Hatwai Creek Subbasin Assessment and TMDLs (Lower Clearwater HUC 17060306)



Department of Environmental Quality

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Abbreviations, Acronyms, and Symbols

§303(d)	Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section
µ	micro, one-one thousandth
§	Section (usually a section of federal or state rules or statutes)
ADB	assessment database
AU	assessment unit
AWS	agricultural water supply
BAG	Basin Advisory Group
BLM	United States Bureau of Land Management
BMP	best management practice
BOD	biochemical oxygen demand
BOR	United States Bureau of Reclamation
Btu	British thermal unit
BURP	Beneficial Use Reconnaissance Program
C	Celsius
CFR	Code of Federal Regulations (refers to citations in the federal administrative rules)
cfs	cubic feet per second
cm	centimeters
CWA	Clean Water Act
CWAL	cold water aquatic life
CWE	cumulative watershed effects
DEQ	Department of Environmental Quality
DO	dissolved oxygen
DOI	U.S. Department of the Interior
DWS	domestic water supply
EMAP	Environmental Monitoring and Assessment Program
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
F	Fahrenheit
FPA	Idaho Forest Practices Act
FWS	U.S. Fish and Wildlife Service
GIS	Geographical Information Systems
HUC	Hydrologic Unit Code
I.C.	Idaho Code
IDAPA	Refers to citations of Idaho administrative rules
IASCD	Idaho Association of Soil Conservation Districts
IDFG	Idaho Department of Fish and Game

IDL Idaho Department of Lands

IDWR Idaho Department of Water Resources

INFISH the federal Inland Native Fish Strategy

IRIS Integrated Risk Information System

km kilometer

km^2 square kilometer

LA load allocation

LC load capacity

m meter

m^3 cubic meter

mi mile

mi^2 square miles

MBI Macroinvertebrate Biotic Index

MGD million gallons per day

mg/L milligrams per liter

mm millimeter

MOS margin of safety

MRCL multiresolution land cover

MWMT maximum weekly maximum temperature

n.a. not applicable

NA not assessed

NB natural background

nd no data (data not available)

NFS not fully supporting

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resources Conservation Service

NTU nephelometric turbidity unit

ORV off-road vehicle

ORW Outstanding Resource Water

PACFISH the federal Pacific Anadromous Fish Strategy

PCR primary contact recreation

PFC proper functioning condition

ppm part(s) per million

QA quality assurance

QC quality control

RBP rapid bioassessment protocol

RDI DEQ's River Diatom Index

RFI DEQ's River Fish Index

RHCA riparian habitat conservation area

RMI DEQ's River Macroinvertebrate Index

RPI DEQ's River Physiochemical Index

SBA subbasin assessment

SCR secondary contact recreation

SFI DEQ's Stream Fish Index

SHI DEQ's Stream Habitat Index

SMI DEQ's Stream Macroinvertebrate Index

SRP soluble reactive phosphorus

SS salmonid spawning suspended sediment

SSOC stream segment of concern

STATSGO State Soil Geographic Database

TDG total dissolved gas

TDS total dissolved solids

T&E threatened and/or endangered species

TIN total inorganic nitrogen

TKN total Kjeldahl nitrogen

TMDL total maximum daily load

TP total phosphorus

TS total solids

TSS total suspended solids

t/y tons per year

U.S. United States

U.S.C. United States Code

USDA United States Department of Agriculture

USDI United States Department of the Interior

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WBAG *Water Body Assessment Guidance*

WBID water body identification number

WET whole effluence toxicity

WLA wasteload allocation

WQLS water quality limited segment

WQMP water quality management plan

WQRP water quality restoration plan

WQS water quality standard

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Executive Summary

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

This document addresses the water bodies in the Hatwai Creek sub-watershed that have been placed on Idaho's current §303(d) list.

This subbasin assessment (SBA) and TMDL analysis have been developed to comply with Idaho's TMDL schedule. The assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Hatwai Creek subwatershed, located 3 miles east of Lewiston, Idaho.

The first part of this document, the SBA, is an important first step in leading to the TMDL. The starting point for this assessment was Idaho's current §303(d) list of water quality limited water bodies. The 2nd order segment of Hatwai Creek was listed on this list. The SBA examines the current status of §303(d) listed waters and defines the extent of impairment and causes of water quality limitation throughout the subbasin. The TMDL analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards.

Subwatershed at a Glance

Hatwai Creek is a third order tributary of the Clearwater River, part of Hydrologic Unit Code ID17060306. It is a relatively small subwatershed, encompassing 19,785 acres. The majority of the acreage in the watershed is cropland and rangeland, while the remainder is used for patureland, suburban dwellings and industrial warehousing. The main stem of Hatwai Creek originates on the southern breaks of the Palouse prairie, along the east side of Idaho State Highway 95, flowing south into a steep basalt canyon where it is fed by several springs before reaching the Clearwater River three miles east of Lewiston, Idaho. Elevation in the watershed ranges from near 3000 feet above sea level at the headwaters to below 800 feet at the mouth (Figures 1 and 2).

According to archeological evidence, the mouth of Hatwai Creek has been used as a fishery for thousands of years. The Nez Perce Tribe were the historic inhabitants of the Hatwai Creek area. Lewis and Clark traveled past the mouth of Hatwai Creek and noted its use as a Nez Perce fishing camp in the fall of 1805. Currently, the Idaho Department of Fish and Game considers Hatwai Creek to have a high intrinsic potential for salmonid spawning and rearing, and as a tributary to the lower Clearwater River, Hatwai Creek is considered critical habitat for threatened anadromous steelhead.

Key Findings

Hatwai Creek Assessment Unit # ID17060306CL067_02 is listed as not meeting state water quality standards in Section 5 of the 2008 Integrated Report (Table A). Section 303(d) of the Clean Water Act states that waters that do not meet water quality standards are required to have total maximum daily loads developed to bring them into compliance with water quality standards.

Table A. §303(d) Segments in the Hatwai Creek Subwatershed.

Water Body Name	Assessment Unit ID Number	Listing	Pollutants
Hatwai Creek	ID17060306CLO67_02	Source to Mouth	Bac, Nut, Temp

Designated and existing beneficial uses for Hatwai Creek include cold water aquatic life and salmonid spawning (Table B). The secondary contact recreation beneficial use is also designated and existing. Water quality must be sufficiently maintained to meet these uses. Both assessment units in Hatwai Creek are addressed by this TMDL and listed in Table B.

Table B. Hatwai Creek beneficial uses.

Stream Name	Listing	Assessment Unit	Designated Beneficial Uses	Existing Beneficial Uses
Hatwai Creek	Source to Mouth	ID17060306CL067_02	COLD, SCR	COLD, SCR, AWS
Hatwai Creek	Source to Mouth	ID17060306CL067_03	COLD, SCR, SS	COLD, SCR, SS

[a] CW – cold water, SS – salmonid spawning, PCR – primary contact recreation, SCR – secondary contact recreation, AWS – agricultural water supply

In July 2006, water quality analysts from DEQ's Lewiston Regional Office (DEQ/LRO) initiated a year-long routine monitoring regimen at a monitoring station near the mouth of Hatwai Creek in the third order segment. This monitoring station was monitored every two weeks for the following parameters and pollutant concentrations: instantaneous stream temperature; dissolved oxygen, ammonia, nitrite+nitrate as nitrogen (NO_2+NO_3-N), and total phosphorus; instantaneous stream flow; and specific conductance. After initial samples exceeded secondary contact recreation criteria, Five *E. coli* bacteria samples were taken three to seven days apart over the 30 day period from July through August 2006, and the resulting geometric mean concentration was calculated..

Based on the data collected, bacteria, nutrient and temperature TMDLs have been developed for the Hatwai Creek subwatershed (Table C). With the exception of storm water construction

permits, loads have been allocated to existing sources currently in the subwatershed. A growth reserve has not been included in the TMDLs. Future sources will need to acquire a load allocation from existing allocations unless the load capacity is increased.

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

Stream	Pollutant(s)
Hatwai Creek, ID17060306CL067_02	NO_2+NO_3 =N, TP, *E. coli*, Temp
Hatwai Creek, ID17060306CL067_03	NO_2+NO_3 =N, TP, *E. coli*, Temp

E. coli **Bacteria**

5 *E. coli* bacteria samples collected every three to five days over a 30 day period were taken at the aforementioned monitoring station near the mouth of Hatwai Creek. The geometric mean calculated from these sample concentrations is in violation of State WQS. Based on these measured samples, a reduction in *E. coli* bacteria concentrations is needed throughout the subwatershed to comply with Idaho's geometric mean criterion of 126 cfu/100ml, and to support the secondary contact recreation beneficial use. *E. coli* load reductions set forth in Section 5 of this document will apply from the monitoring station upstream to all points in the subwatershed in order to restore recreation as a beneficial use.

Nutrients

The average nitrite + nitrate (NO_2+NO_3 =N mg/L) concentration measured in Hatwai Creek during the 2006-07 monitoring year was 2.06mg/L, nearly thirty (30) times higher than the EPA recommendation of 0.072mg/L. The average total phosphorous (TP) concentration measured during the same period was 0.17mg/L, again significantly higher than the recommended 0.03mg/L. Nitrogen and phosphorous concentrations at the levels measured in Hatwai Creek can cause visible slime growths or other nuisance aquatic growth that can cause D.O. to sag and impair the creek's existing beneficial uses. DEQ Water Quality personnel noted the presence of nuisance aquatic plant growths during routine monitoring at the monitoring station. The EPA Columbia Plateau criteria targets have been used to develop nutrient TMDLs designed to restore and protect the beneficial uses of Hatwai Creek.

Temperature

The second order segment of Hatwai Creek is listed as impaired by both temperature and habitat alteration. Riparian vegetation in the second order AU has been removed and replaced with agricultural crops, roads and pasture lands. Stream banks have been opened and the riparian canopy removed to an extent that excess heat load is reaching the stream. A Potential Natural Vegetation (PNV) temperature TMDL that calls for more shade in the second order AU of Hatwai Creek has been written. The 3rd order segment of Hatwai Creek will be included in the Potential Natural Vegetation temperature TMDL, due to instantaneous temperature readings recorded near the mouth, and the consideration of the inputs this segment receives from the

temperature listed and impaired 2nd order segment. If implemented successfully, projects designed to increase shade may also have a positive impact on channel and stream bank restoration, which can eliminate certain sources of pollution and reduce pollutant concentrations in the subwatershed while simultaneously reducing stream temperature.

Table D presents the changes that will be made to Idaho's 303(d) list as a result of the completion of this SBA/TMDL. These changes will be incorporated during the creation of the next, most current version of the Integrated Report.

Table D. Summary of assessment outcomes.

Water Body Segment/ AU	Pollutant	TMDL(s) Complete	Recommended Changes to §303(d) List	Justification
Hatwai Creek, ID17060306CL067_02	NO_2+NO_3 =N, TP, *E. coli*, Temp	Yes	Move to section 4a*	Water quality standards violations, TMDL completed
Hatwai Creek, ID17060306CL067_03	NO_2+NO_3 =N, TP, *E. coli*, Temp	Yes	Move to section 4a*	Water quality standards violations, TMDL completed

*Refers to section 4a of the Integrated Report (DEQ 2008), which includes waters with completed TMDLS.

Public Participation

DEQ developed and finalized this TMDL with the assistance of the combined Hatwai/Lindsay/Tammany Creek Watershed Advisory Group (WAG). Members of the WAG were recommended by the Clearwater Basin Advisory Group and appointed by the DEQ Director. The WAG has already met several times over the past few years, working on the Lindsay Creek TMDL and the Tammany Creek TMDL addendum. Members of the WAG represent agriculture, local government, federal government, the Nez Perce Tribe, recreation, forestry, point source discharge, environmental, mining, livestock and residential interests. At their May 13, 2010 meeting the WAG provided concurrence to complete this TMDL.

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act requires that Idaho restore and maintain the chemical, physical, and biological integrity of state waters. Idaho, pursuant to Section 303 of the Clean Water Act, is to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the state's waters whenever possible. Section 303(d of the Clean Water Act requires Idaho to identify and report waters that do not meet state water quality standards every two years. For waters that are listed, Idaho must develop a total maximum daily load (TMDL) plan to reduce the pollutant loads causing the non compliance and restore the water to comply with water quality standards.

This document includes a watershed characterization, the water quality status, a pollutant inventory, and a summary of past and present pollution control efforts for the Hatwai Creek subwatershed to date. This information was used to develop a TMDL—an estimate of the maximum amount of a pollutant that can be present in a water body and still meet water quality standards—for each pollutant found to exceed Idaho's water quality standards.

1.1 Introduction

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

The Department of Environmental Quality (DEQ) is responsible for compliance with the Clean Water Act in Idaho. The U.S. Environmental Protection Agency is responsible to ensure Idaho's water quality program complies with the Clean Water Act.

Section 303 of the Clean Water Act requires DEQ to adopt water quality standards and to review those standards every three years. Idaho's water quality standards must be approved by the Environmental Protection Agency (EPA). In addition, DEQ must monitor state waters to identify those not meeting state water quality standards; these impaired waters are included on what is called the 303 (d) list. A TMDL must be completed for each water body not meeting water quality standards to restore the water body and comply with the standards.

Section 2 of this document includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Hatwai Creek subwatershed to date. While the assessment is not a requirement of the total maximum daily load, the assessment is required by Idaho state law.

Idaho water quality standards address various beneficial uses designated or presumed for specific water bodies, defining the corresponding numeric and narrative physical and chemical limits, or criteria, needed to support the uses. The Idaho legislature designates beneficial uses for water bodies that are identified in the Idaho water quality standards, IDAPA 58.01.02, including the following:

- Aquatic life support–cold water, seasonal cold water, warm water, salmonid spawning, modified

- Contact recreation–primary, secondary
- Water supply–domestic, agricultural, industrial
- Wildlife habitats
- Aesthetics

Industrial water supply, wildlife habitats, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body has not yet been classified, then cold water and primary contact recreation are assumed to be designated uses when it is assessed.

1.2 Physical and Biological Characteristics

Hatwai Creek is a third-order tributary of the Clearwater River, part of Hydrologic Unit Code ID17060306. It is a relatively small subwatershed, encompassing 19,785 acres. The majority of the acreage in the watershed is cropland and rangeland, while the remainder is used for pastureland, suburban dwellings, and industrial warehousing. The main stem of Hatwai Creek originates on the southern breaks of the Palouse prairie, along the east side of Idaho State Highway 95, flowing south into a steep basalt canyon where it is fed by several springs before reaching the Clearwater River three miles east of Lewiston, Idaho. Elevation in the watershed ranges from near 3000 feet above sea level at the headwaters to below 800 feet at the mouth (Figures 1 and 2).

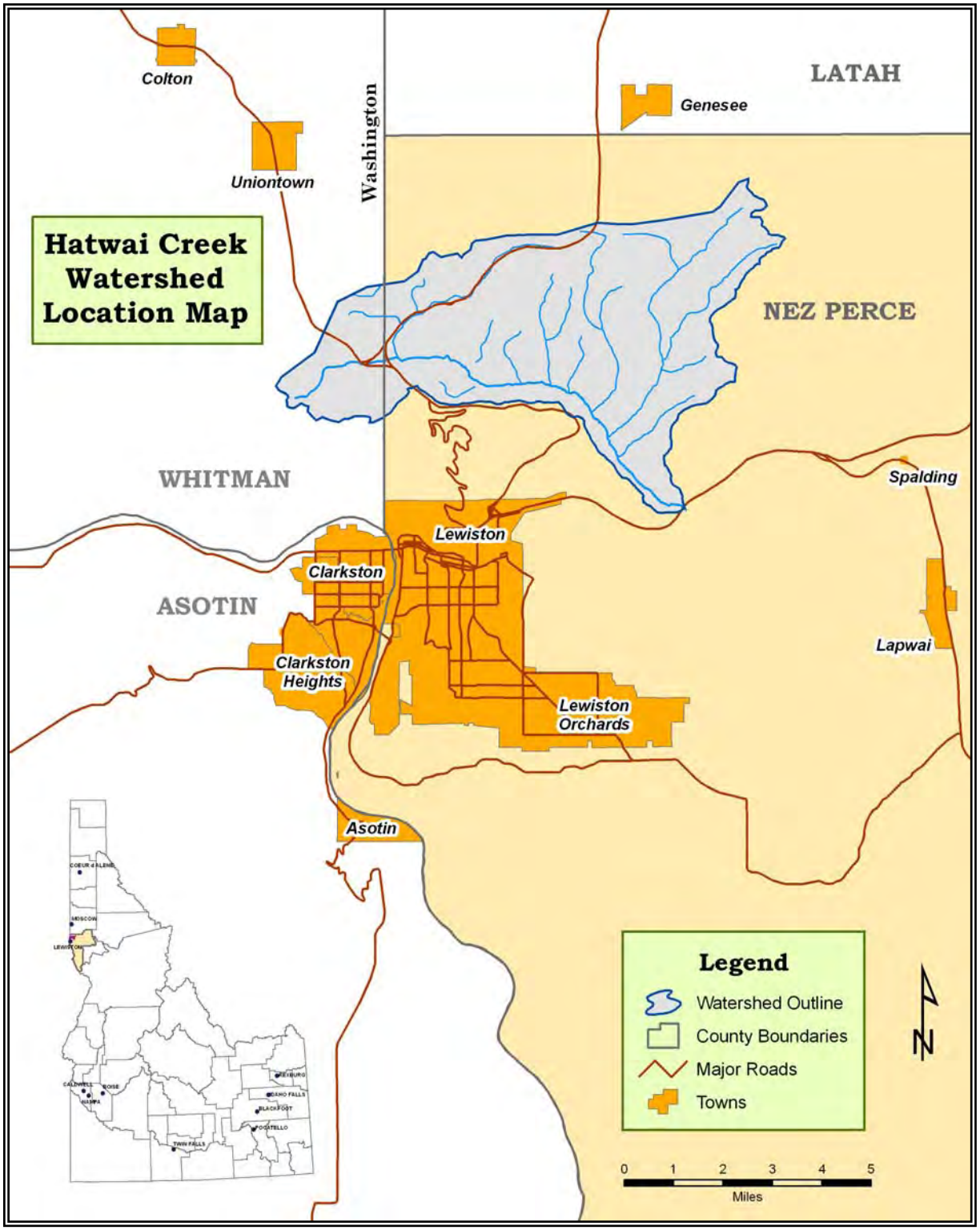


Figure 1. Hatwai Creek Watershed Location Map (Dansart, LSWCD 2008).

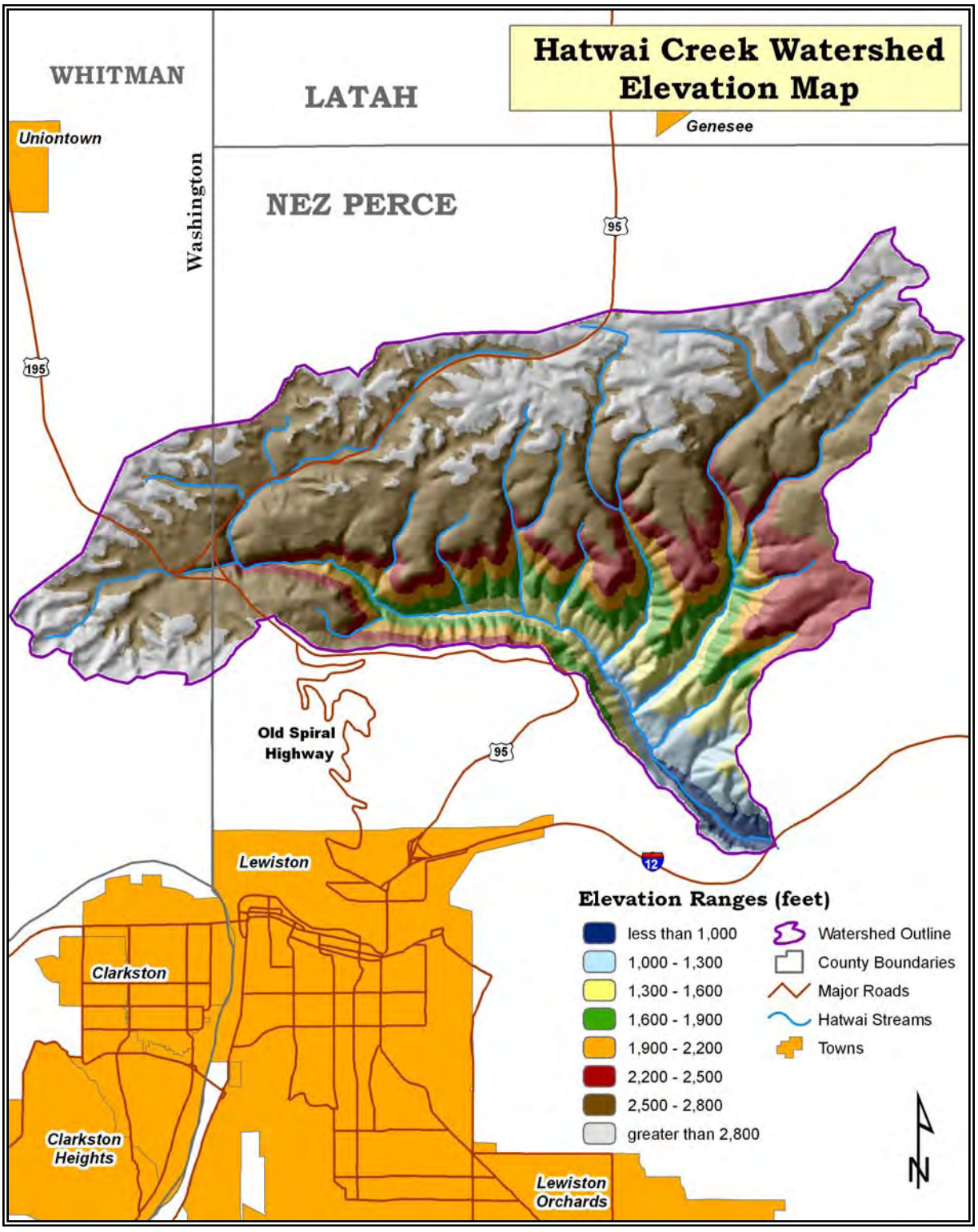


Figure 2. Hatwai Creek Elevation (Dansart, LSWCD 2008).

Climate

North Central Idaho is dominated by Pacific maritime air masses and prevailing westerly winds. Over 85% of the annual precipitation occurs during late fall, winter, and spring months. Cyclonic storms, consisting of a series of frontal systems moving east, produce long duration, low-intensity precipitation during this period of the year. In winter and spring, this inland maritime regime is characterized by prolonged gentle rains, fog, cloudiness, and high humidity, with deep snow accumulations at higher elevations.

The Hatwai Creek subwatershed is located in a semi-arid area, where summer months are hot and dry, with rainfall stemming from occasional thunderstorms and brief heavy precipitation events.

For the years 1948 through 2004, the average maximum air temperature for the months of June through September was 83.4 ^{o}F, with an average minimum temperature of 55.1 ^{o}F. For the same months, the average monthly precipitation was 0.87 inches, with a total average precipitation of 3.48 inches, or 27% of the total annual precipitation. Mean annual precipitation in Lewiston, Idaho is 12.73 inches (Western Regional Climate Center 2005).

The winter months, December through March, are usually cool with approximately 35% of the annual precipitation occurring during this period. The average maximum temperature for the years 1948 through 2004 was 45 ^{o}F, while the average minimum temperature was 30.1 ^{o}F during the winter season. The average monthly precipitation during winter was 1.09 inches. The average total winter precipitation was 4.37 inches, with an average annual snowfall of 15.8 inches (Western Regional Climate Center 2005).

Table 1 shows the annual average temperature and precipitation for 1948 through 2004. Figure 3 displays the 30-year averages (1971-2000) of temperature and precipitation for Lewiston, Idaho (Western Regional Climate Center 2005).

Table 1. Climate summary for Lewiston, Idaho.

Station Name	Source [1]	Elevation (feet)	Period of Record	Mean Annual Temperature (^{o}F)	Mean Annual Precipitation (inches)
Lewiston WSO AP (105241)	WRCC	1440	8/1/1948-12/31/2004	52.5	12.73

1. WRCC = Western Regional Climate Center

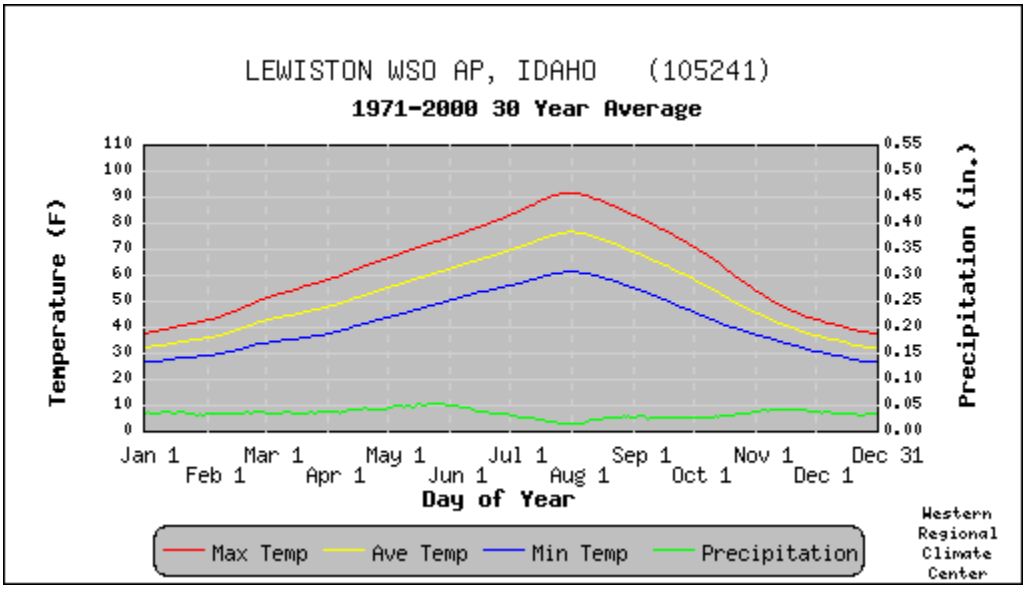


Figure 3. 30-Year Averages for Air Temperature and Precipitation in Lewiston, Idaho (WRCC 2005)

Hydrology

Hatwai Creek lacks a permanent flow gage station, making detailed analysis of historical flow regimes difficult. DEQ collected flow measurements on a bi-weekly basis from July 2006 through July 2007. Measured precipitation was lower than average during the monitoring year, and the majority of the measurements represent base flow conditions. Higher flows beginning in January and then occurring sporadically through April reflect the weather pattern. Most of the precipitation occurs during winter and early spring, with very little precipitation occurring during the summer months. This pattern causes flows to peak in early spring and return to base flows by summer. Base flows in Hatwai Creek were relatively constant during the monitoring year, due to shallow ground water (spring water) inflow. The highest measured flow during the monitoring year of July 2006 through July 2007 was nearly 10 cubic feet per second (cfs) (February 2007), while the lowest measured flow was just under one-third of 1 cfs (November 2006).

Topography, Geology and Soils

Hatwai Creek is located near the boundary between the Columbia Plateau and the Northern Rocky Mountains. The physiography is dominated by the Lewiston basin, a crustal depression between the Northern Rocky Mountains, the Blue Mountains, and the Palouse portion of the Columbia Plateau. Miocene basalt flows of the Columbia River Basalt Group are folded and faulted into the Lewiston basin. Sediments of the Latah Formation are interbedded with basalt flows in the basin, reflecting the effect of tectonic deformation on the drainage system, including placement of the present courses of the Snake and Clearwater Rivers.

In the late Pleistocene era, the Snake and Clearwater Rivers were inundated by both Bonneville and Lake Missoula Floods. Giant gravel bars deposited by the Bonneville Flood are prominent features along the Snake River. Multiple catastrophic floods from the emptying of Glacial Lake

Missoula reversed the flow of the rivers, depositing silt, sand, and ice-rafted cobbles and boulders in the valleys. Rhythmically bedded sediments, typical of Lake Missoula Flood backwater deposits, mantle portions of the landscape to 500 feet above the present river levels.

The cooler and dryer climate of the Pleistocene brought on the cyclical deposition of wind-blown silt that forms the thick loess of the Palouse hills north of the Lewiston Hill. Thinner loess caps the basalt flows on the gently sloping surfaces of Lewiston Orchards and east toward Lapwai. The hummocky block and flow topography and head-wall escarpments of large landslides form the valley side south along the Snake River and the south side of the Clearwater River valley. These large landslides occur where major sedimentary interbeds have been exposed along valley sides (USGS 2004).

Vegetation

The five major vegetation types in the area are cultivated fields, marshes, grasslands, brush lands, and Ponderosa pine forests. Although much of the forest, shrub and native grassland has been converted to agriculture, some remnant species still exist on the canyon sides and in the riparian zone. Dominant forest vegetation once included western larch, Douglas fir, Ponderosa pine, and lodgepole pine. Shrub species consisted of willows, alder, hawthorn, osiers, and Rocky Mountain maple. Idaho fescue, bluebunch, wheatgrass, and prairie junegrass represented the grass species of the area. In the canyon bottom toward the mouth, large black cottonwoods intermingled with the shrub community.

Fisheries

According to archeological evidence, the mouth of Hatwai Creek has been used as a fishery for thousands of years. Among the artifacts dating back more than 10,000 years, "There is scattered evidence for fishing, including a notched net weight in the Windust component at Hatwai" (Ames 2000). More recently, William Clark noted several Nez Perce lodges along the Clearwater River near Hatwai Creek, as the Corp of Discovery made its way down river to the confluence of the Clearwater and Snake Rivers in October of 1805 (Lewis, Clark, et al.). Clark's journal also indicates the expedition stopped along the banks of the Clearwater to trade for salmon.

Currently, the Idaho Department of Fish and Game considers Hatwai Creek to have a high intrinsic potential for salmonid spawning and rearing, and as a tributary to the lower Clearwater River, Hatwai Creek is considered critical habitat for threatened anadromous steelhead. DEQ stream survey fishing efforts in 1996 and 1998 found the following fish species: rainbow trout, redside shiner, speckled dace, dace, and sucker. These surveys determined that both the salmonid spawning beneficial use and cold water aquatic life beneficial use were fully supported in the stream's lower reach.

Restoration efforts conducted on Hatwai Creek in the late 1990s focused on fish habitat improvements and increased canopy cover. The Idaho Department of Fish and Game collected fish data in lower Hatwai Creek, monitoring the responses of wild trout, natural rainbow trout, and steelhead trout to these restoration activities. Monitoring results from a demonstration project for the 1995 to 1998 period indicate that the trout density increased annually throughout the length of the project. Trout density in the project area increased from 0.32 per 100 square

meters (100 m²) in 1995 to a high of 13.24/100 m² in 1998; in the control area, trout density was 0.87/100 m² in 1996, 3.00/100 m² in 1997, and 3.06/100 m² in 1998. This improvement is attributed to improved riparian health, including improved stream banks, increased canopy cover, and decreased stream temperatures. This project is discussed in more detail in Section 4 of this document.

1.3 Cultural Characteristics

Historically, the Nez Perce Tribe were the indigenous inhabitants of the Hatwai Creek area. Lewis and Clark traveled past the mouth of Hatwai Creek and noted its use as a Nez Perce fishing camp in the fall of 1805. In 1860, gold was discovered near Orofino, which prompted the migration of miners to the area. Farms, settlements, and communities were established and in the 1880s timber companies like Potlatch Corporation were harvesting the white pine forests of the northeastern Palouse. The 1900s saw the extension of railroads into north central Idaho and marketing of crops and lumber from the area accelerated its modern settlement.

Population centers include the cities of Lewiston, Idaho and Clarkston, Washington, with the city of Lapwai approximately 6 miles south on Highway 95. Marketable exports are transported to markets through Lewiston or Spokane. Per capita annual income in the region has increased from approximately $9,000 in 1980 to approximately $23,500 in 1999.

Cultural Features and Land Use

Large tracts of the subwatershed's grass lands have been converted to dry land (non-irrigated) agriculture. The Hatwai Creek subwatershed consists of 19,785 acres of cropland (56 percent), rangeland (31.5 percent), pasture/hayland (5 percent), riparian areas (2.5 percent), roads (2 percent), forestland (1 percent), mining (1 percent), and farms and suburban areas (1 percent). The majority of the acreage is privately owned, with industrial warehousing located on both banks at the mouth (Figures 4 and 5).

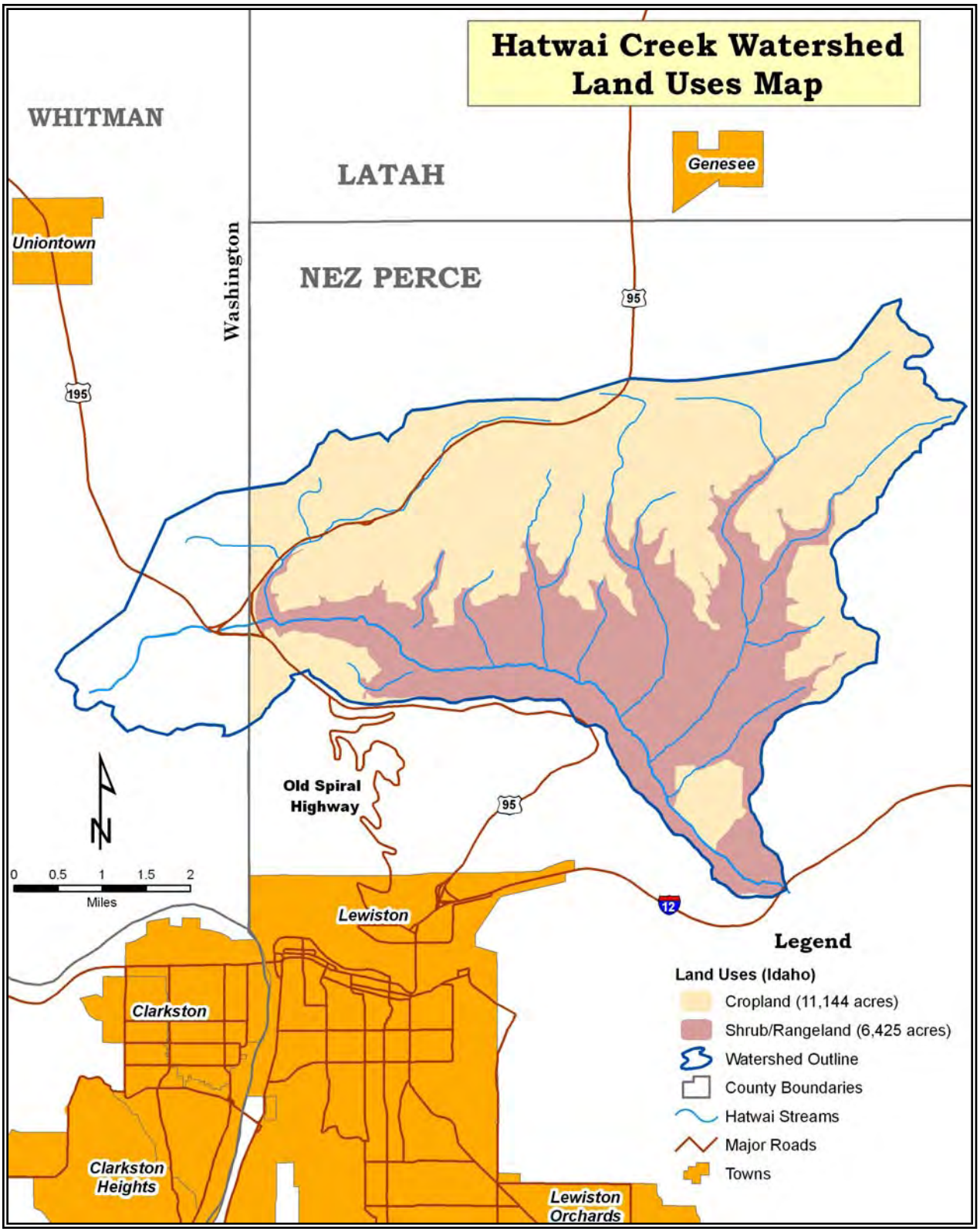


Figure 4. Hatwai Creek Land Use (Dansart, LSWCD 2008).

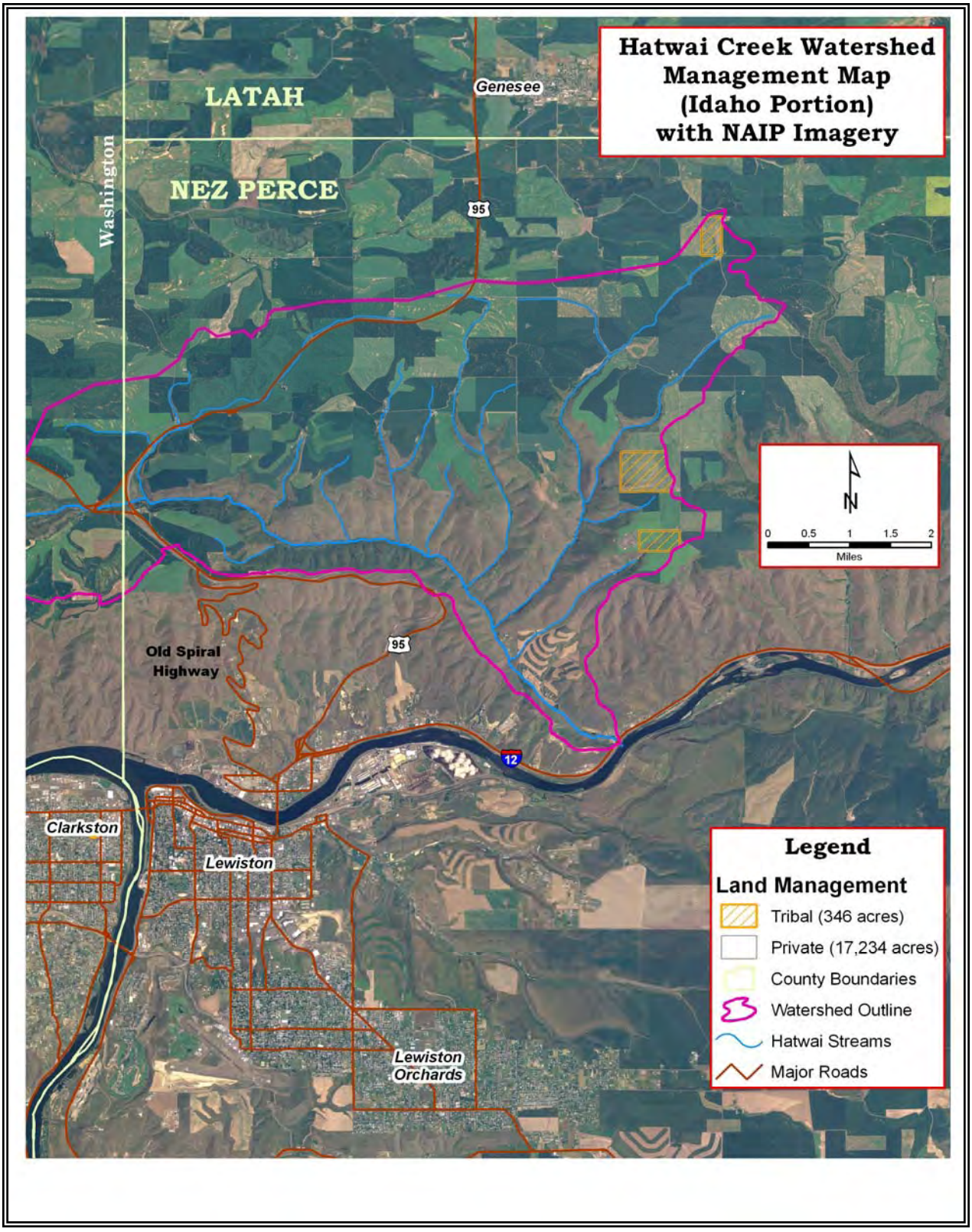


Figure 5. Hatwai Creek Ownership and Management Aerial Photo (Dansart, LSWCD 2008).

2. Subbasin Assessment – Water Quality Concerns and Status

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

Hatwai Creek Assessment Unit # ID17060306CL067_02 was listed in Section 5 of the 2008 Integrated Report, which is the list of water bodies that do not meet state water quality standards and therefore need a TMDL.

Section 303(d) of the Clean Water Act states that waters that do not meet water quality standards are required to have total maximum daily loads developed to bring them into compliance with water quality standards and therefore, this list has also been called the 303(d) list.

About Assessment Units

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

AUs are groups of similar streams that have similar land use practices, ownership, or land management. Stream order, however, is the main basis for determining AUs—even if ownership and land use change significantly, an AU remains the same.

Using assessment units to describe water bodies offers many benefits, the primary benefit being that all the waters of the state are now defined consistently. In addition, using AUs fulfills he fundamental requirement of the 305(b) report, which is required by the EPA in accordance with the Clean Water Act, wherein states report on the condition of all the waters of the state. Because AU numbers are extensions of water body identification numbers that identify water bodies in the water quality standards, there is now a direct tie to the water quality standards for each AU, so that beneficial uses defined in the water quality standards are clearly tied to streams on the landscape.

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

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

When new monitoring data indicate that full support of beneficial uses has been achieved, only the AU represented by the data will be removed (de-listed) from the 303(d) list (Section 5 of the Integrated Report).

Listed Waters

Table 2 shows the pollutants listed in the DEQ 2008 Integrated Report for the Hatwai Creek sub-watershed. Although only the second-order segment of Hatwai Creek is listed, water quality data collected in the third-order segment show ambient concentrations of these pollutants at levels that can cause impairment. All TMDLs associated with these listed pollutants will apply from a monitoring station near the mouth (third-order segment) upstream to the headwaters.

Table 2. 303(d)-listed Segments in the Hatwai Creek Sub-Watershed.

Water Body Name	Assessment Unit ID Number	Listing	Pollutants
Hatwai Creek	ID17060306CL067_02	Source to Mouth	Bacteria, Nutrients, Temperature

2.2 Applicable Water Quality Standards

Idaho water quality standards (WQS) address various beneficial uses designated or presumed for specific water bodies. The WQS define the corresponding numeric and narrative, physical and chemical limits or criteria needed to support these uses. These beneficial uses are identified in the Idaho water quality standards, IDAPA 58.01.02, and include the following:

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

Beneficial Uses

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

Existing Uses

Existing uses under the CWA are "those uses actually attained in the waterbody on or after November 28, 1975, whether or not they are included in the water quality standards." The existing in-stream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.050.02, .02.051.01, and .02.053). Existing uses include uses actually occurring, whether or not the level of quality to fully support the uses

exists. A practical application of this concept would be to apply the existing use of salmonid spawning to a water that could support salmonid spawning, but salmonid spawning is not occurring due to other factors, such as dams blocking migration.

Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho, these include uses such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Water quality must be sufficiently maintained to meet the most sensitive use designated for any particular water body. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.27 and .02.109-.02.160 in addition to citations for existing uses).

Presumed Uses

In the Idaho water quality standards, most water bodies listed in the tables of designated uses do not yet have specific use designations. These undesignated uses are to be designated later. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called "presumed uses," DEQ will apply the numeric cold water criteria and primary or secondary contact recreation criteria to undesignated waters. If, in addition to these presumed uses, an additional existing use, (e.g., salmonid spawning) exists, then because of the requirement to protect levels of water quality for existing uses, the additional numeric criteria for salmonid spawning would additionally apply (e.g., intergravel dissolved oxygen, temperature). However, if for example, cold water aquatic life is not found to be an existing use, then before some other aquatic life criteria (such as seasonal cold) could be applied in lieu of cold water criteria, there would have to be a use designation to that effect (IDAPA 58.01.02.101.01).

Beneficial uses for Hatwai Creek are shown in Table 3.

Table 3. Hatwai Creek beneficial uses.

Stream Name	Listing	Assessment Unit	Designated Beneficial Uses	Existing Beneficial Uses
Hatwai Creek	Source to Mouth	ID17060306CL067_02	COLD, SCR	COLD, SCR, AWS
Hatwai Creek	Source to Mouth	ID17060306CL067_03	COLD, SCR, SS	COLD, SCR, SS

[a] COLD – cold water aquatic life, SS – salmonid spawning, SCR – secondary contact recreation, AWS—agricultural water supply

Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of criteria, which include *narrative* criteria for pollutants such as sediment and nutrients and *numeric* criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity (IDAPA 58.01.02.250) (Table 4).

Excess sediment is described by narrative criteria (IDAPA 58.01.02.200.08): "Sediment shall not exceed quantities specified in Sections 250 and 252 or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Subsection 350."

Narrative criteria for excess nutrients are described in IDAPA 58.01.02.200.06, which states: "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses."

Narrative criteria for floating, suspended, or submerged matter are described in IDAPA 58.01.02.200.05, which states: "Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities."

DEQ's procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.053. The procedure relies heavily upon biological parameters and is presented in detail in the Water Body Assessment Guidance (Grafe et al. 2002). This guidance requires the use of the most complete data available to make beneficial use support status determinations.

Table 4 includes the most common numeric criteria used in TMDLs.

Figure 6 provides an outline of the stream assessment process for determining support status of the beneficial uses of cold water aquatic life, salmonid spawning, and contact recreation.

Table 4. Selected numeric criteria supportive of designated beneficial uses in Idaho water quality standards.

Water Quality Parameter	Designated and Existing Beneficial Uses			
	Primary Contact Recreation	**Secondary Contact Recreation**	**Cold Water Aquatic Life**	**Salmonid Spawning (During Spawning and Incubation Periods for Inhabiting Species)**
Water Quality Standards: IDAPA 58.01.02.250				
Bacteria, ph, and Dissolved Oxygen	Less than 126 *E. coli*/100 ml[a] as a geometric mean of five samples over 30 days; no sample greater than 406 *E. coli* organisms/100 ml	Less than 126 *E. coli*/100 ml as a geometric mean of five samples over 30 days; no sample greater than 576 *E. coli*/100 ml	pH between 6.5 and 9.0 DO[b] exceeds 6.0 mg/L[c]	pH between 6.5 and 9.5 Water Column DO: DO exceeds 6.0 mg/L in water column or 90% saturation, whichever is greater Intergravel DO: DO exceeds 5.0 mg/L for a one day minimum and exceeds 6.0 mg/L for a seven day average
Tempera-ture[d]			22 °C or less daily maximum; 19 °C or less daily average	13 °C or less daily maximum; 9 °C or less daily average Bull trout: not to exceed 13 °C maximum weekly maximum temperature over warmest 7-day period, June – August; not to exceed 9 °C daily average in September and October
			Seasonal Cold Water: Between summer solstice and autumn equinox: 26 °C or less daily maximum; 23 °C or less daily average	
Turbidity			Turbidity shall not exceed background by more than 50 NTU[e] instantaneously or more than 25 NTU for more than 10 consecutive days.	
Ammonia			Ammonia not to exceed calculated concentration based on pH and temperature.	
EPA Bull Trout Temperature Criteria: Water Quality Standards for Idaho, 40 CFR Part 131				
Tempera-ture				7 day moving average of 10 °C or less maximum daily temperature for June - September

[a] *Escherichia coli* per 100 milliliters
[b] dissolved oxygen
[c] milligrams per liter
[d] Temperature Exemption - Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the ninetieth percentile of the seven-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.
[e] Nephelometric turbidity units

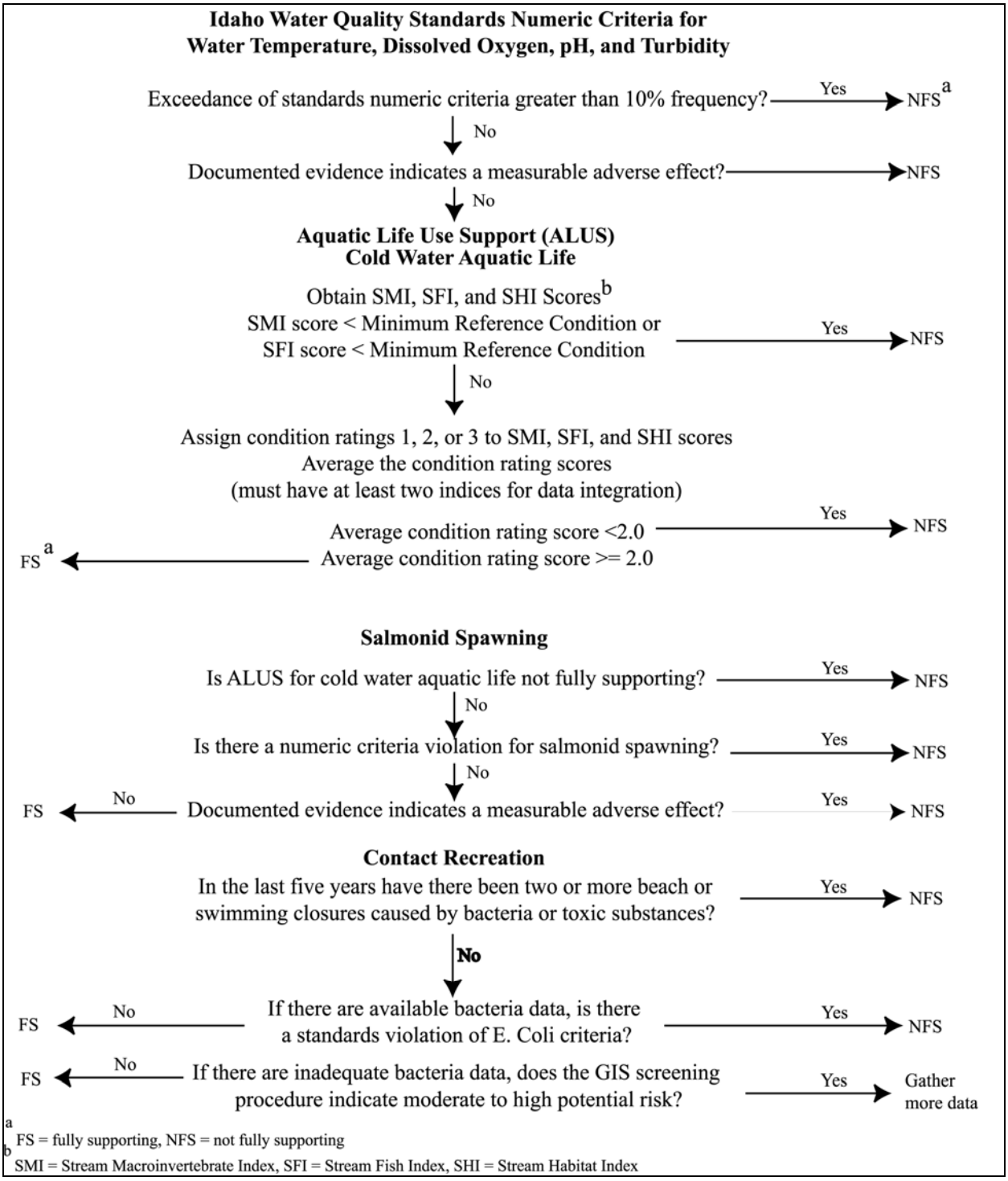


Figure 6. Determination Steps and Criteria for Determining Support Status of Beneficial Uses in Wadeable Streams: Water Body Assessment Guidance, Second Addition (Grafe et al. 2002)

2.3 Pollutant/Beneficial Use Support Status Relationships

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

Temperature

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

Elevated stream temperatures can be harmful to fish at all life stages, especially if they occur in combination with other habitat limitations such as low dissolved oxygen or poor food supply. Acceptable temperature ranges vary for different species of fish, with cold water species being the least tolerant of high water temperatures. Temperature as a chronic stressor to adult fish can result in reduced body weight, reduced oxygen exchange, increased susceptibility to disease, and reduced reproductive capacity. Acutely high temperatures can result in death if they persist for an extended length of time. Juvenile fish are even more sensitive to temperature variations than adult fish, and can experience negative impacts at a lower threshold value than the adults, manifesting in retarded growth rates. High temperatures also affect embryonic development of fish before they even emerge from the substrate. Similar kinds of affects may occur to aquatic invertebrates, amphibians and mollusks, although less is known about them.

Dissolved Oxygen

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

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

Juvenile aquatic organisms are particularly susceptible to the effects of low DO due to their high metabolism and low mobility (they are unable to seek more oxygenated water). In addition,

oxygen is necessary to help decompose organic matter in the water and bottom sediments. Dissolved oxygen reflects the health or the balance of the aquatic ecosystem.

Oxygen is produced during photosynthesis and consumed during plant and animal respiration and decomposition. Oxygen enters water from photosynthesis and from the atmosphere. Where water is more turbulent (e.g., riffles, cascades), the oxygen exchange is greater due to the greater surface area of water coming into contact with air. The process of oxygen entering the water is called aeration.

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

Temperature, flow, nutrient loading, and channel alteration all impact the amount of DO in the water. Colder waters hold more DO than warmer waters. As flows decrease, the amount of aeration typically decreases and the in-stream temperature increases, resulting in decreased DO. Channels that have been altered to increase the effectiveness of conveying water, such as those used in canal systems, often have fewer riffles and less aeration. Thus, these systems may show depressed levels of DO in comparison to the DO levels present before the alteration. Nutrient-enriched waters have a higher biochemical oxygen demand due to the amount of oxygen required for organic matter decomposition and other chemical reactions. This oxygen demand results in lower in-stream DO levels.

Sediment

Both suspended (floating in the water column) and bedload (moving along the stream bottom) sediment can have negative effects on aquatic life communities. Many fish species can tolerate elevated suspended sediment levels for short periods of time, such as during natural spring runoff, but longer durations of exposure are detrimental. Elevated suspended sediment levels can interfere with feeding behavior (difficulty finding food due to visual impairment), damage gills, reduce growth rates, and in extreme cases eventually lead to death.

Newcombe and Jensen (1996) reported the effects of suspended sediment on fish, summarizing 80 published reports on streams and estuaries. For rainbow trout, physiological stress, which includes reduced feeding rate, is evident at suspended sediment concentrations of 50 to 100 mg/L when those concentrations are maintained for 14 to 60 days. Similar effects are observed for other species, although the data sets are less reliable. Adverse effects on habitat were noted at similar concentrations of suspended sediment, especially on spawning and rearing habitat, presumably caused by sediment deposition.

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

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

aquatic macroinvertebrate community is diminished due to the reduction of coarse substrate habitat.

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

Bacteria

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

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

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

Coliform bacteria from both point and nonpoint sources impact water bodies, although point sources are typically permitted and offer some level of bacteria-reducing treatment prior to discharge. Nonpoint sources of bacteria are diffuse and difficult to characterize. Unfortunately, nonpoint sources often have the greatest impact on bacteria concentrations in water bodies. This is particularly the case in urban storm water and agricultural areas. *E. coli* is often measured in colony forming units (cfu) per 100 ml.

Nutrients

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

The first step in identifying a water body's response to nutrient flux is to define which of the critical nutrients is limiting. A limiting nutrient is one that normally is in short supply relative to

biological needs. The relative quantity affects the rate of production of aquatic biomass. Either phosphorus or nitrogen may be the limiting factor for algal growth, although phosphorous is most commonly the limiting nutrient in Idaho waters. Ecologically speaking, a resource is considered limiting if the addition of that resource increases growth.

Total phosphorus (TP) is the combination of all forms of phosphorus in a water sample, including all inorganic and organic particulate and soluble forms. In freshwater systems, typically greater than 90% of the TP present occurs in organic forms as cellular constituents in the biota or adsorbed to particulate materials (Wetzel 1983). The remainder of phosphorus is mainly soluble orthophosphate, a more biologically available form of phosphorus than TP that consequently leads to a more rapid growth of algae. In impaired systems, a larger percentage of the TP fraction is comprised of orthophosphate. Determining the relative amount of each formof phosphorus can provide information on the potential for algal growth within the system.

Nitrogen may be a limiting factor at certain times if there is substantial depletion of nitrogen in sediments due to uptake by rooted macrophyte beds. In systems dominated by blue-green algae, nitrogen is not a limiting nutrient due to the algal ability to fix nitrogen at the water/air interface.

Total nitrogen to TP ratios greater than 7.0 are indicative of a phosphorus-limited system while those ratios less than 7.0 are indicative of a nitrogen-limited system. Only biologically available forms of the nutrients are used in the ratios because these are the forms that are used by the immediate aquatic community.

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

Sediment – Nutrient Relationship

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

Sediment acts as a nutrient sink under aerobic conditions. However, when conditions become anoxic, sediments release phosphorous into the water column. Nitrogen can also be released, but

the mechanism by which it happens is different. The exchange of nitrogen between sediment and the water column is for the most part a microbial process controlled by the amount of oxygen in the sediment. When conditions become anaerobic, the oxygenation of ammonia (nitrification) ceases and an abundance of ammonia is produced. This results in a reduction of nitrogen oxides (NO_x) being lost to the atmosphere.

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

Floating, Suspended, or Submerged Matter (Nuisance Algae)

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

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

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

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

matter can lead to changes in water chemistry and a release of sorbed phosphorus to the water column at the water/sediment interface.

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

2.4 Summary and Analysis of Existing Water Quality Data

In July 2006, water quality analysts from DEQ's Lewiston Regional Office (DEQ/LRO) initiated a year-long routine monitoring regimen at a monitoring station near the mouth of Hatwai Creek in the third-order segment. This monitoring station was monitored every two weeks for the following parameters and pollutant concentrations: instantaneous stream temperature; dissolved oxygen, ammonia, nitrite+nitrate as nitrogen (NO_2+NO_3-N), and total phosphorus; instantaneous stream flow; and specific conductance. The first set of *E. coli* samples taken at the site violated the secondary contact beneficial use criterion and triggered the subsequent 5 samples over 30 days geometric mean criterion sampling protocol. The resulting geometric mean concentration violated State WQS. Further bacteria monitoring focused on DNA analysis to determine possible sources contributing bacteria to Hatwai Creek.

Two Beneficial Use Reconnaissance Program (BURP) surveys, 1996 and 1998, were completed in the third-order segment of Hatwai Creek. These surveys provide data on habitat conditions, stream macroinvertebrates, and fish. In addition, Idaho Fish and Game (IDFG) provided fish distribution and salmonid spawning data.

Flow Characteristics

Hatwai Creek lacks a permanent flow gage station, making more detailed analysis of historical flow regimes difficult. DEQ collected flow measurements on a bi-weekly basis from July 2006 through July 2007. Measured precipitation was lower than average during the monitoring year, and the majority of the measurements represent base flow conditions. Higher flows beginning in January and then occurring sporadically through April reflect the weather pattern. Most of the precipitation occurs during winter and early spring, with very little precipitation occurring during the summer months. This pattern causes flows to peak in early spring and return to base flows by summer. Base flows in Hatwai Creek were relatively constant during the monitoring year, due to shallow ground water (spring water) inflow. The highest measured flow during the monitoring year of July 2006 through July 2007 was nearly 10 cubic feet per second (cfs) (February 2007), while the lowest measured flow was just under one-third of 1 cfs (November 2006).

Water Column Data

Data generated during the year-long routine monitoring effort described above will be used in the analyses included in this TMDL .

Temperature

The third-order segment of Hatwai Creek is not listed for temperature, and biological and fish surveys show that both the salmonid spawning (SS) and cold water aquatic life(COLD) beneficial uses are fully supported in the third-order AU. Although the BURP SFI score indicates support of the salmonid spawning beneficial use, instantaneous temperatures recorded in the 3rd order segment of Hatwai Creek indicate that it is highly likely this segment is temperature impaired. This data, coupled with the inputs this segment receives from the temperature listed and impaired 2nd order segments, led to the development of the PNV temperature TMDL for the 3rd order segment. Solar pathfinder data collected near the mouth also show this segment lacks significant shade when compared to desired targets for it'

The second-order segment of Hatwai Creek is listed as impaired by both temperature and habitat alteration. Although routine monitoring has not occurred in the second-order AU, and year round temperature logger data does not exist, visual evidence of these alterations has been noted by DEQ/LRO analysts. Riparian vegetation in the second-order AU has been removed and replaced with agricultural crops, roads, and pasture lands. Stream banks have been opened and the riparian canopy removed to an extent that excess heat load is reaching the stream. A potential natural vegetation (PNV) temperature TMDL that calls for more shade in the second-order AU of Hatwai Creek has been developed. If implemented successfully, projects designed to increase shade may also have a positive impact on channel and stream bank restoration, which can eliminate certain sources of pollution and reduce pollutant concentrations in the subwatershed while simultaneously reducing stream temperature.

E. coli Bacteria

The state of Idaho criteria for *E. coli* is that bacteria are not to exceed 126 colony forming units per 100 milliliters of solution (cfu/100 ml) as a 30-day geometric mean. Also, there are instantaneous limits of 406 cfu/100 ml for primary contact recreation uses and 576 cfu/100 ml for secondary contact uses. (IDAPA 58.01.02.251.01 & 02).

Primary contact use applies when the ingestion of small quantities of water is likely to occur. Such activities include, but are not restricted to, swimming, water skiing, or skin diving. Secondary contact use applies for uses not included in the primary contact category. These activities may include fishing, boating, wading, infrequent swimming, and other activities where ingestion of raw water is not likely to occur.

The initial *E. coli* sample taken at the monitoring station on Hatwai Creek in July 2006 violated the secondary contact recreation criterion and triggered the subsequent sampling necessary to calculate a geometric mean concentration. Five *E. coli* bacteria samples were taken three to seven days apart over the next 30 days. The five resulting *E. coli* concentrations were then used to calculate the geometric mean concentration, and the resulting concentration is in violation of State WQS. Based on these measured samples, a reduction in *E. coli* bacteria concentrations is needed throughout the subwatershed to comply with Idaho's geometric mean criterion of 126

cfu/100ml. *E. coli* load reductions set forth in Section 5 of this document will apply from the monitoring station upstream to all points in the subwatershed in order to restore recreation as a beneficial use (Table 5).

Table 5. Measured in-stream *E. coli* bacteria geometric mean concentration.

WBID & AU #	Water Body Name	*E. coli* Concentration (cfu/100 ml)
ID17060306CL067_03	Hatwai Creek	348

Dissolved Oxygen

Waters designated for cold water aquatic life must sustain dissolved oxygen concentrations of 6.0 milligrams per liter (mg/l) or greater at all times (IDAPA 58.01.02.250.02.a). The Idaho state criterion for dissolved oxygen in the water column for the salmonid spawning beneficial use is a one-day minimum of not less than 6.0 mg/L or 90% (ninety percent) of saturation, whichever is greater (IDAPA 58.01.02.250.02.f.2.a).

No violations of the standard were recorded during the 2006-2007 monitoring year. The average of instantaneous DO measurements at the monitoring station is nearly 10mg/L, well above the standard. However, the combination of a consistently high percentage saturation of DO and nutrient concentrations above recommended levels could mean that instantaneous DO measurements taken during daylight hours are not sufficient. Excess nutrients can lead to aquatic plant growth, which can lead to diurnal DO sags. In addition to the nutrient TMDL(s) in Section 5 of this document, DEQ/LRO will conduct 24-hour diurnal DO measurements on Hatwai Creek as an element of required TMDL five-year review monitoring, during the summer and early fall, the season most likely to show effects on DO (see also the Data Gap section of this document, starting on page 27).

Nutrients

Idaho's narrative standard for nutrients states "surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses" (IDAPA 58.01.02.200.06). Excessive nutrients affect dissolved oxygen and impair aquatic life beneficial uses due to the growth and decomposition cycle of algae feeding on the nutrients and the biochemical oxygen demand as ammonia is transformed to nitrate-nitrogen. An in-stream dissolved oxygen concentration of 6.0 mg/L is required by Idaho's water quality standards for protection of aquatic life beneficial uses.

Nutrient loading needs to be controlled and managed to ensure adequate dissolved oxygen concentrations remain during the critical flow season when stream temperatures increase and flows decrease.

Table 6 shows nutrient concentrations measured in Hatwai Creek. The average nitrite + nitrate as nitrogen concentration (NO_2+NO_3 =N mg/L) measured in Hatwai Creek during the 2006-2007 monitoring year was 2.27 mg/L, nearly thirty (30) times higher than the EPA recommendation of 0.072 mg/L. The average total phosphorous (TP) concentration measured during the same period was 0.17 mg/L, again significantly higher than the recommended 0.03 mg/L (Table 11).

Measured ammonia (NH_3) concentrations occurred more sporadically, with the average ammonia concentration equaling 0.07 mg/L. Ammonia is rapidly oxidized by certain bacteria, in natural water systems, to nitrite and nitrate—a process that requires the presence of dissolved oxygen. Samples with concentrations of NH_3 show that the ammonia had not yet oxidized, which may mean the ammonia had recently been contributed to Hatwai Creek. Nitrogen, ammonia, and phosphorous concentrations at the levels measured in Hatwai Creek can cause visible slime growths or other nuisance aquatic growth that can cause DO to sag and impair the creek's existing beneficial uses. DEQ/LRO water quality personnel noted just such nuisance aquatic vegetation growths while conducting routine monitoring at the monitoring station. Given the combination of these measured and observed factors, the Columbia Plateau criteria recommendations have been used as targets to develop nitrogen and phosphorous TMDLs designed to restore and protect the beneficial uses of Hatwai Creek. The implementation of management practices aimed at reducing nitrogen and phosphorus will necessarily reduce ammonia as well. Oxidized ammonia becomes a part of the NO_2+NO_3 =N mg/L load, which has been allocated with the necessary reductions calculated. Therefore, a separate TMDL for ammonia is not included.

Table 6. Nutrient concentrations measured in Hatwai Creek.

Date	DO[a] (mg/L)	NO_2+NO_3[b] (mg/L)*	NH_3[c] (mg/L)*	TP[d] (mg/L)	Flow (cfs[e])
7/20/2006	8.9	1.3	No Data	0.17	.439
7/31/06	8.9	1.3	No Data	0.28	.234
8/21/06	8.5	1.2	No Data	No Data	.27
9/1/2006	8.9	0.9	No Data	0.21	.22
9/15/2006	9.1	1.1	No Data	0.2	0.19
9/28/2006	9.3	1.4	No Data	0.22	0.34
10/10/2006	No Data	1.3	No Data	0.08	0.3
10/27/2006	10.3	1.6	No Data	0.08	No Data
11/9/2006	9.4	1.8	No Data	0.09	0.24
11/21/2006	9.6	3.0	No Data	0.22	1.22
12/5/2006	10.2	2.9	No Data	0.2	No Data
12/21/2006	10.9	3.5	No Data	0.19	1.0
1/4/2007	11.8	3.6	No Data	0.11	1.6
1/18/2007	11.9	3.7	No Data	0.08	3.6
1/30/2007	11.6	3.3	No Data	0.09	3.6
2/16/2007	11.2	4.3	Non-detect	0.24	9.0
3/2/2007	12.7	4.5	0.52	0.06	4.76
3/16/2007	11.7	3.8	0.02	0.16	5.1
3/29/2007	11.2	3.38	Non-detect	0.14	4.2
4/10/2007	10.9	2.69	Non-detect	0.18	3.6
4/26/2007	11.0	2.54	0.084	0.19	3

Date	DO[a] (mg/L)	NO_2+NO_3[b] (mg/L)*	NH_3[c] (mg/L)*	TP[d] (mg/L)	Flow (cfs[e])
5/11/2007	9.9	1.84	No Data	0.2	2.2
5/25/2007	9.7	1.8	0.04	0.2	1.46
6/8/2007	9	0.85	Non-detect	0.18	1.7
6/22/2007	12.4	1.13	Non-detect	0.15	1.24
7/6/2007	8.4	1.3	0.065	0.18	.43
7/19/2007	8.5	1.37	Non-detect	0.25	.64
Average	**10**	**2.27**	**0.07**	**0.17**	**1.9**

[a] dissolved oxygen
[b] nitrite + nitrate
[c] ammonia
[d] total phosphorus.
[e] cubic feet per second

Biological and Other Data

Two Beneficial Use Reconnaissance (BURP) surveys, 1996 and 1998, were completed in the third-order segment of Hatwai Creek.

The BURP monitoring protocol includes three types of data: macroinvertebrates, fish, and habitat. A stream macroinvertebrate index (SMI) is generated from seven different qualities of the macroinvertebrates found, including: species diversity, richness of species diversity, species guilds, and pollutant tolerance. A stream fish index (SFI) is developed based on species present, abundance of the different species, and the presence/absence of juveniles. A stream habitat index (SHI) uses both quantitative and qualitative measures of stream habitat including substrate composition, channel structure, streamside vegetation, and stream bank condition. Comparisons between sample indices and statistical reference indices, along with available physical and chemical data, are used to determine whether an AU supports its beneficial uses.

The Idaho Water Body Assessment Guidance, Second Edition (WBAG-II) (Grafe *et al.* 2002) describes DEQ's method for evaluating biological data and determining beneficial use support of Idaho water bodies. (Use support determinations are also called status determinations.) Assessing a water body involves analyzing and integrating multiple types of data to determine the degree of beneficial use support and biological integrity. The WBAG-II considers data less than five years old to be most relevant for supporting status determinations.

Idaho's WBAG-II provides for use of a multimetric index score. A multimetric index score of 2.0 or greater indicates that biological characteristics support beneficial uses, meaning the stream passes the assessment; a score of less than 2.0 indicates that biological characteristics do not support beneficial uses and the stream fails the assessment.

Multmetric index scores for both surveys completed on the third-order segment of Hatwai Creek show full support of the salmonid spawning and cold water aquatic life beneficial uses (Table 7).

Table 7. BURP multi-metric index scores for Hatwai Creek.

Assessment Unit	Stream Name	Year Sampled	SMI	SFI	SHI	Condition Rating	Multi-metric Index Results
ID17060306CL067_03	Hatwai Creek (source to mouth)	1998	3	2	3	2.67	Pass

Status of Beneficial Uses

In addition to the BURP data and WBAG assessments, Tier 1 TMDL monitoring data collected by trained DEQ personnel using established protocols, quality controls and EPA certified laboratories is used in making support status determinations. Table 8 illustrates the most current support status determinations for the Hatwai Creek subwatershed, and the pollutants for which TMDLs will be written, based on all available data. The recreation beneficial use is not fully supported in Hatwai Creek due to the measured violation of the State geometric mean criteria for *E. coli* bacteria. Although the BURP SFI score indicates support of the salmonid spawning beneficial use, instantaneous temperatures recorded in the 3rd order segment of Hatwai Creek indicate that it is highly likely this segment is temperature impaired. This data, coupled with the inputs this segment receives from the temperature listed and impaired 2nd order segments, led to the development of the PNV temperature TMDL for the 3rd order segment.

Table 8. Beneficial use support status and TMDL pollutants.

Stream Name	Extent	AU#	Aquatic Life Uses		Recreation Use	Pollutant
			SS*	CWAL*		
Hatwai Creek	Source to Mouth	ID17060306CL067_03	NFS*	FS*	NFS	Temperature, E.coli, NO_2+NO_3, TP

SS=salmonid spawning, CWAL=cold water aquatic life , NFS=not fully supporting beneficial uses, FS=fully supporting beneficial uses

Conclusions

Based on the data collected, bacteria (*E. coli*), nutrient (NO_2+NO_3, TP), and temperature TMDLs have been developed for the Hatwai Creek subwatershed. With the exception of storm water construction permits, loads have been allocated to existing sources currently in the subwatershed. A growth reserve has not been included in the TMDLs. Future sources will need to acquire a load allocation from existing allocations unless the load capacity is increased.

2.5 Data Gaps

Twenty-four-hour diurnal DO measurements have not been recorded as of yet on Hatwai Creek. DEQ/LRO will conduct 24-hour diurnal DO measurements on Hatwai Creek as an element of required TMDL five-year review monitoring, during the critical low-flow period of late summer and early fall. Further analysis of both *E-coli* and nutrient data could help determine the exact source of the pollutants. Further DNA analysis could determine which types of animals are contributing *E. coli* to the stream. But, in addition to their prohibitive cost, DNA test results have

inherent issues such as false negative results that make authoritative assertions concerning the exact source of the bacteria difficult. The DNA results can positively identify a contributor to the bacteria load in that particular sample, but negative results cannot fully eliminate sources as possibilities. Analysis of the nitrate ions in nutrient samples could determine whether the source is organic (animals) or inorganic (fertilizer).

3. Subbasin Assessment–Pollutant Source Inventory

This section identifies and discusses sources of pollutants affecting water quality in the Hatwai Creek subwatershed. Sources may occur as point sources, regulated by National Pollutant Discharge Elimination System (NPDES) permits, and as nonpoint sources which are not subject to any permitting program. Point sources convey pollutants directly into waters through a pipe, ditch, or other identifiable point of discharge. Nonpoint sources have no exact point of discharge to receiving waters, conveying their associated pollutants over the landscape. To the best knowledge of DEQ, Hatwai Creek receives pollutants from nonpoint sources only, which are discussed in more detail below.

3.1 Sources of Pollutants of Concern

There are no known point sources in the Hatwai Creek subwatershed. Industrial warehouses are located on both banks at the mouth of the stream, but no direct piping from either warehouse has been found entering the creek.

Nonpoint Sources

Nonpoint sources within the Hatwai Creek subwatershed include agriculture, grazing, roads and septic systems. Large tracts of the subwatershed's grass lands have been converted to dry land (non-irrigated) agriculture. The Hatwai Creek subwatershed consists of 19,785 acres of cropland (56 percent), rangeland (31.5 percent), pasture/hayland (5 percent), riparian areas (2.5 percent), roads (2 percent), forestland (1 percent), mining (1 percent), and farms and suburban areas (1 percent). The majority of the acreage is privately owned, with industrial warehousing located on both banks at the mouth.

3.2 Data Gaps

Authoritative water quality evaluations to discern in-stream pollutant load contributions from and between the various nonpoint sources found within the watershed are not possible from the data collected. To ensure effective and efficient load reductions are achieved, more specific identification of pollutant loads attributable to known nonpoint sources located within the delineated watershed areas should be completed by the appropriate designated management agency .

Nonpoint Sources

Nonpoint sources in the Hatwai Creek subwatershed are responsible for the excess pollutant loads of bacteria, nutrients, and temperature found at the monitoring station. The biological source of *E. coli* bacteria can be traced through DNA analysis. Bacteria samples taken from Hatwai Creek were analyzed for the presence of the human gene biomarker and the results of those tests were negative. This negative result should not be interpreted to mean that there is definitely no human contribution to the bacteria load in Hatwai Creek. No human gene

biomarkers were found in that particular sample, but false negative results are an inherent problem with DNA testing. In the future, samples could be tested to determine if birds or other mammals are contributing to the *E. coli* bacteria load.

Further analysis of the nitrate ions in nutrient samples can also be performed to determine if the nitrate found in Hatwai Creek is organic or inorganic. Inorganic forms of nitrate can reach the stream from runoff and infiltration of fertilizer, primarily from agriculture. Organic forms generally come from livestock, pets, and waterfowl.

The potential natural vegetation (PNV) TMDL found in Chapter 5 of this document makes it clear which stream segments have been the most affected or disturbed by riparian plant removal, channelization, impoundment, and possibly wildfire. The lack of shade found in each stream segment illustrates both where and how excess solar radiation is reaching the stream and warming the water. Completion of the PNV temperature TMDL has resulted in the quantification of nonpoint source solar heat loading to Hawai Creek.

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

Pollution control and habitat restoration efforts in the Hatwai Creek subwatershed have been touted as successes. The U.S. Environmental Protection Agency website contains an article that summarizes the pollution prevention and restoration projects completed in the mid 1990s on segments of Hatwai Creek, and gives credit to the entities involved in both funding and actual in-stream work. What follows is quoted directly from the EPA website:

> In the early 1990s the Nez Perce Soil and Water Conservation District (NPSWCD) organized local, state, and federal stakeholders to address water quality and fishery concerns. The watershed plan resulting from that partnership consisted of four separate projects to address water quality and fisheries issues: an EPA 319 project, a U.S. Department of Agriculture Water Quality Incentives Project, a riparian demonstration project funded by the Idaho Soil Conservation Commission, and a USDA Environmental Quality Incentives Program project.
>
> The Idaho Department of Environmental Quality (DEQ) funded a sediment and nutrient reduction project through section 319 funding. The project included landowner education for watershed management and nonpoint source pollution. Many structural conservation practices were installed, including 12 water and sediment control basins, nine grade stabilization structures, two ponds, one off-site water development, eight sediment basins, 8,000 linear feet of terrace, and 5,400 linear feet of riparian improvement practices (brush mattresses, pole plantings, and revetments).
>
> The USDA Water Quality Incentive Program project provided incentive payments for nutrient and pest management and for well testing. Thirty-five landowners participated and received training on soil testing, nutrient budgets, Integrated Pest Management practices, and wellhead protection practices. More than 11,000 acres were treated through this program.
>
> The riparian demonstration project began in 1993 and will be completed in 2001. The primary areas of focus are grazing management on riparian and upland areas, enhancement of the riparian areas, streambank stabilization, and fish habitat improvement.
>
> In June 1999 a special project for reducing sheet and rill erosion on cropland was initiated through the support of the Natural Resources Conservation Service's (NRCS) Environmental Quality Incentives Program. Conservation practices will focus on the implementation of direct seeding systems, a new technology for this area, and there is a possibility of reducing sheet and rill erosion by as much as 25 percent.
>
> The Idaho Department of Fish and Game collected fish data in Lower Hatwai Creek, monitoring the responses of wild trout, natural rainbow trout, and steelhead trout. Monitoring results for the 1995 to 1998 period indicate that the trout density increased annually throughout the length of the demonstration project. Trout density in the project area increased from 0.32 per 100 square meters in 1995 to a high of 13.24/100 m^2 in 1998; in the control area, on the other hand, trout density was only 0.87/100 m^2 in 1996, 3.00/100 m^2 in 1997, and 3.06/100 m^2 in 1998. This improvement is attributed to

improved riparian health, including improved streambank, increased canopy cover, and decreased stream temperatures.

Nineteen erosion control structures were installed, reducing concentrated-flow erosion of sediment by an average of 20 tons per acre per year. Installing sheet and rill erosion control practices on 10,000 acres of nonirrigated cropland resulted in a reduction of 7 tons per acre per year. Installing 9,000 acres of pest and nutrient management practices produced a 20 percent reduction in the amount of pesticides and fertilizers applied.

The NPSWCD also completed a landowner survey to document technology adoption. Eighty-five percent of those surveyed had participated in at least one of the four projects, and 69 percent confirmed that they would participate again in a similar project if given the opportunity. Fifty-four percent of those surveyed were willing to participate in watershed advisory groups. Nineteen different types of conservation practices were installed on more than 14,000 acres of land, representing about three-fourths of the total watershed acreage.

Success is the result of the cooperative efforts of landowners, the public, and various agencies. Groups assisting included DEQ, EPA, Idaho Department of Fish and Game, Idaho Soil and Water Conservation Commission, Nez Perce County Commissioners, Lewiston Senior High School, Lewiston Retired Senior Volunteer Program, Idaho Department of Lands, Idaho Department of Water Resources, NRCS, University of Idaho, local Boy Scout groups, NMFS, and the NPSWCD
(EPA 2002, http://www.epa.gov/nps/Section319III/ID.htm).

For more information about these projects, visit the NPSWCD website or contact Lynn Rasmussen, NRCS District Conservationist (Lynn.Rasmussen@id.usda.gov).

5. Total Maximum Daily Load(s)

A Total Maximum Daily Load (TMDL) calculates the allowable amount of a pollutant that can be in the water body according to state water quality standards. The allowable amount of the pollutant is called the pollutant load capacity. Once the load capacity is calculated it is distributed or allocated among the sources of the pollutant in the watershed.

There are two kinds of pollutant sources: point sources and nonpoint sources. Each point source is assigned a wasteload allocation; nonpoint sources collectively receive a load allocation, though there may be several categories of nonpoint sources, each with a separate load allocation. Since there are no point sources in the Hatwai Creek subwatershed, a wasteload allocation isn't needed. Background is considered part of the load allocation, but it is not available for distribution.

A margin of safety is required to account for uncertainties used in the measurement, analysis, or calculation of the load capacity. The margin of safety may consist of conservative assumptions, or may be added as a separate quantity in the TMDL calculation.
The TMDL can be written as an equation:

Load Capacity = Margin of Safety + Load Allocation + Wasteload Allocation

A total maximum daily load is usually only required for water bodies that do not meet state water quality standards. Once the allowable loads are calculated, current loads also need to be calculated so that the necessary amount of reduction from current loads can be calculated, allowing them to be recognized and achieved by the sources.

The load capacity must be based on critical conditions, the conditions when water quality standards are most likely to be violated. If the load capacity is protective of water quality under critical conditions, it will be protective under all conditions.

A load is calculated by multiplying a pollutant concentration by a water flow volume, whether it is a pollutant concentration that is allowable according to state standards or an existing pollutant concentration found in samples collected from the water body. The critical conditions period is usually during the summer when the pollutant load stays the same but the flow in the water body decreases. Pollutant loads in these TMDLs are based on the most appropriate means available to ensure efficient implementation of control strategies.

5.1 *E. coli* Bacteria TMDL

Target

E. coli bacteria in Hatwai Creek are currently above the concentration allowed by the Idaho state water quality standards, based on the data presented in Section 2.4.

The Idaho water quality standard for *E. coli* bacteria, used as the target for the development of the TMDL, is a geometric mean concentration of 126 colony forming units per 100 milliliters (cfu/100 ml), derived from 5 sample concentrations taken at evenly spaced intervals over a 30-

day period(IDAPA 58.01.02.251.02). A single water sample in which either the primary or secondary recreation use criterion is exceeded does not in itself constitute a violation of WQS; rather, it requires that additional samples be taken every three to seven days over a 30-day period. Those five sample concentrations are then used to calculate a geometric mean concentration to compare against the criterion. A geometric mean is applied to minimize random variability in data associated with surface waters prone to short-term episodic spikes in bacteria concentrations.

Load Capacity

The *E. coli* bacteria load capacity for Hatwai Creek is expressed as the geometric mean concentration of 126 cfu/100 ml. The load capacity is expressed as a concentration (in cfu/100 ml) because it is difficult to calculate a mass load due to several variables (i.e., temperature, moisture conditions, flow) that influence the die-off rate of *E. coli* bacteria in the environment. In spite of these uncertainties, where a mass loading analysis has been requested, the load capacity is expressed as the product of the target minus the margin of safety multiplied by the measured flow for that sampling date.

Estimates of Existing Pollutant Loads

Livestock, pets, septic system drain fields, and wildlife are the most likely sources of *E. coli* bacteria found in Hatwai Creek. Bacteria samples taken from Hatwai Creek were analyzed for the presence of the human gene biomarker and the results of those tests were negative. This negative result should not be interpreted to mean that there is definitely no human contribution to the bacteria load in Hatwai Creek. No human gene biomarkers were found in that particular sample, but false negative results are an inherent problem with DNA testing. The individual percent load contribution from each nonpoint source cannot be determined from the data available at this time.

Load Allocation

Load allocations have not been developed for specific source categories (i.e., tributaries). An in-stream allocation has been developed for Hatwai Creek, based on bacteriological data collected during the months of July and early August in 2006, whereby the geometric mean was computed and assessed against Idaho's numeric criterion set forth to protect the secondary contact recreation designated beneficial use.

Table 9 lists the existing *E. coli* bacteria concentrations found in 2006 at the monitoring station, the secondary contact recreation geometric mean capacity (load capacity), the load allocation, and the reduction in *E. coli* bacteria concentrations that must occur to meet the load allocation.

The *E. coli* bacteria TMDL for Hatwai Creek allocates a geometric mean concentration calculated from 5 samples taken over any 30-day period to all nonpoint sources of *E. coli* bacteria upstream from the monitoring location, and adds a 10% margin of safety to the required load reduction in order to ensure the secondary contact beneficial use is supported throughout the year. As such, sources extending upstream from this location must be managed to reduce the instream *E. coli* bacteria concentrations by 235 cfu/100 ml, or 68%. To ensure that the criterion is not exceeded, this allocation will apply daily throughout the year.

In order to illustrate how bacteria loading needs to be controlled on a daily basis, Table 10 presents a flow-based, instantaneous mass loading analysis. First, the flow is converted from cubic feet per second to milliliters per second. Then, the number of colony forming units (cfu/100ml) measured during each monitoring event in the month long geometric mean sampling effort is multiplied by the measured flow for that monitoring event. A 10% margin of safety is subtracted to ensure necessary reductions account for uncertainties in the sampling process. The results illustrate how bacteria loads tend to fluctuate over the course of a month's time.

Table 9. Load allocation for *E. coli* bacteria in Hatwai Creek.

Location (monitoring station)	Existing Load (#/100 ml)	30-day Load Capacity (#/100 ml)	30-day Load Allocation (#/100 ml)	Explicit Margin of Safety (MOS)	Required Load Reduction (#/100 ml)
Hatwai Creek	348 cfu/100 ml	126 cfu/100 ml	126 cfu/100 ml	10%	235 cfu/100 ml or 68 percent

Table 10. Mass *E. coli* bacteria load allocation for geometric mean sampling events.

Date	E-coli (cfu/100ml)	30 day geomean (cfu/100ml)	Flow (cfs)	Flow (mls)	Existing Load cfu @ flow	Load Cap-MOS cfu @ flow	Load Reduction (cfu@flow)	Percent Reduction%
7/20/2006	191.8		0.34	9627.71	18465.95	10917.83	7548.13	41
7/24/2006	2419.3		0.44	12459.39	301430.07	14128.95	287301.12	95
7/27/2006	313		0.34	9627.71	30134.74	10917.83	19216.91	64
7/31/2006	435.2		0.23	6512.86	28343.98	7385.59	20958.40	74
8/7/2006	130.9		0.41	11609.89	15197.34	13165.61	2031.73	13
8/10/2006	214.3		0.29	8211.87	17598.04	9312.26	8285.78	47
Jul-06		347.9	0.34	9627.71	33494.90	10917.83	22577.07	68

Margin of Safety

The establishment of a TMDL requires that a margin of safety (MOS) be identified to account for uncertainty. A MOS is expressed as either an implicit or explicit portion of a water body's loading capacity that is reserved to allow for uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. The MOS is not allocated to any sources of a pollutant.

By utilizing the state's water quality criterion for the contact recreation beneficial use, DEQ has established a conservative target load for this *E. coli* TMDL. Development of the load capacity and load allocation is in accordance with Idaho Water Quality Standards, where the geometric mean target concentration for *E. coli* bacteria was used and allocated to any 30-day time period for nonpoint sources. The load allocations and reductions called for apply from the monitoring station near the mouth upstream to the headwaters. In addition, DEQ has added an explicit

margin of safety (10%) to the required load reduction in order to ensure the secondary contact beneficial use is supported throughout the year.

Critical Time Period

The *E. coli* bacteria allocations apply on a daily basis throughout the year, since secondary contact recreation may occur at any time of year. Meeting this allocation ensures water quality standards are attained for the protection of public health. Table 11 shows the critical time period for bacteria.

Table 11. Critical time period for the *E. coli* bacteria TMDL.

Pollutant	Critical Period
E. coli Bacteria	Year Round

Background

Background has been incorporated with all other sources into the gross nonpoint source allocation.

Reserve for Growth

A growth reserve has not been included in this TMDL. The load capacity has been allocated to the existing sources currently in the watershed. Any new source would need to be assigned a portion of the existing load allocation.

5.2 Nutrient TMDL

Idaho's narrative standard for nutrients states "surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses" (IDAPA 58.01.02.200.06). Excessive nutrients affect dissolved oxygen and impair aquatic life beneficial uses due to the growth and decomposition cycle of algae feeding on the nutrients and the biochemical oxygen demand as ammonia is transformed to nitrate-nitrogen. An in-stream dissolved oxygen concentration of 6.0 mg/L is required by Idaho's water quality standards for protection of aquatic life beneficial uses.

Nutrient loading needs to be controlled and managed to ensure adequate dissolved oxygen concentrations remain during the critical flow season when stream temperatures increase and flows decrease.

Targets

The EPA Ambient Water Quality Criteria Recommendations set forth nutrient criteria recommendations for rivers and streams by ecoregion (Table 12). Ecoregions are based on

general similarities in geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. The Hatwai Creek subwatershed lies within the Columbia Plateau ecoregion (10), and more specifically the Lower Snake and Clearwater Canyons sub-ecoregion (10I). The Columbia Plateau is an arid sagebrush steppe and grassland surrounded on all sides by moister, predominantly forested, mountainous ecological regions. This region is underlain by lava rock up to two miles thick and is covered in some places by loess soils that have been extensively cultivated for wheat, particularly in the eastern portions of the region where precipitation amounts are greater (EPA 2000).

The Lower Snake and Clearwater Canyons sub-ecoregion consists of deep canyons cut through the basalts of the Columbia Plateau by the Snake and Clearwater rivers. Canyon depths exceed 1,400 feet and create drier conditions than in neighboring regions; mean annual precipitation is only 12 to 25 inches (approximately 12.7 inches per year in Lewiston).

Table 12. EPA Ambient Water Quality Criteria Recommendations by Ecoregion (EPA 2000).

Ecoregion	Description	Nitrite+nitrate (NO_2+NO_3 =N mg/L)	Total Phosphorus (mg/L)
10	Columbia Plateau	0.072	0.03
11	Blue Mountains	0.01	0.0325
12	Snake River Basin	0.272	0.0425
15	Northern Rockies	0.02	0.0077

Load Capacity

A daily pound per day flow-based nutrient load capacity has been calculated using the TMDL target for the respective nutrient and the in-stream flow measurements recorded by the monitoring program conducted in 2006-2007. Nutrient concentrations were converted to pounds per day by multiplying the measured concentrations by the flow recorded during sample collection and a conversion factor (5.39 is the constant used to convert CFS times mg/L to pounds/day). The daily load capacities are presented in Tables 13 and 14 for both nitrogen and phosphorus.

Monthly load capacities have been developed for each month using monthly average flows and monthly average concentrations from those measured during the 2006-07 monitoring year. The following equation describes how the existing monthly loads were generated:

> Existing load (lbs./month)=average monthly concentration(mg/L)* average monthly flow(cfs)*5.39*30(days)
>
> Where: 5.39= conversion factor (converts equation results to pounds per day).

Monthly load capacities are presented in Tables 15 and 16.

Estimates of Existing Pollutant Loads

The average nitrite + nitrate as nitrogen (NO_2+NO_3 =N mg/L) concentration measured in Hatwai Creek during the 2006-2007 monitoring year was 2.27mg/L, nearly thirty (30) times higher than the EPA recommendation of 0.072 mg/L. The average total phosphorous (TP) concentration measured during the same period was 0.17 mg/L; again, significantly higher than the recommended 0.03 mg/L (Table 12). Measured ammonia (NH_3) concentrations occurred more sporadically, with the average ammonia concentration equaling 0.07 mg/L. Ammonia is rapidly oxidized by certain bacteria, in natural water systems, to nitrite and nitrate—a process that requires the presence of dissolved oxygen. Samples with concentrations of NH_3 show that the ammonia had not yet oxidized, which may mean that the ammonia had recently been contributed to Hatwai Creek. Nitrogen, ammonia, and phosphorous concentrations at the levels measured in Hatwai Creek can cause visible slime growths or other nuisance aquatic growth that can cause DO to sag and impair the creek's existing beneficial uses. DEQ/LRO water quality personnel noted just such nuisance aquatic vegetation growths while conducting routine monitoring at the monitoring station. Given the combination of these measured and observed factors, the Columbia Plateau criteria targets have been used to develop nitrogen and phosphorous TMDLs designed to restore and protect the beneficial uses of Hatwai Creek. The implementation of management practices aimed at reducing nitrogen and phosphorous will necessarily reduce ammonia as well. Oxidized ammonia becomes a part of the NO_2+NO_3 =N mg/L load, which has been allocated, with the necessary reductions calculated. Therefore a separate TMDL for ammonia is not included.

Tables 13 and 14 show the existing loads, load capacities, load allocations, and percent load reductions necessary for total phosphorous and nitrite+nitrate-N. Monthly loads are presented in Tables 15 and 16.

Margin of Safety

An explicit margin of safety of 10% was deducted from the load capacity when determining the allocation for each of the nutrients. The explicit deduction accounts for uncertainties about the relationships among physical, chemical, and hydrological factors such as higher ambient air and water temperatures, length of day, and decreased stream flows during the summer growing season, which influence aquatic plant growth cycles, biochemical oxygen demand, and in-stream dissolved oxygen.

Critical Time Period

Although the loading tables illustrate that nutrient loading remains relatively constant throughout the year, it is during the summer months when temperatures increase and flows decrease that diurnal DO can sag below the state water quality standard. Nutrient loading needs to be controlled and managed to ensure DO concentrations remain adequate during this critical period. Adverse effects of excess TP loads are not anticipated to occur during the cool months of the year because of non-optimal aquatic plant growing conditions. Target loads set in this TMDL are protective during the critical time period, May through September. Consequently, these loads are anticipated to also be protective during the cool months.

Table 13. Total phosphorus existing load, load capacity, load allocation, and required reduction for Hatwai Creek at mouth.

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
7/20/2006	NA	0.17	NA	NA	NA	NA
7/27/2006	0.44	NA	NA	0.07	0.06	NA
7/31/2006	0.23	0.28	0.35	0.04	0.03	90.36
8/7/2006	0.41	NA	NA	0.07	0.06	NA
8/10/2006	0.29	NA	NA	0.05	0.04	NA
8/21/2006	0.27	NA	NA	0.04	0.04	NA
9/1/2006	0.22	0.21	0.24	0.03	0.03	87.14
9/15/2006	0.19	0.20	0.20	0.03	0.03	86.50
9/28/2006	0.34	0.22	0.40	0.05	0.05	87.73
10/10/2006	0.30	0.08	0.13	0.05	0.04	66.25
10/27/2006	NA	0.08	NA	NA	NA	NA
11/9/2006	0.24	0.09	0.12	0.04	0.03	70.00
11/21/2006	1.22	0.22	1.45	0.20	0.18	87.73
12/5/2006	NA	0.20	NA	NA	NA	NA
12/21/2006	1.03	0.19	1.05	0.17	0.15	85.79
1/4/2007	1.64	0.11	0.97	0.27	0.24	75.45
1/18/2007	3.62	0.08	1.56	0.59	0.53	66.25
1/30/2007	3.62	0.09	1.75	0.58	0.53	70.00
2/16/2007	9.02	0.24	11.66	1.46	1.31	88.75
3/2/2007	4.76	0.06	1.54	0.77	0.69	55.00
3/16/2007	5.1	0.16	4.40	0.82	0.74	83.13
3/29/2007	4.2	0.14	3.17	0.68	0.61	80.71
4/10/2007	3.6	0.18	3.49	0.58	0.52	85.00
4/26/2007	3.09	0.19	3.16	0.50	0.45	85.79
5/11/2007	2.19	0.2	2.36	0.35	0.32	86.50
5/25/2007	1.463	0.2	1.58	0.24	0.21	86.50
6/8/2007	1.68	0.18	1.63	0.27	0.24	85.00
6/22/2007	1.24	0.15	1.00	0.20	0.18	82.00
7/6/2007	0.428	0.18	0.42	0.07	0.06	85.00
7/19/2007	0.635	0.25	0.86	0.10	0.09	89.20

Table 14. Nitrite+Nitrate-N existing load, load capacity, load allocation, and required reduction for Hatwai Creek at mouth.

Sample Date	Flow (cfs)	NO_2+NO_3-N (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
7/20/2006	NA	1.30	NA	NA	NA	NA
7/27/2006	0.44	NA	NA	0.17	NA	NA
7/31/2006	0.23	1.30	1.64	0.09	0.08	95.02
8/7/2006	0.41	NA	NA	0.16	0.14	NA
8/10/2006	0.29	NA	NA	0.11	0.10	NA
8/21/2006	0.27	1.20	1.74	0.10	0.09	94.60
9/1/2006	0.22	0.90	1.05	0.08	0.08	92.80
9/15/2006	0.19	1.10	1.13	0.07	0.07	94.11
9/28/2006	0.34	1.40	2.56	0.13	0.12	95.37
10/10/2006	0.30	1.30	2.12	0.12	0.11	95.02
10/27/2006	NA	1.60	NA	NA	NA	NA
11/9/2006	0.24	1.80	2.33	0.09	0.08	96.40
11/21/2006	1.22	3.00	19.73	0.47	0.43	97.84
12/5/2006	NA	2.90	NA	NA	NA	NA
12/21/2006	1.03	3.50	19.43	0.40	0.36	98.15
1/4/2007	1.64	3.60	31.82	0.64	0.57	98.20
1/18/2007	3.62	3.70	72.27	1.41	1.27	98.25
1/30/2007	3.62	3.30	64.32	1.40	1.26	98.04
2/16/2007	9.02	4.30	208.99	3.50	3.15	98.49
3/2/2007	4.76	4.50	115.45	1.85	1.66	98.56
3/16/2007	5.1	3.80	104.46	1.98	1.78	98.29
3/29/2007	4.2	3.38	76.52	1.63	1.47	98.08
4/10/2007	3.6	2.69	52.20	1.40	1.26	97.59
4/26/2007	3.09	2.54	42.30	1.20	1.08	97.45
5/11/2007	2.19	1.84	21.72	0.85	0.76	96.48
5/25/2007	1.463	1.80	14.19	0.57	0.51	96.40
6/8/2007	1.68	1.48	13.40	0.65	0.59	95.62
6/22/2007	1.24	1.13	7.55	0.48	0.43	94.27
7/6/2007	0.428	1.30	3.00	0.17	0.15	95.02
7/19/2007	0.635	1.37	4.69	0.25	0.22	95.27

Table 15. Monthly Nitrite+Nitrate-N load allocations.

Month	Ave. Flow (cfs)	Ave. Concentration (mg/L)	Existing Load (lbs/month)	Load Cap. (lbs/month)	Load Allocation (lbs/month)	Reduction %
January	2.96	3.53	1689.57	34.46	31.02	98.16
February	9.02	4.30	6271.70	105.01	94.51	98.49
March	4.69	3.89	2950.07	54.60	49.14	98.33
April	3.35	2.62	1419.24	39.00	35.10	97.53
May	1.83	1.82	538.56	21.31	19.18	96.44
June	1.46	1.31	309.27	17.00	15.30	95.05
July	0.44	1.32	93.92	5.12	4.61	95.09
August	0.32	1.20	62.09	3.73	3.35	94.60
September	0.25	1.13	45.68	2.91	2.62	94.27
October	0.30	1.45	70.34	3.49	3.14	95.53
November	0.73	2.40	283.30	8.50	7.65	97.30
December	1.00	3.20	517.44	11.64	10.48	97.98

Table 16. Monthly Total Phosphorus load allocations.

Month	Ave. Flow (cfs)	Ave. Concentration (mg/L)	Existing Load (lbs/month)	Load Cap. (lbs/month)	Load Allocation (lbs/month)	Reduction %
January	2.96	0.09	43.08	14.36	12.92	70.00
February	9.02	0.24	350.05	43.76	39.38	88.75
March	4.69	0.12	91.00	22.75	20.48	77.50
April	3.35	0.19	102.92	16.25	14.63	85.79
May	1.83	0.20	59.18	8.88	7.99	86.50
June	1.46	0.17	40.13	7.08	6.37	84.12
July	0.44	0.22	15.65	2.13	1.92	87.73
August	0.32	0.08	4.14	1.55	1.40	66.25
September	0.25	0.21	8.49	1.21	1.09	87.14
October	0.30	0.08	3.88	1.46	1.31	66.25
November	0.73	0.16	18.89	3.54	3.19	83.13
December	1.00	0.20	32.34	4.85	4.37	86.50

5.3 Temperature TMDL

In-stream Water Quality Target

The potential natural vegetation (PNV) method has been used to create the Hatwai Creek subwatershed temperature TMDL. Idaho Water Quality Standards, IDAPA 58.01.02.200.09, states: "When natural background conditions exceed any applicable water quality criteria set forth …., the applicable water quality criteria shall not apply; instead, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under Section 401." In these situations, natural conditions are the water quality standard, and the natural level of shade and channel width are the TMDL target. The in-stream temperature which results from these conditions is consistent with the water quality standard, even though it may exceed numeric temperature criteria (DEQ 2004).

Potential Natural Vegetation for Temperature TMDLs

Ground water temperature, air temperature, and direct solar radiation are important contributors to stream temperature (Poole and Berman 2001). Shade and stream morphology affect or control the amount of solar radiation reaching a stream. They are the natural stream conditions most likely to be impaired by anthropogenic activities, and the two that can be readily corrected. The amount of solar radiation reaching the stream may be reduced by restoring the stream bank, vegetation, and channel to more natural conditions.

Although vegetation outside the riparian corridor can provide shade if there is enough relief in the surrounding watershed, riparian vegetation provides the most substantial amount of shade. Effective shade, that shade provided by all objects that intercept the sun as it makes its way across the sky, can be measured in using optical equipment, similar to a fish eye lens on a camera, called a Solar Pathfinder. Effective shade can also be modeled using detailed information about riparian plant communities, topography, and the stream's aspect. In addition to shade, riparian canopy cover is the vegetation that hangs over a stream and is measured using a densiometer or is estimated visually either on site or on aerial photographs. All of these methods tell us information about how much the stream is covered and how much of it is exposed to direct solar radiation.

Potential natural vegetation along a stream is the mature riparian plant community that would exist if it had not been disturbed or reduced—in some cases, it still does exist; in other cases, estimates must be made of what would have existed. The PNV is used as a temperature TMDL target because it provides a natural level of solar loading to the stream. A riparian plant community composed of less than PNV results in the stream heating up from excess solar radiation.

Existing shade was estimated for the Hatwai Creek subwatershed from aerial photos. The estimates were field-verified by measuring shade with a solar pathfinder at selected points in the watershed. PNV targets were determined from an analysis of probable vegetation in the watershed and comparison with shade curves developed for similar vegetation communities presented in the DEQ PNV TMDL Procedure Manual (DEQ 2009). A shade curve shows the relationship between effective shade and stream width. Shade decreases with width as the

vegetation is less able to shade the center of a wide stream. Taller riparian vegetation allows shade to reach further across a stream channel.

Pathfinder Methodology

The solar pathfinder is a device used, at some point in a stream, to trace an outline of objects producing shade on the stream onto a specialized chart called a solar path chart. The percentage of the sun's path covered by these objects is the effective shade on the stream at the point where the tracing is made. In order to adequately characterize the effective shade on a reach of stream, 10 traces are taken at systematic or random intervals along the length of the stream in question.

At each sampling location, the solar pathfinder is placed in the middle of the stream at bankfull water level height and oriented to true south. Starting from a unique location, traces are then taken at fixed intervals proceeding upstream.

Aerial Photo Interpretation

Shade estimates are based on observations about the kind of vegetation present, its density, and the width of the stream. The typical vegetation type shows the kind of landscape a particular shade class usually falls into for a stream 5m wide or less.

Shade class	Amount of Shade	Typical vegetation type on 5m wide stream
0	0 – 9%	agricultural land, denuded areas
10	10 –19%	agricultural land, meadows, open areas, clearcuts
20	20 – 29%	agricultural land, meadows, open areas, clearcuts
30	30 – 39%	agricultural land, meadows, open areas, clearcuts
40	40 – 49%	shrublands/meadows
50	50 – 59%	shrublands/meadows, open forests
60	60 – 69%	shrublands/meadows, open forests
70	70 – 79%	forested
80	80 – 89%	forested
90	90 –100%	forested

The visual estimates of shade in this TMDL were field-verified with a solar pathfinder. The pathfinder measures effective shade and takes into consideration physical features other than vegetation that block the sun from hitting the stream surface (e.g., hillsides and canyon walls). The estimate of shade made visually from an aerial photo does not always take into account topography or any shading that may occur from physical features other than vegetation.

Stream Morphology

Measures of current bankfull width or near-stream disturbance zone width may not reflect widths present under PNV. Width-to-depth ratios tend to increase and streams become wider and shallow as banks and riparian areas are disturbed. Channel width was not determined from the aerial photo work described above. Rather, bankfull width was estimated based on the established relationship between drainage area and bankfull width for streams in the Clearwater River basin, as shown in the curve presented in Figure 7. Existing width was

evaluated from available data. If the stream's existing width was wider than that predicted by the Clearwater River curve in Figure 7, then the curve-based estimate of bankfull width was used in the load analysis. If existing width is smaller than the curve-based estimate, then existing width was used in the load analysis. On most of the smaller tributaries, existing widths were used.

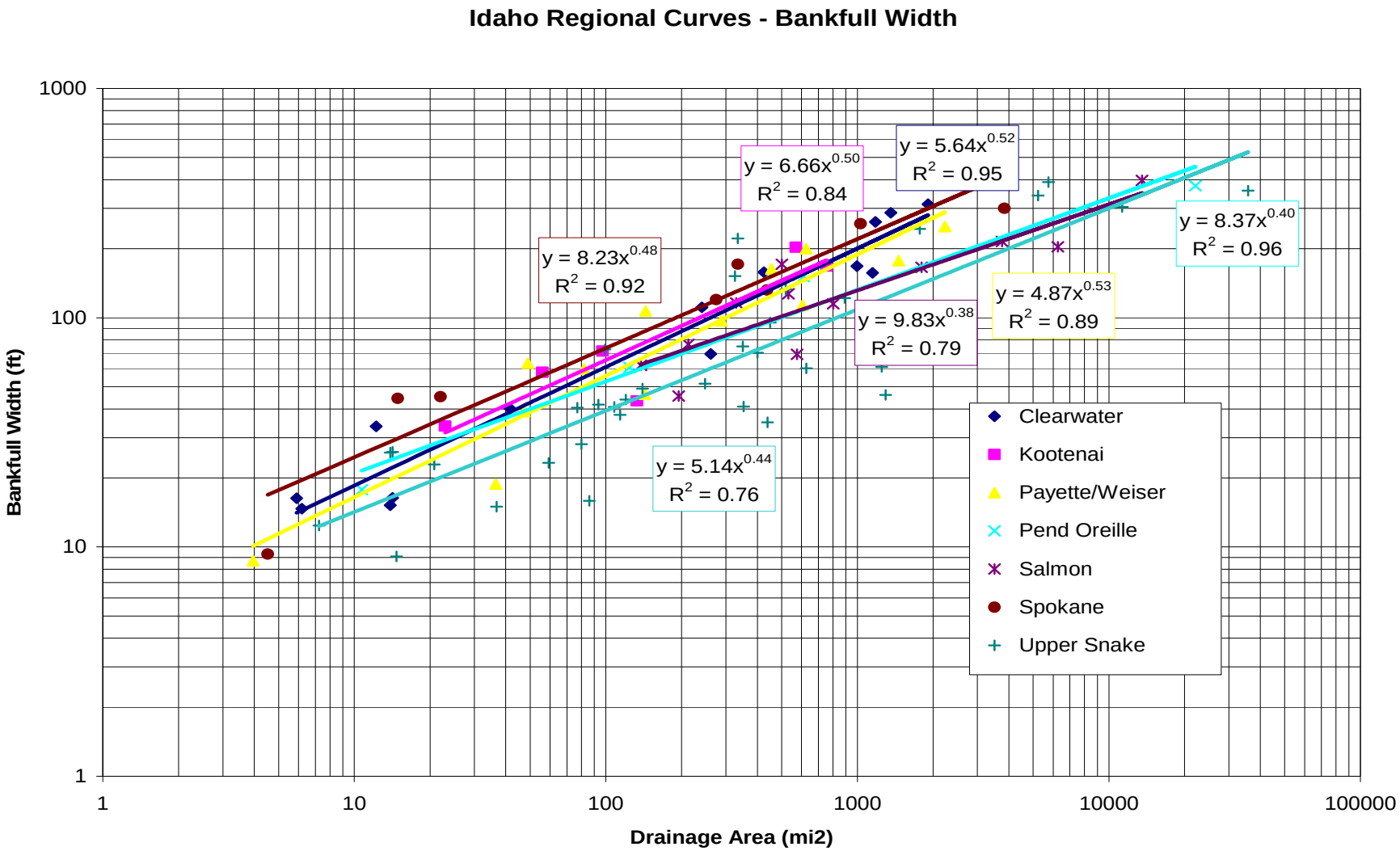


Figure 7. Bankfull Width as a Function of Drainage Area

Design Conditions

The natural vegetation of the upper Hatwai Creek sub-watershed can best be described as bunchgrass-dominated steppe of the Palouse Prairie where it meets the conifer forest.

Rexford Daubenmire, one of the West's best known plant ecologists, (1952) described forest habitat types for this region that vary with elevation and other factors, such as soil type, moisture, and aspect. He described several predominant zones of vegetation that roughly follow a moisture/elevation gradient. The Ponderosa pine zone occupies the lowest and driest zone, then continuing up the elevational/moisture gradient, there is the Douglas fir (*Psuedotsuga menziesii*) zone, followed by the western redcedar (*Thuja plicata*)/ western hemlock (*Tsuga heterophylla*) zone, and finally the Engelmann spruce (*Picea engelmanni*)/subalpine fir (*Abies lasiocarpa*) zone. Franklin and Dryness (1973), in describing the forest zones of eastern Oregon and Washington, list seven forest zones with increasing elevation and moisture. Their list begins with western juniper forests not found in Idaho's Latah County, then includes a Ponderosa pine zone, a lodgepole pine (*Pinus contorta*) zone, a Douglas fir zone, a grand fir (*Abies grandis*) zone, a western hemlock zone (with western redcedar), and finally a subalpine fir zone at the top. Black et al. (1998) described forest communities of the Palouse region on higher elevation mountain and ridges with warmer sites occupied by Ponderosa pine and Douglas fir with a rich understory of oceanspray (*Holodiscus discolor*), ninebark (*Physocarpus malvaceus*), serviceberry (*Amelanchier alnifolia*), snowberry, and rose (*Rosa sp.*) shrubs. On cooler northwest-facing canyons, western redcedar, grand fir, and western larch (*Larix occidentalis*) are supported.

In eastern Washington and presumably adjacent western Idaho, Ponderosa pine stands first appear within the matrix of steppe vegetation and increase in extent in wetter areas until steppe or shrub-steppe vegetation is reduced to mere islands in a matrix of Ponderosa pine forest (Franklin and Dryness 1973). Also, groves of aspen occur on riparian and poorly drained wet areas throughout the Ponderosa pine zone and adjacent forest/steppe zones as well (Franklin and Dryness 1973).

While much has been written about forest types in this region (Daubenmire 1952, Franklin and Dryness 1973), and about the historic steppe and shrub-steppe vegetation of the Palouse Prairie (Black et al. 1998, Weddell 2000, and Weddell 2001), little has been written to describe the vegetation in riparian areas of this region.

Weaver (1917) included wet meadow and floodplain forest types in his "hydrosere" classification system. He described dense thickets of trees and shrubs along streams. Larger streams that cut canyons into the basalt had narrow riparian forests while smaller streams that were intermittent did not cut canyons and thus were exposed to the wind, resulting in no woody vegetation in the riparian area. Weaver described small groves of poplars where aspens or even black cottonwoods were dominant. But by far the major riparian community type was one containing a mixture of alders, hawthorns, willows, serviceberry, and chokecherry. In some cases, alders were the dominant vegetation; in others, dense thickets of pure hawthorn and serviceberry became dominant. Weaver (1917) described wet meadows in both the mountains and the prairie. He listed a variety of wet meadow "types" including tufted hairgrass meadows, sometimes as pure stands, and others such as camas- and cow parsnip-dominated meadows.

Within the fescue/snowberry zone, moist draws were dominated by black hawthorn (*Crataegus douglasii*) (Black et al. 1998, Franklin and Dryness 1973, Weaver 1917). In fact, Franklin and Dryness (1973) describe two plant associations in these wet draws: a hawthorn/snowberry association and a hawthorn/cow-parsnip (*Heracleum lanatum*) association. These draws are dominated by 5- to 7-meter tall hawthorn and may include other shrubs such as shiny-leaf spirea (*Spiraea betulifolia*), Columbia hawthorn (*Crataegus columbiana*), chokecherry (*Prunus virginiana*), and serviceberry (*Amelanchier alnifolia*). Aspens (*Populus tremuloides*) occurred in phases in these hawthorn associations. Because aspen is short-lived, aspen suckers would grow up through the hawthorns, dominate for several years, and then die back, allowing hawthorns to predominate (Franklin and Dryness 1973).

There were two related riparian types briefly described by Daubenmire. They included a black cottonwood (*Populus trichocarpa*)/water-hemlock (*Cicuta douglasii*) association, which replaces hawthorn/cow-parsnip in drier portions of the steppe, and a white alder (*Alnus rhombifolia*) forest occurring in some riparian habitats, sometimes in association with black cottonwood (Franklin and Dryness 1973). Black et al. (1998) indicated that true riparian communities were largely limited to the Palouse and Potlatch Rivers. These communities were comprised of narrow gallery forests of plains cottonwood (*Populus deltoides*), aspens, mountain maple (*Acer glabrum*), and red alder (*Alnus rubra*).

The information clearly demonstrates that riparian areas, whether they were merely moist draws or river gallery forest, were dominated by tall shrubs and trees: hawthorns, aspens, cottonwoods, and alders. Remnants of these species can still be found in the riparian areas of the Hatwai Creek subwatershed. In terms of vegetation height, hawthorns and aspens are relatively small trees (4-20 meters [m]), alders are of intermediate heights (10-25m), and cottonwoods can be very tall (25-30m). Vegetative cover over a small stream (less than 5 meters wide) typically varies from about 40-50% for mature hawthorn-dominated communities, to about 80-100% for mature alder-, aspen- and cottonwood-dominated communities.

The Hatwai Creek sub-watershed, from headwaters to the mouth, was divided into three general riparian vegetation types:

1) *Warm Dry Breaklands*—park-like stands of tall Ponderosa with an understory of ninebark, chokecherry and rose, found on the south facing break-lands of the subwatershed.
2) *Black Hawthorn*—dense growing thickets mixed with serviceberry and chokecherry, once found on mid-elevation prairie segments.
3) *Black Cottonwood*—tall cottonwoods dominating an understory of deciduous shrubs, found in the bottomlands of the subwatershed.

Target Selection

Effective shade curves from existing DEQ temperature TMDLs and the DEQ PNV TMDL Procedure Manual were used to determine potential natural vegetation (PNV) shade targets for the Hatwai Creek watershed (DEQ 2008, DEQ 2009). These shade curves were produced using vegetation community modeling. Effective shade curves relate stream width (on the horizontal axis) with shade percentage (on the vertical axis), so after choosing the appropriate

curve to consult, the shade percentage (percent shade) can be identified for any given stream width. For the Hatwai Creek subwatershed, curves used for shade target determinations were selected by choosing the curve in each case that represents vegetation types most similar to those identified above. Tables 17 through 19 present values taken from the shade curves used for each of the vegetation types. For each vegetation type, the tables specify the shade percentages associated with various stream widths as specified by the appropriate curve.

The effective shade calculations are based on a six-month period from April through September. This time period coincides with the critical time period when temperatures affect beneficial uses such as spring and fall salmonid spawning, and when cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent the period of highest stream temperatures. Solar gains can begin early in the spring and affect not only the highest temperatures reached later on in the summer, but also affect salmonid spawning temperatures in spring and fall. Thus, solar loading in these streams is evaluated from spring (April) to early fall (September).

Table 17. Shade curve values for the Warm Dry Breaklands vegetation type at various stream widths.

Warm Dry Breaklands	Stream Width				
	1m	5m	10m	20m	30m
Warm Dry Breaklands (DEQ 2009)	95	68	48	28	20

a. Curve values are percentages.

Table 18. Shade curve values for the Black Hawthorne vegetation type at various stream widths.

Black Hawthorn	Stream Width				
	1m	3m	5m	10m	15m
Black Hawthorne (DEQ 2008)	90	65	48	29	20

a. Curve values are percentages.

Table 19. Shade curve values for the Black Cottonwood vegetation type at various stream widths.

Black Cottonwood	Stream Width				
	1m	3m	5m	10m	15m
Black Cottonwood (DEQ 2008)	100	99	98	89	78

a. Curve values are percentages.

Monitoring Points

The accuracy of the aerial photo interpretations were field verified with a solar pathfinder at two distinct sites. By sampling sites representing two different riparian plant communities and two existing shade estimates—one segment with significant shade and one lacking shade—the results of these pathfinder sites were used to re-calibrate the original aerial photo interpretation of existing shade. Where necessary, the existing shade estimates were changed and replaced with actual shade measurements. The pathfinder data in Table 20 revealed that

the original interpretation over-estimated shade by an average of 10% ± 7.2 (mean ± 95% C.I.).

Table 20. Pathfinder Results for Two Sites on Hatwai Creek.

Aerial class	Pathfinder actual	Pathfinder class	Delta	Statistics
70	53	50	20.0	
20	27.5	20	0.0	
			10.0	average
			14.1	std dev
			7.2	95% CI

Effective shade monitoring can take place on any reach throughout the Hatwai Creek watershed and be compared to estimates of existing shade seen on Figure 9, and described in Tables 21 and 22. Those areas with the largest disparity between existing shade estimates and shade targets should be monitored with solar pathfinders to verify the existing shade levels and to determine progress towards meeting shade targets. It is important to note that many existing shade estimates have not been field verified, and may require adjustment during the implementation process. Stream segments for each change in existing shade vary in length depending on land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade towards target levels. Ten equally spaced solar pathfinder measurements within that segment averaged together should suffice to determine new shade levels in the future.

Load Capacity

A stream's load capacity based on PNV is the solar load allowed by the shade targets specified for the specific reaches within that stream. These potential/target loads are determined by multiplying the solar radiation load recorded on a flat plate collector under full sun conditions for a given period of time by the fraction of the solar radiation that is not blocked by shade (i.e., the fraction that is "open") in a particular location during that same period of time. In other words, the solar load hitting the collector under full sun is considered to be 100% (1.0), so if a shade target is 60% (0.6), then the solar load hitting the stream under conditions meeting that target would be 40% (0.4).

Solar load data from a flat plate collector at the National Renewable Energy Laboratory weather station in Spokane were used for this TMDL. The solar loads used to calculate the shade target are spring and summer averages occurring between April and September. This period coincides with the time of year when stream temperatures are increasing and vegetation is growing. Table 21 shows the PNV shade targets (Target or Potential Shade) and their corresponding potential summer loads (in kilowatt hours per square meter per day [$kWh/m^2/day$] and kilowatt hours per day [kWh/day]) that serve as the load capacities. Target shade is also visually illustrated, indicating the potential (target) percent shade for each stream segment on an aerial photo, in Figure 8.

Estimates of Existing Pollutant Loads

Regulations allow that loadings "...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading," (Water quality planning and management, 40 CFR § 130.2(I)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the land use and area, but may be aggregated. Background loads should be distinguished from human-caused increases in nonpoint loads to the extent possible.

Existing loads in this temperature TMDL are estimates, derived from estimates of existing shade determined through aerial photo interpretations (Figure 8). Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat plate collector at the Spokane weather station. Existing shade estimates are presented in Table 20 and visually represented in Figure 9. Like load capacities (potential loads), existing loads in Table 20 are presented both on an area basis ($kWh/m^2/day$) and as total loads (kWh/day), with a final column showing the lack of shade (in percent).

Total load amounts are highly variable depending on the size of the stream. Large rivers that are wide have less shade than smaller, narrow streams. Thus, total potential loads on rivers are expected to be quite large. A large river may have a very large existing load, but require only a small increase in shade because its wider bankfull width naturally leaves more of the surface open to solar loading. Conversely, a small stream may have a small existing load in relation to larger streams, but its necessary increase in shade could be high because its narrower bankfull width means that a greater percentage of the stream surface would be shaded under natural conditions..

Existing loads, potential/target loads, and total loads in kWh/day can be summed for the entire stream (or portion of stream) that was examined, in a single loading table. These total loads are shown at the bottom of their respective columns in Table 20. The difference between potential load and existing load is also summed for the entire table. If existing load exceeds potential load, this difference becomes the excess load to be discussed next in the load allocation section.

The excess load can also be expressed as the lack of shade (Figure 10). To calculate the lack of shade, the potential shade fraction is subtracted from the existing shade fraction for each stream reach. The lack of shade for each individual reach is summed and then divided by the number of reaches to produce the average lack of shade for the entire stream. If the average lack of shade shown is a negative number, this means that the shade averaged over the entire water body is less than the target. If the number is positive, this means that the shade averaged over the entire water body meets or exceeds the target. It is important to note that even if the average lack of shade calculated for a given water body is a positive number, it is still likely that individual reaches in that water body do not meet their individual shade targets and should still receive restoration treatment during the implementation phase of this TMDL.

In the load analysis table (Table 20), each vegetation type is highlighted in its own color to distinguish when and where the dominant vegetation type changes. Each of the vegetation

types have their own specific shade targets for each specific stream width, therefore the changes in highlighted color also help visually explain the changes in potential shade.

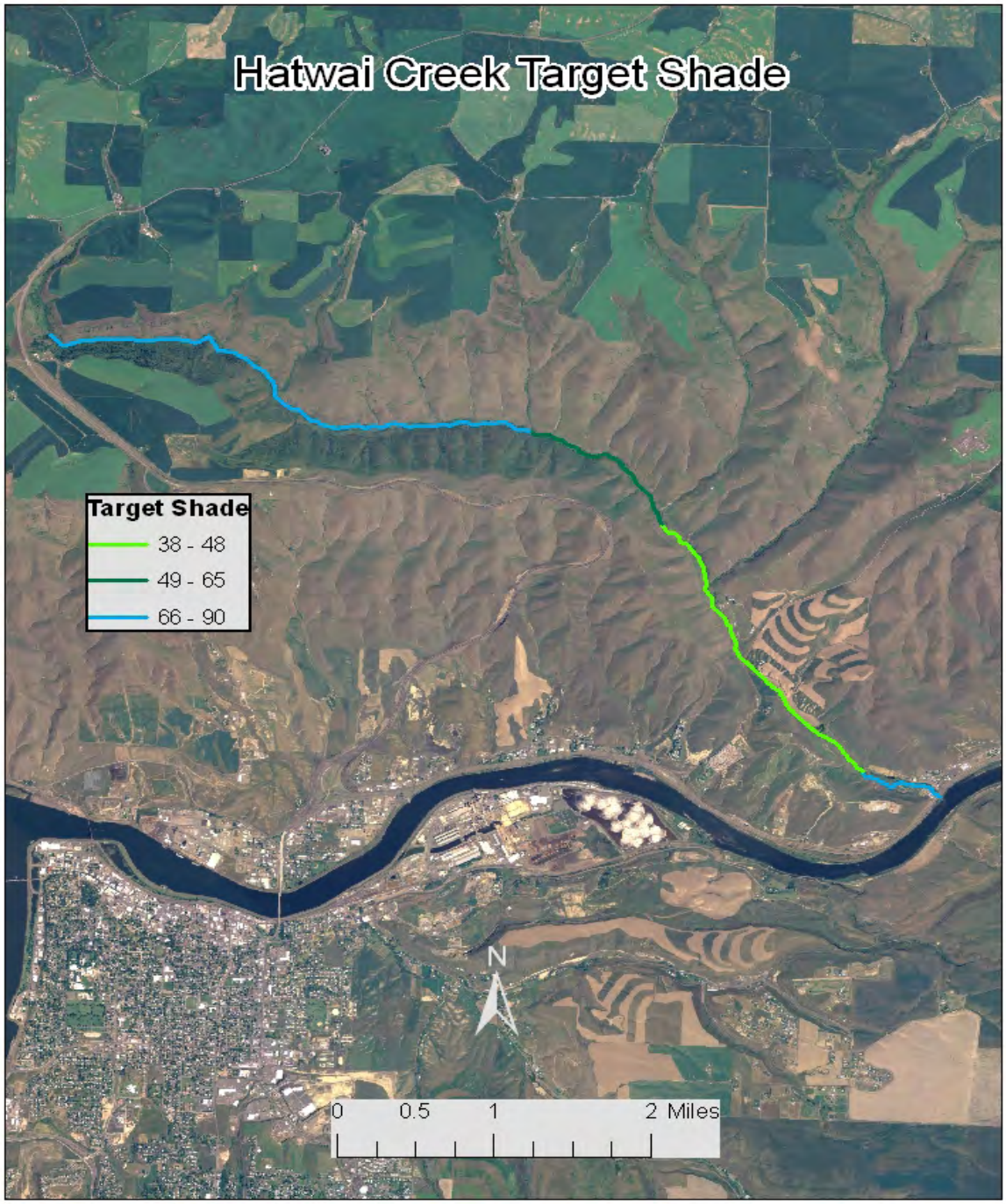


Figure 8. Percent Target Shade for Stream Segments in Hatwai Creek, Based on Regional Shade Curves.

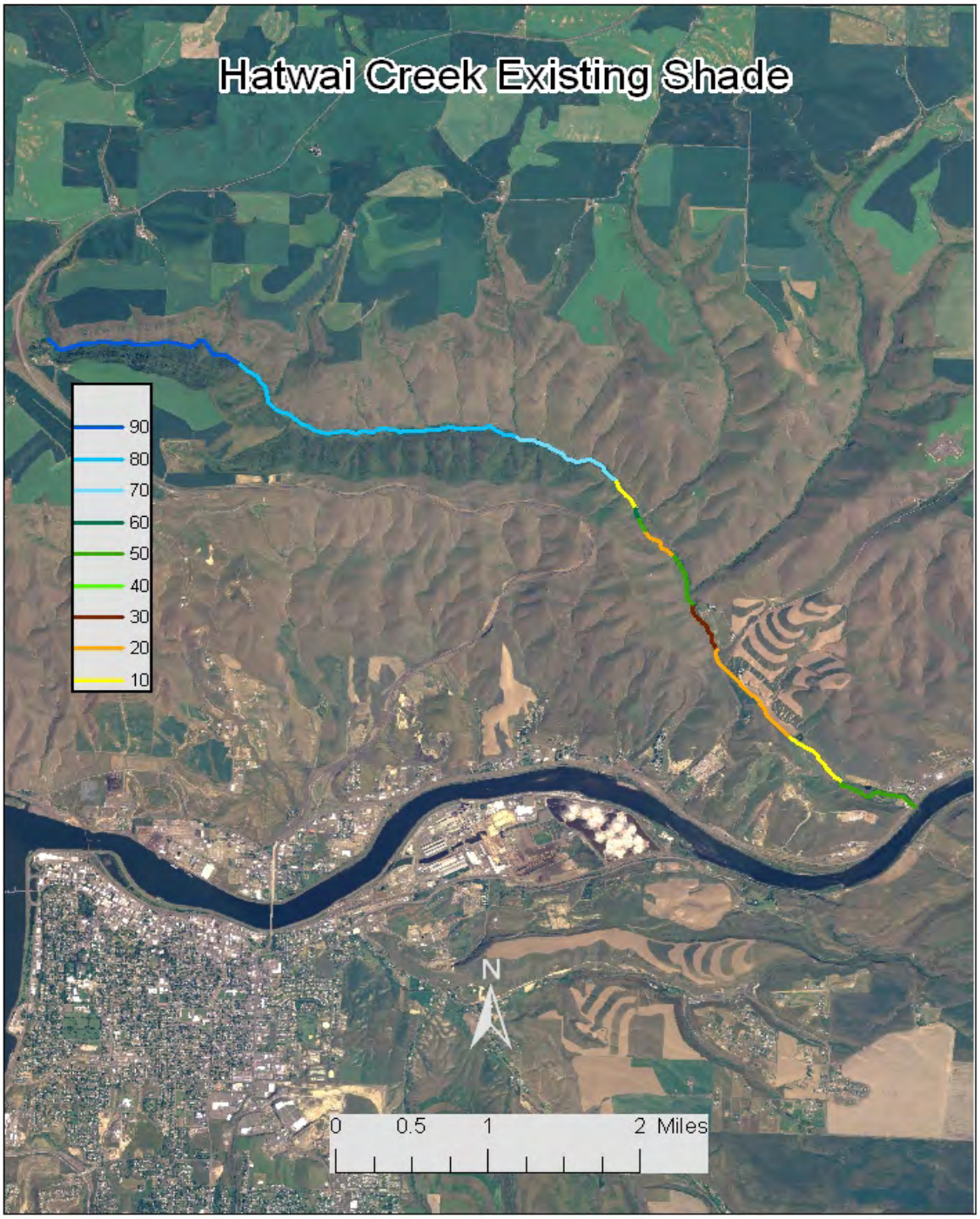


Figure 9. Percent Existing Shade for Stream Segments in Hatwai Creek, Based on Aerial Photo Interpretation.

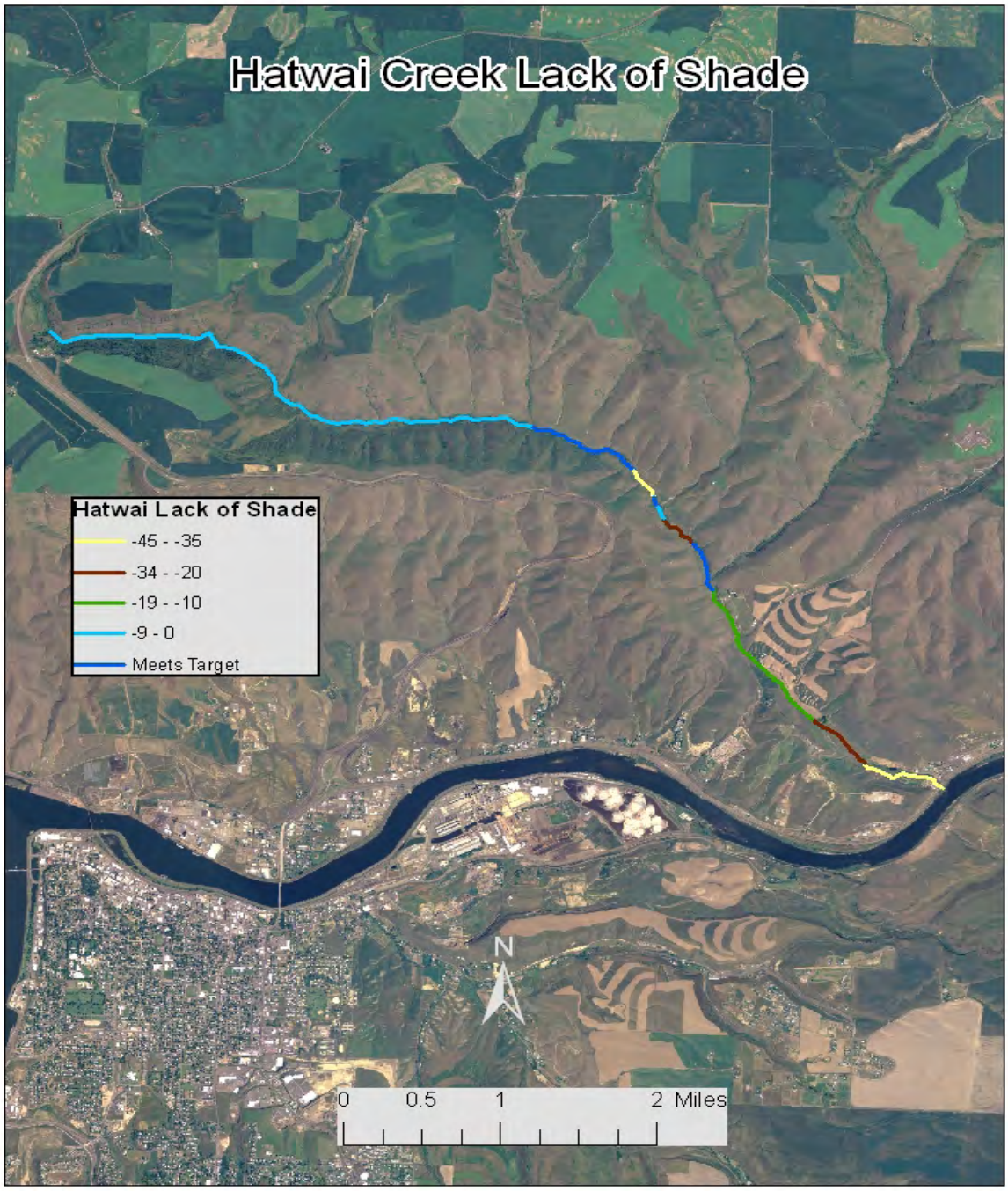


Figure 10. Percent Lack of Shade for Stream Segments in Hatwai Creek, Based on Target Shade Minus Existing Shade.

Load Allocation

This TMDL is based on potential natural vegetation, which is equivalent to natural background loading. Although the unnamed water bodies not listed for temperature in Idaho' integrated report are not included in this analysis, it is necessary for all water bodies in the watersheds to achieve PNV in order for natural background loading to occur. Compliance with the load allocation is achieved when natural background conditions are established. Load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade. Load allocations are therefore stream reach-specific and are dependent upon the target load for a given reach.

The difference between existing shade and target shade (the delta) is visually illustrated for each reach in Figure 10. For any percentage in Figure 10 that is expressed as a negative, this indicates the lack of shade, or the deviation from the target, for that reach. Similarly, where the percentage is expressed as a positive this indicates that the reach meets or exceeds the target.

The load analysis in Table 20 shows the potential shade and load capacity necessary to achieve natural background conditions, and also shows the load reduction needed for each stream reach, listed in descending order. The potential shade has been converted to a summer load by multiplying the inverse fraction (1.0 minus the shade fraction) by the average load recorded on a flat plate collector for the months of April through September.

Table 21. Existing and Potential Solar Loads for Hatwai Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	Dominant Vegetation Community
2236	0.9	0.57	0.94	0.342	-0.228	1.00	1.00	2236	1274.52	2236	764.712	-509.808	-4	WDBreaks
800	0.8	1.14	0.81	1.083	-0.057	2	2	1600	1824	1600	1732.8	-91.2	-1	Hawthorn
1591	0.8	1.14	0.81	1.083	-0.057	2	2	3182	3627.48	3182	3446.106	-181.374	-1	Hawthorn
1006	0.8	1.14	0.81	1.083	-0.057	2	2	2012	2293.68	2012	2178.996	-114.684	-1	Hawthorn
671	0.7	1.71	0.65	1.995	0.285	3	3	2013	3442.23	2013	4015.935	573.705	5	Hawthorn
561	0.7	1.71	0.65	1.995	0.285	3	3	1683	2877.93	1683	3357.585	479.655	5	Hawthorn
381	0.1	5.13	0.55	2.565	-2.565	4	4	1524	7818.12	1524	3909.06	-3909.06	-45	Hawthorn
150	0.5	2.85	0.55	2.565	-0.285	4	4	600	1710	600	1539	-171	-5	Hawthorn
117	0.5	2.85	0.55	2.565	-0.285	4	4	468	1333.8	468	1200.42	-133.38	-5	Hawthorn
451	0.2	4.56	0.48	2.964	-1.596	5	5	2255	10282.8	2255	6683.82	-3598.98	-28	Hawthorn
451	0.5	2.85	0.48	2.964	0.114	5	5	2255	6426.75	2255	6683.82	257.07	2	Hawthorn
142	0.5	2.85	0.43	3.249	0.399	6	6	852	2428.2	852	2768.148	339.948	7	Hawthorn
601	0.3	3.99	0.43	3.249	-0.741	6	6	3606	14387.94	3606	11715.894	-2672.046	-13	Hawthorn
1307	0.2	4.56	0.38	3.534	-1.026	7	7	9149	41719.44	9149	32332.566	-9386.874	-18	Hawthorn
741	0.1	5.13	0.38	3.534	-1.596	7	7	5187	26609.31	5187	18330.858	-8278.452	-28	Hawthorn
929	0.5	2.85	0.89	0.627	-2.223	10	10	9290	26476.5	9290	5824.83	-20651.67	-39	Cottonwood
							Total	**47912**	**154532.7**	**47912**	**106484.55**	**-48048.15**	**-10.56**	

Table 22 shows the total excess heat load (kWh/day) experienced by Hatwai Creek, and the average lack of shade (percentage) for all segments/reaches in that water body. The lack of shade percentage shown in Table 22 represents the average deviation from the target for all the reaches in that water body. It is important to note that even if the average lack of shade calculated for a given water body is a positive number, it is still likely that individual reaches in that water body do not meet their individual shade targets and should still receive restoration treatment during the implementation phase of this TMDL. Entities wishing to estimate load reductions for specific implementation projects should use the reach-specific values shown in the load analysis in Table 21, which represent the load reductions necessary over the length of each specific reach.

Table 22. Excess solar loads and average lack of shade for Hatwai Creek.

Water Body	Excess Load (kWh/day)	Average Lack of Shade (%)
Hatwai Creek	-48,048	-10.6

Wasteload Allocation for Future Growth

No temperature wasteload reductions are required by this temperature TMDL. Temperature wasteload allocations for future growth is the allowable effluent temperature that will not increase temperature of the receiving water by more than 0.3 ^{o}C with a mixing zone of 25% volume of stream flow (IDAPA 58.01.02.060). Future wasteload allocations will be determined through application of the following equation.

Eq. $T_E = \{[Q_E + (0.25 \times Q_S)] \times [T_c + 0.3C] - [(0.25 \times Q_S) \times T_c]\} \div Q_E$

Where: T_E = Effluent temperature (^{o}C)
Q_E = Effluent flow (cfs)
Q_S = stream flow (cfs)
T_c = criteria temperature (^{o}C)
0.25= 25% by volume mixing zone (unit-less)

5.4 Construction Storm Water and TMDL Wasteload Allocations

Margin of Safety

The margin of safety in this TMDL is considered implicit in the design. Because the target is essentially the attainment of background conditions, there are no loads allocated to specific sources or activities. Although the load analysis used in this temperature TMDL involves gross estimations that are likely to have variances, there are no load allocations that may benefit or suffer from that variance.

Seasonal Variation

This TMDL is based on average summer loads, calculated to be inclusive of the 6-month period from April through September. This time period was chosen because it represents the time period when the combination of increasing air and water temperatures coincides with increasing solar inputs and increasing vegetative shade. The critical time periods are June, when spring salmonid spawning is occurring, July and August, when maximum temperatures exceed cold water aquatic life criteria, and September, during fall salmonid spawning. Water temperature is not likely to be a problem for beneficial uses outside of this time period because of cooler weather and lower sun angle.

Construction Storm Water Requirements

Construction Storm Water

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge storm water to a water body or to a municipal storm sewer. In Idaho, EPA has issued a general permit for storm water discharges from construction sites. In the past storm water was treated as a non-point source of pollutants. However, because storm water can be managed on site through management practices or when discharged through a discrete conveyance such as a storm sewer, it now requires a National Pollution Discharge Elimination System (NPDES) Permit.

The Construction General Permit (CGP)

If a construction project disturbs more than one acre of land (or is part of a larger common development that will disturb more than one acre), the operator is required to apply for permit coverage from EPA after developing a site-specific Storm Water Pollution Prevention Plan.

Storm Water Pollution Prevention Plan (SWPPP)

In order to obtain the Construction General Permit operators must develop a site-specific Storm Water Pollution Prevention Plan. The operator must document the erosion, sediment, and pollution controls they intend to use, inspect the controls periodically and maintain the best management practices (BMPs) through the life of the project

Construction Storm Water Requirements

When a stream is on Idaho's § 303(d) list and has a TMDL developed, DEQ may incorporate a gross wasteload allocation (WLA) for anticipated construction storm water activities. TMDLs that do not have a WLA for construction storm water activities will be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement the appropriate best management practices.

Typically, there are specific requirements that must be followed to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for post-construction storm water management. Sediment is usually the main pollutant of concern in storm water from construction sites. The application of specific best management practices from *Idaho's Catalog of Storm Water Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of

the General Construction Permit, unless local ordinances have more stringent and site-specific standards that are applicable.

5.5 Implementation Strategies

Idaho Code, in 39-3611 and 39-3612, provides guidance on the development and implementation of TMDLs in Idaho. The guidance contained in code relies on the participation and assistance of watershed advisory groups (WAGs) and designated management agencies (DMAs).

Reasonable Assurance

Nonpoint sources will be managed by applying the combination of authorities the state has included in the Idaho Nonpoint Source Management Plan (DEQ 1999). Section 319 of the federal Clean Water Act requires each state to submit to EPA a management plan for controlling pollution from nonpoint sources within the state. Idaho's authority for implementing the Idaho Nonpoint Source Management Plan has been certified by the Idaho Attorney General. The plan has been submitted to and approved by EPA as complying with Section 319 of the Clean Water Act.

Nonpoint source pollutant controls or best management practices determined to be ineffective in achieving the desired load reductions are subject to the feedback loop process, or adaptive management, to ensure load reductions are achieved (IDAPA 58.01.02.350). The feedback loop provides for water quality improvements and maintenance through installation, evaluation, and modification of best management practices. Implementing the feedback loop to modify best management practices until water quality standards are met results in compliance with the water quality standards.

Time Frame

A schedule for implementation of best management practices, pollution control strategies, assessment reporting dates, and evaluation of progress will be developed with appropriate designated management agencies and the Lindsay/Hatwai/Tammany Creek Watershed Advisory Group. Based on such assessments and evaluations, implementation strategies for TMDLs may need to be modified if monitoring shows that the water quality standards are not being met. With active implementation and consistent funding, reductions in nutrient and bacteria loading occur within the next 10 years. Riparian plantings take longer to establish, and the shade requirements will likely not be met until the planted trees and shrubs mature.

Approach

This TMDL focuses on implementation of load allocations for *E. coli* bacteria, nutrients, and stream temperature. Both the biological and numeric water quality data analyzed for this project suggests that poor habitat conditions and the exceedance of numeric standards are impairing the designated beneficial uses in some segments of Hatwai Creek.

Nonpoint source best management practices for activities with the potential to contribute bacteria, nutrients, and temperature will be evaluated for application within the watershed by the DMAs responsible for such activities.

Responsible Parties

Idaho Code 39-3612 states designated management agencies are to use TMDL processes for achieving water quality standards. The Department of Environmental Quality will rely on the designated management agencies to implement pollution control measures or best management practices for pollutant sources they identify as priority.

The Department of Environmental Quality also recognizes the authorities and responsibilities of local city and county governments as well as applicable state and federal agencies, and will enlist their involvement and authorities for protecting water quality through implementation of Idaho Administrative Procedures Act 58.01.02 and Clean Water Act Section 401.

The designated state agencies listed below are responsible for assisting and providing technical support for the development of specific implementation plans and other appropriate support to water quality projects. General responsibilities for Idaho designated management agencies are:

- Idaho Soil and Water Conservation Commission: grazing and agriculture.
- Idaho State Department of Agriculture: aquaculture and animal feeding operations.
- Idaho Transportation Department: public roads.
- Idaho Department of Lands: timber harvest, oil and gas exploration, and mining.
- Idaho Department of Water Resources: stream channel alteration activities.
- Department of Environmental Quality: all other activities.

Monitoring Strategy

Idaho Code 39-3611 requires the Department of Environmental Quality to review and evaluate each Idaho TMDL, supporting assessment, implementation plan, and all available data periodically, at intervals no greater than five years. Such reviews are to be conducted using the Beneficial Use Reconnaissance Program protocol and the Water Body Assessment Guidance methodology to determine beneficial use attainability and status, and whether state water quality standards are being achieved.

Permanent monitoring stations for water quality monitoring should be established at the mouth and at the assessment unit boundary. These would be used for long term monitoring to assess trends in cumulative pollutant loading identified by this TMDL. Beneficial use support status monitoring and assessment will be conducted within each assessment unit of the watershed and evaluated using the Water Body Assessment Guidance for compliance with Idaho state water quality standards.

Idaho Code 39-3621 requires designated agencies, in cooperation with the appropriate land management agency, ensure best management practices are monitored for their effect on water quality. The monitoring results should be presented to the Department of Environmental Quality on a schedule agreed to between the designated agency and the

Department. The designated management agency should report the effectiveness of the measures or practices implemented to the Department in the form of load reductions applicable to the TMDL.

Pollutant load reductions gained by the application of pollutant controls and best management practices will be monitored by the Department of Environmental Quality through reports provided by designated management agencies. Information reported will be compiled and tracked over time to determine measurable pollutant load reductions relative to the total maximum daily load allocations.

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that the TMDL goals are not being met or significant progress is not being made toward achieving the goals.

5.6 Conclusions

E. coli, NO_2+NO_3 =N mg/L, TP and temperature TMDLs have been developed for the Hatwai Creek subwatershed (Table 23). With the exception of storm water construction permits, loads have been allocated to existing sources currently in the subwatershed. A growth reserve has not been included in the TMDLs. Future sources will need to acquire a load allocation that is a portion of an existing allocation unless the load capacity is increased.

Table 23. Summary of assessment outcomes.

Water Body Segment/ AU	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Hatwai Creek ID17060306CL067_02	Temperature, Bacteria, Nutrients	Temperature, *E.coli*, TP, $N0_2$+$N0_3$	Move to Section 4a*	Data Collected, TMDLs completed
Hatwai Creek ID17060306CL067_03	Temperature, Bacteria, Nutrients	Temperature, *E.coli*, TP, $N0_2$+$N0_3$	Move to Section 4a*	Data Collected, TMDLs completed

*Refers to section 4a of the Integrated Report (DEQ 2008), which includes waters with completed TMDLS.

Based on measured samples, a reduction in *E. coli* bacteria concentrations is needed throughout the subwatershed to comply with Idaho's geometric mean criterion of 126 cfu/100ml. The bacteria TMDL has been developed to trigger the implementation of best management practices (BMPs) to ensure that the secondary contact recreation beneficial use is maintained for the protection of human health. The bacteria TMDL should guide the implementation of BMPs designed to limit bacteria loading, such as off-site watering, exclusions, and waste management practices that address the sources of bacteria.

Nitrogen and phosphorous concentrations at the levels measured in Hatwai Creek can cause visible slime growths or other nuisance aquatic growth that can cause DO to sag and impair the creek's existing beneficial uses. Nutrient TMDLs addressing the limiting nutrients nitrogen and phosphorus have been developed to restore and protect the beneficial uses of Hatwai Creek. No wasteload allocations have been developed for Hatwai Creek because the subwatershed does not contain a wastewater treatment plant facility or any other known point source.

A potential natural vegetation (PNV) temperature TMDL that calls for more riparian shade in Hatwai Creek has been developed. Streamside vegetation and channel morphology are factors influencing shade, which have been changed by human activities, and which can be the most readily corrected. If implemented successfully, projects designed to increase shade may also have a positive impact on channel and stream bank restoration, which can eliminate certain sources of pollution and reduce other pollutant concentrations in the subwatershed while simultaneously reducing stream temperature.

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GIS Coverage

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Glossary

305(b)	Refers to section 305 subsection “b” of the Clean Water Act. The term “305(b)” generally describes a report of each state’s water quality and is the principle means by which the U.S. Environmental Protection Agency, Congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.
§303(d)	Refers to section 303 subsection “d” of the Clean Water Act. 303(d) requires states to develop a list of water bodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to U.S. Environmental Protection Agency approval.
Acre-foot	A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.
Adsorption	The adhesion of one substance to the surface of another. Clays, for example, can adsorb phosphorus and organic molecules
Aeration	A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.
Aerobic	Describes life, processes, or conditions that require the presence of oxygen.
Adfluvial	Describes fish whose life history involves seasonal migration from lakes to streams for spawning.
Adjunct	In the context of water quality, adjunct refers to areas directly adjacent to focal or refuge habitats that have been degraded by human or natural disturbances and do not presently support high diversity or abundance of native species.

Alevin	A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a water body, living off stored yolk.
Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
Alluvium	Unconsolidated recent stream deposition.
Ambient	General conditions in the environment (Armantrout 1998). In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations or specific disturbances such as a wastewater outfall (EPA 1996).
Anadromous	Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the saltwater but return to fresh water to spawn.
Anaerobic	Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.
Anoxia	The condition of oxygen absence or deficiency.
Anthropogenic	Relating to, or resulting from, the influence of human beings on nature.
Anti-Degradation	Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.61).

Aquatic	Occurring, growing, or living in water.
Aquifer	An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.
Assemblage (aquatic)	An association of interacting populations of organisms in a given water body; for example, a fish assemblage or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).
Assessment Database (ADB)	The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of water bodies and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.
Assessment Unit (AU)	A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.
Assimilative Capacity	The ability to process or dissipate pollutants without ill effect to beneficial uses.
Autotrophic	An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.
Batholith	A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.
Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.

Beneficial Use	Any of the various uses of water, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.
Beneficial Use Reconnaissance Program (BURP)	A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers
Benthic	Pertaining to or living on or in the bottom sediments of a water body
Benthic Organic Matter.	The organic matter on the bottom of a water body.
Benthos	Organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the lake and stream bottoms.
Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
Best Professional Judgment	A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.
Biochemical Oxygen Demand (BOD)	The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.
Biological Integrity	1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).

Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.
Clean Water Act (CWA)	The Federal Water Pollution Control Act (commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.
Coliform Bacteria	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria, *E. Coli*, and Pathogens).
Colluvium	Material transported to a site by gravity.
Community	A group of interacting organisms living together in a given place.
Conductivity	The ability of an aqueous solution to carry electric current, expressed in micro (μ) mhos/centimeter at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.
Cretaceous	The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.
Criteria	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. The U.S. Environmental Protection Agency develops criteria guidance; states establish criteria.

Cubic Feet per Second	A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.
Cultural Eutrophication	The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).
Culturally Induced Erosion	Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).
Debris Torrent	The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.
Decomposition	The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.
Depth Fines	Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 millimeters depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 centimeters).
Designated Uses	Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.
Discharge	The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).
Dissolved Oxygen (DO)	The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.

Disturbance	Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.
E. coli	Short for *Escherichia coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans, but their presence in water is often indicative of fecal contamination. *E. coli* are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.
Ecology	The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.
Ecological Indicator	A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.
Ecological Integrity	The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).
Ecosystem	The interacting system of a biological community and its non-living (abiotic) environmental surroundings.
Effluent	A discharge of untreated, partially treated, or treated wastewater into a receiving water body.
Endangered Species	Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.
Environment	The complete range of external conditions, physical and biological, that affect a particular organism or community.

Eocene	An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.
Eolian	Windblown, referring to the process of erosion, transport, and deposition of material by the wind.
Ephemeral Stream	A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table (American Geological Institute 1962).
Erosion	The wearing away of areas of the earth's surface by water, wind, ice, and other forces.
Eutrophic	From Greek for "well nourished," this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.
Eutrophication	1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter.
Exceedance	A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.
Existing Beneficial Use or Existing Use	A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02).
Exotic Species	A species that is not native (indigenous) to a region.
Extrapolation	Estimation of unknown values by extending or projecting from known values.
Fauna	Animal life, especially the animals characteristic of a region, period, or special environment.

Fecal Coliform Bacteria	Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria, *E. coli*, and Pathogens).
Fecal Streptococci	A species of spherical bacteria including pathogenic strains found in the intestines of warm-blooded animals.
Feedback Loop	In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.
Fixed-Location Monitoring	Sampling or measuring environmental conditions continuously or repeatedly at the same location.
Flow	See *Discharge*.
Fluvial	In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.
Focal	Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.
Fully Supporting	In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Fully Supporting Cold Water	Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions.
Fully Supporting but Threatened	An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a "not fully supporting" status.
Geographical Information Systems (GIS)	A georeferenced database.

Geometric Mean	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
Grab Sample	A single sample collected at a particular time and place. It may represent the composition of the water in that water column.
Gradient	The slope of the land, water, or streambed surface.
Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.
Growth Rate	A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.
Habitat	The living place of an organism or community.
Headwater	The origin or beginning of a stream.
Hydrologic Basin	The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area (also see Watershed).
Hydrologic Cycle	The cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Atmospheric moisture, clouds, rainfall, runoff, surface water, ground water, and water infiltrated in soils are all part of the hydrologic cycle.
Hydrologic Unit	One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, fourth field hydrologic units have been more

	commonly called subbasins. Fifth and sixth field hydrologic units have since been delineated for much of the country and are known as watershed and subwatersheds, respectively.
Hydrologic Unit Code (HUC)	The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.
Hydrology	The science dealing with the properties, distribution, and circulation of water.
Impervious	Describes a surface, such as pavement, that water cannot penetrate.
Influent	A tributary stream.
Inorganic	Materials not derived from biological sources.
Instantaneous	A condition or measurement at a moment (instant) in time.
Intergravel Dissolved Oxygen	The concentration of dissolved oxygen within spawning gravel. Consideration for determining spawning gravel includes species, water depth, velocity, and substrate.
Intermittent Stream	1) A stream that flows only part of the year, such as when the ground water table is high or when the stream receives water from springs or from surface sources such as melting snow in mountainous areas. The stream ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. 2) A stream that has a period of zero flow for at least one week during most years.
Interstate Waters	Waters that flow across or form part of state or international boundaries, including boundaries with Native American nations.
Irrigation Return Flow	Surface (and subsurface) water that leaves a field following the application of irrigation water and eventually flows into streams.

Key Watershed	A watershed that has been designated in Idaho Governor Batt's *State of Idaho Bull Trout Conservation Plan* (1996) as critical to the long-term persistence of regionally important trout populations.
Knickpoint	Any interruption or break of slope.
Land Application	A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.
Limiting Factor	A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.
Limnology	The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.
Load Allocation (LA)	A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).
Load(ing)	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.
Load(ing) Capacity (LC)	A determination of how much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.
Loam	Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.
Loess	A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.

Lotic	An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.
Luxury Consumption	A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.
Macroinvertebrate	An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.
Macrophytes	Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.
Margin of Safety (MOS)	An implicit or explicit portion of a water body's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.
Mass Wasting	A general term for the down slope movement of soil and rock material under the direct influence of gravity.
Mean	Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.
Median	The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; 6 is the median of 1, 2, 5, 7, 9, 11.

Metric	1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.
Milligrams per Liter (mg/L)	A unit of measure for concentration. In water, it is essentially equivalent to parts per million (ppm).
Million Gallons per Day (MGD)	A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.
Miocene	Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.
Monitoring	A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.
Mouth	The location where flowing water enters into a larger water body.
National Pollution Discharge Elimination System (NPDES)	A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.
Natural Condition	The condition that exists with little or no anthropogenic influence.
Nitrogen	An element essential to plant growth, and thus is considered a nutrient.
Nodal	Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for

	grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Not Assessed (NA)	A concept and an assessment category describing water bodies that have been studied, but are missing critical information needed to complete an assessment.
Not Attainable	A concept and an assessment category describing water bodies that demonstrate characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).
Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Not Fully Supporting Cold Water	At least one biological assemblage has been significantly modified beyond the natural range of its reference condition.
Nuisance	Anything that is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.
Nutrient	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
Nutrient Cycling	The flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).
Oligotrophic	The Greek term for “poorly nourished.” This describes a body of water in which productivity is low and nutrients are limiting to algal growth, as typified by low algal density and high clarity.

Organic Matter

Compounds manufactured by plants and animals that contain principally carbon.

Orthophosphate

A form of soluble inorganic phosphorus most readily used for algal growth.

Oxygen-Demanding Materials

Those materials, mainly organic matter, in a water body that consume oxygen during decomposition.

Parameter

A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.

Partitioning

The sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times. Also the separation of a chemical into two or more phases, such as partitioning of phosphorus between the water column and sediment.

Pathogens

A small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa) that can cause sickness or death. Direct measurement of pathogen levels in surface water is difficult. Consequently, indicator bacteria that are often associated with pathogens are assessed. *E. coli*, a type of fecal coliform bacteria, are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.

Perennial Stream

A stream that flows year-around in most years.

Periphyton

Attached microflora (algae and diatoms) growing on the bottom of a water body or on submerged substrates, including larger plants.

Pesticide

Substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.

pH	The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
Phased TMDL	A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
Physiochemical	In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the term “physical/chemical.”
Plankton	Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable “point” of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.
Pollution	A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.

Population	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
Pretreatment	The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.
Primary Productivity	The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quality Assurance (QA)	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training (Rand 1995). The goal of QA is to assure the data provided are of the quality needed and claimed (EPA 1996).
Quality Control (QC)	Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples (Rand 1995). QC is implemented at the field or bench level (EPA 1996).
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.
Reconnaissance	An exploratory or preliminary survey of an area.

Reference	A physical or chemical quantity whose value is known and thus is used to calibrate or standardize instruments.
Reference Condition	1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).
Reference Site	A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.
Representative Sample	A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.
Resident	A term that describes fish that do not migrate.
Respiration	A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.
Riffle	A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.
Riparian Habitat Conservation Area (RHCA)	A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams: ▪ 300 feet from perennial fish-bearing streams ▪ 150 feet from perennial non-fish-bearing streams ▪ 100 feet from intermittent streams, wetlands, and ponds in priority watersheds.

River	A large, natural, or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
Sediments	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stagnation	The absence of mixing in a water body.
Stenothermal	Unable to tolerate a wide temperature range.
Stratification	A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.

Storm Water Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
Stressors	Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.
Subbasin	A large watershed of several hundred thousand acres. This is the name commonly given to 4th field hydrologic units (also see Hydrologic Unit).
Subbasin Assessment (SBA)	A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.
Subwatershed	A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6th field hydrologic units.
Surface Fines	Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 millimeters depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.
Surface Runoff	Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.
Surface Water	All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.

Suspended Sediments	Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.
Taxon	Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).
Tertiary	An interval of geologic time lasting from 66.4 to 1.6 million years ago. It constitutes the first of two periods of the Cenozoic Era, the second being the Quaternary. The Tertiary has five subdivisions, which from oldest to youngest are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs.
Thalweg	The center of a stream's current, where most of the water flows.
Threatened Species	Species, determined by the U.S. Fish and Wildlife Service, which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
Total Maximum Daily Load (TMDL)	A TMDL is a water body's load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.
Total Dissolved Solids	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.

Total Suspended Solids (TSS)	The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Franson et al. 1998) call for using a filter of 2.0 microns or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.
Toxic Pollutants	Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.
Tributary	A stream feeding into a larger stream or lake.
Trophic State	The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.
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Trophic State	The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.

Turbidity	A measure of the extent to which light passing through water is scattered by fine suspended materials. The effect of turbidity depends on the size of the particles (the finer the particles, the greater the effect per unit weight) and the color of the particles.
Vadose Zone	The unsaturated region from the soil surface to the ground water table.
Wasteload Allocation (WLA)	The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.
Water Body	A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.
Water Column	Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.
Water Pollution	Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental, or injurious to public health, safety, or welfare; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.
Water Quality	A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.
Water Quality Criteria	Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.

Water Quality Limited

A label that describes water bodies for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a §303(d) list.

Water Quality Limited Segment (WQLS)

Any segment placed on a state's §303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "§303(d) listed."

Water Quality Management Plan

A state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.

Water Quality Modeling

The prediction of the response of some characteristics of lake or stream water based on mathematical relations of input variables such as climate, stream flow, and inflow water quality.

Water Quality Standards

State-adopted and U.S. Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

Water Table

The upper surface of ground water; below this point, the soil is saturated with water.

Watershed

1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region which contributes water to a point of interest in a water body.

Water Body Identification Number (WBID)

A number that uniquely identifies a water body in Idaho and ties in to the Idaho water quality standards and GIS information.

Wetland	An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.
Young of the Year	Young fish born the year captured, evidence of spawning activity.

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Appendix A. Unit Conversion Chart

Table A-1. Metric - English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square Feet (ft^2) Square Miles (mi^2)	Hectares (ha) Square Meters (m^2) Square Kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (gal) Cubic Feet (ft^3)	Liters (L) Cubic Meters (m^3)	1 gal = 3.78 L 1 L= 0.26 gal 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 gal = 11.35 L 3 L = 0.79 gal 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic Feet per Second (cfs)[a]	Cubic Meters per Second (m^3/sec)	1 cfs = 0.03 m^3/sec 1 m^3/sec = 35.31cfs	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L[b]	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 lb
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 °C = 37.4 °F

[a] 1 cfs = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 cfs.

[b] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water

.

Appendix B. Hatwai Creek Monitoring Data 2006-2007

Table B-1. Hatwai Creek Monitoring Data, 2006 – 2007.

Sample Date	Sample Time	D.O. (mg/L)	Conductivity	NO_2+NO_3-N (mg/L)	TP (mg/L)	NH3-N(mg/L)	Flow (cfs)	Temp C
7/20/2006	8:00	8.9	NA	1.3	0.17	N/A	N/A	16
7/27/2006	10:00	8.4	NA	N/A	N/A	N/A	0.439	18.5
7/31/2006	11:00	8.9	NA	1.3	0.28	N/A	0.234	16
8/3/2006	8:55	8.8	NA	N/A	N/A	N/A	N/A	15.8
8/7/2006	11:00	8.3	352.1	N/A	N/A	N/A	0.4105	18.3
8/10/2006	10:40	8.4	358.7	N/A	N/A	N/A	0.2875	17.9
8/21/2006	11:30	8.5	361.8	1.2	N/A	N/A	0.2695	17.7
9/1/2006	11:00	8.9	365.9	0.9	0.21	N/A	0.2157	15.6
9/15/2006	10:15	9.1	369.2	1.1	0.2	N/A	0.19	13.7
9/28/2006	10:10	9.3	369.7	1.4	0.22	N/A	0.3391	13.9
10/10/2006	13:30	n/a	372.5	1.3	0.08	N/A	0.302	11.1
10/27/2006	13:15	10.3	371.3	1.6	0.08	N/A	N/A	9.2
11/9/2006	11:30	9.4	365	1.8	0.09	N/A	0.2397	10.2
11/21/2006	13:30	9.6	381.6	3	0.22	N/A	1.22	10.8
12/5/2006	9:00	10.2	377.2	2.9	0.2	N/A	N/A	4.7
12/21/2006	11:00	10.9	358.8	3.5	0.19	N/A	1.03	8.1
1/4/2007	10:30	11.8	317.2	3.6	0.11	N/A	1.64	6.1
1/18/2007	1:00	11.9	351	3.7	0.08	N/A	3.624	5.8
1/30/2007	14:45	11.6	341.5	3.3	0.09	N/A	3.616	6.3
2/16/2007	11:15	11.2	337.3	4.3	0.24	ND	9.017	7.6
3/2/2007	11:00	12.7	340.01	4.5	0.06	0.52	4.76	4.9
3/16/2007	10:45	11.7	354.3	3.8	0.16	0.02	5.1	9.1
3/29/2007	1:15	11.2	360.2	3.38	0.136	ND	4.2	11.2
4/10/2007	15:00	10.9	360.9	2.69	0.183	ND	3.6	11.6
4/26/2007	9:30	11	364.5	2.54	0.194	0.084	3.09	9.7
5/11/2007	11:15	9.9	368.9	1.84	0.202	NA	2.19	13.9
5/25/2007	10:00	9.7	361.9	1.8	0.1967	0.0367	1.463	13.8
6/8/2007	9:00	9	NA	0.849	0.1831	ND	1.68	12.1
6/22/2007	12:42	12.42	NA	1.13	0.146	ND	1.24	17.8
7/6/2007	2:00	8.4	383.4	1.3	0.176	0.065	0.428	22.4
7/19/2007	11:30	8.5	NA	1.37	0.251	ND	0.635	20.6

Table B-2. Hatwai Creek *E. coli* Geometric Mean data, 2006.

Hatwai	
LCW-1	
Sample Date	E. coli (cfu/100 ml)
7/20/2006	191.8
7/24/2006	2419.3
7/27/2006	313
7/31/2006	435.2
8/7/2006	130.9
8/10/2006	214.3
Geomean	**347.9**

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Appendix C. Distribution List

Distribution List

Department of Environmental Quality - Lewiston Regional Office, 1118 F Street, Lewiston, Idaho 83501

Department of Environmental Quality - State Office, 1410 North Hilton, Boise, Idaho 83706

US Environmental Protection Agency - Idaho Operations Office, 1435 North Orchard, Boise, Idaho 83706

Clearwater Basin Advisory Group Members

Hatwai Creek Watershed Advisory Group Members

Appendix D. Public Comments

Public Comments

A 30 day public comment period was provided for the draft of the Hatwai Creek SBA/TMDL from July 5 through August 5, 2010. Notice was provided to the general public through the Lewiston Morning Tribune and the document was made available through the Lewiston and State Offices of the Department of Environmental Quality, the Nez Perce Soil and Water Conservation District Office and the Lewiston City Library, and through DEQ's website at www.deq.idaho.gov/public/comment.cfm.

The received comments and DEQ's responses are recorded in this appendix.

Name: William C. Stewart, Environmental Specialist

Address: United States Environmental Protection Agency

1435 N. Orchard

Boise, ID 83706

Affiliation: Federal

Comment EPA 1) On page 15 of the document you have Table 4 which is a description of the criteria to protect designated uses in the Idaho Water Quality Standards. I think you need to spell out the narrative standard for nutrients somewhere in this section. I know the narrative standard is given on page 24 but I think it should be included in the summary table.

DEQ response: The table you mention summarizes the criteria necessary to support beneficial uses, not the WQS on which the nutrient TMDLs are based. Note the DO standard is spelled out because it is directly tied to the support of salmonid spawning and cold water aquatic life beneficial uses. The WQS, narrative and numeric, that are specific to each TMDL pollutant covered in this document are cited and explained in the first paragraphs of each section of Chapter 5.

EPA 2) Section 5.1 titled Bacteria TMDL is interesting and I think there is some good logic in the development of the allocations. We agree that the critical time period seems to be year round. There needs to be a mass daily load of cfu's in the document. Recent court decisions require a mass daily load in TMDLs. A table with numbers in scientific notation will fulfill this requirement.

DEQ response: Section 5.1 has been amended to include Table 10, an example of mass cfu loading analysis for the days on which the geometric mean samples were taken.

EPA 3) The nutrient TMDL in this watershed is well thought out and the targets and allocations seem to be appropriate. It would be helpful to include an explanation of how the allocations by sample date relate to the target concentrations, margin of safety, and the conversion from mg/l to lbs/day. Essentially, it appears that you are using a flow based method of allocating loads. I believe this explanation would be helpful to members of the public that may read the document. I am very happy to see you using the ecoregional values for setting nutrient targets in the TMDL.

DEQ response: Section 5.2 has been amended to include a discussion of how the loads were derived and the conversions were made. The draft included Tables 13 and 14, which illustrate how the concentrations sampled on each sampling date relate to the load capacity, margin of safety, etc. Monthly loads have been calculated and added to the document as Tables 15 and 16.

EPA 4) On page 40, in the first paragraph, you may want to cite that the PNV method was carried out consistent with the October 2009 DEQ Guidance.

DEQ response: This change has been made.

EPA 5) On page 41, there is a discussion of how the shade estimates were field-verified with a solar pathfinder. You should include the field verification data in the appendix and discuss the results. Sometimes adjustments are made to the existing shade estimates based on field data.

DEQ response: Pathfinder data collected at two distinct sites, representing two riparian vegetation types has been added to the existing shade analysis in Section 5.3, under the subheading "Monitoring Points." An explanation of how the data was used to attenuate the existing shade estimates and loading analysis is also included in this sub-section.

EPA 6) The October, 2009 PNV Guidance and Curves are the most up to date. I am not sure why a 2003 ponderosa pine curve is referenced. You might want to look as the "warm/dry breaklands curve" on page 141 in lieu of the old ponderosa pine curve.

DEQ response: The 2003 ponderosa curve was used in the Potlatch River SBA/TMDL and represents a riparian vegetation type identical to that found on upper Hatwai Creek. The difference in target shade derived from these two curves is negligible, if there indeed is any difference in target shade between the two. The 2009 warm/dry breaklands curve is now used in lieu of the ponderosa pine curve in order to maintain consistency with the most current PNV guidance, but using it did not significantly change the targets, loads or load reductions called for in Section 5.3 of this document.

EPA 7) Again, I believe this is a well thought out document and I appreciate the efforts made by the DEQ staff and the Watershed Advisory Group.

DEQ Response: We appreciate your substantive comments and prompt action in helping to finalize this document.