

Biological data is used to indicate support status of beneficial uses, however the WBAG also identifies an exceedance policy for DO, pH, turbidity, and temperature in determining if water quality is capable of fully supporting beneficial uses. As these constituents are numerical criteria in the water quality standards, any elevation above the 10% exceedance policy indicates water quality is not capable of fully supporting beneficial uses. These water chemistry data constituents will be discussed later in the document under the subsection Water Column Data.

Very little biological or habitat data has been collected on Fish Creek. Data was collected through the BURP protocol, once in 1993 and twice in 2001. All three sites are located in the upper half of this segment. There has been no biological or habitat data collected on the lower half of this segment at this time. Macroinvertebrate and habitat data have been collected at all of the sites, fish data has been collected at the 2001 sites.

The BURP files on Fish Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel types and activities affecting the reach for each reach are reported in Table 28. Additional information provided in the BURP files indicate that the upper reaches show evidence of cattle impact and vegetation includes alder, cottonwood, thistle, water hemlock, clove grasses, sedges, golden rod, wild rose bushes, willows, sagebrush and aspen. Information from the middle site indicates that wildlife and cattle are in the area, there is a nice riparian zone that includes grasses, young aspens, alders, willows, rose bushes, rushes and sedge (DEQ 1993-2001).

Table 28. Characteristics of Fish Creek (above the reservoir).

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Upper	3	3	G	RDS, GR
Middle	2	2	D	RDS, GR, BC

^a Data from BURP files.

^b RDS – Roads, GR – Grazing, BC – Beaver Complexes.

Fish Creek was bioassessed through the WBAG process in 1998 and found to be not fully supporting beneficial uses, however preliminary bioassessment of the 2001 sites indicates beneficial uses are fully supported. SMI and SHI condition ratings for the older site were minimum threshold and 1. The minimum threshold value for macroinvertebrates automatically indicates impairment of the water body. *However, SFI, SMI, and SHI scores for the 2001 sites were 3, all around.* (A scoring condition of 2 or greater indicates that beneficial uses are fully supported.) As biological data has only been collected on the upper half of this segment, water chemistry data will also be used to determine the support status of the entire stretch of Fish Creek.

Macroinvertebrate data indicates that macroinvertebrate data in the headwater stretches is better than that data collected downstream. The SMI values for upper segments rated very

good (76-100), while the middle segment rated good (51-75). The pollution tolerance values for upper segments rated good (4.51-5.50) while the middle segment rated fair (5.51-6.50).

Rainbow trout, brook trout, and sculpin have been found to occur in Fish Creek (Table 29). According to stocking records, IDFG has not stocked this water body; however, there could be unrecorded stockings that have occurred historically. As a whole, 100% of all the fish collected on Fish Creek were cold water indicators, 53.3% of the rainbow trout and 84.0% of the brook trout were young of year. Rainbow trout and brook trout salmonid spawning is occurring in this water body. The following table describes the data for each collection event.

Table 29. Fish Creek (above the reservoir) fish data.

Site	Rainbow trout	Brook trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout Young of year
2001STWFA059	15	11	75	0	0	0	8	7
2001STWFA061	0	14	22	0	0	0	0	14

^aData collected by DEQ.

Hydrology

Fish Creek (above the reservoir) is a perennial water body with a number of characteristics that contribute to the hydrology of the creek. There are 12 streams, three of which are perennial, that feed Fish Creek. There are numerous large beaver dam complexes throughout the entire length of the creek as well as in the tributaries of Fish Creek. Braided segments that are likely high flow or old channels occur in the lower portions of the creek. Springs occur throughout the valley of Fish Creek although many may not contribute directly to surface flows of Fish Creek. Finally, Fish Creek contributes to the water levels of Fish Creek Reservoir.

There is not a gauging station located on Fish Creek, currently or historically, therefore flow data collected in 2001-2003 will be used to predict an average stream flow. The site for stream flow measurements occurred at the boat ramp road crossing, approximately half a mile above Fish Creek Reservoir. The Little Wood River gauging station (13147900 - Little Wood River above High Five Creek near Carey) is a functioning station that was used in predicting Fish Creek flows. The Little Wood River and Fish Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Little Wood River and Muldoon Creek watersheds was similar, as well as being similar throughout the period of record. Based on this assumption, a linear regression model of Little Wood River flow versus Fish Creek flow was performed (Figure 24). The statistical values of the regression analysis ($p=0.000$, $r^2=0.847$) indicate that this model can be used to determine a predicted average flow for Fish Creek (Figure 25).

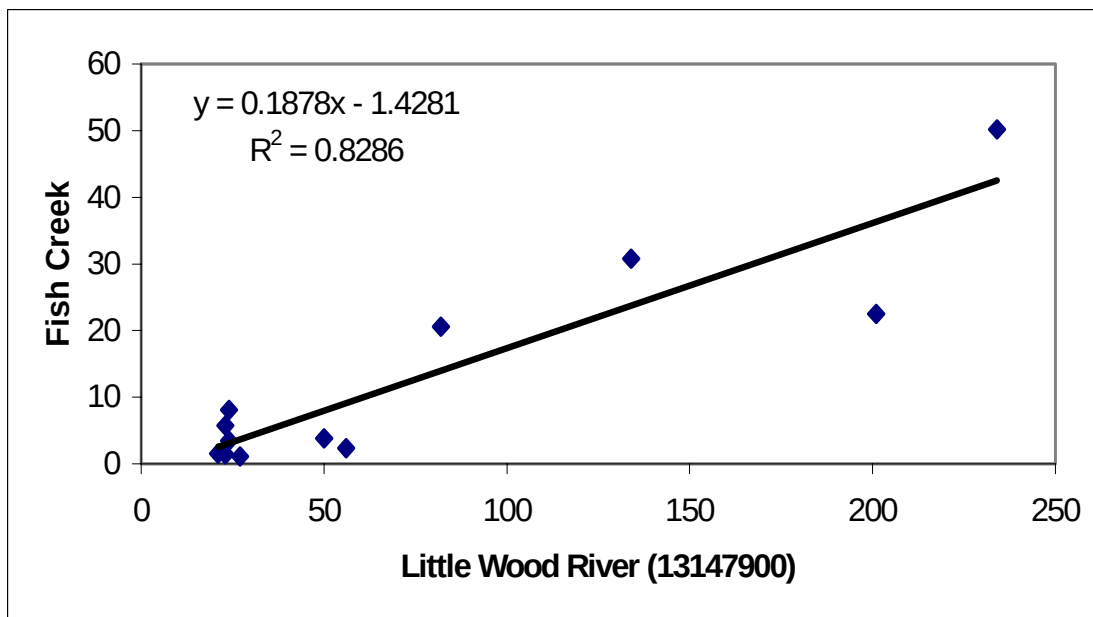


Figure 24. Fish Creek (above the reservoir) flow (cfs) regression analysis.

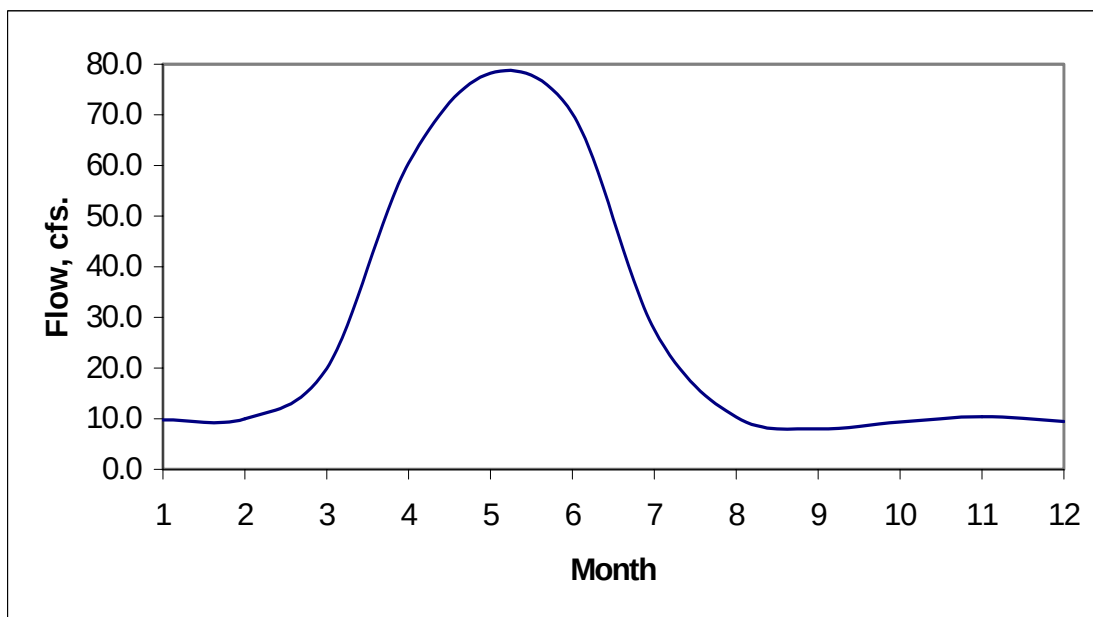


Figure 25. Fish Creek (above the reservoir) predicted hydrograph.

Flows on Fish Creek (above the reservoir) appear to support beneficial uses of the water body. Predicted flows for Fish Creek tend to increase in late March and decrease in late June. High flow for Fish Creek occurs in May and averages 78.3 cfs, with low flows occurring from August to February at less than 10 cfs. Fish Creek has water year round, including drought years. *As there appears to be water present year round in the water body, including during drought years, it is unlikely that flow alteration is directly impacting beneficial uses. However, low flow conditions could contribute to an increase in water temperature.*

There are many water rights for the Fish Creek drainage area. Diversions from Fish Creek itself account for 18.8 cfs of water while diversions from its tributaries account for 13.5 cfs. This water is used for various purposes: irrigation, stockwater, and domestic water supply (IDWR 2002). The amount of diversion occurring on this water body does not seem to be excessive in relation to its average flow.

Water Column Data

Water chemistry data for Fish Creek is very limited. There were four points of sampling performed by the USGS in 1973, 1975, 1976, and 1977 for flow, temperature, and specific conductivity. Bacteria data was collected at two BURP sampling sites by DEQ in the summer/fall of 2001. The Lava Lake Land & Livestock, L.L.C. contracted with the Nature Conservancy to collect TSS samples in the upper end of the watershed. Monthly monitoring for water chemistry data was completed throughout the 2001-2003 period at two sites: an upper and lower site. The lower site was used to identify pollutants impacting water quality and thus beneficial uses. Temperature loggers were also distributed at various locations.

Table 30 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed see Analysis Process, page 45*

Table 30. Fish Creek (above the reservoir) water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number Elevated	Instantaneous Criteria	Average Criteria
Indicators							
SC	15	285.0	212.9	166.5	0	< 500	---
pH	15	8.42	---	7.65	0	6.5 < x < 9.0	---
TNH3	4	0.246	0.133	0.005	0	Variable	---
Turb	15	33.8	6.0	0	0	BG + 50	---
DO	15	12.13	9.26	7.56	0	> 6	---
BOD	4	7	6	4	0	< 10	---
Chl a	6	3.1	2.1	1.5	0	< 15	---
Pollutants							
TSS	8	51.0	12.4	0.5	0	< 80	< 50
TP	8	0.147	0.074	0.040	0	< 0.16	< 0.10
TIN	4	1.709	0.716	0.010	2	< 0.48	< 0.3
<i>E. coli</i>	17	602	97.6	2	1	< 576	< 126

^aSC – Specific Conductivity (uhmos/cm), pH – Hydrogen Ion Concentration (standard units), TNH3 – Total Ammonia (mg/L), Turb – Turbidity (NTUs), TSS – Total Suspended Solids (mg/L), TP – Total Phosphorous (mg/L), TIN – Total Inorganic Nitrogen (mg/L), *E. coli* – Escherichia coli (Colony forming units/100ml).

^bAverage criteria for *E. coli* is a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria with no elevations above the criteria or any policy exceedance. Historical indicators also met the assessment criteria.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO; if these parameters are not elevated beyond standards more than 10% of the time than water quality appears to be capable of supporting beneficial uses. In the case of Fish Creek, neither pH, turbidity, nor DO are elevated during the period of record. *Water quality (DO, pH, and turbidity) appears to be capable of supporting beneficial uses of Fish Creek.*

The water column data (TSS) indicates that sediment is not impacting beneficial uses, however bedload sediment (percent fines) indicates that sediment is impacting beneficial uses of Fish Creek. The TSS average values (12.4 mg/L) averaged well below the average assessment criteria of 50 mg/L. The percent fine data was elevated above the assessment criteria (35%). There were eight collection events in the water body and the values for percent fines ranged from 22.2% to 44.2%. Out of the eight events, five were slightly elevated above the target. Bedload sediment appears to be impacting beneficial uses of Fish Creek.

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events. *Seasonally* TSS values are elevated in April (19.0 mg/L), June (18.0 mg/L), and August (51.0 mg/L) during high flow spring runoff and base flow periods, but never above the 80 mg/L daily maximum assessment value, and are consistently very low (2.3 mg/L) during the remainder of the year. The TSS values are likely elevated during the base flows as a result of anthropogenic activities.

Stream bank inventories were completed on Fish Creek to identify the source of the sediment and they indicate that the stream banks are contributing a larger load of sediment into the creek. Bank stability of upper, upper middle, lower middle and lower portions of the water body were calculated at 40.9%, 81.1%, 72.5%, and 54.0%. The target for stream bank stability is 80%; these targets are not being met. *Sediment erosion from banks is likely impacting beneficial uses, a sediment TMDL will be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the beneficial uses of Fish Creek (above the reservoir). Chlorophyll data is limited; however, values remain below 15 ug/L indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.074 mg/L) averaged well below the average assessment criteria of 0.100 mg/L. The TIN average values (0.716 mg/L) averaged well above the assessment criteria. Chlorophyll data indicates that there is no nuisance aquatic vegetation and TP values are limiting the growth of plants. *Nutrients are not a concern at this time; however an influx of TP would likely provide the components necessary for nuisance aquatic vegetation.*

The critical period for nuisance aquatic vegetation is typically during the late spring into the early fall months, when primary production is elevated. *Seasonally*, average monthly TP values are slightly elevated in August (0.147 mg/L), but not above the daily maximum assessment value, and average low the remainder of the year (0.067 mg/L). *Seasonally* TIN values are elevated in April (0.744 mg/L) and August (0.822 mg/L), and are elevated above the 0.48 mg/L daily maximum assessment value. The TIN values for the remainder of the period of record average at 0.149 mg/L. The TN/TP ratios for Fish Creek average at 9.2, therefore Fish Creek is phosphorous limited.

Nutrients are not impacting the beneficial uses of Fish Creek (above the reservoir); however they are contributing to TP loading of Fish Creek Reservoir and to Fish Creek (below the reservoir). The TP average values (0.074 mg/L) averaged above the average assessment criteria (0.050 mg/L) for a water body flowing into a storage system. *Fish Creek above the reservoir is influencing water quality of downstream waters; as a result a TMDL will be completed to aid in improvement of the water quality of the receiving waters (see Fish Creek below the reservoir).*

Bacteria (*E. coli*) are impacting the secondary contact recreation beneficial use of Fish Creek (above the reservoir). The maximum number of *E. coli* that occurred throughout the period of record was 602, a value that is slightly elevated above the 576 cfu/100ml instantaneous standard. Normally, additional samples would have been collected within 30 days to determine a geometric mean; however, results were not obtained until after the 30-day period. Therefore, the instantaneous value for bacteria will be the critical value for this assessment. *Seasonally*, *E. coli* values are slightly elevated in August (602 cfu/100ml) and September (240 cfu/100ml). The remainder of the months average 73.2 cfu/100ml. *Bacteria are a concern at this time in this water body, a bacteria TMDL will be completed.*

Comparisons of lower and upper sites indicate that late season peaks for both sites vary. The TIN values for the upper site are very similar to the lower site until August, when the lower site peaks and the upper site remains at detection levels. Peaks for TSS, TP, and bacteria occur in August for the lower site, but occur a month later for the upper site. Therefore, there is some activity occurring between both sites increasing the TIN values. The peaks in August are a result of some activity occurring downstream of the upper site, while activities impacting peaks for the upper site are likely not impacting values for the lower site due to increases in water flow.

The existing uses within Fish Creek (above the reservoir) are CWAL and SS; as such, maximum daily and average daily temperatures from 24-hour temperature data is analyzed based on critical time periods for these existing uses. The critical time periods for CWAL are June 22 through September 21. As brook trout and rainbow trout are both spawning in Fish Creek, the critical time periods for salmonid spawning is from October 1 through July 15. Temperature loggers were placed at various locations on Fish Creek for the 2001-2003 period.

In respect to water quality standards, temperature appears to be impacting CWAL existing uses as well as SS existing uses (Table 31, Figure 26, and Figure 27). The daily average

temperatures for CWAL (1.1% exceedance) do not exceed the 10% exceedance policy, however, the daily maximum temperatures for CWAL (16.9% exceedance) do exceed the exceedance policy. The average amount of time maximum temperature standards were elevated in those 15 days was 3.3 hours. The daily average temperatures (97.2% exceedance) and daily maximum temperatures (94.4% exceedance) for SS were both elevated above the 10% exceedance policy.

Table 31. Fish Creek (above the reservoir) elevated temperatures.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2001	Lower	92	89	15	16.9%	1	1.1%
2003	Upper	92	70	0	0%	0	0%
SS							
2001	Lower	288	72	68	94.4%	70	97.2%
2003	Upper	288	285	34	11.9%	40	14.0%

^a CWAL days missing in the 2001 data include September 19 through September 21, days missing in the 2003 data include August 31 through September 21.

^b SS days missing in the 2001 data include October 1 through May 4, days missing in the 2003 data include October 1 through October 4.

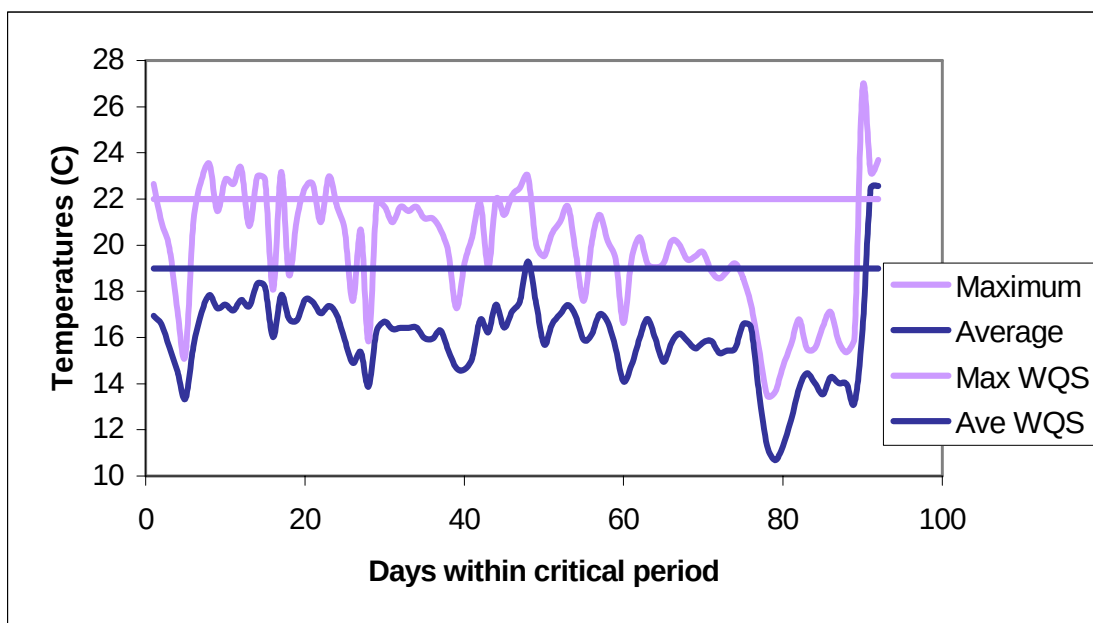


Figure 26. Fish Creek (above the reservoir) CWAL temperatures.

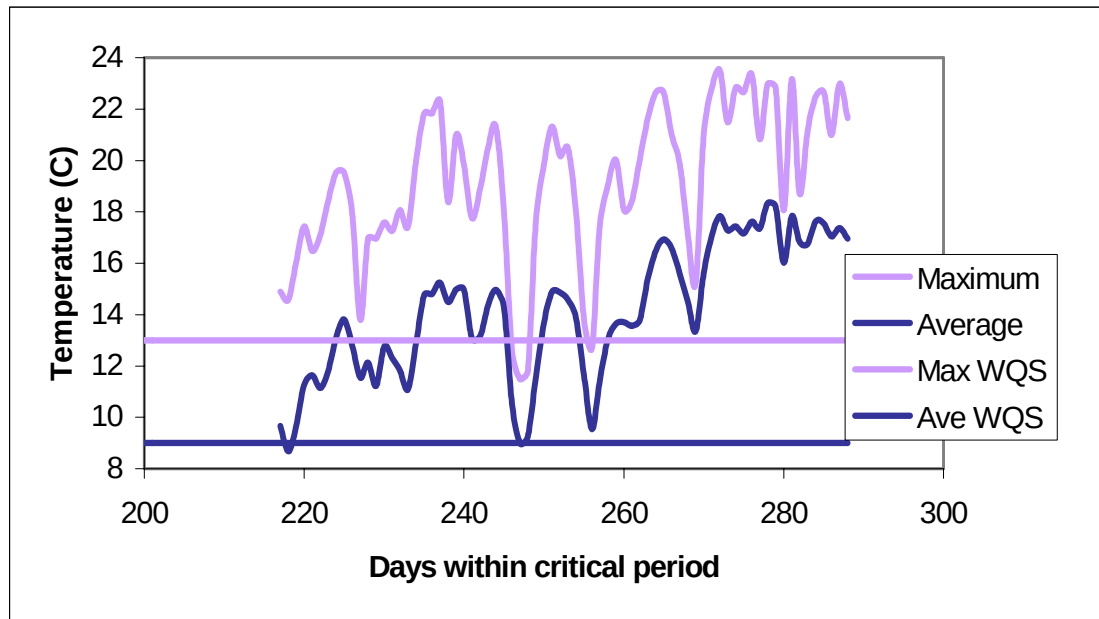


Figure 27. Fish Creek (above the reservoir) SS temperatures.

Temperature elevations may be being influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- There are a number of large beaver dam complexes within the watershed that are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases creating a wetland type area and exposing the water to more solar radiation.
- Fish Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 32). Fish Creek was divided into 22 segment lengths for aerial photo interpretations, the canopy cover ranged from 20% to 60% (Appendix F). The creek was divided into three representative segments to determine the canopy cover targets for each of the 22 segment lengths. Fish Creek is dominated by willows throughout the creek with areas dominated by willow and alders therefore the co-dominant willow-alder community shade curve, willow mix community, and willow community in the Alvord Lake TMDL on page 75 and 77 were the best matching shade curves for all of the segments. Targets for canopy cover on the creek were as follows: upper portions (60%), middle portions (60%), and lower portions (45%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is*

found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Table 32. Fish Creek (above the reservoir) canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Upper (headwaters to road crossing in T2N R23E Sec7)	8.9	willow	40-60	60
Middle (road crossing to road crossing in T2N R23E Sec24)	17.1	Willow-alder-aspen	30-60	60
Lower (road crossing to reservoir)	15.1	willow	20-50	45

^a Bankfull width was determined from BURP data or flow data measurements for each section.

^b Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).

^c The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process the following have been identified for Fish Creek (above the reservoir):

- Biological data in the upper portions indicates the water body is fully supported, however there is a data gap for biological data in the lower portion.
- Flow is sufficient to support beneficial uses.
- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment from stream bank erosion) is impacting beneficial uses of the creek.
- Nutrients (TP) are not impacting the beneficial uses of the creek, but they are contributing to nutrients loads of receiving waters of the creek.
- Bacteria (*E. coli*) are impacting the secondary contact recreation beneficial uses of the creek.
- Temperature is elevated, thus indicating that water quality is not sufficient to support beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for sediment, nutrients, bacteria, and temperature. Fish Creek will be delisted for impairment by flow alteration and DO. If at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Fish Creek (Below the Reservoir)

Fish Creek was described previously as to land ownership, land use, vegetation, geology, and soils in the section on Fish Creek.

Biological and Other Data

IDFG manages fisheries of Fish Creek in a general characterization that is attributed to many of the water bodies in the subbasin. Fish Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

Biological data is used by the state of Idaho in determining if beneficial uses of wadeable perennial streams are fully supported. The WBAG document is used as a tool to assess the biological data and thus the beneficial use support status of the creek. This data includes macroinvertebrate data, fishery data, and habitat data. Two of these data groups must be available before the beneficial uses of a water body can be evaluated through the WBAG process.

Biological data is used to indicate support status of beneficial uses, however the WBAG also identifies an exceedance policy for DO, pH, turbidity, and temperature in determining if beneficial uses are fully supported. As these constituents are numerical criteria in the water quality standards, any elevation above the 10% exceedance policy indicates beneficial uses are not fully supported. These water chemistry data constituents will be discussed later in the document under the subsection Water Column Data.

The BURP files on Fish Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel types and activities affecting each reach are reported in Table 33. Additional information provided in the BURP files indicate that the upper reaches have stream bank erosion occurring, grazing impacts, and riparian plants that include willows, alders, russian olive, aspens, cropped grasses, and bushes. Information from the lower sites in the intermittent section indicates that canal construction has modified the creek, grazing impacts are occurring, lots of dead willows are present, water was dirty (DEQ 1993-2001).

Table 33. Characteristics of Fish Creek (below the reservoir).

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Upper	4	3	C	GR, BC
Lower		0.9, 2	C, B	RDS, GR, AG, DIV

^aData from BURP files.

^bRDS – Roads, GR – Grazing, AG – Agriculture, DIV – Diversions, BC – Beaver Complexes.

Very little biological or habitat data has been collected on Fish Creek. Macroinvertebrate and habitat data was collected at three sites in 1995, while fish data was collected at one site. These sites were located in the lower half of this segment, between the mouth and the road crossing upstream of the Highline Canal. Macroinvertebrate, fish, and habitat data was collected downstream of the dam in 2001.

As the lower half of this segment is intermittent the WBAG process is not an accurate tool to use to assess beneficial uses of this segment of the creek. As the upper half of this segment is water that is released out of the reservoir the WBAG process is also not an accurate tool to use to assess beneficial uses of this segment of the creek (Mebane 2002). As a result water chemistry data will be used to determine if water quality of the creek is impacted.

Suckers, redbside shiners, sculpin, and dace have been found to occur in this segment of Fish Creek (Table 34). According to stocking records IDFG has not stocked this water body; however there could be unrecorded stockings that have occurred historically. As a whole 1.1% of all the fish collected on Fish Creek were cold water indicators, while 25% of the species were cold water indicators. No salmonids were found to be in existence at the time of sampling.

Table 34. Fish Creek (below the reservoir) fish data.

Site	Rainbow trout	Brook trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
2001STWFA058	0	0	3	116	53	8	0	0
1995SCIROA29	0	0	0	49	43	7	0	0

^aData collected by DEQ.

Hydrology

Fish Creek (below the reservoir) is a perennial water body with a number of characteristics that contribute to the hydrology of the creek. There are seven streams, one of which is perennial, that feed Fish Creek. There are at least four channels that take water out of the lower 6.5 miles of Fish Creek and several braided segments. The major channel taking water out of Fish Creek is the Highline Canal which leaves Fish Creek, downstream of this canal, dewatered except during high water years. The upper three miles of Fish Creek flows through a small basalt canyon. There have been large beaver ponds in the creek recently that have contributed to the perennial nature of the creek. The majority of the flow in Fish Creek comes from the release of water from the reservoir. Water is not released from the reservoir during the winter or early spring months, however there is a small amount of water that escapes from the dam in the winter months allowing perennial waters. It is difficult to actually identify what the flows on Fish Creek are during the winter months as the majority

of the creek is inaccessible due to snow depth and as the water within the channel is frozen over.

There is not a gauging station located on Fish Creek (below the reservoir), currently or historically, so flow data collected in 2001-2003 will be used to predict an average stream flow. The site for stream flow measurements occurred just downstream of the dam. The Little Wood River gauging station (13148500 – Little Wood River near Carey, ID) is an active station that was used to predict Fish Creek flows. Fish Creek and the Little Wood River are in the same general area, have similar ecoregions, and have had similar developments. As a result, it was assumed that precipitation and runoff in the Little Wood River and Fish Creek watersheds was similar, as well as being similar throughout the period of record. Based on this assumption a linear regression analysis of Little Wood River flow versus Fish Creek flow was performed (Figure 28). The statistical values of the regression analysis ($p=0.000$, $r^2=0.798$) indicate that this model can be used to determine a predicted average flow for Fish Creek (Figure 29).

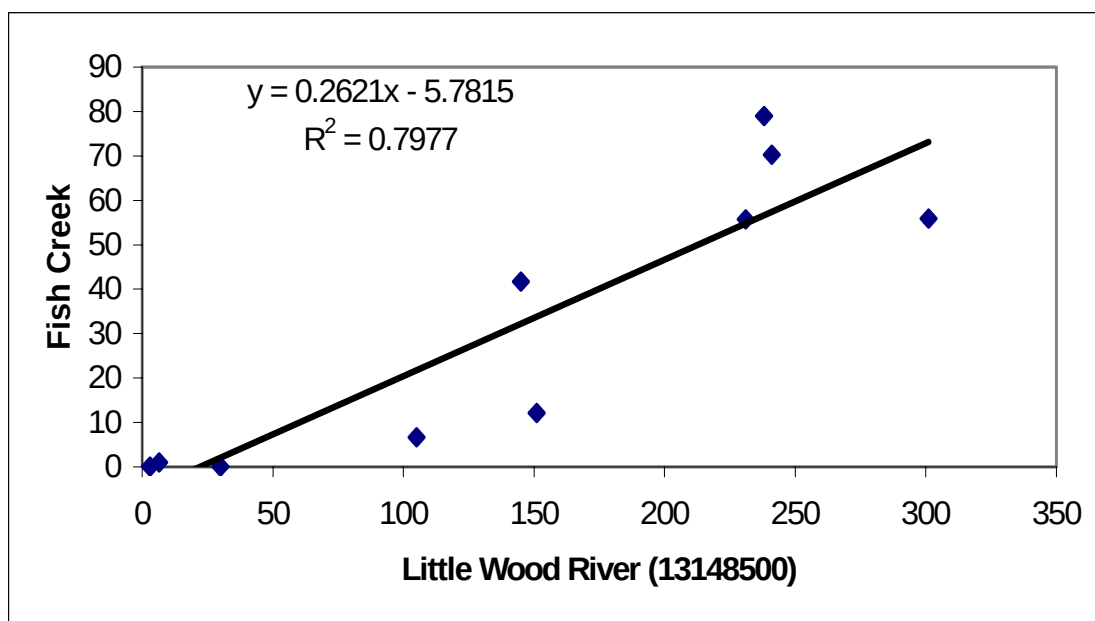


Figure 28. Fish Creek (below the reservoir) flow (cfs) regression analysis.

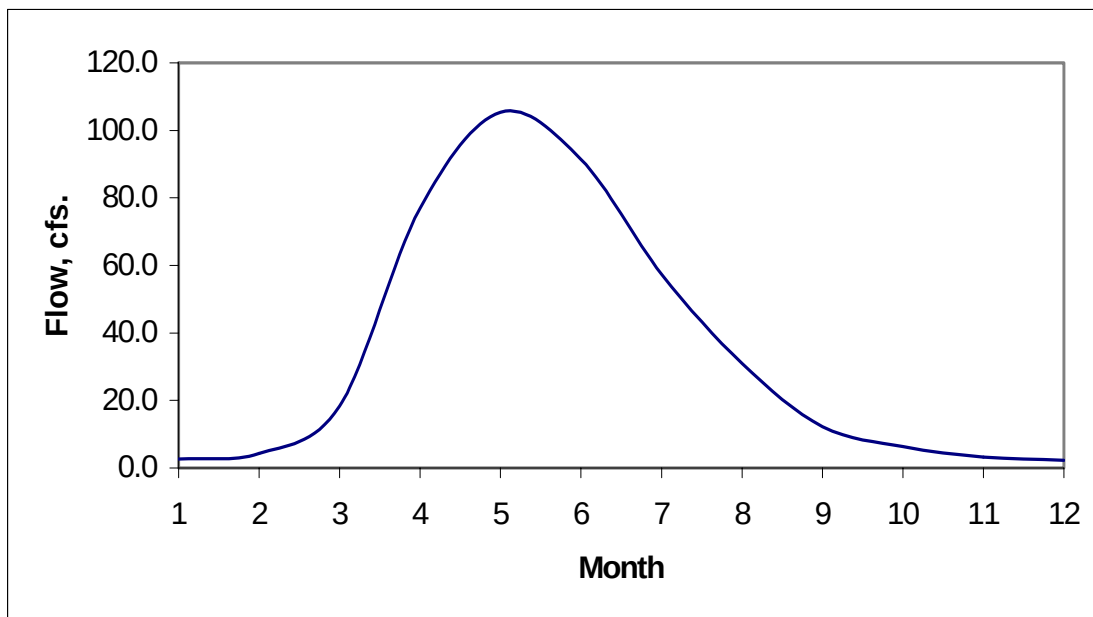


Figure 29. Fish Creek (below the reservoir) predicted hydrograph.

Fish Creek (below the reservoir) is highly flow altered and the flow alteration is likely one of the biggest impacts to water quality and beneficial uses. Predicted flows for Fish Creek tend to increase in late March and decrease in the middle of August. High flow for Fish Creek is in May at 105.4 cfs, with low flows occurring from December to February at less than 5 cfs. *During the period of record, flows on Fish Creek in December and April were 0.1 cfs.*

Water use, rather than natural systems regulate the flow of the water body. Water is diverted down Highline Canal at about 6.5 miles upstream of the mouth. The majority of the water in Fish Creek is diverted down this canal and what is left, if any, flows down the natural channel for about a mile into a ditch. *The segment of Fish Creek from the Highline Ditch to the mouth gets water during the spring runoff when the snow pack has been 120%, which may occur every 5 to 7 years (Simpson, 2001).*

There are many water rights for the Fish Creek drainage area, diversions from Fish Creek (below the reservoir) itself account for 95.8 cfs while diversions from its tributaries account for 0.1 cfs. This water is used for various purposes: irrigation, stockwater, and domestic water supply (IDWR 2002).

Water Column Data

Water chemistry data for Fish Creek (below the reservoir) is very limited. Bacteria data was collected at one BURP sampling sites by DEQ in the summer/fall of 2001. Monthly monitoring for water chemistry data was completed throughout the 2001-2003 period at two sites: an upper and lower site. The lower site was used to determine whether water chemistry data supports beneficial use status, however the upper site was used to indicate impacts

throughout the length of the creek. Temperature loggers were also distributed at various locations.

Table 35 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed see Analysis Process, page 45.*

Table 35. Fish Creek (below the reservoir) water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number Elevated	Instantaneous Criteria	Average Criteria
Indicators							
SC	13	367.0	272.8	206.0	0	< 500	---
pH	13	8.76	---	7.86	0	6.5 < x < 9.0	---
TNH3	4	0.410	0.263	0.050	0	Variable	---
Turb	13	41.3	18.0	3.8	0	BG + 50	---
DO	13	11.80	9.01	6.96	0	> 6	---
BOD	4	10.0	6.8	3.0	0	< 10	---
Chl a	6	28.9	7.1	0	1	< 15	---
Pollutants							
TSS	6	41.0	20.7	7.0	0	< 80	< 50
TP	8	0.175	0.119	0.065	1	< 0.16	< 0.10
TIN	4	0.703	0.504	0.275	1	< 0.48	< 0.3
<i>E. coli</i>	16	313.0	31.6	1.0	0	< 576	< 126

^aSC – Specific Conductivity (uhmos/cm), pH – Hydrogen Ion Concentration (standard units), TNH3 – Total Ammonia (mg/L), Turb – Turbidity (NTUs), DO – Dissolved oxygen (mg/L), BOD – Biological oxygen demand (mg/L), Chl a – chlorophyll a (ug/L), TSS – Total Suspended Solids (mg/L), TP – Total Phosphorous (mg/L), TIN – Total Inorganic Nitrogen (mg/L), *E. coli* – Escherichia coli (Colony forming units/100ml).

^bAverage criteria for *E. coli* is a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria, except chlorophyll. Chlorophyll was elevated in August and could indicate that nutrient levels are elevated in the water body.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO; if these parameters are not elevated beyond standards more than 10% of the time than water quality appears to be capable of supporting beneficial uses. In the case of Fish Creek below the reservoir, neither pH, turbidity, nor DO are elevated during the period of record. *Water quality (DO, pH, and turbidity) appears to be capable of supporting the beneficial uses of Fish Creek.*

The water column data (TSS) indicates that sediment is not impacting the water quality, however bedload sediment data (percent fines) indicates that water quality of Fish Creek

(below the reservoir) is impacted. The TSS average values (20.7 mg/L) averaged below the assessment criteria of 50 mg/L. The percent fines data was elevated above the assessment criteria (35%). There were six collection events in the water body and the values for percent fines ranged from 13.6% to 56.4%. Bedload sediment appears to be impacting water quality of Fish Creek.

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events, however, since this is a flow regulated stretch of the creek critical periods are likely during the irrigation season (May through July). *Seasonally*, TSS values are elevated in May (41.0 mg/L) and July (34.0 mg/L) during higher flow periods, although there are no exceedance of daily maximum values, and are consistently low (12.3 mg/L) during the remainder of the year.

Stream bank erosion inventories were completed on Fish Creek (below the reservoir) to identify the source of the sediment and they indicate that there is a larger load of sediment being delivered into the creek that is likely impacting water quality. Bank stability of upper, middle and lower portions of the water body were calculated at 51.6%, 70.1%, and 66.5%. The target for stream bank stability is 80%; these targets are not being met. *Sediment erosion from banks is impacting water quality, a sediment TMDL will be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are likely impacting the water quality of Fish Creek (below the reservoir). Chlorophyll data is limited; however there was one value (28.9 ug/L) elevated above the 15 ug/L assessment criteria, indicating that nuisance aquatic vegetation is likely. The TP average values (0.119 mg/L) averaged above the assessment criteria of 0.100 mg/L. The TIN average values (0.504 mg/L) averaged above the assessment criteria of 0.300 mg/L. *Nutrients are likely impacting water quality of Fish Creek, a nutrient TMDL will be completed.*

The critical period for nuisance aquatic vegetation is typically during the late spring into the early fall months, when primary production is elevated; however as this is a flow regulated water body critical time periods are from May until September. *Seasonally*, TP values are elevated in April (0.125 mg/L), July (0.128 mg/L), September (0.175 mg/L), October (0.134 mg/L), and December (0.139 mg/L), but only once above the 0.16 mg/L daily assessment value. *Seasonally*, TIN values are elevated in April (0.701 mg/L) and December (0.703 mg/L). The TN/TP ratios for Fish Creek average 5.7, indicating that the water body is a nitrogen-limited water body; during the period of record the water body was nitrogen limited for all events but one.

As both TP and TIN are elevated, nutrients are impacting the water quality of Fish Creek (below the reservoir); however, there are likely many sources contributing to elevated nutrient levels. In addition to land management, there are natural geologic influences and reservoir storage situations that are aiding in the elevation of nutrient levels. There is a possible natural phosphorous source occurring around the reservoir area (Appendix D) along with phosphorous storage within the soils of the reservoir that is aiding in the elevation of phosphorous levels in the creek.

There were overall six sites monitored along the entire length of Fish Creek, four of these sites will be beneficial in describing the water quality of Fish Creek (Figure 30). There was a site above the reservoir (AR) that does not display elevated TP levels, and then there was a site below the reservoir (BR) that displays elevated TP levels. After viewing the TP values collected at these sites, two additional sites within the reservoir were monitored in September and October, when the reservoir was dry and sites were accessible. There is a spring within the reservoir that contributes less than 1 cfs of flow to the reservoir; a site (SPR) was located along this spring upstream of where it confluence's with Fish Creek. A site (ABSPR) was also located on Fish Creek upstream of the spring's confluence with Fish Creek.

Water leaving the reservoir is already elevated in TP concentration, which appears to be assimilated further downstream. The TP concentration entering the reservoir (AR) averages 0.074 mg/L and 0.157 mg/L leaving the reservoir (BR). Further downstream, before the water of Fish Creek is diverted into Highline Canal (AHD), TP concentration averages 0.119 mg/L. Data that was collected was separated into high flow events and low flow (less than 10 cfs) events. During high flow events, water leaving the reservoir is elevated to an average of 0.127 mg/L while the lower site averages at 0.104 mg/L. During low flow events water leaving the reservoir is elevated to an average of 0.198 mg/L while the lower site averages at 0.143 mg/L.

Loads from the reservoir are contributing to the loads in the downstream segment of the creek. *As a result, a TMDL will be done on Fish Creek above the reservoir, with the TP target being 0.05 mg/L to reduce the delivery and further storage of TP to the reservoir. A TMDL will also be completed on Fish Creek below the reservoir and this TMDL will also encompass the reservoir.* The reduction in contribution of existing loads of TP will limit further storage and allow stored TP to be cleaned out of the system. It may take a greater amount of time to reach targets as storage of TP has occurred for many years.

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial use of Fish Creek. The maximum number of *E. coli* that occurred throughout the period of record was 313, a value that is below the 576 cfu/100ml instantaneous standard. As there were never any instantaneous exceedance, it was not necessary to calculate geometric mean values for the system. *Seasonally E. coli* values are slightly elevated in July (313cfu/100ml), but never above the instantaneous criteria. The remainder of the months average 8 cfu/100ml. *Bacteria are not a concern at this time in this water body, a bacteria TMDL will not be completed.*

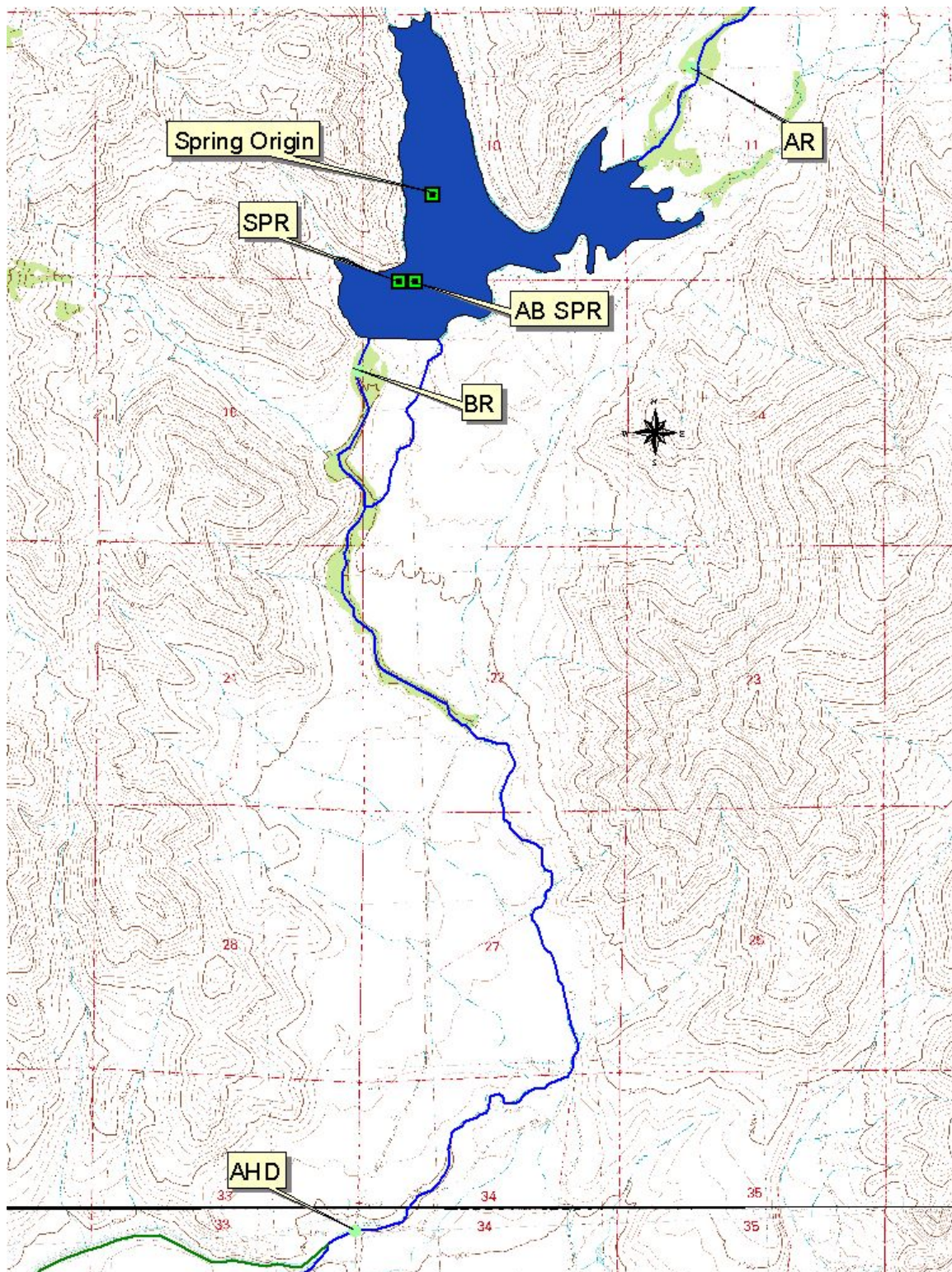


Figure 30. Fish Creek (below the reservoir) sampling sites.

The existing use within Fish Creek (below the reservoir) is CWAL, and as such maximum daily and average daily temperatures from 24-hour temperature data is analyzed based on critical time periods for this existing use. The critical time periods for CWAL are June 22 through September 21. Temperature loggers were placed at various locations on Fish Creek for the 2001-2003 period.

In respect to water quality standards, temperature appears to indicate that water quality is not capable of fully supporting CWAL existing uses (Table 36 and Figure 31), although the water chemistry data discussed previously indicates otherwise. The daily average temperatures for CWAL (25.0% exceedance) do exceed the 10% exceedance policy, as well as do the daily maximum temperatures (27.2% exceedance). Loggers placed downstream of the reservoir in a previous year indicate that out of the reservoir the temperature standards are being met. The maximum daily temperatures (0% exceedance) for CWAL are met, as well as daily average temperatures (7.6% exceedance). *Therefore, water quality standards are met at the source but are elevated at the discharge point.*

Table 36. Fish Creek (below the reservoir) elevated temperatures.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2001	Upper	92	89	0	0%	7	89.0%
2003	Lower	92	70	25	35.7%	23	32.9%

^a CWAL days missing in the 2001 data include September 19 through September 21, days missing in the 2003 data include August 31 through September 21.

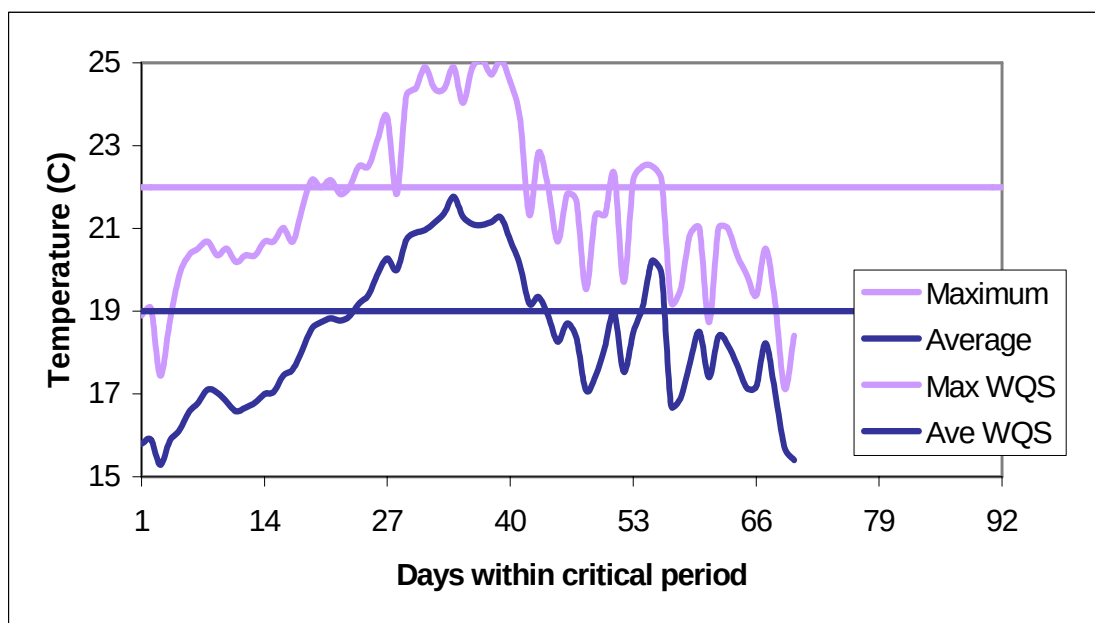


Figure 31. Fish Creek (below the reservoir) CWAL temperatures.

Temperature elevations may be influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- There are a number of large beaver dam complexes within the watershed that are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases creating a wetland type area and exposing the water to more solar radiation.
- Geologic formations are likely contributing to the temperature elevations as the creek runs through basalt lined box canyon areas. These geologic formations could be contributing to the solar radiation exposure due to the inability of the creek, in some areas, to develop larger riparian plants due to restricted growth area. There are also a great deal of basalt rocks that line the box canyons the water body travels through; these rocks are likely conducting a certain amount of heat that contributes to the elevated temperatures.
- Finally, Fish Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 37). Fish Creek was divided into 11 segment lengths for aerial photo interpretations, the canopy cover ranged from 0% to 40% (Appendix F). Fish Creek is dominated by willows therefore the willow mix community shade curve in the Alvord Lake TMDL on page 75 was the best matching shade curve for the creek. Targets for canopy cover on the creek were 35%. *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 37. Fish Creek (below the reservoir) canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Dam to Carey Lake	6.5	Willows, alders, grasses	0-40	35

^a Bankfull width was determined from BURP data or flow data measurements for each section.

^b Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).

^c The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process the following have been identified for Fish Creek (below the reservoir):

- Biological data should not be used to assess support status of the beneficial uses as it is a reservoir outlet despite being in a natural creek channel.
- Flow is likely not sufficient to support beneficial uses.
- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment from stream bank erosion) is impacting the water quality of the creek.
- Nutrients (TP and TIN) are impacting the water quality of the creek and may be naturally elevated within the system due to geologic formations as well as reservoir storage.
- Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial uses of the creek.

As a result of the subbasin assessment, a TMDL will be completed for sediment, nutrients (TP), and temperature and the creek will remain listed as impaired by flow alteration. In addition, DO and bacteria will be delisted as pollutants impairing Fish Creek. If at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Little Wood River

Little Wood River is a fourth order perennial stream that defines the Little Wood River Subbasin. Its headwaters begin in the Sawtooth National Forest in the Pioneer Mountains, and it flows south, southwest, and west into the Big Wood River to make up the Malad River. The Little Wood River is approximately 106.2 miles long and the 303(d)-listed segment is 80.8 miles long. It originates at an elevation of 9,842 feet and discharges at 3,412 feet. Little Wood River has a bankfull width/depth ratio that averages 20.3 and a sinuosity of 1.55. The gradient of this water body is 1.15%, which indicates that it is very depositional.

The Little Wood River will be divided up into four segments based on sources of water (Figure 16, page 37). Segment 1 runs from the headwaters to the reservoir. The water supply for this segment is supplied by natural flows of the Little Wood River and its tributaries. The gradient of this section is 4.15%. Segment 2 runs from the reservoir to the East/West Canal Diversions of the Little Wood River Irrigation District. The Little Wood River Reservoir and some of the ephemeral and intermittent tributaries in the segment contribute to the water supply for this segment. The gradient for this segment is 0.83%. Segment 3 runs from the East/West Canal diversion to the Silver Creek confluence. This section of the Little Wood

River is generally dry. It may receive flow from the reservoir during spring runoff, when water needs to be released in preparation for large and rapid spring runoffs. It has a gradient of 0.52%. Segment 4 runs from the Silver Creek confluence to the Big Wood River. The water in this segment is supplied by Silver Creek water and by irrigation water. The gradient for this segment is 0.36%.

Land use, ownership, and vegetation of Little Wood River will be described based on a one mile-stream corridor approach. Segment 1 originates on USFS land (57.4%), which is the predominant land ownership for the segment above the reservoir. It then passes through BLM land (11.6%) and state land (5.2%) before entering into the private land section (25.3%), which is bordered by state and BLM land. Segment 2 is mostly privately owned (78.2%) with BLM (7.1%) and state land (11.4%) bordering the edge of the corridor. Segment 3 is privately owned (68.7%) with BLM (25.5%) and state land (5.8%) running along the edges of the stream corridor. Segment 4 runs through BLM land (48.7%) with state land (3.7%) bordering it. But soon the river runs through private land (47.6%). However, a great deal of BLM lands surround the private land within the stream corridor (ArcView Coverage, 1992-1996).

The land use for segment 1 is predominately rangeland and forestland with irrigated gravity flow and sprinkler increasing as you move toward the reservoir. Segment 2 consists mainly of rangeland. Segment 3 is predominately irrigated gravity flow with very little irrigated sprinkler and rangeland; there is a small portion of rock in the stream corridor of this segment. The three land uses in segment 4 are rangeland, irrigated gravity flow and sprinkler (ArcView Coverage, 1992-1996).

The vegetation coverage along the Little Wood River is fairly similar as you move downstream. There are forested, shrubland, and a small quantity of agriculture vegetation occurring in segment 1. Segments 2 and 3 consist mainly of shrubland followed by agriculture vegetation. For segment 4 there is more agriculture vegetation and grasslands with less shrubland. There are also several small portions along the river in Segment 4 where wetlands occur within the stream corridor (ArcView Coverage, 1992-1996).

Little Wood River stream corridor passes through 11 different geologic formations. The headwaters of the Little Wood River originate in intrusions and flows through colluvium fanglomerate and talus where it is bordered by thrust marine detritus and schist quartzite and other metasediments. It then runs through alluvium and is bordered by mixed silicic and basaltic volcanic ejecta flows and reworked debris and thrust marine detritus. As it approaches the reservoir, and until it gets near the East and West Canal diversion, it runs through lava flows and is bordered by mixed silicic and basaltic volcanic ejecta flows and reworked debris (ArcView Coverage, 1992-1996).

The geology described above accounts for segments 1 and 2 of the Little Wood River while the following description will incorporate the remaining segments. In segment 3 the river runs through alluvium and is surrounded by mixed silicic and basaltic volcanic ejecta flows and recently relatively unweathered basalt flows and cinder cones. There is a small portion along the edge of the stream corridor that is stream and lake deposits. As the river flows

toward the Silver Creek confluence, surficial cover is the predominant geological formation on the west side. Segment 4 runs through lava flows with recent relatively unweathered basalt flows and cinder cones bordering it on the west side. The river flows the remainder of the way through lava flows with small segments of silicic welded tuff ash and flow rocks. Recent relatively unweathered basalt flows and cinder cones are found along the northern edge of the stream corridor (ArcView Coverage, 1992-1996).

There are 13 types of soils in the Little Wood River stream corridor. These soils pass through four different soil K factor ranges. The headwaters of the Little Wood River begin in soils with a K factor of 0-0.08, but rapidly flows into soils with K factors of 0.25-0.35. The majority of the Little Wood River from the headwaters to the Silver Creek confluence lies in soils of this range. However, from a third of the length of the river, upstream of the reservoir to the southern end of the reservoir, the soils have a higher K factor of 0.35-0.45, while in the lower part of this segment the Lava Plains border the river to the east and have a lower K factor of 0-0.08. Downstream of the Silver Creek confluence the river lies in soils with a K factor of 0.15-0.25. There is a portion of land to the south of the river near Shoshone with a K factor of 0.25-0.35 (ArcView Coverage, 1992-1996).

Little Wood River Segment 1 (Above the Reservoir)

Biological and Other Data

IDFG manages the fisheries of the Little Wood River in two different management styles. The entire stretch of this segment has been identified as a cold water fishery. The upper segment from the second bridge to the headwaters is managed as a wild trout system with desired species of rainbow and brook trout. The lower segment from the reservoir to the second bridge is a put-and-take trout system with desirable species of rainbow trout (IDFG 2001).

Biological data is used by the state of Idaho in determining if beneficial uses of wadeable perennial water bodies are fully supported. The WBAG document is used as a tool to assess the beneficial use support status of the water body. Biological data that has been collected is used to aid in determining the support status of the water body. This data includes macroinvertebrate data, fishery data, and habitat data. Two of these data groups must be available before the beneficial uses of a water body can be evaluated through the WBAG process.

Biological data is used to indicate support status of beneficial uses, however the WBAG also identifies an exceedance policy for DO, pH, turbidity, and temperature in determining if water quality is capable of fully supporting beneficial uses. As these constituents are numerical criteria in the water quality standards, any elevation above the 10% exceedance policy indicates water quality is not capable of fully supporting beneficial uses. These water chemistry data constituents will be discussed later in the document under the subsection Water Column Data.

Very little biological or habitat data has been collected on the Little Wood River (segment 1). Data was collected through the BURP protocol once in 1996 and three times in 2001. All of the 2001 sites were located in the upper seven-mile headwater stretch of the Little Wood River. The 1996 site was located about 5 miles above the reservoir. All of the sites include macroinvertebrate and habitat data, and the 1996 site includes fish data. An additional site was done in 2001, near the reservoir, and this site included fish data only. Biological data has been collected on this section of the Little Wood River by other agencies as well. In September and October of 1999, the Ketchum Ranger District and Sawtooth National Recreation Area contracted with the USFS Fish Ecology unit to conduct a redband trout survey on stretches of the Little Wood River. The sites for this collection event were located in the upper 14 miles of the headwaters. The Bureau of Land Management in August of 2001 had the National Aquatic Monitoring Center of the Department of Fisheries and Wildlife identify aquatic invertebrate samples from the Little Wood River about 6 miles upstream of the reservoir.

The BURP files on the Little Wood River indicate a number of characteristics of the river as well as a number of activities affecting the river. The stream order, gradients, Rosgen stream channel types and activities affecting each reach are reported in Table 38. Additional information provided in the BURP files indicate that the upper reaches are slightly braided in some areas, riparian plants include young aspens, willows, alders, pines, rushes, sedges, berry bushes, and wildflowers, large cobbles aid in providing bank stability, a lot of large organic debris is present, and there are signs of wildlife. Information from the lower sites of the segment indicates that wildlife are present, there is recent beaver activity, road usage has been restricted, riparian zone includes grasses, willows, birch, nettles, cottonwoods, and aspen (DEQ 1993-2001).

Table 38. Characteristics of the Little Wood River (segment 1).

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Upper	2, 4, 4	15.9, 5, 3,	A, C, C,	REC, washouts
Lower	4	2.5	C	REC, GR

^aData from BURP files.

^bREC – Recreation, GR – Grazing.

Little Wood River was bioassessed through the WBAG process in 1998 and found to be fully supporting its beneficial uses; preliminary bioassessment of 2001 data supports this conclusion. The SMI, SFI, and SHI scores for the 1996 site were 3, 1, and 3, respectively. These values yield an average of 2.3. The SMI and SHI scores for the 2001 sites were 3 all around. (A rating of 2 or above indicates that beneficial uses are fully supported).

Macroinvertebrate data indicates that macroinvertebrate data in the upper reaches is better than that data collected downstream. The SMI values for the headwater stretch rated good (51-75), and for middle upper segments rated very good (76-100) and for the lower segment rated good. The pollution tolerance values for the entire length of this segment rated good (4.51-5.50).

Sculpin, mountain whitefish, brook trout, rainbow trout, dace and sucker have been found to occur in this segment of the Little Wood River (Table 39). According to IDFG records the Little Wood River has been stocked. Stocking records do not indicate locality on the river, however the Fisheries Management Plan identifies a stocking program in the high use campground area in this segment. As a whole 66.7% of the fish species of the Little Wood River were cold water indicators, 78.1% of all the fish collected were cold water indicators. For salmonid spawning, 14.0% of the rainbow trout and 50.0% of the brook trout were young of year.

Table 39. Little Wood River (segment 1) fish data.

Site	Rainbow trout	Brook trout	Mountain whitefish	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
1996SCIROA48	6	4	4	23	0	2	0	0	1
2001DEQLWR01	9	0	0	57	3	74	0	2	0
1999USFSLWR01	14	0	0	3	0	0	0	0	0
1999USFSLWR02	15	0	0	5	0	0	0	1	0
1999USFSLWR03	16	1	0	2	0	0	0	3	0
1999USFSLWR04	17	3	0	4	0	0	0	1	3
1999USFSLWR05	5	0	0	14	0	0	0	1	0
1999USFSLWR06	13	0	0	9	0	0	0	0	0
1999USFSLWR07	8	0	0	11	0	0	0	2	0
1999USFSLWR08	11	0	0	9	0	0	0	0	0
1999USFSLWR09	6	0	0	0	0	0	0	2	0
1999USFSLWR10	10	0	0	0	0	0	0	1	0
1999USFSLWR11	17	0	0	0	0	0	0	5	0
1999USFSLWR12	10	0	0	0	0	0	0	4	0

^aData collected by DEQ and USFS.

Hydrology

The Little Wood River (segment 1) is a perennial water body that feeds the Little Wood River Reservoir. There are 37 water bodies that contribute flow to the Little Wood River, 26 of which are perennial. These tributaries drain the mountains of the Little Wood River Subbasin. The largest watersheds within this drainage are the Muldoon Creek drainage and the Baugh Creek drainage.

There is a USGS gauging station (13147900 Little Wood River above High Five Creek near Carey, ID) located on the Little Wood River (segment 1). The period of record for this gauging station is from 1958 to the present. There was a gauging station located downstream of this station previous to this date and its period of record is 1920 to 1958. The flow from these gauging stations was used to determine the average hydrograph of the Little Wood

River. As can be seen in Figure 32, the current gauge hydrograph appears to indicate that peak flows have decreased in relation to the historical gauge hydrograph. This is due to the fact that the current gauging station is located above several intermittent and ephemeral streams whereas the historical gauge was located below them and thus would record their peak flows.

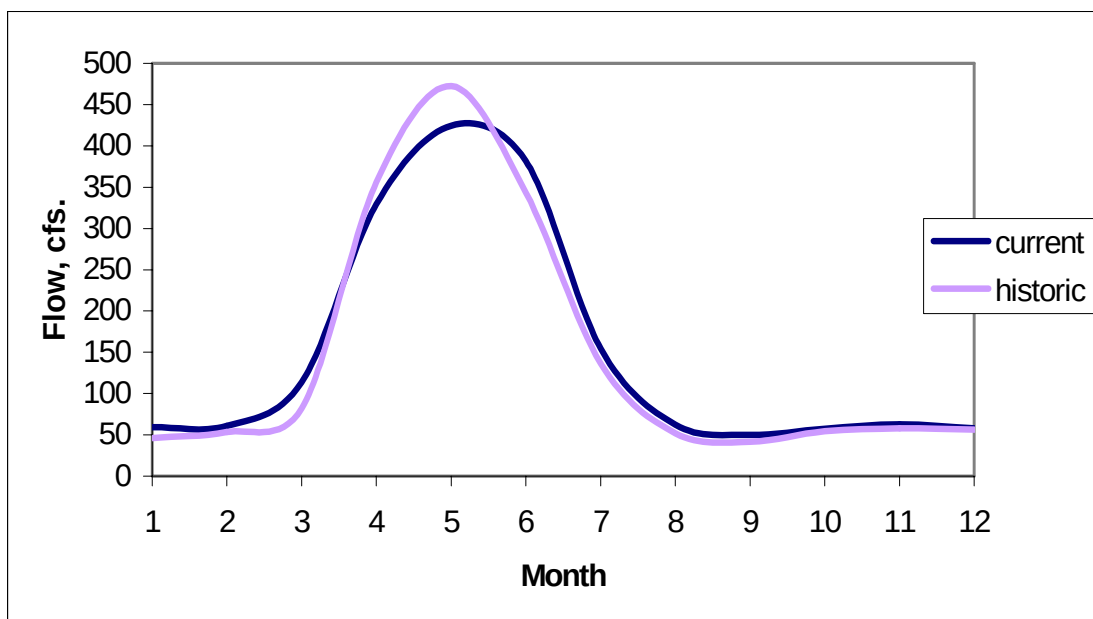


Figure 32. Little Wood River (segment 1) hydrograph.

Flows are not likely impacting the beneficial uses of the Little Wood River. Flows for the Little Wood River tend to increase in early March and decrease in late June. High flow for the Little Wood River occurs in May and averages at 426.5 cfs with low flows occurring from August to February at 50-60 cfs.

Flow diversions are minimal in this section of the Little Wood River and are not likely to be impacting beneficial uses. Diversions from the Little Wood River itself account for 0.1 cfs of water while diversions from the Little Wood River tributaries account for 6.7 cfs. This water is used for various purposes: irrigation, stockwater, domestic water supply, and wildlife (IDWR 2002). The amount of diversion occurring on this water body is not excessive in relation to its average flow. *As there appears to be water present year round in the water body, including during drought years, it is unlikely that flow alteration is directly impacting beneficial uses. However, low flow conditions could contribute to an increase in water temperature.*

Water Column Data

Water chemistry data for Little Wood River (segment 1) is very limited. There were 134 points of sampling performed by the USGS from the 1970's to the 1990's for flow, temperature, and specific conductivity. Monthly monitoring for water chemistry data was

completed throughout the 2001-2003 period. Temperature loggers were also distributed at various locations.

Table 40 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed see Analysis Process, 45.*

Table 40. Little Wood River (segment 1) water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number Elevated	Instantaneous Criteria	Average Criteria
Indicators							
SC	15	290.0	232.8	136.4	0	< 500	---
PH	15	8.73	---	7.45	0	6.5 < x < 9.0	---
TNH3	4	0.079	0.037	0.005	0	Variable	---
Turb	15	82.3	10.9	0.0	1	BG + 50	---
DO	15	13.70	9.94	7.38	0	> 6	---
BOD	4	7	5	3	0	< 10	---
Chl a	6	1.1	0.7	0.0	0	< 15	---
Pollutants							
TSS	8	16.0	3.6	0.5	0	< 80	< 50
TP	8	0.067	0.032	0.011	0	< 0.16	< 0.10
TIN	4	0.193	0.072	0.010	0	< 0.48	< 0.3
<i>E. coli</i>	8	27.0	12.6	1.0	0	< 406	< 126

^aSC – Specific Conductivity (uhmos/cm), pH – Hydrogen Ion Concentration (standard units), TNH3 – Total Ammonia (mg/L), Turb – Turbidity (NTUs), DO – Dissolved oxygen (mg/L), BOD – Biological oxygen demand (mg/L), Chl a – Chlorophyll a (ug/L), TSS – Total Suspended Solids (mg/L), TP – Total Phosphorous (mg/L), TIN – Total Inorganic Nitrogen (mg/L), *E. coli* – Escherichia coli (Colony forming units/100ml).

^bAverage criteria for *E. coli* is a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria, except turbidity. Turbidity is elevated above water quality standards one time. This elevation in turbidity accounts for 6.7% of the measurements within the period of record. This percentage is well below the 10% exceedance policy.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO; if these parameters are not elevated beyond standards more than 10% of the time than water quality appears to be capable of supporting beneficial uses. In the case of the Little Wood River, neither pH, turbidity, nor DO are elevated more than 10% of the time. The DO and pH parameters were never elevated during the period of record. *Water quality (DO, pH, and turbidity) appears to support the conclusion made under the biological data assessment, beneficial uses are fully supported.*

The water column data (TSS) and bedload sediment (percent fines) indicate that sediment is not impacting the beneficial uses of the Little Wood River. The TSS average values (3.6 mg/L) averaged well below the average assessment criteria of 50 mg/L. The percent fine data also was not elevated above the assessment criteria (35%). There were five collection events in the water body and the values for percent fines ranged from 8.2% to 20.5%. *A sediment TMDL will not be completed.*

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events. *Seasonally*, TSS values are elevated in April (4 mg/L), May (5 mg/L), and June (16 mg/L) during higher flow periods but never above daily maximum values and are consistently very low (0.8 mg/L) during base flow periods.

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the beneficial uses of the Little Wood River. Chlorophyll data is limited, however, values remain below 15 ug/L indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.032 mg/L) averaged well below the average assessment criteria of 0.100 mg/L. The TIN average values (0.072 mg/L) averaged well below the average assessment criteria of 0.300 mg/L. *A nutrient TMDL will not be completed.*

The critical period for nuisance aquatic vegetation is typically during the late spring into the early fall months, when primary production is elevated. *Seasonally*, TP values are slightly elevated in April (0.038 mg/L), May (0.047 mg/L), June (0.036 mg/L), and October (0.067 mg/L), but never above the 0.16 mg/L daily assessment value. *Seasonally*, TIN values are elevated in April (0.193 mg/L), but never above the 0.48 mg/L daily assessment value. The TN/TP ratios for the Little Wood River average 9.7, indicating that the water body is a phosphorous limited water body; however during the period of record the water body was nitrogen limited for three of four events. The Little Wood River as the source of water for the Little Wood River Reservoir will also be assessed for its potential impacts to the water quality of the reservoir.

Bacteria (*E. coli*) are not impacting the primary contact recreation beneficial use of the Little Wood River. The maximum number of *E. coli* that occurred throughout the period of record was 27, a value that is well below the 406 cfu/100ml instantaneous standard. As there were never any instantaneous exceedance, it was not necessary to calculate geometric mean values for the system. *Seasonally*, *E. coli* values are slightly elevated in July (17 cfu/100ml), September (27 cfu/100ml), and November (22 cfu/100ml), however never above instantaneous standards. The remainder of the months average 7 cfu/100ml. *A bacteria TMDL will not be completed.*

The existing uses within the Little Wood River are CWAL and SS; as such, maximum daily and average daily temperatures from 24-hour temperature data is analyzed based on critical time periods for these existing uses. The critical time periods for CWAL are June 22 through September 21. As brook trout and rainbow trout are spawning in this segment of the Little Wood River, the critical time periods for salmonid spawning is from October 1 through July

15. Temperature loggers were placed at various locations on the Little Wood River for the 2001-2003 periods.

In respect to water quality standards, temperature appears to be impacting maximum temperatures for CWAL existing uses (Table 41, Figure 33, and Figure 34) although biological data indicates aquatic life uses are fully supported. The daily average temperatures for CWAL (0% exceedance) do not exceed the 10% exceedance policy; however, the daily maximum temperatures (20.7% exceedance) do exceed the policy. There were 38 days in the period of record (184 days) where maximum daily temperatures were elevated above standards. Of the days that violated maximum daily temperatures, there were 40% that were elevated throughout the day for two or less hours. The daily maximum and average temperatures (65.0% exceedance) were both elevated above the 10% exceedance policy. A temperature logger that was placed approximately six miles upstream yielded a 9.5% exceedance for maximum and daily average temperatures for SS. *Data for CWAL and SS indicate that there is no temperature exceedance in the majority of this segment of the river. Upper stretches of the water body could act as a refuge for aquatic life, if temperatures downstream were indeed impacting aquatic life.*

Table 41. Little Wood River (segment 1) elevated temperatures.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2001	Lower	92	92	30	32.6%	0	0.0%
2002	Lower	92	92	8	8.7%	0	0.0%
2002	Upper	92	92	0	0.0%	0	0.0%
2003	Upper	92	71	0	0.0%	0	0.0%
SS							
2001	Lower	288	72	65	90.3%	66	91.7%
2002	Lower	288	28	28	100.0%	28	100.0%
2002	Upper	288	28	27	85.7%	27	96.4%
2003	Upper	288	279	27	9.7%	28	10.0%

^a CWAL days missing in the 2003 data include September 1 through September 21.

^b SS days missing in the 2001 data include October 1 through May 4, days missing in the 2002 data include October 1 through June 17, days missing in the 2003 data include October 1 through October 9.

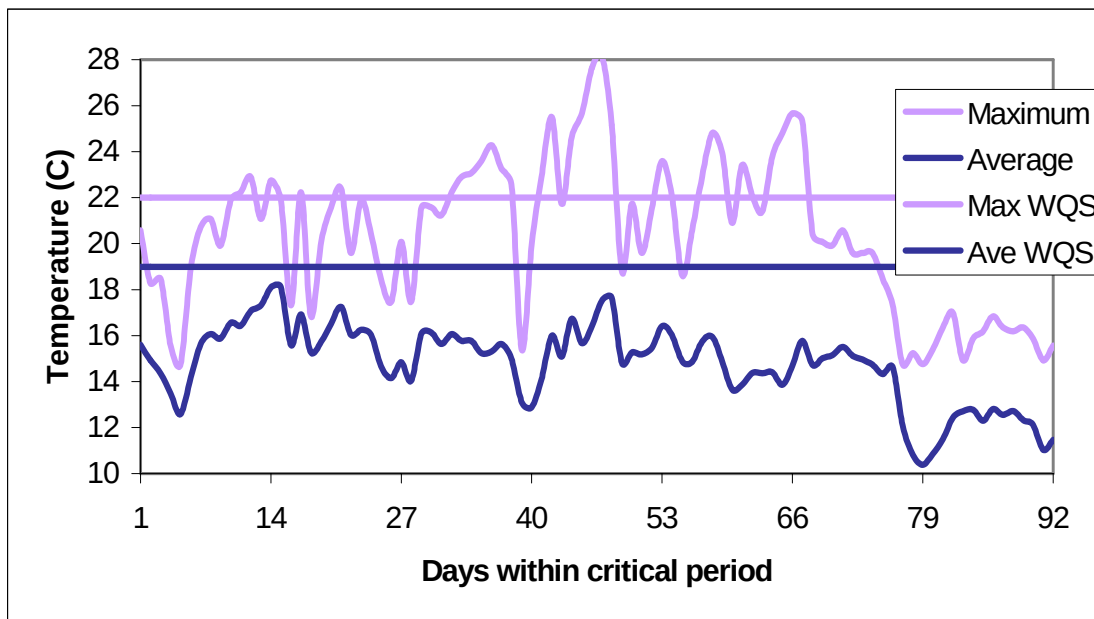


Figure 33. Little Wood River CWAL temperature data (2001).

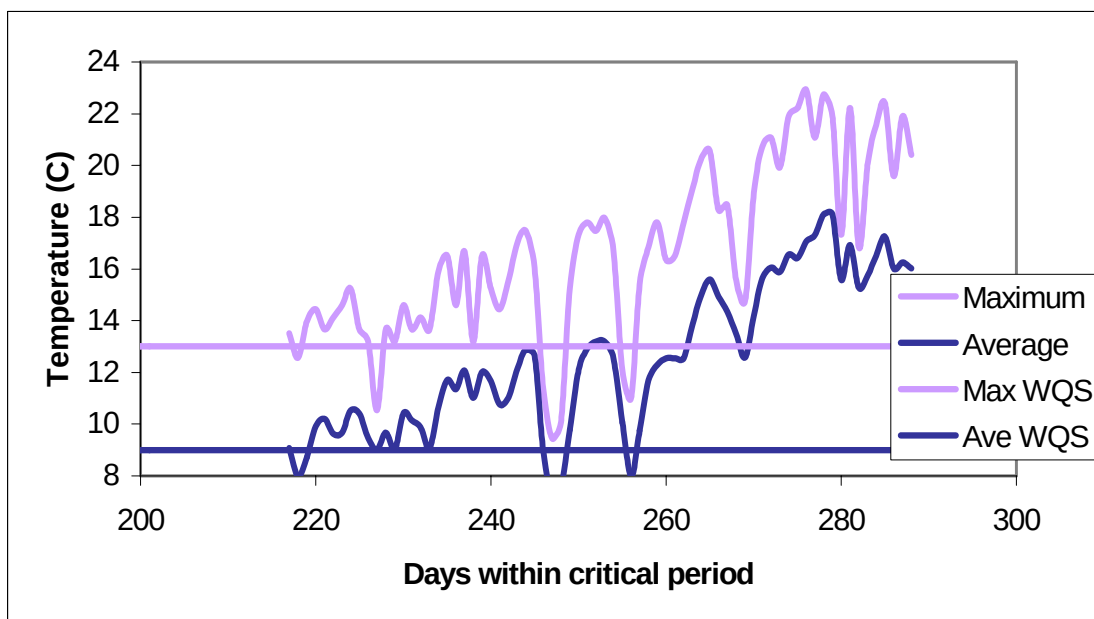


Figure 34. Little Wood River SS temperature data (2001).

Temperature elevations may be influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events that could be a contributing factor to elevated temperatures.

- There are beaver dam complexes within the watershed that are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases creating a wetland type area and exposing the water to more solar radiation.
- Finally, the Little Wood River is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 42). The Little Wood River was divided into 33 segment lengths based on aerial photo interpretations, and the canopy cover ranged from 20% to 70% (Appendix F). The river was divided into three representative segments to determine the canopy cover targets for each of the 33 segment lengths. The river was divided into three representative segments to determine the canopy cover targets for each of the 33 segment lengths. The Little Wood River is dominated by willows, alders, and aspens therefore the co-dominant willow-alder community and co-dominant aspen-willow community shade curve in the Alvord Lake TMDL on page 76 and 77 was the best matching shade curves for the segments. Targets for canopy cover on the river were as follows: upper (40%), middle (40%), and lower (40%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 42. Little Wood River (segment 1) canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Upper (headwaters to Lane Creek)	29.3	Willow-alder	30-40	40
Middle (Lane Creek to Muldoon Creek)	43	Willow-aspen	20-50	40
Lower (Muldoon Creek to reservoir)	43	Willow-aspen	30-40	40

^a Bankfull width was determined from BURP data or flow data measurements for each section.

^b Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).

^c The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process the following have been identified about the Little Wood River (segment 1):

- Biological data indicates that beneficial uses are fully supported.
- Flow is sufficient to support beneficial uses.

- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.
- Sediment (TSS and bedload sediment) is not impacting beneficial uses.
- Nutrients (TP and TIN) are not impacting beneficial uses.
- Bacteria (E. coli) are not impacting secondary contact recreation beneficial uses.
- Temperature is elevated, thus indicating that water quality is not sufficient to support beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for temperature on the Little Wood River. If at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Little Wood River Segment 2 (Reservoir to Canal Diversions)

Biological and Other Data

IDFG manages the fisheries of this segment of the Little Wood River as a put-and-take trout system. The entire stretch of this segment has been identified as a cold water fishery with rainbow trout and brown trout as the desirable game species. Management directions for this segment are to stock the river with hatchery rainbows to develop a fishery (IDFG 2001). The Little Wood River has been reported as being stocked, however, stocking records do not indicate what segments of the river have been stocked.

Biological data is used by the state of Idaho in determining if beneficial uses of wadeable perennial water bodies are fully supported. The WBAG document is used as a tool to assess the beneficial use support status of the water bodies. Biological data that has been collected is used to aid in determining the support status of the water body. This data includes macroinvertebrate data, fishery data, and habitat data. Two of these data groups must be available before the beneficial uses of a water body can be evaluated through the WBAG process.

Biological data is used to indicate support status of beneficial uses, however the WBAG also identifies an exceedance policy for DO, pH, turbidity, and temperature in determining if water quality is capable of fully supporting beneficial uses. As these constituents are numerical criteria in the water quality standards, any elevation above the 10% exceedance policy indicates water quality is not capable of fully supporting beneficial uses. These water chemistry data constituents will be discussed later in the document under the subsection Water Column Data.

No biological or habitat data exists for this segment of the water body. This segment has never had biological or habitat data collected on it; therefore it has never been bioassessed.

Its beneficial use status is unknown. Water chemistry data will be used to identify beneficial use support status.

Hydrology

The Little Wood River (segment 2) is a perennial water body that is used as a transport channel for irrigation demands. Water from the reservoir flows down the channel until it is diverted into the East and West Canals. There are also nine tributaries that feed this segment of the river during spring runoff months. Only one of these tributaries is perennial. There is a small portion in the upper reaches of the segment where the bankfull width is extremely wide and depth is deep, water moves slower in this region then throughout the rest of the river.

There is a current gauging station (13148500 Little Wood River near Carey, ID) located on the Little Wood River just upstream of the East/West Canal diversions. The period of record for this gauging station is from 1925 to the present. The flow from this gauging station was used to determine the average hydrograph of the Little Wood River (Figure 35).

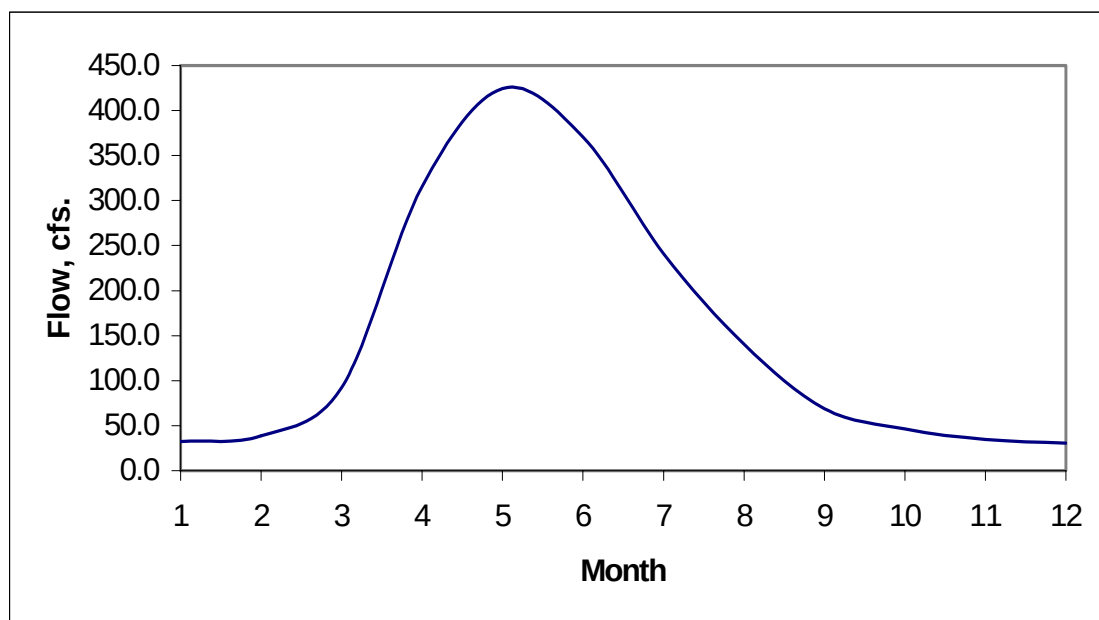


Figure 35. Little Wood River (segment 2) hydrograph.

Flow alteration alters the hydrology of this segment and thus could be impacting beneficial uses, however the support status of this water body is unknown at this time. Flows for the Little Wood River tend to increase in late March and decrease in late June. High flow for Little Wood River occurs in May and averages at 424.2 cfs with low flows occurring from November to February at less than 40 cfs. For the period of record 17.3% of the time flow is less than 10 cfs, and 2.0% of the time it is less than 2 cfs.

There are many water rights for the Little Wood River drainage area. Diversions from the Little Wood River in segment 2 and 3 itself account for 864.6 cfs of water while diversions from the Little Wood River tributaries account for 51.0 cfs. This water is used for various purposes: irrigation, stockwater, domestic water supply, power, and wildlife (IDWR 2002).

Water Column Data

Water chemistry data for the Little Wood River (segment 2) is very limited. There were 17 points of sampling performed by DEQ in the 1970s, 2 sampling points in 1998 and 2000 performed by the USBR, and 179 sampling events by the USGS occurring in the 1970s and into the 1990s. Monthly monitoring for water chemistry data was completed throughout the 2001-2003 period. Temperature loggers were also distributed at various locations.

Table 43 describes the number of samples, maximums, averages, minimums, and number of samples elevated above assessment criteria. The data incorporated into the table is that which was obtained by DEQ at the downstream monitoring point during the 2001-2003 period.

Table 43. Little Wood River (segment 2) water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number Elevated	Instantaneous Criteria	Average Criteria
Indicators							
SC	212	463.0	236.3	102.0	0	< 500	---
PH	54	8.94	---	7.40	0	$6.5 < x < 9.0$	---
TNH3	4	0.500	0.240	0.049	0	Variable	---
Turb	40	44.5	9.5	0	0	BG + 50	---
DO	40	13.84	9.04	6.32	0	> 6	---
BOD	23	11.0	2.4	0.1	1	< 10	---
Chl a	8	4.3	2.4	0.7	0	< 15	---
Pollutants							
TSS	8	19.0	5.5	1.0	0	< 80	< 50
TP	8	0.130	0.071	0.030	0	< 0.16	< 0.10
TIN	4	0.505	0.328	0.076	1	< 0.48	< 0.3
<i>E. coli</i>	14	240.0	21.7	0.5	0	< 406	< 126

^aSC – Specific Conductivity (uhmos/cm), pH – Hydrogen Ion Concentration (standard units), TNH3 – Total Ammonia (mg/L), Turb – Turbidity (NTUs), TSS – Total Suspended Solids (mg/L), TP – Total Phosphorous (mg/L), TIN – Total Inorganic Nitrogen (mg/L), *E. coli* – Escherichia coli (Colony forming units/100ml).

^bAverage criteria for *E. coli* is a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria, except BOD. Elevation in BOD occurred one time in October and was only slightly elevated. At the time of the BOD elevation, DO levels were high (12.73 mg/L) and capable of supporting the biological demand.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO; if these parameters are not elevated beyond standards more than 10% of the time than water quality appears to be capable of supporting beneficial uses. In the case of the Little Wood River (segment 2), neither pH, turbidity, nor DO are elevated during the period of record. *Water quality (DO, pH, and turbidity) appears to be capable of supporting the beneficial uses of the Little Wood River.*

The water column data (TSS) indicates that sediment is not impacting the water quality of the Little Wood River. The TSS average values (5.5 mg/L) averaged well below the average assessment criteria of 50 mg/L. Bedload sediment has not been collected on this water body. *A sediment TMDL will not be completed.*

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events, however as this is a flow regulated segment the critical period is extended to late summer. *Seasonally*, TSS values are elevated in April (7.3 mg/L), June (9.3 mg/L), September (18.0 mg/L), October (10 mg/L), and November (8 mg/L) during higher flow periods, but never above the daily maximum values and are consistently very low (2.6 mg/L) for the remainder of the months..

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the water quality of the Little Wood River. Chlorophyll data is limited; however, values remain below 15 ug/L indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.071 mg/L) averaged below the average assessment criteria of 0.100 mg/L. The TIN average values (0.328 mg/L) averaged above the average assessment criteria of 0.300 mg/L. The TIN values are elevated, however TP values are still low within the system and are likely limiting the growth of nuisance aquatic plants. *A nutrient TMDL will not be completed.*

The critical period for nuisance aquatic vegetation is typically during the late spring into the early fall months when primary production is elevated. *Seasonally*, TP values are slightly elevated in September (0.120 mg/L), but never above the 0.160 mg/L daily assessment value. *Seasonally*, TIN values are elevated in April (0.387 mg/L) and October (0.342 mg/L). The TN/TP ratios for the Little Wood River average 8.0, indicating that the water body is a phosphorous limited water body; during the period of record the water body was nitrogen limited for three of nine events.

Bacteria (*E. coli*) are not impacting the primary contact recreation beneficial use of the Little Wood River. The maximum number of *E. coli* that occurred throughout the period of record was 240, a value that is below the 406 cfu/100ml instantaneous standard. As there were never any instantaneous exceedance, it was not necessary to calculate geometric mean values for the system. *Seasonally*, *E. coli* values are slightly elevated in June (501.8 cfu/100ml) and September (122.0 cfu/100ml). The remainder of the months average 21.5 cfu/100ml. *A bacteria TMDL will not be completed.*

Historical data has been collected by the USGS, USBR, and DEQ and in general supports the above data. For TSS samples, data that was collected in the 1970s range from 8 to 21 mg/L, while data collected in 1998 was 2 mg/L, and that in 2000 was 3 mg/L, values all within the daily maximum assessment criteria. For TP collected by the USGS in the 1970s to 1980s, data ranged from 0.020 to 0.080 mg/L; USBR data collected in 1989 and 2000 falls into this range, however DEQ data collected in the 1970s falls slightly out of the range. The 1970s data ranges from 0.040 to 0.150 mg/L, but still falls within the daily maximum assessment criteria.

Bacteria is a slightly different issue as far as supporting the above data. Bacteria data collected once by DEQ in the 1970s is very low, at less than two colonies, however data collected once in 2000 by the USBR is 2000 colonies. Typically this would indicate that the primary contact beneficial use of the river is impacted, however, as there was only one sample collection and there has been more recent and thorough data collected, the more current and recent data is used to determine if primary contact beneficial uses are supported. In this case they are supported. Therefore, historical data that has been collected supports conclusions made about recreational beneficial uses support status discussed previously.

The designated uses of the Little Wood River are CWAL and SS; as such maximum daily and average daily temperatures from 24-hour temperature data is analyzed based on critical time periods for these designated uses. The critical time periods for CWAL are June 22 through September 21. Fish data has not been collected on this segment of the river; therefore it is unknown what the critical time period is for SS within the river. Temperature loggers were placed at various locations on the Little Wood River for the 2001-2003 periods.

In respect to water quality standards, temperature does not appear to be impacting CWAL existing uses (Table 44 and Figure 36); however sufficient data is not available to determine the impact of temperature during salmonid spawning critical time periods, nor to identify SS critical time periods. The daily average temperatures for CWAL (6.5% exceedance) do not exceed the 10% exceedance policy, nor do the daily maximum temperatures (0% exceedance). There lies a large data gap for salmonid spawning use support status and temperature data impacts. The temperature logger was also placed in an unrepresentative site. It was placed in the backed up waters of the river just prior to the river being diverted into canals. *As a result, fish data as well as temperature data are considered data gaps at this time.*

Table 44. Little Wood River (segment 2) elevated temperatures.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2002	Lower	92	92	0	0.0%	6	6.5%

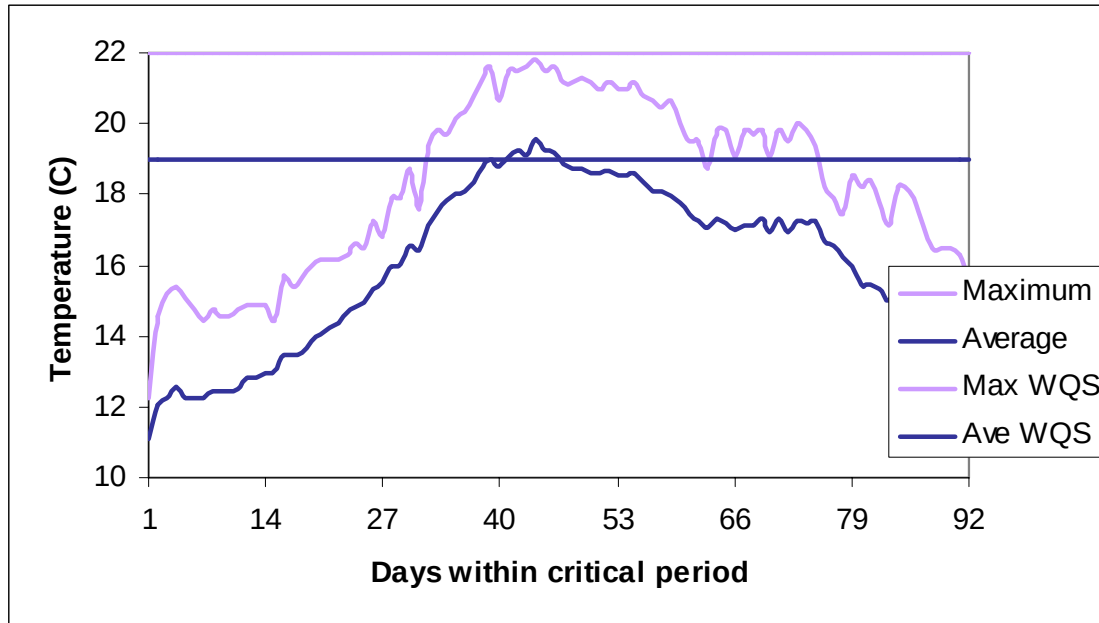


Figure 36. Little Wood River (segment 2) CWAL temperatures.

Conclusions

Through the subbasin assessment process the following have been identified about the Little Wood River (segment 2):

- Biological data should not be used to assess support status on this water body as it is the outflow of a reservoir.
- Flow may not be sufficient to support beneficial uses, however beneficial uses support status is unknown at this time.
- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.
- Sediment (TSS) is not impacting water quality.
- Nutrients (TP and TIN) are not impacting water quality.
- Bacteria (*E. coli*) are not impacting primary contact recreation beneficial uses.
- Temperature is not elevated during CWAL critical time periods, however there is a temperature and fish data gap within the river.

As a result of the subbasin assessment, it has been identified that data for the river indicates that water quality is sufficient to support beneficial uses or that there are data gaps. At this time, the Little Wood River (segment 2) will not be listed as impaired.

Little Wood River Segment 3 (Canal Diversions to Silver Creek)

Biological and Other Data

IDFG manages the fisheries of this segment of the Little Wood River as a general system. This segment has been identified as a cold water fishery with rainbow trout and brown trout as the species of desirable game fishes within the system. Management directions are to support proposed instream flows to develop a fishery (IDFG 2001). IDFG stocking records indicate that stocking has occurred on the Little Wood River; however stocking records do not indicate which segments of the river have been stocked.

Biological data is used by the state of Idaho in determining if beneficial uses of wadeable perennial streams are fully supported. The WBAG document is used as a tool to assess the beneficial use support status of the creek. Biological data that has been collected is used to aid in determining the support status of the creek. This data includes macroinvertebrate data, fishery data, and habitat data. Two of these data groups must be available before the beneficial uses of a water body can be evaluated through the WBAG process.

Biological data is used to indicate support status of beneficial uses, however the WBAG also identifies an exceedance policy for DO, pH, turbidity, and temperature in determining if water quality is capable of fully supporting beneficial uses. As these constituents are numerical criteria in the water quality standards, any elevation above the 10% exceedance policy indicates water quality is not capable of fully supporting beneficial uses. These water chemistry data constituents will be discussed later in the document under the subsection Water Column Data.

This segment of the river is intermittent as a result of reservoir storage and water delivery to water users and, as such, should not be assessed through the WBAG process. Very little biological or habitat data has been collected on this segment of the Little Wood River. Data was collected through the BURP protocol in 1995 about four miles upstream of the Silver Creek confluence. Macroinvertebrate and habitat data were collected at this site.

The BURP files on Fish Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel types and activities affecting the reach for each reach are reported in Table 45. Additional information provided in the BURP files indicates that the lower reaches resemble canals, water is cloudy, and there is irrigation equipment along banks (DEQ 1993-2001).

Table 45. Characteristics of the Little Wood River (segment 3).

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Lower		1	C	RDS, AG, DIV

^a Data from BURP files.

^b RDS – Roads, AG – Agriculture, DIV – Diversions.

Fish data has not been collected on this segment of the Little Wood River.

Water chemistry data for this segment was not collected, as there is typically no water in the water body. However, there is some historical data that was collected from the period of 1975 to 1989. This data was retrieved from the STORET database. The indicator pollutants during this period of historical collection do not indicate impairment of the water body, nor do nutrient data that have been collected. Nutrient data exists in the form of TP and TIN. The critical period for nuisance aquatic vegetation is typically during the spring and into the summer months when primary production is elevated; during this time period monthly averages of TP are not elevated and TIN values are elevated slightly. However, the lack of water in the system is limiting nuisance aquatic vegetation growth.

Hydrology

The Little Wood River (segment 3) is an intermittent river. The majority of this water body is typically dry throughout the year; as a result adequate flow data does not exist. A decree from 1909 states that the water users can choose to use the water that they have a right to, to the point that the Little Wood River above the junction of Silver Creek gets dewatered, despite the water rights that occur downstream (MacMillian 1909).

This segment of the Little Wood River below the diversions has water during the melt off months of April through June and the flow can vary depending on the year and amount of storage room that is needed for the reservoir. In order for water to pass the diversion gates into the river there has to be a minimum of 50 cfs. This water often subs out into the gravel a mile and a half downstream of the diversions (Simpson 2001). The only source of water on the Little Wood River from the East/West Canal diversions until Silver Creek is the confluence of the canals back into the Little Wood River. There are many water rights for the Little Wood River and they were discussed in the previous section about segment 2.

Conclusions

This segment of the Little Wood River, from the East/West Canal diversion to the Silver Creek confluence typically does not receive water unless there is storage room needed in the reservoir. It also has been decreed as a dry stream due to water rights, therefore this segment will be delisted for all pollutants but remain listed as impacted by flow alteration.

Little Wood River Segment 4 (Silver Creek to Big Wood River)

Biological and Other Data

IDFG manages the fisheries of this segment of the Little Wood River in three different management styles. The Little Wood River from Silver Creek to Shoshone has been identified as a cold water fishery, while the segment from Shoshone to the mouth has been identified as a warm water fishery. The desired game fishes for the cold water fisheries are rainbow and brown trout and then small mouth bass for the warm water fisheries. The entire stretch is managed as a general system except for two segments. The upper segment in the

Bear Track Williams State Recreation Area is managed as a trophy system while the lower segment from the Dietrich diversion dam to Shoshone is managed as a put-and-take trout system. Some management directions throughout various portions of the segment are improving riparian conditions, stock fingerling trout as needed, reverse declining trend of rainbow trout population, work to provide year round flows and fish passage (IDFG 2001). According to IDFG records the Little Wood River has been stocked. Stocking records do not indicate locality on the river, however the Fisheries Management Plan identifies a stocking program in much of this segment of the river, so it is assumed that much of the stocking occurred in the high use areas of this segment.

Biological data is used by the state of Idaho in determining if beneficial uses of wadeable perennial streams are fully supported. The WBAG document is used as a tool to assess the beneficial use support status of the water body. Biological data that has been collected is used to aid in determining the support status of the water body. This data includes macroinvertebrate data, fishery data, and habitat data. Two of these data groups must be available before the beneficial uses of a water body can be evaluated through the WBAG process.

Biological data is used to indicate support status of beneficial uses, however the WBAG also identifies an exceedance policy for DO, pH, turbidity, and temperature in determining if water quality is capable of fully supporting beneficial uses. As these constituents are numerical criteria in the water quality standards, any elevation above the 10% exceedance policy indicates water quality is not capable of fully supporting beneficial uses. These water chemistry data constituents will be discussed later in the document under the subsection Water Column Data.

Biological and habitat data has been collected at various locations in this stretch of the Little Wood River. Data was collected through the BURP protocol four times in 1995, twice in 1996, and once in 2001. Five sites were located upstream of the Dietrich Canal and two sites were located between the Dietrich Canal and the Milner Gooding Canal. Macroinvertebrate and habitat data was collected at all of the sites, while fish data was collected at two sites. BLM has collected field and temperature data on the upper portion of this segment. DEQ has collected macroinvertebrate data on this segment of the Little Wood River outside of the BURP protocol. *However, as the Little Wood River is fed by a spring fed system (Silver Creek) and is highly flow altered due to reservoir storage upstream and the use of the river as a water transport channel, the WBAG is not an accurate way to assess beneficial use support status, water chemistry data will be used in its place.*

The BURP files on the Little Wood River indicate a number of characteristics of the river as well as a number of activities affecting the river. The stream order, gradients, Rosgen stream channel types and activities affecting each reach are reported in Table 46. Additional information provided in the BURP files indicate that the upper reaches have grazing impacts, and very little riparian zone, the riparian zone consists of grass and sagebrush, some willows and wild rose bushes. The river runs over lava beds, undercut banks are present as well as large boulders, evidence of sedimentation. There are mineral deposits covering the riverbed, and beds of macrophytes occur in the river, however, the water is clear. Information from

the middle reaches indicates that the river runs over old lava flows, wildlife are present as well as domesticated animals, there are basalt boulders in and along the river, riparian zone is limited but consists of sedges, grasses, cattails, and willows (DEQ 1993-2001).

Table 46. Characteristics of the Little Wood River (segment 4).

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Upper	4,4	2,1.5,1,1.2,1	B, B, C, C, B	GR, REC, RDS, DIV
Middle	5	0.9,2.6	C, C	GR, AG, DIV, RDS, REC

^a Data from BURP files.

^b RDS – Roads, GR – Grazing, AG – Agriculture, DIV – Diversions, REC – Recreation.

Bridgelip sucker, redbside shiner, longnose dace, speckled dace, brown trout, rainbow trout, utah chub, utah sucker, and common carp have been found to occur in this segment of the Little Wood River (Table 47). As a whole, 22.2% of the fish species of this segment of the Little Wood River were cold water indicators, 9.5% of all the fish collected were cold water indicators, 0% of the rainbow trout and 2.1% of the brown trout were young of year. Bridgelip sucker accounted for 14.8% of the fish collected, redbside shiner accounted for 15.2%, longnose dace for 5.1%, speckled dace for 37.0%, brown trout for 9.0%, while utah sucker, utah chub, common carp, and rainbow trout together accounted for 0.5% of the population.

Table 47. Little Wood River (segment 4) fish data.

Site	Rainbow trout	Brook trout	Brown trout	Sculpin	Sucker	Dace	Redside shiners	Utah chub	Rainbow trout young of year	Brook trout young of year	Brown trout young of year
1995SCIROA49	0	0	1	0	90	482	391	---	0	---	0
1995SCIROA68	---	---	---	---	60	31	46	1	---	---	---
1995SCIROA48	---	---	39	---	63	293	182	---	---	---	3
1995SCIROA57	25	---	111	---	---	---	---	---	---	---	---
1993IDFGLWR001	1	---	9	---	51	56	48	1	---	---	---
1993IDFGLWR002	5	---	142	---	60	31	46	1	---	---	1

^a Data collected by DEQ and IDFG.

^b electrofishing event for 1995SCIROA57 may have been targeting species.

Hydrology

The flows of the Little Wood River (segment 4) are highly variable and highly altered. The placement of the Little Wood River Reservoir for flood control and irrigation management has greatly altered the hydrology of the downstream segments of the river. The section immediately above the Silver Creek confluence is dry throughout the year and does not

supply the downstream segment with flow except during the irrigation season. A small amount of water that is irrigation return is delivered from the east/west canals to the river. This flow occurs during the irrigation season and contributes approximately less than 5 cfs of flow to the river. As a result, the major contributor of flow to the Little Wood River is Silver Creek, a spring-fed system. The Little Wood River due to the Silver Creek influence and lack of flow down the natural channel of the river acts to an extent more like a spring-fed system; flushing flows are no longer an annual occurrence in the water body.

This segment of the river can actually be divided further into four more segments based on the hydrology within the river (Figure 37). The upper segment consists of spring-fed flows of Silver Creek with little diversion occurring, as it is predominately rangeland. The next section is predominately spring-fed flows of Silver Creek; however flows can fluctuate within the irrigation season as a result of the removal of water to canal systems. The third section fluctuates during the irrigation season also; however there is an influx of canal water from outside of the subbasin into the river increasing the flows. This water is transported to downstream users. Finally, the last segment fluctuates during the irrigation season to very little flow. The majority of the water up river has been taken out of the river and delivered to water users or transported into a different delivery system.

There is not a current gauging station located on Segment 4 of the Little Wood River, however, there have been historical gauge stations (Figure 38). There are three historical gauges: 13151000-Little Wood River near Richfield, ID (1911 to 1972), 13151500-Little Wood River at Shoshone, ID (1922 to 1959), and 13152000-Little Wood River at Toponis, ID (1896 to 1897). In the years 2001 to 2003 there were 3 monitoring sites within this segment and flow data was collected. The sites were at Preacher Bridge near Silver Creek Confluence, at Richfield, and at the mouth. The current sites are not representative of this segment as a whole throughout time because it is a low flow year and the historical sites are not representative of what has been occurring in the recent past.

As this segment of the river is highly flow altered the assumption can not be made that flows within this segment are similar to flows at any of the gauged stations on the Little Wood River. As a result, predicted average flows for all sites have been determined in the following manner. The amount of flow occurring during the 2001-2003 drought years on Silver Creek were compared to the average flows conditions. It was determined what percent of the average flow occurred during the drought years seasonally. These percentages were then applied to the Little Wood River flow measurements that occurred during the 2001-2003 period to estimate the average flow conditions of the river. This allowed the following hydrograph to represent estimated average conditions rather than drought conditions (Figure 37).

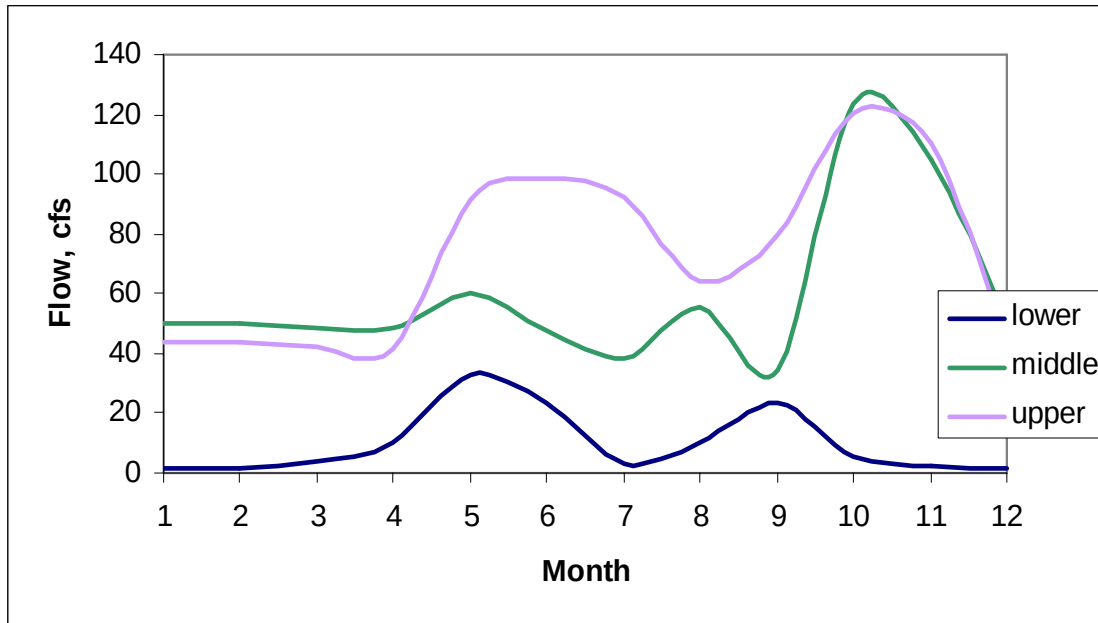


Figure 37. Little Wood River (segment 4) current predicted hydrographs.

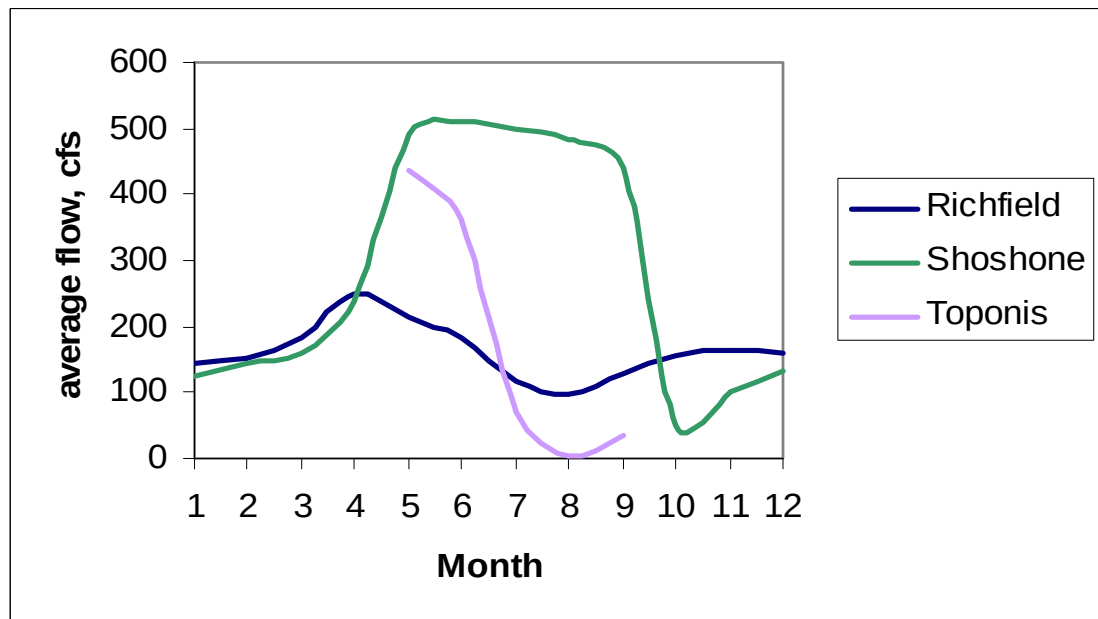


Figure 38. Little Wood River (segment 4) historical hydrographs.

Flow alteration is likely impacting water quality of the river. The average historical data indicates that flow increases in early April and decreases in late September. High flows occur in May at 268 cfs while low flows occur from September to March, ranging from 110 to 150 cfs. The estimated average flows of the current hydrograph indicate that flow increases in late April and decreases in September for a short period. High flows in the lower

segment occur in May and September at 32 and 23 cfs and low flows occur from October to March at 2.9 cfs. Data was not collected from December to March due to inaccessibility of sites. Little Wood River has water year round, typically, however it has been known to go dry for very brief periods of time. *As can be seen by the current hydrograph, there is a lot of activity occurring within the river that is impacting the hydrology of the river and likely also influencing water quality.*

There are many water rights for the Little Wood River drainage area. Diversions off of Little Wood River itself account for 2,350 cfs of water while diversions from Little Wood River tributaries account for 4,252 cfs. This water is used for various purposes: irrigation, stockwater, domestic water supply, minimum instream flow, power, water quality improvement, commercial, and wildlife (IDWR 2002).

Water Column Data

Current water chemistry data for the Little Wood River (segment 4) is limited, however there is a great deal of historical data that has been collected compared to that collected on any other water body in the subbasin. Monthly monitoring for water chemistry data was completed throughout the 2001-2003 period at three sites: an upper, middle, and lower site. The lower site was used to determine whether water chemistry is capable of fully supporting the beneficial uses of the river, and the middle and upper site were used to indicate impacts throughout the length of the creek. In addition, nutrient data was also collected in 2004-2005 to better characterize the nutrients and flow in the lower ends of the river. Temperature loggers were distributed at various locations. Historical data that was collected in the 1970s, 1980s, and 1990s was used to aid in identification of seasonal influences.

Table 48 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed see Analysis Process, page 45.*

Table 48. Little Wood River (segment 4) water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number Elevated	Instantaneous Criteria	Average Criteria
Indicators							
SC	75	509.0	356.3	224.9	2	< 500	---
PH	75	9.24	---	6.61	4	6.5 < x < 9.0	---
TNH3	14	0.583	0.081	0.005	0	Variable	---
Turb	75	258.0	11.8	0	4	BG + 50	---
DO	78	13.23	9.41	4.98	5	> 6	---
BOD	13	9.0	5.5	3.0	0	< 10	---
Chl a	29	34.0	4.7	0.5	2	< 15	---
Pollutants							
TSS	8	16.0	3.3	0.5	0	< 80	< 50
TP (#1)	29	2.3	0.571	0.003	24	< 0.16	< 0.10
TP (#2)	20	0.124	0.051	0.011	0	< 0.16	< 0.10
TIN	4	2.733	0.761	0.010	1	< 0.48	< 0.3
<i>E. coli</i>	30	110.0	15.0	1.0	0	< 406	< 126

^aSC – Specific Conductivity (uhmos/cm), pH – Hydrogen Ion Concentration (standard units), TNH3 – Total Ammonia (mg/L), Turb – Turbidity (NTUs), DO – Dissolved oxygen (mg/L), BOD – Biological oxygen demand (mg/L), Chl a – Chlorophyll a (ug/L), TSS – Total Suspended Solids (mg/L), TP – Total Phosphorous (mg/L), TIN – Total Inorganic Nitrogen (mg/L), *E. coli* – Escherichia coli (colony forming units/100ml).

^bAverage criteria for *E. coli* is a geometric mean rather than an average.

^cThe TP values for site #1 occurred at the mouth of the Little Wood River and represent the area from the Clover Creek Canal Crossing to the Big Wood River. The TP values for site #2 occurred upstream of the Clover Creek Canal Crossing and represent the area from the Silver Creek confluence to the Clover Creek Canal Crossing..

The indicator constituents could be indicating that pollutants are impacting the water body. Data for indicator constituents' at all three sites were used for assessment purposes. Specific conductivity was elevated twice at the lower site during April and May. Elevations occurred in pH four times, June, July and August of 2002 and once in June of 2003. Two of the elevations occurred at the lower site and the other two occurred at the middle site. Turbidity was elevated four times, three of the elevations were slightly elevated and two of these occurred on the same day at different sites. The fourth elevation was elevated to 258 NTUs and was likely a result of equipment problems as the turbidity readings fluctuated from 0 to 586, at any rate turbidity was elevated less than 10% of the time. The assessment criteria for DO were not met for five events, however DO criteria were still met less than 10% of the time. Chlorophyll data was elevated twice during the period of record in June and September in lower reaches of the river and could be indicating that nutrient levels are such that nuisance aquatic growth could be occurring.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is

applied to pH, turbidity, and DO; if these parameters are not elevated beyond standards more than 10% of the time than water quality appears to fully support beneficial uses. In the case of the Little Wood River (segment 4), neither pH, turbidity, nor DO are elevated more than 10% of the time. *Water quality (DO, pH, and turbidity) appears to be capable of supporting the beneficial uses of the Little Wood River.*

The water column data (TSS) indicates that sediment is not impacting water quality of the Little Wood River, however bedload sediment data (percent fines) indicates that sediment does impacting the water quality. The TSS average values (3.3 mg/L) averaged well below the average assessment criteria of 50 mg/L. The percent fines data was elevated above the assessment criteria (35%). There were 11 collection events in the water body and the values for percent fines ranged from 7.1% to 59.2%. *Bedload sediment appears to be impacting the water quality of the Little Wood River.*

The critical period for sediment transport is typically during the spring and early summer, when flow is elevated due to runoff events however, since this is a spring-fed system and flow regulated stretch of the river, critical periods are extended to include the irrigation season (March through July). *Seasonally*, TSS values are elevated in February (41.6 mg/L), March (51.9 mg/L), April (41.5 mg/L), May (25.9 mg/L) and June (31.0 mg/L) and are consistently low (8.5 mg/L) during the remainder of the year. These values except for March remain below the average assessment criteria of 50 mg/L.

Stream bank erosion inventories were completed to identify the source of the sediment and they indicate that there is a larger load of sediment being delivered into the river that is likely impacting water quality. Bank stability of upper, middle, and lower portions of the water body were calculated at 85.2%, 60.8%, and 75.4%. The target for stream bank stability is 80% or higher; these targets are not being met in the middle and lower portions of the river. *Sediment erosion from the banks is impacting water quality; a sediment TMDL will be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are likely impacting water quality of the river. Chlorophyll data is limited; however, two values that were elevated above 15 ug/L could indicate that nuisance aquatic vegetation is occurring in the water body. The TP average value (0.571 mg/L) is elevated above the average assessment criteria of 0.100 mg/L. The TIN average value (0.761 mg/L) is elevated above the average assessment criteria of 0.480 mg/L. As chlorophyll data indicates that nuisance aquatic vegetation could be occurring and both TP and TIN values are elevated, *a nutrient TMDL will be completed on the Little Wood River (segment 4).*

The critical period for nuisance aquatic vegetation is typically during the late spring into the early fall months when primary production is elevated. *Seasonally at the site at the confluence of the river*, monthly TP values are elevated in January (0.850 mg/L), February (0.942 mg/L), March (1.365 mg/L), April (0.718 mg/L), November (0.697 mg/L), and December (1.333 mg/L). *Seasonally*, TIN values are elevated in February (0.931 mg/L), March (0.818 mg/L), April (0.693 mg/L), November (0.650 mg/L), and December (0.944 mg/L). *Seasonally and historically*, TIN values are elevated above the average assessment

criteria during these months. *Seasonally at the site above the Clover Creek Canal Crossing site*, the TP values are elevated in May (0.083 mg/L), June (0.089 mg/L), July (0.111 mg/L), August (0.108 mg/L), and September (0.058 mg/L). However, June and July are the only months in which monthly averages are elevated above monthly average criteria. The TN/TP ratios for the lower segment of the river average at 26.3 indicating that the water body is a phosphorous limited water body. *Nutrients are a concern in this water body.*

Bacteria (*E. coli*) are not impacting the primary contact recreation beneficial use of the Little Wood River (segment 4). The maximum number of *E. coli* that occurred throughout the period of record was 110, a value that is below the 406 cfu/100ml instantaneous standard. As there were never any instantaneous exceedance, it was not necessary to calculate geometric mean values for the system. *Seasonally E. coli* values are slightly elevated in May (31.0 cfu/100ml), June (81.4 cfu/100ml), July (21.7 cfu/100ml), September (29.4 cfu/100ml), and November (37.3 cfu/100ml), but never above the instantaneous criteria. The remainder of the months average 2.6 cfu/100ml. *A bacteria TMDL will not be completed.*

Comparisons of lower, middle, and upper sites indicate that there is a general increase in pollutants in the downstream direction and pollutant peaking at the three sites varies. The *E. coli* concentrations tend to increase in the downstream direction and the peaks from site to site are very similar with only a slight difference as the lower site peaks in November while the other sites remain static. From the upper site to the middle site there is an increase averaging 2 cfu/100ml, while from the middle site to the lower site there is an average increase of 24.6 cfu/100ml. There appears to be activity between the middle and lower site increasing the bacteria concentrations, however the bacteria data is not indicative of impairment.

The TSS concentrations tend to stay consistent throughout the stretch of the river and the peaks for the upper and lower site are very similar with a slight difference in the middle sites peaks. From the upper site to the middle site there is an increase averaging 1.6 mg/L, while from the middle site to the lower site there is an average increase of 2.2 mg/L. The upper and lower site peaks are very similar, and while the TSS concentrations of these sites delve the middle site tends to begin its peak. Therefore, it appears that sediment is being deposited between the upper two sites but is being transported again somewhere between the two lower sites during the spring and summer. During the early summer, sediment is suspended at the middle site and being deposited downstream. However, the TSS data is not indicative of impairment.

The TIN concentrations tend to vary throughout the stretch of the river and the peaks, for the sites are very similar. From the upper site to the middle site there is a decrease in concentration averaging 0.219 mg/L (TIN is being assimilated); while from the middle site to the lower site there is an average increase of 0.534 mg/L (TIN is being reintroduced into the water column).

The TP concentrations and peaks vary little between the upper and middle site, but vary greatly at the lower. From the upper site to the middle site there is an increase in concentration averaging 0.006 mg/L, while from the middle site to the lower site there is an

average increase of 0.186 mg/L. The TP concentrations at the upper and middle site remain fairly consistent throughout the year with slight elevations during the early summer. However, TP concentrations at the lower site fluctuate up and down throughout the year. The TP concentrations will be peaking one month and delve the next only to repeat the peak and valley cycle of the previous months. *There appears to be some activity occurring between the middle and lower site that is increasing the TP concentrations of this river.*

There appears to be a lot of activity occurring within this stretch of the Little Wood River that could be impacting water quality. *As there is so much fluctuation in TP throughout this system, and there is very little data, further data will be collected to refine the TMDL. A more intensive study of impact areas is being completed at this time and will include TSS, TP, TIN, bacteria, and flow data.*

The designated uses within the Little Wood River (segment 4) are CWAL throughout the length and SS throughout the upper portion of the river. As such, maximum daily and average daily temperatures from 24-hour temperature data analyzed based on critical time periods for these existing uses. The critical periods for CWAL are June 22 through September 21. Brown trout are spawning in the upper portions of this segment and as such the critical periods for salmonid spawning are from October 1 to April 1. Temperature loggers were placed at various locations on the Little Wood River for the 2001-2003 period.

In respect to water quality standards, temperature appears to be impacting CWAL designated uses but not SS designated uses (Table 49 and Figure 39). For the period of record, the daily average temperatures for CWAL (75.7% exceedance) do exceed the 10% exceedance policy, as do the daily maximum temperatures. The daily average temperatures for SS (3.0% exceedance) do not exceed the 10% exceedance policy, nor do the daily maximum temperatures (0% exceedance).

Table 49. Little Wood River (segment 4) elevated temperatures.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2001	Lower	92	89	83	93.3%	73	82.0%
2002	Lower	92	88	54	61.4%	62	70.5%
2002	Upper	92	92	32	34.8%	41	44.6%
2003	Lower	92	92	71	77.2%	74	80.4%
2003	Middle	92	92	42	45.7%	70	76.1%
2003	Upper	92	92	32	34.8%	41	44.6%
SS							
2002	Upper	183	26	0	0.0%	1	3.8%
2003	Middle	183	154	0	0.0%	3	1.9%
2003	Upper	183	154	0	0.0%	1	0.6%

^a CWAL days missing in the 2001 data include September 19 through September 21, days missing in the 2002 data include September 18 through September 21.

^b SS days missing in the 2002 data include October 1 through March 6, days missing in the 2003 data include October 1 through October 29.

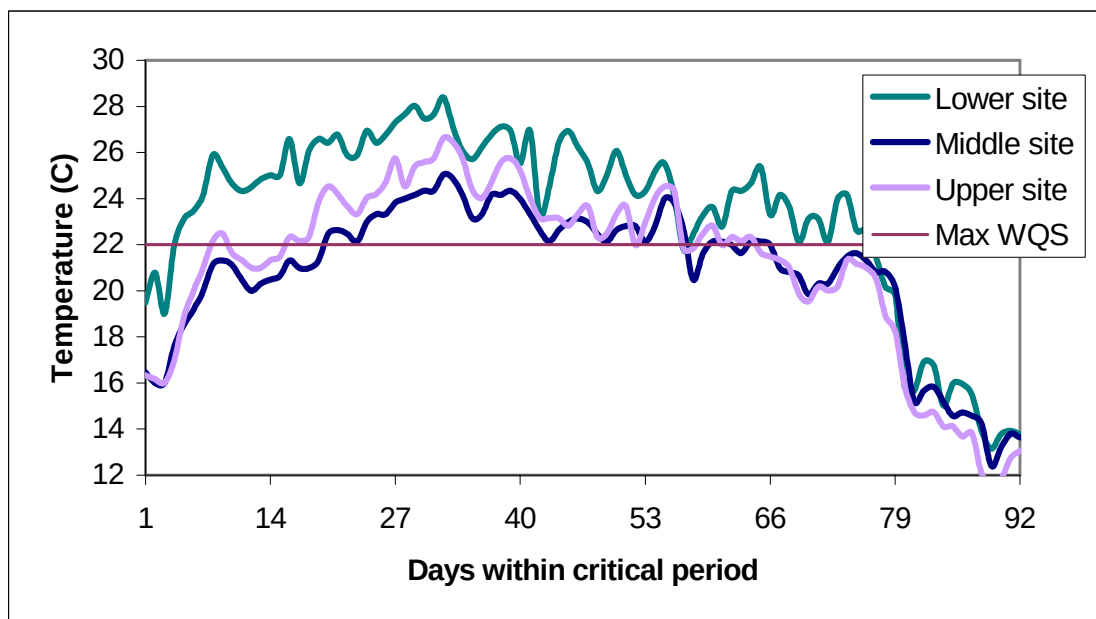


Figure 39. Little Wood River (segment 4) CWAL maximum temperatures (2003).

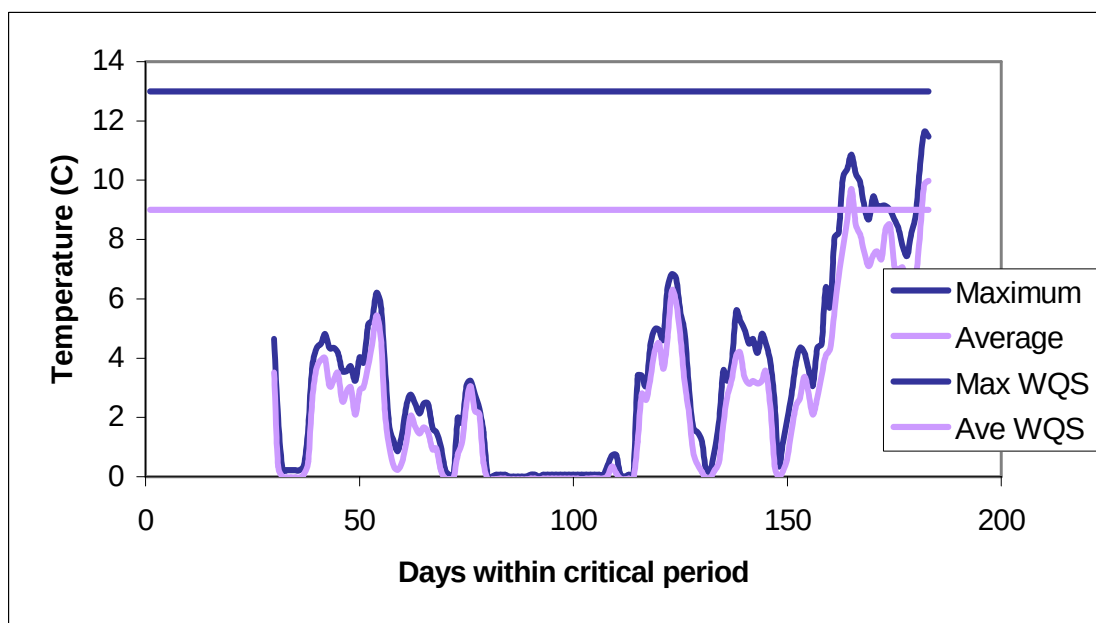


Figure 40. Little Wood River (segment 4) SS temperatures (2003).

Temperature elevations may be being influenced by a number of activities, such as the following:

- There is a lack of natural Little Wood River flow occurring in the system due to flow alteration. The majority of the water is from a spring-fed system, which has a tendency to have elevated temperatures due to wide stream widths and ground water influence.
- The upper portion of the river runs through unweathered basalt flows and metamorphic rock. These geologic formations could be contributing to the solar radiation exposure due to the inability of the creek, in most areas, to develop some larger riparian plants due to restricted growth area. Also a great deal of the river bank and substrate is bedrock, which is likely conducting a certain amount of heat that contributes to the increased temperatures of the water body.
- Finally, the Little Wood River is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 50). The Little Wood River was divided into 88 segment lengths based on aerial photo interpretations, the canopy cover ranged from 0% to 50% (Appendix F). The river was divided into four representative segments to determine the canopy cover targets for each of the 88 segment lengths. The Little Wood River is dominated by willows therefore the willow mix community and willow community shade curves in the Alvord Lake TMDL on page 75 and 77 was the best matching shade curves for all the segments. Targets for canopy cover on the river were as follows: upper (15%), upper middle (30%), lower middle (35%), and lower (40%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 50. Little Wood River (segment 4) canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Upper (Silver Creek to Dietrich Canal)	37	Grasses, willow	10-30	15
Upper middle (Dietrich Canal to Milner Gooding Canal)	27.2	Willow, grass	10-50	30
Lower middle (Milner Gooding Canal to Lateral canal)	25	Willow	0-40	35
Lower (Lateral canal to mouth)	21.5	Willow	0-50	40

^a Bankfull width was determined from BURP data or flow data measurements for each section.

^b Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).

^c The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process the following have been identified about the Little Wood River (segment 4):

- Biological data that has been collected should not be used to assess the beneficial uses support status.
- Flow is sufficient to support beneficial uses in most areas, however flow alteration is affecting the ability of the river to flush itself and is likely contributing to elevated temperatures.
- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment from stream bank erosion) is impacting the water quality of the river.
- Nutrients (TP and TIN) are impacting the water quality of the river.
- Bacteria (*E. coli*) are not impacting the primary contact recreation beneficial uses of the river.
- Temperature data indicates that water quality is not sufficient to support beneficial uses of the river.

As a result of the subbasin assessment, a TMDL will be completed for sediment, nutrients, and temperature, and the river will remain listed as impacted by flow alteration. In addition, DO and bacteria will be delisted as pollutants impacting the water quality of the Little Wood River (segment 4). Further data is being collected at this time and likely as a result will lead to different load allocations than those established in this document.

If at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data was meeting the newer standards, the temperature TMDL will be considered to be completed. At such time, the Little Wood River will have temperature delisted as a pollutant impairing water quality of the river.

Little Wood River Reservoir

The Little Wood River Reservoir lies in the upper third portion of the Little Wood River Subbasin and has a drainage area of 275 square miles. The dam lies in the Little Wood River water course, approximately 28 miles downstream of the headwaters of the Little Wood River and 11 miles northwest of Carey, Idaho. Construction was completed in 1939, and enlargement of the dam was completed in 1960. It is an earth fill dam that is 129 feet in height and 3,100 feet in length. Hydraulically, the dam is 116 feet in height and has an uncontrolled crest. A small power plant run by the Little Wood River Irrigation District began operating in 1985 (USBR, 2004).

Land use, ownership, and vegetation of the Little Wood River Reservoir is described based on a 1-mile-wide corridor approach, as was done in the Upper Snake Rock and Big Wood River TMDLs. The majority of the land surrounding the reservoir is private (77.1%) with open water making up 8.5% of the area. The remainder of the land is managed by the state (13.8%) and BLM (0.5%). The land use for the reservoir is predominately rangeland (75.0%) with irrigated gravity flow making up 20.2% of the area, and irrigated sprinkler (5.6%) the remainder. The vegetation along the reservoir corridor is predominately shrubland (85.9%) followed by riparian (5.1%). The remainder of the corridor consists of grassland (3.2%), water (3.0%), forested (1.8%), and wetlands (0.9%) (ArcView Coverage, 1992-1996).

The Little Wood River Reservoir corridor passes through two different geologic formations as well as three different soil types. The reservoir lies in the Snake Plain lava flows and is surrounded by mixed silicic and basaltic volcanic ejecta flows and reworked debris. The soils of the reservoir corridor that include the reservoir and land to the east of the reservoir have soil erosion potentials (K factors) that are higher (0.35-0.45), while the soils of the land to the west of the reservoir have K factors that are slightly lower (0.25-0.35) (ArcView Coverage, 1992-1996).

Biological and Other Data

IDFG manages the fisheries of the Little Wood River Reservoir as a general system. This reservoir has been identified as a cold water fishery with rainbow trout as the species of desirable game fishes within the system. Management directions are to maintain the fishery with fingerling and catchable rainbow trout stockings, and maintain winter and summer catch rates (IDFG 2001). IDFG stocking records indicate that stocking has occurred frequently in the Little Wood River Reservoir. Species types that have been stocked are rainbow species, with brown trout having been stocked twice in the 1980s.

Hydrology

The Little Wood River Reservoir has a carrying capacity of 30,000 acre-feet. The USBR has reservoir storage data starting from the summer of 1960 to the present. The reservoir has been filled above its storage capacity 5.4% of the time, and 14% of the time the reservoir has had less than 5,000 acre-feet. Figure 41 depicts the average hydrograph for the reservoir. Peak storage capacity is reached during May and June, and storage decreases rapidly until October when the reservoir begins to fill.

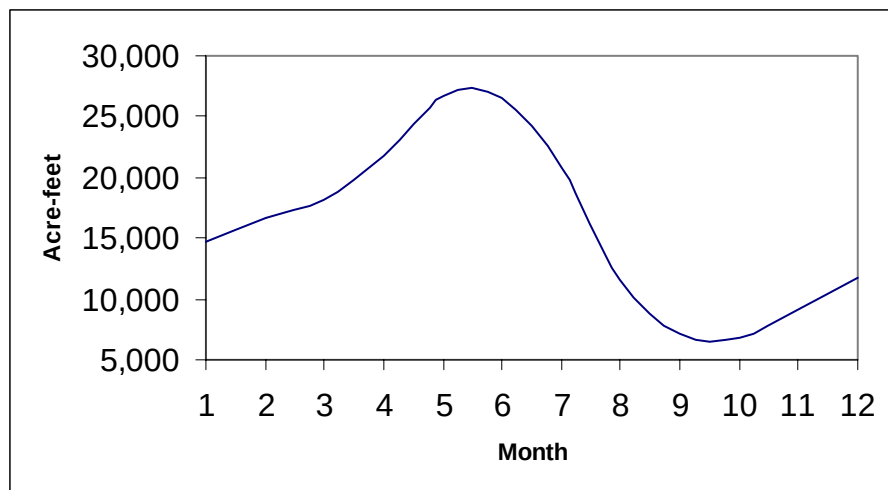


Figure 41. Little Wood River Reservoir average hydrograph.

The Little Wood River is the main water body that feeds into the Little Wood River Reservoir. In addition, there are six intermittent water bodies that feed directly into the reservoir to add to the volume of the reservoir during peak flows. The predicted hydrograph for the Little Wood River was described previously (Figure 32, page 102). Peak flows for the river occur from April to June averaging at 381 cfs, while the remainder of the year contributes to base flows that average at 76 cfs.

By nature, the Little Wood River Reservoir is a flow altered water body. The Little Wood River Project was authorized for irrigation and flood control with minimum requirements for basic recreation facilities and measures to preserve fish and wildlife (USBR 2004). Water volume in the reservoir, on average, decreases from 26,648 acre-feet to 6,882 acre-feet, a 74% decrease in water volume.

Water Column Data

Water chemistry data for the Little Wood River Reservoir is limited. Nutrient data was collected irregularly throughout the data collection period. However, temperature, DO, chlorophyll, and secchi depth were collected regularly and will be used to identify the trophic state of the reservoir. Data was collected at two sites on the reservoir, in the riverine section where the Little Wood River feeds into the reservoir and near the dam, which would be the Z-max or deepest portion of the reservoir. The Z-max is the more critical site location as this is the location where the reservoir starts stratifying. The riverine section is less critical as at this site the reservoir is still tending to act as a river and is more indicative of the external loading that is being delivered (Lay 2003).

The Carlson Trophic State Index (TSI) was used to determine the trophic nature of the Little Wood River Reservoir. This metric can be used to determine if phosphorous is in excess in the system. A TSI score of 50 or more indicates that a lake/reservoir is eutrophic and thus has high productivity (EPA 2004). This value has been used in various other south central TMDLs including the Goose Creek and Raft River Subbasin Assessment and TMDL. The

TSI values for chlorophyll, secchi depth, TP, and total nitrogen were averaged together for an overall TSI score, however each was looked at individually. When looking at individual TSI scores the measured constituents cannot exceed the following values for TSI scores to remain below the TSI threshold value: secchi depth (2m), chlorophyll at 1 meter (7.2ug/L), TP (0.024 mg/L), and total nitrogen (0.7 mg/L).

The overall average TSI score for the Little Wood River Reservoir is 39.9, indicating that the trophic nature of the reservoir is oligotrophic. The average TSI for each site visit ranges from 34.8 to 48.5. TSI values tend to increase as the season progresses and the water volume decreases due to reservoir draw down. The TP and total nitrogen data were not collected regularly, so a trend is difficult to distinguish, however, average TSI scores for each constituent were below the 50 threshold. Total phosphorous exceeded the threshold value once late in the season and total nitrogen values were never exceeded. Average TSI scores for secchi depth and chlorophyll tend to increase as the season progresses; however the average TSI for each constituent did not exceed the 50 threshold. TSI scores for secchi depth range from 35.0 to 55.7. The secchi depth value was exceeded once, late in the season, with a visibility depth of 1.3 meters. The TSI scores for chlorophyll range from 28.41 to 48.96, and never exceeded threshold.

Individual TP and secchi depth site values exceed the threshold TSI score; however, this occurred late in the season when water volume had decreased. Drawdown events in a reservoir can lead to sediment from within the reservoir being released into the water. In addition, phosphorous that is adsorbed to this sediment is also released (Lay 2003). This is an internal loading process rather than an external loading process and, thus, a natural event for a reservoir system.

Temperature profiles were completed on the Little Wood River Reservoir to determine lake stratification (Figure 42). The Little Wood River Reservoir is a stratified reservoir with three layers. Early in the season, the epilimnion is about 5 meters deep, however, as the season progresses, water volume decreases, and wind events are likely more abundant, this layer increases to about 8 meters. The metalimnion is about 4 meters deep early in the season but decreases later in the season to about a meter in depth. The hypolimnion is deeper early in the season and begins at about 10 meters, but decreases in depth later in the season as the reservoir is a bottom withdraw system. Temperatures are elevated in the epilimnion layer of the reservoir and increase as the season progresses, yet they remain within maximum water quality standards criteria of 22 degrees C.

The DO profiles that were completed indicate that DO is not impacting the reservoir. The DO levels in the epilimnion and metalimnion remain above the 10% water quality exceedance policy. There were four events where DO values were below the 6 mg/L water quality standard; these values account for 5.4% of the events during the period of record and all occurred in the metalimnion layer of the reservoir later in the season.

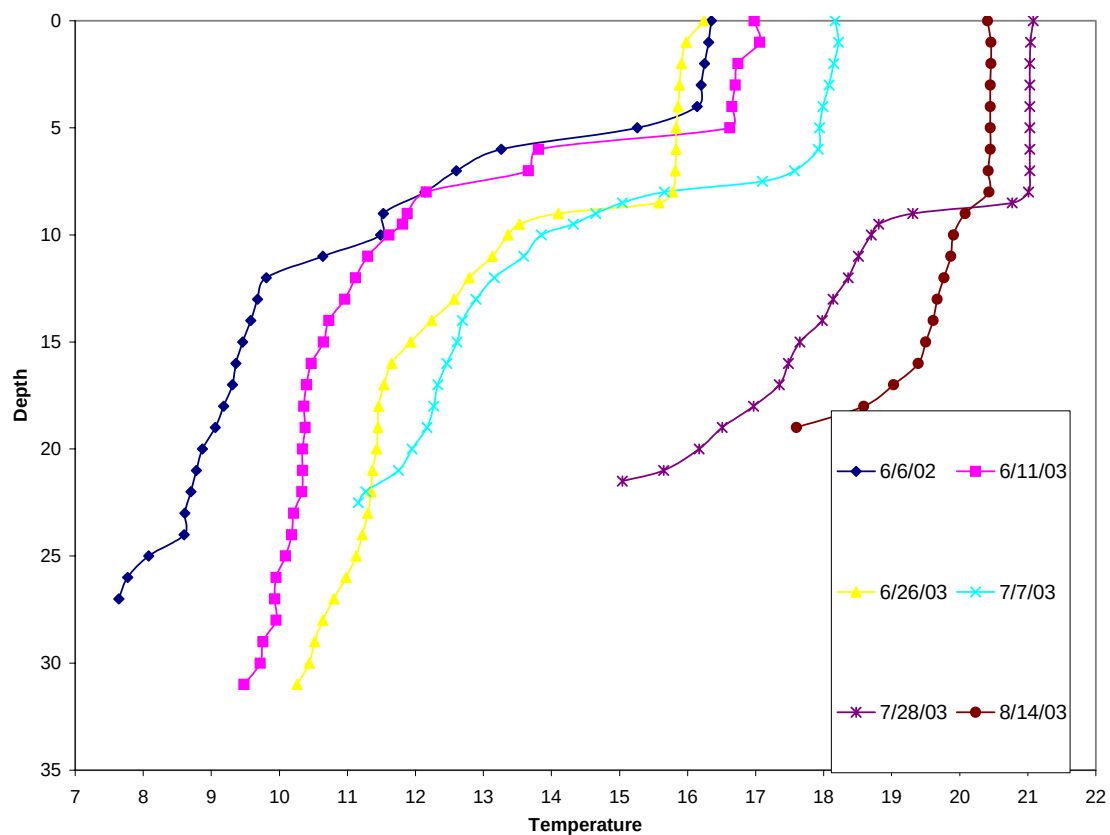


Figure 42. Temperature profile for the Little Wood River Reservoir.

Bacteria (*E. coli*) are not threatening the primary contact beneficial uses of the Little Wood River Reservoir. Bacteria data was collected throughout the summer with the highest value occurring at 1 cfu/100ml, a value significantly below water quality standards.

Conclusions

Through the subbasin assessment process the following have been identified about the Little Wood River Reservoir:

- The Little Wood River Reservoir undergoes hydrologic changes throughout the season as a result of it being developed for irrigation and flood control.
- Bacteria (*E. coli*) is not impacting the primary contact beneficial uses of the reservoir.
- Sediment (TSS and secchi depth) is not impacting water quality of the reservoir.
- Nutrients (TP and TN) are not impacting water quality of the reservoir.
- The DO levels of the reservoir are within water quality standards.

As a result of the subbasin assessment, the Little Wood River Reservoir will remain listed as impaired by flow alteration. In addition, bacteria, DO, nutrients, and sediment will be delisted as pollutants impacting the Little Wood River Reservoir. There will be no TMDLs completed for this water body.

Fish Creek Reservoir

The Fish Creek Reservoir lies in the upper half of the Little Wood River Subbasin and has a drainage area of 76.2 square miles. The dam lies in the Fish Creek water course, approximately 13 miles downstream of the headwaters of Fish Creek. The dam is a series of concrete arches between concrete buttresses and was completed in 1921. The Fish Creek Reservoir Company privately owns the dam. It is an irrigation water dam that is 92 feet in height and 1,700 feet in length. It has a rated capacity of 12,000-acre feet. Hydraulically, it has structured spillways at 88 feet (Larsen, 2003).

Safety concerns due to the structural stability of the dam have led to restrictions of water storage, which is impacting water quality of the reservoir. Dam safety inspectors have indicated that the dam should not be filled any higher than 67 feet full to prevent possible failure of the dam. This restricts the capacity of the reservoir to about 4,300-acre feet, approximately one third of its storage potential. Restrictions are to occur until repairs are made or a new structure is built (Larsen, 2003).

Land use, ownership, and vegetation of the Fish Creek Reservoir is described based on a one mile-wide corridor approach, as was done in the Upper Snake River and Big Wood River TMDLs. The majority of the land surrounding the reservoir is private (67.8%) with open water making up 6.8% of the area. The remainder of the land is managed by BLM (25.3%). The land use for the reservoir is predominately rangeland (91.5%) with irrigated gravity flow making up 8.5% of the area. The vegetation along the reservoir corridor is predominantly shrubland (89.2%) followed by agriculture (4.6%). The remainder of the corridor consists of grassland (1.6%), riparian (1.8%), forested (0.8%), and wetlands (1.9%) (ArcView Coverage, 1992-1996).

The Fish Creek Reservoir corridor passes through three different geologic formations. The reservoir lies within thrust marine detrital, thrust deep-water siliceous argillite and quartzite and lava flows. The soils of the reservoir corridor that include the reservoir and land bordering the reservoir have soil erosion potentials (K factors) of 0.35-0.45 within the reservoir, 0.25-0.35 to the east and west of the reservoir (ArcView Coverage, 1992-1996).

Biological and Other Data

IDFG manages the fisheries of Fish Creek Reservoir as a general system. This reservoir has been identified as a cold water fishery with rainbow trout as the species of desirable game fishes within the system. Management directions are to maintain the fishery with fingerling and catchable rainbow trout stockings, when desirable, and maintain winter and summer catch rates (IDFG 2001). IDFG stocking records indicate that stocking has occurred frequently in the Fish Creek Reservoir. Rainbow species have been stocked since 1973.

Hydrology

The Fish Creek Reservoir has a carrying capacity of 12,000 acre-feet. During sampling time the reservoir was measured 19.5 meters depth at the deepest portion. At last assessable event collection it measured 16.6 meters. There was an almost 3 meter change in depth of the reservoir within a two week period.

Fish Creek is the main water body that feeds into the Fish Creek Reservoir (Figure 25). In addition, there are five intermittent water bodies that feed directly into the reservoir to add to the volume of the reservoir during peak flows. There also lies within the reservoir a spring that contributes slightly less than 1 cfs of water throughout the year. Peak flows for Fish Creek occur from April to June, averaging 69.7 cfs; the remainder of the months contributes to base flows that average 11.5 cfs. Water is actively removed from the reservoir during the irrigation season; the remainder of the year water is not released, however, the reservoir itself discharges a very small amount of flow that contributes to perennial flow.

By nature the Fish Creek Reservoir is a flow altered water body. Due to the inability of the reservoir company to store water at full capacity, flow alteration greatly impacts water quality. Water is released to the point that incoming creek water is all that lies in the reservoir.

Water Column Data

Water chemistry data for the Fish Creek Reservoir is very limited due to site inaccessibility. Nutrients, temperature, DO, chlorophyll, and secchi depth data was collected irregularly throughout the data collection period. Data was collected at three sites on the reservoir: near tributary inlets, where Fish Creek and the West Fork of Fish Creek feeds into the reservoir, and near the dam, which would be the Z-max or deepest portion of the reservoir. The Z-max is the more critical site location as this is the location where the reservoir starts stratifying. The sites near the tributary inlets are less critical as at these sites the reservoir is still tending to act as a creek and is more indicative of the external loading that is being delivered (Lay 2003). Boat accessibility on the reservoir was limited to two sampling events in May and early June; beyond these dates samples were collected at the reservoir water line at the boat ramp. As a result, data collected is not the most representative data for the water body.

The Carlson Trophic State Index (TSI) was used to determine the trophic nature of the Fish Creek Reservoir. This metric can be used to determine if phosphorous is in excess in the system. A TSI score of 50 or more indicates that a lake/reservoir is eutrophic and thus has high productivity (EPA 2004). This value has been used in various other south central TMDLs including the Goose Creek and Raft River Subbasin Assessment and TMDL (Lay 2003). The TSI values for chlorophyll, secchi depth, TP, and total nitrogen were averaged together for an overall TSI score, however each was also looked at individually. When looking at individual TSI scores, the measured constituents cannot exceed the following values for TSI scores to remain below the TSI threshold value: secchi depth (2m), chlorophyll at 1 meter (7.2ug/L), TP (0.24 mg/L), and total nitrogen (0.7 mg/L).

The overall average TSI score for the Fish Creek Reservoir is 53.2, indicating that the trophic nature of the reservoir is slightly mesotrophic. The average TSI for each site visit ranges from 44.8 to 66.1. TSI values tend to increase as the season progresses, and the water volume decreases due to reservoir drawdown. The TP and total nitrogen data were not collected regularly, so a trend is difficult to distinguish, however, average TSI scores for each constituent were elevated above the 50 threshold. Average TSI scores for secchi depth and chlorophyll tend to increase as the season progresses; however the average TSI for each constituent did not exceed the 50 threshold. TSI scores for secchi depth range from 36.8 to 41.3. The secchi depth value was collected only during the first two collection events and was not obtained for the remainder of the sampling period. The TSI scores for chlorophyll range from 31.5 to 67.3 and exceeded threshold once just previous to the reservoir going dry.

Individual TP and total nitrogen values exceed the threshold TSI score; however, chlorophyll TSI scores indicate that the nutrients are not contributing to an excessive amount of chlorophyll within the system until the last of the season, when the reservoir is near zero storage. As the water storage capacity has been restricted, nutrient is likely to occur in larger quantities. Drawdown events in a reservoir can lead to sediment from within the reservoir being released into the water. In addition, phosphorous that is adsorbed to this sediment is also released (Lay 2003). This is an internal loading process rather than an external loading process, and, thus, a natural event for a reservoir system. The nutrient influences are contributed by internal loadings due to drawdown events, therefore impacts are due to flow alteration. However as Fish Creek reservoir has been included in the TMDL to improve beneficial uses of the lower segment of Fish Creek, improvement within the reservoir will likely be seen over time.

Temperature profiles were completed on the Fish Creek Reservoir to determine lake stratification. Fish Creek Reservoir is not stratified; it would likely stratify if water volumes were greater and full storage capacity of the reservoir was reached. Temperature data was obtained in late May and early June when the reservoir was assessable by boat. During these time periods there were no temperatures elevated above water quality standards.

The DO temperatures collected indicate that DO is not impacting the reservoir. The DO levels were collected during late May and early June, when the reservoir was assessable by boat. There were three times (7.7% of the period of record) in which the DO was in exceedance of water quality standards. These exceedances occurred in the lowest meter reaches of the reservoir and water quality standards do not apply to the bottom 20% of the reservoir. Therefore DO is not impacting the reservoir.

Bacteria (*E. coli*) are not threatening the primary contact beneficial uses of Fish Creek Reservoir. Bacteria data was collected throughout the summer, with the highest value occurring at 4 cfu/100mL a value significantly below water quality standards.

Conclusions

Through the subbasin assessment process the following have been identified about Fish Creek Reservoir:

- Fish Creek Reservoir undergoes hydrologic changes throughout the season leading it to become dewatered for the purposes of irrigation demands.
- Bacteria (*E. coli*) are not impacting the primary contact recreation beneficial uses of the reservoir.
- Nutrients (TP and total nitrogen) are not impacting the water quality of the reservoir.
- Sediments (TSS and secchi depth) are not impacting the water quality of the reservoir.
- The water quality standards for DO are being met in the reservoir.

As a result of the subbasin assessment, Fish Creek Reservoir will remain listed as impaired by flow alteration. The reservoir will be included as lying within the area of impact for the segment of Fish Creek downstream of the reservoir and will be included in implementation plans to improve this segment of the creek. In addition, DO, bacteria, nutrients, and sediment will be delisted as pollutants impacting the water quality of the reservoir.

2.5 Data Gaps

This section of the report describes the data gaps that occur within the subbasin. There are a number of data gaps that occur in every water body.

Because flow data was taken in a drought year, which is not representative of normal years, it would be beneficial to have further data for all of the listed water bodies. Especially Fish Creek, Muldoon Creek, Loving Creek, and the Little Wood River (segments 3 and 4). It would be very beneficial to obtain flows throughout Little Wood River (segment 4) to identify where water is being added and taken out and to what extent this is occurring. The needs for the Little Wood River (segment 3) include identifying when water occurs in that segment of the river and where the sources are.

Sampling for the Little Wood River Subbasin occurred once a month and some parameters were measured once every two months. More sampling and more frequency of sampling would yield a more robust analysis.

Temperature data was collected during drought years under low flow conditions. This data is not representative of activities occurring in situations that are not the worse case scenario. It would be beneficial to determine the temperature cycle of the water body in normal water years, as well as the influence of geology and beaver dams on water temperatures.

Much of the fish data that has been collected is historical data; therefore it would be beneficial to gather more current fish data. It is especially important to collect some data on Dry Creek, where no fish data has been collected, to determine if salmonid spawning is in fact occurring in this water body. It would also be beneficial to find out the extent of the Wood River Sculpin population throughout this subbasin, as Wood River Sculpin are a sensitive species and good indicator species. In addition, default salmonid spawning periods were used as the spawning periods in the subbasin are unknown. This periods need to be identified for the subbasin.

As most of the biological data that has been collected on these water bodies is older than 5 years, it would be beneficial to get current biological data. Biological data on the Little Wood River, Dry Creek, and Loving Creek will be especially valuable once methods for assessing the biological data on these water bodies are scientifically sound. Bioassessment data on Fish Creek above the reservoir needs to be completed in the lower half of the creek, since this portion of the creek has never been bioassessed.

There is what is believed to be calcium carbonate settling out onto the rocks in the upper end of the Little Wood River (segment 4). Idaho Department of Fish and Game believes this is filling up the interstitial spaces in the gravel and is potentially affecting salmonid spawning. It would be beneficial to look into this situation a little more closely.

The affect drought conditions have on macroinvertebrate populations is not known. However, it is believed that drought could have a large affect on the populations and, thus, on the scoring criteria. Macroinvertebrate data in both average flow years and low flow years would give a better idea of human induced impacts versus natural impacts.

3. Subbasin Assessment – Pollutant Source Inventory

3.1 Sources of Pollutants of Concern

This section of the subbasin assessment provides an inventory of known or suspected sources of pollutants, including both point sources and nonpoint sources. Any relations between different pollutants and what is known about the delivery potential to impaired water bodies is discussed.

Point Sources

The Little Wood River Subbasin has seven point source facilities in the subbasin (Table 51). Four of these facilities are city municipalities, while the others are used for trout culturing and food processing. There is one other point source in the subbasin, which at this point does not discharge and has never discharged, and that is Idaho Tire Recovery.

Table 51. Point sources contributing pollutant to an impacted stream.

Facility	NPDES ID	Type	Design flow (mgd)	Existing flow (mgd)	Pollutant impacting receiving water	Receiving Water
Richfield	ID-002121-1	wastewater	0.06	0.02	Nutrient, temperature	Little Wood River
Shoshone	ID-022372-8	wastewater	0.20	0.09	Nutrient, temperature	Little Wood River
Gooding	ID-002002-8	wastewater	1.0	0.18-0.32	Nutrient, temperature	Little Wood River
Glanbia Gooding	ID-002712-0	food processing	---	0.18	Nutrient, temperature	Little Wood River

^a Data from NPDES files at DEQ office in Twin Falls.

Nonpoint Sources

Most of the 303(d) listed water bodies have similar nonpoint sources that could be contributing to the pollutant load, however, intensity of the contribution varies. The exact amount of contribution is not known, but load allocations will be designed on a 1-mile stream corridor land use approach.

Non point source activities impacting the subbasin include the following:

- There are numerous bridge crossings in all of the water bodies. Dry Creek and Fish Creek (above the reservoir) have several road crossings in their upper stretches. The roads in the upper part of these creeks also runs along the length of the water body and in close proximity to the water body.

- Mining sites are a nonpoint source that could be contributing sediment and toxic materials to a water body. There are 45 mines in the Little Wood River Subbasin (ArcView Coverage, 1992-1996). Gravel pits have been included in this count. There are about 9 mines within the stream corridor of the Little Wood River. The majority of the mines occurring in the subbasin occur in the headwaters region of Muldoon Creek.
- *Stream bank* erosion is expected to be occurring to some degree in all the 303(d) listed water bodies.
- Buildings that are not connected to a city wastewater treatment facility have septic systems which could be contributing to nutrient levels of the water bodies.
- Hayspur hatchery located near Loving Creek is considered a non point source contributor as the amount of production within the facility does not require it to be permitted.
- Irrigated gravity flow, irrigated sprinkler, forest, rangeland, riparian, urban, and rock are some of the land uses occurring within the subbasin. A more detailed description of the land uses within the stream corridors is described previously in Section 2. For a description of land use acreage based on 5th field HUC descriptions, see Figure 43.
- The hydroelectric projects that are located on the Little Wood River between USGS gauge station 131351500 (west of the juncture of the Milner-Gooding Canal) and east of Gooding, Idaho are the Shoshone Project (FERC No. 9967), the Geo-Bon #2 Project (FERC No. 7548), the Little Wood River Ranch II Project (proposed, FERC No. 12063), and the Little Wood River Ranch I Project (FERC No. 7530).

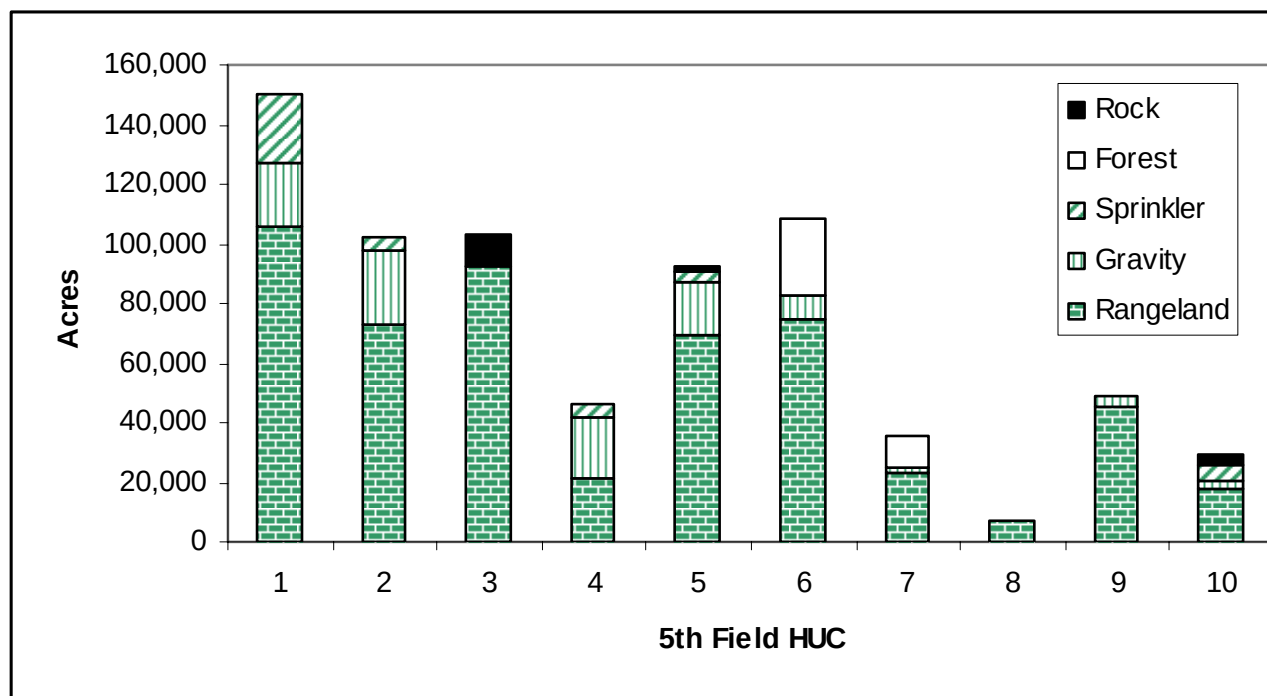


Figure 43. Land use in the 5th Field HUC watersheds of the subbasin.

4. Subbasin Assessment – Summary of Past and Present Pollution Control Efforts

There have been several projects that have occurred on the 1998 303(d) listed water bodies in the Little Wood River Subbasin. As to whether or not these projects have helped improve water quality of the targeted water body cannot be said, as there is little data to indicate trends.

A search of the stream channel alteration permit applications (SCAPA) files has indicated that stream channel alteration has occurred on the Little Wood River and Loving Creek. Little Wood River projects have included *stream bank* stabilization with the use of rocks and willows. Loving Creek projects entail sediment removal from the water body (DEQ 2003).

There have been some big projects in the past and some current projects with great potential to affect the Little Wood River:

- A bypass system was set up so that the water from Jim Byrns Slough would enter the Dietrich Canal without mixing or influencing the water within the Little Wood River.
- A current project that could influence the Little Wood River is the Little Wood River Irrigation District gravity pipeline project. It is believed that this project could potentially return some of the Little Wood River water back to the natural channel.
- Some land area of Muldoon Creek allows public access while still restricting heavy usage of the land, decreasing usage of motor activity along the riparian zones of the water body (O' Sullivan 2004).

There are some large portions of land on the 303(d) listed streams that are managed by the BLM. There have been land management practices adopted in certain locations on some of the listed streams. Dry Creek has a small enclosure and they have adopted a new grazing/riparian management system. New grazing decisions made in 2000 for Muldoon Creek include grazing rotations. There is some riparian fencing on the Little Wood River (BLM 2002).

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5. Total Maximum Daily Loads

A TMDL prescribes an upper limit on discharge of a pollutant from all sources so as to assure water quality standards are met. It further allocates this load capacity (LC) among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation (WLA); and nonpoint sources, each of which receives a load allocation (LA). Natural background (NB), when present, is considered part of the LA, but is often broken out on its own because it represents a part of the load not subject to control. Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (Water quality planning and management, 40 CFR Part 130) require a margin of safety (MOS) be a part of the TMDL.

Practically, the margin of safety is a reduction in the load capacity that is available for allocation to pollutant sources. The natural background load is also effectively a reduction in the load capacity available for allocation to humanmade pollutant sources. This can be summarized symbolically as the equation: $LC = MOS + NB + LA + WLA = TMDL$. The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First the load capacity is determined. Then the load capacity is broken down into its components: the necessary margin of safety is determined and subtracted; then natural background, if relevant, is quantified and subtracted; and then the remainder is allocated among pollutant sources. When the breakdown and allocation are completed the result is a TMDL, which must equal the load capacity.

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. The load capacity must be based on critical conditions – the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both load capacity and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear on the surface.

A load is fundamentally a quantity of a pollutant discharged over some period of time, and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for “other appropriate measures” to be used when necessary. These “other measures” must still be quantifiable, and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads and allow “gross allotment” as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

5.1 TMDL Components

The goal of the TMDL and implementation process is to restore “full support of designated beneficial uses” (Idaho Code 39.3611, 3615) by determining load allocations for the pollutants impacting a water body. Through the subbasin assessment process, it has been identified what pollutants or pollution are impacting the impaired water body. In the case where pollutants are impacting a water body, a TMDL will be completed to determine necessary load allocations for point source and nonpoint source activities occurring in the water body. In the case of pollution (lack of flow or habitat alteration) impacting a water body, a TMDL will not be completed for the pollution.

Design conditions, target selections, and monitoring points become critical issues in developing a TMDL and tracking improvement in a water body and will be discussed for each water body and pollutant impaired.

The load capacity is a value that estimates the quantity of pollutant the water body can assimilate and still meet water quality standards. The load capacity is determined by various calculations depending on the pollutant. The load capacity must be a level to meet “...water quality standards with season variations and a margin of safety that takes into account any lack of knowledge...” (Clean Water Act § 303(d)(C)). When developing a load capacity for the water body likely sources of uncertainty include lack of knowledge of assimilative capacity of the water body, uncertain relation of selected targets to beneficial uses, and variability in target measurement.

Existing loads are estimates of the degree of impact occurring in a water body. Data that is used to determine existing loads is typically very limited and not necessarily very representative of the average consideration. However, due to court appointed timelines, it is the best available data. Regulations allow that loadings “...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading” (Water quality planning and management, 40 CFR § 130.2(I)).

An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed), but may be aggregated by type of source or land area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Load allocation represents the portion of the load capacity of the stream that is allocated to existing nonpoint source activities, nonpoint source future growth (FG), and background loads occurring within the watershed. Waste load allocations are the allocations given to the point sources within the watershed; these allocations are calculated based on discharge monitoring report data and design flows. When data from the point source is not available, estimates are calculated. The following formula represents allocation division in a TMDL:

$$LC = MOS + NB + FG + LA + WLA = TMDL.$$

The margin of safety (MOS) represents 10% of the load capacity of the water body. This value provides an allocation that is not given to a pollutant source to provide for uncertainty in load capacity.

The future growth (FG) component takes into account a portion of the loading capacity that is reserved for future development within the watershed. At the request of the Wood River Watershed Advisory Groups an allocation of 5% has been set aside for future growth.

Seasonal variation occurs within a pollutant and within a water body. The hydrologic regime of the water body, as well as land-use management practices, influences the seasonal variation in the water body. Seasonal variation within each 303(d) listed water body was discussed in the subbasin assessment portion of this document.

The TMDLs that were completed in this subbasin were on the following water bodies: Muldoon Creek, Loving Creek, Dry Creek, Fish Creek (above the reservoir), Fish Creek (below the reservoir), the Little Wood River (segment 1), and the Little Wood River (segment 4).

Muldoon Creek

Through the subbasin assessment process, it has been identified that temperature is the pollutant impairing the water quality of the creek. For a summary of load reductions and load allocations for this water body see Table 52 and Table 53 (page 145), and for segmental breakdown of solar radiation values see Appendix F.

Design Conditions

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on Muldoon Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 91.3 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow period is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the SBA portion of this document under the section Analysis Process (page 45). The water quality standards for the various pollutants can also be viewed in Appendix C.

Temperature is impacting the water quality of Muldoon Creek and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. The creek was divided into three sections to determine target values for canopy cover. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake SBA and TMDL was used to aid in target selection based on these values (Table 22). The targets for the

sections of the water body are as follows: upper (65%), middle (45%), and lower (37%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover, however in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

The monitoring point for temperature collection for TMDL development occurred at two locations, at the mouth and three miles upstream of the mouth. Both sites may be used to identify further trends within the system. However, the site located at the mouth should be used to determine if water quality standards in Muldoon Creek are being met.

Load Capacity

The load capacity for the temperature TMDL on Muldoon Creek was determined by converting canopy cover targets to solar radiation. The quantity of solar radiation flat-plate collectors facing south at a fixed tilt was measured at a National Renewable Energy Lab station in Boise, Idaho. These values yielded the amount of solar radiation contributed when there was 0% cover therefore calculations were completed to determine the amount of solar radiation influencing the creek based on the canopy cover targets. *The load capacity of Muldoon Creek is 535,774.9 kWh/day.*

Estimates of Existing Pollutant Loads

The estimated existing load for the temperature TMDL to be completed on Muldoon Creek is elevated above the load capacity of the water body. *The existing load (620,949.4 kWh/day) for the temperature TMDL* was calculated as the sum of the amount of solar radiation for the three segments of the creek.

Load Allocation

There are no point sources located on Muldoon Creek therefore the waste load allocation for the creek is limited to construction storm water waste load allocations. Construction storm water is not likely to impact the canopy cover; therefore a waste load allocation is not made for construction storm water in this watershed.

The BG, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility (due to uncertainty) within the watershed, and allow for future growth within the watershed. The BG, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the waste load allocations, BG, MOS, and FG values.

Therefore, the load allocation for temperature (solar radiation) in Muldoon Creek is 535,774.9 kWh/day.

Table 52. Muldoon Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
Temperature	91.3	65 - 45 - 37	535,774.9	620,949.4	13.7

^a Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 53. Muldoon Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Waste load allocation	Load Allocation
Temperature (kWh/day)	NA	NA	NA	535,774.9	0	535,774.9

^a Background (BG), margin of safety (MOS), and future growth (FG) are not applicable (NA).

Reasonable Assurance

There is reasonable assurance that implementation, as the next step of the water body management process, will occur. First, this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the Watershed Advisory Group (WAG), and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also, in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained, then further implementation will be necessary and further reassessment performed until full support status is reached. If full support status is reached, then the requirements of the TMDL will be considered completed.

Loving Creek

Through the subbasin assessment process, it has been identified that temperature is the pollutant impairing the water quality of Loving Creek. For a summary of load reductions and load allocations for this water body, see Table 54 and Table 55 (page 147); and for segmental breakdown of solar radiation values see Appendix F.

Design Conditions

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on Loving Creek has been

identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 25.9 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow period is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the SBA portion of this document under the section Analysis Process (page 45). The water quality standards for the various pollutants can also be viewed in Appendix C.

Temperature is impacting the water quality of Loving Creek and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. The creek was divided into four sections to determine target values for canopy cover. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake SBA and TMDL was used to aid in target selection based on these values (Table 25). The targets for the sections of the water body are as follows: upper (20%), middle (45%), upper lower (10%), and lower (28%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover, however in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

The monitoring point for temperature collection for TMDL development occurred about a quarter mile from the mouth as well as at the headwaters of the creek. Both sites may be used to identify further trends within the system. However, the site located near the mouth should be used to determine if water quality standards in Loving Creek are being met.

Load Capacity

The load capacity for the temperature TMDL on Loving Creek was determined by converting canopy cover targets to solar radiation. The quantity of solar radiation flat-plate collectors facing south at a fixed tilt was measured at a National Renewable Energy Lab station in Boise, Idaho. These values yielded the amount of solar radiation contributed when there were 0% cover therefore calculations were completed to determine the amount of solar radiation influencing the creek based on the canopy cover targets. The load capacity of Loving Creek is 477,328.1 kWh/day.

Estimates of Existing Pollutant Loads

The estimated existing load for the temperature TMDL to be completed on Loving Creek is elevated above the load capacity of the water body. The existing load (577,327.4 kWh/day)

for the temperature TMDL was calculated as the sum of the amount of solar radiation for the four segments of the creek.

Load Allocation

There are no NPDES permitted point sources located on Loving Creek therefore the waste load allocation for the creek is limited to construction storm water waste load allocations. Construction storm water is not likely to impact the canopy cover; therefore a waste load allocation is not made for construction storm water in this watershed.

The BG, MOS, and FG are values attributed to the watershed that are beyond human control, providing some flexibility (due to uncertainty) within the watershed, and allow for future growth within the watershed. The BG, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the waste load allocations, BG, MOS, and FG values. Therefore, the load allocation for temperature (solar radiation) in Loving Creek is 477,328.1 kWh/day.

Table 54. Loving Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
Temperature	25.9	20-45-10-28	477,328.1	577,327.4	17.3

^a Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 55. Loving Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Waste load allocation	Load Allocation
Temperature (kWh/day)	NA	NA	NA	477,328.1	0	477,328.1

^a Background (BG), margin of safety (MOS), and future growth (FG) are not applicable (NA).

Reasonable Assurance

There is reasonable assurance that implementation, as the next step of the water body management process, will occur. First, this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the Watershed Advisory Group (WAG), and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also, in measuring the effectiveness of an implementation activity, DEQ will reassess the support

status of the water body to determine if the water body has reached full support status. If full support status has not been obtained, then further implementation will be necessary and further reassessment performed until full support status is reached. If full support status is reached, then the requirements of the TMDL will be considered completed.

Little Wood River #1

Through the subbasin assessment process, it has been identified that temperature is the pollutant impairing the water quality of segment 1 of the Little Wood River (headwaters to reservoir). For a summary of load reductions and load allocations for this water body see Table 56 and Table 57 (page 149), and for segmental breakdown of solar radiation values see Appendix F.

Design Conditions

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on the Little Wood River (segment 1) has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 233.8 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow period is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the SBA portion of this document under the section Analysis Process (page 45). The water quality standards for the various pollutants can also be viewed in Appendix C.

Temperature is impacting the water quality of the Little Wood River and canopy cover is the method used to determine the amount of solar radiation the river is receiving. The river was divided into three sections to determine target values for canopy cover. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake SBA and TMDL was used to aid in target selection based on these values (Table 42). The targets for the sections of the water body are as follows: upper (40%), middle (40%), and lower (40%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover, however in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

The monitoring point for temperature collection for TMDL development occurred at two locations, at the USGS gauge near the mouth and 4 miles upstream of the mouth. Both sites

may be used to identify further trends within the system. However, the site located near the mouth should be used to determine if water quality standards in the Little Wood River are being met.

Load Capacity

The load capacity for the temperature TMDL on the Little Wood River was determined by converting canopy cover targets to solar radiation. The quantity of solar radiation flat-plate collectors facing south at a fixed tilt was measured at a National Renewable Energy Lab station in Boise, Idaho. These values yielded the amount of solar radiation contributed when there was 0% cover therefore a calculation were completed to determine the amount of solar radiation influencing the river based on the canopy cover targets. *The load capacity of the Little Wood River is 1,196,752.1 kWh/day.*

Estimates of Existing Pollutant Loads

The estimated existing load for the temperature TMDL to be completed on the Little Wood river is elevated above the load capacity of the water body. *The existing load (1,220,521.6 kWh/day) for the temperature TMDL* was calculated as the sum of the amount of solar radiation for the three segments of the river.

Load Allocation

There are no point sources located on the Little Wood River (segment 1) therefore the waste load allocation for the creek is limited to construction storm water waste load allocations. Construction storm water is not likely to impact the canopy cover; therefore a waste load allocation is not made for construction storm water in this watershed.

The BG, MOS, and FG are values attributed to the watershed that are beyond human control, providing some flexibility (due to uncertainty) within the watershed, and allow for future growth within the watershed. The BG, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the waste load allocations, BG, MOS, and FG values. Therefore, the load allocation for temperature (solar radiation) in the Little Wood River is 1,196,752.1 kWh/day.

Table 56. Little Wood River (segment 1) load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
Temperature	233.8	40-40-40	1,196,752.1	1,220,521.6	1.9

^a Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 57. Little Wood River (segment 1) load allocations.

Pollutant	MOS	BG	FG	Available Load	Waste load allocation	Load Allocation
Temperature (kWh/day)	NA	NA	NA	1,196,752.1	0	1,196,752.1

^a Background (BG), margin of safety (MOS), future growth (FG) are not applicable (NA).

Reasonable Assurance

There is reasonable assurance that implementation, as the next step of the water body management process, will occur. First, this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the Watershed Advisory Group (WAG), and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also, in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained, then further implementation will be necessary and further reassessment performed until full support status is reached. If full support status is reached, then the requirements of the TMDL will be considered completed.

Fish Creek (Above the Reservoir)

Through the subbasin assessment process, it has been identified that the CWAL, SS, and SCR beneficial uses are being impacted in Fish Creek (above the reservoir). The pollutants of concern in the water body have been found to be sediment, bacteria, and temperature. Nutrients are not impacting this segment of Fish Creek; however, as the lower reach is impacted by nutrients, a TMDL will be completed to aid in maintaining and decreasing TP loads that the reservoir is releasing that contribute to the impairment of the downstream stretch. For a summary of load reductions, load allocations, and segmental breakdown of stream bank erosion values see Table 58, Table 59, and Table 60 (page 154), and for segmental breakdown of solar radiation values see Appendix F.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically, the higher flow events occur during spring runoff or, periodically, during storm situations; as a result the critical period for sediment on Fish Creek has been identified as occurring from April to June. During this time, the critical flow for the water body, based on predicted hydrograph, is 69.7 cfs. As sediment has been found to be occurring as a result of stream bank erosion, the critical flow period is less important in the development of stream bank stability TMDLs.

Bacteria are more likely to impact a water body during lower flow baseline events, when flushing events are not occurring. As much of the land in Fish Creek is used for cattle and sheep grazing, this time period becomes more critical because this is the time when additional impacts are likely to occur to the secondary contact recreation beneficial uses. The critical period, as a result, is from July to September, and the critical flow for this time period, based on predicted hydrographs, is 15.3cfs. The flow of Fish Creek during the critical time period is less critical in determining load capacity of the stream, as water quality standards set the limit for contact recreation beneficial uses. However, these critical periods are the time when impacts are more critical.

Nutrients in a water body that is delivering to a storage system are more likely to impact a reservoir year round as the reservoir acts as a sink and drops nutrients out of the water column. As a result the critical period for nutrients for Fish Creek is from March to October, and the critical flow for this period based on the predicted hydrograph is 35.5 cfs. The average flow during the critical period aids in determining the loading capacity of the water body.

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on Fish Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 42.5 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow period is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the SBA portion of this document under the section Analysis Process (page 45). The water quality standards for the various pollutants can also be viewed in Appendix C.

Sediment is impacting beneficial uses of Fish Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream; however, bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case, then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. It has been determined, in previous Idaho TMDLs, that stream banks with 80% bank stability are indicative of beneficial uses being fully supportive. As a result, if TMDLs for stream bank erosion are completed, the target is for 80% bank stability.

Bacteria are impacting the secondary contact recreation beneficial uses of Fish Creek and are measured by *E. coli* values. According to Idaho Code 58.01.02.251.02a, waters with secondary contact recreation use are not to exceed 576 colonies of *E. coli* organisms per 100ml of sample. If exceedance of this value occurs, then a minimum of five samples have to be taken within a 30 day period and must not exceed a geometric mean of 126 cfu/100ml.

As a result, 576 colonies of *E. coli* organisms will be the target for the bacteria TMDL on Fish Creek. However, the geometric mean value of 126 cfu/100ml will be the value used to determine compliance with the standards.

Nutrients are not impacting the cold water aquatic life beneficial uses of this segment of Fish Creek, but the nutrients from the reservoir are impacting the water quality of the lower segment. The reservoir has storage quantities of TP that are impacting the creek, as water volume in the reservoir decreases. In an effort to reduce further storage of TP, the upper segment of Fish Creek will have a nutrient TMDL completed. Previous TMDLs have set 0.05 mg/L as the goal for attaining full support of beneficial uses in water bodies that discharge into a storage system. As a result, 0.05 mg/L is the target to be used in the development of a nutrient TMDL for Fish Creek.

Temperature is impacting the water quality of Fish Creek and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. The creek was divided into three sections to determine target values for canopy cover. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake SBA and TMDL was used to aid in target selection based on these values (Table 32). The targets for the sections of the water body are as follows: upper (60%), middle (60%), and lower (45%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover, however in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

Because a stream bank erosion TMDL is site specific and cannot be measured by a pour point value, as some of the other constituents can, there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL, the water body has been divided into four segments. These segments are as follows: upper, upper middle, lower middle, and lower.

The monitoring point for bacteria and nutrient collection for TMDL development was located at the downstream end of Fish Creek. This site was located approximately half a mile upstream of the reservoir, at the boat ramp access road crossing. This site should be used to identify further trends or to assess secondary contact recreation beneficial uses within the water body in the future.

The monitoring point for temperature collection for TMDL development occurred about a half mile upstream of the reservoir. This site should be used to identify further trends within the system as well as to determine if water quality standards on Fish Creek are being met.

Load Capacity

The load capacities for the four TMDLs to be completed on Fish Creek (above the reservoir) have been determined in different ways.

- The load capacity (9.57 lbs/day) for nutrient TMDLs was calculated based on target selection and average critical flow.
- The load capacity (576 cfu/100ml) for bacteria TMDLs was set at values defined by the instantaneous water quality standards for secondary contact recreation.
- The load capacity (99.5 t/y) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- And finally, the load capacity (238,629.6 kWh/day) for the temperature TMDL was determined by converting canopy cover targets to solar radiation.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate and still maintain beneficial uses full support status.

Estimates of Existing Pollutant Loads

The estimated existing loads for the four TMDLs to be completed on this segment of Fish Creek are elevated above the load capacity of the water body:

- The existing load (14.16 lbs/day) for nutrient TMDLs was calculated based on average annual values of TP and average critical flow.
- The existing load (604 cfu/100ml) for bacteria TMDLs was set at the values elevated above secondary contact recreation water quality standards.
- The existing load (724.1 t/y) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The existing load (300,040.2 kWh/day) for temperature TMDLs was calculated as the sum of the amount of solar radiation for the three segments of the creek.

These values represent the estimated existing loads of pollutant occurring in the water bodies.

Load Allocation

The waste load allocation for Fish Creek is limited to construction storm water waste load allocations, as there are no other point sources in the watershed. The waste load allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. *As this is the only point source in the watershed, the waste load allocation for nutrients is 0.09 lbs/day, for sediment is 1.7 t/yr, and bacteria is 9.9 cfu/100ml.* Construction storm water is not likely to impact the canopy cover; therefore a waste load allocation is not made for construction storm water in this watershed.

The BG, MOS, and FG are values attributed to the watershed that are beyond human control, providing some flexibility (due to uncertainty) within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background for TP has been established as being 0.02 mg/L, which accounts for a load allocation of 3.83 lbs/day.
- The winter months were observed to determine the background levels of bacteria in the watershed; background for *E. coli* is 23 cfu/100ml.
- Background loads are not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.
- The BG, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.
- The MOS for the TMDLs of Fish Creek is 10%. This yields a MOS of 0.96 lbs/day for nutrients, 57.6 cfu/100ml for *E. coli* and 10.0 t/yr for sediment.
- The FG for the TMDLs of Fish Creek was determined by allocating 5% of the load capacity of the creek to FG. This yields a FG of 0.48 lbs/day for nutrients, 28.8 cfu/100ml for bacteria, and 5.0 t/yr for sediment.

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the waste load allocations, BG, MOS, and FG values. Therefore, the load allocation for nutrients in Fish Creek is 4.22 lbs/day, for *E. coli* is 485.49 cfu/100ml, for sediment is 82.9 t/y, for temperature is 238,629.6 kWh/day.

Table 58. Fish Creek (above the reservoir) load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
Nutrient	35.5	0.05	9.57	14.16	32.4
Bacteria	15.3	576	576	604	85.3
Sediment	69.7	80	99.5	724.1	86.3
Temperature	42.5	60-60-45	238,629.6	300,040.2	20.5

^a Nutrient – target measured in mg/L, load capacity and existing load measured in lbs/day.

^b Bacteria – target, load capacity, and existing load measured in cfu/100ml.

^c Sediment – target measured in percent bank stability, load capacity and existing load measured in t/yr.

^d Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 59. Fish Creek (above the reservoir) load allocations.

Pollutant	MOS	BG	FG	Available Load	Waste load allocation	Load Allocation
Nutrient (lbs/day)	0.96	3.83	0.48	4.31	0.09	4.22
Bacteria (cfu/100ml)	57.6	23	28.8	495.4	9.9	485.5
Sediment (tons/yr)	10.0	Implicit	5.0	84.6	1.7	82.9
Temperature (kWh/day)	NA	NA	NA	238,629.6	0	238,629.6

^a Implicit – Background (BG) is implied within the target.

^b Margin of safety (MOS) , future growth (FG), not applicable (NA)

Table 60. Fish Creek (above the reservoir) stream bank erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	152.0	12.0	372.2	29.3	92	51
Upper middle	10.2	7.2	17.9	12.6	30	3
Lower middle	12.1	4.2	45.4	15.7	65	6
Lower	58.1	8.4	288.6	41.8	86	40
Total			724.1	99.5		

^a See Appendix E for site descriptions.

^b Erosion rates measured in tons/mile/year, total erosion measured in tons/year.

Reasonable Assurance

There is reasonable assurance that implementation, as the next step of the water body management process, will occur. First, this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the Watershed Advisory Group (WAG), and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also, in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained, then further implementation will be necessary and further reassessment performed until full support status is reached. If full support status is reached, then the requirements of the TMDL will be considered completed.

Fish Creek (Below the Reservoir)

Through the subbasin assessment process, it has been identified that the CWAL beneficial uses are being impacted in Fish Creek (below the reservoir). The pollutants of concern in the water body have been found to be sediment, nutrients, and temperature. Each of these pollutants is impacting the water body at different periods throughout the year. For a summary of load reductions, load allocations, and segmental breakdown of stream bank

erosion values see Table 61, Table 62, and Table 63 (page 159); and for segmental breakdown of solar radiation values, see Appendix F.

Lack of flow is likely also impacting beneficial uses of Fish Creek. Fish Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, but not pollutants, a TMDL has not been established for Fish Creek for flow.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically, the higher flow events occur during spring runoff or, periodically, during storm situations; as a result the critical period for sediment on Fish Creek has been identified as occurring from April to July. During this period, the critical flow for the water body, based on the predicted hydrograph, is 82.8 cfs. As sediment has been found to be occurring as a result of stream bank erosion, the critical flow period is less important in the development of stream bank stability TMDLs.

Nutrients are more likely to impact a water body during the summer months, when primary production is occurring within the water body. The critical period, as a result, is from June to September, and the critical flow for this period, based on the predicted hydrograph, is 48.0 cfs. The average flow during the critical period aids in determining the loading capacity of the water body.

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on Fish Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 62.4 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow period is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the SBA portion of this document under the section Analysis Process (page 45). The water quality standards for the various pollutants can also be viewed in Appendix C.

Sediment is impacting beneficial uses of Fish Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case, then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. It has been determined, in previous Idaho TMDLs, that stream banks

with 80% bank stability are indicative of beneficial uses being fully supportive. As a result if TMDLs for stream bank erosion are completed, the target is for 80% bank stability.

Nutrients are impacting the water quality of this segment of Fish Creek and are measured by TP values. Previous TMDLs have set 0.1 mg/L as the goal for attaining full support of beneficial uses. As a result, 0.1 mg/L is the target to be used in the development of a nutrient TMDL for Fish Creek. As water coming out of the reservoir is immediately impacting the creek downstream, the reservoir will be included in the downstream TMDL allocations.

Temperature is impacting the water quality of Fish Creek and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake SBA and TMDL was used to aid in target selection based on these values (Table 37). The canopy cover target of the water body is 35%. If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover, however in terms of the creek as a whole, these balance themselves out. This should be taken into account however during implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

As a stream bank erosion TMDL is site specific and cannot be measured by a pour point value, as some of the other constituents can, there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL, the water body has been divided into three segments. These segments are as follows: upper, middle, and lower.

The monitoring point for nutrient collection for TMDL development was located at the downstream end of Fish Creek. This site was located upstream of the Highline Canal Diversion. This site should be used to identify further trends or to assess water quality standards applications within the water body in the future.

The monitoring point for temperature collection for TMDL development occurred downstream of the reservoir and upstream of the Highline Canal diversion. Both sites can be used to identify further trends within the system, however the site above the diversion should be used to determine if water quality standards on Fish Creek are being met.

Load Capacity

The load capacities for the three TMDLs to be completed on this segment of Fish Creek have been determined in different ways.

- The load capacity (25.9 lbs/day) for nutrient TMDLs was calculated based on target selection and average critical flow.

- The load capacity (43.4 t/y) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and 80% stream bank stability.
- The load capacity (420,792.5 kWh/day) for temperature TMDLs was calculated as the amount of solar radiation of the creek.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate and still maintain beneficial uses full support status.

Estimates of Existing Pollutant Loads

The estimated existing loads for the three TMDLs to be completed on this segment of Fish Creek are elevated above the load capacity of the water body:

- The existing load (30.8 lbs/day) for nutrient TMDLs was calculated based on average annual values of TP and average critical flow.
- The existing load (131.9 t/y) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The existing load (535,918.2 kWh/day) for temperature TMDLs was calculated as amount of solar radiation occurring on the creek.

These values represent the estimated existing loads of pollutant occurring in the water bodies.

Load Allocation

The waste load allocation for Fish Creek is limited to construction storm water waste load allocations, as there are no other point sources in the watershed. The waste load allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. *As this is the only point source in the watershed, the waste load allocation for nutrients is 0.34 lbs/day and for sediment is 0.7 t/yr.* Construction storm water is not likely to impact the canopy cover; therefore a waste load allocation is not made for construction storm water in this watershed.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, providing some flexibility (due to uncertainty) within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background for TP has been established as being 0.02 mg/L, which accounts for a load allocation of 5.17 lbs/day.
- Background loads are not determined for a stream bank erosion TMDL or a canopy cover TMDL because it is implied that background loads occur within the target.
- The BG, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.

- The MOS for the TMDLs of Fish Creek is 10%. This yields a MOS of 2.59 lbs/day for nutrients and 4.3 t/yr for sediment.
- The FG for the TMDLs of Fish Creek is 5% of the load capacity. This yields a FG of 1.29 lbs/day for nutrients and 2.2 t/yr for sediment.

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the waste load allocations, BG, MOS, and FG values. Therefore, the load allocation for nutrients in Fish Creek is 16.48 lbs/day, for sediment is 36.2 t/yr, and for temperature is 420,792.5 kWh/day.

Table 61. Fish Creek (below the reservoir) load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
Nutrient	48.0	0.1	25.9	30.8	16.0
Sediment	82.8	80	43.4	131.9	67.1
Temperature	62.4	35	420,792.5	535,918.2	21.5

^aNutrient – target measured in mg/L, load capacity and existing load measured in lbs/day.

^bSediment – target measured in percent bank stability, load capacity and existing load measured in t/yr.

Table 62. Fish Creek (below the reservoir) load allocations.

Pollutant	MOS	BG	FG	Available Load	Waste load allocation	Load Allocation
Nutrient (lbs/day)	2.59	5.17	1.29	16.82	0.34	16.48
Sediment (tons/yr)	4.3	Implicit	2.2	36.9	0.7	36.2
Temperature (kWh/day)	NA	NA	NA	420,792.5	0	420,792.5

^aImplicit – Background (BG) is implied within the target.

^bMargin of safety (MOS), future growth (FG), not applicable (NA).

Table 63. Fish Creek (below the reservoir) stream bank erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	41.4	7.1	77.5	13.3	83	59
Middle	3.3	2.2	4.2	2.8	33	3
Lower	6.2	3.4	50.3	27.3	46	38
Total			131.9	43.4		

^a See Appendix E for site descriptions.

^b Erosion rates measured in tons/mile/year, total erosion measured in tons/year.

Reasonable Assurance

There is reasonable assurance that implementation, as the next step of the water body management process will occur. First, this document includes implementation strategies that

are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the state's water quality management plan. Also, in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained, then further implementation will be necessary, and further reassessment completed, until full support status is reached. If full support status is reached, then the requirements of the TMDL will be considered completed.

Dry Creek

Through the subbasin assessment process, it has been identified that pollutants are likely impacting the CWAL beneficial uses in this water body. The pollutant of concern in the water body has been found to be sediment. For a summary of load reductions, load allocations, and segmental breakdown of stream bank erosion values see Table 64, Table 65, and Table 66 (page 162).

Lack of flow, both natural and anthropogenic, is likely also impacting beneficial uses of Dry Creek. Dry Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, but not pollutants, a TMDL has not been established for Dry Creek for flow.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically, the higher flow events occur during spring runoff or, periodically, during storm situations; as a result, the critical period for sediment on Dry Creek has been identified as occurring from April to June. During this period the critical flow for the water body, based on predicted hydrograph, is 6.5 cfs. As sediment has been found to be occurring as a result of stream bank erosion, the critical flow period is less important in the development of stream bank stability TMDLs.

Target Selection

Target selections are discussed in more complete detail in the SBA portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix C.

Sediment is likely impacting the beneficial uses of Dry Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however, bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to

indicate that sediment was impacting the water body. If this was the case, then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. It has been determined, in previous Idaho TMDLs, that stream banks with 80% bank stability are indicative of beneficial uses being fully supportive. As a result, the target in TMDLs for stream bank erosion is 80% bank stability.

Monitoring Points

Because a stream bank erosion TMDL is site specific and cannot be measured by a point value as some of the other constituents can, there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL, the water body has been divided into three segments. These segments are as follows: upper, middle, and lower.

Load Capacity

The load capacities for the stream bank erosion TMDL to be completed on Dry Creek have been determined with calculations involving erosion rates, bank height, and 80% stream bank stability conditions. The load capacity was calculated to be 48.9 t/y. This value represents the estimated quantity of pollutant the water body is believed to be able to assimilate and still maintain beneficial uses full support status.

Estimates of Existing Pollutant Loads

The estimated existing loads for the stream bank erosion TMDL to be completed on Dry Creek is elevated above the load capacity of the water body. The existing load (270.4 t/y) for stream bank erosion TMDLs was set by calculations that took into account erosion rates, bank height, and quantity of stream bank stability. These values represent the estimated existing loads of pollutant occurring in the water bodies.

Load Allocation

The waste load allocation for Dry Creek is limited to construction storm water waste load allocations, as there are no other point sources in the watershed. The waste load allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. As this is the only point source in the watershed the allocation for sediment is 0.8 t/yr.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, providing some flexibility (due to uncertainty) within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background loads are not determined for a stream bank erosion TMDL because it is implied that the background loads occur within the target.

- The MOS for the TMDLs of Dry Creek is 10% of the load capacity. This yields a MOS of 4.9 t/yr for sediment.
- The FG for the TMDLs of Fish Creek were determined by allocating 5% of the load capacity of the creek to FG. This yields a FG of 2.4 t/yr.

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the waste load allocations, background, MOS, and FG values. Therefore, the load allocation for sediment is 40.7 t/yr.

Table 64. Dry Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
sediment	6.5	80%	48.9	270.4	81.9

^aSediment – target measured in % bank stability, load capacity and existing load measured in t/yr.

Table 65. Dry Creek load allocations.

Pollutant	MOS	FG	BG	Available Load	Waste load allocation	Load Allocation
Sediment (tons/yr)	4.9	2.4	implicit	41.6	0.8	40.7

^aImplicit – Background (BG) are implied within the percent target.

^bMOS- margin of safety, FG-future growth.

Table 66. Dry Creek stream bank erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	22.7	3.5	108.3	16.8	84	40
Middle	20.6	3.3	51.1	8.2	84	19
Lower	23.2	5.0	111.0	23.9	78	41
Total			270.4	48.9		

^a See Appendix E for site descriptions.

^b Erosion rates measured in tons/mile/year, total erosion measured in tons/year.

Reasonable Assurance

There is reasonable assurance that implementation, as the next step of the water body management process, will occur. First, this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the state's water quality management plan. Also, in measuring the effectiveness of an

implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained, then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed, then the requirements of the TMDL will be considered completed.

Little Wood River Segment #3 (Canal Diversions to Silver Creek)

Through the subbasin assessment process, it has been identified that the CWAL and SS beneficial uses are being impacted in this water body. There are no pollutants of concern in this segment of the water body. Lack of flow, both natural and anthropogenic is the contributing factor to impairment of the Little Wood River. This segment of the Little Wood River is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution but not pollutants, a TMDL has not been established for this segment of the Little Wood River for flow.

Little Wood River Segment #4 (Silver Creek to Big Wood River)

Through the subbasin assessment process it has been identified that the CWAL and SS beneficial uses are being impacted in this water body. The pollutants of concern in the water body have been found to be sediment, nutrients, and temperature. Each of these pollutants is impacting the water body at different periods throughout the year. *The TP TMDL will be discussed separately from sediment and temperature as TP TMDLs are hydrologically derived.* For a summary of load reductions, load allocations, and segmental breakdown of stream bank erosion values see Table 68, Table 69, and Table 70 (page 167), and for segmental breakdown of solar radiation values see Appendix F.

Lack of flow, both natural and anthropogenic, is likely also impacting beneficial uses of the Little Wood River. Little Wood River is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, but not pollutants, a TMDL has not been established for this segment of the Little Wood River for flow.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically, the higher flow events occur during spring runoff or. Periodically, during storm situations, as a result the critical period for sediment on this segment of the Little Wood River has been identified as occurring from April to June. During this time, the critical flow for the water body, based on average gage flow data, is 22.3 cfs. As sediment has been found to be occurring as a result of stream bank erosion, the critical flow period is less important in the development of stream bank stability TMDLs.

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on the Little Wood River has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 17.2 cfs. As a temperature TMDL targets canopy cover of a river, the critical flow period is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the SBA portion of this document under the section Analysis Process (page 45). The water quality standards for the various pollutants can also be viewed in Appendix C.

Sediment is impacting beneficial uses of this segment of the Little Wood River in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however, bedload sediment, measured in the form of percent fines, indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case, then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. It has been determined, in previous Idaho TMDLs, that stream banks with 80% bank stability are indicative of beneficial uses being fully supportive. As a result, the target for sediment TMDLs based on stream bank erosion is 80% bank stability.

Temperature is impacting the water quality of the Little Wood River and canopy cover is the method used to determine the amount of solar radiation the river is receiving. The river was divided into four sections to determine target values for canopy cover. Vegetation type and bankfull width were used to characterize the river, then the Alvord Lake SBA and TMDL was used to aid in target selection based on these values (Table 50). The targets for the sections of the water body are as follows: upper (15%), upper middle (30%), lower middle (35%), and lower (40%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover, however in terms of the river as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

As a stream bank erosion TMDL is site specific and cannot be measured by a pour point value, as some of the other constituents can, there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank

erosion TMDL, the water body has been divided into four segments. These segments are as follows: upper, middle, and lower.

The monitoring point for temperature collection for TMDL development occurred at three locations: near the mouth, near Richfield, and near Silver Creek confluence. All of these sites should be used to identify further trends within the water body in the future, as well as used to determine if water quality standards on the Little Wood River (segment 4) are being met.

Load Capacity

The load capacities for two of the three TMDLs to be completed on this segment of the Little Wood River have been determined in different ways.

- The load capacity (581.6 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and 80% stream bank stability.
- The load capacity (3,295,488.5 kWh/day) for temperature TMDLs was determined by converting canopy cover targets to solar radiation.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate and still maintain full support status for beneficial uses.

Estimates of Existing Pollutant Loads

The estimated existing loads for two of the three TMDLs to be completed on this segment of the Little Wood River are elevated above the load capacity of the water body:

- The existing load (1,058.5 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The existing load (3,501,143.7 kWh/day) for the temperature TMDL was calculated as the sum of the amount of solar radiation for the four segments of the river.

These values represent the estimated existing loads of pollutant occurring in the water bodies.

Load Allocation

The waste load allocation for the Little Wood River (segment 4) includes three waste water treatment facilities, one food processing facility, and construction storm water sites. The wasteload allocation for construction storm water was determined by allocating 2% of the sediment load capacity to construction storm water. The waste load allocation for construction storm water is 9.9 t/yr. The intent of this sediment TMDL is not to make the discharge permits of the facilities any more restrictive than they currently are. The combined wasteload allocation is 73.7 t/yr (see Table 67 for individual wasteload allocations).

Construction storm water is not likely to impact the canopy cover; therefore a waste load allocation is not made for construction storm water in this watershed. However, there are point source facilities that do discharge to the river on a regular basis.

This temperature TMDL is based on meeting potential natural riparian vegetation conditions in the watershed. Shade targets were developed with the idea that once shade levels are met, streams will achieve temperatures consistent with those achievable under natural conditions. Once natural conditions are known, point source discharges must not cumulatively increase receiving water temperature more than 0.3°C above the natural stream temperature as stated in Idaho water quality standards (IDAPA 58.01.02.200.09 and IDAPA 58.01.02.401.03.v).

Prior to determining the natural temperature condition in a stream, point source discharges should not contribute water that will elevate the temperature of the receiving water above a 0.3 degree increase above average cold water aquatic life temperatures (19 degrees Celsius), during the period of elevated temperatures (April 1 through September 21). The temperature of the effluent the point sources will be capable of discharging will vary according to effluent flows and river flows (Table 71, Table 72, and Table 73). Additionally, point source dischargers should collect monitoring data on the temperature of their discharge and their receiving stream immediately above and below the discharge point. These data can be used in the future to ascertain applicability of the above referenced natural background provisions. The City of Richfield does not receive an effluent temperature target based on flows because it does not discharge to the river during the time period in which CWAL temperature standards are exceeded.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility (due to uncertainty) within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background loads are not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.
- The BG, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.
- The MOS for the TMDLs of the Little Wood River is 10%. This yields a MOS of 58.2 t/yr for sediment.
- The FG for the TMDLs of the Little Wood River was determined by allocating 5% of the load capacity of the river to FG. This yields a FG of 29.1 t/yr for sediment.

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the waste load allocations, BG, MOS, and FG values. Therefore, the load allocation for sediment is 420.7 t/yr and for temperature is 3,295,488.5 kWh/day.

Table 67. Sediment waste load allocations on the Little Wood River.

Waste Load Type	Location	Waste Load Allocation (lbs/day)	Waste Load Allocation (t/yr)	NPDES Permit Number
Municipality	Richfield	21.8	4.0	ID-002121-1
Municipality	Shoshone	75.2	13.7	ID-002372-8
Municipality	Gooding	250.6	45.7	ID-002002-8
Food Processing	Glanbia –Richfield	0	0	ID-002700-6
Food Processing	Glanbia-Gooding	1.9	0.3	ID-002712-0
Construction storm water	variable	---	9.9	variable

^a NPDES - National Pollutant Discharge Elimination System

Table 68. Little Wood River (segment 4) load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
Sediment	22.3	80	581.6	1,058.5	45.1
Temperature	17.2	15-30-35-40	3,295,488.5	3,501,143.7	5.9

^a Sediment – target measured in percent bank stability, load capacity and existing load measured in t/yr.

^b Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 69. Little Wood River (segment 4) load allocations.

Pollutant	MOS	FG	BG	Available Load	Waste load allocation	Load Allocation
Sediment (tons/yr)	58.2	29.1	Implicit	494.4	73.7	420.7
Temperature (kWh/day)	NA	NA	NA	3,295,488.5	0	3,295,488.5

^a Implicit – Background (BG) is implied within the target.

^b Margin of safety (MOS), future growth (FG), not applicable (NA).

Table 70. Little Wood River (segment 4) stream bank values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	7.1	9.5	123.5	166.7	0	12
Middle	35.5	12.1	729.4	248.1	66	69
Lower	7.0	5.7	205.5	166.8	19	19

^a See Appendix E for site descriptions.

^b Erosion rates measured in tons/mile/year, total erosion measured in tons/year.

Table 71. City of Gooding allowable effluent temperatures.

Little Wood River flow (cfs)	Gooding Effluent Discharge (cfs)													
	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
0.09	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3
1	19.7	19.6	19.5	19.5	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4
2	20.1	19.8	19.7	19.6	19.6	19.5	19.5	19.5	19.5	19.4	19.4	19.4	19.4	19.4
3	20.4	20.1	19.9	19.8	19.7	19.6	19.6	19.6	19.5	19.5	19.5	19.5	19.5	19.5
5	21.2	20.6	20.2	20.1	19.9	19.8	19.8	19.7	19.7	19.6	19.6	19.6	19.6	19.6
7	21.9	21.1	20.6	20.4	20.2	20.1	20.0	19.9	19.8	19.8	19.7	19.7	19.7	19.7
9	22.7	21.6	21.0	20.7	20.4	20.3	20.1	20.1	20.0	19.9	19.9	19.8	19.8	19.8
10	23.1	21.8	21.2	20.8	20.6	20.4	20.2	20.1	20.1	20.0	19.9	19.9	19.8	19.8
15	24.9	23.1	22.1	21.6	21.2	20.9	20.7	20.6	20.4	20.3	20.2	20.2	20.1	20.1
20	26.8	24.3	23.1	22.3	21.8	21.4	21.2	21.0	20.8	20.7	20.6	20.5	20.4	20.3
25	28.7	25.6	24.0	23.1	22.4	22.0	21.6	21.4	21.2	21.0	20.9	20.7	20.6	20.6

^aThe calculation used to determine the effluent temperatures (degrees Celsius) is $\{[(\text{effluent flow} + (0.25 \times \text{river flow})) \times (19 + 0.3)] - [(0.25 \times \text{river flow}) \times 19]\} / \text{effluent flow}$.

Table 72. City of Shoshone allowable effluent temperatures.

Little Wood River flow (cfs)	Shoshone Effluent Discharge (cfs)						
	0.05	0.1	0.15	0.2	0.25	0.3	0.4
10	34.3	26.8	24.3	23.1	22.3	21.8	21.2
20	49.3	34.3	29.3	26.8	25.3	24.3	23.1
30	64.3	41.8	34.3	30.6	28.3	26.8	24.9
40	79.3	49.3	39.3	34.3	31.3	29.3	26.8
50	94.3	56.8	44.3	38.0	34.3	31.8	28.7
60	109.3	64.3	49.3	41.8	37.3	34.3	30.6
70	124.3	71.8	54.3	45.6	40.3	36.8	32.4

^aThe calculation used to determine the effluent temperatures (degrees Celsius) is $\{[(\text{effluent flow} + (0.25 \times \text{river flow})) \times (19 + 0.3)] - [(0.25 \times \text{river flow}) \times 19]\} / \text{effluent flow}$.

Table 73. Glanbia-Gooding allowable effluent temperatures.

Little Wood River flow (cfs)	Glanbia-Gooding Effluent Discharge (cfs)				
	0.1	0.2	0.3	0.4	0.5
1	20.1	19.7	19.6	19.5	19.5
5	23.1	21.2	20.6	20.2	20.1
10	26.8	23.1	21.8	21.2	20.8
20	34.3	26.8	24.3	23.1	22.3
30	41.8	30.6	26.8	24.9	23.8
40	49.3	34.3	29.3	26.8	25.3
50	56.8	38.0	31.8	28.7	26.8
60	64.3	41.8	34.3	30.6	28.3
70	71.8	45.6	36.8	32.4	29.8

^aThe calculation used to determine the effluent temperatures (degrees Celsius) is $\{[(\text{effluent flow} + (0.25 \times \text{river flow})) \times (19 + 0.3)] - [(0.25 \times \text{river flow}) \times 19]\} / \text{effluent flow}$.

Reasonable Assurance

There is reasonable assurance that implementation, as the next step of the water body management process, will occur. First, this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the state's water quality management plan. Also, in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained, then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

Little Wood River Segment #4 (Silver Creek to Clover Creek Canal, and Clover Creek Canal to Big Wood River)

Through the subbasin assessment process it has been identified that the water quality in this water body is being impacted. The pollutants of concern in the water body have been found to be sediment, nutrients, and temperature. *This segment of the report will discuss the TP TMDL.* For waste load allocations, load reductions, and load allocations see Table 74, Table 75, and Table 76 (page 172).

There will be two TP TMDLs developed for the Little Wood River (segment 4). The TMDL for the upper portion represents the section of the river from Silver Creek to the Clover Creek Canal crossing. This segment of the river represents the segment of the river with higher flows.

The TMDL for the lower portion represents the section of the river from the Clover Creek Canal crossing to the Big Wood River. This segment of the river represents the segment of the river that is nearly dewatered due to irrigation demands.

Design Conditions

Nutrients are more likely to impact a water body during the summer months when primary production is occurring within the water body. The critical period, as a result, is from June to September, and the critical flow for this time period for the upper portion of this segment is 66.5 cfs and for the lower portion is 15 cfs. The average flow during the critical period aids in determining the loading capacity of the water body.

Target Selection

Target selections are discussed in more complete detail in the SBA portion of this document under the section Analysis Process (page 45). The water quality standards for the various pollutants can also be viewed in Appendix C.

Nutrients are impacting the water quality of segment 4 of the Little Wood River and are measured by TP values. Previous TMDLs have set 0.1 mg/L as the goal for attaining full support of beneficial uses. As a result, 0.1 mg/L is the target to be used in the development of nutrient TMDLs for the upper and lower segments.

Monitoring Points

The monitoring point for nutrient collection for TMDL development was located at two locations on the Little Wood River. These sites were located near the mouth by the hydrofacility and upstream of the Clover Creek Canal crossing. These sites should be used to identify further trends within the water body in the future.

Load Capacity

The load capacities for the nutrient TMDL to be completed on this segment of the Little Wood River has been calculated based on target selection and average critical flow. The upper segment has a load capacity of 35.8 lbs/day, while the lower portion has a load capacity of 8.1 lbs/day.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate without impairing water quality.

Estimates of Existing Pollutant Loads

The estimated existing loads for the nutrient TMDL to be completed on this segment of the Little Wood River is elevated above the load capacity of the water body. The existing load for nutrient TMDLs was calculated based on average annual values of TP (at the lower site),

average of the monthly values elevated above monthly targets (at the upper site) and average critical flow. The estimated existing load of the upper portion of the river is 39.1 lbs/day, while the lower portion's existing load is 46.2 lbs/day.

These values represent the estimated existing loads of pollutant occurring in the water bodies.

Load Allocation

The point sources that lie within the upper portion of the river and that discharge to the river include the City of Richfield, the City of Shoshone, and Glanbia in Gooding. The City of Richfield and the City of Shoshone will receive waste load allocations based on their design flows. Glanbia in Gooding will receive waste load allocations based on their expected discharge flows as defined in their NPDES application. Construction storm water is also allocated a waste load allocation of 2% of the load capacity. *Glanbia in Richfield* is also a point source facility that lies within this portion of the river, however they no longer discharge to the river and they only discharged non contact cooling water. *They do not contribute TP to the system*, therefore they will not receive a waste load allocation for TP. *Idaho Tire Recovery* also lies within this portion of the river and they *do not discharge* to the river, therefore they will not receive a waste load allocation for TP.

The point source that lies within the lower portion of the river and discharges to the river is the City of Gooding. The City of Gooding will receive waste load allocations based on their highest monthly average flow that has been reported in their NPDES permit. The City of Gooding load allocations are not based on their design flow as the amount of flow in the river can not support pollutant discharge levels at design flow levels. Construction storm water is also allocated a waste load allocation of 2% of the load capacity.

In determining these estimated allocations for the NPDES permitted waste water facilities, discharge monitoring report data was used to determine existing loads, however, as nutrients are not currently part of the required sampling process, estimates had to be developed. First, it was assumed that since all three waste water facilities are 100% separated sanitary sewer that they were operating at levels in which their wastewater would be classified as a low concentration level. As a result of this, their average discharge of TP would be 4 mg/L (Metcalf, 1991). Limited data collected by Shoshone and Gooding indicate that the average concentration discharged into the river is in this range. These assumed values were then used with conversion factors and design flows or average flows to determine estimated existing loads for the waste water point sources.

Glanbia in Gooding does not actively contribute TP to the system as they are permitted to discharge non-contact cooling water only. However, water that is drawn from their wells is elevated in TP periodically; as a result they are incorporated into the waste load allocation to provide for these levels they will be discharging as a result of elevated ground water. Glanbia's TP limited well data averages at 0.074 mg/L, therefore values were rounded to 0.1 mg/L as the concentration limit that Glanbia can contribute to the river. However, they should not be contributing more than that which already exists in the ground water that they are pumping.

The waste load allocations for the Little Wood River include the point sources described above as well as construction storm water. The waste load allocation for TP on the upper portion of the river is 8.59 lbs/day and for the lower portion is 1.31 lbs/day. Table 74 describes the suggested waste load allocations for each individual point source facility along the Little Wood River, however the facilities may decide to work together to determine their individual allocations as long as the 8.59 lbs/day and 1.31 lbs/day waste load allocations are met.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility within the watersheds, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background for TP has been established as being 0.02 mg/L, which accounts for a load allocation of 7.17 lbs/day for the upper portion and 1.62 lbs/day for the lower portion.
- The MOS for the TP TMDL of the Little Wood River is 10%. This yields a MOS of 3.58 lbs/day for the upper portion and 0.81 lbs/day for the lower portion.
- The FG for the TMDLs of the Little Wood River was determined by allocating 5% of the load capacity of the river to FG. This yields a FG of 1.79 lbs/day for the upper portion and 0.40 lbs/day for the lower portion.

The final load allocation for nonpoint source activity is determined by reducing the loading capacity of the water body by the waste load allocations, BG, MOS, and FG values. Therefore, the load allocation for nutrients on the Little Wood River is 14.71 lbs/day for the upper portion and 3.94 lbs/day for the lower portion.

Table 74. Estimated TP waste load from point sources on Little Wood River.

Waste Load Type	Location	Estimated Existing Load (lbs/day)	Waste Load Allocation (lbs/day)	NPDES Permit Number
Upper				
Municipality	Richfield	2.00	1.84	ID-002121-1
Municipality	Shoshone	6.67	6.12	ID-002372-8
Food Processing	Glanbia –Richfield	0	0	ID-002700-6
Food Processing	Glanbia-Gooding	0.19	0.19	ID-002712-0
Construction storm water	variable	unknown	0.47	variable
Lower				
Municipality	Gooding	6.90	1.21	ID-002002-8
Construction storm water	variable	unknown	0.11	variable

^a NPDES - National Pollutant Discharge Elimination System

Table 75. Little Wood River (segment 4) load reductions.

Pollutant	Site	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
Nutrient	Upper	66.5	0.100	35.8	39.1	8.3
Nutrient	Lower	15.0	0.100	8.1	46.2	82.5

^a Nutrient – target measured in mg/L, load capacity and existing load measured in lbs/day.

Table 76. Little Wood River (segment 4) load allocations.

Pollutant	Site	MOS	FG	BG	Available Load	Total Waste Load Allocation	Load Allocation
Nutrient (lbs/day)	Upper	3.58	1.79	7.17	23.30	8.59	14.71
Nutrient (lbs/day)	Lower	0.81	0.40	1.60	5.26	1.31	3.94

^a Margin of safety (MOS), future growth (FG), background (BG).

Reasonable Assurance

There is reasonable assurance that implementation, as the next step of the water body management process, will occur. First, this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the state's water quality management plan. Also, in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained, then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

Construction Storm Water and TMDL Waste Load Allocations

Construction Storm Water

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge storm water to a water body or to a municipal storm sewer. In Idaho, EPA has issued a general permit for storm water discharges from construction sites. In the past storm water was treated as a non-point source of pollutants. However, because storm water can be managed on site through management practices or when discharged through a discrete conveyance such as a storm sewer, it now requires a National Pollution Discharge Elimination System (NPDES) Permit.

The Construction General Permit (CGP)

If a construction project disturbs more than one acre of land (or is part of larger common development) that will disturb more than one acre), the operator is required to apply for permit coverage from EPA after developing a site-specific Storm Water Pollution Prevention Plan.

Storm Water Pollution Prevention Plan (SWPPP)

In order to obtain the Construction General Permit operators must develop a site-specific Storm Water Pollution Prevention Plan. The operator must document the erosion, sediment, and pollution controls they intend to use, inspect the controls periodically and maintain the best management practices (BMPs) through the life of the project

Construction Storm Water Requirements

When a stream is on Idaho's § 303(d) list and has a TMDL developed DEQ now incorporates a gross waste load allocation (WLA) for anticipated construction storm water activities. TMDLs developed in the past that did not have a WLA for construction storm water activities will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement the appropriate Best Management Practices. Typically there are specific requirements you must follow to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for post-construction storm water management. Sediment is usually the main pollutant of concern in storm water from construction sites. The application of specific best management practices from *Idaho's Catalog of Storm Water Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of the General Construction Permit, unless local ordinances have more stringent and site specific standards that are applicable.

Future Growth Potential

Nonpoint source future growth potential such as subdivision development or similar ventures within the stream corridors must provide sufficient protection of nutrient (TP and nitrogen), sediment (TSS and stream bank stability), temperature (canopy cover), and bacteria pollutants so that TMDL targets and goals are maintained. Subdivisions, although defined as a nonpoint source, have the tendency with septic systems to produce more TP than what would be allocated to straight agricultural lands. This assumes that the septic discharge enters the associated water body. Consequently, the TP loading limit for subsurface sewage disposal (IDAPA 58.01.03) or wastewater land application (IDAPA 58.01.17) is contained in the TMDL as part of the nonpoint source load allocation. Point source wasteload allocations are enforceable under NPDES permits and IDAPA 58.01.02.400. Moreover, nonpoint source load allocations are enforceable under the Idaho Administrative Procedures Act (IDAPA 58.01.02.250). In addition, DEQ policy relative to subdivision development within stream corridors should be reviewed in consultation with local planning and zoning restrictions for appropriate consideration.

5.2 Implementation Strategies

The implementation strategy of the Little Wood River Subbasin is written to provide a brief outline of the implementation plan to be completed 18 months after EPA approval of this document. This strategy will also provide reasonable assurance that Best Management Practices (BMPs) will be implemented to help bring back beneficial use support status. DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that the TMDL goals are not being met or significant progress is not being made toward achieving the goals. The implementation strategy is discussed further in Appendix G.

5.3 Conclusions

This section of the document will summarize available data and assessment outcomes for each of the water bodies.

The following table (Table 77) describes the available data and whether or not assessment criteria were met in the water bodies.

Table 77. Summary of assessment criteria results.

Data type	Muldoon Creek	Loving Creek	Dry Creek	Fish Creek (Above)	Fish Creek (Below)	Little Wood River #1	Little Wood River #2	Little Wood River #3	Little Wood River #4
Hydrology	P	P	I	P	I	P	P	I	P
Flow alteration	NIBU	NIBU	IBU	NIBU	IBU	NIBU	---	IBU	IBU
Biological data (BURP)	MBU	NA	NA	MBU / DG	NA	MBU	DG	NA	DG
DO, pH, turbidity	M	M	M	M	M	M	M	DG	M
TSS	M	M	M	M	M	M	M	DG	M
% fines	M	NM	NM	NM	NM	M	DG	M	NM
Bank Erosion	---	M	NM	NM	NM	---	---	---	NM
Nutrients	M	M	M	M / NM	NM	M / M	M	DG	NM
Bacteria	M	M	M	NM	M	M	M	DG	M
Temperature	NM	NM	M	NM	NM	NM	M, DG	DG	NM
Canopy Cover	NM	NM	---	NM	NM	NM	---	---	NM

^a Abbreviations: P-perennial water body, I-intermittent water body, NIBU-not impacting beneficial uses, IBU-impacting beneficial uses, MBU-meeting beneficial uses, NA-not assessed, DG-data gap, M-meeting standards or assessment criteria, NM-not meeting standards or assessment criteria.

^b Water body segments: Little Wood River #1- headwaters to reservoir, Little Wood River #2 – reservoir to canal diversions, Little Wood River #3- canal diversions to Silver Creek, Little Wood River #4- Silver Creek to Big Wood River, Fish Creek (above)- headwaters to reservoir, Fish Creek (below)- reservoir to Carey Lake.

The following table (Table 78) describes the assessment outcomes made for the Little Wood River Subbasin through the SBA and TMDL process.

Table 78. Summary of pollutants and TMDLs completed.

Water Body Segment	Assessment Unit	Pollutant	TMDL Done	Recommended Changes to §303(d) List	Justification
Little Wood River #1	ID17040221SK020_02 ID17040221SK020_03 ID17040221SK020_04 ID17040221SK020_05 ID17040221SK013_05	TEMP	Yes	List TEMP	Temperature violation
Little Wood River #2	ID17040221SK010_05	None	No	None	---
Little Wood River #3	ID17040221SK010_05a ID17040221SK003_05	None	No	List QALT, Delist SED, NUT, TEMP,	Water body dewatered
Little Wood River #4	ID17040221SK002_05 ID17040221SK001_05 ID17040221SK001_05a ID17040221SK001_05b	NUT, SED, TEMP	Yes	Delist BAC, DO	Meeting standards
Little Wood River Reservoir	ID17040221SK012L_0L	None	No	Delist for BAC, DO, NUT, SED	Meeting criteria
Dry Creek	ID17040221SK022_02	SED	Yes	Delist BAC, DO, NUT	Meeting criteria
Fish Creek (above)	ID17040221SK008_02 ID17040221SK008_03 ID17040221SK008_04	SED,NUT, BAC,TEMP	Yes	Delist for DO, QALT	Meeting standards
Fish Creek (below)	ID17040221SK006_03 ID17040221SK006_04	SED,NUT, TEMP	Yes	Delist for BAC,DO	Meeting standards
Fish Creek Reservoir	ID17040221SK005L_0L	None	No	Delist for BAC, DO,NUT,SED	Meeting criteria
Muldoon Creek	ID17040221SK014_02 ID17040221SK014_03 ID17040221SK014_04	TEMP	Yes	Delist for Unknown	Pollutant identified
Loving Creek	ID17040221SK023_02	TEMP	Yes	Delist for Unknown	Pollutant identified

^a Abbreviations: SED- sediment, NUT- nutrient, BAC- bacteria, TEMP- temperature, DO- dissolved oxygen, QALT- flow alteration.

^b Water body segments: Little Wood River #1- headwaters to reservoir, Little Wood River #2 – reservoir to canal diversions, Little Wood River #3- canal diversions to Silver Creek, Little Wood River #4- Silver Creek to Big Wood River, Fish Creek (above)- headwaters to reservoir, Fish Creek (below)- reservoir to Carey Lake.

The following table (Table 79) identifies the water bodies impacted by flow alteration.

Table 79. Flow alteration impacting water quality.

Water Body Segment	AU	Flow alteration Impacting Water Quality
Little Wood River #1	ID17040221SK020_02	No
Little Wood River #1	ID17040221SK020_03	No
Little Wood River #1	ID17040221SK020_04	No
Little Wood River #1	ID17040221SK020_05	No
Little Wood River #1	IS17040221SK013_05	No
Little Wood River #2	ID17040221SK010_05	No
Little Wood River #3	ID17040221SK010_05a	Yes
Little Wood River #3	ID17040221SK003_05	Yes
Little Wood River #4	ID17040221SK002_05	Yes
Little Wood River #4	ID17040221SK001_05	Yes
Little Wood River #4	ID17040221SK001_05a	Yes
Little Wood River #4	ID17040221SK001_05b	Yes
Little Wood River Reservoir	ID17040221SK012L_0L	Yes
Dry Creek	ID17040221SK022_02	Yes
Fish Creek (above)	ID17040221SK008_02	No
Fish Creek (above)	ID17040221SK008_03	No
Fish Creek (above)	ID17040221SK008_04	No
Fish Creek (below)	ID17040221SK006_03	Yes
Fish Creek (below)	ID17040221SK006_04	Yes
Fish Creek Reservoir	ID17040221SK005L_0L	Yes
Muldoon Creek	ID17040221SK014_02	No
Muldoon Creek	ID17040221SK014_03	No
Muldoon Creek	ID17040221SK014_04	No
Loving Creek	ID17040221SK023_02	No

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inaccuracies or typographical errors. The Department of Environmental Quality may update, modify, or revise the data used at any time, without notice.

Glossary

305(b)

Refers to section 305 subsection “b” of the Clean Water Act. The term “305(b)” generally describes a report of each state’s water quality and is the principle means by which the U.S. Environmental Protection Agency, Congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.

§303(d)

Refers to section 303 subsection “d” of the Clean Water Act. 303(d) requires states to develop a list of water bodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to U.S. Environmental Protection Agency approval.

Acre-foot

A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.

Adsorption

The adhesion of one substance to the surface of another. Clays, for example, can adsorb phosphorus and organic molecules

Aeration

A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.

Aerobic

Describes life, processes, or conditions that require the presence of oxygen.

Adfluvial

Describes fish whose life history involves seasonal migration from lakes to streams for spawning.

Adjunct

In the context of water quality, adjunct refers to areas directly adjacent to focal or refuge habitats that have been degraded by human or natural disturbances and do not presently support high diversity or abundance of native species.

Alevin

A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a water body, living off stored yolk.

Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
Alluvium	Unconsolidated recent stream deposition.
Ambient	General conditions in the environment (Armantrout 1998). In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations or specific disturbances such as a wastewater outfall (EPA 1996).
Anadromous	Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the saltwater but return to fresh water to spawn.
Anaerobic	Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.
Anoxia	The condition of oxygen absence or deficiency.
Anthropogenic	Relating to, or resulting from, the influence of human beings on nature.
Anti-Degradation	Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.61).
Aquatic	Occurring, growing, or living in water.

Aquifer

An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.

Assemblage (aquatic)

An association of interacting populations of organisms in a given water body; for example, a fish assemblage or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).

Assessment Database (ADB)

The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of water bodies and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.

Assessment Unit (AU)

A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.

Assimilative Capacity

The ability to process or dissipate pollutants without ill effect to beneficial uses.

Autotrophic

An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.

Batholith

A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.

Bedload

Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.

Beneficial Use

Any of the various uses of water, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.

Beneficial Use Reconnaissance Program (BURP)

A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers

Benthic

Pertaining to or living on or in the bottom sediments of a water body

Benthic Organic Matter.

The organic matter on the bottom of a water body.

Benthos

Organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the lake and stream bottoms.

Best Management Practices (BMPs)

Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.

Best Professional Judgment

A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.

Biochemical Oxygen Demand (BOD)

The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.

Biological Integrity

1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).

Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.
Clean Water Act (CWA)	The Federal Water Pollution Control Act (commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.
Coliform Bacteria	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria, <i>E. Coli</i> , and Pathogens).
Colluvium	Material transported to a site by gravity.
Community	A group of interacting organisms living together in a given place.
Conductivity	The ability of an aqueous solution to carry electric current, expressed in micro (μ) mhos/centimeter at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.
Cretaceous	The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.
Criteria	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. The U.S. Environmental Protection Agency develops criteria guidance; states establish criteria.

Cubic Feet per Second

A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.

Cultural Eutrophication

The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).

Culturally Induced Erosion

Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).

Debris Torrent

The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.

Decomposition

The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.

Depth Fines

Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 millimeters depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 centimeters).

Designated Uses

Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.

Discharge

The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).

Dissolved Oxygen (DO)

The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.

Disturbance

Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.

E. coli

Short for *Escherichia coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans, but their presence in water is often indicative of fecal contamination. *E. coli* are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.

Ecology

The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.

Ecological Indicator

A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.

Ecological Integrity

The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).

Ecosystem

The interacting system of a biological community and its non-living (abiotic) environmental surroundings.

Effluent

A discharge of untreated, partially treated, or treated wastewater into a receiving water body.

Endangered Species

Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.

Environment

The complete range of external conditions, physical and biological, that affect a particular organism or community.

Eocene	An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.
Eolian	Windblown, referring to the process of erosion, transport, and deposition of material by the wind.
Ephemeral Stream	A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table (American Geological Institute 1962).
Erosion	The wearing away of areas of the earth's surface by water, wind, ice, and other forces.
Eutrophic	From Greek for "well nourished," this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.
Eutrophication	1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter.
Exceedance	A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.
Existing Beneficial Use or Existing Use	A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's <i>Water Quality Standards and Wastewater Treatment Requirements</i> (IDAPA 58.01.02).
Exotic Species	A species that is not native (indigenous) to a region.
Extrapolation	Estimation of unknown values by extending or projecting from known values.
Fauna	Animal life, especially the animals characteristic of a region, period, or special environment.

Fecal Coliform Bacteria

Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria, *E. coli*, and Pathogens).

Fecal Streptococci

A species of spherical bacteria including pathogenic strains found in the intestines of warm-blooded animals.

Feedback Loop

In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.

Fixed-Location Monitoring

Sampling or measuring environmental conditions continuously or repeatedly at the same location.

Flow

See *Discharge*.

Fluvial

In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.

Focal

Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.

Fully Supporting

In compliance with water quality standards and within the range of biological reference conditions for all designated and existing beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

Fully Supporting Cold Water

Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions.

Fully Supporting but Threatened

An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a “not fully supporting” status.

Geographical Information Systems (GIS)

A georeferenced database.

Geometric Mean	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
Grab Sample	A single sample collected at a particular time and place. It may represent the composition of the water in that water column.
Gradient	The slope of the land, water, or streambed surface.
Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.
Growth Rate	A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.
Habitat	The living place of an organism or community.
Headwater	The origin or beginning of a stream.
Hydrologic Basin	The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area (also see Watershed).
Hydrologic Cycle	The cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Atmospheric moisture, clouds, rainfall, runoff, surface water, ground water, and water infiltrated in soils are all part of the hydrologic cycle.
Hydrologic Unit	One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, fourth field hydrologic units have been more

commonly called subbasins. Fifth and sixth field hydrologic units have since been delineated for much of the country and are known as watershed and subwatersheds, respectively.

Hydrologic Unit Code (HUC)

The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.

Hydrology

The science dealing with the properties, distribution, and circulation of water.

Impervious

Describes a surface, such as pavement, that water cannot penetrate.

Influent

A tributary stream.

Inorganic

Materials not derived from biological sources.

Instantaneous

A condition or measurement at a moment (instant) in time.

Intergravel Dissolved Oxygen

The concentration of dissolved oxygen within spawning gravel. Consideration for determining spawning gravel includes species, water depth, velocity, and substrate.

Intermittent Stream

1) A stream that flows only part of the year, such as when the ground water table is high or when the stream receives water from springs or from surface sources such as melting snow in mountainous areas. The stream ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. 2) A stream that has a period of zero flow for at least one week during most years.

Interstate Waters

Waters that flow across or form part of state or international boundaries, including boundaries with Native American nations.

Irrigation Return Flow

Surface (and subsurface) water that leaves a field following the application of irrigation water and eventually flows into streams.

Key Watershed

A watershed that has been designated in Idaho Governor Batt's *State of Idaho Bull Trout Conservation Plan* (1996) as critical

to the long-term persistence of regionally important trout populations.

Knickpoint

Any interruption or break of slope.

Land Application

A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.

Limiting Factor

A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.

Limnology

The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.

Load Allocation (LA)

A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).

Load(ing)

The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.

Load(ing) Capacity (LC)

A determination of how much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.

Loam

Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.

Loess

A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.

Lotic

An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.

Luxury Consumption

A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.

Macroinvertebrate

An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.

Macrophytes

Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum* sp.), are free-floating forms not rooted in sediment.

Margin of Safety (MOS)

An implicit or explicit portion of a water body's loading capacity set aside to allow the uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.

Mass Wasting

A general term for the down slope movement of soil and rock material under the direct influence of gravity.

Mean

Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.

Median

The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; 6 is the median of 1, 2, 5, 7, 9, 11.

Metric

1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.

Milligrams per Liter (mg/L)

A unit of measure for concentration. In water, it is essentially equivalent to parts per million (ppm).

Million Gallons per Day (MGD)

A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.

Miocene

Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.

Monitoring

A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.

Mouth

The location where flowing water enters into a larger water body.

National Pollution Discharge Elimination System (NPDES)

A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.

Natural Condition

The condition that exists with little or no anthropogenic influence.

Nitrogen

An element essential to plant growth, and thus is considered a nutrient.

Nodal

Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.

Nonpoint Source

A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.

Not Assessed (NA)

A concept and an assessment category describing water bodies that have been studied, but are missing critical information needed to complete an assessment.

Not Attainable

A concept and an assessment category describing water bodies that demonstrate characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).

Not Fully Supporting

Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

Not Fully Supporting Cold Water

At least one biological assemblage has been significantly modified beyond the natural range of its reference condition.

Nuisance

Anything that is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.

Nutrient

Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.

Nutrient Cycling

The flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).

Oligotrophic

The Greek term for “poorly nourished.” This describes a body of water in which productivity is low and nutrients are limiting to algal growth, as typified by low algal density and high clarity.

Organic Matter

Compounds manufactured by plants and animals that contain principally carbon.

Orthophosphate

A form of soluble inorganic phosphorus most readily used for algal growth.

Oxygen-Demanding Materials

Those materials, mainly organic matter, in a water body that consume oxygen during decomposition.

Parameter

A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.

Partitioning

The sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times. Also the separation of a chemical into two or more phases, such as partitioning of phosphorus between the water column and sediment.

Pathogens

A small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa) that can cause sickness or death. Direct measurement of pathogen levels in surface water is difficult. Consequently, indicator bacteria that are often associated with pathogens are assessed. *E. coli*, a type of fecal coliform bacteria, are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.

Perennial Stream

A stream that flows year-around in most years.

Periphyton

Attached microflora (algae and diatoms) growing on the bottom of a water body or on submerged substrates, including larger plants.

Pesticide

Substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.

pH

The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.

Phased TMDL

A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.

Phosphorus

An element essential to plant growth, often in limited supply, and thus considered a nutrient.

Physiochemical

In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the term “physical/chemical.”

Plankton

Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.

Point Source

A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable “point” of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.

Pollutant

Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

Pollution

A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.

Population

A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.

Pretreatment	The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.
Primary Productivity	The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quality Assurance (QA)	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training (Rand 1995). The goal of QA is to assure the data provided are of the quality needed and claimed (EPA 1996).
Quality Control (QC)	Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples (Rand 1995). QC is implemented at the field or bench level (EPA 1996).
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.
Reconnaissance	An exploratory or preliminary survey of an area.
Reference	A physical or chemical quantity whose value is known and thus is used to calibrate or standardize instruments.
Reference Condition	1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest

level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).

Reference Site

A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.

Representative Sample

A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.

Resident

A term that describes fish that do not migrate.

Respiration

A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.

Riffle

A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.

Riparian

Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.

Riparian Habitat Conservation Area (RHCA)

A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams:

- 300 feet from perennial fish-bearing streams
- 150 feet from perennial non-fish-bearing streams
- 100 feet from intermittent streams, wetlands, and ponds in priority watersheds.

River

A large, natural, or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.

Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
Sediments	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stagnation	The absence of mixing in a water body.
Stenothermal	Unable to tolerate a wide temperature range.
Stratification	A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.
Storm Water Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the

stream. The water often carries pollutants picked up from these surfaces.

Stressors

Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.

Subbasin

A large watershed of several hundred thousand acres. This is the name commonly given to 4th field hydrologic units (also see Hydrologic Unit).

Subbasin Assessment (SBA)

A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.

Subwatershed

A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6th field hydrologic units.

Surface Fines

Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 millimeters depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.

Surface Runoff

Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.

Surface Water

All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.

Suspended Sediments

Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.

Taxon	Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).
Tertiary	An interval of geologic time lasting from 66.4 to 1.6 million years ago. It constitutes the first of two periods of the Cenozoic Era, the second being the Quaternary. The Tertiary has five subdivisions, which from oldest to youngest are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs.
Thalweg	The center of a stream's current, where most of the water flows.
Threatened Species	Species, determined by the U.S. Fish and Wildlife Service, which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
Total Maximum Daily Load (TMDL)	A TMDL is a water body's load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.
Total Dissolved Solids	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.
Total Suspended Solids (TSS)	The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Franson et al. 1998) call for using a filter of 2.0 microns or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.
Toxic Pollutants	Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.

Tributary	A stream feeding into a larger stream or lake.
Trophic State	The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll <i>a</i> concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.
Total Dissolved Solids	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.
Total Suspended Solids (TSS)	The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Franson et al. 1998) call for using a filter of 2.0 micron or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.
Toxic Pollutants	Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.
Tributary	A stream feeding into a larger stream or lake.
Trophic State	The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll <i>a</i> concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.
Turbidity	A measure of the extent to which light passing through water is scattered by fine suspended materials. The effect of turbidity depends on the size of the particles (the finer the particles, the greater the effect per unit weight) and the color of the particles.
Vadose Zone	The unsaturated region from the soil surface to the ground water table.
Wasteload Allocation (WLA)	The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.

Water Body

A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.

Water Column

Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.

Water Pollution

Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental, or injurious to public health, safety, or welfare; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.

Water Quality

A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.

Water Quality Criteria

Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.

Water Quality Limited

A label that describes water bodies for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a §303(d) list.

Water Quality Limited Segment (WQLS)

Any segment placed on a state's §303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "§303(d) listed."

Water Quality Management Plan

A state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.

Water Quality Modeling

The prediction of the response of some characteristics of lake or stream water based on mathematical relations of input variables such as climate, stream flow, and inflow water quality.

Water Quality Standards

State-adopted and U.S. Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

Water Table

The upper surface of ground water; below this point, the soil is saturated with water.

Watershed

1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller “subwatersheds.” 2) The whole geographic region which contributes water to a point of interest in a water body.

Water Body Identification Number (WBID)

A number that uniquely identifies a water body in Idaho and ties in to the Idaho water quality standards and GIS information.

Wetland

An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.

Young of the Year

Young fish born the year captured, evidence of spawning activity.

Appendix A. Unit Conversion Chart

Table 80. Metric – English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square Feet (ft ²) Square Miles (mi ²)	Hectares (ha) Square Meters (m ²) Square Kilometers (km ²)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft ² = 0.09 m ² 1 m ² = 10.76 ft ² 1 mi ² = 2.59 km ² 1 km ² = 0.39 mi ²	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft ² = 0.28 m ² 3 m ² = 32.29 ft ² 3 mi ² = 7.77 km ² 3 km ² = 1.16 mi ²
Volume	Gallons (g) Cubic Feet (ft ³)	Liters (L) Cubic Meters (m ³)	1 g = 3.78 l 1 l = 0.26 g 1 ft ³ = 0.03 m ³ 1 m ³ = 35.32 ft ³	3 g = 11.35 l 3 l = 0.79 g 3 ft ³ = 0.09 m ³ 3 m ³ = 105.94 ft ³
Flow Rate	Cubic Feet per Second (ft ³ /sec) ¹	Cubic Meters per Second (m ³ /sec)	1 ft ³ /sec = 0.03 m ³ /sec 1 m ³ /sec = ft ³ /sec	3 ft ³ /sec = 0.09 m ³ /sec 3 m ³ /sec = 105.94 ft ³ /sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L ²	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 kg
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 °C = 37.4 °F

¹ 1 ft³/sec = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 ft³/sec.

²The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water.

Appendix B. Threatened and Endangered Species.

Table 81. Threatened, endangered, and sensitive species.

Species	Counties			
	Blaine	Lincoln	Gooding	Jerome
Listed Species				
Canada lynx	X			
Gray wolf	X	X	X	X
Bull trout	X			
Bald eagle	X		X	X
Bliss Rapids snail	X		X	X
Ute ladies'-tresses	X	X	X	X
Utah valvata snail			X	X
Snake River physa snail			X	X
Banbury springs limpet				
Idaho springsnail				
Candidate species				
Slick spot peppergrass				
Sensitive species				
Mammals				
Yuma myotis	X			
Long-eared myotis	X		X	
Long-legged myotis	X			
Western small-footed myotis	X			
Townsend's big eared bat	X	X	X	
Pygmy rabbit	X	X	X	X
Wolverine	X			
Western pipistrelle			X	
Kit fox				
Fisher				
Merriam's shrew				
Fish				
Redband trout	X		X	
Wood River sculpin	X			
Leatherside chub		X		
Shoshone sculpin			X	
White sturgeon				X
Birds				
Columbian sharp-tailed grouse	X			
Greater sage-grouse	X	X	X	X
Yellow-billed cuckoo	X			
White-faced ibis	X			
Trumpeter swan	X		X	
Northern goshawk	X			
Ferruginous hawk	X	X		

Species	Counties			
	Blaine	Lincoln	Gooding	Jerome
Black tern	X			
Long billed curlew	X	X	X	X
Flammulated owl	X			
Boreal owl	X			
Three-toed woodpecker	X			
Western burrowing owl				
Mountain quail				
White-headed woodpecker				
Invertebrates				
Idaho Dunes tiger beetle	X	X		
California floater				X
Amphibians and Reptiles				
Western toad	X	X		X
Northern leopard frog	X	X	X	X
Columbia spotted frog	X	X	X	X
Common garter snake	X	X	X	X
Short-horned lizard	X	X	X	X
Mojave black-collared lizard	X	X	X	
Woodhouse's toad				
Idaho giant salamander				
Longnose snake				
Ground snake				
Plants				
Slender moonwort	X	X	X	X
Meadow pussytoes	X			
Mourning milkvetch	X	X	X	
Bugleg goldenweed	X			
Obscure phacelia	X			
Least phacelia				
Idaho douglasia				
Davis' peppergrass				
Lichens				
Wovenspore lichen				

Appendix C. State and Site-Specific Standards and Criteria

Table 82. Surface water criteria.

IDAPA58.01.02	Criteria
200.	General Surface Water Quality Criteria. The following general water quality criteria apply to all surface waters of the state, in addition to the water quality criteria set forth for specifically designated waters.
01.	Hazardous Materials. Surface waters of the state shall be free from hazardous materials in concentrations found to be of public health significance or to impair designated beneficial uses.
02.	Toxic Substances. Surface waters of the state shall be free from toxic substances in concentrations that impair designated beneficial uses.
03.	Deleterious Materials. Surface waters of the state shall be free from deleterious materials in concentrations that impair designated uses.
04.	Radioactive Materials.
a.	Radioactive materials or radioactivity shall not exceed the values listed in the Code of Federal Regulations, Title 10, Chapter 1, Part 20, Appendix B, Table 2, Effluent Concentrations, Column 2.
b.	Radioactive materials or radioactivity shall not exceed concentrations required to meet the standards set forth in Title 10, Chapter 1, Part 20 of the Code of Federal Regulations for maximum exposure of critical human organs in the case of foodstuffs harvested from these waters for human consumption.
05.	Floating, Suspended or Submerged Matter. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses.
06.	Excess Nutrients. Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.
07.	Oxygen-Demanding Materials. Surface waters of the state shall be free from oxygen-demanding materials in concentrations that would result in an anaerobic water condition.
08.	Sediment. Sediment shall not exceed quantities specified in Sections 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses.
09.	Natural Background Conditions. When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253 the applicable water quality criteria shall not apply; instead, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under Section 401.
250.	Surface Water Quality Criteria for Aquatic Life Use Designations
01.	General Criteria
a.	Hydrogen Ion Concentration(pH) values within the range of 6.5 to 9.0
b.	The total concentration of dissolved gas not exceeding 110% of saturation at atmospheric pressure at the point of sample collection
c.	Total chlorine residual. One hour average concentration not to exceed 19ug/l or four day average concentration not to exceed 11ug/l
02.	Cold Water

IDAPA58.01.02	Criteria
a.	Dissolved Oxygen Concentrations exceeding 6 mg/L at all times. In lakes and reservoirs this standard does not always apply
b.	Water temperatures of 22 degrees C or less with a maximum daily average of no greater than 19 degrees C.
c.	Temperature in lakes shall have no measurable change from natural background conditions.
d.	Ammonia. The following criteria are not to be exceeded dependent on the temperature and pH of the water body
i.	Acute Criterion. The one hour average concentration of total ammonia nitrogen is not to exceed more than once every 3 years, the calculated CMC value
ii.	Chronic Criterion. The thirty day average concentration of total ammonia nitrogen is not to exceed, more than once every 3 years, the calculated CCC value.
d.	Turbidity, below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than 50NTU instantaneously or more than 25 NTU for more than 10 consecutive days.
e.	Salmonid spawning: waters designated for salmonid spawning are to exhibit the following characteristics during the spawning period and incubation for the particular species inhabiting those waters:
i.(1)	Dissolved Oxygen. Intergravel dissolved oxygen. One day minimum of not less than 5.0 mg/L.
i.(2)	Water-Column dissolved Oxygen. One day minimum of not less than 6.0 mg/L or 90% of saturation, whichever is greater
ii.	Water temperatures of 13 degrees C or less with a maximum daily average no greater than 9 degrees C
251.	Surface water quality criteria for recreation use designations
01.	Primary Contact recreation. Waters designated for primary contact recreation are not to contain <i>E. coli</i> bacteria significant to the public health in concentrations exceeding
b.	For all other waters designated for primary contact recreation, a single sample of four hundred six <i>E. coli</i> organisms per 100ml or
c.	A geometric mean of 126 <i>E. coli</i> organisms per 100ml based on a minimum of 5 samples taken every 3 to 5 days over a 30 day period.
02.	Secondary Contact recreation. Waters designated for secondary contact recreation are not to contain <i>E. coli</i> bacteria significant to the public health in concentrations exceeding:
a.	A single sample of 576 <i>E. coli</i> organisms per 100ml or
b.	A geometric mean of 126 <i>E. coli</i> organisms per 100 ml based on a minimum of 5 samples taken every 3 to 5 days over a 30day period.
252.	Surface Water Quality Criteria for Water Supply Use Designation
02.	Agricultural. Water quality criteria for agricultural water supplies will generally be satisfied by the water quality criteria set for in Section 200.
03.	Industrial. Water quality criteria for industrial water supplies will generally be satisfied by the general water quality criteria set forth in Section 200.
253.	Surface Water Quality Criteria for Wildlife and Aesthetic Use Designations
01.	Wildlife Habitats. Water quality criteria for wildlife habitats will generally be satisfied by the general water quality criteria set forth in Section 200.
02.	Aesthetics. Water quality criteria for aesthetics will generally be satisfied by the general water quality criteria set forth in Section 200.

IDAPA58.01.02	Criteria
401.03	Treatment Requirements. Unless more stringent limitations are necessary to meet the applicable requirements of Sections 200 through 300 or unless specific exemptions are made pursuant to Subsection 080.02 or 401.05, wastewaters discharged into surface waters of the state must have the following characteristics:
a.	Temperature-the wastewater must not affect the receiving water outside the mixing zone so that
i.	The temperature of the receiving water or of downstream waters will interfere with designated beneficial uses
ii.	Daily and seasonal temperature cycles characteristic of the water body are not maintained
iii.	If the water is designated for warm water aquatic life, the induced variation is more than plus two (+2) degrees C
iv.	If the water is designated for cold water aquatic life, seasonal cold water aquatic life, or salmonid spawning, the induced variation is more than plus one (+1) degree C.
v.	If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then Subsections 401.03.a.iii. and 401.03.a.iv. do not apply and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C.

^a Criteria copied from Water Quality Standards and Wastewater Treatment Requirements.

Appendix D. Geology of Fish Creek Reservoir

General Description of Geology of the area near Fish Creek Dam, Blaine County Idaho

Prepared by Terril Stevenson
USDA, NRCS Idaho
July 23, 2003

Fish Creek Dam and Reservoir are located in the Pioneer Mountains along the northern edge of the Snake River Plain. The dam and reservoir are in the small (narrow) alluvial valley of Fish Creek. Fish Creek flows to the south and then west to Carey Lake. This drainage pattern is controlled by the recent (Quaternary Age) basalt flows associated with the Craters of the Moon and Great Rift volcanic area to the south and east.

The dam and reservoir are in the border zone between the Eastern Snake River Plain and the Northern Rocky Mountain Geomorphic Provinces. Mountains on the west side of the area are formed by block- and thrust-faulted, folded, predominantly Tertiary Age Challis Volcanics rocks consisting of welded volcanic tuff, latite and andesite conglomerates. Mountains on the east side are formed in Paleozoic age sedimentary rocks consisting mainly of dolomites, limestones, and calcareous argillites or claystones. Bedrock on the east side has also been thrust and block faulted.

The slopes that form the valley walls immediately adjacent to the dam are faulted Paleozoic rock. There appears to be a major thrust fault trending northwest-southeast that bisects the valley at about the location of the dam. Additionally, there is an inferred block fault that follows the trace of the valley, trending north-northeast. The Paleozoic rock sequence is partially repeated as a result of the faulting.

The alluvial valley is partially filled with Quaternary Age basalt. The dam is constructed over basalt. Shallow deposits of Quaternary Age loess (windblown sediment) overlie the basalt. Coarse colluvium and alluvial fan deposits of clay, silt, sand and gravel have formed at the base of the mountains throughout the area.

The Paleozoic Formations mapped in the area include:

- Wood River Formation: calcareous siltstone, argillite, sandstone, and limestone.
- Copper Basin Formation: limestone, sandstone, siltstone, and argillite.
- Picabo Formation: dolomite.
- Three Forks Limestone: limestone and shale.
- Jefferson Dolomite.
- Carey Dolomite.
- Roberts Mountain Formation: limestone, siltstone.

None of these Formations contain phosphates in commercial quantities however dolomite, shale, limestone, and argillite typically contain higher levels of phosphorus than other rock types. Additionally, the Paleozoic rock section places the Phosphoria Formation

stratigraphically as the next unit above the Wood River Formation. The Phosphoria Formation has not been mapped in the area but is found with these same Formations in southeastern Idaho, Utah, Wyoming and Montana.

Loess and alluvial sediments derived from these formations may contain significant phosphorus. Ground and surface water associated with these sediments may exhibit background levels of phosphorus that are higher than water in sediment derived from other Formations.

Geology References:

- Rember, W.C. and E.H. Bennett, 1979, Geologic Map of the Idaho Falls Quadrangle, Idaho; Idaho Bureau of Mines and Geology (Idaho Geological Survey) 1 plate.
- Ross, C.P. and J.D. Forester, 1958, Outline of the Geology of Idaho; Idaho Bureau of Mines and Geology (Idaho Geological Survey) Bulletin 15, 74 pp.
- Scott, W.E., 1982, Surficial Geologic Map of the Eastern Snake River Plain and Adjacent Areas, 111 To 115 W., Idaho and Wyoming, USGS Miscellaneous Investigations Series Map I-1372, 2 Plates.
- Whitehead, R. L., 1986, Geohydrologic Framework of the Snake River Plain, Idaho and Eastern Oregon; USGS Atlas HA-681, 3 Plates.

Appendix E. Stream Bank Inventory Information.

This appendix includes the segment breaks for the stream bank erosion inventories completed for each creek that has had a sediment TMDL completed and the methodology for the NRCS Stream Bank Erosion Inventory Process.

Table 83 identifies the segment breaks for each segment of the creeks that have had sediment TMDLs completed.

Table 83. Stream bank segments in the Little Wood River Subbasin.

Creek	Segment	Upper GPS point			Lower GPS point		
		deg	min	sec	deg	min	sec
Dry Creek	Upper	43	22	47	43	20	31
		114	06	06	114	02	09
	Middle	43	20	31	43	19	43
		114	02	09	114	00	05
	Lower	43	19	43	43	17	15
		114	00	05	113	56	56
Fish Creek (Above the Reservoir)	Upper	43	34	54	43	33	10
		113	42	25	113	43	27
	Upper Middle	43	33	10	43	32	17
		113	43	27	113	44	59
	Lower Middle	43	32	17	43	46	42
		113	44	59	113	46	42
	Lower	43	46	42	43	25	58
		113	46	42	113	48	38
Fish Creek (Below the Reservoir)	Upper	43	25	20	43	24	03
		113	49	53	113	49	25
	Middle	43	24	03	43	23	11
		113	49	25	113	49	25
	Lower	43	23	11	43	22	22
		113	49	03	113	50	04
Little Wood River (Segment #4)	Upper	43	11	56	43	02	37
		114	00	36	114	08	17
	Middle	43	02	37	42	56	48
		114	08	17	114	22	53
	Lower	42	56	48	43	56	37
		114	22	53	114	47	41

The following information has been provided by Melissa Thompson (DEQ) in 2005 and describes the methodology of the NRCS Stream Bank Erosion Inventory Process.

The stream bank erosion inventory was used to estimate background and existing stream bank erosion following methods outlined in the proceedings from the Natural Resource

Conservation Service (NRCS) Channel Evaluation Workshop (NRCS, 1983). Using the direct volume method, sub-sections of 1998 §303(d) watersheds were surveyed to determine the extent of chronic bank erosion and estimate the needed reductions.

Stream bank Erosion Inventory

The NRCS Stream bank Erosion Inventory is a field based methodology, which measures stream bank/channel stability, length of active eroding banks, and bank geometry (Stevenson, 1994). The stream bank/channel stability inventories were used to estimate the long-term lateral recession rate. The recession rate is determined from field evaluation of stream bank characteristics that are assigned a categorical rating ranging from 0 to 3. The categories of rating the factors and rating scores are:

Bank Stability:

- Do not appear to be eroding - 0
- Erosion evident - 1
- Erosion and cracking present - 2
- Slumps and clumps sloughing off - 3

Bank Condition:

- Some bare bank, few rills, no vegetative overhang - 0
- Predominantly bare, some rills, moderate vegetative overhang - 1
- Bare, rills, severe vegetative overhang, exposed roots - 2
- Bare, rills and gullies, severe vegetative overhang, falling trees - 3

Vegetation / Cover On Banks:

- Predominantly perennials or rock-covered - 0
- Annuals / perennials mixed or about 40% bare - 1
- Annuals or about 70% bare - 2
- Predominantly bare - 3

Bank / Channel Shape:

- V - Shaped channel, sloped banks - 0
- Steep V - Shaped channel, near vertical banks - 1
- Vertical Banks, U - Shaped channel - 2
- U - Shaped channel, undercut banks, meandering channel - 3

Channel Bottom:

- Channel in bedrock / noneroding - 0
- Soil bottom, gravels or cobbles, minor erosion - 1
- Silt bottom, evidence of active downcutting - 2

Deposition:

- No evidence of recent deposition - 1
- Evidence of recent deposits, silt bars - 0

Cumulative Rating

Slight (0-4) Moderate (5-8) Severe (9+)

From the Cumulative Rating, the lateral recession rate is assigned.

0.01 - 0.05 feet per year **Slight**
 0.06 - 0.15 feet per year **Moderate**

0.16 - 0.3 feet per year	Severe
0.5+ feet per year	Very Severe

Stream bank stability can also be characterized through the following definition and the corresponding stream bank erosion condition rating from Bank Stability or Bank Condition above are included in italics.

Stream banks are considered stable if they do not show indications of any of the following features:

- **Breakdown** - Obvious blocks of bank broken away and lying adjacent to the bank breakage. *Bank Stability Rating 3*
- **Slumping or False Bank** - Bank has obviously slipped down, cracks may or may not be obvious, but the slump feature is obvious. *Bank Stability Rating 2*
- **Fracture** - A crack is visibly obvious on the bank indicating that the block of bank is about to slump or move into the stream. *Bank Stability Rating 2*
- **Vertical and Eroding** - The bank is mostly uncovered and the bank angle is steeper than 80 degrees from the horizontal. *Bank Stability Rating 1*

Stream banks are considered covered if they show any of the following features:

- Perennial vegetation ground cover is greater than 50%. *Vegetation/Cover Rating 0*
- Roots of vegetation cover more than 50% of the bank (deep rooted plants such as willows and sedges provide such root cover). *Vegetation/Cover Rating 1*
- At least 50% of the bank surfaces are protected by rocks of cobble size or larger. *Vegetation/Cover Rating 0*
- At least 50% of the bank surfaces are protected by logs of 4 inch diameter or larger. *Vegetation/Cover Rating 1*

Stream bank stability is estimated using a simplified modification of Platts, Megahan, and Minshall (1983, p. 13) as stated in *Monitoring Protocols to Evaluate Water Quality Effects of Grazing Management on Western Rangeland Streams* (Bauer and Burton, 1993). The modification allows for measuring stream bank stability in a more objective fashion. The lengths of banks on both sides of the stream throughout the entire linear distance of the representative reach are measured and proportioned into four stability classes as follows:

- **Mostly covered and stable (non-erosional).** Stream banks are Over 50% Covered as defined above. Stream banks are Stable as defined above. Banks associated with gravel bars having perennial vegetation above the scourline are in this category. *Cumulative Rating 0 - 4 (slight erosion) with a corresponding lateral recession rate of 0.01 - 0.05 feet per year.*
- **Mostly covered and unstable (vulnerable).** Stream banks are Over 50% Covered as defined above. Stream banks are Unstable as defined above. Such banks are typical of "false banks" observed in meadows where breakdown, slumping, and/or fracture show instability yet vegetative cover is abundant. *Cumulative Rating 5 - 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 - 0.2 feet per year.*

- **Mostly uncovered and stable (vulnerable).** Stream banks are less than 50% Covered as defined above. Stream banks are Stable as defined above. Uncovered, stable banks are typical of stream banks trampled by concentrations of cattle. Such trampling flattens the bank so that slumping and breakdown do not occur even though vegetative cover is significantly reduced or eliminated. *Cumulative Rating 5 - 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 - 0.2 feet per year.*
- **Mostly uncovered and unstable (erosional).** Stream banks are less than 50% Covered as defined above. They are also Unstable as defined above. These are bare eroding stream banks and include ALL banks mostly uncovered, which are at a steep angle to the water surface. *Cumulative Rating 9+ (severe erosion) with a corresponding lateral recession rate of over 0.5 feet per year.*

Stream banks were inventoried to quantify bank erosion rate and annual average erosion. These data were used to develop a quantitative sediment budget to be used for TMDL development.

Site Selection

The first step in the bank erosion inventory is to identify key problem areas. Stream bank erosion tends to increase as a function of watershed area (NRCS, 1983). As a result, the lower stream segments of larger watersheds tend to be problem areas. These stream segments tend to be alluvial streams commonly classified as response reaches (Rosgen B and C channel types) (Rosgen, 1996).

Because it is often unrealistic to survey every stream segment, sampled reaches were used and bank erosion rates are extrapolated over a larger stream segment. The length of the sampled reach is a function of stream type variability where stream segments with highly variable channel types need a large sample, whereas segments with uniform gradient and consistent geometry need less. Typically between 10 and 30 percent of stream bank needs to be inventoried. Often, the location of some stream inventory reaches is more dependent on land ownership than watershed characteristics. For example, private land owners are sometimes unwilling to allow access to stream segments within their property. Stream reaches are subdivided into *sites* with similar channel and bank characteristics. Breaks between sites are made where channel type and/or dominant bank characteristics change substantially. In a stream with uniform channel geometry there may be only one site per stream reach, whereas in an area with variable conditions there may be several sites. Subdivision of stream reaches is at the discretion of the field crew leader.

Field Methods

Stream bank erosion or channel stability inventory field methods were originally developed by the USDA USFS (Pfankuch, 1975). Further development of channel stability inventory methods are outlined in Lohrey (1989) and NRCS (1983). As stated above, the NRCS (1983) document outlines field methods used in this inventory. However, slight modifications to the field methods were made and are documented.

Bank Erosion Calculations

The direct volume method is used to calculate average annual erosion rates for a given stream segment based on bank recession rate determined in the survey (NRCS, 1983). The erosion rate (tons/mile/year) is used to estimate the total bank erosion of the selected stream corridor.

The direct volume method is summarized in the following equations:

$$E = [A_E * R_{LR} * \rho_B] / 2000 \text{ (lbs/ton)}$$

where:

E = bank erosion over sampled stream reach
(tons/yr/sample reach)

A_E = eroding area (ft²)

R_{LR} = lateral recession rate (ft/yr)

ρ_B = bulk density of bank material (lbs/ft³)

The bank erosion rate (E_R) is calculated by dividing the sampled bank erosion (E) by the total stream length sampled:

$$E_R = E / L_{BB}$$

where:

E_R = bank erosion rate (tons/mile/year)

E = bank erosion over sampled stream reach
(tons/yr/sample reach)

L_{BB} = bank to bank stream length over sampled reach

Total bank erosion is expressed as an annual average. However, the frequency and magnitude of bank erosion events are greatly a function of soil moisture and stream discharge (Leopold et al, 1964). Because channel erosion events typically result from above average flow events, the annual average bank erosion value should be considered a long term average. For example, a 50 year flood event might cause five feet of bank erosion in one year and over a ten year period this events accounts for the majority of bank erosion. These factors have less of an influence where bank trampling is the major cause of channel instability.

The *eroding area* (A_E) is the product of linear horizontal bank distance and average bank slope height. Bank length and slope heights are measured while walking along the stream channel. Pacing is used to measure horizontal distance, and bank slope heights are continually measured and averaged over a given reach or site. The horizontal length is the length of the right or left bank, not both. Typically, one bank along the stream channel is actively eroding. For example, the bank on the outside of a meander. However, both banks of channels with severe headcuts or gullies will be eroding and are to be measured separately and eventually summed.

Determining the *lateral recession rate* (R_{LR}) is one of the most critical factors in this methodology (NRCS, 1983). Several techniques are available to quantify bank erosion rates:

for example, aerial photo interpretation, anecdotal data, bank pins, and channel cross-sections.

To facilitate consistent data collection, the NRCS developed rating factors used to estimate lateral recession rate. Similar to methods developed by Pfankuch (1975), the NRCS method measures bank and channel stability, and then uses the ratings as surrogates for bank erosion rates.

The *bulk density* (ρ_B) of bank material is measured ocularly in the field. Soil bulk density is the weight of material divided by its volume, including the volume of its pore spaces. A table of typical soil bulk densities can be used, or soil samples can be collected and soil bulk density measured in the laboratory.

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Appendix F. Information Related to Temperature.

This appendix includes the segment breaks for the canopy cover targets and existing loads, solar path finder field data comparisons to aerial photo interpretations, and the methodology for the aerial photo interpretation.

Table 84 identifies the segment breaks and existing and potential load for each segment of the creeks that have had temperature TMDLs completed. ArcView maps of the creeks showing existing canopy cover and canopy cover targets can be obtained at the DEQ Twin Falls office.

Table 84. Canopy cover estimates and targets.

Water body	Segment	SL (miles)	EC (%)	ESL (kWh/day)	TC (%)	PSL (kWh/day)	EL - PL (kWh/day)
Muldoon Creek	Upper	1.75	0.5	39,530.3	0.65	27,671.2	11,859.1
		0.5	0.6	9,035.5	0.65	7,906.1	1,129.4
		2.2	0.5	49,695.3	0.65	34,786.7	14,908.6
		0.5	0.6	9,035.5	0.65	7,906.1	1,129.4
		0.5	0.5	11,294.4	0.65	7,906.1	3,388.3
	Middle	1.75	0.4	91,638.5	0.45	84,001.9	7,636.5
		0.3	0.3	18,327.7	0.45	14,400.3	3,927.4
		0.25	0.4	13,091.2	0.45	12,000.3	1,090.9
		0.5	0.5	21,818.7	0.45	24,000.5	0.0
		0.5	0.4	26,182.4	0.45	24,000.5	2,181.9
		0.25	0.2	17,454.9	0.45	12,000.3	5,454.7
		0.5	0.4	26,182.4	0.45	24,000.5	2,181.9
		0.6	0.3	36,655.4	0.45	28,800.7	7,854.7
		1.4	0.2	97,747.7	0.45	67,201.5	30,546.2
	Lower	0.6	0.3	46,142.7	0.37	41,528.4	4,614.3
		0.2	0.5	10,986.3	0.37	13,842.8	0.0
		1	0.4	65,918.1	0.37	69,214.0	0.0
		0.25	0.5	13,732.9	0.37	17,303.5	0.0
		0.25	0.4	16,479.5	0.37	17,303.5	0.0
Fish Creek below reservoir		0.7	0.4	28,030.6	0.35	30,366.5	0.0
		1.2	0.3	56,061.2	0.35	52,056.8	4,004.4
		0.8	0.4	32,035.0	0.35	34,704.5	0.0
		0.4	0.2	21,356.6	0.35	17,352.3	4,004.4
		0.5	0.3	23,358.8	0.35	21,690.3	1,668.5
		0.5	0.4	20,021.8	0.35	21,690.3	0.0
		0.2	0.1	12,013.1	0.35	8,676.1	3,337.0
		0.2	0.2	10,678.3	0.35	8,676.1	2,002.2
		0.7	0.1	42,045.9	0.35	30,366.5	11,679.4
		1.5	0.1	90,098.3	0.35	65,071.0	25,027.3
Fish Creek above reservoir	Upper	3	0	200,218.5	0.35	130,142.0	70,076.5
		0.5	0.4	8,316.8	0.6	5,544.5	2,772.3
		0.25	0.6	2,772.3	0.6	2,772.3	0.0

Water body	Segment	SL (miles)	EC (%)	ESL (kWh/day)	TC (%)	PSL (kWh/day)	EL - PL (kWh/day)
		0.5	0.4	8,316.8	0.6	5,544.5	2,772.3
		1.2	0.5	16,633.5	0.6	13,306.8	3,326.7
		0.6	0.4	9,980.1	0.6	6,653.4	3,326.7
		0.5	0.6	5,544.5	0.6	5,544.5	0.0
	Middle	0.8	0.4	25,628.0	0.6	17,085.3	8,542.7
		0.2	0.6	4,271.3	0.6	4,271.3	0.0
		0.5	0.5	13,347.9	0.6	10,678.3	2,669.6
		0.3	0.4	9,610.5	0.6	6,407.0	3,203.5
		1.7	0.5	45,382.9	0.6	36,306.3	9,076.6
		0.3	0.4	9,610.5	0.6	6,407.0	3,203.5
		0.3	0.3	11,212.2	0.6	6,407.0	4,805.2
	Lower	0.5	0.4	14,169.3	0.45	12,988.5	1,180.8
		0.6	0.5	14,169.3	0.45	15,586.2	0.0
		0.5	0.2	18,892.4	0.45	12,988.5	5,903.9
		0.2	0.5	4,723.1	0.45	5,195.4	0.0
		0.7	0.2	26,449.4	0.45	18,183.9	8,265.4
		0.2	0.5	4,723.1	0.45	5,195.4	0.0
		0.2	0.2	7,557.0	0.45	5,195.4	2,361.6
		1	0.5	23,615.5	0.45	25,977.1	0.0
		0.4	0.2	15,113.9	0.45	10,390.8	4,723.1
Loving Creek	Upper	0.2	0	18,687.1	0.2	14,949.6	3,737.4
	Middle	0.8	0.3	35,074.2	0.45	27,558.3	7,515.9
		0.5	0.4	18,789.7	0.45	17,223.9	1,565.8
		0.8	0.2	40,084.8	0.45	27,558.3	12,526.5
		0.5	0.4	18,789.7	0.45	17,223.9	1,565.8
		0.6	0.4	22,547.7	0.45	20,668.7	1,879.0
		0.8	0.1	45,095.4	0.45	27,558.3	17,537.1
		0.2	0.4	7,515.9	0.45	6,889.6	626.3
		1.5	0.2	75,158.9	0.45	51,671.8	23,487.2
	Upper lower	1.1	0	223,628.6	0.1	201,265.8	22,362.9
	Lower lower	0.2	0.4	17,988.9	0.28	21,586.6	0.0
		0.4	0.1	53,966.6	0.28	43,173.3	10,793.3
Little Wood River Segment 1	Upper	1	0.7	27,414.5	0.4	54,829.1	0.0
		0.5	0.5	22,845.4	0.4	27,414.5	0.0
		0.5	0.4	27,414.5	0.4	27,414.5	0.0
		0.5	0.5	22,845.4	0.4	27,414.5	0.0
		0.6	0.4	32,897.4	0.4	32,897.4	0.0
		1.2	0.6	43,863.3	0.4	65,794.9	0.0
		1	0.5	45,690.9	0.4	54,829.1	0.0
		0.7	0.4	38,380.3	0.4	38,380.3	0.0
		0.5	0.5	22,845.4	0.4	27,414.5	0.0
		0.5	0.3	31,983.6	0.4	27,414.5	4,569.1
		0.8	0.4	43,863.3	0.4	43,863.3	0.0
		0.6	0.3	38,380.3	0.4	32,897.4	5,482.9
		0.3	0.4	16,448.7	0.4	16,448.7	0.0
		1	0.3	63,967.2	0.4	54,829.1	9,138.2

Water body	Segment	SL (miles)	EC (%)	ESL (kWh/day)	TC (%)	PSL (kWh/day)	EL - PL (kWh/day)
		0.3	0.4	16,448.7	0.4	16,448.7	0.0
		0.8	0.3	51,173.8	0.4	43,863.3	7,310.5
	Middle	0.4	0.2	43,041.8	0.4	32,281.4	10,760.5
		0.2	0.3	18,830.8	0.4	16,140.7	2,690.1
		0.3	0.4	24,211.0	0.4	24,211.0	0.0
		0.6	0.3	56,492.4	0.4	48,422.1	8,070.3
		0.5	0.5	33,626.4	0.4	40,351.7	0.0
		0.3	0.4	24,211.0	0.4	24,211.0	0.0
		0.2	0.2	21,520.9	0.4	16,140.7	5,380.2
		0.7	0.4	56,492.4	0.4	56,492.4	0.0
		0.2	0.5	13,450.6	0.4	16,140.7	0.0
		0.5	0.3	47,077.0	0.4	40,351.7	6,725.3
		0.4	0.2	43,041.8	0.4	32,281.4	10,760.5
		0.2	0.3	18,830.8	0.4	16,140.7	2,690.1
		0.3	0.4	24,211.0	0.4	24,211.0	0.0
		0.3	0.3	28,246.2	0.4	24,211.0	4,035.2
		0.3	0.2	32,281.4	0.4	24,211.0	8,070.3
	Lower	0.6	0.4	50,639.9	0.4	50,639.9	0.0
		1.4	0.3	137,853.0	0.4	118,159.7	19,693.3
Little Wood River Segment 4	Upper	0.4	0.1	41,768.7	0.15	39,448.2	2,320.5
		0.5	0.2	46,409.6	0.15	49,310.2	0.0
		0.6	0.3	48,730.1	0.15	59,172.3	0.0
		0.3	0.2	27,845.8	0.15	29,586.1	0.0
		0.2	0.3	16,243.4	0.15	19,724.1	0.0
		0.4	0.2	37,127.7	0.15	39,448.2	0.0
		0.4	0.1	41,768.7	0.15	39,448.2	2,320.5
		2.5	0.2	232,048.1	0.15	246,551.1	0.0
		0.3	0.3	24,365.0	0.15	29,586.1	0.0
		0.6	0.2	55,691.5	0.15	59,172.3	0.0
		0.6	0.3	48,730.1	0.15	59,172.3	0.0
		1.2	0.2	111,383.1	0.15	118,344.5	0.0
		1	0.1	104,421.6	0.15	98,620.4	5,801.2
		2	0.2	185,638.5	0.15	197,240.9	0.0
		2	0.1	208,843.3	0.15	197,240.9	11,602.4
		0.3	0.2	27,845.8	0.15	29,586.1	0.0
	Upper middle	1.4	0.3	83,516.8	0.3	83,516.8	0.0
		0.5	0.4	25,566.4	0.3	29,827.4	0.0
		1	0.3	59,654.8	0.3	59,654.8	0.0
		0.8	0.2	54,541.6	0.3	47,723.9	6,817.7
		0.3	0.1	23,009.7	0.3	17,896.5	5,113.3
		0.9	0.2	61,359.3	0.3	53,689.4	7,669.9
		0.6	0.4	30,679.6	0.3	35,792.9	0.0
		0.7	0.5	29,827.4	0.3	41,758.4	0.0
		0.3	0.4	15,339.8	0.3	17,896.5	0.0
		0.3	0.3	17,896.5	0.3	17,896.5	0.0
		0.2	0.4	10,226.5	0.3	11,931.0	0.0

Water body	Segment	SL (miles)	EC (%)	ESL (kWh/day)	TC (%)	PSL (kWh/day)	EL - PL (kWh/day)
		0.6	0.3	35,792.9	0.3	35,792.9	0.0
		0.3	0.2	20,453.1	0.3	17,896.5	2,556.6
		1.2	0.3	71,585.8	0.3	71,585.8	0.0
		0.7	0.2	47,723.9	0.3	41,758.4	5,965.5
		1.2	0.3	71,585.8	0.3	71,585.8	0.0
		0.2	0.2	13,635.4	0.3	11,931.0	1,704.4
		0.3	0.3	17,896.5	0.3	17,896.5	0.0
		1.2	0.2	81,812.4	0.3	71,585.8	10,226.5
		0.7	0.3	41,758.4	0.3	41,758.4	0.0
		0.6	0.4	30,679.6	0.3	35,792.9	0.0
		0.5	0.3	29,827.4	0.3	29,827.4	0.0
		1	0.4	51,132.7	0.3	59,654.8	0.0
		0.6	0.1	46,019.4	0.3	35,792.9	10,226.5
	Lower middle	0.4	0	31,213.5	0.35	20,288.8	10,924.7
		0.2	0.2	12,485.4	0.35	10,144.4	2,341.0
		0.3	0.3	16,387.1	0.35	15,216.6	1,170.5
		0.4	0.4	18,728.1	0.35	20,288.8	0.0
		0.2	0.2	12,485.4	0.35	10,144.4	2,341.0
		0.4	0.3	21,849.5	0.35	20,288.8	1,560.7
		0.5	0.1	35,115.2	0.35	25,361.0	9,754.2
		0.4	0.2	24,970.8	0.35	20,288.8	4,682.0
		0.3	0.3	16,387.1	0.35	15,216.6	1,170.5
		0.5	0.2	31,213.5	0.35	25,361.0	5,852.5
		0.4	0.1	28,092.2	0.35	20,288.8	7,803.4
		0.2	0.2	12,485.4	0.35	10,144.4	2,341.0
		0.3	0.4	14,046.1	0.35	15,216.6	0.0
		0.3	0.2	18,728.1	0.35	15,216.6	3,511.5
		0.2	0.3	10,924.7	0.35	10,144.4	780.3
		0.3	0.2	18,728.1	0.35	15,216.6	3,511.5
		0.4	0.1	28,092.2	0.35	20,288.8	7,803.4
		1	0.2	62,427.1	0.35	50,722.0	11,705.1
		1	0.1	70,230.5	0.35	50,722.0	19,508.5
		0.3	0.2	18,728.1	0.35	15,216.6	3,511.5
		0.5	0.1	35,115.2	0.35	25,361.0	9,754.2
		0.5	0	39,016.9	0.35	25,361.0	13,655.9
		0.3	0.2	18,728.1	0.35	15,216.6	3,511.5
		0.7	0.1	49,161.3	0.35	35,505.4	13,655.9
		0.2	0.2	12,485.4	0.35	10,144.4	2,341.0
		0.3	0.1	21,069.1	0.35	15,216.6	5,852.5
		0.5	0.3	27,311.9	0.35	25,361.0	1,950.8
		1	0.4	46,820.3	0.35	50,722.0	0.0
	Lower	0.6	0.3	28,461.8	0.4	24,395.9	4,066.0
		0.5	0.2	27,106.5	0.4	20,329.9	6,776.6
		0.4	0.5	13,553.3	0.4	16,263.9	0.0
		1	0.3	47,436.4	0.4	40,659.8	6,776.6
		0.3	0.4	12,197.9	0.4	12,197.9	0.0

Water body	Segment	SL (miles)	EC (%)	ESL (kWh/day)	TC (%)	PSL (kWh/day)	EL - PL (kWh/day)
		0.4	0.2	21,685.2	0.4	16,263.9	5,421.3
		0.2	0.3	9,487.3	0.4	8,132.0	1,355.3
		0.9	0.4	36,593.8	0.4	36,593.8	0.0
		0.3	0.2	16,263.9	0.4	12,197.9	4,066.0
		0.3	0.1	18,296.9	0.4	12,197.9	6,099.0
		1	0	67,766.3	0.4	40,659.8	27,106.5
		0.3	0.2	16,263.9	0.4	12,197.9	4,066.0
		0.4	0.4	16,263.9	0.4	16,263.9	0.0
		0.3	0.3	14,230.9	0.4	12,197.9	2,033.0
		0.5	0.2	27,106.5	0.4	20,329.9	6,776.6
		0.5	0.4	20,329.9	0.4	20,329.9	0.0
		0.4	0.3	18,974.6	0.4	16,263.9	2,710.7
		0.5	0.2	27,106.5	0.4	20,329.9	6,776.6
		0.4	0.1	24,395.9	0.4	16,263.9	8,132.0
		1	0.2	54,213.0	0.4	40,659.8	13,553.3

^a SL – segment length, EC – existing canopy cover, ESL – existing summer load, TC – target canopy cover, PSL – proposed summer load, EL – PL – existing load minus proposed load, kWh/day – kilowatt hours per day.

Table 85 identifies the similarities between aerial photo interpretations and solar path finder field data for canopy cover.

Table 85. Aerial versus pathfinder data.

Water body	Average Annual Shade	Average Summer Shade	Aerial Photo Cover	Aerial minus Summer Average	Aerial minus Annual Average
Fish Creek (above reservoir)	54.4	44.3	40	-4.3	-14.4
Fish Creek (below reservoir)	58.4	51.5	40	-11.5	-18.4
Muldoon Creek (mouth)	54.8	29.9	40	10.1	-14.8
Little Wood River (above reservoir)	34.7	27.6	30	2.4	-4.7
Little Wood River (Bear Track Williams)	8.9	2.4	20	17.6	11.1
Average	42.2	31.1	34	2.9	-8.2

^a Pathfinder data provided by DEQ Twin Falls, Aerial Photo interpretation provided by Mark Shumar (DEQ state office).

The following information was provided by Mark Shumar (DEQ) in 2005 and describes the usage of potential natural vegetation for temperature TMDLs and the methodology for aerial photo interpretation of canopy cover.

Potential Natural Vegetation for Temperature TMDLs

There are a several important contributors of heat to a stream including ground water temperature, air temperature and direct solar radiation. Of these, direct solar radiation is the source of heat that is easiest to control or manipulate. The parameter that affects or controls the amount of solar radiation hitting a stream throughout its length is shade. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Again, the amount of shade provided by objects other than vegetation is not easy to control or manipulate. This leaves vegetation as the most likely source of change in solar radiation hitting a stream.

Depending on how much vertical elevation also surrounds the stream, vegetation further away from the riparian corridor can provide shade. However, riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. We can measure the amount of shade that a stream enjoys in a number of ways. Effective shade, that shade provided by all objects that intercept the sun as it makes its way across the sky, can be measured in a given spot with a solar pathfinder or with optical equipment similar to a fish-eye lens on a camera. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and the stream's aspect. In addition to shade, canopy cover is a similar parameter that affects solar radiation. Canopy cover is the vegetation that hangs directly over the stream, and can be measured using a densiometer, or estimated visually either on site or on aerial photography. All of these methods tell us information about how much the stream is covered and how much of it is exposed to direct solar radiation.

Potential natural vegetation (PNV) along a stream is that intact riparian plant community that has grown to its fullest extent and has not been disturbed or reduced in anyway. The PNV can be removed by disturbance either naturally (wildfire, disease/old age, wind-blown, wildlife grazing) or anthropogenically (domestic livestock grazing, vegetation removal, erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides the most shade and the least achievable solar loading to the stream. Anything less than PNV is allowing the stream to heat up from excess solar inputs. We can estimate PNV from models of plant community structure (shade curves for specific riparian plant communities), and we can measure existing vegetative cover or shade. Comparing the two will tell us how much excess solar load the stream is receiving, and what can be done to decrease solar gain.

Existing shade or cover will be estimated for entire lengths of streams from visual observations of aerial photos. These estimates can be field verified by measuring shade with solar pathfinders or cover with densiometers at randomly or systematically located points along the stream (see below for methodology). PNV will be determined from existing shade curves developed for similar vegetation communities. A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, the shade decreases as the vegetation has less ability to shade the center of wide streams. Existing and PNV shade can be converted to solar load from data collected on flat plate collectors at the nearest weather station collecting these data. The difference between existing and potential solar load, assuming existing load is higher, is the load reduction necessary to bring the stream back into

compliance with water quality standards. Existing shade cannot be greater than PNV shade, thus existing loads cannot be less than PNV loads. PNV shade and loads are assumed to be the natural condition, thus stream temperatures under PNV conditions are considered to be the lowest achievable temperatures (so long as there are no point sources or any other anthropogenic sources of heat in the watershed).

Pathfinder Methodology

The solar pathfinder is a device that allows one to trace the outline of shade producing objects on monthly solar path charts. The percentage of the sun's path covered by these objects is the effective shade on the stream at the spot that the tracing is made. In order to adequately characterize the effective shade on a stream, as many of these traces as possible should be taken at systematic or random intervals along the length of the stream in question. At a minimum, five charts should be taken to be averaged to represent shade on a stream reach.

At each sampling location the solar pathfinder should be placed in the middle of the stream about one foot above the water. Follow the manufacturer's instructions (orient to true south and level) for taking traces. Systematic sampling is easiest to accomplish and still not bias the location of sampling. Start at a unique location such as 100 m from a bridge or fence line and then proceed upstream or downstream stopping to take additional traces at fixed intervals (e.g. every 100m, every half-mile, every degree change on a GPS, every 0.5 mile change on an odometer, etc.). One can also randomly locate points of measurement by generating random numbers to be used as interval distances. The more traces the better, for example, if the stream is four miles long paralleled by a road, you could stop at every ¼ mile to take a trace resulting in a good number of traces (about 17). If you stopped at every 0.1 mile interval, you could take over 40 traces.

It is a good idea to take notes while taking solar pathfinder traces, and to photograph the stream at several unique locations. Pay special attention to changes in riparian plant communities and what kinds of plant species (the large, dominant, shade producing ones) are present. Additionally, one can take densiometer readings at the same location as solar pathfinder traces. This provides the potential to develop relationships between canopy cover and effective shade for a given stream.

Aerial Photo Interpretation

Canopy coverage estimates are provided for 200-foot elevational intervals, or natural breaks in vegetation density, marked out on a 1:100K hydrography. Each interval is assigned a single value representing the bottom of a 10% canopy coverage class as described below (*adapted from the CWE process, IDL, 2000*):

Cover class	Typical vegetation type
0 = 0 – 9% cover	agricultural land, denuded areas
10 = 10 –19%	ag land, meadows, open areas, clearcuts

20 = 20 – 29%	ag land, meadows, open areas, clearcuts
30 = 30 – 39%	ag land, meadows, open areas, clearcuts
40 = 40 – 49%	shrublands/meadows
50 = 50 – 59%	shrublands/meadows, open forests
60 = 60 – 69%	shrublands/meadows, open forests
70 = 70 – 79%	forested
80 = 80 – 89%	forested
90 = 90 – 100%	forested

Additionally, a code can be provided to indicate condition or type of vegetation seen at that interval. These codes are as follows:

N = natural forest or larger than a buffer area around stream

B = buffer area around stream, cut or open area with a short distance from stream

C = opening or clearcut on stream itself (stream exposed)

M = meadow/shrubland or alpine type

NA = In some cases no recognizable channel was seen on the photo even though the map shows a stream at 1:100K hydrography. In these few instances we have marked them as NA, no channel visible. Doesn't mean that there is not something down there, we just can't see it.

The visual estimates of cover should be field verified with either a densiometer or a solar pathfinder. The pathfinder measures effective shade and is taking into consideration other physical features that block the sun from hitting the stream surface (e.g. hillsides, canyon walls, terraces, man-made structures). The densiometer simply measures the more immediate canopy surrounding the stream. The estimate of cover made visually from an aerial photo does not take into account topography or any shading that may occur from physical features other than vegetation. However, research has shown that measurements taken by the two techniques are remarkably similar (OWEB, no date).

References

IDL. 2000. Forest Practices Cumulative Watershed Effects Process for Idaho. Idaho Department of Lands. March 2000.

OWEB. (no date). Addendum to Water Quality Monitoring Technical Guide Book: Chapter 14 Stream Shade and Canopy Cover Monitoring Methods. Oregon's Watershed Enhancement Board. 775 Summer St. NE., Suite 360, Salem, OR 97301-1290.

Appendix G. Implementation Strategies

Little Wood River Implementation Strategies

As part of the Little Wood River Total Maximum Daily Load

Little Wood River (2511)

Boundary: Richfield town to Big Wood River

Primary Pollutant-of-Concern: Nutrients, Sediment, Temperature, Flow Alteration

TMDLs Completed: Nutrient, Sediment, Temperature

Delisting: Bacteria and Dissolved Oxygen

TMDL Modification: Waterbody is meeting standards for Bacteria and Dissolved Oxygen

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEG Lakes/Reservoir Project
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	NA	-	-
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Little Wood River (2512)

Boundary: Silver Creek to Richfield town

Primary Pollutant-of-Concern: Nutrients, Sediment, Temperature, Flow Alteration

TMDLs Completed: Nutrient, Sediments, Temperature

Delisting: NA

TMDL Modification: Upstream segment is dewatered

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEG Lakes/Reservoir Project
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	NA	-	-
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDFG	2025		
Other Parties: IDEQ	2025	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Little Wood River (2513)

Boundary: East Canal Diversion to Silver Creek

Primary Pollutant-of-Concern: Flow Alteration

TMDLs Completed: None

Delisting: Nutrients, Sediment, Temperature

TMDL Modification: Dewatered segment

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2004	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2004	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	NA	-	-
BLM	2004	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2004	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Little Wood River Reservoir (2515)

Boundary: The entire Little Wood River Reservoir

Primary Pollutant-of-Concern: Flow Alteration

TMDLs Completed: None

Delisting: Bacteria, Dissolved Oxygen, Nutrients, Sediment

TMDL Modification: Waterbody is meeting standards for Bacteria, Dissolved Oxygen, Nutrients, and Sediment

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2004	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2004	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	NA	-	-
BLM	2004	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2004	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Little Wood River ()

Boundary: Headwaters of the Little Wood River to the reservoir

Primary Pollutant-of-Concern: Temperature

TMDLs Completed: Temperature

Delisting: None

TMDL Modification: Waterbody is meeting beneficial uses and standards for other analytes

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	2025	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Dry Creek (2521)

Boundary: Headwaters to Little Wood River

Primary Pollutant-of-Concern: Sediment, Flow Alteration

TMDLs Completed: Sediment

Delisting: Bacteria, Dissolved Oxygen, Nutrients

TMDL Modification: Waterbody is meeting standards for Bacteria, Dissolved Oxygen, and Nutrients

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	NA	-	-
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Fish Creek Reservoir (2523)

Boundary: The Entire Fish Creek Reservoir

Primary Pollutant-of-Concern: None

TMDLs Completed: None

Delisting: Bacteria, Dissolved Oxygen, Nutrients, Sediment

TMDL Modification: Waterbody is meeting standards for Bacteria, Dissolved Oxygen, Nutrients, and Sediment

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Maintain Status SCD Involvement	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDeq Lakes/Reservoir Project
IDL	NA	-	-
USFS	NA	-	-
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Muldoon Creek (5288)

Boundary: Headwaters to Little Wood River

Primary Pollutant-of-Concern: Temperature

TMDLs Completed: Temperature

Delisting: Unknown

TMDL Modification: Waterbody is meeting standard for Unknown

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Maintain Status SCD Involvement	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	2025	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Loving Creek (5289)

Boundary: Headwaters to Silver Creek

Primary Pollutant-of-Concern: Temperature

TMDLs Completed: Temperature

Delisting: Unknown

TMDL Modification: Waterbody not meeting standards for Temperature

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Maintain Status SCD Involvement	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys
IDL	NA	-	-
USFS	NA	-	-
BLM	NA	-	-
Other Parties:			
Other Parties: IDEQ	2025	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Fish Creek (5650)

Boundary: Headwaters to Fish Creek Reservoir

Primary Pollutant-of-Concern: Sediment, Nutrients, Bacteria, and Temperature

TMDLs Completed: Sediment, Nutrients, Bacteria, and Temperature

Delisting: Dissolved Oxygen and Flow Alteration

TMDL Modification: Waterbody is meeting standards for Dissolved Oxygen and Flow Alteration

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	2025	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Fish Creek (2522)

Boundary: Fish Creek Reservoir to Carey Lake

Primary Pollutant-of-Concern: Sediment, Nutrients, Temperature, and Flow Alteration

TMDLs Completed: Sediment, Nutrients, and Temperature

Delisting: Bacteria, Dissolved Oxygen

TMDL Modification: Waterbody is meeting standards for Bacteria and Dissolved Oxygen

Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2045	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys
IDL	2045	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	NA	-	-
BLM	2045	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2045	BURP Program WBAG Process	IDEQ WQ Monitoring IDEQ WQ Assessment

Personnel from the various agencies involved in the interpretation of the time frame, approaches, and monitoring strategy are summarized as follows:

ISCC Personnel: Charles Pentzer, Water Quality Resource Conservationist
Joe Schwarzbach, Water Quality Resource Conservationist

IDL Personnel: Timothy C. Duffner, Area Supervisor, South Central Area,
Gooding ID

USFS Personnel: Valdon Hancock, Hydrologist, Sawtooth National Forest, Region
4, Twin Falls Field Office

BLM Personnel: Doug Barnum, Supervisory Natural Resource Specialist, Shoshone
Field Office

IDFG Personnel: NA

IDEQ Personnel: Jennifer Claire, Senior Water Quality Analyst – TMDL Writer
Dr. Balthasar B. Buhidar, Regional Manager – WQ Protection
Mike Etcheverry, Senior Water Quality Analyst

Appendix H. Data Sources

Table 86. Data sources for the Little Wood River Subbasin Assessment.

Water body	Data Source	Type of Data	When Collected
Muldoon Creek	DEQ, Twin Falls, ID	Flow, water chemistry, habitat, temperature	2001-2004
Muldoon Creek	USGS, website	Water chemistry	1975,1976,1977
Muldoon Creek	DEQ, Twin Falls, ID	Fish, macroinvertebrate, habitat data	2001
Fish Creek	DEQ, Twin Falls, ID	Flow, water chemistry, habitat, temperature	2001-2004
Fish Creek	DEQ, Twin Falls, ID	Fish, macroinvertebrate, habitat data	1993-2001
Loving Creek	DEQ, Twin Falls, ID	Flow, water chemistry, habitat, temperature	1975, 2001-2004
Dry Creek	DEQ, Twin Falls, ID	Flow, water chemistry, habitat	2001-2004
Dry Creek	BLM, Shoshone, ID	Habitat and macroinvertebrate data	2000
Little Wood River	DEQ, Twin Falls, ID	Flow, water chemistry, habitat, temperature	2001-2004
Little Wood River	DEQ, Twin Falls, ID	Fish, macroinvertebrate, habitat data	1993-2001
Little Wood River	USGS, website	Water chemistry	1973-1996
Little Wood River	USBR, website	Water chemistry	1998, 2000
Little Wood River	USGS, website	Flow	1896-1897, 1920-2003
Silver Creek	USGS, website	Flow	1920-2003

Appendix I. Distribution List

Balthasar Buhidar. Idaho Department of Environmental Quality, Twin Falls Office.
Clyde Lay. Idaho Department of Environmental Quality, Twin Falls Office.
Sean Woodhead. Idaho Department of Environmental Quality, Twin Falls Office.
Rob Sharpnack. Idaho Department of Environmental Quality, Twin Falls Office.
Mike Etcheverry. Idaho Department of Environmental Quality, Twin Falls Office.
Marti Bridges. Idaho Department of Environmental Quality, state office (Boise).
Mike McDonald. Idaho Department of Fish and Game, Jerome Office.
Terry Blau. Idaho Department of Water Resources, Twin Falls Office.
Water quality coordinator. Idaho Department of Lands, Shoshone Office.
Valdon Hancock. United States Department of Agriculture Forest Service, Twin Falls Office.
Codie Martin. United States Bureau of Land Management, Shoshone Office.
Chuck Caranaha. Idaho Department of Transportation, Shoshone Office.
Mark Dallan. Idaho Association of Soil Conservation Districts, Twin Falls ID.
Chuck Pentzer. Idaho Soil Conservation Commission, Jerome ID.
Steve Thompson. Natural Resources Conservation Service, Gooding Office.
Bill Hazen. University of Idaho County Extension Services, Gooding County.
Polly Huggins. Resource Conservation and Development, Gooding ID.
Karen Pratt. Nature Conservancy, Hailey ID.
Blaine County Soil Conservation District, Hailey ID.
Gooding County Commissioners, Gooding ID.
Blaine County Commissioners, Hailey ID.
Lincoln County Commissioners, Shoshone ID.
Idaho Rivers United, Boise ID.
Western Watersheds Project, Hailey ID.
Doug Pettinger. Glanbia Richfield and Gooding, Gooding ID.
City of Gooding, Gooding ID.
City of Shoshone, Shoshone ID.
City of Richfield, Richfield ID.
City of Carey, Carey ID.
Tess O'Sullivan, Lava Lake Livestock,
Roger Blew, Upper Snake BAG Committee, Rep-at-Large, Idaho Falls ID.
Matt Woodard, Upper Snake BAG Committee, Environment East Side Soil & Water, Idaho Falls ID.
Brian Olmstead, Upper Snake BAG Committee, Irrigated Ag, Twin Falls ID.
Hunter Osborne, Upper Snake BAG Committee, Sho-Ban Tribes, Fort Hall ID.
Brad Orme, Upper Snake BAG Committee, Livestock, St Anthony, ID.
Gary Marquardt, Upper Snake BAG Committee, Non-Municipal Permittee, Buhl ID.
Don Mays, Upper Snake BAG Committee, Recreation, Gooding ID.
Chris Randolph, Upper Snake BAG Committee, Hydropower, Boise ID.
Greg Shenton, Upper Snake BAG Committee, Local Government, DuBois ID.
Dennis Facer, Upper Snake BAG Committee, Mining, DuBois ID.
Mark Toone, Wood River WAG Committee, Gooding ID.
Clint Krahn, Wood River WAG Committee, Fairfield ID.
Bob Simpson, Wood River WAG Committee, Carey ID.

Rob Struthers, Wood River WAG Committee, Bellevue ID.
 Jerry Nance, Wood River WAG Committee, Dietrich ID.
 Carl Rey, Wood River WAG Committee, Fairfield ID.
 Lee Brown, Wood River WAG Committee, Ketchum ID.
 Roger Parker, Wood River WAG Committee, Hailey ID.
 Dennis Strom, Wood River WAG Committee, Hill City ID.
 Daryle James, Wood River WAG Committee, Hailey ID.
 Kent Scott, Wood River WAG Committee, Gooding ID.
 Carol Blackburn, Wood River WAG Committee, Shoshone ID.
 Lynn Harmon, Wood River WAG Committee, Shoshone ID.
 Jo Lowe, Wood River WAG Committee, Idaho Conservation League, Ketchum ID.
 Dennis Koyle, Wood River WAG Committee, Gooding ID.
 Bill Davis, Wood River WAG Committee, Fairfield ID.
 Wood River SCD, Shoshone ID.
 Bryan Ravenscroft, Wood River WAG Committee, Bliss ID.
 Scott Boettger, Wood River WAG Committee, Ketchum ID.
 Tom Pomeroy, Wood River WAG Committee, Ketchum ID.
 Dwight Osborne, Wood River WAG Committee, Hagerman ID.
 Bob Bolte, Wood River WAG Committee, Gooding ID.
 Jack Straubhar, Wood River WAG Committee, Twin Falls ID.
 Martha Turvey, EPA, Seattle WA.
 Leigh Woodruff, EPA, Boise ID.

Appendix J. Public Comments

The 30 day public comment period closed on January 21, 2005 at 5:00 p.m. During this period comments were received from the Lava Lake Land & Livestock, L.L.C., the US Forest Service, the Idaho Department of Lands, and the US Environmental Protection Agency. Those comments that were editorial were incorporated into the document. The remainder of the comments are addressed in this appendix and DEQ's responses follow the comments in italics.

IDAHO DEPARTMENT OF LANDS PUBLIC COMMENTS

IDL #1. Page 25: "Publicly owned and managed by the State of Idaho". This statement needs to be clarified based on the actual classification of the State land. Three different State agencies manage land in this watershed with very different missions/objectives. The State Endowment Lands administered by Idaho Department of Lands (IDL) are more similar to private land than publicly owned land. IDL's mission is to "Manage endowment trust lands to maximize long-term financial returns to the beneficiary institutions; provide protection to Idaho's natural resources." Idaho Department of Fish and Game (IDFG) and Idaho Department of Parks and Recreation (IDPR) also administers State owned land within the area according to their respective missions and authority. In very rough figures, we estimate the breakdown of State land within this watershed as follows:
Endowment land – approximately 40,180 acres in multiple parcels (320 acres in the Normal School Endowment, remainder in Public School Endowment)
IDFG managed land – approximately 1,100 acres in 5 parcels
IDPR managed land – 400 acres in 2 parcels

These approximate figures were added as a footnote describing state owned land in Table 12.

IDL #2. Page 30: IDFG's Hayspur Fish Hatchery is listed in the narrative as a non-point source. However, on page 29 in table 14 and the map on page 31, it is listed as a point source. This discrepancy should be clarified.

Excerpts from an EPA letter were added to the document to clarify the classification of the Hayspur Fish Hatchery as a non point source rather than a point source. This is based on fish production and hatchery size, however, GIS coverage at this time still indicates that all hatcheries are point sources.

IDL #3. Regarding the Little Wood River Implementation Strategies (appendix E): We consider the timeframe and monitoring strategies identified for IDL on all of the segments to be attainable. IDL personnel involved in these TMDL comments and the future approaches and monitoring strategies identified in Appendix E are as follows: Tim Duffner (Area Supervisor), Meribeth Lomkin (Sr. Resource Manager), Jake Zollinger (Sr. Resource Manager), and Erik Kriwox (Resource Manager).

The implementation strategies incorporated into the document at the time did not represent the temperature TMDLs therefore some slight changes will be incorporated into the implementation strategies document.

LAVA LAKE LAND & LIVESTOCK, L.L.C PUBLIC COMMENTS

LLL&L #1. We noticed that temperature was added to the 303(d) list for Muldoon Creek and the Little Wood River from the headwaters to the mouth, but then later in the report you state that there is “no temperature exceedance in the headwaters of the creek. Upper stretches of the water body could act as a refuge for aquatic life...” (p.58, p.104). Please clarify which segments of the creek are suspected to be above desired temperature levels.

Temperature loggers were placed in headwater stretches of the water bodies to identify background temperatures on a water body if there were natural causes that were elevating the temperatures, such as geothermal springs, etc. However, there was not enough data collected in most water bodies and not enough minimally impacted land available in the subbasin to identify background levels.

Temperature was collected near the mouths of water bodies to determine if the water temperatures were meeting water quality standards. Temperature loggers were placed to determine if water quality standards were being met, not to determine which segments were meeting standards. When temperature standards were not being met, canopy cover targets on the creek were used as a surrogate method that would aid in reaching the desired in stream water temperatures. Canopy cover at any site of the creek that is not meeting the canopy cover target for that location could be contributing to an overall elevation in temperature throughout the system, even though temperature standards are still being met at that particular site. Eventually this accumulation of poor canopy coverage will lead to temperatures elevated above standards in the downstream segments.

LLL&L #2. We noticed that the report for Muldoon Creek cited an IDFG survey of Muldoon Creek from 1987 regarding the fishery. While we feel that this information may have been valid at the time, we think that it would be important to have some more recent information, particularly because the land ownership has changed (at least in part) since that time. Was the data from the 2003 IDFG fish survey of the area incorporated into this assessment?

The 1987 data collected by IDFG was mentioned as an aid in determining if CWAL and SS are existing uses within Muldoon Creek. As has been mentioned in the document existing uses are those uses that have occurred in the water body after November 28, 1975. The 1987 data was also mentioned as it may minimally help indicate changes within the system; however it was not used to determine the support status of Muldoon Creek. The 2003 fish survey completed by IDFG was not incorporated into the assessment as it was not available during the report compilation.

LLL&L #3. In terms of Fish Creek, we noticed that in Table 28 the list of activities affecting the upper reach does not include beaver dam complexes. There are several beaver

complexes that extend into what we consider the upper portions of this stream (just before it becomes very steep).

The data in the tables describing the characteristics of the water bodies is data that comes directly from the BURP files. Either the BURP crew that collected the data did not notice the beaver dams, the beaver dams did not exist at the time, or the crew just neglected to mark it as an activity that was impacting the reach. This data is informational, and compiled with the information that was readily available.

LLL&L #4. In addition, we noted that the monitoring points for temperature, bacteria, and nutrient collection are all in close proximity to the reservoir. This location is not representative of conditions in the upper reaches of the watershed.

Monitoring sites at pour points allow us to see what is occurring in the water body as a whole, this does not necessarily tell us what is going on in certain segments of the water body or where the pollutant is specifically coming from. During the implementation planning phase, the designated land management agency should collect information concerning segments of concern. This information will be used to direct implementation projects.

LLL&L #5. Finally, the report indicates that The Nature Conservancy collected TSS samples in upper Fish Creek. This work was actually carried out by Lava Lake Land & Livestock (coordinated by Alan Sands of TNC under a contract with Lava Lake).

The appropriate adjustments have been made in the document.

THE US FOREST SERVICE PUBLIC COMMENTS

USFS #1. My concerns with the results are primarily proposals concerning Muldoon Creek and the Little Wood River (segment 1) within the Sawtooth National Forest. Within the Forest, these streams have no temperature exceedance, as you have noted. Considering this, it would seem to be inappropriate to put these segments on the 303(d) list as impaired waters. I am sure, though, that Forest Service managers all want to cooperate with you on useful targets designed to improve water quality. However, the dominant land use on National Forest land in this area is sheep grazing; there is no cattle grazing. I believe that sheep grazing has a negligible effect on stream canopy cover. Probably the roads along Copper Creek and Muldoon Creek have a greater impact on canopy cover; aside from those roads and past activities, the canopy cover may be very nearly natural conditions.

The purpose of the temperature TMDL is to meet water quality standards throughout the length of the water body. In order to do this canopy cover is used as a surrogate to aid in attaining water quality temperature standards. The source of impairment to canopy cover targets have not been identified, roads may be a contributing factor to the reduced canopy cover in the system. Data collected during the time period was limited, further data may need to be collected to identify critical areas throughout the length of the water bodies in which implementation of BMPs will aid in canopy cover and thus in water temperature.

USFS #2. I am concerned also because the paper presented by Mark Shumar at the January 2004 Nonpoint Source Water Quality Monitoring Results Workshop stated that available aerial photos could not be used to determine canopy coverage. However, aerial photos were likely all you had to develop existing cover, and until better measurements can be made, will have to do. Also, there are all south-facing drainages, most likely to be directly affected by the sun, in spite of cover.

Canopy cover data was also collected for each water body with the solar path finder. This data was used to determine that the aerial photo interpretations were consistent with the existing conditions. Further data collected in the implementation phase may refine the TMDL and the areas that need more work; it may also help us identify natural sources of temperature influence. The solar path finder data was not incorporated into the document during the public comment phase, but the document has been adjusted and now incorporates the field data.

USFS #3. The Implementation Strategies in Appendix E were pointed out as something DEQ would like help with. As water quality standards and probably canopy cover targets (to the extent that anthropogenic activities may be affecting them) a target of 2004 (already accomplished) as shown for other parties involved in Muldoon Creek (5288) is likely appropriate. The Grazing Allotment Permit is monitored, but a PFC process is not used. Please note that there is no National Forest land on the Little Wood River (2511) downstream of Richfield (or downstream of the Forest boundary in Township 3N, for that matter.)

The implementation strategies will be altered as they did not incorporate the temperature TMDL information. Muldoon Creek and the Little Wood River (segment 1) will be added to the strategy. The appropriate changes will be made for land ownership on the lower segment of the Little Wood River.

US ENVIRONMENTAL PROTECTION AGENCY PUBLIC COMMENTS

USEPA #1. Page 29 Table 14. Please explain why the Idaho Tire Recovery facility has no loading associated with it.

A paragraph has been placed in this section identifying that the facility does not discharge. Also see page 169, first paragraph after the subheading Load allocation, last sentence.

USEPA #2. Page xiv: The 50 mg/L TSS target is described as a yearly average target. Is this correct, or is it a monthly average target intended to be applied year-round.

This has been further described in the Analysis Process segment page 49 describing how TSS was analyzed.

USEPA #3. Page 30. Based on the feed rates of 70,000 to 80,000 lbs/yr, the Hayspur hatchery would be considered to be a point source, because it averages greater than 5,000 lbs feed per month. As such, an NPDES permit is required, and it should be treated as a point

source in the TMDL, unless it can be shown to not be a contributor of pollutant loading to Loving Creek.

See the response to IDL #2.

USEPA #4. Page 36: Section 2.2. Applicable water quality standards. This section should describe the natural conditions provision of the Idaho water quality standards as they relate to temperature and point sources, used later in the temperature TMDL.

This has been added to the document more specifically point source language has been added to the appendix.

USEPA #5. Page xix, 48. 0.10 and 0.16 mg/L TP targets. The basis for these targets is identified as being the EPA Gold Book (1986). These recommendations were superseded by EPA Ecoregional Nutrient Criteria, which may be found at the following address: <http://www.epa.gov/waterscience/criteria/nutrient/ecoregions/>. We recommend that you consider these new recommendations in establishing phosphorous targets from streams in the Little Wood River Subbasin. We have serious concerns about using a total phosphorous trigger of 0.16 mg/L without further rationale for determining nutrient impairments. Levels far below this concentration are known to be associated with nutrient impacts, and TMDL goals for streams are typically much less than this.

The values described in the EPA Ecoregional Nutrient Criteria were considered, but it was decided were not applicable at this time.

USEPA #6. Page xix, 49. 35% substrate target. Numerous other sediment TMDLs in the region have used a substrate target of 28% depth fines based on information in Idaho sediment guidance. We recommend including data in the TMDL (or appendix) which supports the use of 35% fine sediment as a target which would protect for salmonid spawning and other aquatic life uses.

I have added a chart, Figure 17, which displays the bedload sediment (percent fines) data that occurs in streams in the subbasin that are meeting beneficial uses.

USEPA #7. Page 59. It would be helpful to describe the methods used to evaluate existing canopy closure, ie. the air photo interpretation. For example, detailed methods describing analysis methods could be included in an appendix to the TMDL. Also, I understand in talking with Mark Shumar that field verification of his air photo estimates were conducted using solar path finder readings. This type of information would be invaluable to include in the TMDL (appendix) to further support the validity of the air photo interpretation methods being used.

The solar path finder data has been added to the document to show comparisons between aerial photo interpretation and field data. An appendix has also been added to the document discussing aerial photo interpretation methodology.

USEPA #8. Page 138. Mines are considered to be point sources under the Clean Water Act and per federal definitions. If they are sources of sediment or nutrient loading to stream segments addressed by these TMDLs, they should be identified and included in the allocations.

There are no active mine sites in the subbasin at the time, based on current knowledge. Nor are any of the abandoned mines in the subbasin currently identified as CERCLA sites as a result they are identified as a nonpoint source component of the TMDL (Buhidar 2005).

USEPA #9. Page 143. Either here or in Section 2.2 it should be described how it is concluded that temperature exceeds criteria naturally, in order to justify the use of natural vegetation targets without an explicit link to meeting numeric temperature criteria.

This has been added to the document.

USEPA #10. Page 144. The MOS discussion specifically identifies a 10% MOS in the temperature TMDL, which is translated into a numeric heat load. However, the shade targets do not appear to be adjusted to take into account the MOS, ie. They have not been increased by 10%.

The MOS and FG allocations were misapplied to solar radiation loads for canopy cover TMDLS. Canopy cover targets address the potential natural conditions therefore MOS and FG should not be applied. These adjustments have been made in the temperature TMDLs.

USEPA #11. Page 144. For Muldoon Creek and other waters, only the cold water aquatic life temperature criteria are cited. The TMDL should indicate that salmonid spawning criteria should also be met where salmonid spawning is a designated or existing use.

In coordination with the state office, temperature issues related to point sources has been reevaluated and adjustments have been made in the document.

USEPA #12. Page 166. The TMDL states that “Waste load allocations are not made for these point source facilities and construction storm water sites for a sediment TMDL based on stream bank erosion or a temperature TMDL because they are unlikely to impact stream banks or canopy covers.”

The municipal treatment plants and food processing facility are sources of both sediment and heat loading to the Little Wood River, so should receive a waste load allocation in the TMDL for these parameters.

At this time, point source facilities will be required to meet their current NPDES limits for TSS and construction storm water sites will receive 2% of the available sediment load.

For a temperature TMDL, canopy cover is being used as a surrogate to reach temperature water quality standards of the water body. The facilities do not impact the canopy cover

therefore they will not receive a waste load allocation, however although they do contribute heat to the system.

If these sources are relatively small contributors of sediment to the system, one common option is to set their waste load allocation at the level of their current NPDES permit limits and the facilities design flow, with explanation in the TMDL that the intent is not to make their permit limits any more restrictive than they are currently.

TSS loads have been given to the point sources, with the explanation that their permits are not to be any more restrictive than they are currently.

Since the temperature TMDL is based on natural conditions provisions of the Idaho water quality standards, these facilities must not cumulatively increase receiving water temperature more than 0.3 C above the natural stream temperature (IDAPA 58.01.02_____)

A statement has been added to the temperature TMDLs that incorporates this standard as well as the way in which point source temperatures will be dealt with until natural conditions are restored to the water body.

Construction storm water may not be a source of heat loading during summer months when temperature criteria are exceeded due to the lack of precipitation, but it may be a source of sediment loading at other times of the year, and should receive a waste load allocation in the TMDL.

A waste load allocation for construction storm water has been added to the sediment TMDLs.

USEPA #13. Page 171 Table 70. I would suggest re-labeling the Suggested Load column to: Waste load Allocation.

USEPA #14. Page 171 Table 72. I would suggest re-labeling the Waste Load Allocation column to Total Waste Load Allocation. Also, the total waste load allocation for the upper segment should be 10.06 lbs/day rather than 11.38.

These changes have been made.

EPA #15. Excel loading spreadsheet. You should double check the conversion from MGD to cfs in the phosphorous loading table, I came up with slightly different cfs figures based on the MGD values given for all facilities, especially Glanbia-Gooding.

In looking up these values it was noticed that the design flows in cfs on the spreadsheet were miscalculated. These numbers were recalculated. As a result load allocations for the Little Wood River TP TMDL have been adjusted.

EPA #16. Page xix. Was there any observations of nuisance aquatic growth recorded during field investigations?

Field notes do not identify the type of aquatic vegetation or quantity within the water body. It was noted that there was aquatic vegetation in the segment of Fish Creek below the reservoir, in segment 4 of the Little Wood River, Loving Creek, and Muldoon Creek.

EPA #17. Page 10. It would be helpful to include a description of land-use types and erosion rates if it is part of the calculation to determine contributions to sediment loading.

A soil erosivity map has been added to the document to identify areas that may be more critical areas within the subbasin based on soil erosivity (K factors).

EPA #18. Page 18. It would be helpful to describe what anthropogenic activities contribute to the rise of E. coli levels in the summer months.

This graph was created from all of the water bodies that were monitored. As a result, the activities causing the rise could vary from water body to water body, but I will list some activities that could be influencing this increase within the subbasin.

EPA # 19. Page 29. Table 14. Is the design flow for Shoshone wastewater correct? Also, what is the design flow for the Glanbia Gooding food processing facility?

See EPA comment #15.

EPA #20. Page 51. The K factors are provided but without providing context to describe if this region has a relatively high or low erosion potential. A description of what a K factor is and a map describing these soil conditions would be helpful in the main body of the document.

See EPA comment # 17.

EPA #21. Page 110. This discussion comparing old data to more recent data collection would be stronger if you could provide more details on how many samples were collected in the more recent studies or provide references in an appendix.

The number of samples in the recent data was listed in Table 43. Little Wood River (segment 2) water chemistry data.

EPA #22. Page 137. The Hayspur Hatchery should be added as a point source to table 51.

See IDL Comment # 2.

EPA #23. Page 165. Please include the erosion rates and calculations either in this section or appendix.

The summary sheets for each creek with a sediment TMDL was already done, in addition to this stream bank erosion inventory methodology was added to the appendix.

EPA #24. General Comments. In many of the water body segments macroinvertebrate data and habitat data were mentioned as having been collected but no additional summary information is included. It would be helpful to have a summary of this information to support observations made about other conditions of the stream segments.

More information about macroinvertebrate data will be added for each water body.

EPA #25. General Comments. Field observations and documentation methods should be included in the appendix.

Field observations are part of the administrative record and are available for review, although they are not a part of this document. Explanations of methodology for aerial photo canopy cover interpretations and stream bank inventories have been added into the document.

EPA #26. General Comments. I recommend including information on whether a stream segment is intermittent or perennial in a table with what has been done in terms of assessments as a way to summarize this information.

A table describing available data and intermittent/perennial status of the 303(d) listed water bodies has been added to the document.