Lapwai Creek
Aquatic Assessment

Prepared By

The Center for Environmental Education,
Washington State University

For

Nez Perce Tribe, Watershed Department

The Lapwai Creek aquatic assessment was produced for the Nez Perce Tribe Department of Fisheries, Watershed Division, under BPA Contract #8200100. The contract was to conduct an inventory of Nez Perce Indian Reservation and ceded territory streams, focusing on the physical habitat and associated biological communities. The inventory emphasizes identification of limiting factors for salmon and steelhead production in the Lapwai Creek watershed.

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1 - INTRODUCTION

This assessment of the Lapwai Creek aquatics was conducted by the Washington State University Center for Environmental Education (WSU CEEd) under contract with the Nez Perce Tribe (NPT). Watershed/aquatic assessments are a process used to evaluate how well a watershed is working. Processes used to conduct watershed assessments are varied, but generally include the identification of factors that characterize the features, resources, history, and issues within the watershed. The outcome allows resource managers to specifically direct actions or activities to restore, protect, or enhance the watershed.

Purpose

The Lapwai aquatic assessment was conducted to provide resource managers with a watershed perspective of the aquatic ecosystem. The assessment is designed to accomplish the following goals:

- Identify features and processes important to fish habitat and water quality.
- Determine how natural processes are influencing these resources.
- Understand how human activities are affecting fish habitat and water quality.
- Evaluate the cumulative effects of land management practices over time.
- Identify existing data gaps.
- Provide a basis for research and restoration needs aimed at restoring watershed function and fish habitat within the Lapwai Creek watershed.

Key Issues

The Lapwai aquatic assessment will address the following key watershed issues (Figure 1):

- A description of the watershed, including discussions of historical conditions and channel habitat types.
- A characterization of ecological processes and conditions in the watershed, including descriptions of hydrology, riparian vegetation, sedimentation, channel morphology, water quality, and fish/fish habitat.
- A final assessment of aquatics, including discussions on how current conditions may affect fish and fish habitat and specific actions resource managers should consider in the future.

Limitations

Previous assessments of the Lapwai Creek watershed have typically been limited in scope, addressing only particular portions of the watershed, land uses, ownership patterns, or disturbance regimes (i.e., Mission/Lapwai Creeks, agricultural lands, tribal ownership, or sediment sources, respectively). This assessment attempts to address the watershed as a whole, including all land uses, owners, and disturbance regimes to provide a better overall picture of watershed condition, function and restoration needs as they specifically relate to aquatic resources. Information was compiled primarily from existing data sources, with limited field data collection used primarily to verify existing or derived data.

Since much of the document is written from extant data sources, it was not possible to address all components identified in the organizational template (refer to Methods Chapter 2). Where data was insufficient for analysis, as suggested in the template, investigators used alternative methods for examination or identified data gaps where appropriate.

Theoretical Assumptions

The links between watershed features and processes important to fish habitat and water quality have been well documented (Reid 1993; Swanston 1991; Bjornn and Reiser 1991). The majority of analyses contained within this document are based on these scientifically established links. Specifically, the components that focus on the characterization of watershed processes, such as hydrology, riparian vegetation, sedimentation, channel morphology, water quality, and fish/fish habitat, assume that changes to given features or processes will likely influence aquatic health. For instance, it is assumed that the condition of a riparian area will influence salmonid production through temperature regulation (e.g. Theurer et al. 1985; Gregory 1991), channel stabilization (e.g. Reid 1993; Gregory 1991), woody debris recruitment (e.g. Beschta et al. 1987; Bilby 1991), and energy inputs (e.g. Reid 1993; Gregory 1991). Similarly, it is assumed that a given change in the sediment regime will likely result in changes to salmonid habitat (e.g. Swanston 1991; Rhodes and Huntington 2000; Reid 1993; Platts 1985; Nelson et al. 1991; Megahan and Kidd 1972; Hicks et al. 1991). Based on these and other relationships, the authors of this document assumed that the established causal relationships would accurately characterize watershed function as it relates to water quality and fish/fish habitat.

The general framework of this document, as suggested in the Oregon Watershed Assessment Manual (OWAM), is organized into three main sections: watershed description, watershed characterization, and watershed assessment (Figure 1). Topics covered include:

- Start-up and identification of watershed issues, which sets the stage for the assessment

- A general description of the watershed and methods used for analyses

- Six procedural components used for watershed characterization and aquatic assessment, with a summarization of key findings at the end of each chapter

- A discussion chapter, which considers results from analyses of procedural components and how they specifically relate to aquatic ecosystem function.

A conclusions and recommendations chapter, which identifies major needs for fish and other aquatic resources, potential limiting factors, and the types of solutions needed to improve the aquatic resources of the watershed.

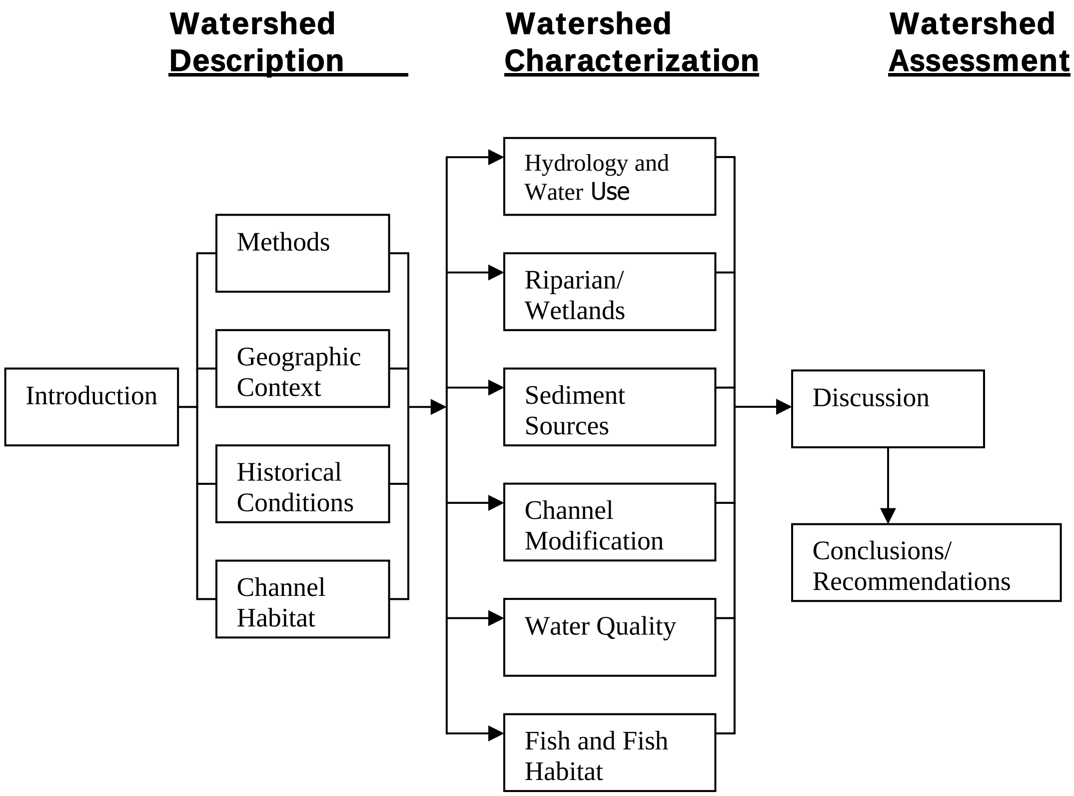

Figure 1. Skeletal framework of Lapwai aquatic assessment as it is presented in this document.

2 - METHODS

This assessment generally follows the guidelines presented in the Oregon Watershed Assessment Manual (OWAM) (Watershed Professionals Network 1999). The purpose of the OWAM is to provide citizens groups, watershed councils, and conservation groups with a consistent and standardized methodology to assess watershed conditions. The goal of the process is to identify areas within a watershed in need of restoration and/or protection, and to direct additional data collection as necessary.

The OWAM manual focuses on salmonid habitat and instream or near-stream conditions since they are most readily addressed by restoration activities. However, the manual also provides for general characterization of overall watershed characteristics including types and distributions of land use activities, vegetation, geology, and soil characteristics.

The OWAM manual generally uses a "cookbook" approach that walks the user through procedures that assess natural processes or features related to fish habitat and water quality. It was designed to be used by the average citizen interested in watersheds, although it is applicable to groups with a wide range of technical expertise. The manual advocates user-flexibility, and recognizes that not all information will be readily accessible.

Each section or component of the manual begins with a standard set of topics.

These topics include

- A list of *critical questions* to guide the approach used in each component
- The *assumptions* behind the component
- The *skills needed* to complete the component.

Upon addressing the questions, the user is guided through the necessary steps for component completion. These tasks often include the completion of a series of tables that are eventually used in the final assessment phase. Exclusion of a table or a series of tables due to lack of data is not addressed in the OWAM.

Alternate Methods

To complete the Lapwai assessment it was often necessary to employ alternative approaches not defined in the OWAM methodology. This was due in part to the difference in watershed size. The OWAM protocol was designed for assessment of 5th field watersheds typically consisting of about 60,000 acres. The Lapwai Creek watershed is considerably larger than this at nearly 171,000 acres. The OWAM states however, that the assessment process may be applied to several connected watersheds, allowing for assessment of a larger basin, suggesting that the processes described in the manual will adequately describe conditions within a larger area such as the Lapwai Creek watershed.

Because the OWAM was designed for use in Oregon, some methods described rely heavily on data sources not directly available in other states. This factor, and the general lack of data pertaining to various components, required deviation from the OWAM methodology. Specific methods used in the assessment, as they differ from OWAM protocol, are shown in

Table 1 and are specifically discussed in respective sections.

The size of the Lapwai watershed necessitated a division of the land area into units for analysis. It was agreed that the most efficient way of analyzing watershed function across 171,000 acres would be to divide the watershed into subwatersheds using methodology developed by the United States Geological Service (USGS). Thirteen subwatersheds within Lapwai Creek were characterized, representing what are commonly referred to as 6th field hydrologic unit codes (HUCs). The subwatersheds were delineated by the USGS and obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP) website (U. S. Forest Service and Bureau of Land Management 2000).

Individual subwatersheds within the Lapwai Creek watershed range in size from 6.2 square miles to 40.9 square miles, and each is uniquely identified by both a 12 digit numerical code and a textual name (Figure 2). Number codes associated with subwatersheds were derived by the USGS during a hierarchical delineation process. Names were subjectively assigned for the purposes of this assessment to provide a brief descriptor of the subwatershed location (i.e., upper Lapwai Creek). Subwatershed names rather than numerical codes will be used in this report for ease of understanding.

GIS software was used to map and summarize watershed attributes. A summary of GIS map layers used and their sources and scales are included in Appendix A.

Table 1. Alternative methods used by the W.S.U. CEEd in the Lapwai aquatic assessment.

Component	Chapter	Variable Assessed	Method Used	Rationale
Hydrology	6	Water use	Derived water use from IDWR and SRBA databases	No information on water use as presented in OWAM
Hydrology: land use	6	Road type	Multiple road types defined within a single land-use category	OWAM definition too narrow
Riparian Vegetation	7	Riparian Vegetation	Remote sensing techniques – Idaho GAP	Lack of current and comprehensive data
Sedimentation	8	Road Instability	Level I Stability Analysis (LISA)	Lack of current and comprehensive data
Sedimentation	8	Rural road runoff	Remote sensing techniques – NPT GIS layers	Lack of current and comprehensive data
Sedimentation	8	Surface erosion from cropland	NRCS SSURGO data; Remote sensing techniques	Lack of current and comprehensive data
Channel Modification	9	100-year floodplain	Remote sensing techniques	Lack of current and comprehensive data
Water Quality	10	WQ trend data	N/A	Inconsistent data collection methods (lack of current and comprehensive data)

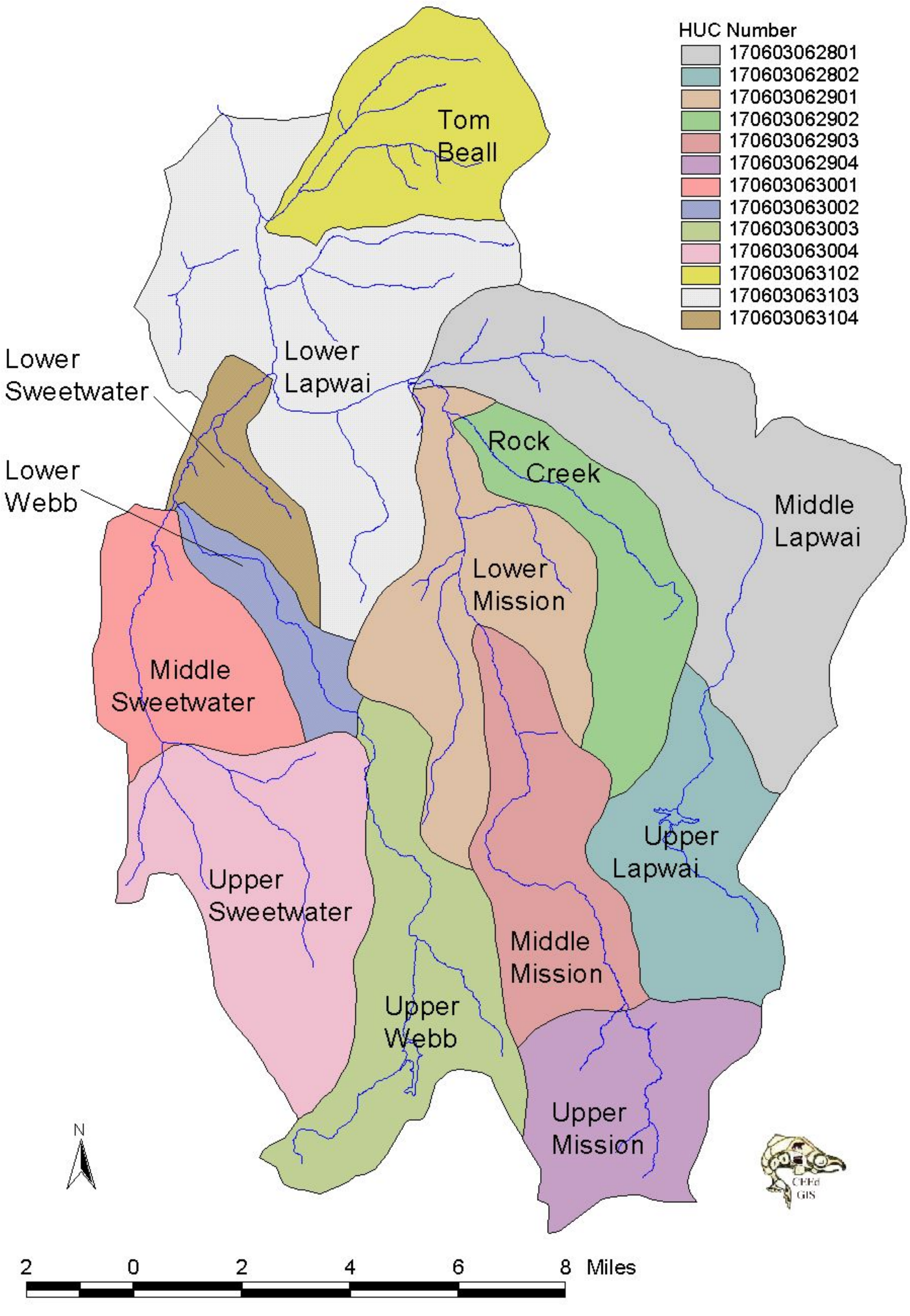

Figure 2. HUC names and numbers corresponding to subwatersheds within Lapwai Creek.

3 - GEOGRAPHIC CONTEXT

Lapwai Creek is a tributary to the Clearwater River, joining it 11 miles east of Lewiston, Idaho (Figure 3). The watershed drains approximately 267 square miles and includes the tributaries of Tom Beall, Sweetwater, Webb, and Mission Creeks. The majority of the watershed lies within Nez Perce County, with the uppermost portions of Mission and Lapwai Creeks extending into Lewis County. Problems or degradation associated with water quality, fisheries, threatened and endangered species, cultural resources, and native traditions all pose a high degree of concern within the watershed (Idaho Department of Fish and Game et al. 1994).

All subwatersheds within the Lapwai Creek drainage have beneficial use designations for primary and secondary contact recreation, agricultural water supply, cold-water biota, and salmonid spawning. Winchester Lake has designated beneficial uses associated with domestic water supply and special resource water (Nez Perce Soil and Water Conservation District 1998).

Human Population

Ancestors of the Nez Perce Indians are thought to have been the first inhabitants of the Palouse region, including the Camas Prairie (Black et al. 1997). Anthropologists theorize these people arrived in the area approximately 12,000 years ago following glacial retreat, although some Nez Perce do not agree (see Slickpoo and Walker 1973 for further discussion). European settlement in the area began with discoveries of gold and other minerals in the 1860s.

The Lapwai Creek watershed lies almost entirely within the present boundaries of the Nez Perce Indian Reservation; however, most of this land is owned by non-Indians, primarily as a result of the Dawes General Allotment Act of 1887 which gave land "allotments" to individual tribal members and opened up most of the remaining, unalloted portion of the reservation to white settlement. After a period of time tribal members could sell their allotments resulting in further land transfer to non-Indians.

The Lapwai Creek watershed is primarily rural-agricultural in nature, with a relatively sparse population distribution. The principal population center within the watershed is the town of Lapwai, which is also the location of the Nez Perce Tribal headquarters, with a population of approximately 970 in 1998 (Idaho Department of Commerce 2000). Other towns for which recent population information is available include Culdesac and Winchester with 1998 populations of 312 and 287, respectively. Smaller communities include Slickpoo, Sweetwater, Spalding, and Reubens, all of which had 1990 populations of 150 or less.

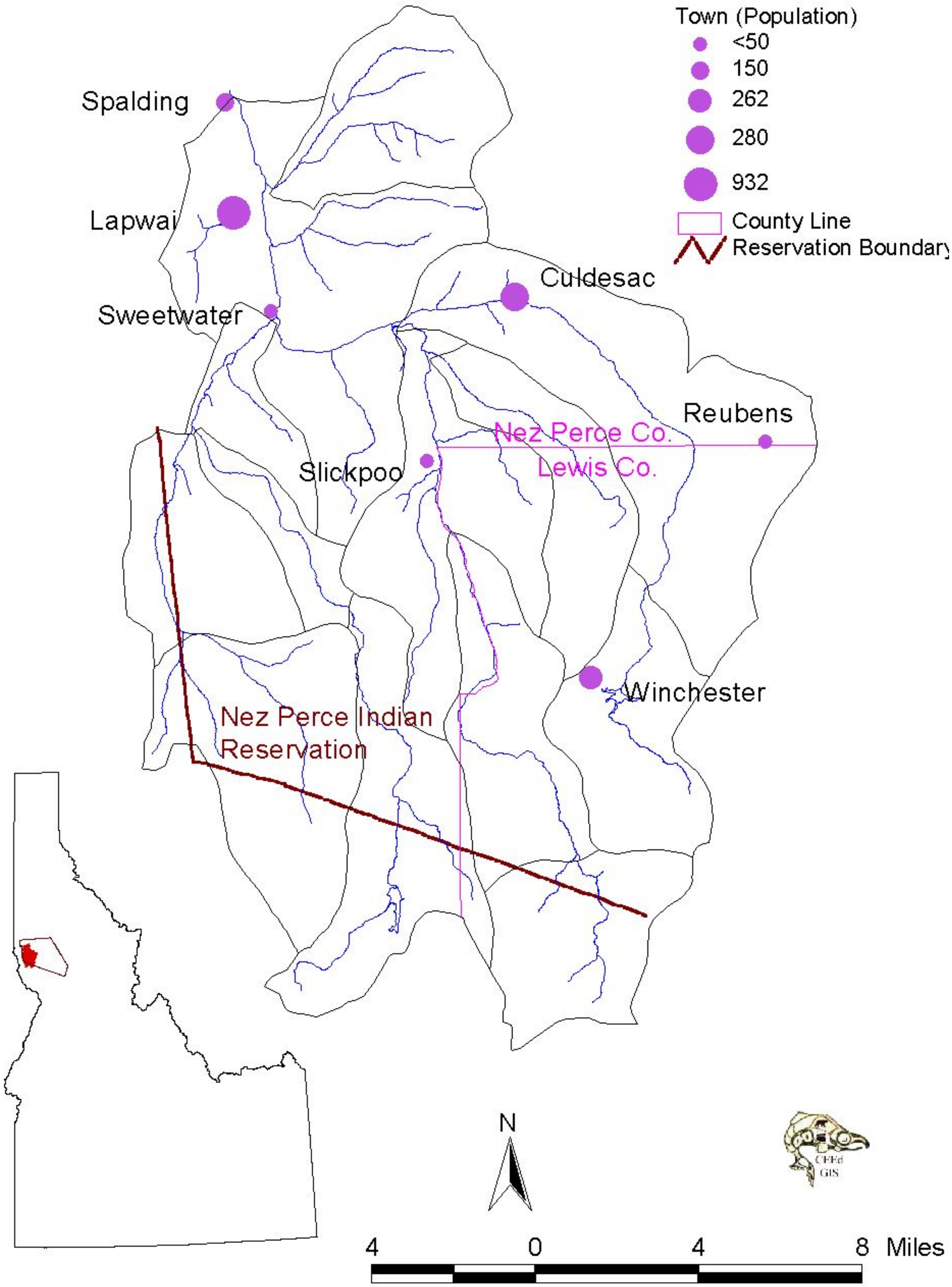

Figure 3. Location of Lapwai Creek watershed, Nez Perce Indian Reservation, towns and county boundaries

The population density within the Lapwai Creek watershed is best represented by the estimates for Lewis County at 6.4–8.4 persons/square mile (Idaho Department of Commerce 2000). Population density estimates for Nez Perce County (26.3–43.4 persons/square mile) are strongly influenced by the population of Lewiston (30,363) and do not accurately represent population densities in the Lapwai Creek watershed.

Climate

The regional climate pattern encompassing the Lapwai Creek watershed is maritime influenced. Average annual precipitation generally increases with elevation, ranging from approximately 13 inches in the vicinity of Lapwai to about 27 inches in the headwater areas of Sweetwater and Webb Creeks (Figure 4).

Climate data stations located at Winchester and Lewiston, Idaho best represent the climatic conditions in the upper and lower Lapwai Creek watershed, respectively (Table 2). Climatic differences are substantial, with average temperatures differing by 10°F annually and approximately 13°F during the summer. Average snowfall is more than six times greater in the upper elevations than the lower elevations. The annual average growing season ranges from about 84 days in Winchester to 201 days in Lewiston.

Table 2. Summary of climatic conditions recorded at Winchester and Lewiston, Idaho (Natural Resources Conservation Service 2000).

Climatic Conditions	**Winchester, Idaho**[1]	**Lewiston, Idaho**[2]
Avg. Annual Temperature (°F)	42.8	52.7
Avg. Temperature – January (°F)	26.2	33.3
Avg. Temperature – July (°F)	61.0	74.1
Avg. Total Annual Snowfall (inches)	101.5	16.0
Growing Season (# days)[3]	84	201

[1]Period of record for Winchester, Idaho is 1965-1990
[2]Period of record for Lewiston, Idaho is 1961-1990
[3]Based on 70% chance of growing season temperatures of 32^0F or greater

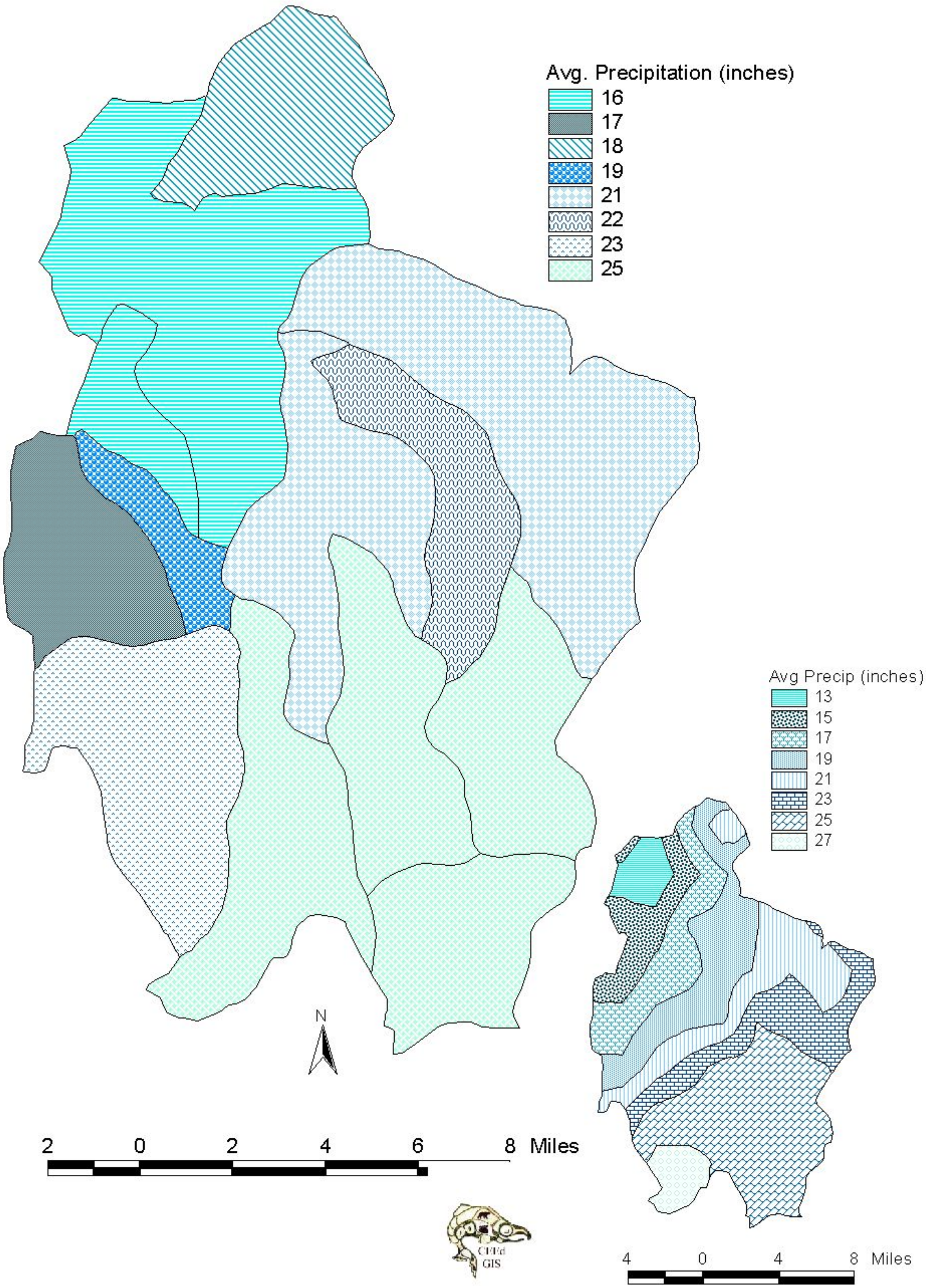

Figure 4. Average annual precipitation by HUC within the Lapwai Creek watershed. Inset shows actual PRISM data.

Topography

Elevations within the Lapwai Creek watershed range from 856 feet above MSL near the stream mouth to 4,800 feet above MSL in the headwaters of Sweetwater and Webb Creeks (Table 3). Mean elevation ranges from 1,673 feet above MSL in the Tom Beall Creek subwatershed to over 4,400 feet MSL in the upper Mission Creek and upper Webb Creek subwatersheds.

A southwest to northeast trending fault forms an escarpment approximately 1,000 feet high (Soil Conservation Service et al. 1990), dividing the Lapwai Creek watershed roughly in half. The upper section of the watershed is characterized by gently rolling topography, while the lower portion is divided by steep basalt canyons that dissect the otherwise rolling topography (Figure 5). Drainage patterns are dominated by erosion and weathering of basalt. Drainages developed in basalt by stream erosion consist of deeply incised valleys with vertical to nearly vertical walls (Bureau of Land Management 2000). Differential erosion of basalt flows creates narrow flat benches, giving the hillsides a step-like appearance. Drainage patterns are dominated by erosion and weathering of basalt. Drainages developed in basalt by stream erosion consist of deeply incised valleys with vertical to nearly vertical walls (Bureau of Land Management 2000). Differential erosion of basalt flows creates narrow flat benches, giving the hillsides a step-like appearance.

Table 3. Area, elevation, and precipitation characteristics of individual subwatersheds within the Lapwai Creek watershed.

Subwatershed Name	Sub-watershed Area (mi^2)	Mean Elevation (feet)	Minimum Elevation (feet)	Maximum Elevation (feet)	Mean Annual Precip. (inches)
Tom Beall	17.45	1,673	1,014	1,998	18
Lower Lapwai	40.04	1,752	856	2,864	16
Middle Lapwai	40.91	30,09	1,388	3,921	21
Upper Lapwai	17.21	4,091	3,615	4,324	25
Lower Sweetwater	7.28	1,847	1,201	2,415	16
Middle Sweetwater	15.53	2,523	1,798	3,399	17
Upper Sweetwater	26.44	3,930	2,398	4,800	23
Lower Webb	6.19	2,592	1,624	3,399	18
Upper Webb	22.78	4,423	2,999	4,800	25
Lower Mission	23.32	3,051	1,742	4,199	21
Middle Mission	18.41	4,022	2,425	4,498	25
Upper Mission	16.34	4,439	4,209	4,695	25
Rock Creek	15.30	3,297	1,598	4,177	22
Total Watershed	267.19				

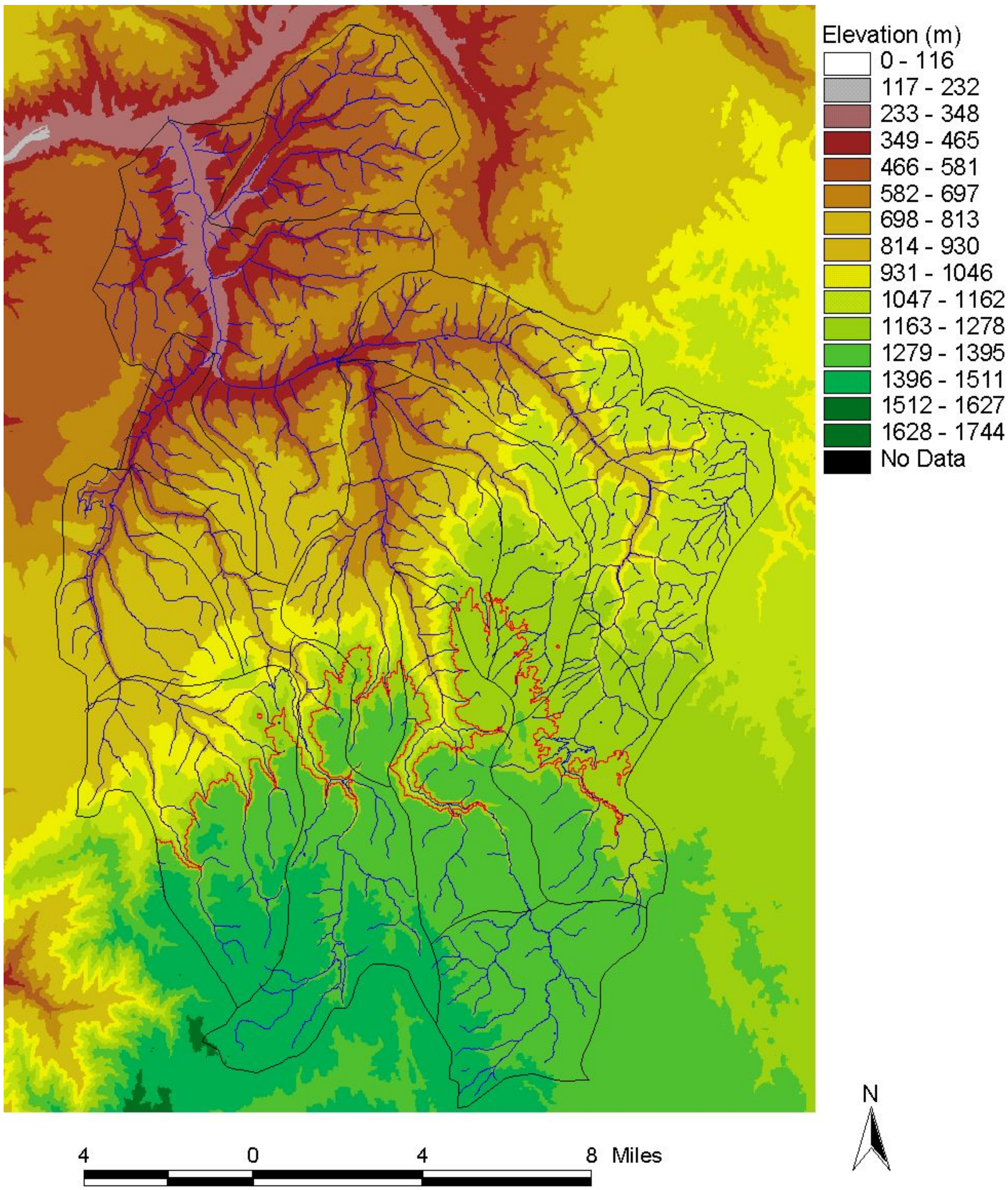

Figure 5. Elevation and topography of the Lapwai Creek watershed. The red line indicates the rain-on-snow boundary (4000′)

Geology

The predominant rock type in the Lapwai Creek watershed is the Columbia River basalt group, consisting of a series of extrusive volcanic flows measuring 2,000 to 4,000 feet in thickness (Figure 6). As many as 17 different flows have been counted with each flow ranging from 25 to 150 feet thick. Loess deposits blanket the basalt above the escarpment with steep channel slopes carved through the basalts below. A semi-circular band of granitics representative of the Idaho batholith extends through the upper portions of the watershed. The granitics are centered around Winchester Lake and extend from the Lapwai Creek headwaters through central Mission Creek and southward along the divide between the headwaters of Sweetwater and Webb Creeks.

Wildlife

According to the Soil Conservation Service (SCS) et al. (1990), local variations in elevation, climate, landforms, and vegetation type create diverse wildlife habitat in the Lapwai and Mission Creek subwatersheds. Upland game species include ring-necked pheasant, chukar, gray partridge, valley quail, ruffed and blue grouse, mourning doves, wild turkey, and cottontail rabbit. The SCS et al. (1990) suggests that land use practices including agriculture, grazing, and timber harvest have impacted local upland game populations.

Big game species include mule deer, white-tailed deer, elk, black bear, and mountain lion. Of these, white-tailed deer are most common, with bear and lions present in small numbers and elk and mule deer primarily winter inhabitants. Additional wildlife species found locally include bald eagles, songbirds, beaver, muskrat, raccoon, mink, red fox, coyote, and bobcat (SCS et al. 1990).

Sensitive Species

Occurrence of sensitive species found either in or near the Lapwai Creek watershed were obtained from the Idaho Conservation Data Center (ICDC) database supplied by Idaho Fish and Game (Table 4). Status information for sensitive species was obtained from multiple sources to ensure reporting of recent status designations.

Seven sensitive plant and one sensitive invertebrate species are identified in the ICDC database as occurring in the Lapwai Creek watershed. An additional six plant and three animal species were found within one-mile border of the watershed. The Mission Creek Oregonian (*Cryptomastix magnidentata*) and steelhead (*Oncorhynchus mykiss*) are the only aquatic sensitive species found within the watershed. Steelhead are found throughout most of the major tributaries, while the Mission Creek Oregonian was recorded only in Mission Creek, but may occur in other streams within the watershed (Soil Conservation Service et al. 1990)

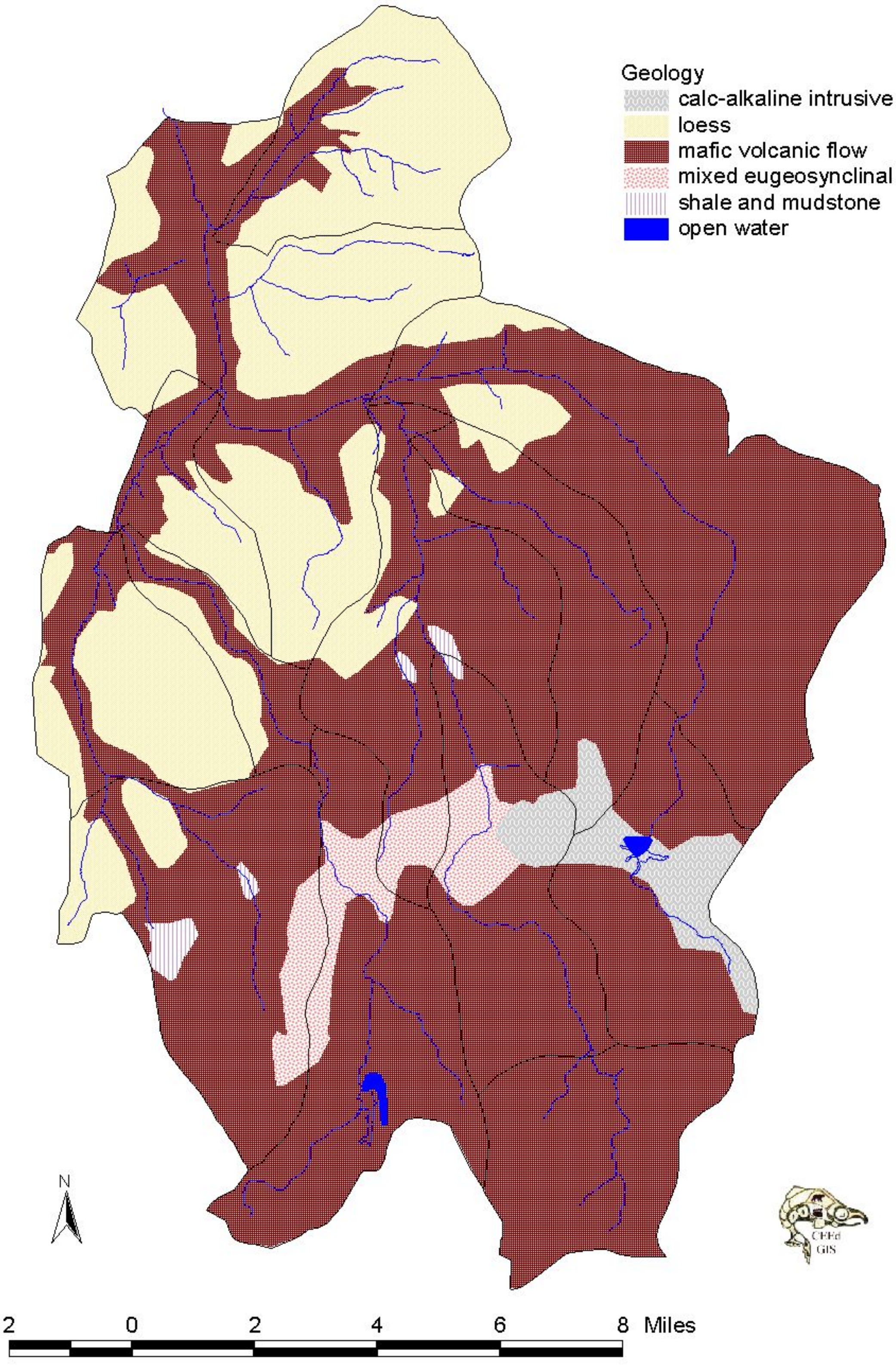

Figure 6. Lithology of the Lapwai Creek watershed

Table 4. Sensitive plant and animal species found in or near the Lapwai Creek watershed.

Common Name	Scientific Name	Federal Status	State Status
Species Found Within the Lapwai Creek Watershed			
Plants			
Broad-fruit Mariposa	*Calochortus nitidus*	Candidate - ESA	Rare
Fern-leaved Desert-parsley	*Lomatium dissectum var dissectum*	N/A	Monitor
Idaho Hawksbeard	*Crepis bakeri ssp idahoensis*	N/A	Imperiled
Jessica's Aster	*Aster jessicae*	Candidate - ESA	Imperiled
Palouse Goldenweed	*Haplopappus liatriformis*	Candidate - ESA	Imperiled
Plumed Clover	*Trifolium plumosum var amplifolium*	N/A	Imperiled
Sticky Goldenweed	*Haplopappus hirtus var sonchifolius*	N/A	Imperiled
Invertebrates			
Mission Creek Oregonian	*Cryptomastix magnidentata*	Sensitive - BLM	
Fish			
Steelhead	*Oncorhynchus mykiss*	Threatened - ESA	
Additional Species Found Near the Lapwai Creek Watershed			
Plants			
Bank Monkeyflower	*Mimulus clivicola*	N/A	Monitor
Green-band Mariposa Lily	*Calochortus macrocarpus var maculosus*	N/A	Imperiled
Salmon-flower Desert-parsley	*Lomatium salmoniflorum*	N/A	Rare
Spacious Monkeyflower	*Mimulus ampliatus*	N/A	Critically imperiled
Spalding's Silene	*Silene spaldingii*	Candidate - ESA	Imperiled
Wolf's Currant	*Ribes wolfii*	N/A	Monitor
Animals			
White-headed Woodpecker	*Picoides albolarvatus*	Watch	Special Concern
Bald Eagle*	*Haliaeetus leucocephalus*	Threatened	Endangered
Ringneck Snake	*Diadophis punctatus*	Watch	Special Concern

* Cited in Soil Conservation Service et al. 1990

Historic Vegetation

Historic land cover was comprised of a mixture of Bluebunch wheatgrass/Idaho fescue and various tree species including lodgepole pine, grand fir, Douglas fir, ponderosa pine, and western larch (Idaho Department of Fish and Game et al. 1994). According to Black et al. (1999), the historic distribution of vegetation throughout the Camas Prairie was likely composed of forest communities on higher elevation mountains and ridges, and grasslands in the canyons and lower elevation plateaus. This general pattern is still seen today, although much of the grassland areas have been converted to agricultural use.

Figure 7 illustrates the potential historic vegetative composition within the Lapwai Creek watershed as modeled by the USFS as part of the ICBEMP. This information was intended for use at relatively large scales (> 3,000 sq. km) and may not be accurate at finer scales (U. S. Forest Service and Bureau of Land Management 2000). However, the historic vegetative composition is in general agreement with descriptions by Black et al. (1997) and is treated here as a coarse scale picture of potential historical vegetative composition.

Current Land Use

The most recent available land use data was obtained from the NPT's Land Services Department in a GIS coverage derived approximately two years ago. Land uses are delineated based on scanned ortho-photos and aerial photo interpretation at a scale of 1:24,000. Table 5 summarizes major land use categories by subwatershed within the Lapwai Creek watershed. Urban/rural residential areas comprise 1.6% of the total land use in the watershed, with the remainder used for forestry (32%) or agriculture and range (66%).

Agriculture is the predominant (39.7%) land use in the Lapwai Creek watershed (Figure 8). Croplands within the watershed consist primarily of dryland agriculture with winter wheat, spring barley, winter peas, dry peas, and hay as predominant crops (Bureau of Land Management 2000). Bluegrass is also commonly grown within the watershed according to local NRCS representatives (L. Rasmussen, Nez Perce County NRCS, personal communication April 19, 2000). Dryland cropping practices in the watershed involve crop rotations ranging from 2–10 years. One irrigated orchard exists in the lower portion of the watershed.

Forest and rangeland is also important in the watershed, comprising 32.5% and 26.0% of the land area, respectively. Closed forest (>=25% crown closure) and open forest (<25% crown closure), composed primarily of pine and fir, comprise 61% and 38% respectively of the total forest cover in the watershed. Formerly forested areas (harvested) comprise just over 1% of the land area used for forestry purposes. Hardwoods make up only 0.4% of the land area within the Lapwai Creek watershed; they were considered rangeland for this assessment since they are comprised primarily of riparian willows and alders located in canyon bottoms where range use is most common. Rangelands generally consist of bluebunch wheatgrass and Idaho fescue, although livestock grazing has degraded most of the natural grasslands. Noxious weeds, including yellow starthistle, common crupina, poison hemlock, scotch thistle, and cheatgrass currently dominate much of the rangeland (Bureau of Land Management 2000).

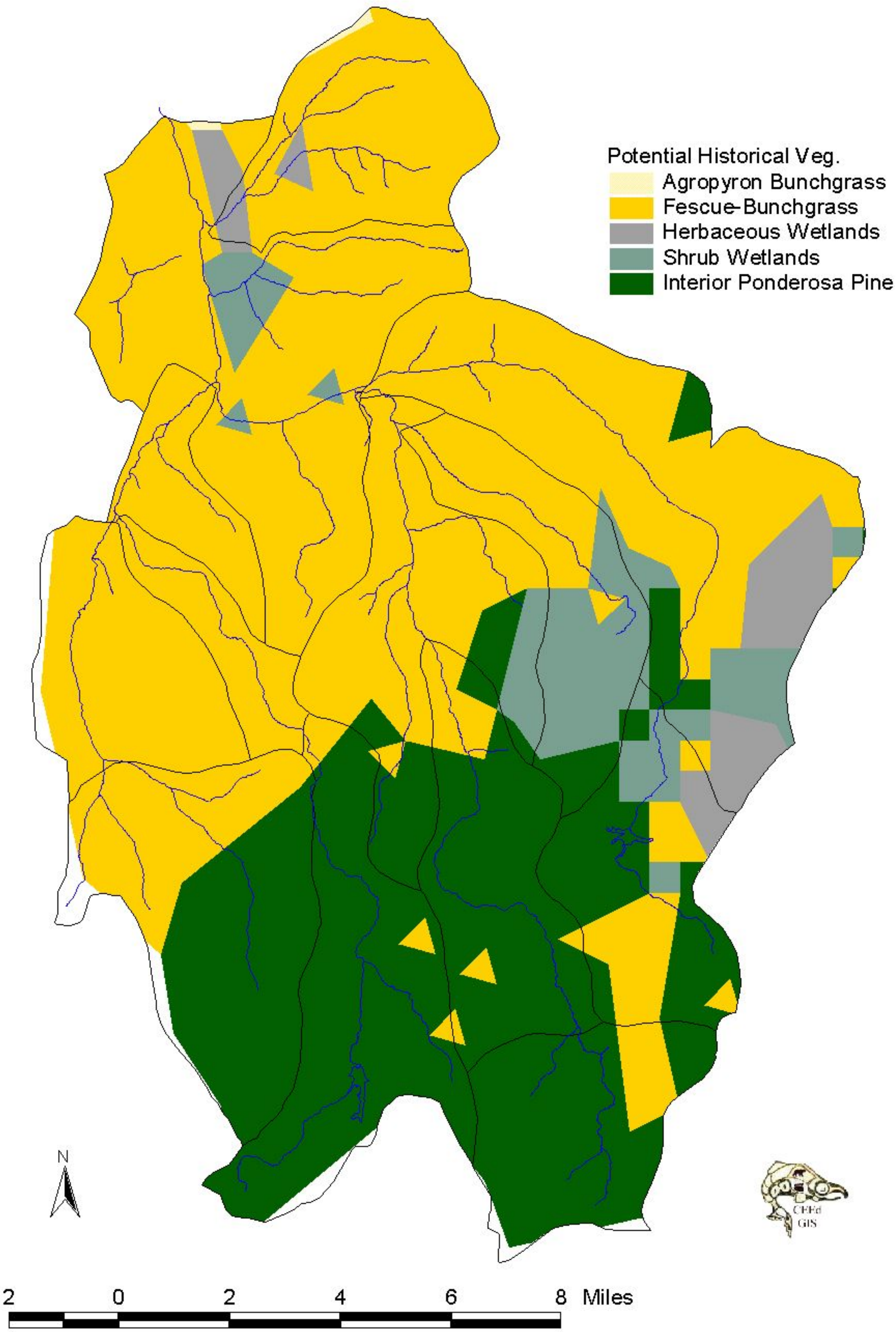

Figure 7. Potential historic vegetation types as modeled by ICBEMP. Data are subject to a low degree of accuracy at this scale and are presented only as a general overview of potential vegetation

Table 5. Land use and general land cover characteristics of individual subwatersheds within the Lapwai Creek watershed.

Subwatershed Name	Area (Acres)	Forestry Acres	Forestry Percent	Ag/Range Acres	Ag/Range Percent	Urban Acres	Urban Percent	Other Acres	Other Percent
Tom Beall	11,168	0	0.0	11,027	98.7	142	1.3	0	0.0
Lower Lapwai	25,623	0	0.0	24,550	95.8	1,074	4.2	0	0.0
Middle Lapwai	26,180	5,965	22.8	19,496	74.5	719	2.7	0	0.0
Upper Lapwai	11,015	4,552	41.3	6,191	56.2	158	1.4	112	1.0
Lower Sweetwater	4,659	0	0.0	4,555	97.8	106	2.3	0	0.0
Middle Sweetwater	9,940	82	0.8	9,832	98.9	26	0.3	0	0.0
Upper Sweetwater	16,919	10,218	60.4	6,640	39.2	43	0.3	19	0.1
Lower Webb	3,964	500	12.6	3,452	87.1	13	0.3	0	0.0
Upper Webb	14,579	12,500	85.7	1,641	11.3	10	0.1	429	2.9
Lower Mission	14,923	4,648	31.1	9,777	65.5	316	2.1	181	1.2
Middle Mission	11,779	7,895	67.0	3,688	31.3	34	0.3	166	1.4
Upper Mission	10,460	6,302	60.3	4,153	39.7	0	0.0	5	0.0
Rock Creek	9,790	2,282	23.3	7,340	75.0	167	1.7	0	0.0
Total Watershed	171,000	54,944	32.1	112,342	65.7	2,807	1.6	913	0.5

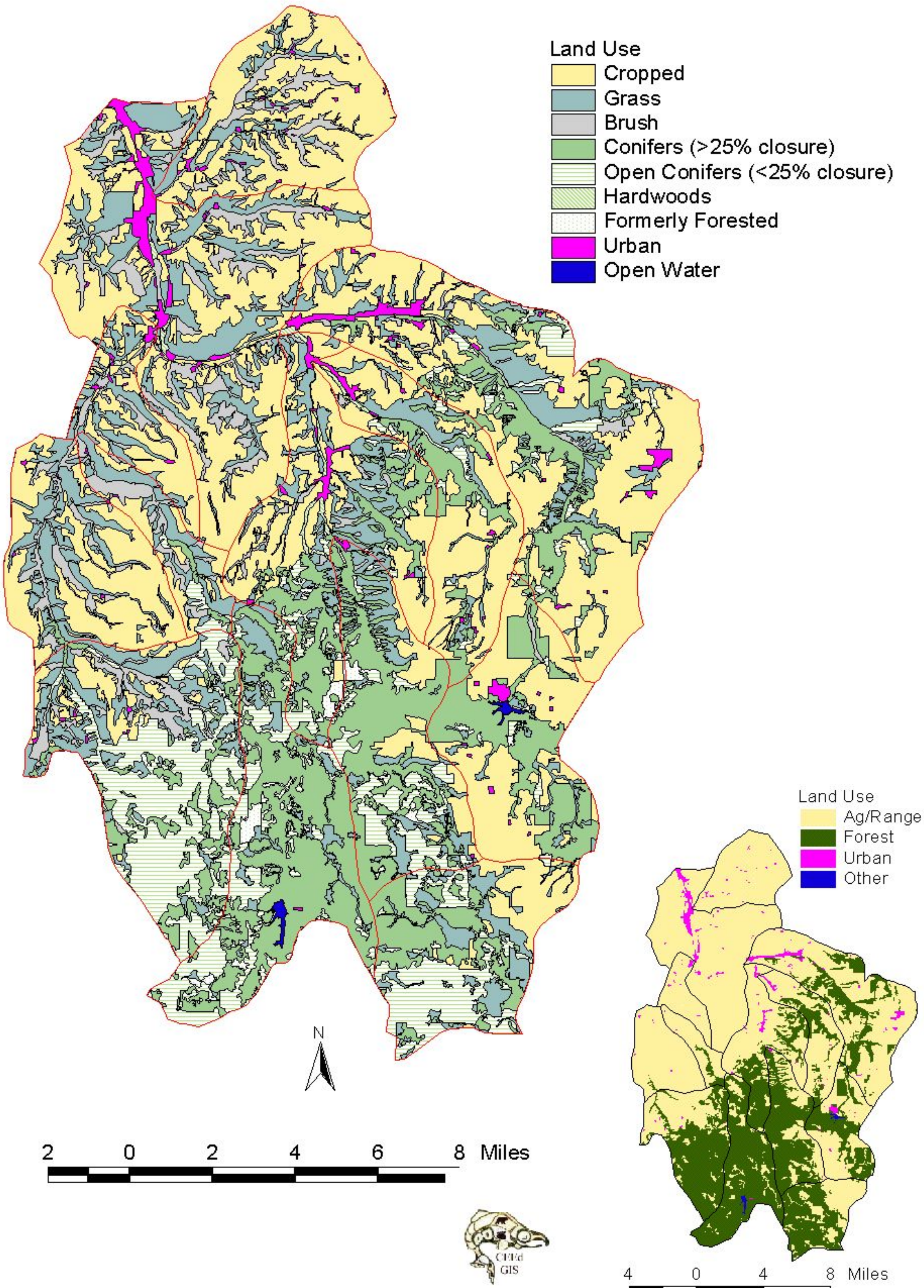

Figure 8. Land use characteristics of the Lapwai Creek watershed. Inset shows general land use categories

4 - HISTORY

30–40 million YBP	Columbia River basalt flows form general topography of study area
≈ 10,000 YBP	Known occupation of Nez Perce Tribe in the Northwest
early 1700s	Arrival of domesticated horses
1780s	Smallpox epidemic hits Nez Perce Indians
1805	Lewis and Clark expedition rendezvous with indigenous peoples near the mouth of Lapwai Creek; contemporary name "Nez Perce" given
1810–1850s	Northwest Territory opens up for fur trading and westward movement of settlers
1836–1837	Spalding Mission established at mouth of Lapwai Creek
1855	Stevens Treaty of 1855 establishes the Nez Perce reservation
1862	Fort Lapwai constructed at present-day Lapwai
1863	Treaty of 1863 reduces reservation size and reduces tribal independence
1874	St. Joseph's Mission constructed on Mission Creek by Father Joseph Cataldo
1887	General Allotment Act passed by Congress
1894	Significant flood event; "towns were inundated…"
≈ 1900	Town of Winchester established
1906	Lewiston Orchards Project constructed by private interests
≈ 1910	Camas Prairie Railroad is formed
1910	Craig Mountain Lumber Company establishes mill in Winchester; creates Winchester Lake (Lapwai Lake)
1923	Soldier's Meadow reservoir completed
1924	Nez Perce Tribe gains U. S. citizenship
1929–1972	Lewiston Dam constructed on Clearwater River; blocks upstream anadromous migration; marks extirpation of native chinook
≈ 1930	Combines used extensively for harvesting
1930s	Construction of ≈ 13 miles of railroad tracks along stream channels in headwater portions of Mission Creek
1934	Indian Reorganization Act passed by Congress
1934	Legislature provides for the purchase of the site of Spalding Mission as a state park
1942	Lewiston Lime Company begins quarry operation on Mission Creek (Ferrians 1958)
1946	Introduction of fertilizers
1948	USBR construction of Webb Creek Diversion Dam, Sweetwater Diversion Dam, and WF Sweetwater Diversion Dam
1948	Significant flood event; estimated flow at Lapwai ≈ 3,800 cfs
1955	Completion of construction of Highway 95 through Lapwai canyon
1964–1965	Significant flood events cause extensive damage; estimated flow of Lapwai Creek at Sweetwater ≈ 4,000 cfs
1965	Flood control project completed at Sweetwater by Walla Walla USACE April 28

1965	USACE snagging and clearing completed on Lapwai and Mission Creeks
1965	USACE flood control project completed at St. Joseph's Children's Home on Mission Creek
1965	U. S. National Park Service creates the Nez Perce National Historic Park, with an administrative and interpretive center at Spalding
1969	Flood event; estimated flow of Lapwai Creek at Sweetwater ≈ 2,400 cfs
1970–1972	Dworshak Dam and NFH completed; steelhead supplementation program initiated
1971	USACE Flood control project completed on Lapwai Creek at Culdesac
1983	USACE snagging and clearing completed on Lapwai Creek
1996	Significant flood event; peak flow measured at USGS station #13342450 near Lapwai = 5,010 cfs

Original Human Inhabitants

The first human inhabitants of the lower Clearwater region are believed by anthropologists to be ancestors of the present-day Nez Perce Indians. Anthropologists estimate the Nez Perce occupied the area some 10-12,000 years ago, living on the natural resources of the area by hunting for elk, deer, bear, rabbit, and grouse, gathering camas, and fishing salmon as major staple foods (Josephy 1997).

The early 1700s marked the arrival of domesticated horses. The Nez Perce and other tribes subsequently became reliant upon the horse for transportation and hunting, using the fertile upland areas of the lower Clearwater as open range grazing. The Nez Perce people at this time were estimated to number between 4,000 and 8,000 in the Northwest (Black et al. 1997). In the 1780s, the population was dramatically reduced following a series of major smallpox epidemics resulting from indirect contact with European explorers (Meinig 1995).

European Contact

In 1805, the Lewis and Clark Expedition encountered the Nez Perce Tribe near the mouth of Lapwai Creek. The east-west trade route they identified and the detailed account of terrain and conditions they compiled indirectly led to the establishment of the Northwest Territory. The Stevens Treaty of 1855 was the first legal attempt to limit confrontation between the Nez Perce people and white settlers. The treaty proposed a 7.25 million acre reservation for the Nez Perce in return for yielding their right to lands they had occupied for generations. A successive treaty in 1863 reduced the original reservation to 790,000 acres (Josephy 1997) and opened up more of the drainage to white settlers. In 1887, Congress passed the General Allotment Act or Dawes Act, creating the checkerboard ownership of the contemporary Nez Perce reservation. Following the Dawes Act, traders, miners, and farmers subsequently colonized the Lapwai drainage.

During the mid- to late 1800s numerous missions and forts were constructed as part of an attempt to convert Native

Americans to Christianity and western civilization. In 1836, Presbyterian missionaries Henry and Eliza Spalding established a log cabin at the mouth of Lapwai Creek and opened a day school for the Nez Perce. The structure was relocated in 1838 to a higher point two miles to the south. The mission remained functional for approximately 64 years, providing the Nez Perce with the European-American perspective of religion, academics, trade, and agriculture. Spalding Mission was later designated a state park in 1935. In 1862, Fort Lapwai was constructed at present-day Lapwai. As the first military fort built in Idaho, its primary purpose was to prevent turmoil when gold was discovered around Pierce. It was also used to quell unrest from disgruntled Nez Perce who had lost their independence and land to white settlers. In 1874 Father Joseph Cataldo constructed St. Joseph's Mission on present-day Mission Creek.

European Settlement

European settlement of the Lapwai watershed began in earnest following the discovery of precious metals in the Clearwater River drainage circa 1860. The influx of miners resulted in a demand for farm produce. Settlers quickly established claims in the valley bottoms near timber and water resources, leaving the steep hillsides and hilltops for grazing (Black et al. 1997). Early farms were small in scale and planted mainly for subsistence purposes. Livestock were allowed to roam freely, gaining nourishment on native bunch grass and shrub communities (Prevost 1985). In addition to the small-scale farms, fruit orchards were commonplace along the lower Clearwater River. In 1889 the lowland portions between Lewiston and the reservation border were collectively referred to as "one immense orchard." The mouth of Lapwai Creek served as a port for steamers to transport the crops grown in the valley to downstream locales such as Lewiston and Riparia (Simon-Smolinski 1984).

Farmers soon realized that the upland areas (i.e., Camas Prairie) of the drainage contained many of the region's fertile soils. Farming operations were subsequently expanded and relocated, although livestock grazing remained restricted to the valley bottoms and canyon walls. The continued perturbation of the steep valley soils and defoliation of riparian areas may have contributed to the first documented significant flood event in 1894, which caused extensive damage to low-lying towns (Simon-Smolinski 1984). Improvements in farm equipment in the early to mid 1900s intensified agricultural practices in the Lapwai watershed (Williams 1991). Land once deemed as "waste" rapidly opened up to cultivation following the advent of threshers, combines, and tractors. Conversion of native brush, grass, and riparian vegetation to cereal grains, oats, barley, and legumes occurred at this time.

Water Diversion

Other changes to upland portions of the Lapwai drainage during the early 1900s included the Lewiston Orchards Project in 1906. Initiated by private irrigation interests, the project consisted of an irrigation system designed to provide water to the Lewiston orchards and municipality. The initial system consisted of a timber flume and canal to carry water from Sweetwater Creek to a storage reservoir (Mann's Lake). This water was then distributed through a system of wood-stave pressure pipelines to the project lands (Bureau of Reclamation 2000). The water supply was augmented in 1915, 1922, 1934, and 1939 by making new diversions and increasing overall storage capacity (construction of Soldier's Meadow Reservoir in 1923). The Lapwai system was updated by the Bureau of Reclamation in 1946 and currently consists of three diversion structures (Webb Creek, Sweetwater Creek, and the westfork of Sweetwater Creek), a series of feeder canals, and Soldier's Meadow Reservoir. Out-of-basin components of the system include a diversion on Captain John Creek, feeder canals, and Mann's Lake and Lake Waha storage reservoirs (*see also Chapter 6*).

Transportation

In order to get their crops to market, farmers needed an effective means of transportation. Steamers provided the first connection, but could make the journey to Lapwai Creek only when the Clearwater was at high stage (Mullan 1865). The Camas Prairie Railroad was consequently formed in 1910, providing access from the prairie region to the larger markets in the lower Clearwater and Snake River valleys. The completion of the railroad grade was hydrologically significant as it functionally restricted lower portions of the Lapwai Creek stream channel from its historic floodplain, forming an embankment which provided 50-year protection (98%) from all flooding (U. S. Army Corps of Engineers 2000). Railroad grades and tracks were also constructed in headwater portions of Mission Creek for timber harvest. Nearly 13 miles of track were laid, the majority along stream channels, to provide an effective means to transport timber to local mills (Thomas et al. 1985).

Forest Clearing

With an improved transportation system and mechanized farming equipment, the economic benefits of agricultural practices increased. In an effort to expand agricultural areas, timbered ground was cleared and converted to tillable ground in many of the headwater portions of the drainage. The two practices thus proved mutually beneficial; agricultural interests were satisfied through an increase in farmable land while silvicultural interests were satisfied through an increase in saleable harvest. In 1910, the Craig Mountain Lumber Company moved in and established a mill in the town of Winchester (Idaho Travel Council 2000). The company created Winchester Lake for a log storage area by building an earthen dam across Lapwai Creek. Following the mill's closure in 1965, the area was developed into a state park in 1967 after a land trade between the IDFG and PFI.

Agricultural Industrialization

The era between 1931 and 1970 saw rapid agricultural industrialization. Petroleum-based technology provided an alternative to horse and human labor and by 1970, was widespread throughout the region. The new equipment meant that farmers no longer needed extensive pasture land to feed livestock, and that even the steepest slopes could be farmed. The introduction of fertilizers in the mid to late 1940s and initiation of federal agricultural programs encouraging farmers to drain seasonally wet areas allowed an increase in crop production by 200%–400% (Black et al. 1997). While these changes benefited the local economy, they also resulted in further fragmentation and/or elimination of refugia for native communities.

Channel Modification

The completion of U. S. Highway 95 in 1955 (Reichmuth 1997) greatly restricted portions of Lapwai Creek from its historic floodplain. The section of channel from the confluence with the Clearwater River upstream to the town of Culdesac was effectively channelized between the new roadbed and existing Camas Prairie railroad grade (U. S. Army Corps of Engineers 1959). The reach between Sweetwater and Culdesac was heavily channelized during the 1955 road construction, creating an oversteepened gradient within the stream channel. In an attempt to compensate for the gradient change and ameliorate high flows, a series of rock-filled wire mesh (gabion) drops were installed along the new channel. The majority of these structures failed in the 1980s (Reichmuth 1997). In combination with the morphology of the canyon upstream from Culdesac, the new roadbed further restricted the natural sinuosity of the stream and altered its energy.

Urbanization and Flood Control

The development of urban areas and transportation networks in or near the floodplain, coupled with the reduction of upland storage through silvicultural and agricultural practices, combined to create a hydrologically hazardous situation. In 1948 flood flows at Lapwai were estimated at 3,800 cfs. According to local residents, this was "…probably the largest flood of the last 30 to 40 years" (U. S. Army Corps of Engineers 1959). Another significant flood event occurred in 1965 when Lapwai Creek flows at Sweetwater were an estimated 4,000 cfs. Damage estimates for the Lapwai watershed alone were in excess of $1.3 million (Waananen et al. 1970). Four years later at the same location, flood flows were estimated at 2,400 cfs, although property damage was not as extensive as previous events (U. S. Army Corps of Engineers 1971). The earliest continuous flow measurements recorded on Lapwai Creek date back to 1975 when a USGS gaging station was installed near the town of Lapwai. Since that time peak flows exceeded the estimated "25-year event" flow of 4,800 cfs in 1996 (5,010 cfs), and exceeded the estimated "10-year event" flow of 2,960 cfs in 1986 (3,380 cfs) and again in 1997 (3,190 cfs).

The occurrence and magnitude of flood-related damage prompted federal, state, and local authorities to take reparatory and preventative actions. Numerous levees and riprap projects were proposed and completed over the years throughout the drainage in attempts to restrict floodwaters from the historic floodplain. The USACE's Walla Walla District was instrumental in the initiation of emergency flood control work following flood events in 1957 and 1965 near the town of Sweetwater (U. S. Army Corps of Engineers 1959; 1967; 1971), and in 1965 through the town of Culdesac (U. S. Army Corps of Engineers 1966). The Corps was also responsible for preventative work at Sweetwater, Culdesac, and near the Slickpoo Mission on Mission Creek. Work included channel straightening and enlargement, riprapping banks, levee construction, and removal of flow-impeding debris ("snagging and clearing") from the channel (*see Chapter 9*).

Fisheries

The regional flood control efforts, which continued through the mid 1960s and early 1970s, directly and indirectly affected Lapwai fisheries. Concern for flood protection, especially in the larger downstream municipalities of Lewiston and Clarkston, prompted the construction of Dworshak dam in 1970 by the USACE; it was operational for flood control by 1972. Because the dam represented a migration barrier to anadromous salmonids, Dworshak NFH was concurrently constructed as mitigation. The hatchery initiated an intensive supplementation program, producing more B-run steelhead smolt than any other hatchery facility worldwide (Columbia River Inter-Tribal Fish Commission 1996).

Although the supplementation efforts appeared beneficial to anglers, biologists suspected the absolute numbers of fish released into the Clearwater were genetically impacting native species of 'A-run' steelhead residing in lower Clearwater tributaries. A study by Kucera and Johnson (1986) determined that 'A-run' steelhead residing in Mission Creek were "genetically indistinguishable" from an upstream population of fish in the Clearwater tributary Bedrock Creek, and that the Bedrock steelhead were "not significantly different from Dworshak Hatchery B-run steelhead." However, a later study on Bedrock Creek confirmed Clearwater A-run steelhead remained genetically distinct from the Dworshak B-run steelhead and the genetics of the wild population had not significantly changed (U. S. Fish and Wildlife Service and Nez Perce Tribe 1995).

Other supplementation efforts in the Lapwai watershed include the Sweetwater springs hatchery facility, operated by the Nez Perce Tribe. The facility is used exclusively to rear spring chinook salmon for release at sites throughout the Clearwater subbasin and is capable of hatching two million salmon eggs (Murphy and Metzker 1962; *see also chapter 11*).

5 - CHANNEL HABITAT TYPES

The Oregon Watershed Assessment Manual (OWAM) (Watershed Professionals Network 1999) provides a classification method for channel habitat types (CHTs) at the scale of stream reaches based primarily on channel gradient and confinement. Valley shape and stream size are also considered in assigning some CHTs. The method uses topographic maps to determine much of the necessary information, making the classification of entire stream systems possible in a relatively timely manner. Field verification is then used to determine the accuracy of CHT classifications. A list of CHT defined within the OWAM and their characteristics are presented in Appendix B.

CHT provides a method to assess relative sensitivity or potential response of channel segments to either disturbance or restoration efforts, and can therefore help to guide management decisions. It is assumed that stream responses to inputs of sediment, water, and woody debris will be relatively consistent within a given CHT and different between CHTs. Since each CHT responds uniquely to system inputs, their sensitivity to changes caused either through disturbance or restoration will also differ. Channel sensitivity and resultant responses to natural or introduced inputs will influence the relative quantity, quality, and distribution of habitats for various fish species throughout a watershed.

Methods

Streams segments within the Lapwai Creek watershed were classified by Channel Habitat Type (CHT) according to the OWAM as follows:

- Using 7.5′ USGS topographic maps, stream segments were defined using tributary junctions and notable breaks in stream gradient.
- Stream gradient was estimated for each stream segment by measuring stream length between the upper and lower map contours in the segment, and calculating percent gradient as rise/run.
- Channel confinement was estimated for each stream segment using topographic map features. Confinement was defined as Unconfined, Moderately confined, or Confined.
- CHTs were assigned to each segment using information in the OWAM (Watershed Professionals Network 1999), which is reproduced in this report in Appendix B.
- Field verification was conducted for a representative sample of stream segments to verify accuracy of confinement ratings.
- Assignment of final CHTs was conducted based on map interpretation, field verification, and channel attribute descriptions provided in Appendix III-A of the OWAM.

Following these procedures, eight CHTs were identified within the Lapwai Creek watershed (Figure 9). The CHTs and general characteristics associated with each are listed in Table 6 and discussed below.

Table 6. CHTs identified in the Lapwai Creek watershed and corresponding characteristics of each as identified in the OWAM

CHT Code	CHT Name	Gradient	Channel Confinement	Stream Size	Channel Sensitivity*
LC	Low Gradient Confined	< 2%	Confined	Variable	Moderate
LM	Low Gradient Moderately Confined	< 2%	Moderately Confined	Variable	High
MM	Moderate Gradient Moderately Confined	2–4%	Moderately Confined	Variable	High
MC	Moderate Gradient Confined	2–4%	Confined	Variable	Moderate
MV	Moderately Steep Narrow Valley	3–10%	Confined	Small to medium	Moderate
MH	Moderate Gradient Headwater	1–6%	Confined	Small	Moderate
SV	Steep Narrow Valley	8–16%	Confined	Small	Low
VH	Very Steep Headwater	> 16%	Confined	Small	Low

- Overall sensitivity to changes in LWD, fine or coarse sediment load, and/or peak flows. See Appendix B for sensitivity to individual factors, and ranking definitions.

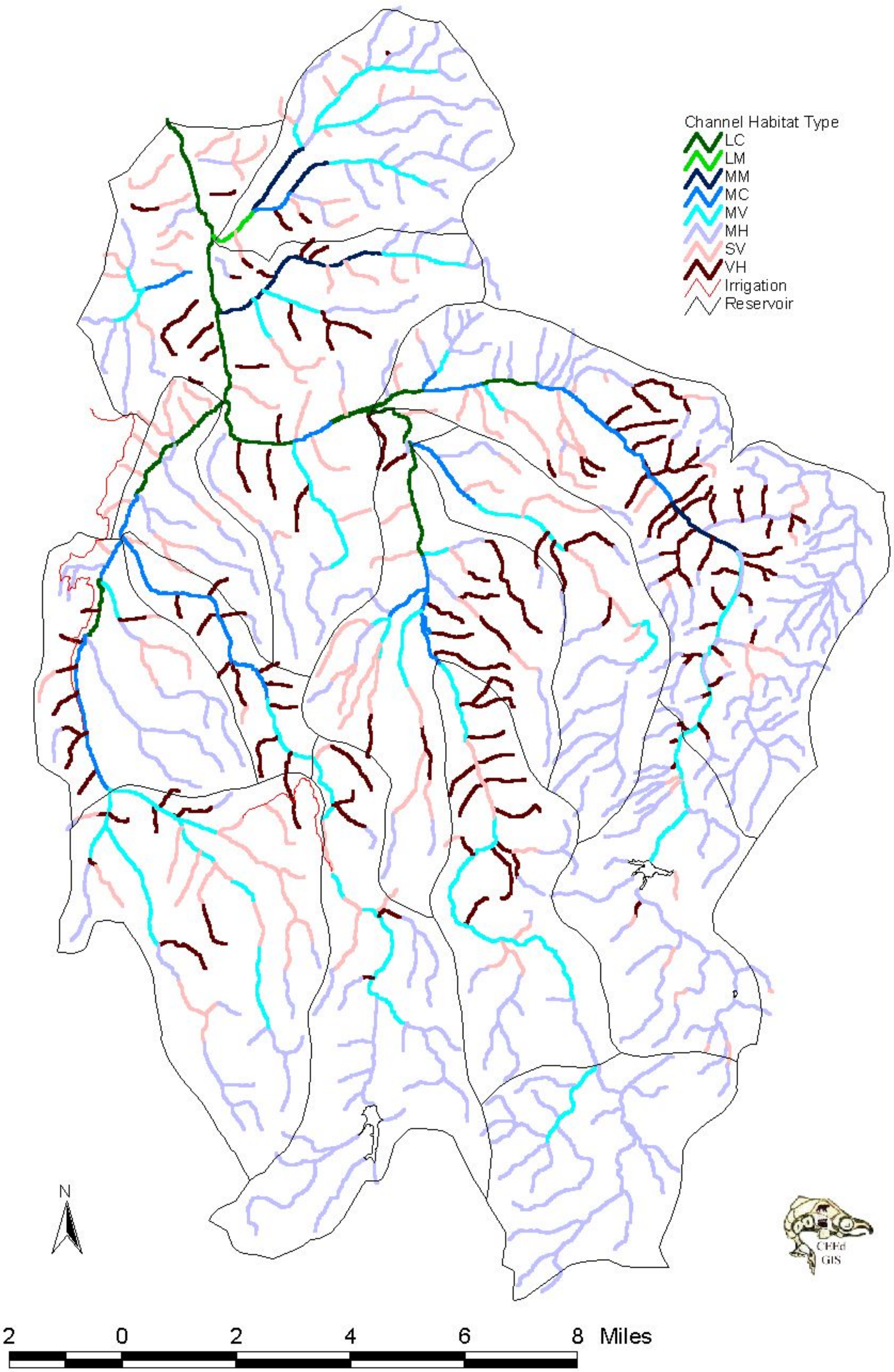

Figure 9. Channel Habitat Types (CHT's) defined within the Lapwai Creek watershed

Classification of Stream Segments

Low Gradient Confined (LC)

These channels are located within low gradient streams incised or confined by hillslopes. Narrow floodplains may exist in some reaches, and channels are typically single and relatively straight to slightly sinuous. Substrate in these channels is typically large (cobble, boulders, bedrock) with pockets of smaller sands, gravel, and cobble. Within the Lapwai Creek watershed, these channel types generally occur in the lower mainstem reaches of Lapwai, Mission, and Sweetwater Creeks where they typically result from artificial confinement and may function more similarly to LM channels elsewhere in the watershed.

LC channels are not considered highly responsive to enhancements. Channel responsiveness is low to moderate for changes in LWD or peak flows, and low to moderate for changes in fine and coarse sediment, respectively. Due to their confined nature, establishment of riparian vegetation may aid in temperature reduction. These channels can be prone to bank erosion and may benefit from livestock access control.

Low Gradient, Moderately Confined (LM)

LM channels are low-gradient reaches with variable confinement, generally by low hills or terraces. Narrow floodplains are common, but may be discontinuous along the channel length, and channel patterns may be single or braided. These channels tend to have substrate ranging from sand and gravel to bedrock, and are slightly to moderately sinuous. Within the Lapwai Creek watershed only one stream segment was defined as LM, located at the mouth of Tom Beall Creek.

LM channel responsiveness is moderate to high for changes in LWD and both fine and coarse sediment loads, and moderate for changes in peak flows. These channel types are typically good candidates for enhancement efforts, especially increased roughness in forested areas and bank stabilization efforts in non-forested areas.

Moderate Gradient, Moderately Confined (MM)

By definition, these channels are moderately confined by various landforms and generally have low to moderate sinuosity. Floodplains are narrow and may alternate from bank to bank. The channels are typically single and may contain bedrock steps and cascades; substrates range from gravel to small boulders. MM channels typically host a variety of aquatic habitats formed by bedrock, boulders, and LWD and are commonly associated with beaver use. MM channels were defined in the lower tributaries to Lapwai Creek (Tom Beall Creek and Garden Gulch) and in one low gradient reach of Lapwai Creek upstream from Culdesac.

These channels are considered good candidates for enhancement because of their high degree of responsiveness and confined nature. MM channel responsiveness is generally high with regard to LWD and coarse sediment loads, and moderate with regard to changes in fine sediments and peak flows. Increases in LWD or boulders are often beneficial in forested areas, as are bank stabilization efforts in non-forested areas.

Moderate Gradient, Confined Channel (MC)

MC channels have moderate gradients and gentle to narrow V-shaped valleys with minimal floodplain development. These channels are generally high energy, sediment transport systems with single channel configurations. Substrates are commonly large particles ranging from coarse gravels to bedrock. In the Lapwai watershed, MC channels were defined in the central mainstem portions of major tributaries (Lapwai, Mission, and Sweetwater Creeks) and the lower reaches of smaller tributaries (east fork Sweetwater and Rock Creek).

Due to their confined nature and typically large substrate size, MC channels are not considered very responsive to changing inputs. They have low responsiveness to LWD and fine sediments and moderate responsiveness to coarse sediments and peak flows. These channels are often relatively stable, but may benefit most from riparian re-vegetation and livestock exclusions.

Moderately Steep, Narrow Valley (MV)

MV channels are straight, moderately steep, and confined by adjacent moderate to steep slopes. Minimal flood plain development generally occurs, and these reaches are typically transport reaches for fine and coarse sediments. Substrates range from small cobble to bedrock, and bedrock steps and boulder substrates may be common. In the Lapwai Creek watershed, MV channel types were identified in the upper-central portions of most perennial streams, including all main tributaries.

The responsiveness of these channels is limited by gradient and confinement, and is low for changes in fine sediment and moderate for changes in LWD, coarse sediment, and peak flows. These channels are typically stable even though subjected to relatively high energy, and enhancement efforts are best directed at riparian vegetation and livestock exclusion.

Moderate Gradient Headwater (MH)

MH channels are common in basaltic plateaus and generally occur only in headwater areas, often above the anadromous fish distribution zone. They are similar to LC channels with confined straight channels of relatively low gradient. As headwater segments, small drainage areas, limited sediment supply zones, and low stream power typify MH habitats. In the Lapwai Creek watershed, MH channels almost exclusively represent first- and second-order ephemeral stream channels.

MH channel responsiveness to changes in LWD, fine sediment, and peak flows is moderate, ranging from moderate to high for coarse sediments. Due to their location in the watershed, restoration of these channels provides little direct benefit to fish habitat although riparian vegetation and stream bank protection may reduce temperatures and sediment in downstream segments. However, because MH channels in the Lapwai Creek watershed are almost exclusively in ephemeral stream segments that flow primarily during spring runoff, temperature benefits will likely be minimal.

Steep Narrow Valley (SV) and Very Steep Headwater Headwater (VH)

These two channel types are very similar in nature, although VH channels (> 16% slope) are steeper than SV channels (8–

16% slope). Both are generally found in headwaters and on steep side slopes to larger streams; this is true in the Lapwai Creek system where SV and VH channels typically represent steep first-order ephemeral stream segments throughout the watershed. Channels are highly confined, single, and relatively straight.
The magnitude of channel response in these CHTs is low, limited by high gradient and bedrock substrates. SV and VH channels are often source areas for sediment and/or wood supplied to downstream reaches; potential enhancement efforts are best centered around these issues.

Summary

- LC streams generally occur in the lower mainstem reaches of Lapwai, Mission, and Sweetwater Creeks. Primary management action should be livestock access control.

- LM channels are limited in their occurrence to one segment at the mouth of Tom Beall Creek.

- MM channels were defined in the lower tributaries to Lapwai Creek (Tom Beall Creek and Garden Gulch) and in one low gradient reach of Lapwai Creek upstream from Culdesac. Primary management action should focus on bank stabilization efforts in non-forested areas.

- MC channels occur in the central mainstem portions of major tributaries (Lapwai, Mission, and Sweetwater Creeks) and the lower reaches of smaller tributaries (east fork Sweetwater and Rock Creek). Primary management action should be livestock access control.

- MV channel types were identified in the upper-central portions of most perennial streams, including all main tributaries. Primary management action should be livestock access control.

- MH stream channels almost exclusively represent first- and second-order ephemeral stream channels. Primary management action should be livestock access control.

- VH and SV channels typically represent steep first-order ephemeral stream segments throughout the watershed. Primary management action should to protect and maintain existing riparian vegetation.

6 - HYDROLOGY AND WATER USE

Hydrology plays an important function in supporting aquatic biota and other stream uses. Natural factors influencing the hydrograph include the size and topography of the watershed, amount, form, and distribution of precipitation, soil type, climate, elevation, and groundwater characteristics. Changes in land cover and land use related to urbanization, forestry, agriculture, and roading can substantially alter runoff patterns across a watershed. Alterations to natural hydrologic regimes often lead to increased peak flows and reductions in low flows that may impact water temperature and sediment transport and deposition patterns. These factors may combine to negatively impact aquatic biota and other beneficial uses.

Methods

Methods used to assess hydrological regimes in the Lapwai watershed follow those presented in the OWAM. Exceptions exist in the *water use* section, the *hydrologic characterization* section, and the *assessment of forest and rural roads* section, in which alternative approaches were applied. Methods used, as they differ from the OWAM, are discussed below.

Hydrology

Hydrologic Characterization

Mean annual precipitation within the Lapwai Creek watershed ranges from approximately 16 inches in the lowest portions of the drainage to 25 inches in the headwaters areas of Webb, Mission, and Lapwai Creeks (refer to Figure 4). Approximately 30% of the Lapwai Creek watershed is dominated by spring snowmelt runoff patterns, with the remaining 70% subject to rain-on-snow events during the winter and spring. Differences in spring runoff patterns generally follow the watershed division formed by the escarpment, with spring snowmelt patterns in the higher elevations and rain-on-snow potential in the lower elevations (refer to Figure 5).

Two storage reservoirs are located in the watershed; both have seasonal impacts on downstream water availability. Created on upper Lapwai Creek in 1910, Winchester Lake has a surface area of approximately 100 acres and drains approximately 7,800 acres and is located within Winchester Lake State Park (Winchester Lake Watershed Advisory Group 1999). The Soldiers Meadows reservoir covers approximately 124 surface acres in the headwaters of Webb Creek. Water availability within the Lapwai watershed is also influenced by diversions from both Webb and Sweetwater Creeks for storage outside the watershed in Mann's Lake by the Lewiston Orchards Irrigation District (LOID).

Annual peak flow information has been recorded for Lapwai Creek for water years 1975 through 1998 near the town of Lapwai, Idaho (USGS gaging station #13342450). This is the only gaging station located within the Lapwai Creek watershed.

Annual peak flows in Lapwai Creek have ranged from 71 cfs in water year 1992 to 5,010 cfs during water year 1996 (Table 7). The average annual peak flow for the same period is 1,199 cfs with a standard deviation nearly equal to the average (1,176), illustrating the highly variable nature of annual flows realized in the Lapwai Creek watershed. For individual water years, peak flow timing varied from December 1, 1976 through May 29, 1990, illustrating the variability in runoff timing as well as amount within the Lapwai Creek watershed.

Idaho Department of Fish and Game et al. (1994) modeled historic (natural) versus current peak discharge patterns for the Mission/Lapwai Creek drainages. The model estimated a 267% increase in the 10-year 24-hour storm peak discharge, ranging from 1,800 cfs under natural land cover conditions to 6,600 cfs under current land cover conditions. These numbers appear speculative since the maximum peak flow recorded near the mouth of Lapwai Creek since 1975 is 5,010 cfs (Feb. 9, 1996; USGS gage #13342450).

In 1998 the USGS released a report wherein monthly and annual discharge were modeled for over 1,000 subwatersheds within the Salmon and Clearwater subbasins, including those within the Lapwai Creek system (Lipscomb 1998). Information from this report is presented in Figure 10 for mean annual discharge and mean monthly discharge during both high (April) and low (August) flow periods. Subwatershed delineations used by Lipscomb (1998) are roughly comparable to those used in this assessment, and the data provide a reasonable picture of discharge patterns for general hydrologic characterization within the context of this assessment.

Table 7. Peak flows by water year recorded for Lapwai Creek near Lapwai, Idaho (USGS gaging station #13342450).

Water Year	Peak Flow (cfs)	Date of Peak	Recurrence Interval (yrs)
1975	752	5/12/75	1.9
1976	2,200	12/1/75	6.5
1977	294	4/18/77	1.2
1978	925	12/14/77	2.4
1979	1,910	5/5/79	4.3
1980	984	5/26/80	2.9
1981	460	2/16/81	1.3
1982	2,050	2/16/82	5.2
1983	478	3/14/83	1.4
1984	962	3/21/84	2.6
1985	1,100	4/2/85	3.3
1986	3,380	2/23/86	13.0
1987	335	3/6/87	1.2
1988	178	4/3/88	1.1
1989	1,160	3/11/89	3.7
1990	900	5/29/90	2.2
1991	716	5/19/91	1.7
1992	71	12/7/91	1.0
1993	760	5/4/93	2.0
1994	252	3/2/94	1.1
1995	521	5/12/95	1.4
1996	5,010	2/9/96	26.0
1997	3,190	1/1/97	8.7
1998	700	5/26/98	1.6
1999	698	3/26/99	1.5
Average	**1,199**		

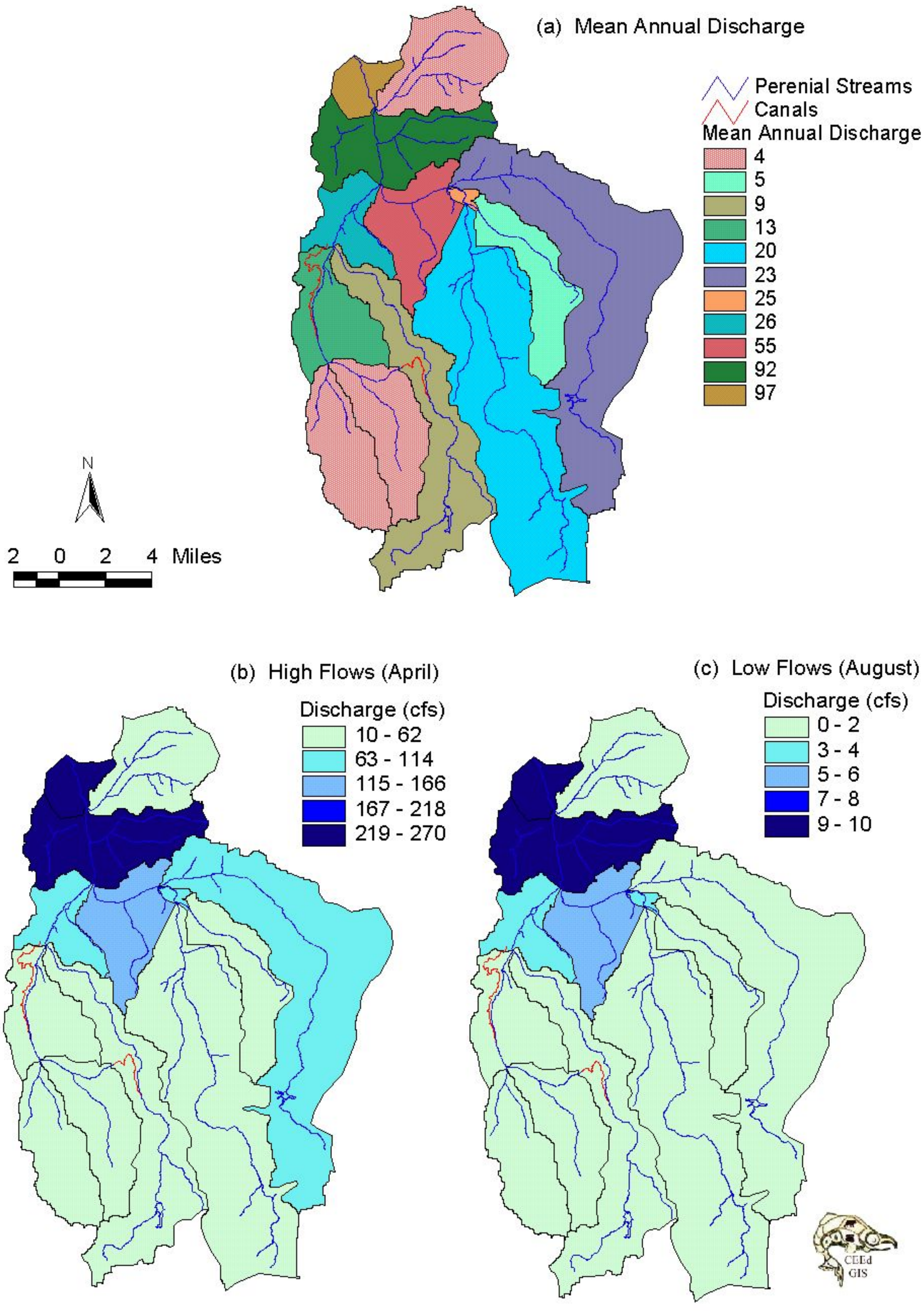

Figure 10. Comparison of mean annual, high, and low discharge (cfs) for subwatersheds within the Lapwai Creek watershed. Data and subwatershed delineations taken from Lipscomb (1998)

Note: In the following 2 paragraphs, references to subwatersheds will utilize information taken from Lipscomb (1998) and presented in Figure 10. These subwatershed delineations are inconsistent with those used throughout the remainder of this assessment.

Estimates of mean annual discharge vary dramatically across subwatersheds, from 97 cfs at the mouth of Lapwai Creek to as little as 4 cfs in subwatersheds encompassing Tom Beall and the headwaters of Sweetwater Creek (refer to Figure 10a). Mean annual discharge estimates appear most directly tied to contributing drainage area, but may increase moving from west to east through the Lapwai Creek watershed as well. This pattern seems related to mean annual precipitation (refer to Figure 4) and elevation differences (refer to Figure 5), with higher elevation areas receiving more precipitation.

For characterization purposes, mean monthly discharge modeled by Lipscomb (1998) for April and August were selected to represent high and low flow periods, respectively (refer to Figure 10b-c). Predicted mean monthly flows during both high and low flow periods follow a similar distribution to mean annual discharge, with the lowest discharges occurring from Tom Beall Creek and the Sweetwater Creek headwaters. Discharge appears most directly tied to contributing drainage area. Predicted low flows during August range from 0 to 10 cfs, whereas predicted high flows ranged from 10 to 270 cfs during April. This data illustrates the highly variable nature of annual flows within the watershed, which is commonly cited by other authors (Morrison-Maierle, Inc. 1977; Fuller et al. 1985; Cates 1981; Idaho Fish and Game et al. 1994; Nez Perce Soil and Water Conservation District 1998). These results lend further support to the validity of using Lipscomb's (1998) modeled data for hydrologic characterization.

Land Use

Identifying the location of land use activities that have the potential to significantly impact hydrology in the watershed will permit the targeting of areas for more thorough hydrologic analyses.

Forestry

Forestry practices have substantial influences on the natural hydrograph under certain conditions. Removal of forest canopy from extensive areas within a watershed may result in increased runoff magnitude resulting from rain-on-snow events; it has been shown to produce increased spring snowmelt peak flows in the Rocky Mountains (Troendle and King 1985, cited in Watershed Professionals Network 1999). Timber harvest primarily influences hydrology by altering the distribution of precipitation that reaches the ground, amount intercepted by foliage, and water storage capacity of local soils (Meehan 1991).

Methodologies described in the OWAM were used to assess forestry impacts to hydrology for individual subwatersheds within the Lapwai Creek project area. In subwatersheds where rain-on-snow patterns affect more than 25% of the land area, the Watershed Professionals Network (1999) suggests using crown closure characteristics and percent area in rain-on-snow areas to assess the potential for hydrology impacts from forestry activities. The OWAM does not provide nor suggest a method for assessing potential hydrologic impacts of timber harvest activities in subwatersheds where more than 75% of the area is dominated by spring snowmelt runoff patterns. Within the Lapwai Creek watershed, this situation applies to the upper Mission Creek and upper Webb Creek subwatersheds that have only 0 and 10% of the subwatershed, respectively, below the snowmelt-dominated elevation zone (Table 8).

The OWAM (Watershed Professionals Network 1999) defines the potential for timber harvest impacts for areas where tree density (% canopy cover) is reduced substantially relative to historical conditions. Although data are limited on historical vegetative condition and distribution within the Lapwai Creek watershed, sufficient information was available to imply the distributions of potentially forested and non-forested areas at the subwatershed scale. Timber harvest does not appear to have substantially altered the hydrologic function of any individual subwatershed within the Lapwai Creek watershed.

Based on the analysis presented in Table 8, the potential for peak flow enhancement due solely to timber harvest is low in all subwatersheds for which a determination could be made (11 of 13). Broad descriptions of historical vegetative communities provided by Black et al. (1997) suggest the historical distribution of forested areas within the Lapwai Creek watershed has not been significantly altered as does information presented in Figure 7. Current land use and vegetative data (refer to Figure 8; Table 8) indicate that existing forested areas generally maintain sufficient canopy closure to prevent substantial risks of peak flow enhancement during rain-on-snow events.

No determination on hydrologic impacts of timber harvest could be reached for the upper Webb Creek and upper Mission Creek subwatersheds because they are dominated by spring snowmelt patterns as opposed to potential rain-on-snow. However, land use mapping of these subwatersheds indicates they are extensively timbered (refer to Table 8) and maintain relatively high canopy closure (> 25%). This suggests that any substantial hydrologic impacts based solely on timber harvest are also unlikely in these subwatersheds.

Table 8. Potential risk of peak flow enhancement due to forestry activities for each subwatershed within the Lapwai Creek watershed.

Subwatershed	Historic Crown Closure in R-on-S (%)[1]	Percent of Subwatershed in R-on-S (%)	% of R-on-S areas with < 30% Crown closure (%)[2]	% of R-on-S areas with < 40% Crown closure (%)[3]	Flow Enhancement Risk of Peak (Potential/Low/ Unknown)
Tom Beall	< 30	100	98.9	99.2	Low
Lower Lapwai	< 30	100	93.2	94.6	Low
Middle Lapwai	< 30	100	66.4	73.2	Low
Upper Lapwai	< 30	38	24.8	27.4	Low
Lower Sweetwater	< 30	100	94.9	95.9	Low
Middle Sweetwater	< 30	99	94.2	95.2	Low
Upper Sweetwater	Unknown	51	13.7	21.1	Low
Lower Webb	< 30	100	63.4	70.8	Low
Upper Webb	Unknown	10	-1.0	1.2	Unknown
Lower Mission	< 30	82	44.2	51.7	Low
Middle Mission	Unknown	29	-1.8	4.5	Low
Upper Mission	Unknown	0	0.0	0.0	Unknown
Rock Creek	< 50	89	64.8	69.6	Low

[1]Estimated based on information illustrated in Figure 7 and statements by Black et al. 1997
[2]Estimated as percent area with < 40% closure-0.25* remainder of subwatershed area
[3]Obtained from Idaho GAP Analysis program, University of Idaho

Agricultural and Rangelands

Summarization of agricultural practices, cropping, and land use information by subwatershed was provided by the Natural Resource Conservation Service in Lewiston, Idaho (Table 9). Due to differing crop rotations and land use practices associated with each crop, the summaries provided are coarse in scale and intended to capture the general characteristics associated with agricultural land uses in each subwatershed. These summaries are not intended for use at smaller scales, and do not necessarily represent all land practices in use within a given subwatershed.

Screening for hydrologic impacts of agricultural and rangelands was conducted according to procedures described in the OWAM. The process consisted of grouping subwatersheds according to their hydrologic soil group (HSG) characteristics, a soil classification method used to describe the minimum rate of infiltration obtained for bare soil after prolonged wetting. Three analysis groups were defined for which relative composition of HSG's were similar among subwatersheds (Table 10). Analysis groups were characterized as 1) predominantly comprised of soils in the B hydrologic group (moderate infiltration rates when thoroughly wetted – low runoff potential), 2) somewhat equally comprised of B and C hydrologic groups (C HSG's maintain slow infiltration rates when thoroughly wetted), and 3) containing a substantive amount (> 10%) of soil in the D hydrologic group (D HSG's have a very low infiltration rate when thoroughly wetted and high runoff potential). All of the subwatersheds with substantive amounts of soils with D hydrologic groups were predominantly forested and therefore not assessed for hydrologic impacts related to agricultural practices.

To estimate the background hydrologic condition for agricultural lands, historic cover types were assumed to consist of grasslands with continuous forage available. The condition of historic grasslands was assumed fair, consisting of 50-75% groundcover. The assumption of cover type was based on limited descriptions of historic vegetation discussed previously (refer to pp. 17-18).

Localized rainfall information and calculated current and assumed historic hydrologic status of agricultural lands were then used to estimate relative hydrologic impacts related to agricultural practices. The Tom Beall and Middle Sweetwater subwatersheds contained the highest percentages of agricultural land within analysis groups 1 and 2, respectively (refer to Table 2 and Table 10). As an initial screening procedure, these two subwatersheds were assessed assuming that if hydrologic impacts were low, similar results would be found in the remaining subwatersheds with similar soil characteristics and less agricultural use.

Table 9. Cropping systems characteristics of subwatersheds. Only those with $\geq$ 8% of their total area defined as agricultural are shown (L. Rasmussen, Nez Perce County Natural Resources Service, personal communication August 2000).

6th Field HUC	Avg. Crop Rotation (Yrs.)	Crops Rotated	Crop Residue Value (overwinter)	Contour Practices	Tile Use (Approx)
Tom Beall	2	[1]wheat or barley/	60-70%	Poor-Fair	Rare
		summer fallow	10-20%		
Lower Lapwai	2	[1]wheat or barley/	60-70%	Poor-Fair	Rare
		summer fallow	10-20%		
Middle Lapwai	2 (60% of HUC)	wheat or barley/	60-70% (grains)	Fair-Good	10,000 LF
		[2]either peas, lentils, garbanzo beans, canola or buckwheat	10-15% (pea/lentil/bean)		
	3 (40% of HUC)	winter cereal grain/	25-60% (canola)		
		spring cereal grain/	30-50% (buckwheat)		
		[2]either peas, lentils, garbanzo beans, canola or buckwheat			
Lower Sweetwater	2 (60% of HUC)	wheat or barley/	60-70% (grains)	Fair-Good	Rare
		[2]either peas, lentils, garbanzo beans, canola or buckwheat	10-15% (pea/lentil/bean)		
	3 (40% of HUC)	winter cereal grain/	25-60% (canola)		
		spring cereal grain/	30-50% (buckwheat)		
		[2]either peas, lentils, garbanzo beans, canola or buckwheat			
Middle Sweetwater	2 (60% of HUC)	wheat or barley/	60-70% (grains)	Fair-Good	3,000 LF
		[2]either peas, lentils, garbanzo beans, canola or buckwheat	10-15% (pea/lentil/bean)		
	3 (40% of HUC)	winter cereal grain/	25-60% (canola)		
		spring cereal grain/	30-50% (buckwheat)		
		[2]either peas, lentils, garbanzo beans, canola or buckwheat			
Lower Webb	2 (60% of HUC)	wheat or barley/	60-70% (grains)	Fair-Good	800 LF
		[2]either peas, lentils, garbanzo beans, canola or buckwheat	10-15% (pea/lentil/bean)		
	3 (40% of HUC)	winter cereal grain/	25-60% (canola)		
		spring cereal grain/	30-50% (buckwheat)		
		[2]either peas, lentils, garbanzo beans, canola or buckwheat			
Lower Mission	2 (60% of HUC)	wheat or barley/	60-70% (grains)	Fair-Good	Rare
		[2]either peas, lentils, garbanzo beans, canola or buckwheat	10-15% (pea/lentil/bean)		
	3 (40% of HUC)	winter cereal grain/	25-60% (canola)		
		spring cereal grain/	30-50% (buckwheat)		
		[2]either peas, lentils, garbanzo beans, canola or buckwheat			
Rock Creek	2 (60% of HUC)	wheat or barley/	60-70% (grains)	Fair-Good	Rare
		[2]either peas, lentils, garbanzo beans, canola or buckwheat	10-15% (pea/lentil/bean)		
	3 (40% of HUC)	winter cereal grain/	25-60% (canola)		
		spring cereal grain/	30-50% (buckwheat)		
		[2]either peas, lentils, garbanzo beans, canola or buckwheat			

Table 10. HSG characteristics of individual subwatersheds within the Lapwai Creek watershed showing similar groupings used in hydrologic analyses

Subwatershed	**Ag/Range Acres**	**Percent of Ag/Range soils by HSG**				**Analysis Groups**
		A	**B**	**C**	**D**	
Tom Beall	11,027	0	77	23	0	1
Lower Lapwai	24,550	0	82	17	1	1
Middle Lapwai	19,496	0	31	61	7	2
Upper Lapwai	6,191	0	25	63	11	3
Lower Sweetwater	4,555	0	72	25	3	1
Middle Sweetwater	9,832	0	49	49	2	2
Upper Sweetwater	6,640	0	43	53	1	2
Lower Webb	3,452	0	32	68	1	2
Upper Webb	1,641	0	26	55	18	3
Lower Mission	9,777	0	63	34	3	1
Middle Mission	3,688	0	32	57	10	3
Upper Mission	4,153	0	16	68	16	3
Rock Creek	7,340	0	41	56	3	2
Total Watershed	**112,342**	**0**	**53**	**42**	**4**	

Table 11 illustrates the results of analyses directed at assessing agricultural impacts to hydrology. The change from background runoff conditions for a two-year 24-hour storm event was 0.20 and 0.02 inches, respectively for the Tom Beall and Middle Sweetwater subwatersheds. According to the OWAM manual, changes of less than 0.25 inches represent a low relative potential for peak flow enhancement. Based on these results, the relative impacts of agricultural practices throughout other subwatersheds (with lesser percentages of agricultural land use) are assumed low.

The analysis shows that relative impacts of agricultural land uses are greater in those subwatersheds with higher percentages of B hydrologic soil groups (HSG's) (refer to Table 10). B-type HSG's occur in the Tom Beall, Lower Lapwai, Lower Sweetwater, and Lower Mission subwatersheds (refer to Table 10). Localized hydrologic impacts of agricultural practices may exist in these subwatersheds, as the calculated change for Tom Beall (0.20) was close to the cutoff (0.25 inches) value, indicative of a "moderate" relative potential for peak flow enhancement (Watershed Professionals Network 1999). However, since the values presented by the OWAM were developed for eastern Oregon, they may not be directly applicable to the Lapwai Creek watershed.

Table 11. Calculation summary for agricultural impacts to hydrology for representative subwatersheds within the Lapwai Creek watershed.

Sub-watershed	HSG (%)	Cover Type / Treatment (Rotation yrs.)	Hydrologic Condition	Curve Number	Bkgrnd. Curve Number	2 Yr. – 24 hr. Precip.	Runoff Depth (Current)	Runoff Depth (Bkgrnd.)	Change from Bkgrnd.
Tom Beall	B (77)	Grains	Fair	73.5	69	1.3	0.08	0.045	0.035
		Fallow	Poor	85	69	1.3	0.33	0.045	0.285
		Bare Soil	----	86	69	1.3	0.33	0.045	0.285
	C (23)	Grains	Fair	80.5	79	1.3	0.20	0.19	0.01
		Fallow	Poor	90	79	1.3	0.53	0.19	0.34
		Bare Soil	----	91	79	1.3	0.54	0.19	0.35
	Avg. B/C	Grains	Fair						0.028
		Fallow	Poor						0.286
		Bare Soil	----						0.289
							Subwatershed Avg.		**0.20**
Middle Sweetwater	B (50)	Grain (2)	Good	72.5	69	1.3	0.075	0.045	0.03
		Legumes (2)	Fair	72	69	1.3	0.075	0.045	0.03
		Grain (3)	Good	72.5	69	1.3	0.075	0.045	0.03
		Grain (3)	Good	72.5	69	1.3	0.075	0.045	0.03
		Legume (3)	Fair	72	69	1.3	0.075	0.045	0.03
	C (50)	Grain (2)	Good	80.5	79	1.3	0.20	0.19	0.01
		Legumes (2)	Fair	80.5	79	1.3	0.20	0.19	0.01
		Grain (3)	Good	80.5	79	1.3	0.20	0.19	0.01
		Grain (3)	Good	80.5	79	1.3	0.20	0.19	0.01
		Legume (3)	Fair	80.5	79	1.3	0.20	0.19	0.01
							Subwatershed Avg.		**0.02**

Forest and Rural Roads

The OWAM methodology used to analyze the potential hydrological impacts from forest and rural roads required a sufficiently higher resolution set of data than were available for this assessment. The analysis method suggested in OWAM acknowledges a difference in construction methods of forest and rural roads, but does not allow for differentiation of road types within a single land use category. For example, a majority of the roads that occur in forested landscapes in the Lapwai drainage are relatively wide, gravel-surfaced roads that extend into the agricultural landscape. By OWAM standards these roads are classified as "rural roads", even though they occur in a forested landscape.

The OWAM methods were thus modified to provide a more accurate description of possible roading impacts on hydrology by allowing for the existence of multiple road types ("forest/rural") within a single land use category. This new methodology was consistent with OWAM in that it examined the percent of land area covered by roads. Lacking comprehensive data on road characteristics, standard road widths of 25 feet for forest roads and 35 feet for rural roads were assumed (Watershed Professionals Network 1999, Form H-6). The linear length of all roads present in each subwatershed was multiplied by respective widths and then divided by the subwatershed area to arrive at an estimate of the percentage of each subwatershed physically covered by roads.

Without comprehensive data on road composition (construction materials/ methods) or condition (road surface type), road types were assigned assuming the impacts of roading to hydrology are dependent on road density as well as road design. "Forest" roads are typically narrower, less maintained (dirt or lightly graveled vs. more heavily graveled or paved), more sinuous, and on steeper slopes than "rural" roads.

According to guidelines suggested by the Watershed Professionals Network (1999), roaded areas comprising 4%, 4–8%, and greater than 8% of a watershed represent low, moderate, and high risk, respectively, for potential hydrologic impacts caused by roads. Road surface area does not exceed 3% of the total surface area within any subwatershed. As a result, the potential for peak flow enhancement is considered low.

Slightly less than 1% (0.94%) of the total land area of the Lapwai Creek watershed is encompassed by forest roads, which extend approximately 536 linear miles. Mileage of forest roads in individual subwatersheds ranges from less than one to 138 miles, with roaded areas comprising between zero and 2.5% of individual subwatersheds. Forest roads are most abundant in upper Webb and Sweetwater Creeks, comprising approximately 2.5% of each subwatershed (Table 12). The land area covered by forest roads in central Mission Creek is approximately 1.7%, also above the watershed average.

Table 12. Summary of land area covered by forest and rural roads in the Lapwai Creek watershed.

Subwatershed	Area (sq. mi)	Linear Distance Forest Roads (mi.)	Percent Area in Forest Roads	Linear Distance Rural Roads (mi.)	Percent Area in Rural Roads	Linear Distance All Roads (mi.)	Total Percent Area Roaded	Relative Potential for Peak Flow Enhancement
Tom Beall	17.45	12.25	0.33	18.34	0.69	30.59	1.02	Low
Lower Lapwai	40.04	24.16	0.28	46.98	0.77	71.14	1.06	Low
Middle Lapwai	40.91	38.35	0.44	54.46	0.88	92.80	1.32	Low
Upper Lapwai	17.21	21.75	0.59	27.39	1.05	49.14	1.64	Low
Lower Sweetwater	7.28	7.38	0.48	11.45	1.04	18.83	1.51	Low
Middle Sweetwater	15.53	23.49	0.71	9.94	0.42	33.43	1.13	Low
Upper Sweetwater	26.44	137.67	2.45	21.9	0.55	159.57	2.99	Low
Lower Webb	6.19	0.09	0.01	0.99	0.11	1.08	0.11	Low
Upper Webb	22.78	120.66	2.49	10.08	0.29	130.74	2.78	Low
Lower Mission	23.32	40.76	0.82	18.36	0.52	59.12	1.34	Low
Middle Mission	18.41	65.84	1.68	2.96	0.11	68.80	1.79	Low
Upper Mission	16.34	25.86	0.74	11.69	0.47	37.55	1.22	Low
Rock Creek	15.30	17.93	0.55	18.03	0.78	35.96	1.33	Low
Total Watershed	**267.19**	**536.18**	**0.94**	**252.59**	**0.62**	**788.77**	**1.34**	

Estimated percent land area covered by rural roads is 0.62% for the entire Lapwai Creek watershed, ranging from 0.1 to 1.1% in individual subwatersheds. Coverage of rural roads is greatest in subwatersheds containing the towns of Lapwai, Culdesac, Winchester, and Sweetwater. Total roaded area accounts for approximately 1.6% of the Lapwai Creek watershed, ranging in individual subwatersheds from 0.1 to 3.0%. Only the lower Webb subwatershed has a percentage of roaded area less than one, and only the upper Webb and upper Sweetwater have percentages greater than two. Based on the total percent roaded area (forest + rural), the relative potential for peak flow enhancement based on roads is low for all subwatersheds. This analysis applies to the subwatershed scale, and is unlikely to be true at a finer scale.

When roaded area is examined by land section, 15 square miles of the Lapwai Creek watershed have moderate potential for hydrologic impacts due to roading (4-8% of surface area is comprised of roads). Areas of increased road density are generally associated with forest roads in the upper Webb and Sweetwater Creek subwatersheds and the towns of Lapwai and Culdesac (Figure 11). The percentage of land area as roads in these sections ranges from 4.0 to 5.9, suggesting that even at a fine scale no areas within the watershed have a high potential for hydrologic impacts due to roading alone.

Urban and Residential

Two methods were proposed within OWAM for assessing potential peak flow enhancement due to urban and residential development (Watershed Professionals Network 1999). Method one relies on estimating total impervious area (TIA) for each subwatershed based on the percentage of urban or rural residential land use, dominant land use within these areas, and percentage of impervious area based on tabled values. Method two applies more specifically to urbanized (rather than rural residential) areas, drawing a link between urban road density and percent imperviousness within a subwatershed. Due to the predominance of rural residential as opposed to urban land use throughout the Lapwai Creek watershed, Method one was chosen as the most appropriate method.

Urban and rural residential land use poses only a low potential for peak flow enhancement in the Lapwai Creek watershed (Table 13). Moderate or high risk for potential peak flow enhancement is assigned only if the TIA exceeds 5%. Table 13 illustrates that no individual subwatershed contains more than 4.2% urban/rural residential land use. Percent TIA is lower than percent urban/rural residential use since even highly urbanized areas are not entirely impervious. This analysis does not necessarily illustrate that urban areas within the watershed have no localized impacts to hydrology, but rather that urban and residential land uses pose only a low risk of peak flow enhancement at the watershed or subwatershed scale due to limited extent.

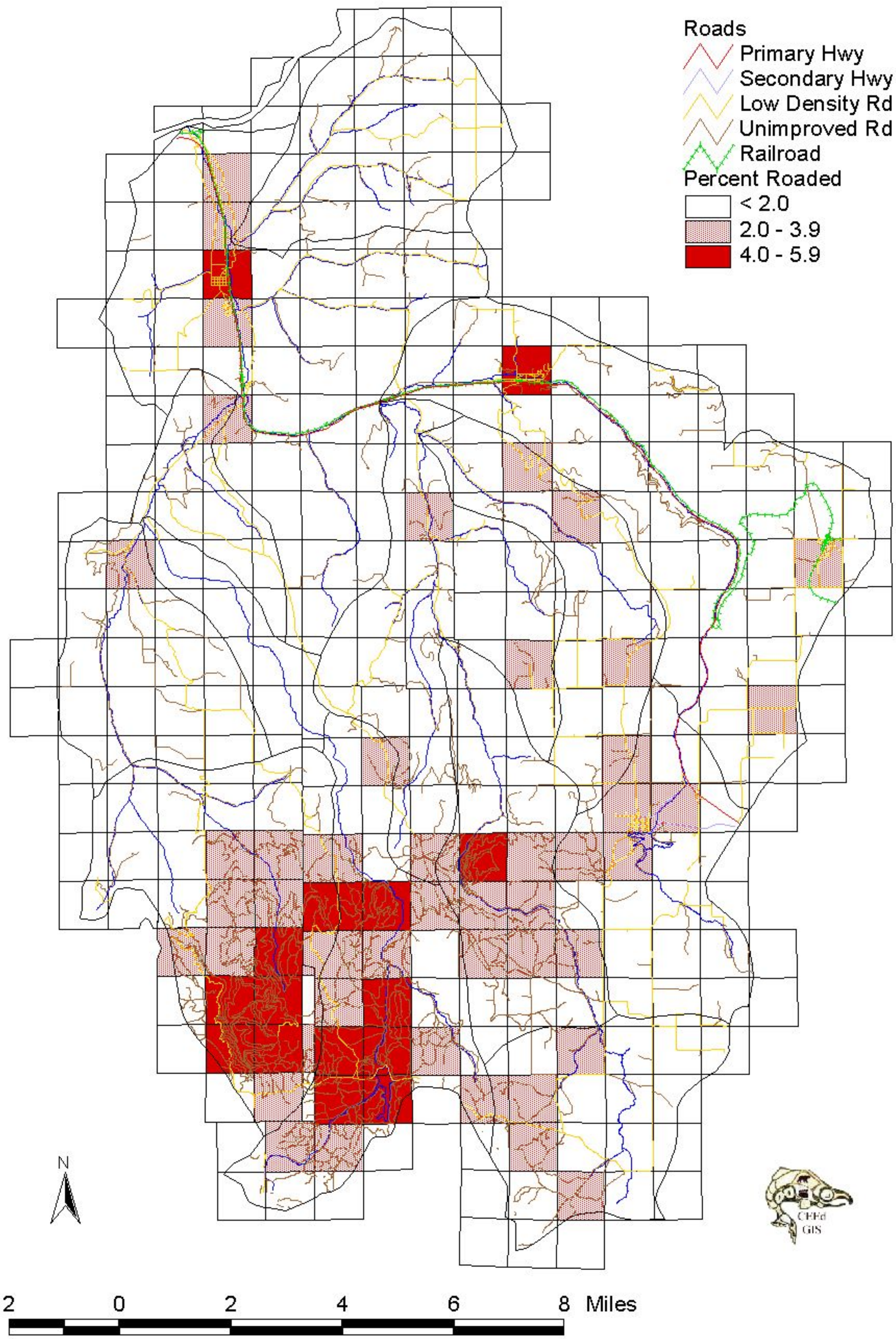

Figure 11. Percent of area roaded for individual land sections within the Lapwai Creek watershed

Table 13. Summary of imperviousness associated with urban and rural residential land uses within the Lapwai Creek watershed.

Subwatershed	Percent Urban/ Rural Residential	Urban Percent Impervious (Range)	Potential Percent Impervious (Range)	Estimated Percent Impervious	Relative Potential for Peak Flow Enhancement
Tom Beall	1.3	12-85	0.16-1.11	0.64	Low
Lower Lapwai	4.2	12-85	0.50-3.57	1.20	Low
Middle Lapwai	2.7	12-85	0.32-2.30	1.35	Low
Upper Lapwai	1.4	12-85	0.17-1.19	0.70	Low
Lower Sweetwater	2.3	12-85	0.28-1.96	1.15	Low
Middle Sweetwater	0.3	12-85	0.04-0.26	0.15	Low
Upper Sweetwater	0.3	12-85	0.04-0.26	0.15	Low
Lower Webb	0.3	12-85	0.04-0.26	0.15	Low
Upper Webb	0.1	12-85	0.01-0.09	0.05	Low
Lower Mission	2.1	12-85	0.25-1.79	1.05	Low
Middle Mission	0.3	12-85	0.04-0.26	0.15	Low
Upper Mission	0.0	12-85	0.00	0.00	Low
Rock Creek	1.7	12-85	0.20-1.45	0.85	Low
Total Watershed	**1.6**	**12-85**	**0.19-1.36**	**0.80**	

Water Use

No information is available on actual rather than permitted and potential water use within Idaho. Data regarding potential water use was derived from IDWR records on water rights and adjudication claims filed under the Snake River Basin Adjudication (SRBA) process, a statutorily-created lawsuit that required the inventory of all surface and ground water rights in a given stream system. Since water rights and adjudication data may lead to erroneous information regarding current water use if examined separately, both databases were integrated to produce the most accurate picture of potential current water use. The decision to integrate the two databases was made based on consultation with IDWR Water Rights Supervisor Shelly Keen (personal communication May, 2000).

The IDWR water rights database underestimates the number of rights existing prior to 1963 for groundwater and 1971 for surface water, when licensing was formally required, because water rights existed prior to 1900. The database also fails to account for changes in water use over time, including abandoned or forfeited claims.

The adjudication claims data supplied by IDWR include only those claims to water rights existing prior to November 19, 1987 that were filed with the courts as part of the SRBA. The database may include competing claims for the same water right resulting in potential over-allocation of water in some areas, although this was found to be uncommon. In contrast, numerous claims under the SRBA list a lower amount of water than that of the corresponding water right, suggesting that water use diminished over time or the amount licensed under the water right was less than that originally claimed or permitted. In these cases, it was assumed that current water use was best represented by the amount claimed under the SRBA rather than the amount listed in the water rights database.

To integrate information from both the water rights and adjudication claims databases supplied by IDWR, the following rules were applied:

1) Claims filed under the SRBA with illustrated beneficial uses represent real and legal water uses that may not be represented in the water rights database. Such rights may have been in place prior to the current permitting process (1963/1971) or do not require water rights permits under the current process (i.e., small domestic or groundwater uses). These claims are represented in the adjudication claims database where the letter "J" is indicated in the column titled "STG."
2) Water rights listed in the water rights database with priority dates prior to November 19, 1987 with no corresponding SRBA claim are considered abandoned.
3) Adjudication claims data best represents existing water uses for water rights filed prior to November 19, 1987. Adjudication claims data includes claims to legal non-licensed rights filed prior to 1963/1971 but omits abandoned water rights. Reductions in the amount of water claimed under the SRBA provide a more accurate depiction of current water use than information for corresponding water rights.
4) Water rights data is assumed to accurately represent water use associated with claims filed after November 19, 1987.

Water use for this assessment was summarized as maximum allowable use (MAU) by land section (square mile). MAU was determined by summing the maximum legal water use from all water rights or applicable adjudication claims within each section, and is presented in this report as the volume allowed in acre-feet per year (AFY). For example, approximately 724 AFY would be supplied by a source providing 1 cfs continually over the course of one year.

The amount of water available under a water right may be limited by either the rate (cfs) at which water may be drawn under the right, the volume (AFY) allowed to be taken, or both. For determining MAU, the maximum volume allowed (AFY) was compared with the volume that could be drawn under the maximum rate (cfs) limitations of the water right assuming a constant diversion rate throughout the allowable period of use. MAU was defined as the most limiting (minimum) of these two water use estimates. Where only one factor (rate or volume) limited water use under a particular water right or claim, that factor was used to estimate the MAU for that water right/claim.

Many water rights include numerous points of diversion or take, with no stipulation on how much water can or should be drawn from any single diversion point. Therefore, where water rights or claims have multiple sources included in multiple land sections, the entire amount claimed was included in the MAU for each section. This approach produces an accurate picture of MAU within any single section, but will overestimate the total water use within the watershed if sectional maxima are summed.

The USGS has modeled water availability for subwatersheds throughout the Clearwater subbasin, including those in the Lapwai Creek watershed (Lipscomb 1998) as part of the SRBA process. This modeling process allows for general comparison of water use with water availability for individual subwatersheds.

Water use in the Lapwai Creek watershed is driven primarily by surface water withdrawals that account for approximately 96.5% of the maximum allowable water use. By individual land section, maximum allowable surface water use ranges to over 53,000 AFY, whereas the maximum allowable groundwater use does not exceed 1,450 AFY (Table 14). If providedwith a constant year-round water supply, these volumes would require an annual average of approximately 73.5 cfs for surface water uses and 2 cfs for groundwater uses.

Table 14. Relative distribution and MAU for ground, surface, and total water use in the Lapwai Creek watershed.

	Groundwater Use	**Surface Water Use**	**Total Water Use**
# Land Sections w/Use	16	35	45
Avg. MAU by Section			
AFY	294	3,454	2,863
cfs equivalent*	0.4	4.8	4.0
Highest MAU Value			
AFY	1,448	53,224	53,224
cfs equivalent*	2.0	73.5	73.5
Lowest MAU Value			
AFY	5.4	0.7	0.7
cfs equivalent*	0.0	0.0	0.0

Groundwater use (maximum allowable) is scattered, but generally associated with subwatersheds along the mainstem of Lapwai Creek from its headwaters to its confluence with the Clearwater River (Figure 12). Groundwater use by section is typically less than 362 AFY, equivalent to 0.5 cfs delivered at a constant rate throughout the year. By land section, the greatest use of groundwater within the watershed is 1,448 AFY, equating to 2 cfs delivered at a constant rate year-round. The highest groundwater use within the watershed is associated with land sections associated with the town of Lapwai and mouth of Sweetwater Creek.

Surface water use primarily occurs in the central and western portions of the Lapwai Creek watershed, with only limited use in the upper Lapwai Creek subwatersheds (Figure 13). With the exceptions of upper Sweetwater and Webb Creeks, surface water MAU by land section is less than 1,448 AFY (2 cfs delivered at a constant rate year-round) throughout the Lapwai Creek watershed. The most substantial surface water withdrawals are associated with the Manns Lake irrigation canal, which draws from Webb and Sweetwater Creeks for use outside of the watershed by the LOID. Maximum allowable surface water use in land sections associated with these withdrawals is 19,464 and 53,224 AFY from Webb and Sweetwater Creeks, respectively (equating to approximately 27 and 74 cfs, respectively, under constant year-round diversion rates). Other areas in the headwaters of Webb and Sweetwater Creeks also have substantial surface water MAU, ranging from 14,479 to 15,204 AFY (20–21 cfs under constant flow). This applies to two land sections in upper Webb Creek with water rights associated with the Captain John Canal, which transfers irrigation water from Captain John Creek to Webb Creek for storage in Soldiers Meadows Reservoir. The Captain John Canal is a part of the LOID water supply system. The MAU under surface water rights near Soldiers Meadows Reservoir is 2,000 AFY or approximately 2.75 cfs under constant year-round diversion.

The LOID maintains water rights for over 95% of the total MAU within the Lapwai Creek watershed. As a municipal water supplier, the LOID maintains the ability to hold water rights for water in excess of the amount currently or historically used in order to accommodate future growth of the associated municipality. Consequently, the total amount of water used or diverted by the LOID at some points of diversion is considerably less than the amount for which water rights are held. For instance, LOID holds water rights for as much as 73.5 cfs at the Sweetwater diversion dam but maximal water use is limited by the capacity of the downstream canal system, which is between 38 and 42 cfs (A. Jensen, Jensen Engineering, personal communication July 14, 2000). All of the water used by the LOID from the Lapwai Creek watershed is associated with municipal irrigation purposes, with domestic water supplied through other sources.

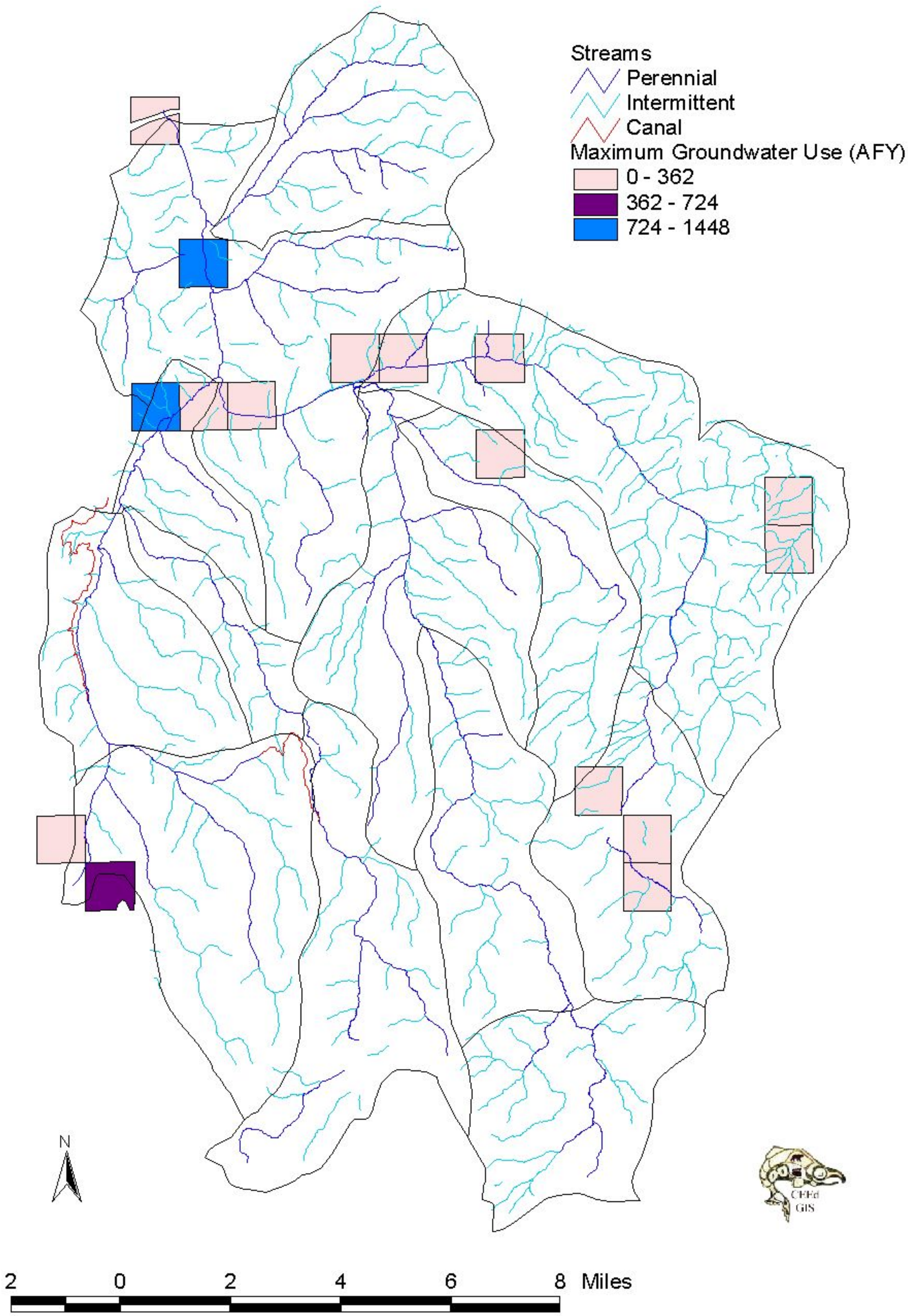

Figure 12. Maximum allowable use of groundwater by land section within the Lapwai Creek watershed.

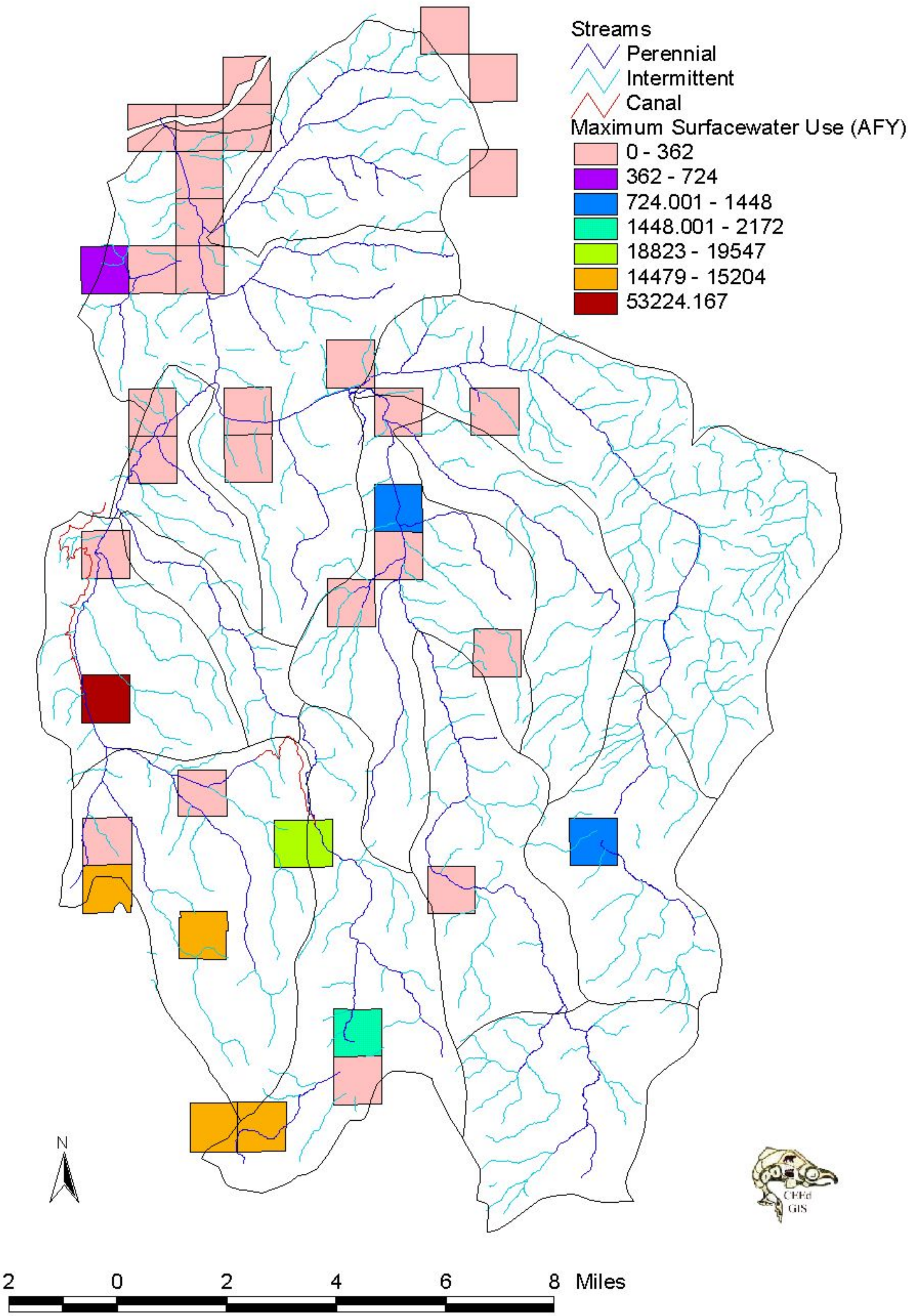

Figure 13. Maximum allowable use of surfacewater by land section within the Lapwai Creek watershed.

All water rights and claims within the Lapwai Creek watershed are currently involved in litigation under the SRBA process. Due to the pending litigation, any attempt to address potential changes to water use within the watershed would be pointless. However, Morrison Knudsen Corp. (1992) and Wyatt Engineering (1995) examined potential population growth of the Lewiston Orchards and associated water requirements for the LOID.

Summary

- 30% of the Lapwai Creek watershed is dominated by spring snowmelt runoff patterns, with the remaining 70% subject to rain-on-snow events

- water availability within the Lapwai watershed is influenced by Winchester and Soldier's Meadow storage reservoirs, and by diversions on both Webb and Sweetwater Creeks

- annual flows and peak flow timing in the Lapwai watershed and within individual subwatersheds are highly variable

- the potential for peak flow enhancement due solely to timber harvest is low in all subwatersheds except for Upper Webb and Upper Mission where it is unknown

- the potential for peak flow enhancement due solely to agricultural activities is low; subwatersheds with high percentages of B hydrologic soil groups represent those areas with the highest potential for peak flow enhancement resulting from agricultural activities. These areas are generally located in lower portions of the watershed

- the potential for peak flow enhancement due solely to forest and rural roads is low in all subwatersheds; highest densities of forest roads occur in upper Webb and Sweetwater Creeks, while highest densities of rural roads are greatest in subwatersheds containing the towns of Lapwai, Culdesac, Winchester, and Sweetwater

- the total impervious area created by urban and residential land uses pose only a low risk of peak flow enhancement at the watershed or subwatershed scale

- it was not possible to assess the effects of water use on flow enhancement due to pending water rights adjudication; surface water withdrawals account for approximately 96.5% of the maximum allowable water use and are primarily associated with the Manns Lake irrigation canal, which draws from Webb and Sweetwater Creeks for use outside of the watershed by the LOID.

7 - RIPARIAN AREAS AND WETLANDS

Riparian ecosystems characteristic of the canyon streams of the Snake and Clearwater Rivers have important habitat values because they provide wet areas in an otherwise dry landscape. A study by Black et al. (1997) suggests that true riparian communities during presettlement conditions were largely limited to the broad outwash plains along sections of the Snake and Clearwater Rivers. Communities included narrow gallery forests of plains cottonwood (*Populus deltoides*), quaking aspen (*P. tremuloides*), mountain maple (*Acer glabrum*), and red alder (*Alnus rubra*; Daubenmire 1942). This vegetation has been considerably altered over the last century through land use practices and water development.

Anecdotal accounts suggest that riparian vegetation in the Lapwai watershed during presettlement conditions consisted of cottonwood (*Populus spp.*), willow (*Salix spp.*), birch (*Betula spp.*), and alder. Historic estimates of multi-story vegetation along the mainstem Mission Creek are as high as 70% (Idaho Department of Fish and Game et al. 1994), while the current estimate is 52%.

Current riparian vegetation documented in Lapwai Creek includes black cottonwood (*Populus trichocarpa*), alder (*Alnus spp.*), dogwood (*Cornus spp.*), mock orange (*Philadelphus lewisii*), serviceberry (*Amelanchier spp.*), black hawthorn (*Cretaegus douglasii*), common chokecherry (*Prunus virginiana*), and bitter cherry (*Prunus emarginata*). Noxious weeds currently known to

occupy streamside corridors include yellow starthistle (*Centaurea solstitialis*), poison hemlock (*Conium maculatum*), scotch thistle (*Onopordum acanthium*), and spotted knapweed (*Centaurea maculosa*) (Bureau of Land Management 2000). These species are known to degrade wildlife habitat, choke streams and waterways, crowd out beneficial native plants, poison livestock and humans and foul recreation sites from use (Callihan and Miller 1997).

Streamside plant communities in the Lapwai watershed are roughly divided in half; grass/forb communities dominate the lower portion of the watershed, while the upper portion is dominated by woody vegetation. This division is coincident with a southwest to northeast trending fault, delimited by a 1,000' high escarpment (Soil Conservation Service et al. 1990). Generally, land uses in the Lapwai drainage also coincide with the fault line demarcation. There tends to be little difference in plant composition between perennial and ephemeral stream channel riparian borders with coniferous tree species and grass/shrub understory predominating. Exceptions include the greater incidence of crop species along ephemeral streams, and a dominance of coniferous forest at higher elevations along both stream types.

Land uses in the lower portion of the drainage include tilled agriculture and grazing while in the upper portion of the drainage forestry predominates. This division corresponds to the topography, climate, and geological characteristics of the respective locations. Additional anthropogenic modifications to riparian environments include extensive stream channelization (most notably in the lower portion of the subwatershed), roading, and urban encroachment into riparian areas.

The native vegetation in the higher elevations is grand fir (*Abies grandis*), Douglas fir, ponderosa pine (*Pinus ponderosa*), lodgepole pine (*Pinus contorta*) mallow ninebark (*Physocarpus malvaceus*), and snowberry (*Symphoricarpos Duhamel*), all of which have been cleared to some extent for cultivation (Soil Conservation Service et al. 1990). Potential native vegetation in the lower portions is bluebunch wheatgrass (*Agropyron spicatum*)/Idaho fescue (*Festuca idahoensis*), with pockets of ponderosa pine (Soil Conservation Service et al. 1990).

The interrelationship between riparian vegetation and fluvial processes dictates that the modification of one will likely affect the other. Riparian communities currently present in the Lapwai watershed reflect this interdependency. Areas that have been extensively channelized have correspondingly homogeneous streamside vegetation, whereas extensive conversion/removal of riparian vegetation has resulted in a flashy hydrograph or reduction in perennial flows.

Methods

It was not possible to follow all methods outlined in the OWAM to assess riparian and wetland conditions in the Lapwai watershed. The OWAM suggests using aerial photo interpretation and stream survey data to determine the type of vegetation present, the amount of disturbance in the riparian area, and the relative condition of streamside vegetation. The manual further specifies the use of National wetland inventory maps, aerial photos and/or soil survey maps to characterize wetland areas. Aerial photographs from a 1996 flight were used, but were generally not of sufficient resolution to provide an accurate interpretation of vegetation type and relative condition. The available of stream survey data was not current and not comprehensive. Wetland assessment was not possible due to the lack of current, comprehensive data.

Specific riparian characteristics of Lapwai Creek were evaluated using land cover data compiled at a two-hectare minimum mapping unit by the Idaho GAP using remote sensing techniques. These data were collected using the best methods available at the time; however, interpretation of the data is scale limited, and therefore warrants field verification of riparian conditions. Similar investigations are clearly needed for wetland areas.

A 100’ buffer on either side of the stream channel was assigned to analyze riparian characteristics. This area was assumed to accurately define the microsites associated with an active riparian zone and follows descriptions provided in Gregory (1991). The land cover types in the buffer zone were summarized by subwatershed, as was the percentage contribution of a particular cover type to the total buffer area. Cover types included non-plants such as rock, urban areas, and water, but these variables proved negligible in relation to the vegetative forms of cover. Wetland inventory data for the watershed was minimal. The Nez Perce Tribe Water Resources Department is currently conducting analyses of wetland areas.

The vegetation analysis was further stratified by streamflow characteristics; vegetation within 100 feet of perennial streams was examined independently from vegetation within 100 feet of ephemeral streams. Cover types were assigned to one of six groups to examine riparian function (Table 15).

Table 15. Classification of cover types used in analysis of riparian vegetation (cover types shown are those defined by the Idaho GAP analysis).

Coniferous	**Deciduous**	**Shrubs/ Brush**	**Grasses/ Forbs**	**Agri-cultural**	**Other**
Montane Parkland/ Subalpine Meadow	Needleleaf/ Broadleaf Riparian[1]	Warm Mesic Shrubs	Foothills Grassland	Agricultural	Urban
Lodgepole Pine	Curlleaf Mountain Mahogany	Shrub Dominated Riparian	Disturbed Grassland		Water
Ponderosa Pine			Graminoid or Forb-Dominated Riparian		Exposed Rock
Grand Fir					
Western Red Cedar					
Douglas-fir					
Mixed Mesic Forest					
Mixed Xeric Forest					
Doug.-fir/Grand Fir					
W. Red Cedar/Grand Fir Forest					
Needleleaf Dominated Riparian					
[1]Needleleaf/ Broadleaf Riparian					

[1]Because conifers are combined with deciduous trees, values occurring in this category were divided in half.

Riparian Vegetation Characteristics

Table 16, Figure 14, and Figure 15 provide the estimated percent a given plant community or other cover type contributes to the buffer area (100 feet on either side of the stream channel) within the Lapwai watershed.

Streamside vegetation along perennial channels is typically comprised of a combination of conifers, agricultural vegetation, grass/forbs, and shrub/brush communities. Coniferous vegetation (41%) is dominant. Ephemeral streams generally have vegetative communities similar to that of perennial streams, with the exception of agricultural foliage, which comprises a greater percentage (31%) of the total riparian area than grass/forbs (12%), shrub/brush (15%), and deciduous (3%) combined.

Table 16. Percent contribution of land cover to riparian areas occurring along perennial and ephemeral stream channels in the Lapwai watershed.

Lapwai Watershed	Stream Type	Percent Conifer	Percent Deciduous	Percent Shrubs/ Brush	Percent Grass/ Forbs	Percent Ag.	Percent Other
Tom Beall	[1]P	11	11	10	2	67	0
	E	3.5	3.5	7	8	78	0
Lower Lapwai	P	10	3	13	26.5	46.5	1
	E	13	2	7	28	50	
Middle Lapwai	P	52	2	18	23	2	3
	E	30	3	16	10	36	2
Upper Lapwai	P	52	4	16	1	1	26
	E	36	6	19	6	27	0
Lower Sweetwater	P	13	6	11	70	0	0
	E	21	2	5	20	50	1
Middle Sweetwater	P	21	3	14	55	5	2
	E	3	2	7	35	49	3
Upper Sweetwater	P	62	1	18	17	0	2
	E	70	2	18	6	2	1
Lower Webb	P	37	0	19	43	1	0
	E	46	1	16	10	24	3
Upper Webb	P	65	2	18	4	0	11
	E	75	3	17	2	0	0
Lower Mission	P	34	8	17	11	31	0
	E	35	3	20	10	27	2
Middle Mission	P	72	1	25	2	0	0
	E	73	2	21	2	0	0
Upper Mission	P	72	4	21	4	0	0
	E	61	5	20	5	5	0
Rock	P	46	3	19	20	13	0
	E	9	4	12	4	67	0

[1]perennial
[2]ephemeral

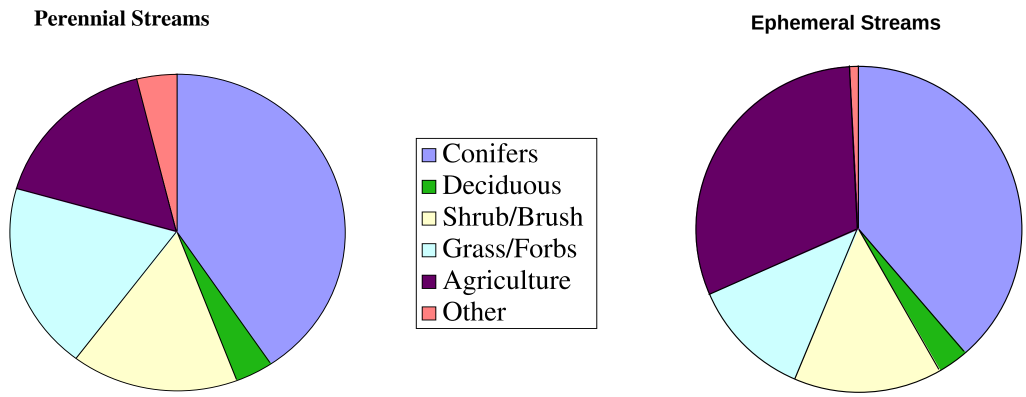

Figure 14. Percent contribution of land cover occurring within one hundred feet of perennial and ephemeral stream channels in the Lapwai watershed.

Mainstem Lapwai

Grass and agricultural plant species border the lower mainstem of Lapwai Creek. Functionally, the deeper-rooted grass/forb communities may provide a certain degree of bank stabilization during late spring or summer months, but are largely ineffective during periods of runoff. Stabilization efficiency through grass and forbs should be considered as limited, especially in areas where livestock are allowed stream access. Disruption of crop plants through cultivation and harvest further decreases any potential stabilizing properties provided by crops. Due to the lack of canopy-providing vegetation, stream shading and overhead salmonid cover in these areas is minimal. Instream habitat that is provided by large woody debris (LWD) is primarily limited to upstream recruitment.

Following the mainstem Lapwai Creek upstream, streamside vegetation in select areas becomes more heterogeneous, supporting a multi-story vegetative community. For example, over half of the riparian vegetation in the middle section of the mainstem Lapwai Creek is made up of conifer species, with shrub/brush communities and grass/forb communities comprising the understory in relatively equal proportions. An instream flow study by the USFWS (Cates 1981) found an abundance of riparian cover and pool habitat for a reach just below the town of Culdesac. However, this reach was the only one in the entire watershed possessing such characteristics at the time of the study.

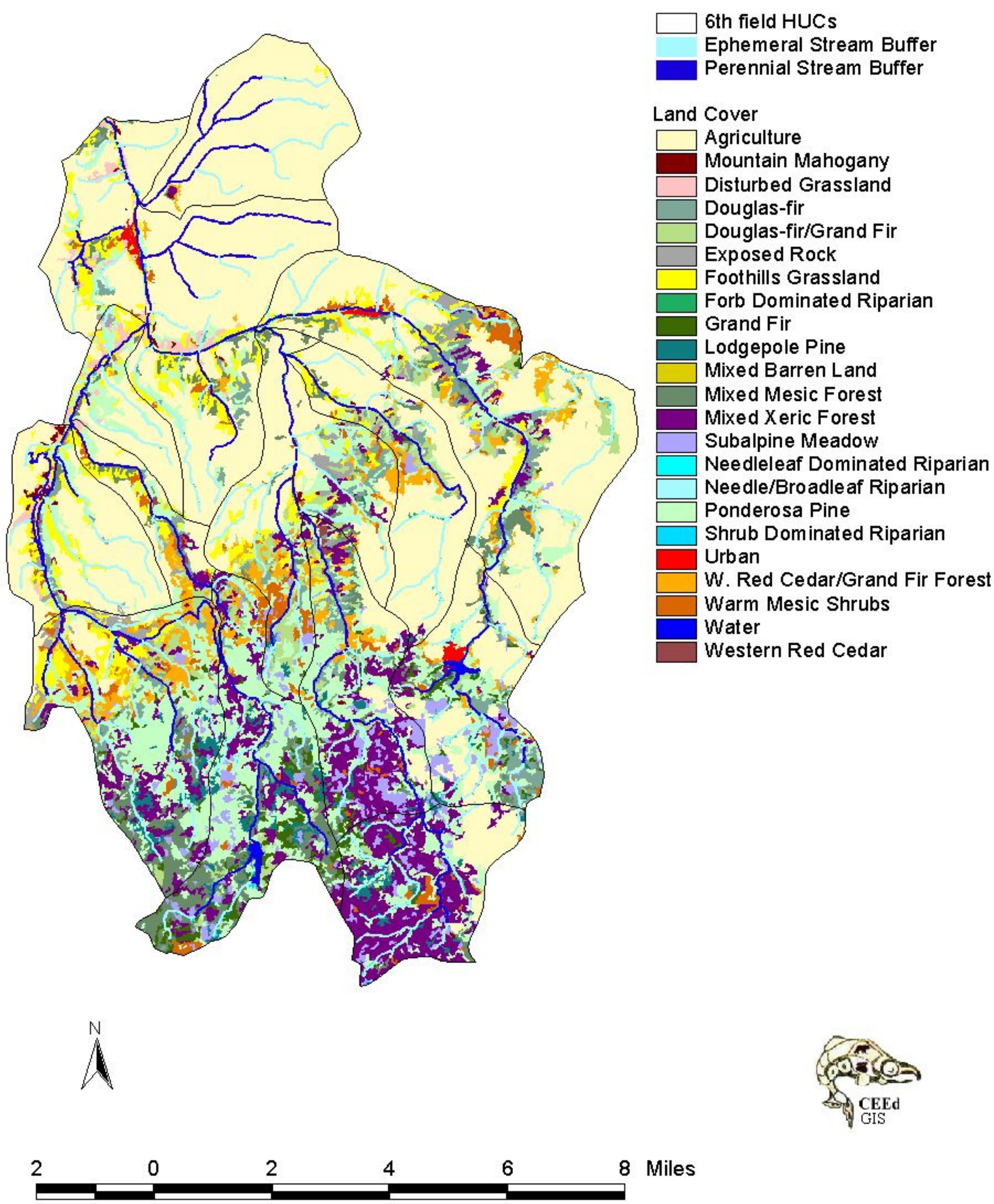

Figure 15. The 100-foot buffer surrounding perennial and ephemeral streams used to intersect land cover layer and evaluate riparian vegetation

Land cover types in the middle and upper Lapwai subwatersheds are mixed. The middle Lapwai subwatershed is dominated by agriculture and range (74.5%) while the upper subwatershed is nearly equally divided by forests (56.2%) and tillage agriculture or range (41.3%). The most prominent modification to riparian areas along the middle Lapwai Creek subwatershed is from the construction of roads and railroads immediately adjacent to the channel. Approximately 23 miles of Highway 95 and 19 miles of the Camas Prairie Railroad parallel Lapwai Creek. The completion of U. S. Highway 95 in 1955 (Reichmuth 1997) greatly restricted portions of Lapwai Creek from its historic floodplain by sandwiching the stream between the roadbed and railroad grade. The reach between Sweetwater and Culdesac was heavily channelized during the 1955 road construction and re-routed in some areas following floods in 1965 (U. S. Army Corps of Engineers 1959). The prohibition of floodwaters from entering the floodplain eliminated interaction with nearby vegetation, creating extensive areas of bank instability. Many riparian species common to the region are dependent on flood-induced channel change. In the absence of such flows and associated channel function, riparian vegetation such as cottonwood forests will often revert to grassland (Auble and Scott 1998) and provide little or no soil-stabilization properties.

There are 174 road crossings throughout the middle Lapwai watershed with 0.32 mi/mi^2 of road networks occurring < 200' from a stream on a slope > 50%. The encroachment of roads into riparian areas not only limits the potential width of the zone, but reduces the efficiency of streamside vegetation and overall diversity found therein (refer to pp. 74-83 for a discussion on roads/sediment contribution).

While the Idaho GAP data documents a predominance of conifers in the riparian area, substantial portions of the riparian corridor throughout the canyon reach were eliminated or modified following a flood event in 1996. Flood flows exceeded bankfull depth, uprooting and depositing mature trees and understory vegetation throughout the floodplain and to downstream reaches (L. Rasmussen, Nez Perce County Natural Resource Conservation Service, personal communication, April 19th, 2000). Coarse alluvium was subsequently deposited along the stream channel and floodplain, creating an inhospitable environment for some species while opening up new habitat for species with low shade tolerance or fast growth (i.e., cottonwood or alder). Although detrimental effects of the 1996 event were considerable, the floods were instrumental in redistribution of organic matter, scouring of stored sediments, and recruitment of nutrient-rich sediments to nutrient-poor streambanks (L. Rasmussen, Nez Perce County Natural Resource Conservation Service, personal communication, April 19th, 2000).

Primary Lapwai Tributaries

Physical and botanical characteristics of riparian corridors along primary tributaries of Lapwai Creek (i.e., Mission, Sweetwater, Webb, and Rock Creeks) are similar in that the plant diversity generally increases with an increase in elevation. The subwatersheds through which the streams flow are similar in the relative degrees and types of land uses that occur within them.

Comparisons of streamside vegetation throughout the lower, middle, and upper portions of Sweetwater Creek illustrate the gradient of plant diversity. Riparian vegetation along the lower section of Sweetwater Creek is comprised almost entirely of grasses and forbs. Grasses and forbs primarily dominate the middle section of Sweetwater Creek, although conifers increase upstream. The conifers dominate along headwater portions of Sweetwater Creek, supported by a shrub and brush community with a grass/forb understory.

Riparian areas along Sweetwater Creek are subjected to varying types and intensities of land use. The dominant land uses occurring in the lower and middle subwatersheds of Sweetwater Creek are tillage agriculture and grazing. Typically, the canyon areas that are too steep to farm are used for grazing. Because streams and riparian areas are located at the bottoms of these canyons, they become prime locations for watering and grazing livestock. The current number of stream miles for which cattle are allowed access to the riparian area is unknown; however, it is probable that unless specifically excluded, cattle will use these areas.

Because the vegetative communities at higher elevations generally are conifer-dominated, there is a shift in land cover type from cultivated fields and rangelands to forests. Land cover types in the upper Sweetwater subwatershed include forests (60.4%) and tillage agriculture and range (39%). The high density (0.37 mi/mi^2) of roads occurring < 200' from a stream channel on slopes > 50% should be considered a potentially limiting factor to riparian function and development. Road networks throughout this area are extensive and relatively unmaintained, crossing stream channels in approximately 71 different areas.

The Sweetwater diversion/canal that parallels the mainstem Sweetwater Creek through portions of the upper and middle subwatersheds has created numerous wetland areas from seepage losses along the length of the canal. These areas currently support a diverse plant community and may function as sources for perennial flows in the mainstem Sweetwater Creek (L. Rasmussen, NRCS, personal communication April19, 2000). Additional investigation of these areas is warranted.

A grass/forbs and conifer riparian component border Webb Creek, a primary tributary to Sweetwater Creek. Similar to the lower and middle portions of Sweetwater Creek, a considerable amount of the ground in lower Webb Creek is farmed or grazed. An estimated 81% of the land use in lower Webb Creek is designated as tillage agriculture and range land. Surprisingly, the lower portion of Webb Creek is essentially unroaded, making this a candidate reach for riparian restoration efforts. The lower reaches currently serve as spawning and rearing area for steelhead, but stream temperatures and habitat limit their success.

The upstream portion of Webb Creek is bordered in areas by stands of conifers. Along the drier aspects of the stream corridor, ponderosa pine provides the dominant form of woody vegetation. Although the degree to which the native riparian community has been modified is unclear, the most likely contributor to change in this area is from silvicultural practices. An estimated 85.7 % of the upper Webb Creek subwatershed is in the forestland cover type. Potential impacts from canopy removal on the physical and chemical characteristics of streams and riparian areas include:

- Hydrologic (increase in high flows, decrease in low flows)
- Light and temperature (increase in minimum and maximum temperatures and changes in diurnal fluctuation)
- Energy inputs (decrease in allocthonous organic matter and increase in autocthonous input)
- Water quality (decrease in water quality through sediment loading)
- Stream structure and morphology (decrease in stream/hydrologic complexity)

Riparian vegetation in the Mission Creek drainage is similar to that found along other perennial tributaries to Lapwai Creek in that it largely reflects the type and degree of respective land uses occurring proximal to the corridor. For example, existing riparian vegetation in the Mission Creek drainage has been subjected to the following influences:

- construction of over 100 miles of logging, county and state roads (nine miles of which parallel the mainstem from its mouth upstream to the headwaters)
- railroad grades
- grazing
- logging
- quarry mining
- stream channelization
- conversion or removal of riparian vegetation for agricultural purposes.

In 1985, Thomas et al. concluded that 72% of the mainstem of Mission Creek was lacking adequate multi-layered riparian vegetation. Nine years later, the Idaho Department of Fish and Game et al. (1994) determined that 58% of the mainstem lacked adequate multi-layered vegetation.

The lower portion of Mission and Rock Creek primarily consists of agricultural vegetation interspersed with conifer and hardwood species. This low gradient (≤ 2%) section courses through a broad U-shaped valley that provided a wide floodplain and adequate multi-layered riparian vegetation during pre-settlement conditions (Thomas et al. 1985). Since then, a considerable amount (≥ 1.2 miles; Thomas et al. 1985) of the channel has been riprapped and straightened to prevent property loss from flooding (U. S. Army Corps of Engineers 1959; Cates 1981). Much of the property in jeopardy is crop or rangeland, thus limiting the amount and diversity of multi-layered riparian communities. Irrigation withdrawals further exacerbate conditions for the development of mesic plant communities by greatly reducing streamflows during critical summer months (see Ch. 4). Shade-providing plant species throughout the reach are sparse.

The middle section of Mission Creek flows through a steep canyon. Mission Creek has a gradient increase of approximately 3.1% though this section. Streamside slopes occurring in the reach average from 15 to 17%, with lengths of 200 feet (Soil Conservation Service et al. 1990). Riparian vegetation in the reach is composed primarily of conifers. Riparian modifications that limit salmonid habitat include road construction, clear-cut logging, grazing, and wildfire (Thomas et al. 1985). Aerial photo interpretation suggests that skid and haul roads near the stream channel may be greatly limiting riparian function.

Upper Mission Creek is characterized by gently rolling topography (stream gradient ≈ 1.7%) with a coniferous/shrub riparian community. Thomas et al. (1985) characterized riparian vegetation throughout this section as "very sparse" and streambank stability as the lowest of any sections along Mission Creek (75% unstable). Interpretation of aerial photos suggests that the proportion of stream surface area shaded by streamside vegetation decreases coincident with increasing elevation. Based on aerial photo interpretation, percent stream shading through streamside vegetation noticeably decreases with an increase in elevation. Although historic features of riparian vegetation throughout this area are unknown, the highly sinuous nature of the stream channel and the low gradient characterizing the reach suggests that the primary functions of organic matter would have been shading and bank stabilization rather than pool-forming cover. One would therefore expect that non-forest communities with shrubs, grasses, and forbs predominating would have been present historically. There is a lack of multi-layered riparian vegetation along the upper reaches of Mission Creek as well as shrub/brush and grass/forb communities. Land uses such as agriculture and forestry have contributed to this absence.

Wetlands

Wetland inventories for the Lapwai watershed are limited. An inventory conducted by the Soil Conservation Service et al. (1990) used soil survey information, hydric soil lists, USGS quad sheets, and ASCS aerial photos and slides to identify areas and classify acreage. While the total wetland acreage is 362, only 2.5 of these are farmed, and none considered converted. Specific locations of wetland areas were unavailable.

Summary

- the dominant form of vegetative cover occurring within 100 feet of all stream channels in the Lapwai watershed is conifers and agricultural vegetation

- shade- and cover-providing riparian vegetation throughout lower portions of the mainstem is patchy and limited to uncultivated, non-grazed areas

- functional riparian communities throughout the middle and upper portions of the mainstem Lapwai Creek exhibit greater heterogeneity than lower portions, but are limited by channelization, disconnection from the floodplain, and the effects of the 1996 flood event

- physical and botanical characteristics of riparian corridors along primary tributaries of Lapwai Creek (i.e., Mission, Sweetwater, Webb, and Rock Creeks) are similar to those occurring along the mainstem in that the plant diversity generally increases with an increase in elevation and reflect the type and degree of land uses occurring near the corridor

- riparian restoration opportunities exist along Webb Creek

- Wetland areas created by seepage from the Sweetwater canal system may be extensive and warrant further investigation

8 - SEDIMENT SOURCES

Erosion that occurs in or near streams is a natural process in any watershed. Fish and other aquatic organisms evolve with local and regional sedimentation processes and are able to deal with varying amounts in lotic and lentic habitats. The degree to which sediment accrual and dispersal occurs in these habitats is spatially and temporally variable. Sediment movement is greatest during periods of high flows, and will distribute along a predictable gradient. The most significant land-forming events may occur during peak events that happen only once every decade or more.

Human-induced erosion is difficult to separate from natural erosion because they often occur together. Timing and spatial patterns of both types of erosional processes are highly variable and it is often difficult to determine cause and affect relationships and to distinguish it from natural processes.

The degree to which anthropogenic-related erosional processes may be considered a limiting factor to aquatic ecosystem function is most often measured by the relative deviation from a stream's natural background sediment regime. The greater a stream's deviation from its natural sediment regime, the greater the chance that fish and other aquatic organisms will be affected.

Cropland erosion and associated nutrient transport in the Lapwai watershed are the primary agents that adversely affect cold water biota (Idaho Department of Fish and Game et al. 2000).

About two-thirds of the agricultural land in the Lapwai drainage is classified as highly erodible (Shi 1987, cited in Prato et al. 1989). Federal, state, and local entities have developed projects designed to assess and reduce these inputs. The Mission-Lapwai Creek Watershed Protection Plan, first completed in 1990, combined federal technical assistance funds with state financial assistance to improve water quality through reductions in cropland erosion and nutrient transport. To date, two iterations of the plan have been completed, claiming to have reduced on-site erosion by 310,295 tons (59%) and off-site sedimentation and related nutrient loading by 100,378 tons (71%) in the original project area (Idaho Department of Fish and Game et al. 2000).

The second supplement to the Mission-Lapwai Creek Watershed Protection Plan (first draft June 2000) identifies various causes and effects of sediment-related pollution across the western portion of the subwatershed. Causes include agricultural activities such as conventional tilling practices and the lack of enduring land treatment practices designed to reduce gully and concentrated flow erosion, improve poor range conditions, improve riparian cover, develop proper road construction and maintenance, and well planned rural development. The effects of erosion in the Lapwai watershed are evident at the Clearwater confluence following storm events (Figure 16), and can be seen as far down river as the upper pool of Lower Granite Reservoir.

Figure 16. Confluence of Lapwai Creek with the Clearwater River. Photo was taken by Nick Gerhardt four days (4/18/00) following a spring storm event and associated slope failure in the Thiessen Gulch area.

Flood protection for the city of Lewiston and barge traffic capacity is compromised by sediment deposition, which reduces river depth. In Lapwai Creek, suspended sediment and bedload movement negatively affect anadromous and resident fish habitat during most life history stages. Silt and sand deposition in spawning habitat reduces overall reproductive productivity of resident and anadromous fisheries (Idaho Department of Fish and Game et al. 2000).

Methods

To determine the degree to which erosional processes may be considered a limiting factor to aquatic ecosystem function in the Lapwai watershed, this chapter addresses the following critical questions:

- What are the important current sediment sources in the watershed?
- What are the important future sources of sediment in the watershed?
- Where do erosion problems qualify as high priority for remedying conditions in the watershed?

Evaluation of potential sediment sources in the Lapwai watershed was conducted using methods outlined in the OWAM (Watershed Professionals Network 1999). The manual defines eight potential sediment sources that should be considered:

1) road instability
2) slope instability
3) rural road runoff
4) urban area runoff
5) sediment from crop land
6) sediment from range or pasture lands
7) sediment from burned areas
8) sediment from other identified sources.

The manual suggests using aerial photographs, topographical maps, database inventories, and field verification to produce a database and maps that identify sediment sources.

The latest road assessment layer from the Land Services Department at NPT headquarters in Lapwai, Idaho was used to update the road layers using GIS. This included many secondary roads not shown on USGS 7.5-min. quadrangle maps or older GIS layers. Sediment sources most relevant to the Lapwai watershed were determined based in part on data availability, interviews, discussions with landowners and local resource managers, and literature review. Table 17 lists the results from this process.

The four most likely contributors of sediment to aquatic ecosystems throughout the Lapwai watershed include

- road instability
- rural road runoff
- cropland
- rangeland.

Individual sources were evaluated using a variety of methods.

Table 17. Coarse screen for sediment sources in the Lapwai watershed.

Sediment Source		Observations	Priority
Source 1: Road Instability	Are rural roads common in the watershed? Do many washouts occur following high rainfall? Are many new roads or road reconstruction planned?	Yes Occasional No	4th
Source 2: Slope Instability (not roads)	Are landslides common in the watershed? Many high-sediment, large-scale landslides?	No No	Topic not a high priority
Source 3: Rural Road Runoff	Are sediment-laden runoff from rural roads and turbidity in streams common? Is there a high density of rural roads?	Mod. Mod.	3rd
Source 4: Urban Runoff	Are many portions of the watershed urbanized? Importance of tributaries to watershed council:	No Mod.	Topic not a high priority
Source 5: Surface Erosion from Cropland	Is there much cropland in the watershed? Is there much evidence of sediment in streams flowing through cropland?	Yes Yes	1st
Source 6: Surface Erosion from Rangeland	Is there much rangeland in the watershed? Is there evidence of sediment in streams flowing through rangeland?	Yes Yes	2nd
Source 7: Surface Erosion from Burned Land	Have many burns occurred recently (last five years)? Was there much sediment created by these burns?	No No	Topic not a high priority
Source 8: Other Discrete Sediment Sources	List or identify any other suspected sediment sources: did timber harvest occur in headwater areas?	Mod.	Topic not a high priority

Road Instability

To address the construction and condition of Lapwai roads and their relationship to failure, the OWAM suggests three activities:

- collect road-related database information from various sources and entities
- use aerial photography to identify recent and historic landslide scars
- conduct field surveys of stream crossings and culvert condition to identify locations where road failures have occurred or might occur.

Information relating to road-related slope failures, culvert location and condition, and/or road surface condition is limited. Certain information concerning road surface type, culvert location, road condition, landslide areas, and wetland areas will be available in a GIS-based format through the Nez Perce County Road and Bridge Department in the near future (J. Black, Nez Perce County Road and Bridge, personal communication July 29, 2000) and through cooperative efforts between the Nez Perce Tribe, NRCS, and local landowners.

The scale at which aerial photos from a 1992 flight were flown prohibited a sufficiently comprehensive interpretation of recent or historic road-related landslide events, road condition, or culvert location/condition, however the aerials were of sufficient quality to aid in the identification of culvert survey locations. The general location of gravel-surfaced and native-surfaced roads was determined based on conversations with highway district personnel; aerial photos were used to estimate their relative distribution across the study area. To verify the aerial photo interpretation, a general field review of road surface condition and type was conducted; however, the review was incomplete due to the number of private roads and access issues.

The Level I Stability Analysis (LISA) computer program was used to help estimate the relative stability of natural slopes or landforms. The model is a tool that resource managers can use to base management decisions at the multi-project or resource allocation level of planning. The model aids in understanding slope stability processes, provides relative comparisons between the stability of landforms, and identifies areas that should be targeted for additional analysis (Hammond et al. 1992).

The LISA uses soil depth, slope, tree surcharge, root cohesion, soil angle of friction, soil cohesion, the dry weight of the soil, and groundwater depth to determine the likelihood of a slope failure. The LISA program allows the user to input a range of values for each model component to more accurately represent the stochasticity present in natural systems; 1,000 iterations of the model were run for each map unit, with the resulting output defining a range of safety factors. The stability of the slope or landform decreases as the safety factor approaches a value of one, at which point failure occurs.

The primary source of LISA input data in the Lapwai Creek watershed are the 151 map units delineated in the Nez Perce County SSURGO collected by the Natural Resources Conservation Service (1995). In this hierarchical database system, each map unit can contain up to three components with up to six-soil layers (e.g.

Hammond et al. 1992). To determine values for use in LISA averages across the soil horizon and soil components in each map unit were used (refer to Appendix C for a detailed description on methods used in the assignment of values to soil depth, slope, tree surcharge, root cohesion, soil angle of friction, soil cohesion, dry weight, and depth to groundwater).

A general culvert inventory throughout portions of the basin was conducted to address road drainage and stream crossing issues. Three crossings in each subwatershed were selected based on analyses using topographic maps and aerial photos to provide a relative picture of areas in which inadequate sizing or placement of culverts may be contributing to road instability. The inventories were conducted during periods of high flow (March–April) so that culvert function could best be evaluated. Selected crossings typically occurred on mid-slope areas where gradient was sufficiently high to allow for downslope delivery of sediment to a stream channel or riparian area. Sample sites were defined by slope dissections, high gradient roadbeds, or draws proximal to stream channels. Survey data included culvert type, diameter, condition, location (using GPS technology), length, and gradient. This data was used in conjunction with methods outlined in the OWAM to determine culvert capacity and the risk of significant sediment loading to the stream.

Rural Road Runoff

General methods described in the OWAM were used to determine the amount of sediment contribution to aquatic ecosystems from rural road runoff. The OWAM assessment protocol requires:

- the area of the study unit
- length and density of roads < 200′ from stream channels
- roads < 200′ from stream channels and on slopes > 50%
- frequency of road crossings

Since the data available for this assessment did not allow for differentiation between rural paved and rural unpaved road surfaces, the two surface types were combined and assessed together. In light of this factor, sediment contributions in subwatersheds containing both rural paved and rural unpaved road surfaces may not accurately characterize conditions. GIS layers obtained from the NPT Land Services Department were used to determine subwatershed area, road proximity to stream channels, and relationship to slope. Road survey data provided through the NRCS was used in the analyses to verify estimates of sediment contribution.

Cropland Erosion

Evaluation of agriculturally induced erosion to streams was conducted using a combination of methods outlined in the OWAM and applied to data sources provided by the NRCS. The NRCS state geologist, along with NRCS soil scientists and agronomists for Lewis and Nez Perce Counties, had the most current and comprehensive sediment yield and sediment delivery estimates pertinent to the Lapwai drainage (refer to methodology discussed in Soil Conservation Service et al. 1990; Idaho Department of Fish and Game et al. 1994; 2000).

GIS layers were used to characterize soils, climate, slope, and land use throughout the subwatershed (Soil Conservation Service et al. 1990; Idaho Department of Fish and Game et al. 1994, 2000). Land area and estimates of sediment delivery and yield (using a weighted average of the five cropland treatment units -TU's) were adjusted to the subwatershed-mapping units throughout this document (Figure 17). Data were applied to each subwatershed in the following TU categories:

1) cropland 0-8% slopes
2) cropland 8-20% slopes
3) cropland > 20% slopes
4) cropland > 22" precipitation 0-20% slopes
5) cropland > 22" precipitation 0-15% slopes

Total cropland acreage values were analyzed using NRCS definitions, and are therefore not reflective of cropland acreage values discussed throughout other portions of this document.

To aid in the characterization of the erosive potential of agricultural soils, erosion factors noted as "K" values were assigned to respective subwatersheds using SSURGO data (Natural Resources Conservation Service 1995). The SSURGO data characterizes soil types throughout the drainage, and provides an estimate of the respective erosivity (K factor) with each class. This information is presented in conjunction with the average slope of each subwatershed to assist in the interpretation of sediment transport and deposition. Specific field boundaries with associated crop types were not delineated due to the size of the watershed and lack of available data, but general references are made to common agricultural rotation strategies practiced within each subwatershed.

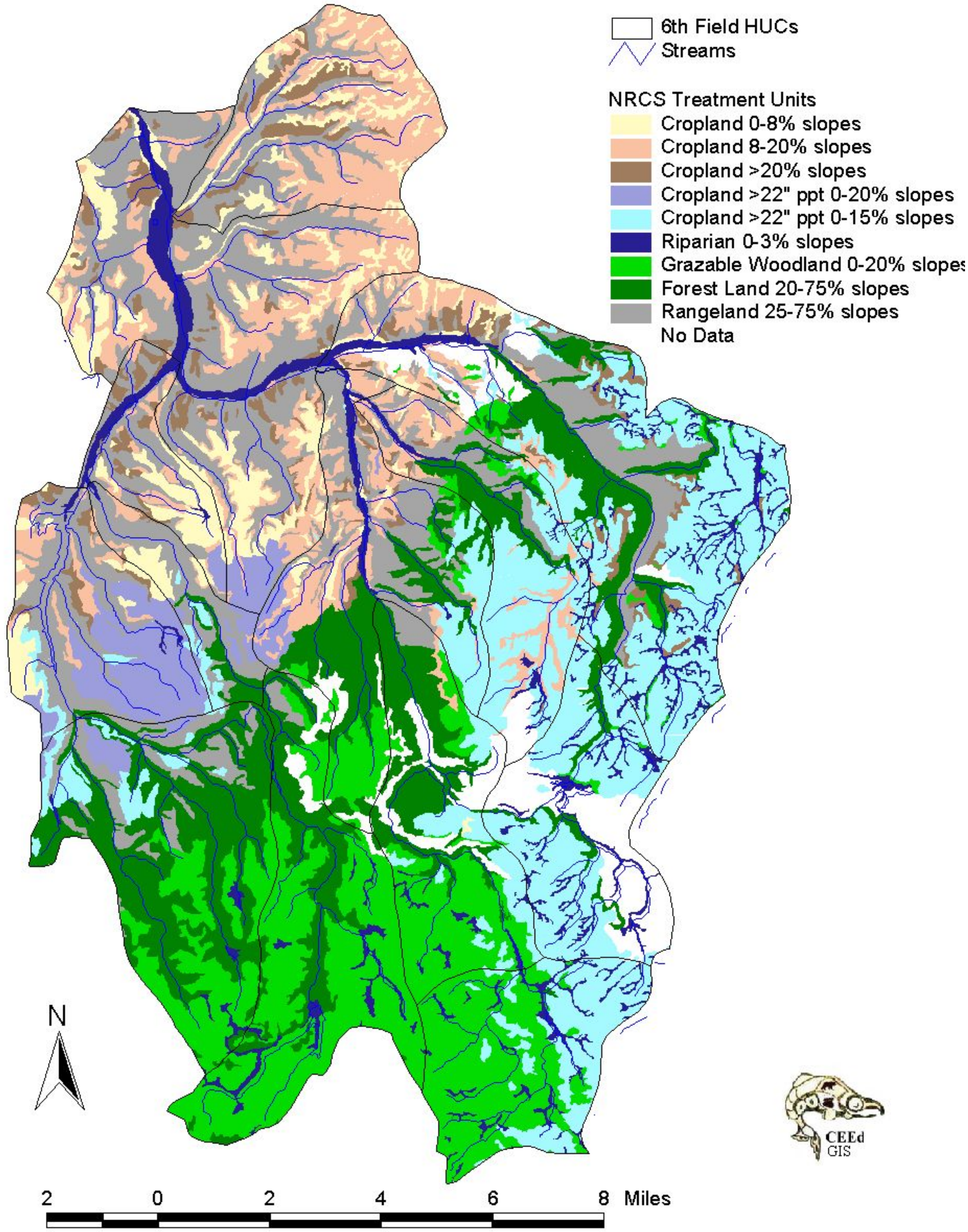

Figure 17. Natural Resource Conservation Service Treatment Units in Lapwai Creek

Rangeland Erosion

Methods to estimate potential sediment contribution to streams from grazing are similar to those used to estimate sediment contribution from agricultural practices.

TUs used were (refer to Figure 17):

- grazable woodland 0-20% slope
- rangeland 25-75% slope

In the absence of specific data such as animal unit (AU), concentration of animals, and the distance or accessibility to streams and riparian areas, the analyses only provides an indicator of the erosive potential of a given area.

Sediment Source Characterization

Road Instability

The LISA results characterize those areas within the Lapwai Creek watershed most prone to failure under elevated groundwater conditions (Figure 18). The values obtained by running the LISA model may portray a higher degree of safety than actually present in some areas since data characterizing groundwater influences were applied uniformly to all soil types in the drainage. More extensive analysis of conditions should be conducted prior to the application of these results.

Stability analyses show that the most unstable landforms (those with the lowest minimum factor of safety – MFS) occur in the lower Webb (MFS = 1.97), middle Sweetwater (MFS = 2.26) and lower Sweetwater (MFS = 2.28) subwatersheds (Table 18). The most stable landforms in the Lapwai watershed are in the upper Mission (MFS = 7.97) and Lapwai (MFS = 5.90) subwatersheds.

The observational database of road failures in the Lapwai watershed is limited. Discussions with NPT foresters and highway district personnel suggest that road-related mass wasting may be a greater problem in agricultural areas than elsewhere. Culverts and ditches in agricultural areas are more likely to become plugged with accumulations of sediment, tumbleweeds and other debris, causing runoff to cut across roadbeds and saturate road prisms (J. Black, Nez Perce County Road and Bridge, personal communication July 29, 2000). Observations during field reconnaissance identified road slumps on native-surfaced (non-paved and non-graveled) roads primarily in the upper Sweetwater and upper Webb Creek subwatersheds (Figure 19; Figure 20). These failures were primarily attributed to saturated road fill and inadequate drainage.

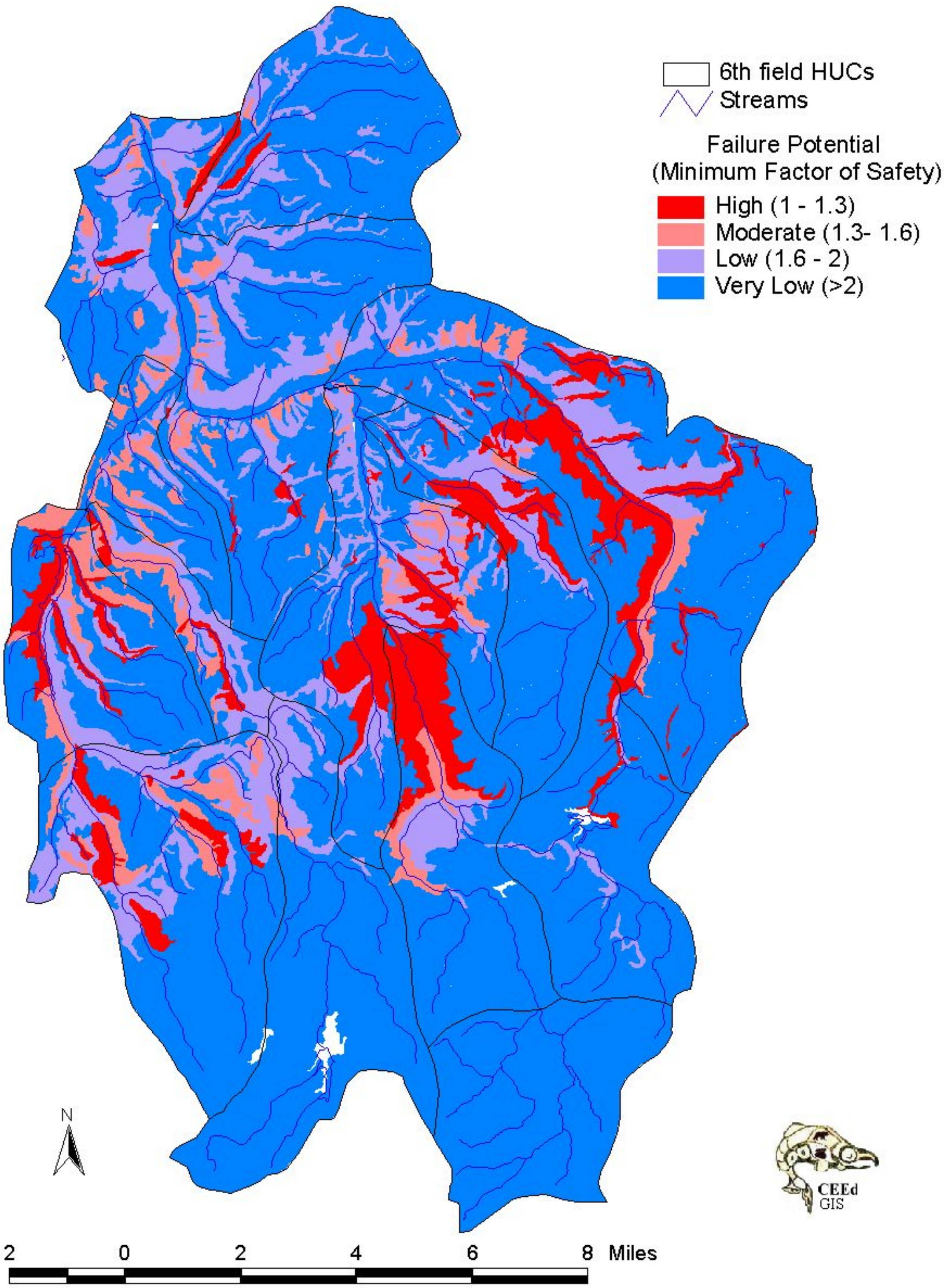

Figure 18. Land failure potential and minimum factor of safety, obtained through Level I Stability Analysis

Table 18. Results from LISA for the Lapwai drainage. Values shown represent an average of the lowest scores associated with each subwatershed.

Subwatershed	Average Minimum Factor of Safety Value
Tom Beall	2.63
Lower Lapwai	2.39
Middle Lapwai	3.70
Upper Lapwai	5.90
Lower Sweetwater	2.29
Middle Sweetwater	2.26
Upper Sweetwater	3.26
Lower Webb	1.97
Upper Webb	5.60
Lower Mission	2.86
Middle Mission	4.64
Upper Mission	7.97
Rock Creek	4.09

Figure 19. Road slump on native-surfaced road in the upper Sweetwater HUC. Slump attributed to lack of culvert/saturated road fill. Surveyed March 2000.

Figure 20. Road slump on native-surfaced secondary forest roads in the upper Sweetwater HUC. Top photos show initiation point, lower photo shows deposition. Surveyed March 2000.

A total of eight stream crossings were assessed in the Lapwai watershed during March and April 2000 (Table 19; Figure 21). The original survey was designed to evaluate at least three stream crossings per subwatershed, or a total of 32 crossings. The reduction in the sample size, which was primarily a result of access issues, including locked gates, poor road conditions, and non-compliance with landowners, prohibited a statistically significant analysis of the risk of culvert failure. The sample was further reduced when surveyors encountered small (<2 ft. width), ephemeral channels that did not appear to represent a significant threat to road failure. For future studies, site selection protocol should include areas accessible to the public and off highway vehicles during the period of the survey, and roads crossing streams ≥ 3rd order.

Table 19. Culvert capacity and risk of large amounts of sediment entering the stream.

Subwatershed	Tom Beall	Tom Beall	Lower Lapwai	Lower Lapwai	Middle Sweet-water	Upper Lapwai	Upper Sweet-water	Upper Sweet-water	Upper Sweet-water
Diameter (in.)	18.00	22.00	33.00	15.00	60 & 24[1]	60.00	18.00	54.00	18.00
Capacity (cfs)	5.50	8.00	26.00	3.50	115	115.00	5.50	88.00	5.50
50-yr. Peak-flow Value (cfs/mi[2])	14.12	14.12	24.63	24.63	19.63	26.35	17.63	18.42[2]	17.63
Drainage Area (mi[2])	0.98	3.85	5.51	0.86	0.82	2.00	6.46	23.70	0.51
50-yr. Peak-flow (cfs)	13.84	54.36	135.71	21.18	16.09	52.70	113.88	436.55	8.99
Culvert Size Needed for 50-yr. Flow	27.00	48.00	72.00	33.00	27.00	48.00	60.00	108.00	24.00
Ratio of 50-yr. Flow to Current Capacity	2.57	1.77	0.95	7.04	0.17	0.23	3.21	0.21	3.20
Fill Height (ft.)	2.00	1.33	1.60	3.20	6.50	3.00	3.50	N/A	9.00
Hazard Rating[3]	High	Mod.	V. Low	V. High	V. Low	V. Low	V. High	N/A[4]	V. High

[1]Crossing had two culverts, the smaller of which was classified "overflow" (dry during time of the survey)
[2]Stream crossing captures flow diverted from Webb Creek drainage; estimate should be considered rough
[3]see Watershed Professionals Network 1999 for derivation
[4]Rating was based on an average of 50-year peak flows from two drainages, and was therefore not assigned. field observations/photos suggest, however, that the culvert is undersized and misaligned.

Generally, culverts on agricultural ground appeared to require a considerable degree of maintenance since vegetation and inorganic debris accumulation were frequently observed above, below, and within the culvert (Figure 22). Culverts in forested areas appeared more prone to failure from erosional processes due to inadequate sizing or poor placement relative to thalweg location (Figure 23 and Figure 24). The majority of culverts surveyed were in adequate to good condition, especially those occurring on maintained county roads in the middle portions of the watershed. Damaged culverts were most prevalent on unmaintained roads in forested portions of the watershed such as the Craig Mountain area or upper Sweetwater/Webb Creek subwatersheds (Figure 25).

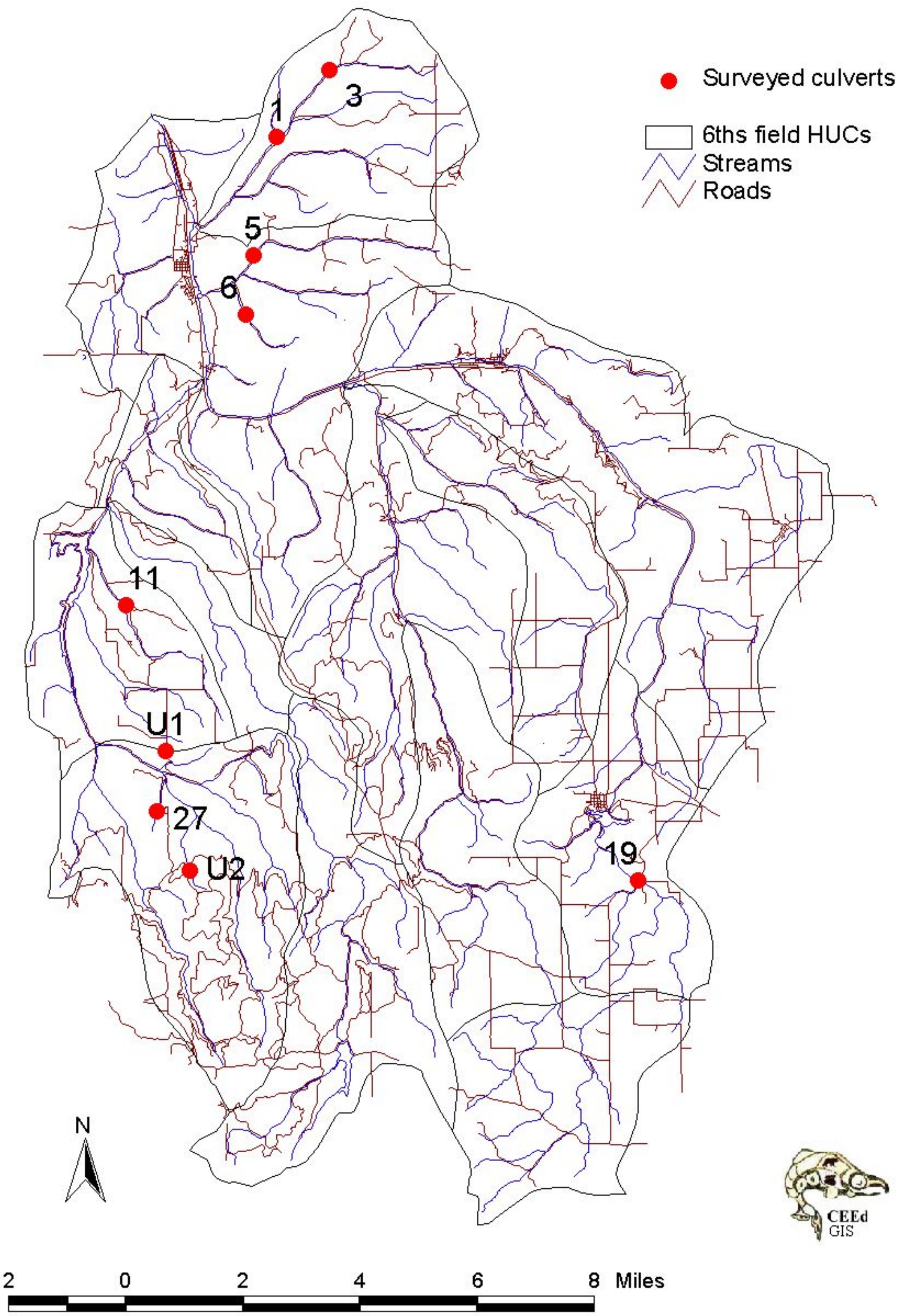

Figure 21. Surveyed culvert locations, Lapwai Creek watershed

Figure 22. Culverts draining agricultural ground. Culvert locations are (clockwise) Middle Sweetwater, Tom Beall, and Tom Beall. Surveys conducted March 2000.

Figure 23. Inadequately sized culvert located in the upper Sweetwater HUC. Note culvert placement/alignment in relation to thalweg.

Figure 24. Upstream view through misaligned culvert located in upper Sweetwater HUC. Note the standing wave at the culvert entrance. Surveyed March 2000.

Figure 25. Culvert draining unnamed tributary to the East Fork Sweetwater Creek. Photo illustrates the effect of a crushed culvert inlet and corresponding surface erosion.

Rural Road Runoff

Summary statistics for rural roads occurring within 200’ of a stream channel or on slopes exceeding 50% are shown in Table 20. Estimating potential sediment contribution to stream channels from rural road runoff was not possible due to the lack of information on relative road usage, surface material composition, ditch and cut-slope condition, and culvert condition. Inferences can be made based on the information presented in Table 20 and Figure 26.

The upper and middle Sweetwater subwatersheds contain the highest density of roads both proximal to stream channels and on slopes exceeding 50%. Roads cross stream channels in the upper Sweetwater subwatershed at 71 locations, further adding to surface runoff potential. Although the middle Lapwai subwatershed contains a higher density of steep roads near stream channels, the majority of these are paved (i.e., Highway 95) and are thus not considered primary sediment producers. Streams in the lower Webb Creek and upper Mission Creek subwatersheds appear least susceptible to sediment contributions through road surface runoff based on road length and density estimates.

Estimates of surface erosion volume caused by roads are presented in Idaho Department of Fish and Game et al. (2000). Combined sheet, rill, and gully erosion from roads in the watershed is estimated to be 11,450 tons per year, with a sediment delivery rate into stream channels of 32%, or 3,664 tons annually. Estimates include unimproved (typically unmaintained) (9,268 tons/year – yield; 2,966 tons/year – delivery) and improved (typically maintained) (2,172 tons/year – yield; 695 tons/year – delivery) dirt surface types only.

Table 20. Summary of information relating to rural road runoff.

Subwatershed	**Area (mi.^{2})**	**Roads <200’ from Stream**		**Roads <200’ from Stream & Slope > 50%**		**Number of Times Roads Cross Streams**
		Length (mi.)	Density (mi./mi.^{2})	Length (mi.)	Density (mi./mi.^{2})	
Tom Beall	17.49	22.65	1.29	0.65	0.04	54
Lower Lapwai	40.14	47.05	1.17	5.31	0.13	67
Middle Lapwai	41.01	50.72	1.24	13.01	0.32	174
Upper Lapwai	17.25	15.30	0.89	1.30	0.08	47
Lower Sweetwater	7.30	8.95	1.23	0.78	0.11	12
Middle Sweetwater	15.57	22.02	1.41	5.20	0.33	33
Upper Sweetwater	26.50	32.86	1.24	9.77	0.37	71
Lower Webb	6.21	0.41	0.07	0.00	0.00	3
Upper Webb	22.84	31.09	1.36	1.86	0.08	50
Lower Mission	23.38	20.65	0.88	2.20	0.09	50
Middle Mission	18.45	23.75	1.29	7.49	0.41	53
Upper Mission	16.38	15.64	0.95	0.00	0.00	60
Rock Creek	15.34	11.28	0.74	2.74	0.18	26

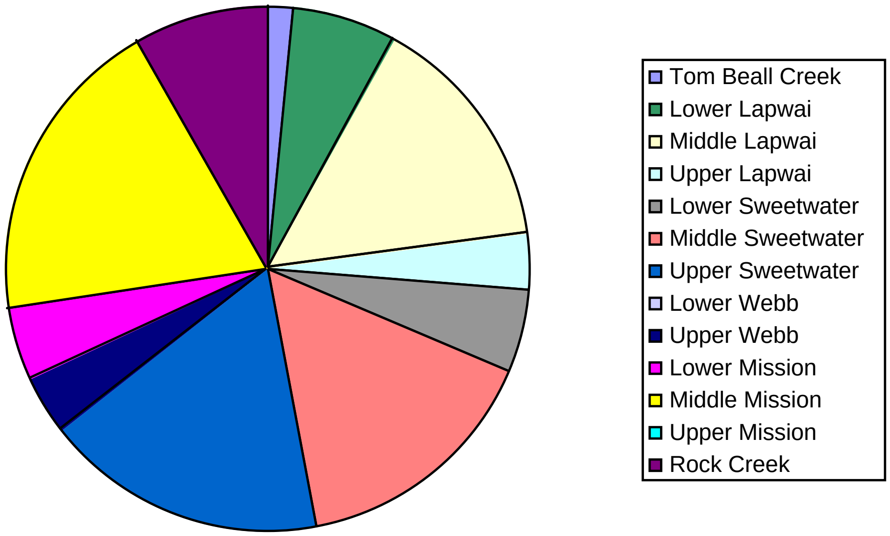

Figure 26. Percentage of rural roads in the Lapwai sub-watershed occurring ≤200′ from a stream channel on slopes ≥50%.

Cropland Erosion

Surface erosion from cropland is the primary sediment source in the Lapwai watershed. Combined, the lower Lapwai, middle Lapwai, and Tom Beall subwatersheds produce half (114,681.8 tons) of all agriculturally generated sediment delivered to stream channels (Table 21). These subwatersheds also have the greatest area of agricultural ground. Per acre, the greatest erosional potential (sheet and gully combined) is in the middle Sweetwater (20.86 tons/acre), upper Sweetwater (20.06 tons/acre), and upper Mission (17.5 tons/acre) subwatersheds. Sheet and rill erosion are most effectively delivered to stream channels in the middle Sweetwater (Sediment Delivered (SD) = 2.95), upper Sweetwater (SD = 2.64), and lower Webb (SD = 2.40) subwatersheds, while sediment delivery via gully erosion is most prevalent in the lower Sweetwater (SD = 1.18), Tom Beall (SD = 1.13), and lower Lapwai (SD = 1.12) subwatersheds (refer to Figure 27).

On average, the erosiveness of soils in the Lapwai watershed is greatest in the Tom Beall ($\overline{K} = 0.39$), upper Lapwai ($\overline{K} = 0.37$), and Rock Creek ($\overline{K} = 0.36$) subwatersheds (Table 22; Figure 28). The greatest proportion of land area covered by soils with a K factor > 0.4 are in the Tom Beall (61%), middle Lapwai (53%), and upper Lapwai (51%) subwatersheds. The average slope is greatest in the lower Webb ($\overline{S} = 31.6\%$), upper Sweetwater ($\overline{S} = 23.5\%$), and lower Mission ($\overline{S} = 23.1\%$) subwatersheds.

Table 21. Surface erosion from cropland in the Lapwai watershed (Stevenson 2000).

Sub-watershed	Ag. Acreage in sub-watershed	Sheet and Rill Erosion		Concentrated Flow Erosion		Est. Total Sed. Yield (tons)	Est. Total Sed. Delivered (tons)
		Ton/Acre[1]	SD[2]	Ton/Acre	SD		
Tom Beall	7832.08	11.49	2.27	2.68	1.13	110,973.8	26,569.5
Lower Lapwai	12771.47	11.80	2.24	2.72	1.12	185,512.1	42,881.8
Middle Lapwai	13779.6	14.43	2.39	2.58	0.89	234,414.1	45,230.5
Upper Lapwai	5722.4	14.99	2.25	2.50	0.75	100,099.1	17,168.6
Lower Sweetwater	2507.9	12.33	2.38	2.84	1.18	38,067.6	8,953.2
Middle Sweetwater	6379.2	18.25	2.95	2.61	0.91	133,071.0	24,578.8
Upper Sweetwater	1796.7	17.57	2.64	2.50	0.75	36,054.3	6,084.2
Lower Webb	1341.7	14.77	2.40	2.67	0.94	23,393.7	4,482.1
Upper Webb	0.67	0.00	0.00	0.00	0.00		
Lower Mission	5173.3	13.86	2.37	2.57	0.94	84,964.8	17,154.5
Middle Mission	1816.9	14.56	2.22	2.51	0.78	31,013.3	5,461.0
Upper Mission	3403.9	15.00	2.25	2.50	0.75	59,569.6	10,211.9
Rock Creek	5997.1	13.72	2.22	2.52	0.85	97,386.0	18,404.9

[1] The weighted average of NRCS TU area scaled to the subwatershed

[2] Derivation based on the product of the NRCS SDR (Stevenson 2000)

Table 22. K factors and average slopes associated with subwatersheds in the Lapwai watershed (Natural Resources Conservation Service 1995).

Subwatershed	Mean K Factor	% of subwatershed where K Factor > 0.4	Mean % Slope
Tom Beall	0.39	0.61	17.0
Lower Lapwai	0.36	0.38	19.4
Middle Lapwai	0.36	0.53	19.7
Upper Lapwai	0.37	0.51	8.9
Lower Sweetwater	0.33	0.30	18.3
Middle Sweetwater	0.34	0.49	19.4
Upper Sweetwater	0.25	0.11	23.4
Lower Webb	0.26	0.23	31.6
Upper Webb	0.28	0.02	13.4
Lower Mission	0.30	0.22	23.1
Middle Mission	0.29	0.19	21.7
Upper Mission	0.36	0.45	6.7
Rock Creek	0.36	0.44	17.8

Figure 27. Sheet and rill and gully erosion in the middle Lapwai HUC. Photographs taken by Nick Gerhardt, 4/18/00.

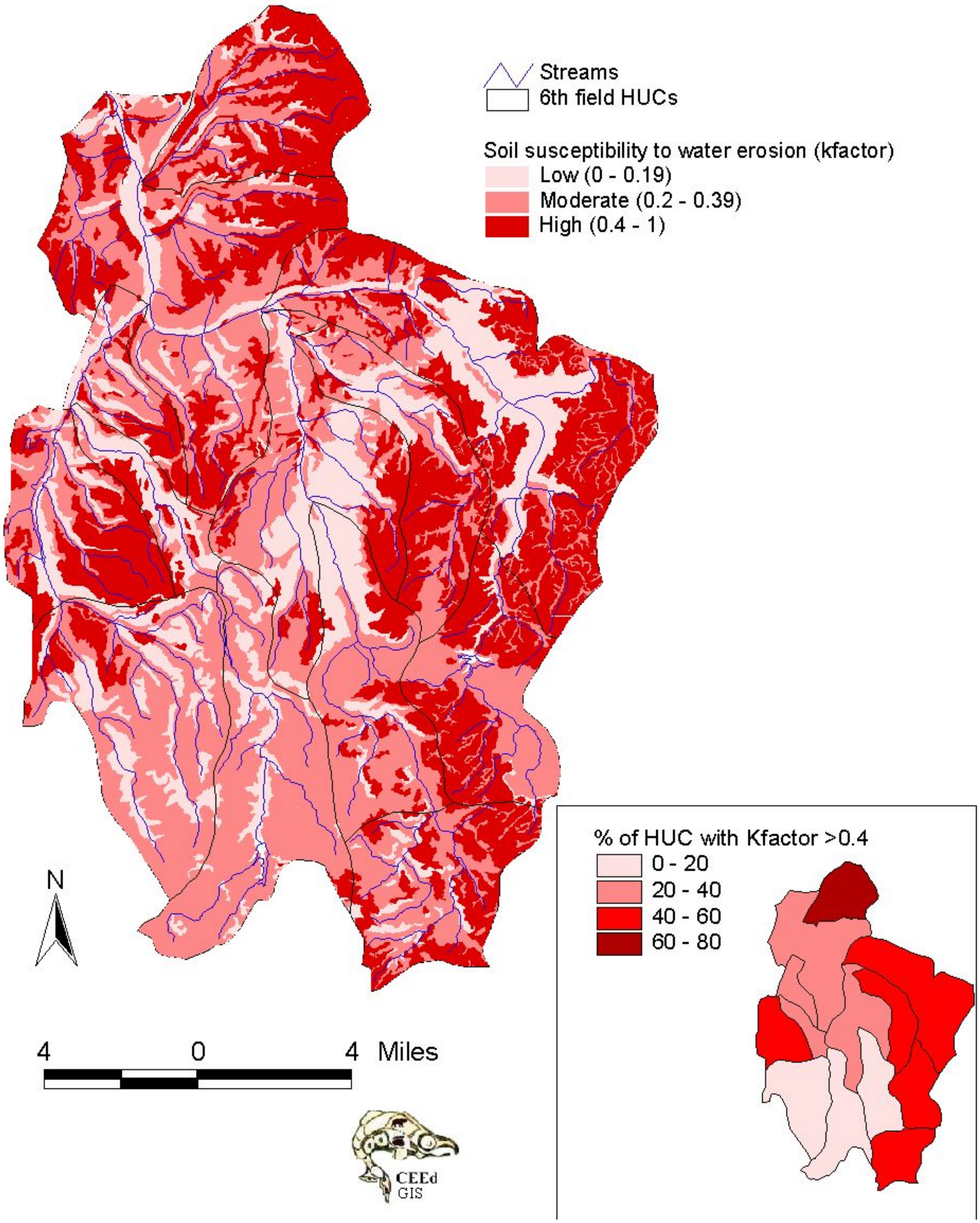

Figure 28. Relative soil susceptibility to water erosion throughout the Lapwai Creek watershed and component subwatersheds based on the K-factor.

Typically, a two-year crop rotation with grain and summer fallow is used in the Tom Beall and lower Lapwai watersheds (refer to Table 9). Some spring crops are seeded when winter moisture levels sufficiently wet the soil profile. If a crop is substituted for fallow it will most likely be garbanzo beans. Use of contour farming practices is rated fair to poor in these areas, with bare soil constituting 40-50% of the cropland acreage in any given year. Use of conservation practices to reduce soil erosion is minimal. Some grain fields are plowed but left uncultivated through the winter, which provides a rough surface condition and approximately 60% residue. The fallow year has poor residue (10-20% over winter) and a smooth soil surface.

Crop rotation strategies for the other agricultural subwatersheds (middle Lapwai, lower Sweetwater, middle Sweetwater, lower Webb, lower Mission, and Rock Creek) are similar to those in the Tom Beall and lower Lapwai watersheds, although subwatershed-specific cropping approaches may differ (refer to Table 9). Usually, 60% of the cropland acreage is in a two-year rotation, while the remainder is in a three-year rotation. The two-year rotation consists of a winter cereal grain such as wheat or barley in the first year, with peas, lentils, garbanzo beans, canola, or buckwheat the following year. The three-year rotation consists of a winter cereal grain in the first year, a spring cereal grain in the second year, and peas, lentils, garbanzo beans, canola, or buckwheat in the third year. Agricultural best management practices (BMP's), such as contour farming, are applied throughout portions of individual subwatersheds, comprising $\geq$50% of the cropland acreage in any given year. Grain crops are plowed over winter leaving a rough soil surface with <30-40% of the surface as bare ground. Lentil and garbanzo bean crops have a poor residue (10-15%), canola crops have a fair to good residue (25-60%), and buckwheat leaves a good residue (30-50%). In any given year there is about 50% grain crops, 5% canola, 5% buckwheat, 10% garbanzo beans, 15% lentils, and 15% peas.

Rangeland Erosion

Estimated sediment production from range and grazable woodland is presented in Table 23. The lower Lapwai subwatershed accounts for 28% of all grazing-derived sediment delivered to stream channels (18,835.7 tons). The rangeland in this area consists mostly of yellow starthistle and annual grasses. Livestock feeding operations impact water quality in the lower Lapwai watershed (Rasmussen 2000).

The propensity for sediment to be delivered to a stream channel is greater from sheet and rill processes than concentrated flow processes ($\overline{SD}_{sheet} = 0.82$ vs. $\overline{SD}_{gully} = 0.41$). Sediment production values (3.56 tons/acre from sheet and rill vs. 0.80 tons/acre from concentrated flow and gully) from rangelands in the Lapwai watershed reveal that sheet and rill erosion is greater than concentrated flow erosion.

Table 23. Surface erosion from rangeland in the Lapwai watershed (Stevenson 2000).

Sub-watershed	Range Acreage in Sub-watershed	Sheet & Rill Erosion		Concentrated Flow Erosion		Est. Total Sed. Yield (tons)	Est. Total Sed. Delivered (tons)
		Ton/Acre[1]	SD[2]	Ton/Acre	SD		
Tom Beall	3335.26	4.50	1.13	1.00	0.55	18,343.9	5,586.5
Lower Lapwai	11245.2	4.50	1.13	1.00	0.55	61,848.45	18,835.7
Middle Lapwai	4518.6	4.17	1.02	0.93	0.50	23,064.1	6,873.5
Upper Lapwai	89.9	2.12	0.36	0.50	0.20	235.4	49.9
Lower Sweetwater	1741.6	4.50	1.13	1.00	0.55	9,578.7	2,917.1
Middle Sweetwater	3424.2	4.50	1.13	1.00	0.55	18,833.17	5,735.6
Upper Sweetwater	6204.8	2.97	0.63	0.68	0.32	22,604.6	5,913.9
Lower Webb	2039.6	4.50	1.13	1.00	0.55	11,217.71	3,416.3
Upper Webb	9817.4	2.18	0.38	0.51	0.20	26,403.7	5,717.8
Lower Mission	5032.1	3.72	0.87	0.84	0.43	22,901.8	6,572.6
Middle Mission	4497.3	2.31	0.42	0.54	0.22	12,837.74	2,907.9
Upper Mission	6242.6	2.12	0.36	0.50	0.20	16,355.7	3,467.2
Rock Creek	1578.3	4.17	1.02	0.93	0.50	8,053.2	2,399.7

[1] The weighted average of NRCS TU area scaled to the subwatershed
[2]Derivation based on the product of the NRCS SDR (Stevenson 2000)

Summary

- The greatest amount of sediment contributed to aquatic ecosystems in the Lapwai watershed is agriculturally derived.

- The least stable landforms throughout the watershed occur in the upper Sweetwater, lower Webb, and middle Sweetwater subwatersheds. These are areas where road failure may most likely occur, but warrant further investigation prior to application of management actions.

- The risk of large amounts of sediment entering the stream as a result of culvert failure was not evaluated due to an insufficient sample size. Observational data however, suggests that culverts occurring on native-surfaced, unmaintained roads throughout upper portions of the watershed (Craig Mountain area or upper Sweetwater/Webb Creek subwatersheds) are at a greater risk of failure than those occurring under maintained conditions.

- Potential sediment contribution to stream channels via rural road runoff was greatest in the upper and middle Sweetwater subwatersheds. These areas were evaluated as having the highest road density, the most linear miles proximal to stream channels, and as areas where slopes commonly exceed 50%.

- Estimated sediment production from cropland was greatest in the lower Lapwai, middle Lapwai, and Tom Beall subwatersheds. The combined estimated sediment production from the three drainage areas amounted to half (114,681.8 tons) of all agriculturally generated sediment delivered to stream channels in the Lapwai watershed.

- On average, the erosiveness of soils in the Lapwai watershed is greatest in the Tom Beall, upper Lapwai, and Rock Creek subwatersheds.

- The lower Lapwai subwatershed accounts for 28% of all grazing-derived sediment delivered to stream channels (18,835.7 tons).

9 - CHANNEL MODIFICATION

Channel modifications are any human-caused physical alteration or activity that changes a stream from its natural channel shape, sinuosity, and hydrologic connectivity. Channel modifications can move a stream from its natural channel and floodplain, affect water velocities causing erosion, and severely impact aquatic and riparian habitat.

Modifications affecting aquatic resources in the Lapwai watershed include roads next to streams, culverts and stream crossings, direct manipulation of the channel using either dikes, levees, riprap, pilings, bulkheads, contouring, widening, or straightening, and developed areas in floodplains and in or near stream channels (Table 24).

Table 24. Potential impacts of channel modification activities to aquatic resources in the Lapwai watershed.

Channel Modification Activity	Potential Impact
Roads/railroads immediately proximal to stream channels	Loss of side-channels, lateral pools, and riparian function
Culverts/stream crossings	Velocity amplification/attenuation
Direct channel manipulation (dikes, levees, riprap, pilings, bulkheads, widening, straightening or relocation)	Loss of side-channels and floodplain function, decrease in channel length, reduction of habitat complexity, reduction in key habitat features such as pools and sorted gravel, decrease in lateral scour pools.
Development of floodplains and or stream channels	Loss of side-channels, flood attenuation, and food-chain support

Understanding how and where modifications affect stream morphology and function is important for understanding fish and wildlife habitat, minimizing economic impacts, and prioritizing and planning restoration activities in areas where they will have the greatest positive impact.

Methods

As outlined in the OWAM, methods for assessing historic and current channel modification generally consist of three steps: 1) compiling available information, 2) mapping channel modifications, and 3) evaluating the impact of modifications.

Due to the absence of detailed stream survey data, the 100-year floodplain was only estimated in areas where channel confinement is low (i.e., LM or FP1-3 CHT designation); a blanket 50′ floodplain was assigned to all other streams. The assignment of the 50′ floodplain to low-order streams was assumed relevant, since the majority of these channels occur in deeply dissected draws and have limited or no floodplain interaction (L. Rasmussen, Nez Perce County Natural Resource Conservation Service, personal communication, April 19th, 2000). The 100-year floodplain was estimated using remote sensing (GIS) techniques. Any land use practices that occur within the floodplain were considered to potentially alter channel morphology.

Variables that best describe channel-altering land use practices within the Lapwai Creek watershed include

- Linear miles of roads and railroads within either 50' of the stream channel or within the 100-year floodplain
- Number of stream crossings (i.e., culverts, bridges, fords)
- Linear miles of channel or floodplain reconstructed or directly manipulated through either dikes, levees, riprap, pilings, bulkheads, straightening, widening, recontouring, relocation, or other forms of channelization
- Square miles of riparian zones or floodplains converted to agricultural or urban areas

Historic Channel Modification

Historically, stream channels, riparian areas, and floodplains in the Lapwai watershed were modified primarily to facilitate economic activities and mitigate or prevent economic loss. Encroachment of urban areas and livestock into the riparian areas of lower Mission and Lapwai Creeks likely contributed to damage following a flood event in 1894. In 1906 the Lewiston Orchards Irrigation District constructed a series of diversions and flumes on Webb and Sweetwater Creeks to irrigate neighboring fruit orchards in Lewiston. The system was updated by the Bureau of Reclamation in 1946 and currently consists of three diversion structures, a series of feeder canals, and Soldier's Meadow Reservoir.

In 1910, the Camas Prairie railroad constructed a grade along the lower portion of Lapwai Creek, functionally restricting the stream from its historic floodplain by forming an embankment that provided for 50-year flood protection. Railroad grades and tracks were also constructed in the headwater portions of Mission Creek for timber harvest. Nearly 13 miles were laid, the majority of which occurred along stream channels. Also in 1910, Winchester Lake was created by impounding the upper portion of Lapwai Creek to address the need for a log storage area for a local mill.

In 1955 U. S. Highway 95 was completed, further restricting portions of Lapwai Creek from its historic floodplain. The section of channel from the confluence with the Clearwater River upstream to the town of Culdesac was effectively channelized in places between the new roadbed and existing Camas Prairie railroad grade. The reach between Sweetwater and Culdesac was heavily channelized during the 1955 road construction, creating an oversteepened gradient within the stream channel. In an attempt to compensate for the gradient change and ameliorate high flows, a series of rock-filled wire mesh (gabion) drops were installed along the new channel. The majority of these structures failed in the 1980s.

The occurrence and magnitude of flooding in the drainage led to the construction of numerous levees and riprap projects in an effort to restrict floodwaters from entering the historic floodplain. The USACE's Walla Walla District was instrumental in the initiation of emergency flood control work following flood events in 1957 and 1965 near the town of Sweetwater (U. S. Army Corps of Engineers 1959, 1967, 1971), and in 1965 below the town of Lapwai and through the town of Culdesac (U. S. Army Corps of Engineers 1966;

Rasmussen 2000). The Corps was also responsible for preventative flood work at Sweetwater, Culdesac, and near the Slickpoo Mission on Mission Creek. Work included channel straightening and enlargement,
riprapping banks, levee construction, and removal of flow-impeding debris ("snagging and clearing") from the channel.

Current Channel Modification

All stream channels in the Lapwai watershed have been modified to some extent. The majority of channel modifications occur in the lower elevations of the drainage, which support the greatest economic development and human population (Figure 29). Table 25 describes results from analyses of current channel modification in the Lapwai drainage.

Tom Beall Subwatershed

The primary modification to stream channels in the Tom Beall subwatershed has been the conversion of floodplain and riparian areas to agricultural ground. Approximately 73% of the total active floodplain area in the Tom Beall drainage has been altered due to agricultural encroachment. Typically, the floodplain and riparian areas are converted to pasture or hay fields and sometimes cultivated for crops. The result is a loss of side-channels, flood attenuation, and food-chain support.

Channels are currently modified from their natural course due to roads and road prisms within either the historic or active floodplain. All stream segments (south, middle, and north forks) have roads that parallel or cross the channel throughout the entire length of the stream segment (with the exception of the uppermost reach of the middle fork). The roads and road prisms occur along the bottoms of the precipitous canyons, which the Tom Beall tributaries drain. Because of valley confinement and relatively small drainage size, there probably never was a high degree of interaction between the stream and floodplain. The width of the canyon floor basically defines the 100-year floodplain along most of the Tom Beall tributaries. Generally, it is only in these flatter areas that road construction is possible due to the high relief of the surrounding terrain. The naturally limited floodplain has thus been further reduced by the presence of roads that simplify the channel, amplify runoff velocities, and reduce baseflow velocities due to decreased roughness and storage.

Table 25. Current channel modification by subwatershed in the Lapwai drainage.

Sub-watershed	Square Miles in Floodplain	Channel-Altering Roads/Railroads (mi)	Stream Crossings (#)[1]	Channel Reconstruction (mi)[2]	Ag./Urban Encroachment (mi^2/mi^2 FP)[3]
Tom Beall	0.49	1.37	27	No data	0.36
Lower Lapwai	3.02	32.29	62	2.2	1.60
Middle Lapwai	1.31	9.88	69	0.87	0.37
Upper Lapwai	0.48	0.00	28	No data	0.07
Lower Sweetwater	0.50	1.93	7	No data	0.07
Middle Sweetwater	0.48	0.00	21	No data	0.13
Upper Sweetwater	0.70	0.86	28	No data	0.01
Lower Webb	0.17	0.02	0	No data	0.01
Upper Webb	0.58	0.48	12	No data	0.00
Lower Mission	1.07	0.00	30	No data	0.48
Middle Mission	0.38	0.00	21	0.32	0.00
Upper Mission	0.43	0.00	14	No data	0.01
Rock Creek	0.42	0.00	15	No data	0.16

[1]The value shown represents only the absolute number of stream miles affected by culverts/stream crossings in a subwatershed

[2]Channel reconstruction includes areas where the channel/floodplain has been either relocated or altered via riprap, pilings, bulkheads, dikes, or levees

[3]Ag./Urban encroachment is expressed as square miles of area converted for agricultural or urban uses per square miles of floodplain or riparian area

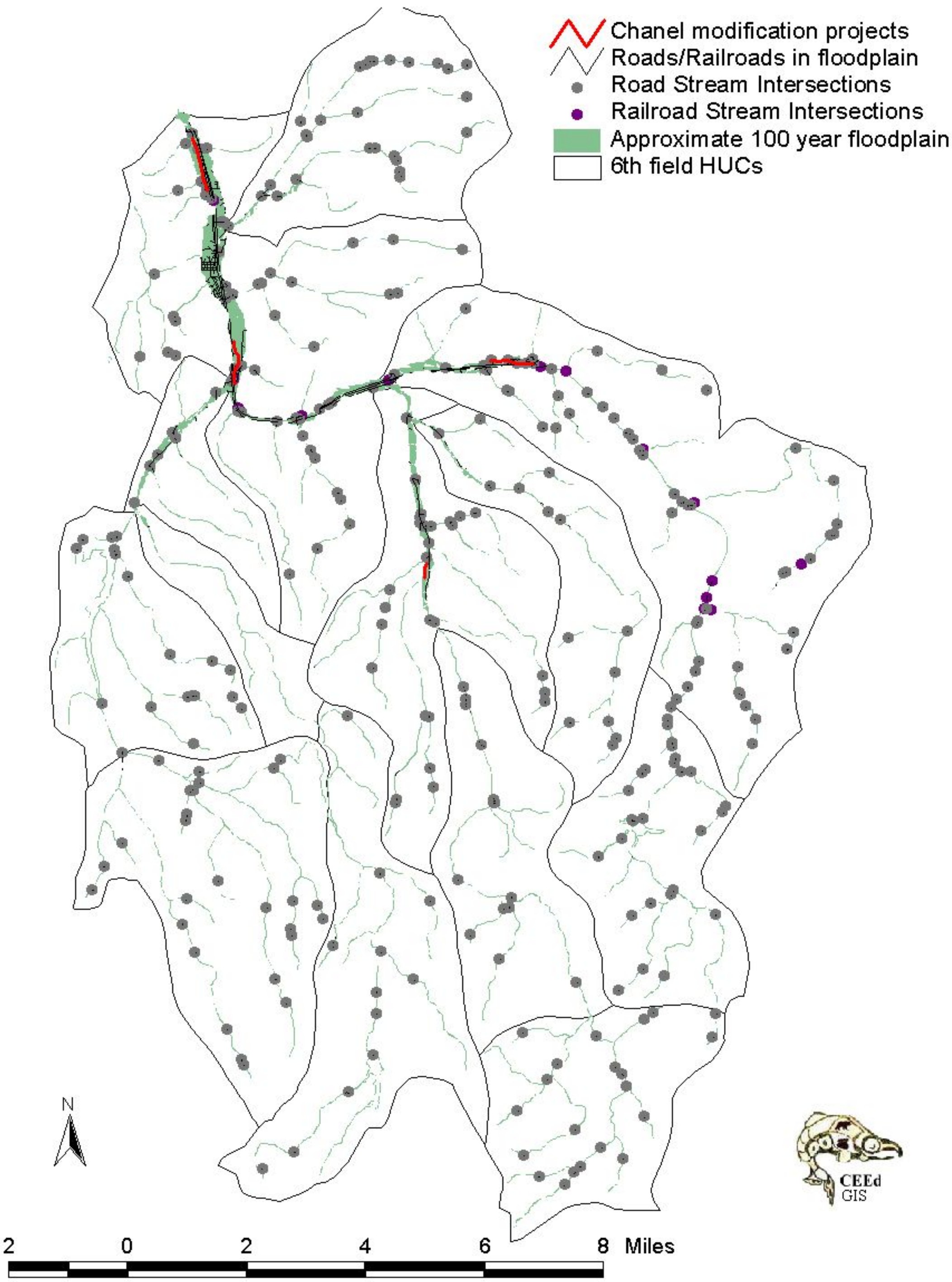

Figure 29. Channel modifications in the Lapwai watershed

Lower Lapwai

The entire length (from the confluence with the Clearwater River to the confluence with Mission Creek) of the lower section of Lapwai Creek has been altered to some degree by land use practices (U. S. Army Corps of Engineers 1959). Perhaps the most evident channel-altering activity are the roads and railroads which parallel, cross, or confine the stream channel along 61% of its length. Of the nearly 53 linear miles of stream channel, there is an estimated 32 linear miles of road and railroad, which may alter the natural morphology of the channel. Additionally, roads and railroads cross streams in the lower Lapwai subwatershed an estimated 62 times, further contributing to changes in hydrological function and stream shape.

Approximately 1,675′ of channel levees immediately below Sweetwater and the Lapwai Game Farm were constructed out of riprap material to contain floodwaters in 1957 (U. S. Army Corps of Engineers 1959, 1967, 1971). The banks were 2-4′ high above the natural ground. Work in 1965 straightened approximately 1/4 mile of channel immediately above the confluence of Sweetwater Creek with Lapwai Creek. Reconstruction of these levees, as well as the construction of new levees downstream from the confluence of Sweetwater Creek, is ongoing. An estimated one-mile section of Lapwai Creek, located approximately .75 miles below the confluence of Tom Beall Creek, has been confined through levees and riprap material in an attempt to protect the neighboring highway (Interstate 95) and railroad grade (Camas Prairie) following the 1965 flood (L. Rasmussen, Nez Perce County NRCS, personal communication August 2000). Although some of the channel reconstruction work is still visible, a considerable portion was destroyed following the 1996 flood.

The stream channel above the Sweetwater area is confined between Highway 95 and the Camas Prairie Railroad bed. The confined channel extends upstream for approximately three miles (near the confluence of Mission and Lapwai Creeks). The bank revetment and reconstruction efforts through the Sweetwater reach will continue to need refortification based on the location of the upstream confined channel and effects of the 1996 flood. Flood flows throughout the confined reach will be amplified due to the lack of floodplain interaction and will continue to scour and erode the downstream channel in an attempt to return the channel to its natural hydrologic equilibrium.

Agricultural and urban development modified approximately 53% of the active and historic floodplain in the lower Lapwai subwatershed. The towns of Lapwai and Sweetwater are estimated to influence approximately 9% of the floodplain. Potential impacts of urbanization include:

- increased runoff and decreased ground infiltration due to impervious surfaces (e.g. pavement, roofs)
- restriction of the floodplain/stream channel interface
- loss of habitat
- water withdrawals (i.e., irrigation for gardens and lawns)

Agricultural development is responsible for modifying the remaining 44% of the floodplain. Agronomic practices in the historic and active floodplain of the lower Lapwai subwatershed include lawns, gardens, pastures, and cropland. The irrigation in this area is primarily facilitated by unscreened portable pump units that are removed in the winter and early spring due to high flows (Rasmussen 2000).

Middle Lapwai

There are nearly 45 linear miles of stream channel and 1.31 square miles of floodplain in the middle Lapwai subwatershed. Roads and railroads modified approximately 22 miles of the channel, while urban growth or agricultural development altered 28% (0.37 mi^2) of the floodplain. In an effort to protect the town of Culdesac, approximately 0.87 miles of channel were reconstructed.

The mainstem of Lapwai Creek, the primary stream in the subwatershed, is heavily channelized between Sweetwater and Culdesac. An artifact of 1955 road construction, the alteration created an oversteepened gradient within the stream channel (Reichmuth 1997). From this point upstream to the southernmost boundary of the subwatershed the stream channel has been extensively modified. Following the 1965 floods, the USACE conducted emergency channel reconstruction through the town of Culdesac. A 9' levee (measured from stream bottom to the top of the levee) was built, extending upstream approximately 4,600' from just below the city sewage lagoons to just above the city limits (U. S. Army Corps of Engineers 1966). The construction process consisted of channel widening, bank contouring, and stream bank revettement using riprap material. The confinement process has virtually eliminated any interaction with the adjacentfloodplain. The natural morphology of the canyon upstream from Culdesac, in combination with Highway 95 and the associated 69 road crossings, has restricted the natural sinuosity of the stream and altered its energy.

An estimated 22% of the floodplain has been developed for agricultural purposes. Development of the floodplain along the middle portion of Lapwai Creek consists primarily of pasture, hayfields, and crop production. The riparian corridor that was present throughout these agriculturally developed sections was of insufficient size to ameliorate the effects of the 1996 runoff event (Idaho Department of Fish and Game et al. 2000).

Lower Sweetwater

Roads are the primary cause of stream channel modification in the lower Sweetwater subwatershed. Most of these roads occur along the middle and lower portions of Sweetwater Creek.

Middle Sweetwater

Channel modification in the middle Sweetwater subwatershed is primarily attributed to agricultural and urban encroachment of the floodplain. More than one quarter of the estimated historic floodplain has been developed for agricultural purposes. Water withdrawals from the Sweetwater irrigation diversion also modify the middle Sweetwater channel, especially with respect to instream flows and associated hydrological processes (refer also to pp. 48-54). Downstream effects of the diversion likely include reduced summer base flow, reduced salmonid habitat, and potentially degraded water quality. The extent of these effects has not been assessed.

Lower Mission

Agricultural and urban developments have modified an estimated 45% of the lower Mission Creek floodplain. The stream channel has been restricted from its floodplain to provide for pasture and tillable acreage, and in many areas has been relocated to the outside edge of the floodplain.

Middle Mission
Reconstruction is the primary form of channel modification in the middle portion of Mission Creek. In 1965 the U. S. Army Corps of Engineers constructed a flood control project along the stream reach passing through the St. Joseph's Children Home (U. S. Army Corps of Engineers 1959, 1961, 2000). Channel enlargement and right-bank levee construction was completed along a 0.32 mile section of stream. In addition to the channel work, snagging and clearing of in-channel debris was performed in 1961 and 1962.

Rock Creek
Channel modification in the Rock Creek subwatershed is due primarily to the encroachment of agriculture onto the floodplain. Approximately 37% of the floodplain is used for tilled agriculture. Agricultural conversion of the riparian and floodplain area has likely contributed to the instability of the channel and the high frequency and great magnitude of runoff events.

Summary

- Stream channels in the lower Lapwai subwatershed have considerably more channel-altering roads and railroads, levees and dikes, and land area converted for agricultural or urban development than all other subwatersheds.

- Roads and railroads have had the most influence on the degree to which stream channels in the Lapwai watershed have been modified.

10 - WATER QUALITY

Water quality in the Lapwai watershed is of primary concern to the assessment of watershed condition. Unlike many other variables used to evaluate the condition of the aquatic ecosystem, water quality can be evaluated by comparing key indicators against certain evaluation criteria. This criterion has been established in part through the federal Clean Water Act.

The federal Clean Water Act (CWA) requires maintenance and restoration of the integrity of the nation's waters where necessary. As part of the CWA, the state of Idaho is required to develop water quality standards appropriate for protection, maintenance, and restoration of waters within its boundaries. Surface water beneficial use classifications were developed and assigned to protect the various uses of surface waters in Idaho as part of this process. Idaho waters with designated beneficial uses are listed in Idaho's Water Quality Standards and Wastewater Treatment Requirements (Idaho Department of Health and Welfare 1999).

Methods

Methods outlined in the OWAM were generally followed for the assessment of water quality in the Lapwai watershed. Specifically, investigators used the outline to address the following questions:

1) What are the designated beneficial uses of water in the Lapwai watershed?
2) What are the water quality criteria that apply to various study areas?
3) Which stream reaches (if any) are listed as water quality limited segments on the 303(d) list by the state of Idaho?
4) Which stream reaches (if any) are identified as "Outstanding Resource Waters"?
5) Are there studies, which indicate that water quality has been degraded or is limiting the beneficial uses?

The OWAM identifies the following assumptions, which were used in this assessment:

- Water quality parameters evaluated are those that most frequently are an issue in watershed analyses. These include: temperature, dissolved oxygen, pH, nutrients, bacteria, turbidity, organic contaminants, and metal contaminants.

- Evaluation criteria are derived from the [Idaho] Water Quality Standards.

- Sensitive beneficial uses such as salmonid fish serve as surrogate measures for other beneficial uses of water to characterize water quality.

- The scope of parameters is limited to evaluation indicators or criteria that are representative of a type of pollution.

Data presented throughout this component reflect that which has been collected through various agencies and entities. We conducted no field studies relating to this specific component.

Characterization of Water Quality

Designated beneficial uses for Lapwai Creek from its mouth upstream to Winchester Lake include

- agricultural water supply
- primary and secondary contact recreation
- cold water biota
- salmonid spawning.

Winchester Lake and upper Lapwai Creek (above Winchester Lake) have designated beneficial uses, which include:

- domestic and agricultural water supply
- primary and secondary contact recreation
- cold water biota
- salmonid spawning

Winchester Lake is also designated a special resource water due to its location within Winchester State Park.

Based on designated beneficial uses and associated water quality standards, Section 303(d) of the CWA requires that states identify and prioritize water quality limited waterbodies within their boundaries. Based on the prioritization process, states must then develop Total Maximum Daily Loads (TMDLs) for each listed waterbody to achieve state water quality standards within a specified period of time.

Two segments within the Lapwai Creek watershed are currently listed under Section 303(d) of the CWA (Idaho Department of Health and Welfare 1998). From its mouth to RM 16.32, Lapwai Creek is listed as water quality limited for

- Bacteria
- Nutrients
- Turbidity and suspended solids
- Temperature
- dissolved oxygen (DO)
- flow and habitat alterations.

Winchester Lake is listed separately for the same limitations as Lapwai Creek as well as organic pesticides.

In 1999, the Winchester Lake Watershed Advisory Group completed a TMDL for Winchester Lake and upper Lapwai Creek. The area included in the study lies entirely within the upper Lapwai Creek subwatershed as defined in this assessment (refer to Figure 2). Major findings of the TMDL process are summarized in Table 26. This assessment will not duplicate the efforts of the TMDL for Winchester Lake/upper Lapwai Creek, but references the report as the most recent and comprehensive assessment of water quality conditions and information relative to that portion of the watershed.

Data for the remaining portions of the Lapwai Creek watershed were solicited from EPA, IDHW, NPT, NRCS, and BLM. The EPA STORET database (Environmental Protection Agency 1999) provides a central database of water quality data collected by a variety of agencies and represents the most comprehensive view of water quality conditions within the Lapwai Creek watershed. With the exception of this database, no other water quality information was obtained.

Water quality data from the Environmental Protection Agency (1999) for the Lapwai Creek watershed is limited and largely dated (1970-1990). Some of the most comprehensive data is associated with Winchester Lake and has been incorporated into the recently completed TMDL (Winchester Lake Watershed Advisory Group 1999). The data collected in other areas of the watershed is not suitable for comparison to water quality standards due to limited numbers of observations, which were collected inconsistently over long periods of time (the maximum is approximately 150 observations since 1974 at Lapwai Creek near Lapwai). Because of these limitations it is difficult to include a substantive discussion of water quality concerns as they relate to the Lapwai Creek watershed. Discussions of bacteria and pesticide issues within the watershed however, will be presented to address inconsistencies in "reported" versus "recorded" bacteria levels, as well as recent conclusions concerning pesticides.

Bacteria

Fecal coliforms are the most commonly used indicator of potential pollution by various pathogens in surface waters (Laws 1993 p170). A study conducted by the Idaho Department of Health and Welfare (1980) is commonly cited for reporting frequent bacteria violations within the Lapwai Creek system (Kucera et al. 1983; Fuller et al. 1985). Idaho water quality standards (Idaho Department of Health and Welfare 1999) state that waters designated for primary contact recreation should not exceed:

- 500 colonies/100 ml of fecal coliform at any time
- 200 colonies/100 ml in more than 10% of samples collected over a 30 day period
- or a geometric mean of 50 colonies/100 ml based on five samples taken within a 30 day period

The Idaho Department of Health and Welfare (1980) took bimonthly samples from four mainstem locations on Lapwai Creek during 1978 and 1979. Although the study reported frequent bacteria violations, this determination appears to be in error based on the published standard. The study apparently drew single samples at each site during each of six sampling events. This approach allows for comparison only to the single sample standard of 500/100 ml.

A study conducted by Latham (1986) supports the idea that coliform violations in Lapwai Creek may be less frequent than reported by the Idaho Department of Health and Welfare (1980). Latham (1986) reported that only one of 91 samples collected was in violation of the applicable standard (500/100 ml). Results were based on biweekly samples collected from seven locations within the Mission and upper Lapwai Creek drainages during portions of 1985 and 1986.

Table 26. Winchester Lake and upper Lapwai Creek loading and allocation summary (Winchester Lake Watershed Advisory Group 1999).

Pollutant	Waterbody	Target(s)	Sub-watershed[1]	Load	Load Allocation	Reduction Needed
Nutrients	Winchester L.	37 ug/l total P				62%
	Lapwai Cr.	50 ug/l total P (May-Oct)				57%
Sediment	Winchester L.	Total reduction in sediment to Winchester Lake is the same as that in LP-6		571 tons/yr	43 tons/yr	93%
	Lapwai Cr.	Improving trend in average annual sediment load with natural background as interim target and full support of salmonid spawning and cold water biota uses as the ultimate measure of success	LP-1	322 tons/yr	21 tons/yr	93%
			LP-2	122 tons/yr	13 tons/yr	89%
			LP-3	234 tons/yr	18 tons/yr	92%
			LP-4	526 tons/yr	36 tons/yr	93%
			LP-5	555 tons/yr	40 tons/yr	93%
			LP-6	571 tons/yr	43 tons/yr	93%
Pathogens	Winchester L.	TMDL determined unnecessary				
	Lapwai Cr.	< 500 cfu/100 ml at all times > 200 cfu/100 ml in < 10% of samples over 30 days < 50 cfu/100 ml as geo. mean in 5 samples over 30 days		1.9 E 10 cfu/day @ 0.37 cfs	1.8 E09 cfu/day @ 0.37 cfs	90%
Temperature	Winchester L.	Phosphorous/DO TMDL established as surrogate				
	Lapwai Cr.			($j/m^2/sec$)	($j/m^2/sec$)	Shade increase needed
		78% shade	LP-1	225.6	68.9	50%
		92% shade	LP-2	297.6	25.1	87%
		79% shade	LP-3	?[2]	65.8	76%
		78% shade	LP-4	283.1	68.9	54%
		79% shade	LP-5	244.4	65.8	57%
		95% shade	LP-6	134.7	15.7	38%
Pesticides	Winchester L.	TMDL determined unnecessary				

Pesticides

Winchester Lake is the only waterbody within the Lapwai Creek watershed on the 303(d) list for pesticide contamination, a listing that occurred in 1994. Pesticide contamination was identified as a potential concern within Winchester Lake when low levels of DDT, hexachlorobenzene, and hexachlorocyclohexane were found in trout and bullhead in 1985 (Winchester Lake Watershed Advisory Group 1999 p6). More extensive testing of fish tissues was conducted in 1998 by examining trout, bullheads, perch, muskie, and largemouth bass. DDT compounds, hexachlorobenzene, triallate, and DDMU were detected in fish tissues collected in 1998, with the highest concentrations found in bullheads. Because the health risks associated with fish consumption did not exceed risk levels associated with state water quality standards, Winchester Lake was recommended for removal from the 303(d) pesticide listing.

Summary

- The designated beneficial uses for Lapwai Creek from its mouth upstream to River Mile 16.32 are limited by bacteria, nutrients, turbidity and suspended solids, temperature, dissolved oxygen, and flow and habitat alterations.

- The designated beneficial uses for Winchester Lake are limited by bacteria, nutrients, turbidity and suspended solids, temperature, dissolved oxygen, flow and habitat alterations, and organic pesticide contamination.

- Current and comprehensive water quality data is limited to Winchester Lake. The lack of data collection consistency in other portions of the watershed does not allow for suitable comparisons to be made against water quality standards. This represents a data gap, which needs to be addressed.

- Bacteria standards on the mainstem of Lapwai Creek were reportedly in violation and warrant further investigation.

11 - FISHERIES

This chapter characterizes Lapwai fish assemblages and evaluates their habitat. The fish assemblages serve as indicators of biological conditions in the subwatersheds. They indicate that either naturally or as a result of anthropogenic activities, an area of habitat is not suitable.

Methods

Assessment of the Lapwai watershed fishery was conducted using methods outlined in the OWAM. The manual suggests relying exclusively on published or non-published data to answer the following questions (reproduced from Watershed Professionals Network 1999):

- What fish species are documented in the watershed? Are any of these currently state- or federally listed as endangered or candidate species?
- What is the distribution, relative abundance, and population status of salmonid species in the watershed?
- Which salmonid species are native to the watershed, and which have been introduced?
- Are there potential interactions between native and introduced species?
- What is the condition of fish habitat in the watershed according to existing habitat data?
- Where are potential barriers to fish migration?

The following assumptions were used in this component (reproduced from Watershed Professionals Network 1999):

- Salmonid fish are typically the most sensitive fish species occurring within a stream network. If habitat conditions are suitable for salmonid fish, then they reflect "good" habitat conditions for the watershed.

- Fish distribution is a function of the quantity and quality of habitat types available in the watershed. The distribution of fish species in a watershed is a function of the distribution and condition of the CHT's found there.

Data for this component have been previously collected. No field studies were conducted.

Fisheries Characterization

With the exception of rainbow and steelhead trout, little emphasis has been placed on documenting fisheries within Lapwai Creek watershed. Steelhead are by far the most suited anadromous fish to the Lapwai Creek system (Cates 1981). Only one juvenile chinook salmon has been observed in the Lapwai Creek watershed, and it is thought to have strayed from another system (Kucera et al. 1983). No natural production of chinook salmon is known to occur in the watershed (Kucera et al. 1983).

Kucera and Johnson (1986) found less than 10% age two overyearling rainbow trout and steelhead among those collected in central Mission Creek, and none age three or greater. These findings suggest that the majority of the population observed at the time of the survey consisted of anadromous rather than resident forms of rainbow trout. This assumes that the majority of outmigrating anadromous salmonids (smolts) will do so after no more than three years of freshwater residence. The drainage and known to exist above Winchester Lake. Thomas et al. (1985) documented spawning of 9-12" rainbow trout in the upper-most reaches of Mission Creek, probably representing redband trout.

Species Present/Distribution

Kucera et al. (1983) found 10 species of fish inhabiting the lotic environments of Lapwai Creek during 1982 surveys (Table 27). Others have corroborated the 1982 survey findings (Fuller et al. 1985; Kucera and Johnson 1986). Surveys by the Idaho Department of Fish and Game (1999) additionally found westslope cutthroat trout and brook trout inhabiting Mission Creek. Surveys conducted by the Winchester Lake Watershed Advisory Group (1999) and Thomas (et al. 1985) documented the presence of redband rainbow trout in the headwater reaches of Lapwai and Mission Creeks, raising the total number of species inhabiting lotic environments in the Lapwai watershed to 13.

A total of 18 distinct fish species have been identified in the Lapwai Creek watershed, including both resident and anadromous forms of rainbow trout and steelhead (Table 27 and Table 28). Of the 18 species, seven represent introduced Winchester Lake Watershed Advisory Group (1999) however, states that native redband trout are also present in the species, five of which have been introduced into Winchester Lake (Table 28). Both perch and black crappie were illegally introduced into Winchester Lake in recent years (E. Schreiver, IDFG Fisheries Biologist, personal communication January 13, 2000). With the exception of tiger muskie (*Esox lucius x masquinongy*), a sterile species, all introduced fish species in Winchester Lake exhibit self-reproducing populations (Winchester Lake Watershed Advisory Group 1999).

Spawning and Rearing

Spawning and rearing of salmonids occur within all major tributaries to Lapwai Creek, including Sweetwater, Mission, Webb, Rock, and Tom Beall Creeks (Figure 30), with spawning typically occurring during March and April (Table 29). Spawning and rearing of steelhead generally occurs in the lower elevation areas below the escarpment that divides the watershed. Passage barriers occur in all tributaries except Tom Beall and Rock Creek, assumedly limiting upstream movement of anadromous fish. Spawning and rearing of resident salmonids (redband trout) has been documented in the upper reaches of Lapwai and Mission Creeks, and is likely to occur in the upper reaches of Webb and Sweetwater Creeks.

Table 27. Fish species identified or cited within lotic environments of the Lapwai Creek watershed.

Common Name	Scientific Name	Location (Major Tributary)	Notes	Primary Source(s)
Rainbow trout/Steelhead	*Oncorhynchus mykiss*	Lapwai, Sweetwater, Webb, Mission Creeks	ESA threatened species.	1
Chinook salmon	*Oncorhynchus tshawytscha*	Lapwai Creek (lower)	Probable stray	1
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	Mission Creek		2
Redband trout	*Oncorhynchus mykiss*	Lapwai Creek above Winch. Lake Mission Creek (upper 5.5 miles)		3, 4
Brook trout	*Salvelinus fontinalis*	Mission Creek	Introduced species	2
Speckled dace	*Rhinichthys osculus*	Lapwai, Sweetwater, Webb, Mission Creeks		1
Redside shiner	*Richardsonius balteatus*	Lapwai, Sweetwater, Mission Creeks		1
Chiselmouth chub	*Acrocheilus alutaceus*	Lapwai Creek, Mission Creeks		1
Northern pikeminnow	*Ptychocheilus oregonensis*	Lapwai, Mission Creeks		1
Bridgelip sucker	*Catostomus columbianus*	Lapwai, Sweetwater, Webb Creeks		1
Largescale sucker	*Catostomus macrocheilus*	Lapwai Creek		1
Smallmouth bass	*Micropterus dolomieui*	Lapwai Creek (lower)	Introduced species	1
Piute sculpin	*Cottus beldingi*	Lapwai, Sweetwater, Webb, Mission Creeks		1

1 Kucera et al. 1983
2 Idaho Department of Fish and Game 1999
3 Winchester Lake Watershed Advisory Group 1999
4 Thomas et al. 1985

Table 28. Fish species identified or cited as inhabiting Winchester Lake (Winchester Lake WAG 1999).

Common Name	Scientific Name	Notes
Tiger muskie	*Esox lucius* x *masquinongy*	Introduced species
Black bullhead	*Ictalurus melas*	Introduced species
Black crappie	*Pomoxis nigromaculatus*	Illegally introduced species
Largemouth bass	*Micropterus salmoides*	Introduced species
Yellow perch	*Perca flavescens*	Illegally introduced species

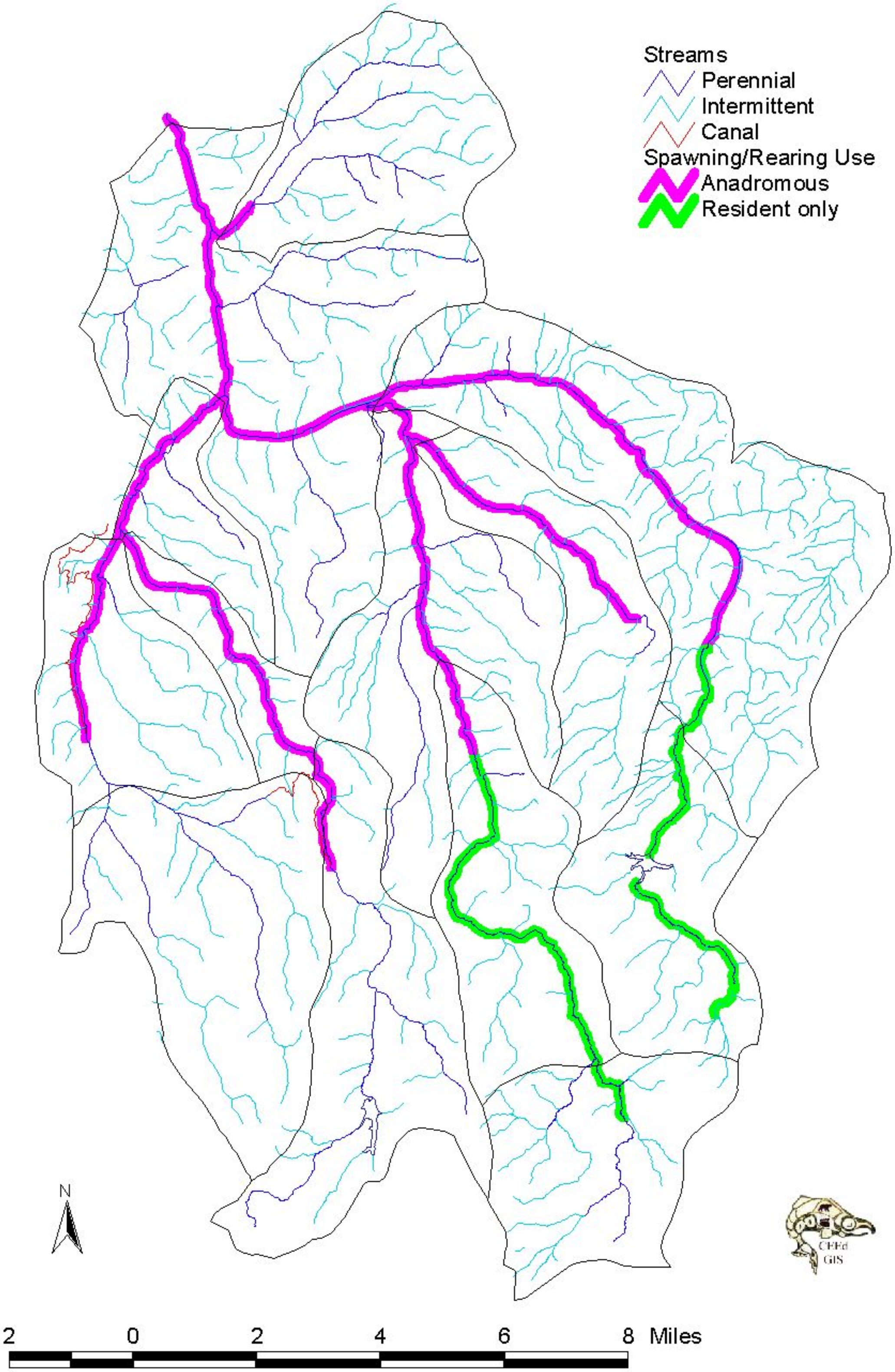

Figure 30. Spawning and rearing use by resident and anadromous salmonids in the Lapwai Creek watershed

Table 29. Timing of various life history activities of A-run steelhead for the Lapwai Creek watershed.

Activity	Timing/Duration
Adult pre-spawn migration (up/downstream)	March-April
Adult post-spawn migration (up/downstream)	April-May
Spawning	March-April
Emergence	June
Rearing	June through 2nd April
Smolt outmigration	2nd April after emergence
Non-specific adult migration (up/downstream)	October-April
Non-specific juvenile migration (up/downstream)	April-November

Barriers

Seven full-, partial-, or potential fish passage barriers occur in the Lapwai Creek watershed. Four of these are in Mission Creek, while Sweetwater, Webb, and Lapwai Creeks contain one each (Table 30). There is poor documentation of fish barriers within the Lapwai Creek system, with only approximate locations cited, often with no description of what actually forms the barrier(s). Barrier status (i.e., partial or complete) is often neglected or conflicting between authors.

Murphy and Metsker (1962) estimated that approximately one third of the suitable spawning area in Mission Creek is blocked to anadromous fish by a series of barriers. The Bureau of Land Management (2000) reported a similar series of barriers in Mission Creek, as did Kucera et al. (1983). The specific locations and descriptions of barriers as reported in Kucera et al. (1983), were not defined but assumedly correspond to those identified in previous investigations due to their relative proximity. Several small waterfalls located upstream of the aforementioned barrier(s) were identified as potential barriers by Cates (1981), and as complete barriers by Murphy and Metsker (1962). The locations of these waterfalls differ between the two reports, again making interpretation of the actual number of obstructions in Mission Creek unclear.

Irrigation diversions operated by LOID form a complete barrier to fish migration in Sweetwater Creek at RM 8.9 (Bureau of Land Management 2000; Cates 1981; Kucera et al. 1983) and at least a partial barrier in Webb Creek at approximately RM 9.3 (Kucera et al. 1983). In another description of the Sweetwater Creek diversion dam, Murphy and Metsker (1962) suggest that it represents only a partial or potential barrier to upstream migration. The more recent descriptions are likely more accurate due to modifications to the structure since 1962. Kucera et al. (1983) identified several culverts in Lapwai Creek as potential fish barriers, but no substantive information was provided regarding their locations.

Table 30. Locations, status, and structure of fish passage barriers identified within the Lapwai Creek watershed.

Stream	Location	Status	Forming Structure	Source
Mission Creek	RM 8.7	Complete	Waterfall – 4' high	Murphy and Metsker 1962; Bureau of Land Management 2000
Mission Creek	RM 9.7	Potential	Unidentified	Kucera et al. 1983
Mission Creek	Above RM 13	Potential	Several small waterfalls	Cates 1981
Mission Creek	RM 8.7 -9.3	Complete	Several small waterfalls	Murpy and Metsker 1962
Sweetwater Creek	RM 8.9	Complete	Irrigation diversion structure (LOID)	Bureau of Land Management 2000; Cates 1981; Kucera et al. 1983
Webb Creek	RM 9.3	At least partial	Irrigation diversion structure (LOID)	Kucera et al. 1983
Lapwai Creek	Several miles below RM 21.3	Potential	Several culverts	Kucera et al. 1983

Hatcheries and Fish Stocking

The Nez Perce Tribe operates the only hatchery in the Lapwai Creek watershed at Sweetwater springs. The facility has the capacity to hatch two million salmon eggs (Murphy and Metsker 1962), and is used to rear chinook salmon for release at sites throughout the Clearwater River subbasin; however, none are released within the Lapwai Creek watershed.

Fish stocking records were obtained through the Idaho Department of Fish and Game (2000) online stocking database and are summarized in Table 31. This database contains IDFG stocking records for the period from 1967 through 1996. Murphy and Metsker (1962) reported the earlier existence of a sport fishery involving planted rainbow trout within the Lapwai Creek watershed, but provide no information on stocking locations. Both largemouth bass and black bullhead were introduced to Winchester Lake (Winchester Lake Watershed Advisory Group 1999). No stocking records were found in the IDFG online database, suggesting that stocking of these species occurred prior to 1967.

Since 1967, the majority of fish stocking in the Lapwai Creek watershed has been in Winchester Lake, which has been stocked with single or multiple species annually since at least 1968. Species stocked into Winchester Lake include numerous strains of rainbow, kamloops, and rainbow/cutthroat trout hybrids. Webb Creek was stocked with rainbow trout from 1979 through 1981, and brook trout were planted in Sweetwater Creek in 1979.

Table 31. Summary of fish stocking information available for waters within the Lapwai Creek watershed.

Species	Years Stocked	# Stocked	Stocking Location	Source
Rainbow trout	Pre- 1967[1]	Unknown	Unknown	Murphy and Metsker 1962
Largemouth bass	Pre- 1967[1]	Unknown	Winchester Lake	Winchester Lake Watershed Advisory Group 1999[2]
Black bullhead	Pre- 1967[1]	Unknown	Winchester Lake	Winchester Lake Watershed Advisory Group 1999
Cutthroat trout	1968–1975	563,446	Winchester Lake	Idaho Department of Fish and Game 2000
Kamloops	1991, 1993, 1994	10,004	Winchester Lake	Idaho Department of Fish and Game 2000
Kamloop/Steelhead cross	1987–1990, 1992, 1994–1996	139,138	Winchester Lake	Idaho Department of Fish and Game 2000
Rainbow/Cutthroat trout hybrid	1976, 1977, 1981, 1989, 1990, 1991, 1995	105,168	Winchester Lake	Idaho Department of Fish and Game 2000a
Rainbow trout (various strains)	Since 1968	2,298,630	Winchester Lake	Idaho Department of Fish and Game 2000
Brook trout	1979	1,940	Sweetwater Creek	Idaho Department of Fish and Game 2000
Rainbow trout	1979–1981	3,150	Webb Creek	Idaho Department of Fish and Game 2000
Coho salmon	Since 1996	Unknown	Unknown	Author Notes[3]

[1]Records pre-date those included in the IDFG online database
[2]Winchester Lake Watershed Advisory Group 1999
[3]Coho trapping summary notes obtained at Interagency Coordination Meeting, 5/9/00

Habitat Condition

Kucera et al. (1983) conducted the most comprehensive review of fish habitat conditions in the watershed, including 12 sites divided among Lapwai, Sweetwater, Mission, and Webb Creeks (Table 32). Although much of the habitat data collected was qualitative in nature, it does provide a relative picture of habitat variability between streams and between sites within streams. High annual flow variation, low summer flows, high summer temperature, sedimentation, and lack of instream cover have been identified as habitat concerns (Kucera et al. 1983; Fuller et al. 1985).

Since the habitat conditions reported by Kucera et al. (1983) are based on data collected in 1982, they are unlikely to accurately represent current conditions in all areas; however, the study is the most comprehensive assessment of fish habitat conditions within the watershed. The study's purpose was to delineate baseline stream habitat conditions, and will provide useful information about the success of enhancement strategies when data become available for comparison.

Table 32. Summary of habitat conditions reported by Kucera et al. (1983) for streams within the Lapwai Creek watershed.

Stream (Length in miles)	Stream Mile Sampled	Flow Variation	Max. Temp.	% Instream Cover	% Bank Erosion	Riparian Vegetation	Grazing Pressure	Spawning Substrate	Cobble Embed.	% Fines[2]
Lapwai Creek (28.0)	21.3	Moderate	25.0	5.5	20.0	Very sparse	Absent	----	½ gasket	----
	15.3	Extreme	27.2	1.7	8.3	Sparse	Little	Abundant	----	10
	8.5	Extreme	22.2	0.6	26.5	Sparse	----	Abundant	½ gasket	----
	0.8	Extreme	> 26.4	5.2	7.3	Light	----	Abundant	----	10
Sweetwater Creek (9.2)	5.4	Extreme	22.2	3.1	46.3	Good	Mod.-Heavy	----	----	----
	1.7	Extreme	22.2	5.4	15.0	Good	Mod.-Heavy	----	----	----
Mission Creek (21.3)	16.7	Moderate	26.1	16.1	43.4	Negligible	Mod.-Heavy	Present	½ gasket	30
	13.9	Moderate	26.1	7.7	38.3	Light	Light-Mod.	Abundant	½ gasket	25
	8.0	Moderate	22.2	7.2	9.7	Light	Moderate	Abundant	½ gasket	----
	0.2	Extreme	24.4	0.4	25.0	----	Present	Abundant	½ gasket	25
Webb Creek (17.0)	10.8	Moderate	21.1	9.5	10.2	Light-Mod.	----	Adequate	½ gasket	20
	0.8	Moderate	21.7	4.4	6.4	Light-Mod.	Moderate	Abundant	----	5

1 No effect: Cobble easily moved, surrounded by large substrate (> 0.25 inch);
¼ gasket: Cobble still easily moved but ¼ of surface area surrounded by sand and fine material; According to Fuller et al. (1985) embeddedness values greater than ¼ gasket indicate that steelhead habitat is being reduced;
½ gasket: Cobble difficult to move with hand or foot; ½ of surface area lost to sand and fine material;
¾ gasket: Cobble very difficult to move; ¾ of surface material lost to sand and fine material;
Full gasket: Cobble almost impossible to dislocate from streambed; surface area needed for aquatic insect habitat almost completely eliminated; "gasket" of sediment even with upper surface of cobble.

2 Bjornn and Reiser (1991; Fig. 4.9) report that emergence of steelhead fry is substantially reduced when fines constitute more than 30% of the substrate.

Habitat Improvement

The only record of habitat improvement work in the Lapwai Creek watershed was a project completed by the NRCS. The Nez Perce Tribe submitted proposals for restoration and habitat enhancement to potential funding agencies, although no reports on the completion of such work were located. Contact with the Nez Perce Tribal Watershed Department suggests that such proposals were either not funded or are yet to be completed (F. McGowan, Nez Perce Tribe, personal communication August, 2000).

Substantial efforts have been directed at reducing runoff and sedimentation from agricultural land in Mission and upper and middle Lapwai Creeks since 1990. The work has been conducted through the NRCS and other agencies as part of the Idaho State Agricultural Water Quality Program (SAWQP; Idaho Department of Fish and Game et al. 1994). Efforts include improving instream habitat in response to the former Soil Conservation Service's (currently NRCS) anadromous fisheries recovery initiative (Idaho Department of Fish and Game et al. 1994). Potential project benefits include riparian protection and enhancement, enhancement of instream habitat, improved baseflow conditions, and reduced sediment, bacteria, and nutrient loading (Idaho Department of Fish and Game et al. 2000).

In 1990 the SCS (Soil Conservation Service, now the NRCS) recommended changes to farming practices including increased use of no-till (1,440 acres) and crop residue (22,360 acres), cross slope farming (580 acres), stripcropping (1,280 acres), pasture and hayland planting (2,270 acres), grassed waterways (37,000'), and 14 sediment basins and land terraces (35,600'; Soil Conservation Service et al. 1990). In 1994 Idaho Department of Fish and Game et al. (1994) recommended additional changes to farming practices, including

- channel vegetation (five acres)
- riparian fencing (95,440')
- deferred grazing (11 acres)
- livestock exclusion (32 acres)
- streambank and shoreline protection (9,080')
- stockwater sources (29)
- stock trails (21)
- sediment basins (71)
- water and sediment control basins (643)
- flood plain easements (97,150').

As of 1994, approximately $1.4 million had been spent to implement the land treatment practices within the Lapwai and Mission Creek subwatersheds proposed in 1990, with an estimated $310,000 required to fully implement the remaining land treatment alterations as proposed. Another $2 million was to be spent on the supplemental improvements proposed in 1994 (Idaho Department of Fish and Game et al. 1994). In 2000, approximately 90% of the SAWQP work proposed in 1990 and 30% of the restoration work proposed in 1994 was completed (Idaho Department of Fish and Game et al. 2000). Information on which land use alterations were implemented was unavailable. Although substantial work has been completed, no monitoring of instream impacts has been conducted.

Summary

- There are currently a total of 18 species of fish inhabiting the Lapwai watershed. Fourteen of these species occur exclusively in lotic environments while four occur within Winchester Lake. Of the fourteen species occurring in mainstem or primary tributaries, five are classified as salmonids.

- Rainbow trout/Steelhead are an ESA threatened species, and occur within Lapwai, Sweetwater, Webb and Mission Creeks. They are thought to be limited to anadromous forms only.

- Seven fish passage barriers occur in the Lapwai Creek watershed. Four are located in Mission Creek, while Sweetwater, Webb, and Lapwai Creeks contain one each. The barriers represent full, partial or potential blockage to fish passage. Further investigation regarding the specific locations of barriers, type of barrier, and the species-specific life history stages that are impeded is warranted.

- Fish stocking of species in lotic portions of the watershed is currently limited to a reintroduction effort of coho salmon. Fish are currently stocked in Winchester Lake as a put-and-take fishery and include numerous strains of rainbow, kamloops, and rainbow/cutthroat trout hybrids.

- The most current and comprehensive fish habitat data available was from 1985. This data identified high annual flow variation, low summer flows, high summer temperature, sedimentation, and lack of instream cover as primary habitat concerns.

  - Data describing habitat improvement efforts in the Lapwai watershed are limited. Although not directly related to instream habitat improvement, there have been substantial efforts directed at reducing runoff and sedimentation from agricultural land in Mission and upper and middle Lapwai Creeks. This work has been ongoing since 1990.

12 - THEORETICAL IMPLICATIONS FOR AQUATIC RESOURCES

When drafting an assessment, it is often difficult to separate out "generic" information from that which specifically pertains to the study area. The definition of "generic" in this case, refers to that information which may be applicable over a wide area, such as discussions regarding limiting factors to fish distribution and abundance. With this in mind, the authors agreed that an individual chapter devoted primarily to the discussion of non-specific information, as it relates to individual components, would be warranted. Furthermore, the inclusion of this section will provide users with an additional source of information for decision making and planning.

Based upon the Lapwai Creek watershed characterization component, land-use activities have historically and are currently impacting the aquatic resources of the drainage, the effects of which appear to be cumulative. The absence of comprehensive historic or current aquatic baseline data in the water quality and fish/fish habitat components effectively prohibited an assessment of the degree to which aquatic resources have been influenced. Assumptions relating to the health of the aquatic ecosystem are therefore predicated upon surrogate components including 1) hydrology and water use, 2) riparian/wetlands, 3) sediment sources, and 4) channel modification.

Hydrology and Water Use

The current hydrological condition in the Lapwai watershed does not appear favorable for aquatic and semi-aquatic flora and fauna. The substantial irregularity in both the timing and volume of annual peak flows coupled with extended periods of low baseflows create inhospitable conditions for many species. Excessively high peak flows, such as those generated in 1996, remove or disrupt riparian vegetation, alter channel morphology, and eliminate vertebrate and invertebrate habitat. Prolonged periods of low flows restrict cold-water biota to areas with sufficient dissolved oxygen and temperatures, which in Lapwai Creek are minimal.

No overriding or definitive factors emerged from our analyses that could be exclusively attributed to the current hydrological conditions in the Lapwai watershed, thus suggesting impacts to be cumulative. For example, analyses of various land-use activities and their associated potential for peak flow enhancement were either inconclusive or low for all respective activities, a result which failed to explain the highly variable peak and annual flow timing recorded near the mouth and estimated throughout the various subwatersheds.

It is likely that prolonged, widespread agricultural practices, grazing, and channel modification in Lapwai Creek interact to affect the contemporary hydrograph. Consequences of repeated, progressive, sequential, or coexisting land use activities upon a given landscape may result in cumulative watershed effects (CWE's) that are influenced through either similar, complementary, cascading, or interdependent land-use activities (Reid 1993). In the case of Lapwai Creek and its associated tributaries, one of the most notable but least calculable cumulative effects is the altered hydrograph.

Of all the landscape changes caused by human activities, agricultural practices probably have had the widest impact (Allan 1995), and when coupled with grazing, have probably had the greatest influence on hydrology in the Lapwai watershed. Agricultural activities typically promote the maximization of tillable ground, which in many cases is at the expense of lotic environments. Channel morphologies are made straighter, wider, and deeper to promote drainage of low-lying areas (Quigley and Arbelbide 1997c), affecting flow timing and volume (Gordon et al. 1992). Channelization or straightening a stream accelerates water movement downstream, causing the channel to deepen and water table to lower (Forman 1995). In this respect, the indirect modification of stream channels to promote agriculture represents a "cascading" cumulative effect, or one in which one type of use influences a second to provoke an environmental response (Reid 1993).

Another type of cumulative effect likely influencing the Lapwai hydrograph is the "same influence" effect. If an environmental parameter (i.e. channel morphology) is altered in the same way by repeated or multiple activities (i.e. agriculture and diking), those activities all contribute to the watershed's response (i.e. altered peak flow) (Reid 1993). The consequent effect of the altered response (increased peak flow) may then contribute to the alteration of other environmental processes such as sediment generation and transport, production and transport of organic matter, and production and transport of chemicals and heat (Reid 1993).

Complementary CWE's are also likely contributing to the altered hydrology of the watershed. Complementary effects occur when land-use activities contribute to the same result through different mechanisms (Reid 1993). An example of a complementary CWE in the Lapwai watershed is ground compaction from grazing and diverted channels from agriculture, both of which contribute to altered peak flows. Livestock in riparian areas may cause, among other impacts, streambank compaction through trampling (Platts 1985; 1991). The reduction in the infiltration capacity of the soil often results in decreased runoff storage, increased peak flows, and prolonged periods of reduced baseflows (Gordon et al. 1992). Flood protection efforts through diking or construction of levees restrict the natural lateral movement of channels, thereby changing peak flow timing (Brooks et al. 1991).

The withdrawals of water by the Lewiston Orchards Irrigation District have also contributed to changes in the flow regime in the Lapwai watershed. Similar to the cascading cumulative effects from agriculture and grazing, water withdrawals and consequent changes to hydrological characteristics have been shown to alter the physical, chemical and biological characteristics of streams and rivers. Water withdrawals for off-stream uses, such as agricultural irrigation, can modify the hydrologic regime of a stream by reducing the water table, floods, channel migration and temporal and spatial heterogeneity of instream habitat (Forman 1995). Reduced flooding and lowered water tables have negative implications for vegetation occurring along streambanks. A decrease in the dispersal of nutrients and seeds that commonly accompany flooding will have repercussions for future or continued establishment of riparian flora (Gecy and

Wilson 1990). Effects of a decrease or reduction in riparian communities are discussed below.

Riparian / Wetlands

Loss or reduction of riparian vegetation and wetland areas appears to be common in the Lapwai watershed. Based upon literature review and assessment of GIS layers, functional riparian areas are most often associated with portions of the watershed that are too steep to farm, ungrazed, maintain annual or semi-annual flow, or in areas not bordered by roads or structures.

As discussed in previous sections of this document, tillable acreage in the Lapwai watershed accounts for the greatest land use percentage by area and often abuts stream channels. Riparian vegetation occurring in these areas is commonly restricted to either a thin (<50 feet) vegetation buffer strip (VBS) or is functionally absent. The long-term effectiveness of the VBS at ameliorating the transport of sediment and nutrients (i.e. fertilizers) into streams depends upon the volume of sediment accumulation (Allan 1995) and plant uptake ability (respectively) (Omernik et al. 1981).

In the Lapwai watershed, sediment from agriculture has likely been accumulating in or near stream channels for more than 100 years, especially in depositional or low-lying stream reaches. Furthermore, plant uptake ability is restricted due to the conversion of mature vegetation to annual crops, hence contributing to water quality problems. Especially serious challenges to the effectiveness of VBS are drain tiles beneath croplands, which carry sub-surface water directly into stream channels, bypassing the riparian zone completely (Allan 1995). Draining agricultural ground through tiling is a common practice in the Lapwai watershed due to the limited growing season (L. Rasmussen, NRCS, personal communication, April, 2000), although it is unknown as to the extent to which fields drain directly into stream channels.

In addition to their filtration and storage functions, riparian areas provide shade, cover, food, and other valuable resources for aquatic biota, endemic wildlife species, and domestic livestock. Riparian areas attract livestock for the same reasons that they attract wildlife; the areas contain more forage (i.e., the protein content found in sedges and saplings is higher and more constant than in upland species), water, and shade (Platts1991). Some potential effects livestock have when present in riparian areas include

- Shearing or sloughing of streambank soils, trampling
- Increases in fecal coliform bacteria, and/or changes in the magnitude or timing of streamflow events resulting from a loss in vegetative cover
- Increased width:depth ratios or shifts in channel shape due to streambank sloughing
- Changes from woody species to grasses and forbs, or a decrease in plant vigor

The hydrological modification caused from the conversion of riparian vegetation to crops affects downstream riparian areas not bordered by tillable ground. In an agriculturally dominated landscape, such as the Lapwai watershed, spring floodwaters, which normally recharge soils and aquifers, are exported, consequently lowering water tables and reducing summer baseflows. The subsequent water stress debilitates riparian vegetation, especially under the high evaporative demand of hot summer days. Continued water stress can eventually cause riparian corridors to shrink and shift in composition (Allan 1995; Smith et al. 1991).

Encroachment of roads, dikes, levees, and berms has further reduced the amount of riparian areas in the Lapwai watershed. In an effort to protect roadbeds and/or personal property, a proportionate amount of the linear stream miles in the watershed have been straightened, often at the expense of the adjoining riparian area. Riprap boulders, cement, gravel or rock berms and levees effectively disconnect the crucial aquatic/terrestrial interface, which is required by many riparian plant species. And, as discussed previously, the restriction of lateral exchanges between river and floodplain will limit the overall biological productivity of the reach (Alan 1995). Lowland portions of the Lapwai watershed are those most affected by channelization, and contain the fewest linear miles of functional riparian areas.

Sediment Sources

As discussed earlier in the assessment, it is likely that the majority of the sediment currently being contributed to stream channels originates through the surface runoff generated from agricultural practices in the uplands. Combined with the altered hydrology, the sediment delivered to Lapwai Creek and associated tributaries have contributed to the degradation of aquatic resources and pose a threat to downriver resources. Other mechanisms modifying sedimentation to streams in the Lapwai watershed include roads, forestry, and grazing.

Processes of soil mass movement, surface, gully and stream channel erosion are natural phenomena, and vary with the inherent erodibility of soils, geology, topography, climate and vegetation. The rates at which these processes occur may be exacerbated by land use activities. Changes in sediment delivery rates have direct bearing on fish presence since they may potentially disrupt the structural characteristics of the stream (i.e. channel morphology), the quantity/quality of stream habitat (i.e. substrate composition), and ultimately the migration, spawning, incubation, emergence and rearing success of the species (Furniss et al. 1991; MacDonald et al. 1991).

An increased load of silt and sediments is typical of rivers draining agricultural and urbanized landscapes (Alan 1995). Sedimentation affects the distribution of fish species, which vary widely in their tolerance for silty conditions (Bjornn and Reiser 1991). Lapwai Creek A-run steelhead, which are the primary fish species of concern, maintain a relatively low tolerance to high rates of sedimentation, especially during spawning and incubation life history stages. Similarly, the various macroinvertebrate prey species present are affected by excessively high amounts of sediment, and in an agricultural landscape such as the Lapwai watershed, are dominated by only those forms tolerant of sediment pollution (Delong and Brusven 1998). Multimetric studies of macroinvertebrate communities and fish habitat in Lapwai Creek have established proportional relationships between pollution tolerant forms and degraded habitat conditions (Delong and Brusven 1998).

Morphological features of streams that are degraded by excessive sedimentation include those with high width to depth ratios and high degrees of streambed aggradation (Overton et al. 1997). Similarly, a high degree of cobble embeddedness, high percentages of surface fines, high percentages of fines by depth, low pool frequency, and poor pool quality characterize instream habitat conditions of sediment-laden streams (Overton et al. 1997). Based on our analyses and review of the literature, the Lapwai watershed largely suffers from these conditions, much of which likely has been caused through agricultural sediment sources.

In addition to agriculture, natural processes of surface erosion may also be altered through the presence of roads and road networks. Roadbed surfaces, drainage ditches, and cut-and-fill surfaces will often provide an effective conduit for overland flows that transport fine sediment to downslope locations (Gibbons and Salo 1973; Rhodes and Huntington 1999; Wemple et al. 1996). The primary variables inherent to surface erosion processes include slope steepness, soil erodibility, surface runoff, slope length and ground cover (Furniss et al. 1991). And because these variables differ both spatially and temporally, so do levels of road-related surface erosion. For example, a heavily used gravel road, such as those common throughout the Lapwai watershed, may contribute up to 100 times as much fine sediment as an abandoned road, or a paved road along which ditches and cut slopes are the only sources of sediment (Reid and Dunne 1984).

Grading or resurfacing has been shown to have a major influence on the amount of sediment transported by the road ditch during the next period of precipitation (Bilby 1985), and is a concern in the Lapwai drainage (L. Rasmussen, NRCS, personal communication, April, 2000). Similar to the effects of road-related mass wasting, road-derived sediment from surface erosion may be chronic in nature, affecting aquatic habitat over extended periods of time (Furniss et al. 1991).

Roads and road networks may also alter the natural flow regime of a drainage by affecting the routing characteristics of low order streams in a sub watershed (Rhodes and Huntington 2000; Wemple et al. 1996). Road presence will often alter the local drainage characteristics of a given hillslope by changing infiltration rates, interception and diversion of subsurface flow, and changing flow timing to channels. The effects of altered hydrologic regimes of small streams are often cumulative, and may potentially cause a restructuring of fish habitat and instream conditions.

Timber harvest activities may be contributing to sediment problems in the mainstem Lapwai and tributary reaches. The effects of timber management activities on erosion are most notable from roads (see above) and near harvest units. Skid trails, bulldozed firebreaks, or trails created by cable yarding may concentrate water or intercept shallow subsurface flows. These areas become highly susceptible to erosion and often provide an efficient conduit to stream channels (Wemple et al. 1996).

MacDonald et al. (1991) describes how the cutting and yarding of trees disturbs the soil, exposes it to erosion, and may lead to a decrease in slope stability. This statement holds true depending upon its context. Logging practices have improved considerably over the last 56 years, and may cause only a slight increase in sediment production depending upon the technique applied (Megahan and Kidd 1972), presence or absence of vegetation or duff layer (Dunne and Leopold 1978), and geologic and topographic properties of the landscape. For example, a study by Megahan and Kidd (1972) showed that skyline logging in steep ephemeral drainages in the Idaho batholith produced less sediment than conventional tractor/jammer-skidding methods common during the 1940s and 1950s. While the difference was primarily attributed to a disparity between road density, the method of skyline logging resulted in less soil disturbance and minimal damage to the residual stand due to the partial to complete suspension of logs from stump to landing.

Grazing may also affect processes of sedimentation in a given watershed, and because of its prevalence in the Lapwai drainage, likely has influenced the condition of aquatic resources. Livestock grazing can affect the riparian environment by reducing, changing or eliminating vegetation (Platts 1991). Upon removal of bank-stabilizing vegetation, processes of erosion are accelerated and water storage capacity is reduced, often resulting in a widened or aggraded stream channel that has a lowered water table (MacDonald et al. 1991). Channel widening and aggradation occur as pools fill with fine sediment and natural processes of substrate sorting are altered. Processes of erosion are similarly accelerated by livestock presence as streambanks are trampled, causing banks to slough off into the channel, or causing bank withdrawal.

Channel Modification

As mentioned previously, many streams and/or stream reaches in the Lapwai watershed have been effectively disconnected from their floodplains through stream channel modification. Agricultural activity, Highway 95, the Camas Prairie Railroad, homes, and communities occurring within the streambottom have caused the lack of floodplain connectivity. This loss directly influences processes of erosion, hydrology, and nutrient transport and dispersal. Cumulatively, the physical, hydrological, and chemical changes that result from channel modification change the ecology of rivers in many ways. Typically, the energy base becomes less heterotrophic and more autotrophic, especially in small streams (Allan 1995).

A shift from heterotrophy to autotrophy is likely to occur in streams affected by intensive agricultural activity because of reduced shading and increased nutrient levels (i.e. decreased filtration) (Alan 1995). Delong and Brusven (1992) found the amount of periphyton chlorophyll *a* in Lapwai Creek to be two to ten times higher than reported for comparable undisturbed streams. The study attributed these levels primarily to the high nutrient levels that accompanied rain events.

Autotrophic systems, especially those impacted through agriculture, typically have reduced energy inputs through reductions in allocthonous matter (Delong 1991). Delong and Brusven (1993) found that the highest benthic organic matter was related to those areas throughout the Lapwai watershed that received the greatest amount of litterfall inputs, and that overall, Lapwai Creek organic matter was lower than comparable, undisturbed streams. These findings were not consistent with the longitudinal trends predicted by the river continuum concept for an unaltered river (e.g. Vannote et al. 1980), thereby suggesting an imbalance in the general ecological function of Lapwai Creek.

13 - SUMMARY AND RECOMMENDATIONS

This section will summarize findings of this assessment, including data needs or limitations and current watershed condition(s) with regard to each watershed component. General recommendations are provided based on the analyses completed during the assessment. Recommendations are not intended to assign specific project actions, but rather to provide a framework within which actual projects should fit. This approach allows managers flexibility to address problems in the context of their own capacity, budgets, and time constraints while designing specific projects, which will compliment a larger watershed scale restoration effort.

In compiling data for use in this assessment, it became apparent that data collection has not been well coordinated between agencies, nor have any long-term visions or goals been set forth for restoration of the Lapwai Creek watershed. A coordinated interagency, interdisciplinary approach will be necessary for successful watershed restoration. Although information on various disciplines has been presented in specific chapters within this assessment, no individual discipline stands alone. All are highly interrelated, a fact that must be addressed in order to plan and execute a successful watershed restoration effort. No single discipline can be addressed at a watershed or subwatershed scale without direct and/or indirect impacts to others. With this in mind, coordination between agencies and departments within those agencies is essential to maximize results while minimizing expenditures.

Channel Habitat Types

Summary

Eight channel habitat types were identified in this assessment according to gradient, confinement, and spatial distribution in the watershed. CHT's with the highest overall sensitivity to changes in LWD, sediment load, and flows are LM and MM channels, which are limited in extent in the Lapwai Creek watershed. However, sensitivity of CHT's is at least moderate for the majority of perennial and ephemeral streams in all subwatersheds, with low sensitivity only in the highest gradient (>16%) reaches.

Data Needs

Additional field verification of assigned CHT's will increase confidence in the data layer developed during this portion of the assessment. Limited field verification conducted during the assessment suggests that gradient and confinement were estimated with a relatively high degree of accuracy. However, no verification of instream channel characteristics was conducted. Accuracy of 'assumed' channel and habitat characteristics for assigned CHT's (based on descriptions provided in OWAM) will impact the utility of CHT's during project planning.

Recommendations

Project planning in the Lapwai Creek watershed should consider channel habitat types as a potential screen to limit particular actions to reaches where proposed actions will be most beneficial. This applies to both instream and upland project planning. Consideration of impacts by instream projects will likely be immediate or short-term, whereas for upland projects, longer-term vision will be required to imply potential instream effects. Consideration of CHT's will assist managers in predicting both short and long-term outcomes of specific project actions on stream characteristics and habitat.

Hydrology / Water Use

Summary

The hydrology of the Lapwai Creek is highly variable in nature, with substantial irregularity in both the timing and volume of annual peak flows recorded at the mouth. The division of the watershed by an escarpment approximately 1,000 feet high provides for substantial spatial disparity in hydrologic regimes between component subwatersheds. Substantial differences in annual precipitation, land cover/use, and susceptibility to rain-on-snow events exist between subwatersheds above, below, or divided by the escarpment.

Relative impacts to hydrology contributable to forestry, agricultural practices, roading and urbanization were each defined to be 'Low' at the subwatershed scale. Cumulative impacts of these factors on hydrologic regimes were not investigated during this assessment. Although the scale of available data prohibited examining impacts of other factors at scales smaller than that of the subwatershed, finer scale analysis suggests that localized impacts of road densities on hydrology may be expected in some areas.

Data is not available regarding actual water use in the watershed. Allowable water use (water rights/claims) throughout the watershed is driven by surface water withdrawals, which account for over 96% of total water use. Lewiston Orchards Irrigation District (LOID) holds water rights for approximately 95% of all allowable water use in the Lapwai Creek watershed. The capacity of LOID to withdraw water from the watershed is limited in some areas by the capacity of diversion canals, and may represent less than one-half of the allowable withdrawal.

Data Needs

- Historical discharge patterns and/or historic variability in discharge should be modeled for comparison to current records.
- Permanent water gaging stations should be established in each major tributary to Lapwai Creek to allow for better assessment of spatial variations in hydrology.
- Information regarding to the extent of illegal water use/diversions

Recommendations

Project planning in the Lapwai Creek watershed should address both temporal and spatial differences in hydrologic regimes and anticipate that the relative success of any actions taken are likely to be impacted by annual hydrologic variability. Managers should realize that results of projects aimed at assessing condition(s) within a single year in the Lapwai Creek watershed are likely to be severely limited in applicability across years. Long-term commitment may be necessary to adequately plan, implement, and monitor restoration measures in the watershed due to the annual hydrologic variability.

Recommendations regarding water use in the Lapwai Creek watershed made at this time would be premature given the involvement of current water rights/claims in the Snake River Basin Adjudication Process. Managers should however, consider current levels of allowable water use when planning or implementing projects. For localized project planning, efforts should be made to assess actual rather than allowable water use, although the two may be similar in many areas.

Riparian/Wetlands

Summary

Due to lack of existing, comprehensive information on riparian cover and condition in the Lapwai Creek watershed, riparian vegetation descriptions were derived from existing vegetation data using a standard 100' buffer around all streams. Riparian vegetation around ephemeral streams contains a substantially higher proportion of agricultural, and a lower proportion of grass/forb cover than that surrounding perennial streams. Riparian vegetative composition was otherwise comparable between ephemeral and perennial streams at the watershed scale, with both dominated by coniferous cover types.

At the subwatershed scale, disparities between riparian vegetation surrounding perennial and ephemeral streams were, not surprisingly, greatest in the central subwatersheds. The topography and land use characteristics for the central subwatersheds illustrate the intensive agricultural use in the uplands (along ephemeral streams) and more natural vegetative communities in the steep sided canyons along most perennial streams.

Wetland inventories are limited in extent and utility, encompassing approximately one-half of the Lapwai Creek watershed and identifying only potential wetland areas. A total of 362 acres of potential wetlands have been identified in the drainage areas encompassing Mission Creek and Lapwai Creek above its confluence with Mission Creek.

Data Needs

- Historic riparian condition information.
- Map of existing and potential riparian areas including extent and vegetative characteristics.
- Field verification of 'potential' wetland areas already identified.
- Field survey and mapping of existing wetlands.

Recommendations

Survey and mapping of riparian and wetland extent and conditions should be completed to aid in planning of restoration activities. Riparian condition is closely tied to hydrology, sedimentation, water quality, and fish habitat. Knowledge of riparian conditions will benefit planning efforts directed not only at riparian restoration, but each of these other areas as well. Riparian/wetland mapping will also assist in monitoring and evaluation restoration efforts by providing important information that may influence expected results.

Sediment Sources

Summary

Primary potential sediment sources within the watershed were defined as surface erosion from croplands and rangelands, rural road runoff, and road instability. Surface erosion from croplands is a primary sediment source in the watershed, with the greatest erosion rates (tons/acre) occurring in the middle and upper Sweetwater and upper Mission subwatersheds. However, due to the relative abundance of agricultural lands, the lower and middle Lapwai and Tom Beall subwatersheds combined to contribute roughly half of all sediment delivered to streams throughout the watershed.

Sediment production potential from rangelands follows a pattern similar to that on agricultural lands, and is highest in the lower Lapwai Creek subwatershed. Modeling of land instability suggests that greatest potential for road instabilities exists in upper portions of Webb and Sweetwater Creek drainages. Rural road runoff is most likely to impact streams in the upper and middle Sweetwater and middle Mission Creek subwatersheds, and least likely to impact those in lower Webb and upper Mission Creek.

Data Needs

- Estimates of natural/historic sediment production.
- Estimates of stream capacity to accommodate sediment loading under variable hydrologic conditions.
- Information on road surface, condition, and design, including associated culvert information.
- Database on landslides and road slumps/failures including volumes and estimates of delivery to streams(s).
- Field verification of land failure potential analysis produced using LISA.

Recommendations

A long-term monitoring program should be developed to assess the impacts of changing agricultural practices and their relative benefits to Instream habitat conditions in the Mission and upper Lapwai Creek subwatersheds. Quantitative data should be collected with a timeline consistent with the anticipated rate of habitat improvement (i.e. every 3-5 years). Existing qualitative habitat data collected prior to 1991 may provide baseline information for comparison in the Mission and upper Lapwai Creek areas. Data collected from subwatersheds within the next 1-2 years can be used as a baseline for sediment reduction efforts scheduled to begin in 2002 throughout the remainder of the watershed. Such an effort should be coordinated between applicable agencies and address recommendations of those agencies currently involved in implementation of restoration activities.

A centralized database on landslides and road slumps/failures, including sediment volumes and estimated delivery to stream(s) should be developed. Data could be gathered prior to essential road repairs following slumps or failures, or during site visits when landslides are reported or investigated. Such a database need not necessarily be comprehensive (i.e. record every road slump) to provide useful data for temporal and spatial characterization of road susceptibility to failure and/or related contribution(s) of sediment to stream systems.

Channel Modifications

Summary

For the purposes of this assessment, channel modifications were considered to be any anthropogenic alteration that influences or has the potential to influence channel morphology, including floodplain modifications or development. Floodplain mapping was completed at a somewhat subjective and coarse scale, allowing only for comparison of relative spatial impacts due to floodplain modification.

Many historic channel modification structures have failed during flood events over the past 20-30 years, leaving the total extent of impacts somewhat speculative. Floodplain encroachment by roads, agriculture/urban areas and channel reconstruction projects directed at flood control were the commonly identified channel modifications. All subwatersheds have been impacted by channel modification to some extent, with impacts being greatest in the lower subwatersheds, and most commonly associated with existing towns.

Data Needs

- Field assessment and mapping of existing channel modifications.
- Mapping of historic and active floodplain, including changes in channel sinuosity

Recommendations

Further work should examine the relative extent of impacts due to channel modifications throughout the study area. Detailed field assessment of existing channel and floodplain modifications and their status (i.e. full or partial floodplain function) will be necessary. Any such project should take into account potential cumulative impacts of existing channel modifications, as well as the highly variable hydrologic regime of the watershed.

Water Quality

Summary

Designated beneficial water uses in the Lapwai Creek watershed include agricultural water supply, primary and secondary contact recreation, coldwater biota, and salmonid spawning. Winchester Lake is also designated as a special resource water. Stream segments within the watershed are listed as water quality limited with regards to bacteria, nutrients, turbidity/suspended solids, temperature, dissolved oxygen, and both flow and habitat alteration. Winchester Lake is also listed for organic pesticides, but a recently completed TMDL has recommended removal of this particular listing.

Water quality data pertaining to the Lapwai Creek watershed is limited and generally consists of measurements made at specific, non-comparable points in time and space. Much of the water quality data that does exist is dated, often exceeding 10 years in age. Data age and inconsistencies in spatial and temporal sampling schemes and parameters assessed make data that does exist of little utility for examination of spatial or temporal trends/variation.

Data Needs

- Spatially and temporally consistent water quality measurements on Lapwai Creek and each major tributary.
- Replication of past water quality studies, duplicating methods and stations sampled to provide comparability between years/seasons /flow conditions

Recommendations

Water quality is inherently tied to stream hydrology, among other factors. Water quality sampling conducted in the Lapwai Creek drainage needs to take into account the highly variable hydrologic regime within the watershed. Water quality sampling designs should therefore consider long-term data collection strategies that provide consistency among locations, dates/seasons, methods, and parameters used. A sampling design of this nature will eventually allow for examination of long-term trends, and investigation into the impacts of annual stream flow variation on water quality. A standardized seasonal assessment plan should be developed, with consideration of available resources used to determine parameters assessed and the extent and distribution of sampling to be conducted.

Where practical, water quality sampling designs should consider sampling sites used in previous studies in order to facilitate comparisons.

Fisheries

Summary

Fish stocking in the watershed is primarily limited to Winchester Lake, although stocking has occurred in other areas of the watershed as well. Seventeen fish species have been identified in the Lapwai Creek watershed, with steelhead being most extensively studied. Steelhead spawn primarily in the lower subwatersheds in all major tributary streams, and resident rainbow trout are known to spawn in the upper reaches of Mission and Lapwai Creeks. Barriers inhibit upstream migration of steelhead in all tributaries except Tom Beall Creek.

Available data on fish habitat is approximately 18 years old and generally qualitative in nature, but does provide a relatively extensive overview of relative habitat condition throughout the watershed. Data on fish habitat and associated use was compiled primarily within a single year, preventing any assessment of variability or trends. Habitat improvement efforts have been extensive since 1991 and tied to improvements in agricultural practices and associated runoff and sedimentation rates. Sedimentation and runoff from agricultural lands is said to have improved markedly, but no Instream monitoring of impacts has been conducted.

Data Needs

- Historic distribution of anadromous and resident fish species.
- Current extent and distribution of suitable spawning habitat for resident and anadromous salmonids.
- Redd counts and spawning surveys to determine distribution and extent of use by steelhead and resident species.
- Information on the extent and distribution of use by hatchery produced steelhead in Lapwai creek and its tributaries.
- Distribution and status of resident rainbow (redband) trout and other native species.
- Detailed assessment of natural and manmade fish passage barriers.
- Information on the extent and effectiveness of fish screens used at water diversions.
- Monitoring data to assess impacts of completed or ongoing habitat improvement efforts conducted by NRCS.

Recommendations

A long-term monitoring program should be developed to assess the impacts of changing agricultural practices to instream habitat conditions in the Mission and upper Lapwai subwatersheds. Quantitative data should be collected with a timeline consistent with the anticipated rate of habitat improvement (i.e. every 3-5 years). Existing qualitative habitat data collected before implementation may provide baseline information for comparison. Such an effort should be coordinated between applicable agencies and address recommendations of those agencies currently involved in implementation of restoration activities.

Future fisheries or related habitat surveys should collect quantitative data and when practical, consider sampling at sites used in previous studies to facilitate data comparison. Any efforts directed at habitat enhancement or restoration should consider both the variability in the annual hydrograph and the responsiveness of various CHT's to enhancement activities.

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APPENDIX A – GIS LAYERS USED AND THEIR SOURCES

General Description	Source	Scale / Resolution
States	ICBEMP	1:100,000
Counties	ICBEMP	1:100,000
Cities	ICBEMP	1:100,000
Nez Perce Indian Reservation Boundary	Nez Perce Tribe – Land Services Dept.	1:24,000
HUCs – 6th code	ICBEMP	1:100,000
Digital Elevation Model (DEM)	USGS	30m grid cells
Lithology	Idaho Dept. Water Resources	1:500,000
Precipitation	PRISM	2.25 minute
Streams	Streamnet	1:100,000
Channel Habitat Types	WSU – Derived	1:24,000
100 Year Floodlain	WSU – Derived	1:100,000
Seasonal Discharge	Lipscomb (1998)	6th Field HUC
Roads	Nez Perce Tribe – Land Services Dept.	1:24,000
Land Use (Figure 8)	Nez Perce Tribe – Land Services Dept.	1:24,000
Land Cover (Figure 15)	Idaho GAP	30 m grid cells
Potential Historic Vegetation	ICBEMP	1km grid cells
Fish Distributions/Status	WSU - Derived from multiple sources	1:100,000
Soils data and associated attributes	SSURGO	1:24,000
NRCS Treatment Units	WSU – Derived	1:24,000

APPENDIX B – CHANNEL HABITAT TYPES

Information presented here is reproduced from the Watershed Professionals Network (1999) to facilitate understanding of methods used in this assessment.

Table B-1 CHTs.

Code	CHT Name	Gradient	Confinement	Relative Size*
ES	Small Estuary	< 1%	Unconfined to moderately confined.	Small to medium
EL	Large Estuary	< 1%	Unconfined to moderately confined.	Large
FP1	Low Gradient Large Floodplain	< 1%	Unconfined	Large
FP2	Low Gradient Med. Floodplain	< 2%	Unconfined	Medium to large
FP3	Low Gradient Small Floodplain	< 2%	Unconfined	Small to medium
AF	Alluvial Fan	1-5%	Variable	Small to medium
LM	Low Gradient Moderately Confined	<2%	Moderately confined	Variable
LC	Low Gradient Confined	< 2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2-4%	Moderately confined	Variable
MC	Moderate Gradient Confined	2-4%	Confined	Variable
MH	Moderate Gradient Headwater	1-6%	Confined	Small
MV	Moderately Steep Narrow Valley	3-10%	Confined	Small to medium
BC	Bedrock Canyon	1-> 20%	Confined	Variable
SV	Steep Narrow Valley	8–16%	Confined	Small
VH	Very Steep Headwater	> 16%	Confined	Small

* Stream size refers to the ODF designations based on average annual streamflow as follows: small streams ≤ 2 cfs; 2 cfs < medium streams < 10 cfs; Large streams 10 cfs or greater.

Table B-2 Channel confinement classes.

Map Code	Confinement Class	Floodplain Width
U	Unconfined	> 4 x bankfull width
M	Moderately Confined	> 2 but < 4 x bankfull width
C	Confined	< 2 x bankfull width

Figure B-1 CHT sensitivity for CHTs assigned to stream segments within the Lapwai Creek watershed.

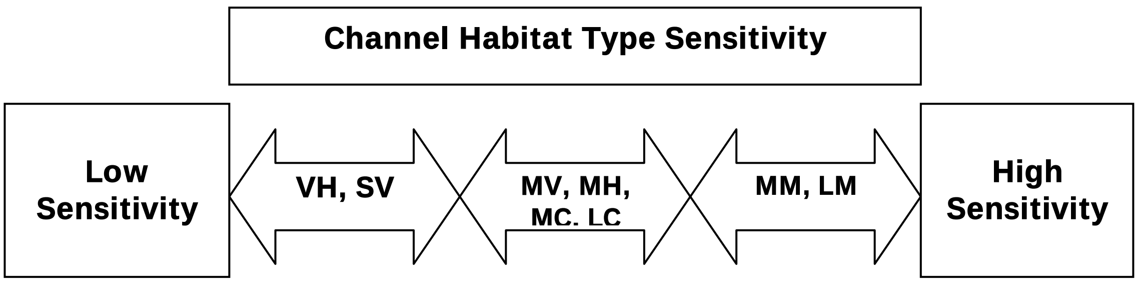

Table B-3 Channel response descriptions.

Rating	LWD	Fine Sediment	Coarse Sediment	Peak Flows
High	Critical element in maintenance of channel form, pool formation, gravel trapping/sorting, bank protection.	Fines are readily stored with increases in available sediment resulting in widespread pool filling and loss of overall complexity of bed form.	Bedload deposition dominant active channel process; general decrease in substrate size, channel widening, conversion to plane-bed morphology if sediment is added.	Nearly all bed material is mobilized; significant widening or deepening of channel.
Moderate	One of a number of toughness elements present; contributes to pool formation and gravel sorting.	Increases in sediment would result in minor pool filling and bed fining.	Slight change in overall morphology; localized widening and shallowing.	Detectable changes in channel form; minor widening, scour expected.
Low	Not a primary roughness element; often found only along channel margins.	Temporary storage only; most is transported through with little impact.	Temporary storage only; most is transported through with little impact.	Minimal change in physical channel characteristics, some scour and fill.

APPENDIX C – LEVEL I STABILITY ANALYSIS (LISA) METHODS USE

The Level 1 Stability Analysis (LISA) computer program was used to estimate the stability of landforms in the watershed. LISA uses the infinite slope stability model to compute the factor of safety (FS) against a slope failure. The factor of safety is the ratio of the forces resisting a slope failure (i.e. tree roots, soil friction) to the forces driving the failure (gravity). The larger the FS value of a landform the more stable it is considered to be (Hammond *et* al. 2000). Soil depth, slope, tree surcharge, root strength, the soils angle of friction, soil cohesion, soil dry weight, and groundwater depth are inputs into the LISA model. The quality of data available in the Lapwai watershed on these factors was highly variable. The data and assumptions used in running the LISA model for the Lapwai watershed are discussed below. The results of the model should not be interpreted as identifying areas where slope failures will occur but as identifying areas where slope failures are relatively more or less likely to occur. Field verification and further data collection should be undertaken to refine the model before project specific application.

The soil polygons delineated by the NRCS Soil Survey Geographic Database (SSURGO) for Lewis and Nez Perce county Idaho were used as map units for the project. Each of the 155 different soil units in the layer has associated soil attributes that were used to supply many of the inputs to the LISA model.

Soil depth
The depth of soil for each map unit in the SSURGO layer was supplied by SSURGO

Slope
The average slope in each soil unit was determined using a slope map derived using a 30 meter USGS DEM.

Tree surcharge
Tree surcharge depends on the species, size and density of trees on the study area.
The factor of safety calculated by the infinite slope equation is fairly insensitive to the value of surcharge and it is commonly omitted from LISA analysis (Hammond et al. 1992). Data detailing tree size and density was unavailable for most of the watershed and consequently this variable was omitted from the analysis.

Root strength
Roots stabilize soils by holding underlying soils in place, anchoring unstable soil mantels to more stable subsoils and rock, and acting as a barrier to the downslope slide of soils (Hammond et al. 1992). The root cohesion factor in the LISA model attempts to account for this reinforcing force. Literature reported in the LISA manual (Hammond et al. 1992) and local expertise indicate that trees provide more reinforcement than shrubs and shrubs provide more reinforcement than grasses. Coniferous trees in Idaho were generally considered to provide more reinforcement than deciduous trees. The land cover types in the 30 meter land cover grid developed by the Idaho GAP Analysis Program were group

into broad vegetation form categories and assigned root strength values based on their perceived ability to stabilize soil (Table A1).

Table 1A. Cover types and associated root strength values.

Cover Type	Root Strength (psf)
Urban and barren	0
Agricultural, Disturbed grasslands, Clearcut and burned areas	50
Grasslands	75
Shrubland	100
Deciduous forest	150
Coniferous forest	200

Soils angle of friction and soil cohesion

The angle of friction and soil cohesion factors measure the resistance to failure provided by particle-to-particle contact in a soil. Higher friction angles tend to occur in coarse-grained soils due to a greater interlocking of particles. However, a rounded gravel soil would likely have friction angles less than a well graded angular sand. Cohesion values tend to increase as the clay content of a soil increases, as silts, sands and gravels have little or no cohesion (Hammond et al 2000).

Detailed information on properties of the soils in the Lapwai watershed was not available, and project scale, and resource constraints prevent the collection of this information. The Unified Soil Classifications (USC) provided in SSURGO were used to correlate the Lapwai soils with the range of values from the literature and summarized in the LISA manual.

Soil dry weight

The Unified Soil Classifications (USC) provided in SSURGO were used to correlate the Lapwai soils with the range of soil dry weight values from the literature summarized in the LISA manual.

Groundwater depth

Information on groundwater characteristics was not available across the Lapwai watershed. To determine each soil units potential for failure when partially saturated, uniform groundwater heights were assumed across the watershed. This resulted in an underestimate of the potential for failure in wet or seasonally wet areas and an overestimate in well-drained soils.