Palouse River Tributaries

Subbasin Assessment and TMDL

Idaho Department of Environmental Quality
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Thank you!

Cover photo by Robert D. Henderson

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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

AWS agricultural water supply

CBAG Clearwater Basin Advisory Group

BLM United States Bureau of Land Management

BMPs best management practices

BOD biochemical oxygen demand

Btu British thermal unit

BURP Beneficial Use Reconnaissance Program

ºC Celsius

CNF Clearwater National Forest

CFR Code of Federal Regulations (refers to citations in the federal administrative rules)

cfs cubic feet per second

cm centimeters

Cr. Creek

CW cold water

CWA Clean Water Act

CWE cumulative watershed effects

DEQ Idaho Department of Environmental Quality

DO dissolved oxygen

DWS domestic water supply

EMAP Environmental Monitoring and Assessment Program

EPA United States Environmental Protection Agency

ESA Endangered Species Act

ºF 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

ICWB-Ave Idaho Cold Water Aquatic Life - average

ISS-Ave Idaho Salmonid Spawning - average

IDAPA Refers to citations of Idaho administrative rules

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

LNFCRS Lower North Fork Clearwater River Subbasin

m meter

m^3 cubic meter

mi mile

mi^2 square miles

MBI macroinvertebrate index

MGD million gallons per day

mg/l milligrams per liter

mm millimeter

MOS margin of safety

MWMT maximum weekly maximum temperature

n.a. not applicable

NA not assessed

NB natural background

ND no data (data not available)

PCR primary contact recreation

ppm part(s) per million

NFS not fully supporting

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resources Conservation Service

NTU nephlometric turbidity unit

ORV off-road vehicle

ORW Outstanding Resource Water

PACFISH The federal Pacific Anadromous Fish Strategy

PFC proper functioning condition

PRS Palouse River Subbasin

QA quality assurance

QC quality control

RBP rapid bioassessment protocol

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

SPZ Stream Protection Zone

SS salmonid spawning

SSOC stream segment of concern

TDS total dissolved solids

TMDL total maximum daily load

TP total phosphorus

TSS total suspended solids

U.S. United States

USC 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

WLA waste load allocation

WQLS water quality limited segment

WQS water quality standard

WWA Western Watershed Analysts

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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 Palouse River Subbasin that have been placed on Idaho's current §303(d) list.

This subbasin assessment (SBA) and TMDL analysis has 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 Palouse River Subbasin, located in northern 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. Eight segments of the Palouse River Subbasin were listed on the list. The SBA examines the current status of the §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.

Subbasin at a Glance

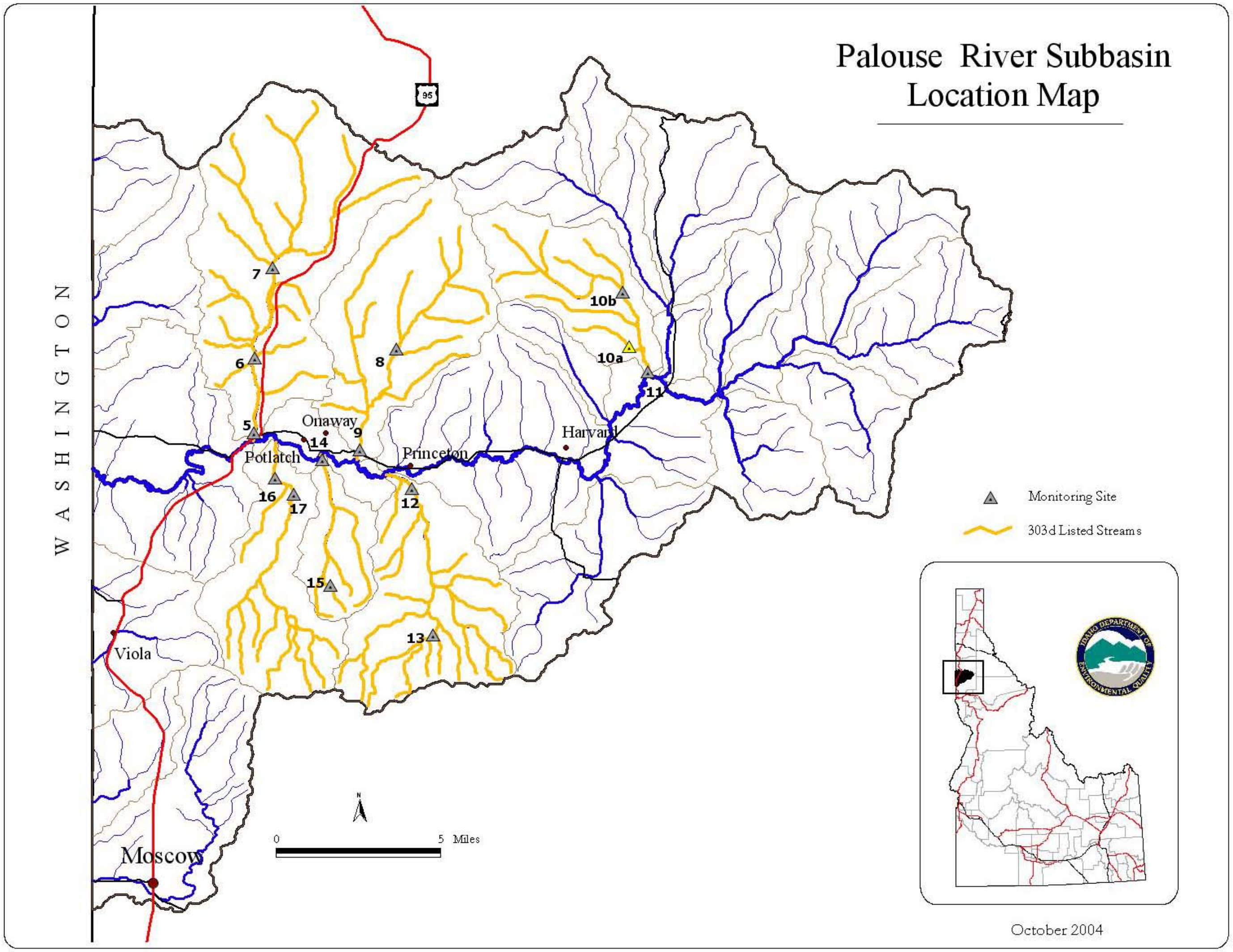
Within the Palouse River Subbasin (HUC #17060108), there are eight water bodies on the 1998 §303(d) list:

1. Big Creek
2. Deep Creek
3. Flannigan Creek
4. Gold Creek
5. Hatter Creek
6. Rock Creek
7. Cow Creek
8. South Fork Palouse River

Two of these water bodies, Cow Creek and the South Fork Palouse River, will be addressed in separate subbasin assessments and TMDLs. The remaining six water bodies will be addressed in this document.

The subbasin assessment portion of this document examines the current status of §303(d)-listed waters and determines if a water body is impaired, and if it is, the extent and cause(s) of impairment. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition that meets water quality standards.

Map A displays the general geographical location of the Palouse River Subbasin and the location of the §303(d) listed water bodies. The headwaters of the Palouse River originate in the Hoodoo Mountains of the St. Joe National Forest. The Palouse River and most of its tributaries originate in forested, mountainous terrain and flow downstream into the lower gradient rolling hill terrain of the Palouse River Subbasin, which is dominated by agricultural uses. The Palouse River flows into the State of Washington about six miles west of the town of Potlatch. The Palouse River Subbasin is approximately 407.25 square miles (260,641 acres) and is located primarily in Latah County. There are no anadromous fish in the Palouse River as Palouse River Falls, located in the State of Washington, blocks fish migration. Elevations range from 2,453 ft at the state line to 5,334 ft on Bald Mountain in the Hoodoo Mountain range. Most elevations are within 2,500 to 3,500 ft with most of the mid- to lower-elevation topography in the basin being the Palouse Loess. The north slopes are of moderate to steep rolling hills, while the south slopes are more gentle.



Map A. Location of the Palouse River Subbasin, Hydrological Unit 17060108 and the 303(d) waterbodies

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The Palouse River Subbasin is a sparsely populated area with one major town, Moscow, and several other small towns and communities, including Potlatch, Princeton, and Harvard. Total population in Latah County is 34,935 people (2000 census), which gives a density of 32.4 people per square mile. Agriculture, grazing, forestry, residential developments, and recreational activities are the major land uses of the subbasin. The Palouse River Subbasin is a popular destination for outdoor recreation activities, such as hunting, hiking, motorized recreation, mountain biking, camping, and fishing. There are no point sources within the §303(d) stream watershed boundaries.

The Palouse prairie is one of most productive agricultural areas in the world. The fertile soils and abundant winter and spring rain create ideal conditions for the production of wheat, barley, peas, and lentils, which are exported all over the globe. Historically, in the 1860s, the first European settlers used the Palouse hills as pastures but soon discovered the soils fertility and planted grain on the dry meadows and lower-side slopes. Horse and mule teams worked the land in the early 1900s. Machinery soon began to change farming and by 1930, 90% of the Palouse wheat was harvested using combines (Black, etc). The use of fertilizers after World War II increased crop production 200% to 400% (Black, etc). During this period, federal agricultural programs encouraged farmers to drain seasonally wet areas. In fewer than 100 years, small family farms have mostly disappeared as technology has allowed individual farmers to cultivate larger areas of land more efficiently. In the last few decades, some highly erodible lands have been removed from crop production under the Federal Conservation Reserve Program (CRP). Today, only a few patches of the Palouse River Subbasin are covered by native vegetation. Although agriculture is the most economically important feature of today's Palouse River Subbasin, it has had detrimental effects on the native landscape.

Over the last 100 years, farming has led to the loss of vast amounts of native plant habitat, and the native habitat that remains is badly fragmented into small isolated spots separated by acres of cultivated fields (Cook and Hufford). Most of the wetlands in the Palouse River Subbasin have been eliminated. These wetlands retained water during the wet periods and released cool groundwater into the streams during the dry summer months. Without these wetlands, rainfall and snowmelt do not infiltrate into the ground; instead, they flow rapidly as overland runoff into surface waterways and create problems such as gully, rill and in-stream erosion, flooding, deeply incised channels, higher peak runoffs, and low summer flows. The change in hydrology has changed the aquatic biota as well. Because of low summer flows, reduced shade, and loss of channel diversity, aquatic organism populations, such as fish and insects, have been eliminated or severely altered. An example of these changes is captured below:

- Deep Creek, once named for its deep perennial pools, is now classified as an intermittent stream downstream of the forest to agriculture interface. Historical information classified the entire portion of Deep Creek as a perennial stream. A United States Geological Survey (USGS) quad map dated 1955 displays Deep Creek as a perennial stream while the current USGS quad map displays Deep Creek as intermittent. Many intermittent streams in the Palouse are probably similar.

The economy of the Palouse is dominated by agriculture and two universities: the University of Idaho and Washington State University. Forestry, livestock, grazing, construction, and recreation are other economic factors. All of these affect water quality to some degree. Agriculture is and will continue to be the dominant economic factor in the Palouse River Subbasin. Preventing the rich, fertile soil of the Palouse River Subbasin from eroding and keeping it intact on the landscape is the major theme for this document. This theme, not only maintains and improves water quality but it is also the economic life force of the Palouse.

This document addresses the six water bodies on the 1998 §303(d) list that flow into the mainstem Palouse River within the state of Idaho: Big Creek, Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek and the West Fork of Rock Creek (referred to as Rock Creek in this document) all flow into the Palouse River and are wholly located in the state of Idaho.

Table A displays the water bodies for which TMDLs were written and lists their respective pollutants of concern. All the streams have cold water aquatic life and secondary recreation as existing or designated beneficial uses. Some of the streams have salmonid spawning as an existing or designated use as well. DEQ collaborated with the Palouse River Tributaries Watershed Advisory Group and other participants to write five sediment, five temperature, five bacteria, and two nutrient TMDLs based primarily monitoring plan in Appendix A. The pollutants in the Palouse River Subbasin are from nonpoint sources.

The following are the major nonpoint sources for each of the pollutants:

- Sediment (above background): sheet and rill erosion off the landscape, roads, and stream bank and riparian areas
- Temperature: solar radiation
- Bacteria: cattle and other livestock, wildlife, and humans (homes and recreation)
- Nutrients: fertilizers, livestock, and septic systems

The TMDL loading capacity for each pollutant is based on the following:

- Sediment TMDLs: 25 nephlometric turbidity units (NTUs)s above background (the state standard)
- Temperature TMDLs: temperatures in streams shall not exceed natural background conditions (the state standard)
- Bacteria TMDLs: waters are not to contain E. coli bacteria significant to the public health in concentrations exceeding, a geometric mean of 126 *E.Coli* organisms per 100 ml based on a minimum of five samples taken every three to five days over a 30 day period at any 30 day period throughout the year or a single sample of 576 E. coli organisms per one hundred 100 ml (the state standard).
- Nutrient TMDLs: 0.10 mg/L total phosphorus and 6.0 mg/L dissolved oxygen (the state standard)

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

Stream (Creek)	Assessment Units	Pollutant(s)
Big	ID1706108CL027a_02 ID1706108CL027b_02	Temperature
Deep	ID1706108CL032a_02 ID1706108CL032a_03 ID1706108CL032b_02 ID1706108CL032b_03	Sediment, Temperature, Bacteria
Flannigan	ID1706108CL011a_02 ID1706108CL011a_03 ID1706108CL011b_02 ID1706108CL011b_03	Sediment, Temperature, Bacteria, Nutrients
Gold	ID1706108CL029_02 ID1706108CL029_03 ID1706108CL030_02 ID1706108CL031a_02 ID1706108CL031b_02	Sediment, Temperature, Bacteria
Hatter-upper	ID1706108CL015a_02	Sediment, Temperature, Bacteria
Hatter-lower	ID1706108CL015b_02 ID1706108CL015b_03	Sediment, Temperature, Bacteria, Nutrients
Rock	ID1706108CL012_03 ID1706108CL013a_02 ID1706108CL013b_03 ID1706108CL014a_02 ID1706108CL014b_02	Sediment, Bacteria

Key Findings

The subbasin assessment was written for the entire Palouse River Subbasin; however, only the six listed water bodies were intensively evaluated. TMDLs were only considered for the listed pollutants on the six listed water bodies. In the end seventeen TMDLs with four different pollutants were written for all six of the water bodies. Some pollutants were found to not be impairing beneficial uses for those streams and are recommended for removal from the §303(d) list. These decisions were based on data collected primarily through a monitoring plan jointly created and approved by the following governmental entities: DEQ-Lewiston Regional Office (LRO), Latah Soil and Water Conservation District (LSWCD), Idaho Soil Conversation Commission, and the Idaho Department of Agriculture. Idaho Association of Soil Conversation District, LSWCD, and DEQ-LRO staff conducted the monitoring.

Sediment

Sediment TMDLs were developed for five of the six §303(d) listed streams in this report: Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek and Rock Creek. In these five water bodies, the beneficial uses of salmonid spawning and/or cold water aquatic life are not being fully supported. The target (load allocation) for the sediment TMDLs was based on the turbidity standard, which states that waters shall not exceed 25 NTU over background levels for greater than 10 days and shall not exceed 50 NTU over background at any time. The in-stream water quality target for sediment was developed to restore full support of designated beneficial uses.

Ten years of data from USGS Palouse River gage site near the town of Potlatch was gathered and compiled. By following the Lipscomb 1998 methodology for each §303(d)-listed stream, modifications were then made to the flows based on watershed size differences between each stream and the Palouse River's elevation, precipitation, geology, land cover, basin slope, and channel characteristics.

Based on the collected data in the monitoring year November 2001-November 2002, numeric relationships between discharge and NTU, discharge and TSS, and NTU and TSS were developed by plotting the values on a graph. These relationships can be expressed as mathematical equations, called regression equations, which were then used to determine existing TSS and NTU values on a daily basis and averaged daily for a 10-year period.

The background TSS value was calculated by multiplying a background ratio and the existing TSS value. A background ratio was calculated by dividing the background erosion value from the total sediment erosion value within the Revised Universal Soil Loss Equation (RUSLE) model.

The load capacity was calculated by taking the TSS value equal to 25 NTU, multiplying by daily flow and a conversion factor (to express the load capacity in tons per day), and then adding the background TSS in tons per day. The load allocation is determined by subtracting the background sediment from the load capacity. Once the load capacity was determined the excess load or load reduction was calculated by subtracting the load capacity from the existing TSS load. The excess load was then expressed in tons per year and a percentage was calculated. These steps were performed for each §303(d)-listed stream.

The load reductions are displayed as total tons per year and as a percentage in Table B. To reach the load reductions stated below, the amount of TSS measured in the streams will have to be lowered during the winter and spring seasons, as this is when the majority of the sediment is being transported. These reductions are applicable throughout each watershed (headwaters to mouth and all tributaries within the watershed).

Table B. Sediment nonpoint source load analysis for Palouse River Subbasin.

Source (Creek)	Existing Load[a]	Back-ground[a]	Load Capacity[a]	Load Allocation[a]	Load Reduction[a]	Load Reduction (%)
Deep	7040.85 t/yr	233.60 t/yr	613.20 t/yr	379.60 t/yr	6541.15 t/yr	96%
Flannigan	1452.70 t/yr	62.10 t/yr	525.60 t/yr	463.55 t/yr	937.69 t/yr	67%
Gold	661.65 t/yr	25.55 t/yr	368.65 t/yr	343.10 t/yr	294.47 t/yr	46%
Hatter	1222.75 t/yr	219.00 t/yr	795.70 t/yr	546.70 t/yr	466.77 t/yr	46%
Rock	147.88 t/yr	12.34 t/yr	54.75 t/yr	42.41 t/yr	94.90 t/yr	69%

[a] t/yr = tons per year

Temperature

Temperature TMDLs were written for the Big Creek, Deep Creek, Flannigan Creek, Gold Creek and Hatter Creek watersheds. In these five watersheds, heat is a pollutant impairing the beneficial uses of salmonid spawning and/or cold water aquatic life. The temperature targets are based on (IDAPA 58.01.02.200.09 which states, “When natural background conditions exceed any applicable water quality criteria set forth in Sections 21,250,251, or 253, the applicable water quality criteria shall not apply; instead, pollutant levels shall not exceed the natural background conditions). In laymen’s terms the temperature targets are based on a natural riparian plant cover condition over the streams. In this TMDL, potential natural vegetation cover (PNV) represents the loading capacity of the stream in terms of minimum heat load. This analysis contains an implicit margin of safety as all streams are assumed to be at maximum PNV at loading capacity, when in reality natural cover can be more variable due to natural forces (e.g. aspect, precipitation zones, fire, wind throw, drought or other natural events). Existing vegetative cover represents the existing load of heat to the streams. Those segments of the streams with the largest differential between PNV and existing cover (existing cover less than potential cover) are assumed to cause the most heating to the stream.

This analysis was accomplished by overlaying a soil survey Geographical Information Systems (GIS) layer with the stream GIS layer. For each soil type a respective vegetation community exists. The maximum potential for each vegetation community (when the vegetation community is at a climax) is the PNV. Within each assessment unit (AU) (section of a stream) several soils types intersect with the stream creating numerous reaches with different PNVs. The tables in Appendix E display all of these reaches for each AU and their existing loads, load capacities and load allocations. The information in Appendix E should be referenced to assist with implementation of this TMDL. For the executive summary, the soil reach information was summarized for each AU and major tributary within an AU in Tables C through G.

The tables C through G summarize this information into average existing loads, average load capacities and average load allocations for each AU and major tributary within an AU for the Big Creek, Deep Creek, Flannigan Creek, Gold Creek and Hatter Creek watersheds. Because these reaches are averaged, an AU or major tributary that has a classification of ‘good’ is not necessarily exempt from a load reduction (shade increase). It is possible that within these ‘good’ AUs or major tributaries there are individual reaches that need a shade increase but the overall average for that AU is in a ‘good’ condition. Maps E-1 and E-2 visually display these shade increases and they exist in virtually every AU or major tributary even if its average overall condition is classified as ‘good.’

Table C. Temperature load nonpoint source allocations for Big Creek.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class
Lower Big Creek (AU #ID17060108CL027b_02)	70%	56.7%	Fair
Lost Creek (AU #ID17060108CL027b_02)	73.3%	63.3%	Fair
Last Chance Creek (AU #ID17060108CL027b_02)	80%	80%	Good
Tributaries to Lower Big (AU #ID17060108CL027b_02)	71.7%	61.7%	Fair
Upper Big Creek (AU #ID17060108CL027a_02)	80%	80%	Good
Tributaries to Upper Big (AU #ID17060108CL027a_02)	82.5%	73.8%	Fair

LA= ((Existing cover – Potential cover)/Potential cover) x 100.

Table D. Temperature load nonpoint source allocations for Deep Creek.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class
Lower Deep Creek (AU #ID17060108CL032b_03)	54.4%	15.6%	Very Poor
Tributaries to Lower Deep (AU#ID17060108CL032b_02)	65.2%	21.2%	Very Poor
Upper Deep Creek (AU #ID17060108CL032a_03)	50%	25%	Very Poor
East Fork Deep Creek (AU #ID17060108CL032a_02)	68.5%	47.7%	Poor
Middle Fork Deep & Tribs (AU#ID17060108CL032a_02)	69.5%	54%	Poor
West Fork Deep & Trib (AU #ID17060108CL032a_02)	71.8%	62.9%	Fair
Tributary to Upper Deep (AU #ID17060108CL032a_02)	68.9%	43.3%	Poor

LA= ((Existing cover – Potential cover)/Potential cover) x 100.

Table E. Temperature load nonpoint source allocations for Flannigan Creek.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class
Lower Flannigan (AU #ID17060108CL011b_03)	68%	43%	Poor
Upper Flannigan (AU #ID17060108CL011a_03)	56.7%	58.3%	Good
Tributary to Lower Flannigan (AU#ID17060108CL011b_02)	70%	35.7%	Very Poor
Tributary to Upper Flannigan (AU#ID17060108CL011a_02)	76.7%	73.3%	Fair
Tributary to Upper Flannigan (AU#ID17060108CL011a_02)	76%	78%	Good
Tributary to Upper Flannigan (AU#ID17060108CL011a_02)	76.7%	70%	Fair
West Fork Flannigan (AU #ID17060108CL011a_02)	62.2%	62.2%	Good
Tributary to WF Flannigan (AU#ID17060108CL011a_02)	80%	75%	Fair
Tributary to WF Flannigan (AU#ID17060108CL011a_02)	87.5%	75%	Fair

LA= ((Existing cover – Potential cover)/Potential cover) x 100.

Table F. Temperature load nonpoint source allocations for Gold Creek.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class
Lower Gold & Lowest Trib (AU #ID17060108CL029_03)	60%	23.3%	Very Poor
Upper Gold (AU #ID17060108CL030_02)	67.7%	63.1%	Fair
Nelson Creek (AU #ID17060108CL030_02)	71.1%	70%	Good
Tributary to Upper Gold (AU #ID17060108CL030_02)	78%	66%	Fair
Waterhole Creek (AU #ID17060108CL030_02)	75%	75%	Good
Tributary to Upper Gold (AU #ID17060108CL030_02)	80%	75%	Fair
Tributaries to Upper Gold (AU #ID17060108CL030_02)	83.3%	83.3%	Good
Lower Crane Creek (AU #ID17060108CL031b_02)	70%	55%	Poor
Tributaries to Lower Crane (AU #17060108CL031b_02)	70%	31.3%	Very Poor
Upper Crane Creek (AU #ID17060108CL031a_02)	76%	72%	Fair

LA= ((Existing cover – Potential cover)/Potential cover) x 100.

Table G. Temperature load nonpoint source allocations for Hatter Creek.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class
Lower Hatter (AU #ID17060108CL015b_03)	63.3%	38.7%	Poor
Tributary to Lower Hatter (AU #ID17060108CL015b_02)	70%	47%	Poor
Tributary to Lower Hatter (AU#ID17060108CL015b_02)	72.3%	59.2%	Fair
Tributary to Lower Hatter (AU #ID17060108CL015b_02)	78.6%	58.6%	Poor
Tributary Complex to Lower Hatter (AU#ID17060108 CL015b_02)	77.9%	64.5%	Fair
Tributary to Lower Hatter (AU #ID17060108CL015b_02)	77.1%	58.6%	Poor
Upper Hatter and Tributaries (AU#ID17060108CL015a_02)	84.3%	72.5%	Fair
Long Creek (AU #ID17060108CL015a_02)	85.7%	68.6%	Fair

LA= ((Existing cover – Potential cover)/Potential cover) x 100.

Bacteria

Bacteria TMDLs were developed for five of the six §303(d)-listed streams in this report: Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek and Rock Creek. In these water bodies, the beneficial use of secondary contact recreation is not being fully supported. The three main sources of bacteria are cattle and other livestock, wildlife, and humans (homes and recreation), but specific sources are unknown. Tables H through M display the current load, load allocation, margin of safety, and load reductions fro each of the five streams with a bacteria TMDL. The target for the bacteria TMDLs is IDAPA 58.01.02.251.02 which states that, "Waters designated for secondary contact recreation not to contain *E. coli* bacteria significant to the public health in concentrations exceeding: a single sample of five hundred seventy-six (576) *E. coli* organisms per one hundred (100) ml; or a geometric mean of one hundred twenty -six (126) per one hundred (100) ml based on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period." The bacteria TMDLs are based on the month when exceedance(s) occurred.

E. coli and other harmful bacterium have a lifespan outside of warm-blooded digestional tracks of about 24-30 hours, which is enough time for bacteria sources in the headwaters of a stream to move downstream throughout the entire stream and into other water bodies like the Palouse River. Therefore, it is critical that all sources of bacteria be reduced and maintained within state standards to ensure the contact recreational beneficial use is protected throughout the Palouse River Subbasin.

The bacteria load capacity for Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek, and Rock Creek is set at a level that fully supports the recreational beneficial use. Seasonal variations, background levels, and a 10% margin of safety to account for any uncertainty were calculated within the load capacity. Each §303(d)-listed stream has a different seasonal variation of when bacteria exceedances occurred. Tables H through L display these exceedance occurrences. Since harmful bacteria has a relatively short lifespan, it made sense to specify the month for load reductions. Bacteria, unlike sediment, does not stay in a stream network for weeks, months, or years; it stays within a stream network for about a day and then dies.

Table H. Bacteria nonpoint sources load allocations for Deep Creek.

Source	Month	Current Load (*E.coli* organisms/day)	Load Allocation (*E.coli* organisms/day)	MOS (10%)	Load Reduction (*E.coli* organisms/day)
Unknown (PR5)	Dec	2.99×10^{11}	1.01×10^{11}	1.98×10^{10}	2.18×10^{11}
Unknown (PR6)	Dec	3.26×10^{11}	7.83×10^{10}	2.48×10^{10}	2.73×10^{11}
Unknown (PR5)	Dec	3.95×10^{11}	2.32×10^{11}	1.63×10^{10}	1.79×10^{10}
Unknown (PR6)	Dec	3.49×10^{11}	3.24×10^{11}	2.5×10^{9}	2.75×10^{10}
Unknown (PR5)	Mar	1.53×10^{12}	1.01×10^{12}	5.2×10^{10}	5.72×10^{11}
Unknown (PR5)	Mar	8.49×10^{11}	7.08×10^{11}	1.41×10^{10}	1.55×10^{11}
Unknown (PR6)	May	2.15×10^{11}	2.03×10^{11}	1.2×10^{9}	1.32×10^{10}
Unknown (PR7)	June	3.64×10^{10}	1.75×10^{10}	1.89×10^{9}	2.08×10^{10}

Table I. Bacteria nonpoint sources load allocations for Flannigan Creek.

Source	Month	Current Load (*E.coli* organisms/day)	Load Allocation (*E.coli* organisms/day)	MOS (10%)	Load Reduction (*E.coli* organisms/day)
Unknown (PR16)	Mar	6.65×10^{11}	6.28×10^{11}	3.7×10^{9}	4.07×10^{10}
Unknown (PR16)	May	5.81×10^{11}	1.39×10^{11}	4.42×10^{10}	4.86×10^{11}
Unknown (PR17)	May	4.16×10^{11}	1.50×10^{11}	2.66×10^{10}	2.93×10^{11}
Unknown (PR17)	Jun	3.35×10^{10}	2.79×10^{10}	5.6×10^{8}	6.16×10^{9}
Unknown (PR17)	Jul	8.83×10^{10}	2.12×10^{10}	6.71×10^{9}	7.38×10^{10}
Unknown (PR17)	Jul	1.27×10^{10}	1.09×10^{10}	1.8×10^{8}	1.98×10^{9}
Unknown (PR17)	Jul	2.09×10^{10}	5.02×10^{9}	1.59×10^{9}	1.75×10^{10}
Unknown (PR17)	Aug	2.44×10^{9}	2.34×10^{9}	1.00×10^{7}	1.10×10^{8}
Unknown (PR17)	Sep	8.17×10^{9}	4.71×10^{9}	3.46×10^{8}	3.81×10^{9}
Unknown (PR17)	Sep	1.04×10^{10}	2.51×10^{9}	7.89×10^{8}	8.68×10^{9}
Unknown (PR17)	Oct	8.94×10^{9}	5.99×10^{9}	2.95×10^{8}	3.25×10^{9}

Table J. Bacteria nonpoint sources load allocations for Gold Creek.

Source	Month	Current Load (*E.coli* organisms/day)	Load Allocation (*E.coli* organisms/day)	MOS (10%)	Load Reduction (*E.coli* organisms/day)
Unknown (PR9)	Nov	1.18×10^{11}	2.82×10^{10}	8.98×10^{9}	9.88×10^{10}
Unknown (PR9)	Dec	1.34×10^{11}	1.19×10^{11}	1.5×10^{9}	1.65×10^{10}
Unknown (PR8)	Aug	2.59×10^{9}	1.35×10^{9}	1.24×10^{8}	1.36×10^{9}
Unknown (PR9)	Sep	1.96×10^{10}	4.71×10^{9}	1.49×10^{9}	1.64×10^{10}
Unknown (PR8)	Oct	3.80×10^{9}	3.78×10^{9}	2.0×10^{6}	2.20×10^{7}

Table K. Bacteria nonpoint sources load allocations for Hatter Creek.

Source	Month	Current Load (*E.coli* organisms/day)	Load Allocation (*E.coli* organisms/day)	MOS (10%)	Load Reduction (*E.coli* organisms/day)
Unknown (PR12)	Dec	4.54×10^{10}	3.79×10^{10}	7.50×10^{8}	8.25×10^{9}
Unknown (PR12)	Mar	3.72×10^{12}	8.93×10^{11}	2.83×10^{11}	3.11×10^{12}
Unknown (PR13)	Mar	3.29×10^{12}	7.89×10^{11}	2.5×10^{11}	2.75×10^{12}
Unknown (PR12)	May	1.00×10^{12}	5.25×10^{11}	4.75×10^{10}	5.23×10^{11}
Unknown (PR12)	Jun	1.19×10^{11}	9.96×10^{10}	1.94×10^{9}	2.13×10^{10}
Unknown (PR12)	Jul	2.21×10^{10}	1.96×10^{10}	2.5×10^{8}	2.75×10^{10}
Unknown (PR13)	Jul	5.59×10^{10}	3.28×10^{10}	2.31×10^{9}	2.54×10^{10}
Unknown (PR12)	Jul	1.45×10^{10}	8.35×10^{9}	6.15×10^{8}	6.77×10^{9}
Unknown (PR13)	Jul	2.43×10^{10}	2.03×10^{10}	4.0×10^{8}	4.4×10^{9}
Unknown (PR12)	Aug	1.53×10^{9}	1.21×10^{9}	3.2×10^{7}	3.52×10^{8}

Table L. Bacteria nonpoint sources load allocations for Rock Creek.

Source	Month	Current Load (*E.coli* organisms/day)	Load Allocation (*E.coli* organisms/day)	MOS (10%)	Load Reduction (*E.coli* organisms/day)
Unknown (PR14)	Dec	8.91×10^{10}	8.41×10^{10}	5.0×10^{8}	5.5×10^{9}
Unknown (PR15)	Mar	8.29×10^{10}	8.24×10^{10}	5.0×10^{7}	5.5×10^{8}

Nutrients

Nutrient TMDLs were developed for the lower section of Hatter Creek watershed and the entire Flannigan Creek watershed. The nutrient target is based on the state's numeric standard for dissolved oxygen (DO), which requires DO levels to be greater than 6.0 mg/L at all times, and a narrative target, which requires that surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. The data supporting the nutrient TMDLs show a consecutive period of elevated total phosphorus levels and low DO levels during the growing season.

The load capacity is defined as the amount of pollutant a water body can receive without violating water quality standards. The load capacity for Flannigan Creek and Hatter Creek is set at a level that fully supports beneficial uses. Seasonal variation, a background amount (BK), a margin of safety (MS), and a load allocation (LA), were all considered to determine the load capacity (LC),which is represented in the following equation:

LC=MS+BK+LA.

Nutrient data was collected between 2001 and 2002 within four reference watersheds with similar geologies, land-uses, and very minimal anthropogenic (human-caused) impacts. The yearly TP average of these watersheds ranged from 0.0314 to 0.0398 mg/L, with a combined average of 0.035. This is the background value that was used in the TMDL loading calculation.

A load allocation (LA) of 0.070 mg/L (nearly double the background amount) was established for these TMDLs. A margin of safety of 0.05 mg/L was applied to the equation to arrive at the 0.10 mg/L TP as a load capacity for nutrient TMDLs in the Palouse River Tributaries Subbasin. In addition to the TP target, the DO readings within Flannigan Creek and the lower portion of Hatter Creek will need to stay above 6.0 mg/L. These nutrient TMDLs only apply during the growing season, May-October, of each year. Typically, this is the critical time period when low DO levels are present because of excess nutrients and low stream flows. Best Management Practices should be applied on the landscape throughout the year as to ensure that excessive nutrients do not get into a stream and to ensure that the goals of these nutrient TMDLs are achieved. It should be noted low summer flows contributed in some manner to the low DO readings collected in this report.

For Flannigan Creek, the mass per unit volumes for the current load, load capacity, and load reduction amounts were calculated based on the discharge data averaged over a period of one month. Load reductions are required during the months of June and July at both sites, followed by a load reduction for the lower site only in the month of August. These load reductions are shown in Table M. For Hatter Creek, the mass per unit volumes for the current load, load capacity, and load reduction amounts were calculated based on the discharge data for each exceedance averaged over a period of one month. The load reductions in Hatter Creek will be required during August 15th through September 15th of each year. This load reduction for the lower portion of Hatter Creek is shown in Table N. Load allocations were assigned calculated to Flannigan Creek and the lower portion of Hatter Creek. The load allocation is the load capacity minus the natural background. A value was calculated for each §303(d)-listed water body and is displayed in Table M.

Table M. Nutrient nonpoint source load analysis for Palouse River Subbasin.

Source (Creek)	Month	Pollutant	Existing Load	Load Capacity	Load Allocation	Load Reduction
Flannigan (PR-16)	6/1-6/30	Total Phosphorus	1.883 lbs/day	1.487 lbs/day	1.368 lbs/day	0.396 lbs/day
Flannigan (PR-17)	6/1-6/30	Total Phosphorus	2.397 lbs/day	2.122 lbs/day	1.655 lbs/day	0.275 lbs/day
Flannigan (PR-16)	7/1-7/31	Total Phosphorus	0.501 lbs/day	0.418 lbs/day	0.355 lbs/day	0.083 lbs/day
Flannigan (PR-17)	7/1-7/31	Total Phosphorus	0.743 lbs/day	0.474 lbs/day	0.578 lbs/day	0.269 lbs/day
Flannigan (PR-16)	8/1-8/31	Total Phosphorus	0.087 lbs/day	0.083 lbs/day	0.083 lbs/day	0.004 lbs/day
Hatter (PR-12)	8/15-9/15	Total Phosphorus	0.061 lbs/day	0.051 lbs/day	0.051 lbs/day	0.011 lbs/day

Summary

Table N displays the proposed outcomes for all six listed water bodies. It includes recommended changes to the §303(d) list. All recommendations are based on the most current and accurate data and data analysis available to DEQ.

Table N. Summary of assessment outcomes.

Segment (Creek)	Assessment Units	Pollutant	TMDL(s) Completed	Recommended Changes to 303(d) List	Justification
Big	ID1706108CL027a_02 ID1706108CL027b_02	Sed[1], Temp[2], Nut[3], Bact[4]	Yes- Temp	Remove Sed; Nut, Bact	Data
Deep	ID1706108CL032a_02 ID1706108CL032a_03 ID1706108CL032b_02 ID1706108CL032b_03	Sed, Temp, Nut, Bact	Yes-Sed, Temp, Bact	Remove Nut	Data / Intermittent Stream
Flannigan	ID1706108CL011a_02 ID1706108CL011a_03 ID1706108CL011b_02 ID1706108CL011b_03	Sed, Temp, Nut, Bact	Yes-Sed, Temp, Bact, Nut	None	Data
Gold	ID1706108CL029_02 ID1706108CL029_03 ID1706108CL030_02 ID1706108CL031a_02 ID1706108CL031b_02	Sed, Temp, Nut, Bact	Yes-Sed, Temp, Bact	Remove Nut	Data
Hatter-upper	ID1706108CL015a_02	Sed, Temp, Nut, Bact	Yes-Sed, Temp, Bact	Remove Nut	Data
Hatter-lower	ID1706108CL015b_02 ID1706108CL015b_03	Sed, Temp, Nut, Bact	Yes-Sed, Temp, Bact, Nut	Remove Nut from (upper ½)	Data
Rock	ID1706108CL012_03 ID1706108CL013a_02 ID1706108CL013b_03 ID1706108CL014a_02 ID1706108CL014b_02	Sed, Temp, Nut, Bact	Yes-Sed, Bact	Remove Temp, Nut	Data / Intermittent Stream

[1] Sed = Sediment
[2] Temp = Temperature
[3] Nut = Nutrients
[4] Bact = Bacteria

Public Input and Meetings

A public meeting was held in June 2003 to solicit citizen participation. A news release, advertisements in three local newspapers, a radio public service announcement, and an advertisement on the DEQ Web site were all coordinated for the June meeting. The Palouse River Tributaries Watershed Advisory Group (WAG) was formed in October of 2003 with fifteen representatives compiling the land-uses within the Palouse area. Meetings were held in July 2003, September 2003, April 2004, June 2004, August 2004, and October 2004. Several other individuals are participating with the group even though they are not official WAG members. Membership on the WAG includes citizens at large, ranch owners, farmers, environmental interests, landowners in the basin, Potlatch Corporation, Bennett Lumber, and several local, state, and federal government representatives. The WAG has reviewed two different draft versions of this document. The WAG submitted informal comments to DEQ, which were incorporated in the final document. This informal comment process gave the WAG members an opportunity to add significant input to the document. The WAG's involvement with the TMDL process and development of this document has been instrumental, and they should be commended for their efforts. A public meeting was held in the town of Potlatch on November 15, 2004, (during the 30-day formal comment period) as part of the Clearwater Basin Advisory Group's November meeting. A meeting was held in December 2004 with the Palouse River Tributaries WAG to focus on how to begin implementation of the TMDL. The WAG continues to make progress as a meeting is scheduled for January 2005 and most probably future meetings in order to complete the implementation for this TMDL. The WAG should be commended on their efforts and significant amount of time that they have invested in the Palouse River Tributaries TMDL process.

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the 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. (In common language, a TMDL also refers to the written document that contains the statement of loads and supporting analysis, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.)

This document addresses the water bodies in the Palouse River Subbasin that have been placed on Idaho's §303(d) list.

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

1.1 Introduction

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Environment Federation 1987, p. 9). The act and the programs it has generated have changed over the years, as experience and perceptions of water quality have changed.

The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Background

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

Section 303 of the CWA requires DEQ to adopt water quality standards and to review those standards every three years (EPA must approve Idaho's water quality standards). Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish a TMDL for each pollutant impairing the waters. Further, the agency must set appropriate controls to restore water quality and allow the water bodies to meet their designated uses.

These requirements result in a list of impaired waters, called the "§303(d) list." This list describes water bodies not meeting water quality standards. Waters identified on this list require further analysis. A SBA and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the §303(d) list. The *Palouse River Tributaries Subbasin Assessment and TMDL* provides this summary for the currently listed waters in the Palouse River Subbasin.

The SBA section of this report (Sections 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Palouse River Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (Water quality planning and management, 40 CFR 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also allocates allowable discharges of individual pollutants among the various sources discharging the pollutant.

Some conditions that impair water quality do not receive TMDLs. The EPA does consider certain unnatural conditions, such as flow alteration, human-caused lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutants as "pollution." However, TMDLs are not required for water bodies impaired by pollution, but not by specific pollutants. A TMDL is only required when a pollutant can be identified and in some way quantified.

Idaho's Role

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

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

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

- Contact recreation–primary (swimming), secondary (boating)
- Water supply–domestic, agricultural, industrial
- Wildlife habitats
- Aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitats, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water aquatic life and primary contact recreation are used as additional default designated uses when water bodies are assessed.
A SBA entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data to address several objectives:

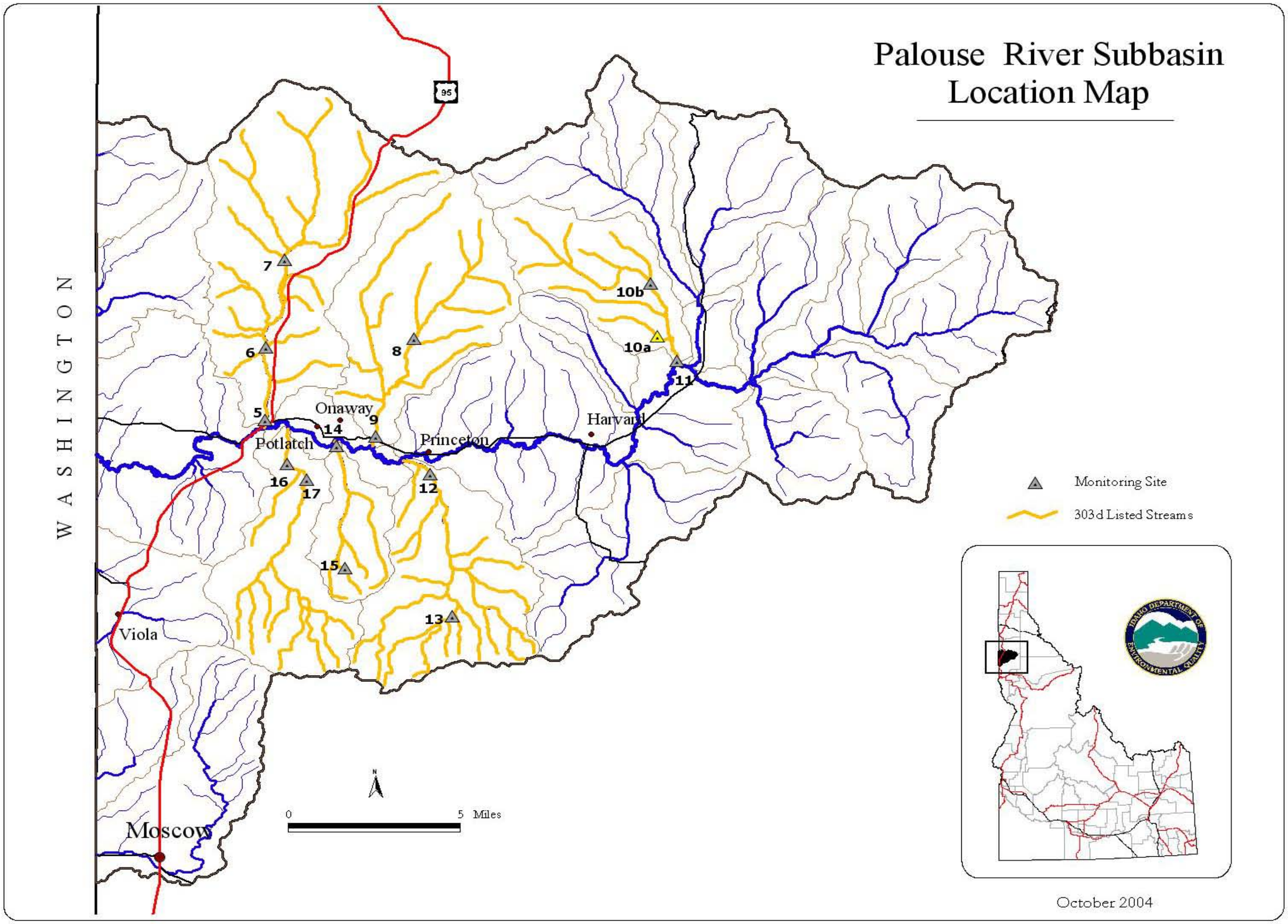
- Determine the degree of designated beneficial use support of the water body (i.e., attaining or not attaining water quality standards).
- Determine the degree of achievement of biological integrity.
- Compile descriptive information about the water body, particularly the identity and location of pollutant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

1.2 Physical and Biological Characteristics

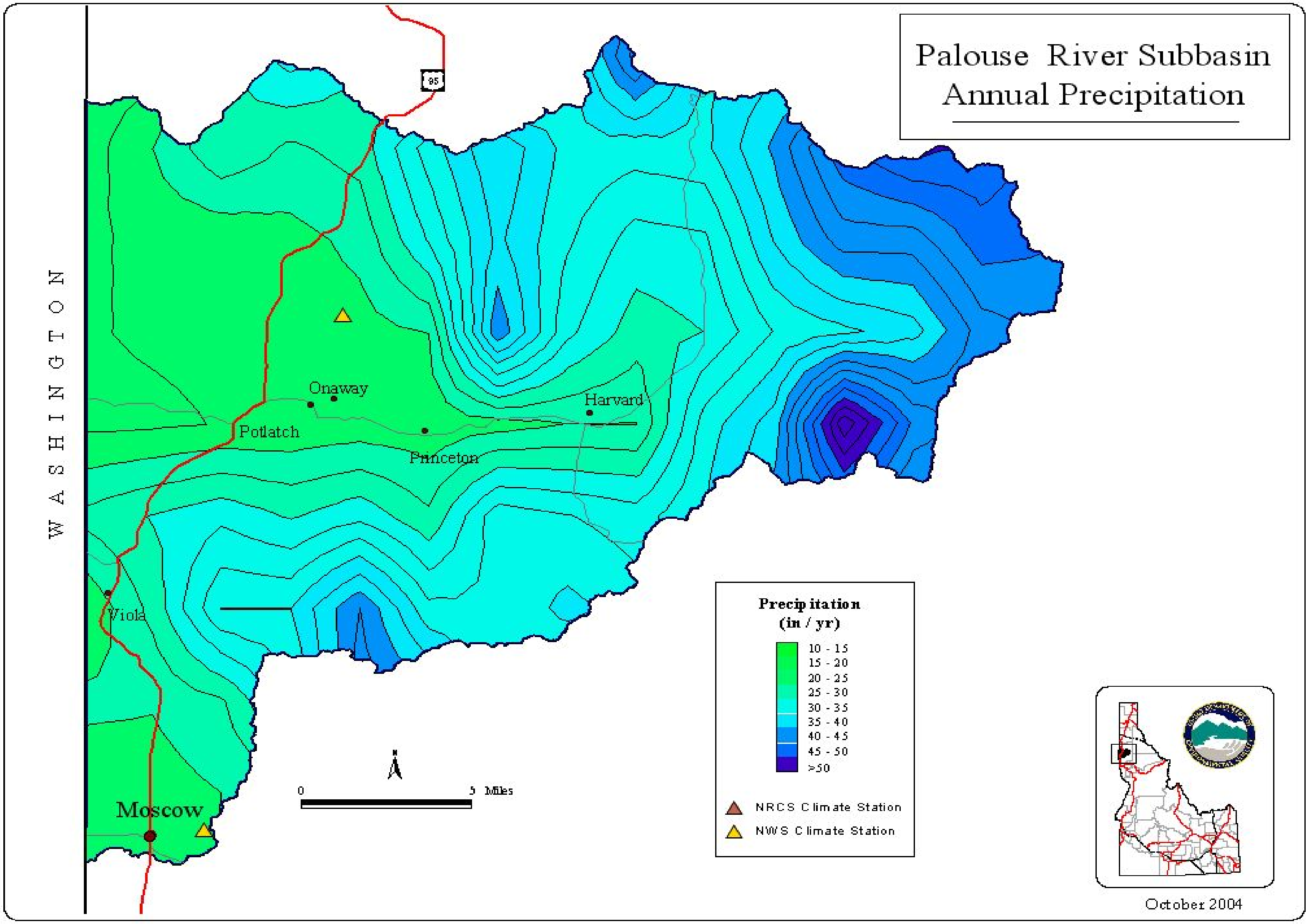
In this section, the physical, biological, and cultural characteristics of the Palouse River Subbasin will be characterized and described. The data presented in this characterization is pertinent to issues affecting water quality in the basin and in each §303(d)-listed subwatershed. Map 1-1 shows the general geographical location of the Palouse River Subbasin and the location of the §303(d) water bodies. The headwaters of the Palouse River originate in the Hoodoo Mountains of the St. Joe National Forest. The Palouse River and most of its tributaries originate in forested, mountainous terrain and flow downstream into the lower gradient rolling hill terrain of the Palouse, which is dominated by agriculture. The Palouse River flows into the State of Washington about six miles west of the town of Potlatch. Bordering the Palouse River Subbasin on the north and to the northeast is the St. Maries River drainage; to the east and southeast is the Potlatch River drainage; and to the south is the South Fork Palouse River drainage. The Palouse River Subbasin is approximately 407.25 square miles (260,641 acres) and is located primarily in Latah County. There are no anadromous fish in the Palouse River as Palouse River Falls, located in the State of Washington, blocks fish migration.

Climate

North Central Idaho is dominated by maritime air masses and prevailing westerly winds. During the fall, winter, and spring months, cyclonic storms move towards the east and produce low-intensity, long-duration precipitation, which accounts for most of the annual precipitation. Prolonged gentle rains and deep snow accumulations at higher elevations with fog, cloudiness, and high humidity characterize the basin in the fall, winter, and spring months. Winter temperatures are often 15^{o} F to 25^{o} F warmer than the continental locations of the same latitude. A seasonal snow pack generally covers elevations above 4,000 feet from December to May. The climate during the summer months is influenced by high-pressure stationary systems. These systems sometimes produce high-intensity electrical storms, which cause frequent wildfires, especially during exceptionally hot and dry summers. Precipitation isohyetals (bands) for the Palouse River Subbasin are shown on Map 1-2.



Map 1-1. General Location



Map 1-2. Annual Precipitation Isohyetals Amount for the Palouse River Subbasin

Climatic data was collected for this report from a total of five locations and is summarized in Table 1-1. In general, as elevation increases, so does the amount of precipitation, with portions of that in snowfall. There is also a considerable temperature difference based on elevation. For example, the City of Moscow (elevation 2,660 ft) averages over 25 days per year where the temperature exceeds 90° F, while Moscow Mountain (elevation 4,700 ft) averages 3 days per year where temperatures exceed 90° F. In the summer months, the average temperatures are about 10-15° F warmer at the lower elevations than at the summit and butte locations. Hot summer temperatures are common at the middle to lower elevations in the Palouse River Subbasin and are the major factor influencing water temperatures. Air temperatures at the middle to lower elevations will exceed 90° F anywhere from 20% to 70% of the time in the July and August. This fact should be considered when measuring thermal heat loads to the water bodies. Table B-1(Appendix B) displays the average monthly means, maximums, and minimums for temperatures, as well as the average monthly precipitation for each station.

Table 1-1. Summary of climate data.

Station Name	Type	Eleva-tion (ft)	Period of Record	Mean Annual Temp (ºF)	Mean Annual Precipitation (inches)	# of Days > 90 ºF per year
Moscow, U of I	ISCS[1]	2660	1/1/71-12/31/00	47.3	27.4	25.4
Pullman, WA	WRCS[2]	2550	1/1/71-12/31/00	47.4	21.0	27.6
Potlatch, ID	ISCS	2600	1/1/71-12/31/00	45.5	26.6	11.2
Moscow Mountain, ID	NRCS[3]	4700	1/1/01-12/31/02	41.5	40.1	3.0
Sherwin, ID	NRCS	3200	1/1/71-12/31/00	ND	42.2	ND

[1] ISCS = Idaho State Climate Services
[2] WRCS = Western Region Climate Center
[3] NRCS = Natural Resource Conservation Service

Hydrology

The Palouse River flows approximately 29 miles from its headwaters near the Hoodoo Mountains to the Idaho/Washington state line. In the State of Washington, the Palouse River flows approximately another 110 miles before reaching the Columbia River. The United States Geological Service has kept a gauge on the Palouse River located two miles west of the town of Potlatch. The period of record is from October 1914 through September 1919, and from December 1966 through the current year. The median daily stream flow based on 39 years of record from this gage is displayed in Figure 1-1.

The streams in the basin have a pattern of low flows during the late summer and early fall months and high flows in the spring and early summer months. The peak discharge is typically in late March, April, or early May. A peak discharge of 14,600 cubic feet per second (cfs) was recorded on the Palouse River on February 9, 1996, while a minimum flow of 0.09 cfs was recorded on September 24, 1973. Several of §303(d)-listed streams in the Palouse River Subbasin are intermittent from their source to the mouth; some §303(d)-listed streams begin as perennial streams and then become intermittent; others completely perennial streams.

In general, the hydrology of the streams in the upper Palouse River Subbasin are controlled by snowmelt and ground water while the hydrology of the streams running through agricultural land in the lower Palouse River Subbasin are controlled by snowmelt and precipitation events. Over the past century it is likely that the hydrology of the Palouse River has changed due to changes in land use. For example, Deep Creek, once named for its deep perennial pools, is now classified as an intermittent stream. Historical information classifies Deep Creek as a perennial stream. A USGS quad map dated 1955 displays Deep Creek as a perennial stream while the current USGS quad map displays Deep Creek as intermittent. Many intermittent streams in the Palouse are probably similar. The most current USGS Quad maps classify Deep and Rock Creeks as intermittent streams, and Big, Flannigan, Gold and Hatter Creeks as perennial streams.

The data collected for this TMDL about the §303(d)-listed streams correspond to USGS information regarding stream classification. Flow data for each §303(d)-listed stream from November 2001 through November 2002 are displayed below in Figures 1-2 through 1-7. The peak discharges for each stream are not measured values. They are discharge estimates.

When the discharge becomes very large, it becomes physically impossible to enter the streams for a measurement. It is also interesting to note that Rock and Deep Creeks went completely dry in the summer of 2002, while Big Creek, Flannigan Creek, Gold Creek and Hatter Creek had some water flowing in them during the entire year.

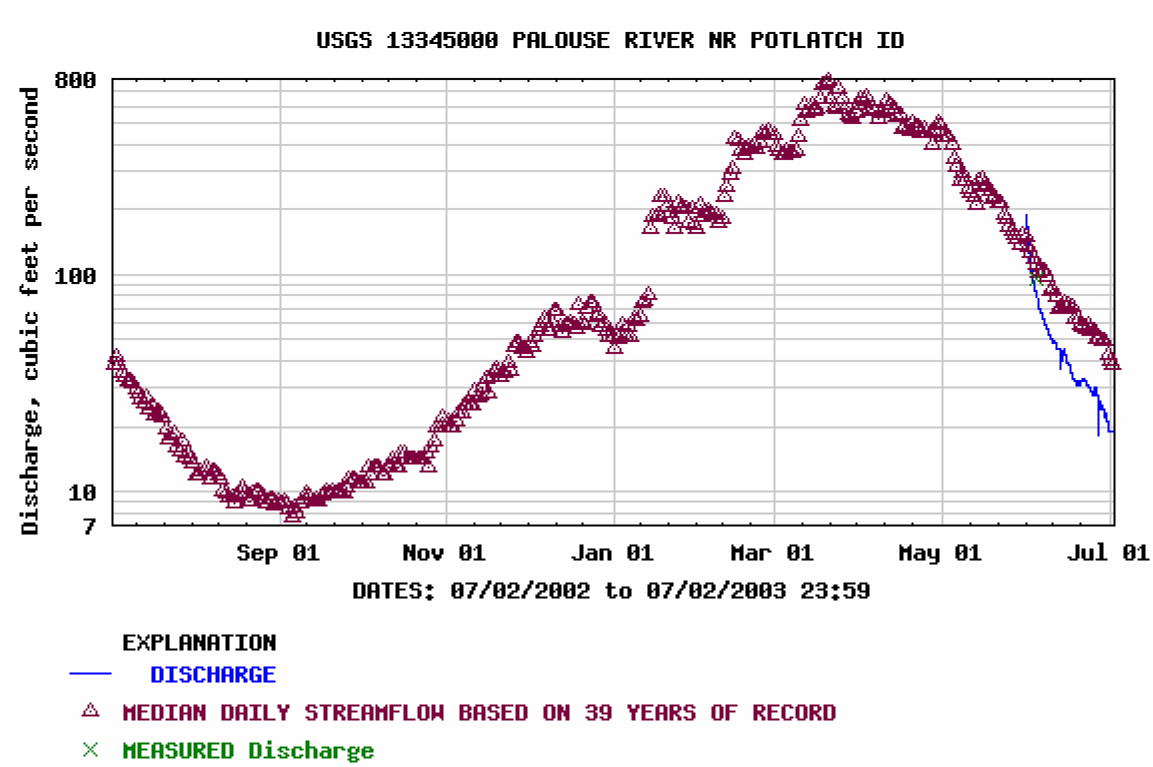


Figure 1-1. Historical Median Daily Stream flow Palouse River Discharge at USGS Gauge Site

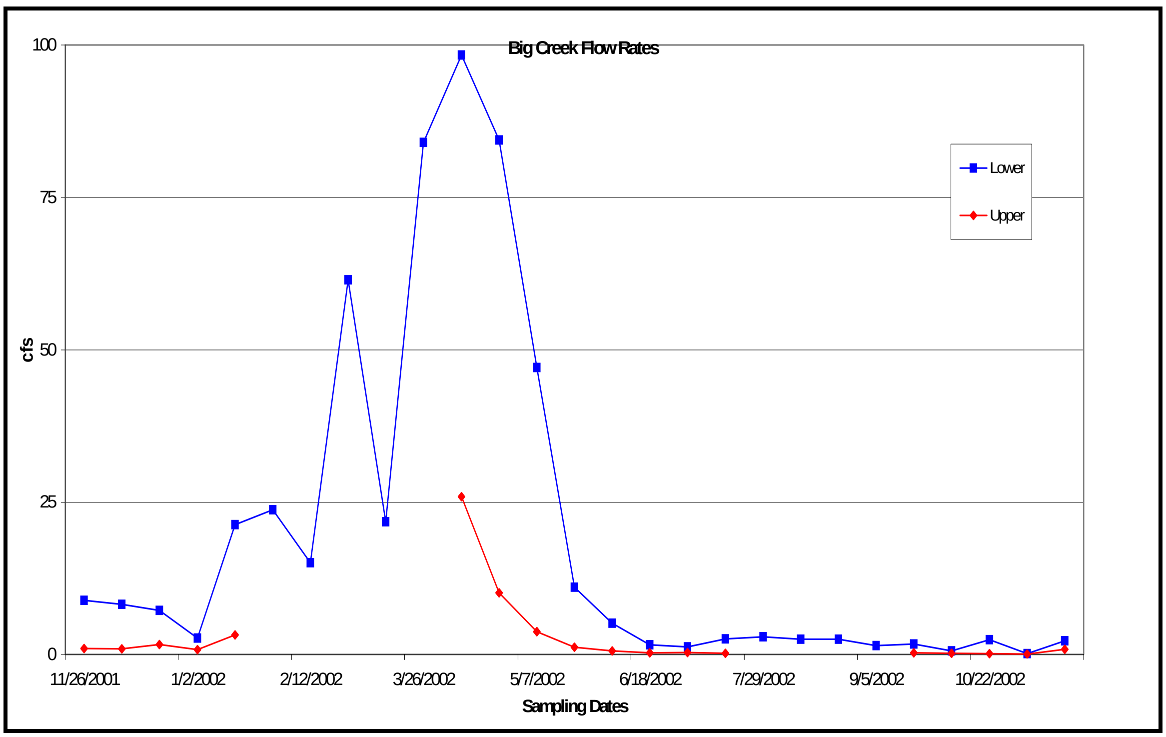


Figure 1-2. Big Creek Flow Rates

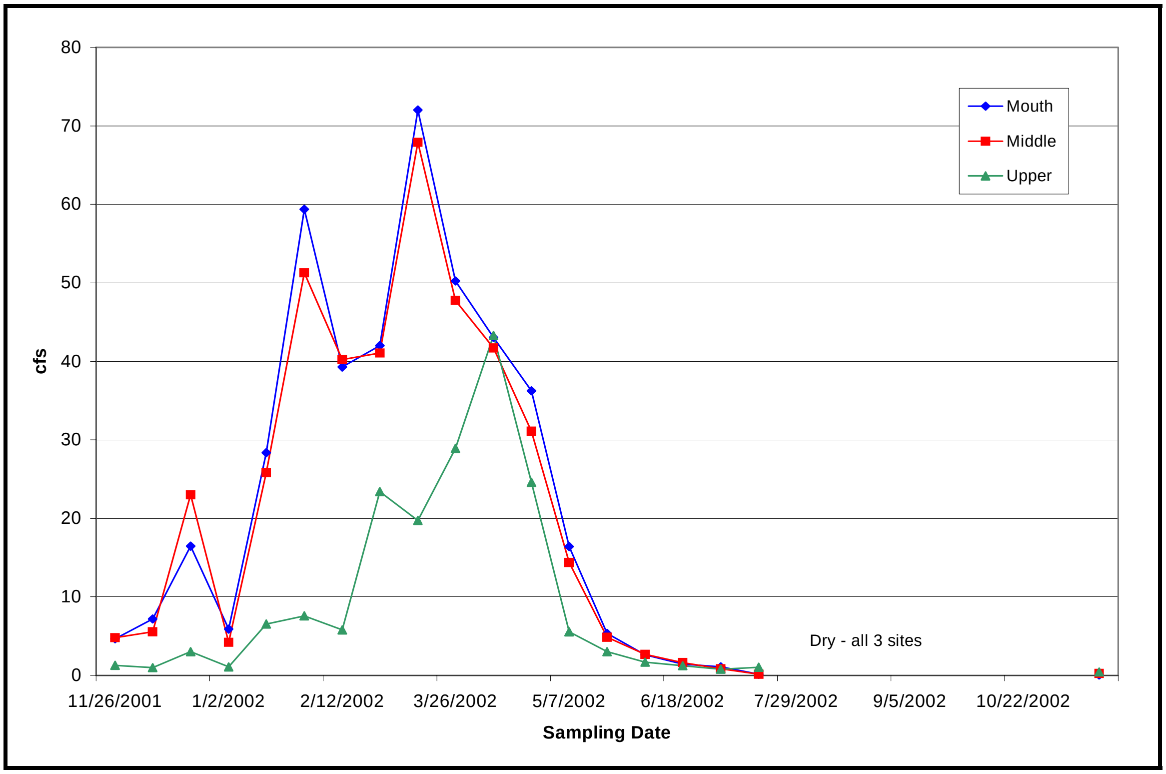


Figure 1-3. Deep Creek Flow Rates

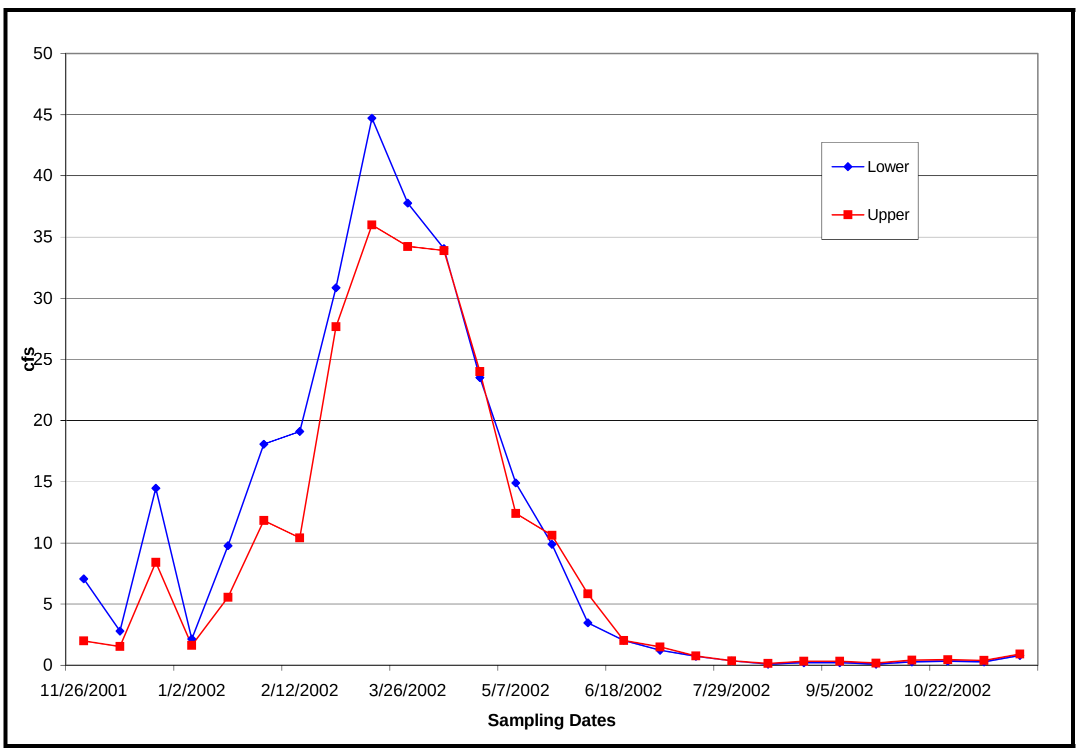


Figure 1-4. Flannigan Creek Flow Rates

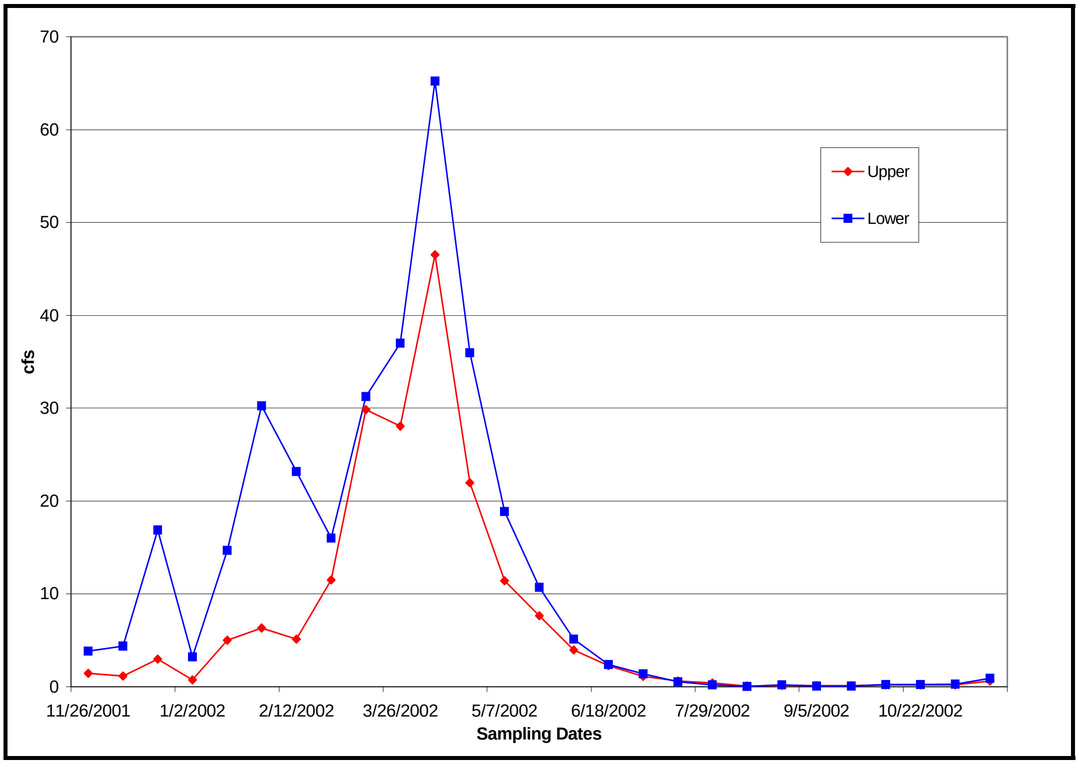


Figure 1-5. Gold Creek Flow Rates

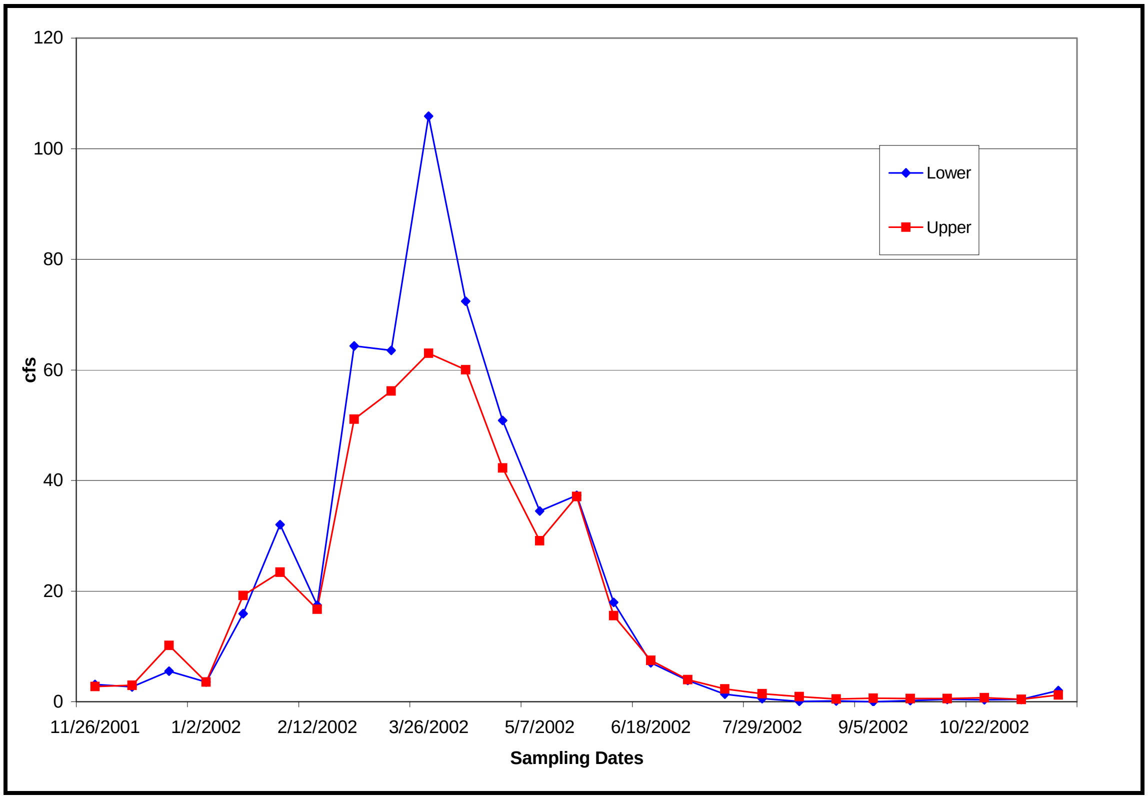


Figure 1-6. Hatter Creek Flow Rates

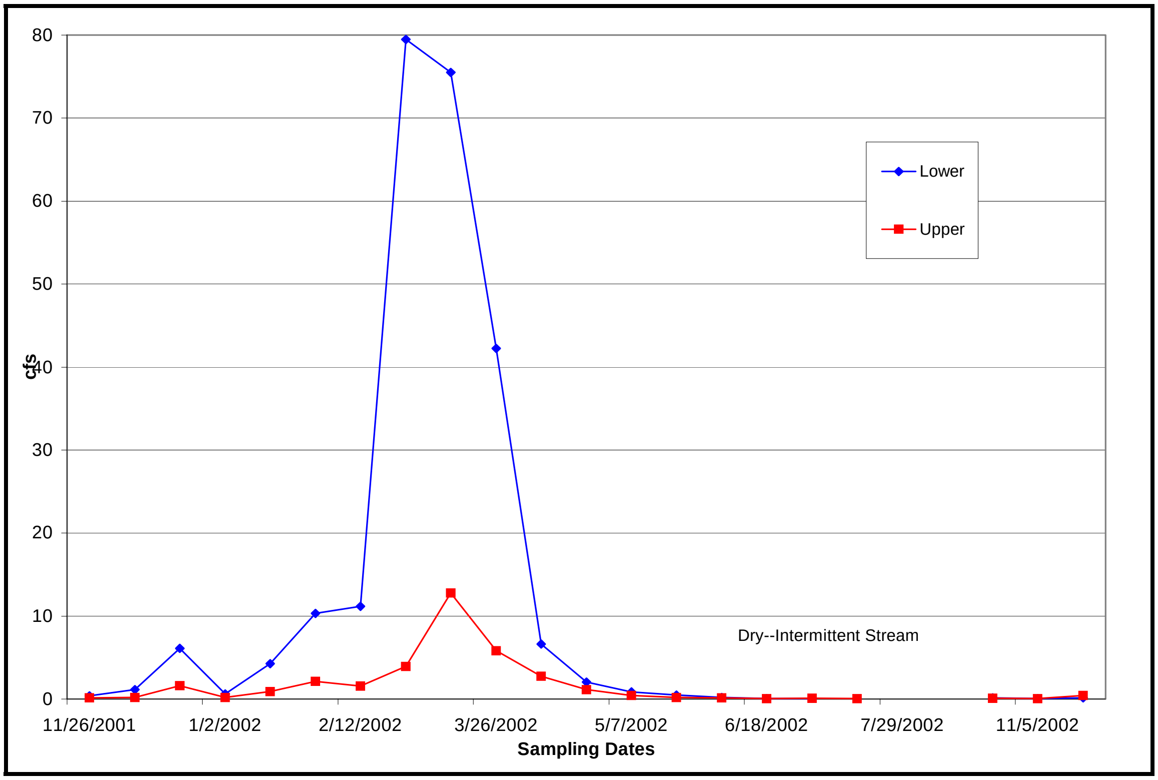


Figure 1-7. WF Rock Creek Flow Rates

Topography, Geology and Soils

In the Palouse River Subbasin, elevations range from 2,453 ft at the state line to 5,334 ft on Bald Mountain in the Hoodoo Mountain range. Most elevations are within 2,500 to 3,500 feet. The north slopes are of moderately to steeply rolling hills, while the south slopes are more moderate. Map 1-3 displays the topographic relief of the Palouse River Subbasin.

The general surface geology is represented on Map 1-4. Several landforms compromise the topography of the Palouse River Subbasin. Most the Palouse River Subbasin is covered by rolling hills (Palouse Loess), which were created by wind deposition. The hills are anywhere from 100- to 300-feet thick and form some of the most agriculturally productive soils in the world. These rich, silty-loam soils are the main reason the Palouse area was settled and the land converted from prairie grasslands into dryland agriculture.

The high elevations in the middle portions of the Palouse River Subbasin are weathered granitic features like Moscow Mountain and Gold Hill. The highest elevations to the north and east, like the Hoodoo Mountain range and Bald Mountain, are metasedimentary rocks of the Belt Series. Basalt outcroppings appear underneath the Palouse Loess in the western potions of the watershed. In the valley bottoms along the Palouse River and the main tributaries, coarse textured alluvium sediment deposition is present.

The soils derived from metasedimentary rocks generally weather to finer textured soils with varying amounts of course fragments. Granitics weather rapidly to grus, which are sandy and excessively well-drained in composition. Basalt rock has a tendency to weather into large cobble-size material. The Palouse Loess erodes fine silt, which is relatively easily transported into waterways. The fine silt from the Palouse Loess under cultivation practices is the largest source of sediment in the streams of the Palouse River Subbasin.

Erosion

According to information collected by the USGS, it appears that sediment runoff into the streams has decreased since the 1960s and 1970s. Suspended sediment levels in the Palouse River in Hooper, Washington, show a decreasing trend as in Figure 1-8 (Ebbert and Roe, 1998). Other information from the USGS displays that the highest concentration of suspended sediments occur during storm events. The same conclusion can be drawn from the data that DEQ collected monitoring November 2001 through November 2002.

Another trend that was observed was the increase in suspended sediment amounts within the stream where different land-use practices exist. Table 1-3 shows the differences in suspended sediment and nephlometric turbidity unit (NTU) levels between agricultural lands and forestlands based on the data collected for this report from November 2001 through November 2002. In general sedimentation levels detected in the 303(d) listed streams adjacent to agricultural lands are higher than those in the 303(d) listed streams adjacent to forest lands.

Two exceptions to the observed sediment situation are Hatter Creek and Rock Creek, which both have a limited amount of tilled agricultural land. The main agricultural crop within these two watersheds is hay. Hatter Creek is also significantly impacted by a road paralleling a majority of the main stem, which has significant erosion from cut and fill slopes, altering the ratio between the forest lands and agricultural lands. The upper site in Rock Creek is close to a culvert crossing, which is a significant sediment source as the downstream side of the culvert is eroding into Rock Creek.

In general, a greater amount of sediment will reach stream channels when the soil surface is disturbed. In the Palouse River Subbasin, the agricultural lands are generally more disturbed than forestlands. This trend may be represented in the data that was collected for this report as sediment was measured in the lower sections of the streams.

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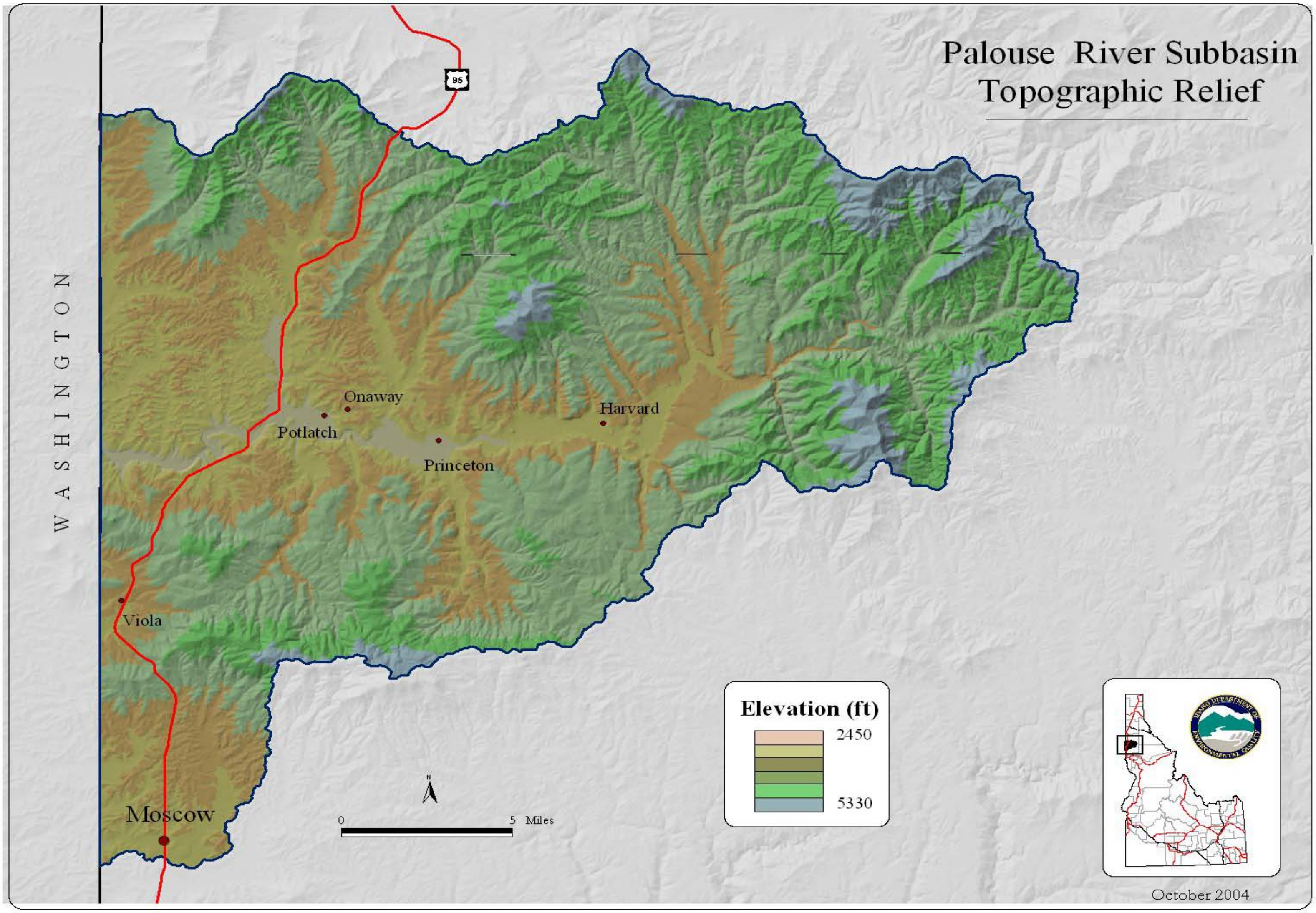
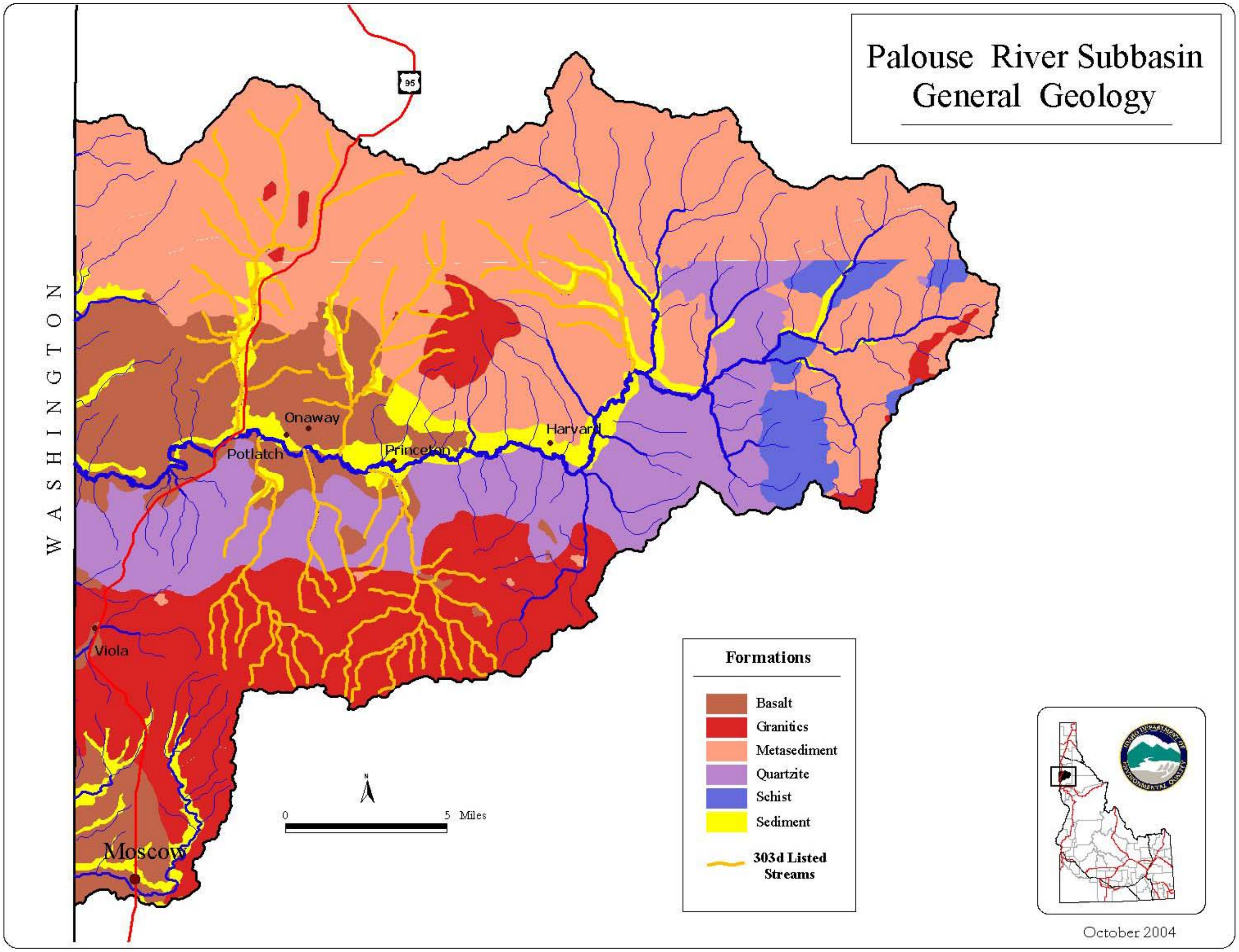


Map 1-3. Topographic Relief of the Palouse River Subbasin.



Map 1-4. General Geology Map.

Background erosion rates

Erosion in some areas of the Palouse River Subbasin is enormous and the Palouse has been called one of the most erosive areas in the United States (Beus, 1990). The United States Department of Agriculture (USDA) estimated that from 1939 through 1977, the average annual rate of soil erosion in the Palouse was 14 tons/acre on cultivated cropland. Although this process is the major contributor of sediment to the streams, this is not the amount that reaches a water body, just the amount displaced from the slopes. In the 1930s and '40s, as much as 100 tons of soil could be washed from an acre in one storm (Sorensen, 2002). Some researchers believe that 40% of the soils have been lost to erosion (Pimentel and others, 1995). It takes 300 to 1,000 years to create one inch of topsoil, but the average loss on the Palouse since the 1920's is one inch per twelve years (Soule and Piper, 1992).

Another way to look at background soil erosion rates on agricultural lands is to run the Revised Universal Soil Loss Equation (RUSLE) model using a vegetation community that resembles natural vegetation. Table 1-2 displays background erosion rates that were calculated by RUSLE. These values represent the amount of sediment delivered to a stream and were used to determine the background ratio and the RUSLE supplemental sediment data in Appendix D.

Table 1-2. Sediment background numbers

Watershed	Size (acres)	Size (mile^2)	Amount (tons/acre/yr)	Amount (tons/mile^2/yr)	Amount (tons/yr)
Big	10300.72	16.09	0.11	72.96	1174.28
Deep	27315.56	42.68	0.09	58.05	2477.52
Flannigan	12246.82	19.14	0.12	79.55	1522.28
Gold	18069.78	28.23	0.11	71.17	2009.36
Hatter	16163.44	25.26	0.10	66.18	1671.30
Rock	5174.76	8.09	0.12	74.50	602.34

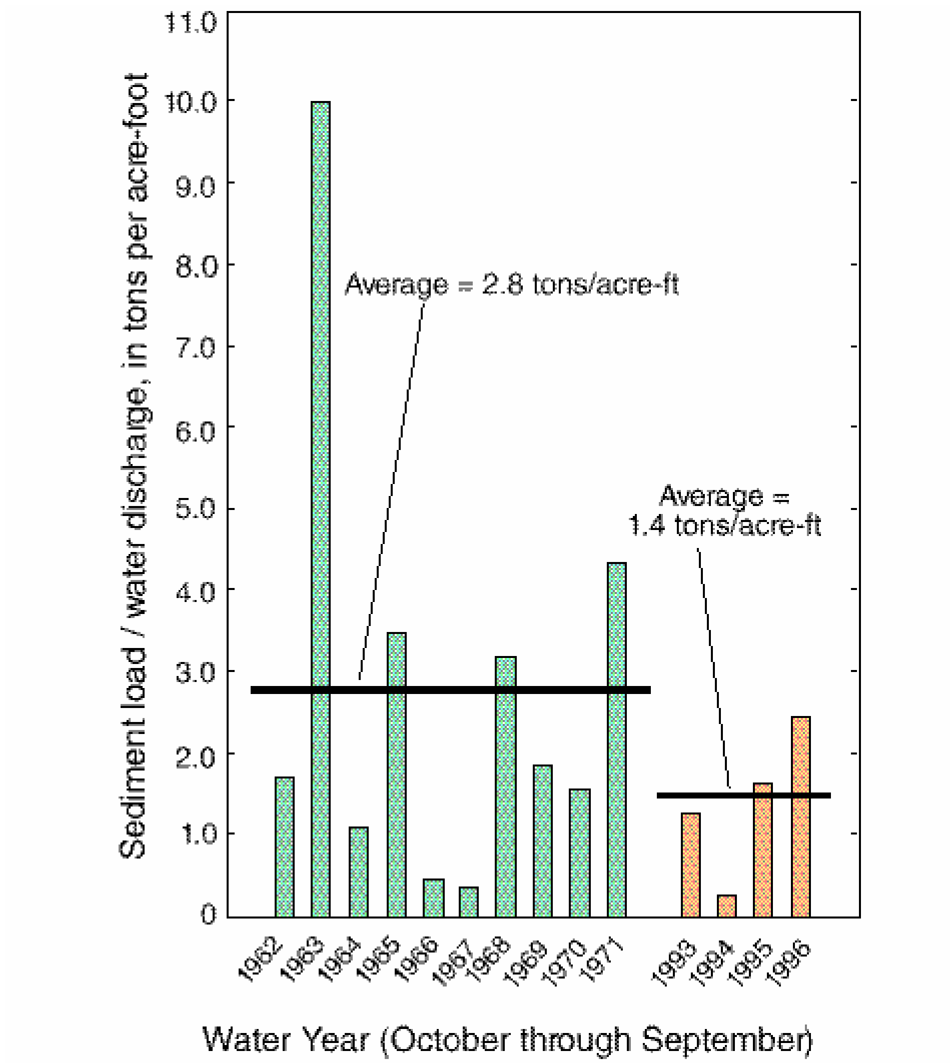


Figure 1-8. Decreasing Annual Concentration of Suspended Sediment In Palouse River Hooper Washington (USGS)

Table 1-3. Suspended Sediment and NTU levels between different land uses-agriculture and forestry.

Monitoring Site Creek	Land Use	SS[1] max (mg/L)	SS[2] ave (mg/L)	NTU[3] max	NTU[4] ave
Upper Big	Forest	43	16	46.8	6.13
Lower Big	Agriculture	423	320	25.8	10.57
Upper Deep	Forest	245	140	1000	49.98
Lower Deep	Agriculture	1431	1100	1000	53.49
Upper Flannigan	Forest	906	620	368	30.43
Lower Flannigan	Agriculture	1191	650	541	39.54
Upper Gold	Forest	233	130	34.6	18.95
Lower Gold	Agriculture	508	260	1000	55.62
Upper Hatter	Forest	904	600	359	28.68
Lower Hatter	Agriculture	714	270	178	23.85
Upper Rock	Forest	874	610	759	44.16
Lower Rock	Agriculture	1174	1000	450	32.8
Forest-averages totaled		3505		n.a.	29.72
Agriculture-averages totaled		n.a.	5141	n.a.	35.98

[1] SS max = Suspended sediment maximum value
[2] SS ave = Suspended sediment average value
[3] NTU max = nephlometric turbidity unit maximum value
[4] NTU ave = nephlometric turbidity unit average value

Vegetation

Historically, prairie grasslands, shrubs, and ponderosa forests dominated the Palouse River Subbasin landscape. The prairie grasslands were composed of Idaho fescue, blue bunch wheatgrass, and in the valley bottoms, camas root. Snowberry, serviceberry, wild rose, willows, red-osier dogwood, alder, ponderosa pine, and Douglas Hawthorn grew in the foothills. In a mosaic of age, structure, and successional classes, forested areas comprised primarily grand fir, western red cedar, western white pine, larch, and Douglas fir.

Currently, six major vegetation categories are recognized in the Palouse Range (IDFG 2001). These include cultivated fields, marshes, grasslands, brush lands, Ponderosa pine forests and mountain forests. Species are influenced by soil type, aspect, moisture, elevation, successional type, and disturbance through fire, agriculture, flooding, disease and insect outbreaks, logging, and urbanization. Dominant forest vegetation includes western white pine, larch, grand fir, Rocky Mountain Douglas Fir, Ponderosa pine, and lodgepole pine. Shrub species include willows and Rocky Mountain maple. Grass species include Idaho fescue, bluebunch, wheatgrass, and prairie junegrass.

Vegetation of the Palouse River Subbasin has been significantly altered since 1900. Mining, logging, farming, grazing, road-building, urbanization, disease, insects, and fire suppression activities have changed the forest composition from being dominated by long-lived, shade-intolerant species to forestlands dominated by short-lived, shade-tolerant species. White pine blister rust and logging activities have largely eliminated western white pine stands. Additionally, cultivated and non-cultivated dryland agriculture and grazing uses have changed the composition of native grass species on the Palouse River Subbasin prairie.

Plant communities were strongly influenced by recurrent fire, which sustained the diversity of habitats and species. This type of mosaic was before European settlement, and now this unique plant community for the most part has disappeared. Remnant native riparian bottomlands composed of native grasses and cedar groves exist in the upper Palouse River Subbasin, but they occupy a very small portion of the landscape.

Fisheries

All native species are limited to non-game fish (IDFG 2001). Historical records indicate that the only salmonid native to the Palouse River Subbasin was an isolated population of Yellowstone cutthroat trout, as Palouse Falls was an effective barrier to redband trout migration (IDFG 2001). In the last half-century, stream surveys conducted by the Clearwater National Forest (CNF), Idaho Department of Fish and Game (IDFG), DEQ and others have never documented cutthroat trout in the Palouse River Subbasin. However, a report from the St. Joe National Forest (1938) documented cutthroat in the Palouse River and several tributaries including Big Creek, Hatter Creek and Big Sand Creek. It appears that the species has been eliminated from the Palouse River System due to the changes on the Palouse River Subbasin over the last century. The IDFG considers the Palouse River Subbasin a low-priority fisheries watershed because of no native salmonid species and no anadromous fish exist in the drainage.

The following native fish may be found in the subbasin.

Common Name	Taxonomic Nomenclature
Torrent sculpin	(*Cottus rhotheus*)
Longnose dace	(*Rhinichthys cataractae*)
Speckled dace	(*Rhinichthys osculus*)
Redside Shiner	(*Richardsonius balteatus*)
Largescale sucker	(*Catostomus macrocheilus*)
Bridgelip sucker	(*Catostomus columbianus*

The following species have been introduced in the subbasin.

Common Name	Taxonomic Nomenclature
Brook trout	(*Salvelinus fontinalis*)
Brown Trout	(*Salmo trutta*)
Rainbow trout	(*Oncorhynchus mykiss*)
Mottled sculpin	(*Cottus bairdi)*

Northern pike minnow	(*Ptychocheilus oregonensis*)
Chiselmouth	(*Acrocheilus alutaceus*)
Black crappie	(*Pomoxus nigromaculatus*)
Largemouth bass	(*Micropterus salmoides*)
Smallmouth bass	(*Micropterus dolomieui*)
Pumpkinseed sunfish	(*Lepomis gibbosus*)
Green sunfish	(*Lepomis cyanellus*)
Brown bullhead catfish	(*Ictalurus nebulosus*)

Brook Trout

Brook trout were first introduced into the Palouse River in 1936 (IDFG 2001). Subsequent stocking occurred in Big Sand Creek, Little Sand Creek, and the East Fork of Meadow Creek. Brook trout have established themselves in many tributaries as well as the mainstem Palouse River where habitat conditions and water temperatures allow their persistence.

Brown Trout

Brown trout were introduced by IDFG from 1979-1986 in the Palouse River primarily near Laird Park (IDFG 2001). Brown trout were introduced based on available habitat and water conditions to provide a sport fishery. The last brown trout sampled through various fish surveys was in 1992, in Hatter Creek. It is believed that stocking failed to establish a viable population.

Rainbow Trout

The first stocking of rainbow trout occurred in 1950 in the Palouse River (IDFG 2001). The size of rainbow trout stocked has been "catchable" size (8-12 inches) to provide trout fisherman a chance to catch the species. Evidence supports natural reproduction is occurring, as rainbow trout have been recently sampled in streams where stocking never occurred or is no longer occurring. Stocking of rainbow has varied over the years depending on egg availability.

1.3 Cultural Characteristics

The Palouse River Subbasin is a sparsely populated area with one major town, Moscow, and several other small towns and communities, including Potlatch, Princeton, and Harvard. Total population in Latah county is 34,935 (2000 census), which gives a density of 32.4 people per square mile. Agriculture, grazing, forestry, urban usages and recreational activities dominate the land use of the basin. The Palouse River Subbasin is a popular destination for outdoor recreation activities such as hunting, hiking, motorized recreation, mountain biking, camping and fishing.

History

Archeologists believe that the first humans moved into Idaho about 15,000 years ago. Originally, they came from Asia across a broad plain when the oceans were several hundred feet lower. American Indians have lived in the Palouse area for thousands of years. In the 1700s, they acquired horses, which grazed in the grassy areas of the Palouse. The Palouse was a transitional area between the Nez Perce and Coeur d'Alene tribes. The Palouse has always been important for the traditional uses of the American Indians.

The first known European people to enter the area were in the Lewis and Clark expedition in 1805. The expedition camped in the Weippe prairie and in Lewiston. Trappers arrived in the Palouse area in the early 1800s. Gold was first discovered in 1860 in Idaho, which created opportunities for other miners and settlers in the area. A few years later, gold was discovered in the Hoodoo Mountains.

Latah County was established in its current place and size in May 14, 1888, with its county seat at Moscow (Website Idaho State Homepage). The name Latah is Nez Perce and means "the place of pine trees and pestle," because the Indians found stones here suitable for pulverizing camas roots and shade under the pine trees in which to work (Website Idaho State Homepage). Idaho officially became a state in 1890, and soon homesteaders began to occupy lands in the Palouse.

Ranching/grazing, farming, logging, and mining were the main economic resources in the area. Mining, logging, farming, grazing, and urbanization have had the greatest influence on the landscape in the Palouse in past 150 years. The establishment of the University of Idaho and Washington State University in the late 1880s as land grant colleges increased the population in the Palouse.

Land Use

Today, farming, logging, grazing, and outdoor recreation are the primary land uses in this basin. There are many recreational uses as it is a popular destination spot for all kinds of outdoor activities. There are several grazing leases on public lands in the Palouse River Subbasin. The main land use in the Palouse River Subbasin is agriculture, specifically the cultivation of wheat, peas, barley, and hay. The various land uses are illustrated on Map 1-5.

Few patches of the Palouse today are covered by native vegetation. While agriculture is the most economically important feature of today's Palouse, it has had a detrimental effect on the landscape. Disturbance by farming has led to the loss of vast amounts of native plant habitat, and the remaining habitat is badly fragmented into small isolated spots separated by acres of cultivated fields (Cook and Hufford 2004). Most of the wetlands in the Palouse have been eliminated. These wetlands retained water during the wet periods and released cool ground water into the streams during the dry summer periods. Without these wetlands, rainfall and snowmelt do not infiltrate into the ground; instead they flow rapidly as overland runoff into surface waterways creating other problems such as gully, rill and instream erosion, flooding, deeply incised channels, higher peak runoffs and low summer flows.

The change in hydrology has changed the aquatic biota as well. Because of low summer flows, reduced shade and loss of channel diversity, aquatic organisms such as fish and insects have been removed or permanently altered. The only native salmonid, the cutthroat trout, has been eliminated from the Palouse drainage. Because of the extensive farming in the Palouse region, there are very few places where undisturbed native plant communities exist today. Much of the native fauna have been removed or have relocated to isolated sections of the subbasin, and some species are on the verge of extinction.

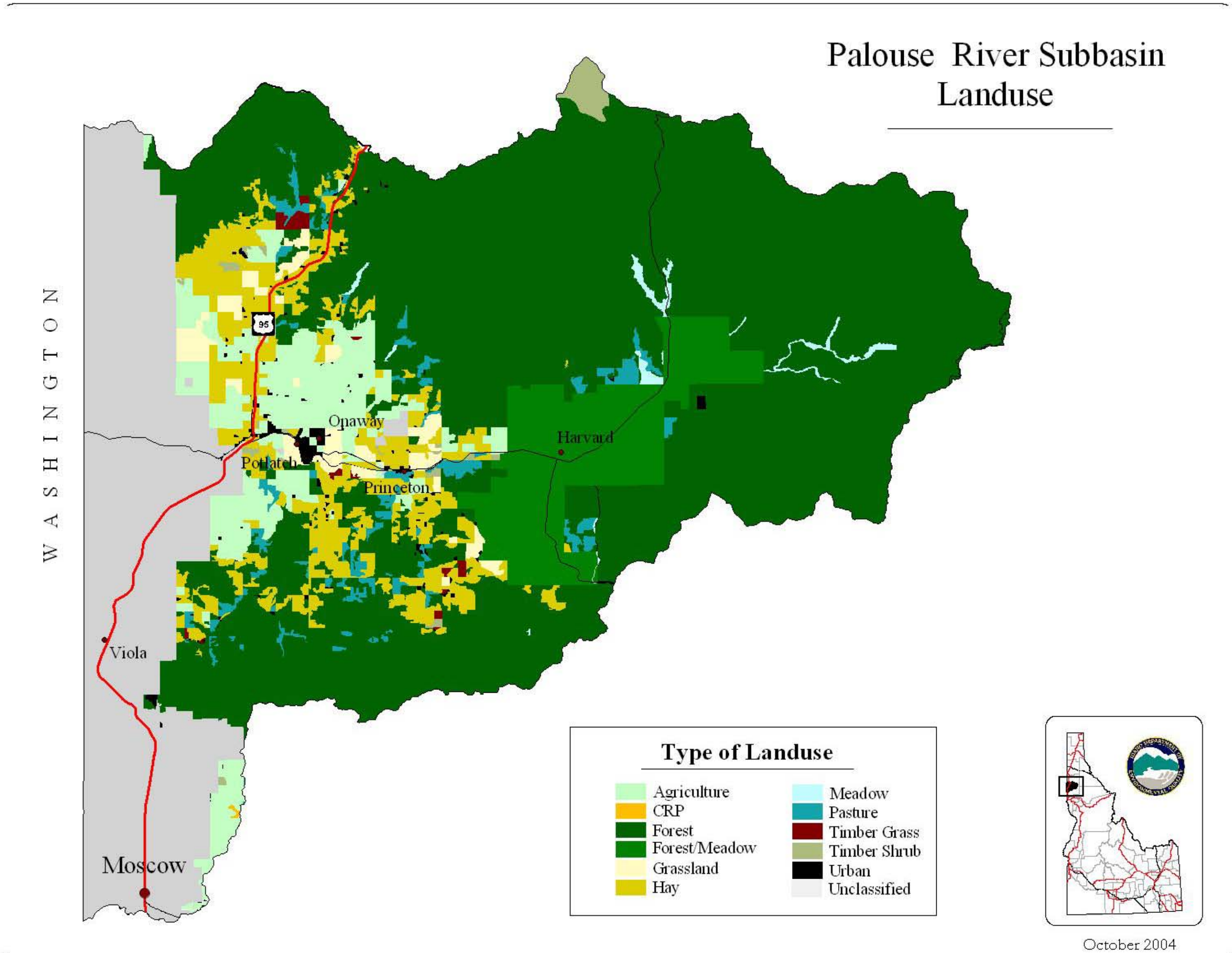
Agriculture

The Palouse prairie is one of most productive agricultural areas in the world due to the fertile soils and winter and spring rainfall. In the 1860s, the first European settlers used the Palouse hills as pastures but soon discovered the soil's fertility and planted grain on the dry meadows and lower-side slopes. The opening of the railroad in the Palouse just after the turn of the twentieth century had a major impact on the Palouse as agricultural goods, equipment, and supplies were easily transported into the area. Wheat and other cereals were planted and adapted well to the hillsides and climate of the Palouse (Black et al. 1998). These crops were shipped to other markets. Horse and mule teams worked the land in the early 1900s. Machinery soon began to change farming, and by 1930, 90% of the Palouse wheat was harvested using combines (Black et al. 1998). Fertilizers were introduced after World War II and increased crop production 200%-400% (Black et al. 1998). During this time frame federal agricultural programs encouraged farmers to drain seasonal wet areas. In less than 100 years small family farms have mostly disappeared as technology has allowed farmers to cultivate more acres of land more efficiently.

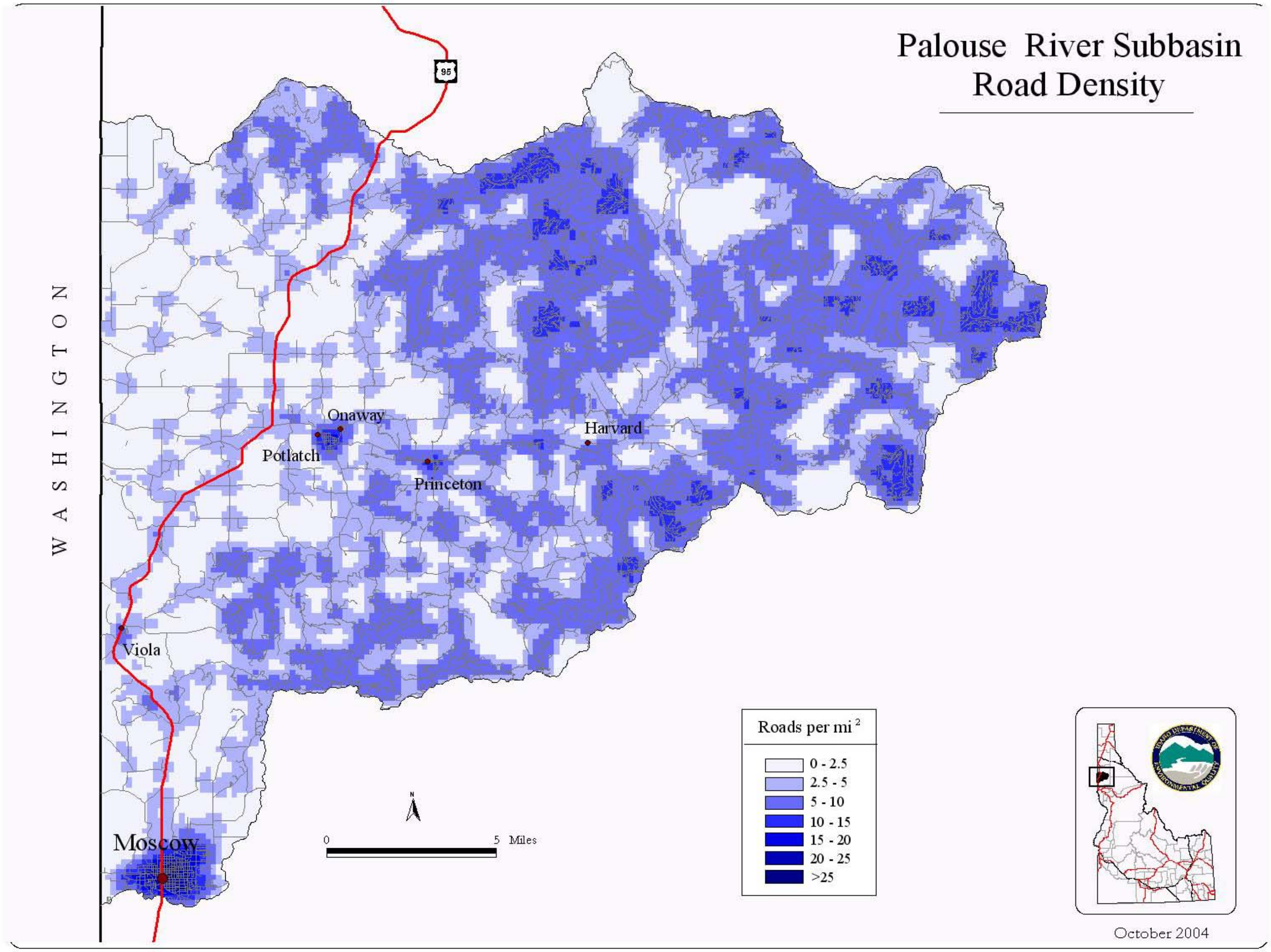
In the last few decades some highly erodible lands have been removed from crop production under the Federal Conservation Reserve Program (CRP) In Latah county about 54 square miles (34, 600 acres) have been placed in CRP land (Black et al. 1998.). Additionally six square miles (3852 acres) have been included into the Idaho Fish and Game Department's Habitat Improvement Program. This program converts cropland to ponds and native plantings (Black et al. 1998). Wheat, barley, peas, and lentils from this area are exported all over the globe.

Forestry

Originally, logging began in the 1880s to clear land and provide wood for homes. However, it was soon recognized that logging could also provide a good source of income. The major logging boom began in 1905 with the creation the Potlatch mill and the town of Potlatch. The mill remained in existence until 1980, with the most productive decades being the 1960s and 1970s (Table 1-4). Due to this reduction in logging, the town of Potlatch is much smaller today and more a farming community than a mill town. Although greatly reduced, logging is still important to the economies of the Palouse. Bennett Lumber Products Inc. and Potlatch Corporation Inc. still manage several thousand acres in the Palouse primarily for silverculture activities. The CNF and the Idaho Department of Lands (IDL) also manage thousands of acres in the Palouse for silverculture and recreational activities.



Map 1-5. Land use in the Palouse River Subbasin.



Map 1-6. Road Density in the Palouse River Subbasin.

Table 1-4. Timber harvest by decade in millions of board feet from CNF land.

Decade	Millions of Board Feet Harvested
1930s	40
1940s	51
1950s	173
1960s	726
1970s	694
1980s	318
1990s	228

Recreation

Recreational activities include fishing, hunting, camping, snowmobiling, cross country skiing, four-wheeling, canoeing, swimming, mountain biking, berry picking, mushroom hunting, wildlife and scenery viewing, trapping, motorcycling, hiking, photography, and sight-seeing historical areas of interest. Camping, fishing, and off-road vehicle usage are probably the most popular recreational activities in the area. These activities provide economic support to Moscow, Potlatch, and the surrounding communities of Troy, Deary, and St. Maries. The CNF maintains several campgrounds and many other unofficial campgrounds. Other unofficial campsites are located on IDL, Bennett Lumber, and Potlatch Corporation lands.

Livestock and Grazing

Small fenced pastures are prevalent in all of the §303(d) watersheds, although Flannigan Creek, Hatter Creek, and Deep Creek have the most pasture activity. Some of these fields receive heavy use, especially when the livestock are allowed to graze an area until there is no vegetation left. In addition several animal feeding operations (AFOs) exist. These AFOs are used primarily for winter feeing and calving of livestock that graze in other areas during the rest of the season.

Within some of these pastures are perennial or intermittent streams. In these locations, negative impacts to water quality can directly occur when livestock come to the water or the riparian areas to drink or stay cool. Impacts include destruction or removal of riparian vegetation, increased sedimentation levels to the streams, and fecal material deposition in or near waterways. Pastures not located within stream riparian areas can impact water quality as well; rain and snowmelt run-off can transport material from a pasture to a stream channel through empheral drainages.

IDL, Potlatch Corporation, and the Clearwater National Forest have a cooperative agreement regarding grazing allotments on their lands. Information from IDL shows that open-range grazing of cattle does occur in portions of the Palouse River Subbasin. Like fenced pastures, impacts from open grazing include destruction or removal of riparian vegetation, increased sedimentation levels to the streams, and fecal material deposition in or near waterways.

An Animal Unit Month (AUM) is the unit of measurement for cattle in these allotments. An AUM equals the amount of forage necessary to feed one cow and her calf for one month. The following allotments are located within the Palouse River Subbasin:

1) Sec 16, T42N, R3W, 29 AUM (Big Creek Watershed)
2) Sec 24, T41N, R5W, 110 AUM (Flannigan Creek Watershed)

Because fencing is limited on open-range grazing lands, cattle can move from one area to another, roaming from watershed to watershed. The above leases are required to have full-time livestock herders, and salt and minerals placement within 600 feet from major streams is prohibited. The ideal is that herders and salt and mineral placement encourages cattle to spend less time in the riparian areas.

Mining

Historically, mining played a major role in shaping the economy and changing the landscape in the subbasin. Many features on the landscape were named after mining, such as Gold Creek, Gold Hill, and Mica Mountain. Mining began back in the 1860s and continued through 1912 (CNF 1988). During the great depression, miners tried their luck again in the Palouse Drainage. Gold Creek, Crane Creek and other non-§303(d)-listed streams and their tributaries were placer-mined by hand, dredges, and other large machinery. In 1940, a large mining company began a massive river dredging operation on the North Fork Palouse and Palouse Rivers. The operation only lasted a few years, but the effects from that operation can still be seen today, especially on the lower miles of the North Fork Palouse River.

Today, there is a very limited amount of mining activity in the Palouse River Subbasin. Historically, in Latah County at least, nine mining districts were created, although none are active today. Current recreational dredge mining may occur in limited areas in the subbasin, but the impacts to water quality appear to be minimal. Currently, there are no permitted mining activities in the subbasin. There are several quarries within the Palouse River Subbasin that are actively mined for gravel, however.

Transportation

All of the §303(d) streams are affected to some degree by roads. Map 1-6 is a map of the road density in the Palouse River Subbasin.

In the late 1800s and early 1900s, railroads were the primary transportation system in the area, bringing people and supplies into Idaho. Supplies were brought in and out of the Palouse to support the agriculture, timber, and mining industries. Today, highways, barges, and airfreight have replaced the railways for transporting supplies in the Palouse. Old grades and tresses remain in some areas in the Palouse River Subbasin. Some of these abandoned railroad lines have massive fill slopes, which have the potential for large mass failures and should be removed if possible.

Land Ownership, Cultural Features and Population

The Palouse River Subbasin is under three primary landowner types: federal lands, state lands, and private lands. Major land owners include the state of Idaho, CNF, Potlatch Corporation, and Bennett Lumber Products. Table 1-5 displays approximate land ownership percentages and Map 1-7 shows the locations in the drainage. Most of the basin is either dryland agriculture or managed for timber production.

Population in Latah County is 34,935 (2000 census); however, most of the county's population live within the town of Moscow, which has a population of 21,291 people (2000 census). Population in the subbasin continues to grow, and many of the agricultural lands are being parceled into lots for homes. Agriculture continues to be the main source of income while the timber industry has decreased over the past few decades. The University of Idaho, Bennett Lumber Products, Wal-mart, Gritman Medical Center, and the public school districts are the major employers in Latah County. Population trends for Latah County and the cities of Moscow and Potlatch are displayed in Table 1-6.

Table 1-5. Land ownership of the Palouse River Subbasin.

Ownership	Percentage
Private land ownership- non industry	52.1%
National Forest Lands (USFS)	20.0%
Potlatch Corporation	14.8%
Bennett Lumber Products Inc.	6.8%
State of Idaho (IDL)	2.7%
University of Idaho	2.4%
Forest Capital Partners	1.2%
City of Troy	< 0.1%
Nature Conservancy	< 0.1%
Water	< 0.1%

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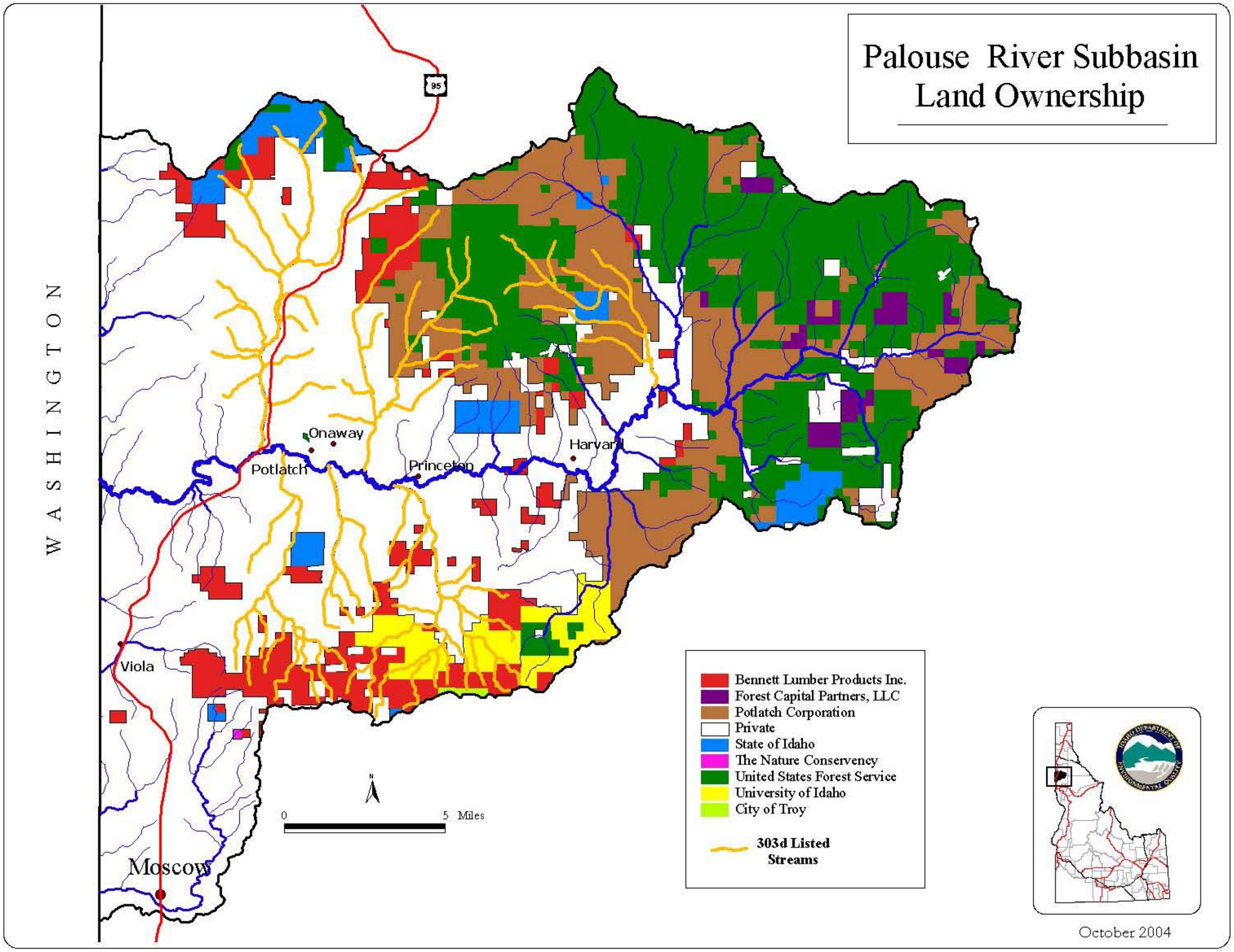
Table 1-6. Population trends.

City/County	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
Moscow	ND	ND	2484	3670	3956	4476	6014	10,593	11,183	14,146	16,513	18,398	21,291
Potlatch	ND	ND	ND	2055	ND	ND	ND	819	880	871	819	790	791
Lewiston	739	849	2425	6043	6574	9403	10,548	12,985	12,691	26,068	27,986	28,082	30,904
Latah County	ND	9173	13,451	18,818	18,092	17,798	18,804	20,971	21,170	24,898	28,749	30,617	34,935



Map 1-7. Land Ownership

Economy

Today, the economy of the Palouse is dominated by agriculture and two universities: the University of Idaho and Washington State University. Historically, the economy of the basin was first dominated by mining activities. As miners and other settlers arrived in the area, they took advantage of the grasslands for grazing livestock. The soil proved to be very fertile as wheat, barley, peas and other dryland crops flourished. Several mills were also built, and the town of Potlatch was established by Potlatch Corporation in 1905. Some logs were transported down the Palouse River to mills, while others were hauled by horse to the mills. In the 1880s, the railroads had reached the Palouse, allowing for wheat, barley, oats, straw, peas, timber, and fruit to be transported to other markets.

In addition the agriculture and the universities, forestry, livestock, grazing, construction, and recreation are other major economic factors in the Palouse River Subbasin. All of these affect water quality to some degree. Although the amount of timber removal on U.S. Forest Service (USFS) lands has decreased significantly, state and private lands have been able to maintain a modest harvest to keep some of the local mills in business. Some mills have been able to cut back or make adjustments while others were no longer able to make a profit and have closed as a result. The surrounding landscape provides good fishing, hunting ,and other outdoor recreation opportunities that help the local economy to a lesser degree than agriculture, forestry, and construction. Agriculture is and will continue to be the dominant economic driving force in the Palouse. Preventing the rich, fertile soil of the Palouse from eroding is the major theme for this document. This theme, not only improves and maintains high water quality, but it also is the economic life force of the Palouse.

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2. Subbasin Assessment – Water Quality Concerns and Status

This section describes the water quality concerns and status of the 303(d)-listed water bodies in the Palouse River Subbasin. Included in the discussion are the following:

- A description of the 303(d)-listed water bodies and the justification for their 303(d) listing.
- An overview of the water quality data used in the subbasin assessment to analyze and compare the different listed water bodies. The data presented illustrate which 303(d)-listed water bodies are truly impaired and require a TMDL to improve water quality, and which water bodies are not in need of a TMDL because beneficial uses are being met.
- Various characteristics of the 303(d) water bodies, such as are displayed in Tables 2-1 through 2-9, Figures 2-1 through 2-49, and Maps 2-1 through 2-6.
- Recommendations for each 303(d)-listed water body.

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

Within the Palouse River Subbasin (HUC #17060108) there are eight water bodies on the 1998 303(d) list. Two of these water bodies, Cow Creek and the South Fork Palouse River, will be addressed in separate subbasin assessments and TMDLs. The remaining six water bodies are addressed in this document.

Table 2-1 lists all the 303(d) water bodies and their boundaries, listing basis, pollutants, segment IDs, and designated uses. All of these streams are listed because they were listed as impaired in *The 1992 Idaho Water Quality Status Report*, Appendix D (DEQ 1992) as being impaired. When these water bodies were placed on the original 303(d) list in 1994, there was a very limited amount of data if any at all to support their listing. All of these water bodies were placed on the 303(d) list because of “evaluated” information; meaning best professional judgment was used at the time. Since then, sufficient data has been collected to properly assess these water bodies.

In this report the West Fork of Rock Creek (WFRC) and Rock Creek are considered to be the same watershed. On the 303(d) list, the WFRC is listed with the boundaries being the headwaters to the Palouse River. This is not correct; technically, the WFRC joins with the East Fork of Rock Creek (EFRC) to form Rock Creek, which flows into the Palouse River. We looked at the entire Rock Creek watershed, from headwaters to the Palouse River, and in this document it is referred to as Rock Creek, which is technically more correct.

Table 2-1. §303(d) segments in the Palouse River Subbasin.

Water body Name	Assessment Units	1998 §303(d)[1] Boundaries	Pollutants[2]	Listing Basis[3]
Big Creek	ID1706108CL027a_02 ID1706108CL027b_02	HW[4] to Palouse R.	Sed, Nut, Temp, Bac	A
Deep Creek	ID1706108CL032a_02 ID1706108CL032a_03 ID1706108CL032b_02 ID1706108CL032b_03	HW to Palouse R.	Sed, Nut, Temp, Bac	A, B
Flannigan Creek	ID1706108CL011a_02 ID1706108CL011a_03 ID1706108CL011b_02 ID1706108CL011b_03	HW to Palouse R.	Sed, Nut, Temp, Bac	A
Gold Creek	ID1706108CL029_02 ID1706108CL029_03 ID1706108CL030_02 ID1706108CL031a_02 ID1706108CL031b_02	Waterhole Cr. to Palouse R.	Sed, Nut, Temp, Bac	A
Hatter Creek	ID1706108CL015a_02 ID1706108CL015b_02 ID1706108CL015b_03	HW to Palouse R.	Sed, Nut, Temp, Bac	A
Rock Creek	ID1706108CL012_03 ID1706108CL013a_02 ID1706108CL013b_03 ID1706108CL014a_02 ID1706108CL014b_02	HW to Palouse R. (West Fork Rock Creek)	Sed, Nut, Temp, Bac	A

[1] Refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.
[2] Sed = Sediment, Nut = Nutrients, Temp = Temperature, Bac = Bacteria
[3] Listing Basis A= Streams were on the 1992 305(b) report, B = Information submitted by the Columbia River Intertribal Fish Commission
[4] HW = Headwaters

2.2 Applicable Water Quality Standards

This section covers the applicable water quality standards and water quality criteria for the 303(d)-listed segments in the Palouse River Subbasin. The determination of the existing and designated beneficial uses is discussed in this section, and the results are displayed in Table 2-2. A description of the different kinds of beneficial uses, and what those specific beneficial uses are, is also included in this section.

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 (DEQ 2002) gives a more detailed description of beneficial use identification for use assessment purposes.

Existing Uses

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

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 aquatic life support, recreation in and on the water, domestic water supply, and agricultural use. Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160 in addition to citations for existing uses).

Presumed Uses

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

Table 2-2. Palouse River Subbasin designated and existing beneficial uses.

Water body	Designated Uses[1]	Existing Uses	1998 §303(d) List Boundaries[2]
Big Cr.	Upper - CW, SS, SCR Lower - CW, SCR	Upper - CW, SS, SCR Lower - CW, SCR	HW[4] to Palouse R.
Deep Cr.	CW, SCR	CW, SCR	HW to Palouse R.
Flannigan Cr.	CW, SCR	Upper - CW, SS, SCR Lower - CW, SCR	HW to Palouse R.
Gold Cr.	Upper - CW, SS, SCR Lower - CW, SCR	Upper - CW, SS, SCR Lower - CW, SCR	Waterhole Cr. to Palouse R.
Hatter Cr.	CW, SCR	CW, SS,SCR	HW to Palouse R.
Rock Cr.	CW, SCR	CW, SCR	HW to Palouse R.

[1]CW - Cold Water, SS - Salmonid Spawning, SC - Seasonal Cold Water, PCR - Primary Contact Recreation, SCR - Secondary Contact Recreation, DWS - Domestic Water Supply
[2]Refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.

Water Quality Standards

By law, Idaho must protect designated beneficial uses of surface waters: aquatic life, recreation, water supply, wildlife habitats, and aesthetics (IDAPA 58.01.02.100).

Aquatic Life

Protections for aquatic life beneficial uses include the following:

- *Cold water* (COLD): waters quality appropriate for the protection and maintenance of a viable aquatic life community for cold water species.

- *Salmonid spawning* (SS): waters that provide or could provide a habitat for active self-propagating populations of salmonid fishes.

- *Seasonal cold water* (SC): water quality appropriate for the protection and maintenance of a viable aquatic life community of cool and cold water species, where cold water aquatic life may be absent during, or tolerant of, seasonally warm temperatures.

- *Warm water* (WARM): water quality appropriate for the protection and maintenance of a viable aquatic life community for warm water species.

Recreation

Primary contact recreation (PCR): water quality appropriate for prolonged and intimate contact by humans or for recreational activities when the ingestion of small quantities of water is likely to occur. Such activities include, but are not restricted to, swimming, water skiing, and skin diving.

Secondary contact recreation (SCR): water quality appropriate for recreational uses on or about the water and which are 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.

Water Supply

Domestic: water quality appropriate for drinking water supplies.

Agricultural: water quality appropriate for the irrigation of crops or drinking water for livestock. This use applies to all surface waters of the state.

Industrial: water quality appropriate for industrial water supplies. This use applies to all surface waters of the state.

Wildlife habitats

Wildlife: water quality appropriate for wildlife habitats. This use applies to all surface waters of the state.

Aesthetics

This use applies to all surface waters of the state.

DEQ asserts in IDAPA 58.01.02.101.01 that cold water aquatic life and primary or secondary contact recreation will be applied to all waters that do not have designations.

Criteria For Protecting Existing Uses

The following general water quality criteria apply to all surface waters of the state in addition to the water quality criteria set forth for specifically designated waters.

- *Hazardous Materials*: Surface waters of the state shall be free from hazardous materials concentrations found to be of public health significance or to impair designated beneficial uses. These materials do not include suspended sediment produced because of nonpoint source activities.

- *Toxic Substance*: Surface waters of the state shall be free from toxic substances in concentrations that impair designated beneficial uses. These substances do not include suspended sediment produced as a result of nonpoint source activities.

- *Deleterious Materials:* Surface waters of the state shall be free from deleterious materials in concentrations found to be of public health significance or to impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities.

- *Radioactive Materials:* Radioactive materials or radioactivity shall not exceed the values listed in the Code of Federal Regulations, Title 10, Chapter 1, Part 20, Appendix B, Table 2, *Effluent Concentrations*, Column 2. Radioactive materials or radioactivity shall not exceed concentrations required to meet standards set forth in Title 10, Chapter 1, Part 20 of the Code of Federal Regulations for maximum exposure of critical human organs in the case of foodstuffs harvested from these waters for human consumption.

- *Floating, Suspended or Submerged Matter:* Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities.

- *Excess Nutrients:* Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or nuisance aquatic growths impairing designated beneficial uses.

- *Oxygen-Demanding Materials:* Surface waters of the state shall be free from oxygen-demanding materials in concentrations that would result in an anaerobic water condition.

- *Sediment*: Sediment shall not exceed quantities specified in IDAPA 58.01.02 Section 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 350.02.

- *Natural Background Conditions*: When natural background conditions exceed any applicable water quality criteria set fourth in IDAPA 58.01.02 Sections 210, 250, 251, 525, or 253, the applicable water quality criteria shall not apply; instead, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under IDAPA 58.01.02 Section 401.

In addition to the general water quality criteria, there are specific criteria that apply to waters of the state. Selected criteria from IDAPA 58.01.02. that are applicable to the Palouse River Subbasin are listed in Table 2-3.

Table 2-3. Surface water quality criteria.[1]

Use	Water Quality Criteria
Primary Contact Recreation	For areas within waters designated PCR that are additionally specified as public swimming beaches, a single sample of 235 *E. coli* organisms per 100ml. A single sample of 406 *E. coli* organisms per 100ml or a geometric mean of 126 *E. coli* organisms based on a minimum of five samples taken every three to five days over a 30 day period is a violation.
Secondary Contact Recreation	A single sample of 576 *E. coli* organisms per 100ml or a geometric mean of 126 *E. coli* organisms based on a minimum of five samples taken every three to five days over a 30 day period is a violation.
Cold Water Aquatic Life	Surface waters are not to vary from the following characteristics due to human activities: pH between 6.5 and 9.0. DO[4] must be greater than 6.0 (milligrams per liter) mg/L at all times in the water column. In lakes and reservoirs this does not apply to the bottom 20% where depths are less than 35 meters. Turbidity below any mixing zone set by the DEQ shall not exceed background turbidity by more than 50 NTU[5] instantaneously or more than 25 for NTU more than 10 consecutive days. Water temperature must be equal to or less than 22^{o}C with a maximum daily average of no greater than 19^{o}C.
Salmonid Spawning	Surface waters are not to vary from the following characteristics due to human activities: pH between 6.5 and 9.0. DO must be greater than 6.0mg/L or 90% of the saturation, whichever is greater. Water temperature must be equal to or less than 13^{o}C with a maximum daily average of no greater than 9^{o}C. Bull trout- water temperatures shall not exceed 13^{o}C maximum weekly maximum temperature during June, July and August for juvenile bull trout rearing, 9^{o}C daily average during September and October for bull trout spawning.
Temperature	
Measuring Purposes—the daily average shall be generated from a recording device with a minimum of six (6) evenly spaced measurements in a 24-hour period. Exemption -Exceeding the water quality temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the ninetieth (90th) percentile of the seven (7) day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station. * *These above two standards do not apply to the federally promulgated bull trout streams or temperature criteria.* EPA Bull Trout Temperature Criteria: Water Quality standards for Idaho (40 CFR Part 131.33(a)): “A temperature criterion of 10^{o}C expressed as average of daily maximum temperatures over a seven-day period which applies…during the months of June, July, August and September.”	

[1] IDAPA58.01.02
[2] PCR = Primary Contact Recreation
[3] SCR = Secondary Contact Recreation
[4] DO-Dissolved Oxygen
[5] NTU- nephlometric turbidity unit

2.3 Summary and Analysis of Existing Water Quality Data

In this section, the various data sets that were collected and analyzed are discussed. Below is a list of the various water quality data used in this document. Collectively, this data was used to determine whether or not the streams in question are water quality impaired. A majority of the analysis comes from the data collected by DEQ-LRO, Idaho Association of Soil Conservation Districts (IASCD), and the Latah Soil and Water Conservation District (LSWCD) during November 2001 and November 2002. A monitoring plan was jointly developed by DEQ-LRO, IASCD, LSWCD, and the Department of Agriculture and is located in Appendix A.

Water quality data sources used during this assessment included the following:

- DEQ-LRO, IASCD, LSWCD Monitoring Data—Year 2001-2002
- GIS Analysis
- Beneficial Use Reconnaissance Program (BURP) data, WBAG II process
- Cumulative Watershed Effects (CWE) process data
- Revised Universal Soil Loss Equation (RUSLE)
- Watershed Erosion Prediction Project (WEPP)-road analysis
- In-Stream Erosion
- Clearwater National Forest (CNF) Stream Bio-Physical Studies reports
- Stream temperature data
- Fish data
- Flow data

Each of these data sources are described in the following.

<u>DEQ- IASCD Monitoring Data—Year 2001-2002</u>

In 2001, DEQ collaborated with IASCD, the Latah Soil and Water Conservation District, the Idaho Soil Conservation Commission, the Idaho State Department of Agriculture, and local landowners in developing a monitoring plan designed to complete the following goals:

- Evaluate the water quality and discharge rates at selected locations on each 303 (d) listed tributary

- Attempt to determine which areas contribute to water quality exceedances or degradation

- Prioritize loading areas that may require BMP implementation or other possible management strategies

- Determine the relationship between turbidity and total suspended solids

- Make data available to the public

The plan was implemented and executed from November 2001 through November 2002. The following analyses were performed on collected water samples: total phosphorus (TP), nitrate and nitrite (NO^2/NO^3), ammonia (NH^4), total suspended solids (TSS), and fecal and total coliform counts. Other parameters collected in the field included flow, pH, specific conductivity, dissolved oxygen (DO), and air and water temperatures. A map located on the last page of the monitoring plan (Appendix A) displays the locations of the monitoring stations.

Sample collection began in November of 2001 and continued for a full calendar year, with IASCD, LSWCD, and DEQ staff sampling the sites every two weeks. At times during the year, some sites were not sampled: in the winter and spring, snow and large runoff events made accessibility and sampling impossible, and in the summer some sites were dry.

This monitoring plan was the backbone of this TMDL and subbasin assessment. The data collected was the primary determining factor as to whether or not the 303(d) streams need a TMDL. For more detailed information, please refer to the actual monitoring plan, located in Appendix A.

GIS Analysis

Using GIS software, watersheds were delineated for 303(d)-listed streams, so that the Revised Universal Soil Loss Equation (RUSLE), Watershed Erosion Prediction Project (WEPP), and Potential Natural Vegetation (PNV) models could be used to quantify pollutant loads. In addition, all of the maps used in this document were made using the GIS.

GIS is a powerful tool for illustrating, comparing, calculating, and analyzing data in a way not previously possible. For example, GIS-provided information, like total stream miles, acres of forested land, agricultural land, and road miles, were used in this report.

Although GIS attempt to represent actual conditions on the ground, it is important to note that the data used for GIS analysis may not be completely accurate. There is no one central GIS database; it was necessary to gather, compile, change, modify, and create data from various sources. In addition, landscape conditions change somewhat rapidly: roads are obliterated or built, timber is removed while trees are growing, ownership changes, streams shift, etc. To update the database for the Palouse River Subbasin continually at this scale would be impossible given the resources available. With that said, the best data currently available has been compiled and is presented in this report. The following is the disclaimer from DEQ regarding data usage in GIS Analysis. “Restriction of liability: Neither the State of Idaho nor the Idaho Department of Environmental Quality, nor any of their employees make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any information or data provided. Metadata is provided for all data sets, and no data should be used without first reading and understanding its limitations. The data could include technical inaccuracies or typographical errors. The Department of Environmental Quality may update, modify, or revise the data used at any time, without notice.”

BURP Data and WBAG II

Developed from rapid bioassessment concepts developed by EPA, BURP is a DEQ water-monitoring program that has been in existence for nearly a decade. Each year, between July and September, BURP crews collect biological, chemical, and physical data. This data is used to determine whether a water body is supporting its designated beneficial uses. BURP is a good tool to evaluate biological changes in the environment:

- The BURP process collects data on macroinvertebrates, fish, other aquatic life, and stream physical habitat
- BURP data is easily reproducible and an extensive database has been established with this data
- BURP information collected will be valuable in future years to evaluate the condition of the water bodies in the state, including the Palouse River Subbasin

BURP surveys were completed on the 303(d) streams in the Palouse River Subbasin during the summer monitoring seasons of 1996 and 2002.

WBAG II is a guidance document used by DEQ to determine whether a water body fully supports designated and existing beneficial uses, relying on physical, chemical, and biological parameters typically collected during the BURP process (Grafe et al. 2002). Its primary purpose is for 303(d) listing and 305(b) reporting. Once a water body is on the 303(d) list, a subbasin assessment must be completed to determine if a TMDL is necessary. Typically a subbasin assessment compiles more information about the water body(s) in question; WBAG II assessment calls are then used as part of the information to determine beneficial use status. Therefore, the subbasin assessment is the document that determines if a TMDL is necessary not the WBAG II.

WBAG II stratifies streams into segments based on stream order and land use. First and second order streams are combined; physically, chemical and biologically these streams are very similar. BURP data is used to determine the index scores (stream macrobiotic index [SMI], stream fish index [SFI], and stream habitat index [SHI]). In determining the total SMI, SFI, and SHI scores, numerous indicators and metrics are evaluated to get the total score for that index.

For example, the SHI metrics include parameters like large organic debris, percent canopy cover, embeddedness, and channel shape; SMI metrics include parameters like total number of taxa, number of mayflies, number of stoneflies, and number of caddisflies. These metrics scores are compared to a reference condition for the appropriate bioregion and given an index score (0, 1, 2, or 3). The index scores are then added and divided by three to get an average composite score for each segment. If two BURP sites are located in a steam segment, the lower of the two scores is used to interpret aquatic life support calls. If more than two sites are on a segment, they are averaged to determine an aquatic life support call. An averaged composite score of two or greater passes (full support, FS) while a score of less than two fails (not full support, NFS).

Data collected outside of DEQ can also be used to assist with determining designated beneficial use if the data is less than 5 years old and if it meets certain requirements outlined in WBAG II.

Table 2-4 displays the WBAG II results for the 303(d)-listed streams in the Palouse River Subbasin; some streams have multiple BURP sites and/or multiple years of BURP data collection. The table displays the information currently available from BURP surveys conducted in 2002. At this time (November 2004), the SFI scores are not available. The average scores without the SFI are also shown. The SFI, as is the SHI and SMI, is critical when determining beneficial use status. The WBAG II beneficial use status calls, as shown, do not directly identify pollutants and for this report were used on a limited basis to determine whether a stream required a TMDL.

Table 2-4. WBAG II beneficial use status calls for 303(d)-listed water bodies.

Water Body (Creek)	Stream Macrobiotic Index (SMI)	Stream Fish Index (SFI)	Stream Habitat Index (SHI)	Average Score FS/NFS
Big – upper	56.07 (3)	NOT AV	62 (3)	3
Big – lower	56.76 (3)	NOT AV	57 (2)	2
Deep Creek – upper	51.42 (3)	NOT AV	45 (1)	2
Deep – lower	32.59 (0)	NOT AV	30 (1)	0
Flannigan – upper	DRY	DRY	DRY	DRY
Flannigan – lower	46.21 (2)	NOT AV	34 (1)	1.5
Gold – upper	73.45 (3)	NOT AV	60 (3)	3
Gold – lower	43.56 (2)	NOT AV	34 (1)	1.5
Gold – Crane tributary	UN	UN	UN	UN
Hatter – upper	51.83 (3)	NOT AV	66 (3)	3
Hatter – lower	67.61 (3)	NOT AV	42 (1)	2
West Fork Rock – upper	DRY	DRY	DRY	DRY
West Fork Rock – lower	DRY	DRY	DRY	DRY

[1] FS = Full support
[2] DRY = Dry site at time of survey
[3] NFS = Not full support
[4] UN =Unknown
[5] NOT AV =Data not available

Idaho's Cumulative Watershed Effects Process (CWE)

The Cumulative Watershed Effects (CWE) process is a watershed model that evaluates a variety of conditions, related to timber activities on the ground, to determine impacts to the environment. The CWE process is a framework for collecting and organizing data on mass failures, surface erosion hazards, stream temperature, watershed canopy conditions, hydrologic risks, sediment production and delivery to a waterway, stream channel stability, and water nutrient conditions. The process relies on the WBAG II beneficial use support determination as the measure of whether or not a stream is water quality impaired. The CWE methodology analyzes data collected from on-the-ground conditions, and determines whether forest practices are creating “adverse conditions” due to sediment, temperature, nutrients, and/or hydrologic impacts (IDL 2000[b]). CWE assessments, including road data, were collected on all of the upper most portions of the watersheds of the 303(d)-listed streams.

The intent of CWE is to allow forest managers to respond to the CWA when forest practice standards are not being met. Adverse conditions are not defined using the state’s water quality standards, but these standards do allow forest managers to pinpoint the condition impacting water quality. CWE is physically conducted in the watershed, and the results are an up-to-date, systematic assessment of on-the-ground conditions. When CWE identifies an adverse condition for sediment, temperature, nutrients, or hydrologic function, managers and area foresters should investigate that particular area and determine what corrective actions are needed.

While CWE produces, in the final analysis, a pass/fail for each of the pollutant types, the CWE scores derived from the data provide a continuous-scale rating of the situation. When a CWE assessment conclusion does not agree with conclusions of the DEQ WBAG assessment or the 303(d) list, the CWE data can be analyzed to help explain the discordance and arrive at a conclusion about the status and causes of water quality problems.

CWE reports for all of the 303(d) listed streams in this subbasin are available on line at http://www2.state.id.us/lands/bureau/forasst or at the Deary IDL office. These reports were examined and some of the data was used. The adverse condition results and the total sediment delivery rating/scores are of are particular interest and are displayed at the end of each CWE report.

The sediment delivery score gives a total score from all sources of sediment from the watershed including roads, mass failures, and trails. The ratings for sediment are *low*, *moderate*, or *high*, with *low* being a high-quality condition and *high* being a low quality condition. These results were used in this evaluation to help determine water quality impairment from adverse sediment conditions. Stream segments with high temperatures were also identified. Forest managers should take note of the management problems identified in the CWE. Correcting these management problems would be good start to improving water quality on the TMDL streams.

Revised Universal Soil Loss Equation (RUSLE)

The Revised Universal Soil Loss Equation (RUSLE) is a set of mathematical equations that estimate average annual soil loss and sediment yield resulting from interrill and rill erosion. RUSLE reflects the evolutionary development of erosion-prediction technology. For nearly 100 years, erosion data have been collected, analyzed, presented, and discussed in the professional arenas of agricultural and civil engineers, agronomists, soil scientists, geologists, hydrologists, and geomorphologists. The breadth and depth of these scientific investigations allow confidence in the application of RUSLE for the estimation of soil loss from mined lands, construction sites, and reclaimed lands.

RUSLE does not estimate erosion in channels or erosion from roads; it merely computes erosion from the soil surface. Derived from the theory of erosion processes, more than 10,000 plot-years of data from natural rainfall plots, and numerous rainfall-simulation plots, RUSLE is an exceptionally well-validated and documented model. A strength of RUSLE is that it was developed by a group of nationally recognized scientists and soil conservationists who had considerable experience with erosional processes. RUSLE retains the structure of its predecessor, the Universal Soil Loss Equation (USLE).

RUSLE resulted from a 1985 workshop of government agency and university soil-erosion scientists. The workshop participants concluded that the USLE should be updated to incorporate the considerable amount of erosion information that had accumulated since the publication of Agriculture Handbook 537 (in 1978) and to specifically address the application of the USLE to land uses other than agriculture. This effort resulted in the computerized technology of RUSLE.

RUSLE is expressed as follows:

$$A = R * K * LS * C * P$$

Where
A = estimated average soil loss in tons per acre per year
R = rainfall-runoff erosivity factor
K = soil erodibility factor
L = slope length factor
S = slope steepness factor
C = cover-management factor
P = support practice factor

To determine the C and P factors, land-use maps were created by DEQ for each 303(d) watershed by taking printed maps of aerial photos and driving to hilltops to determine land-use during the 2002 calendar year

Watershed Erosion Prediction Project (WEPP)–WEPP Road

Erosion from roadways is significant in the Palouse, especially in the 303(d) watersheds. To quantify these processes, the road analysis portion of the WEPP model was performed.

WEPP is a soil erosion model that can provide estimates of soil erosion and sediment yield for specific soil, climate, ground cover, and topographic conditions. Developed by an interagency group of scientists, including the U.S. Department of Agriculture’s Agriculture Research Service (ARS), Forest Service and Natural Resources Conservation Service, and the U.S. Department of Interior's Bureau of Land Management and Geological Survey, WEPP simulates the conditions that impact erosion—such as the amount of vegetation canopy, the surface residue, and the soil water content for every day in a multiple-year run. For each day that has a precipitation event, WEPP determines whether the event is rain or snow and calculates the infiltration and runoff. If there is runoff, WEPP routes the runoff over the surface, calculating erosion or deposition rates for at least 100 points on the hill slope. It then calculates the average sediment yield from the hill slope. *WEPP:Road* is an interface to the WEPP soil erosion model that allows users to easily describe numerous road erosion conditions and quantify erosion amounts. The *WEPP:Road* template has three overland flow elements: a road, a fill slope, and a forested buffer. The WEPP model allows a hill slope to be divided into segments with similar soils and vegetation called *overland flow elements*.

Roads in the Palouse were slowly driven in order to input geographically linked (GIS) information regarding the road and erosional conditions. Information like the type of road, surface of road, ditch information, cross-drain locations, buffer types and lengths to a waterway, and fillslope information were entered onto a Global Position System device (GPS). This information was downloaded into GIS for analysis. The data is arranged to show total sediment delivered to a water body within each 303(d) watershed.

Channel/Stream Bank Erosion

A significant amount of erosion occurs along the stream banks, and in all channels naturally erode to some degree. It is significant enough that several studies have attempted to quantify this phenomenon. For this TMDL, the National Resource Conservation Service (NRCS) field estimate procedure for channel erosion was conducted on all of the 303(d) listed streams to quantify in-stream channel erosion above natural conditions caused by anthropogenic effects. It has been proposed that a stream is in constant search of equilibrium and four forces control this equilibrium: sediment load, size of sediment particle, water quantity, and slope of stream channel (NRCS 1983). These forces can be changed by natural and/or human intrusion. The equation below was developed by the NRCS to quantify in stream erosion.

$$\text{Erosion} = \frac{(\text{Eroding Area in sq.ft}) (\text{Lateral Recession Rate in ft/yr}) (\text{Density in lbs/cubic ft})}{2000 \text{ lbs/ton}}$$

Several sites were evaluated for each 303(d)-listed stream. Sites were selected based primarily on riparian and stream banks conditions and accessibility. Some sites that have significant amounts of erosion were not sampled because DEQ was not able to obtain access.

In general, the riparian areas along the entire length of each 303(d)-listed stream were grouped together based on their condition-good, fair or poor. This judgment was used to describe the riparian and stream bank conditions for the entire stream. This very basic approach revealed that riparian areas with *good* conditions have no measurable amount of erosion above background, while *fair* areas have minimal amount of erosion above background, and *poor* areas have significant amounts of erosion above background. Therefore, an attempt was made to sample the fair and poor reaches.

The reach samples sites are shown on Map D-2 (Appendix D). Although not directly part of the TMDL, this information can be used as a starting and reference site for the future after project implementation has begun.

At each site, sampled distances, stream widths, sinuosity, streambed particle size, canopy observations, were recorded. In addition, a stream erosion condition inventory was also completed. The stream erosion condition inventory describes bank erosion evidence, bank stability condition, bank cover/vegetation, lateral channel stability, channel bottom stability, and in-channel deposition. The inventory was used to help determine the lateral recession rate. The total amount of sediment eroded from each reach was calculated using the above equation, based on the field data (see Table D-3, Appendix D).

Stream Temperature Data

Continuous temperature data came from the 2001-2002 monitoring effort by DEQ and IAWSCD. In the spring of 2002, continuous temperature data logger probes were placed in all the 303(d)-listed streams at monitoring sites PR-11, PR 5, PR-9, PR-12, PR-14, and PR-16. (Appendix A). These temperature loggers recorded temperatures every hour for each 24-hour period. The probes were removed in the late fall of 2002.

Most streams exceeded the salmonid spawning standard and all streams exceeded the cold water aquatic life temperature standard for significant periods during the summer months. A graphical display and discussion of each temperature logger data are shown later in this section (see Subwatershed Characteristics, page 52).

Instantaneous stream temperatures have been taken by numerous sources, including but not limited to, DEQ BURP crews, contractors hired by the CNF, USGS, and (during the 2001-2002 monitoring effort), by DEQ and IASWCD. The CNF has continuous temperature logger data for non-303 (d) streams on the forested sections of the Palouse watershed but this data is not included in this report. A more thorough discussion regarding temperature is located in Chapter 5.

Fish Data

Table 2-5, based on data obtained from DEQ, IDFG, CNF, the St. Joe National Forest, and Potlatch Corporation, summarizes the fish data for the 303(d)-listed streams and some other major tributaries in the Palouse River Subbasin, displaying age classes of salmonids, as well as the total number present. Total numbers of non-salmonid species are shown as well.
The table also notes when young of the year were observed, an indicator that successful spawning and rearing occur in the stream. Age class determination was based on information in the CNF surveys, which indicated the determination was made by the CNF fish biologist. This data demonstrates whether the water quality of each water body provides protection, maintenance, and propagation of a salmonid fish population.

Flow data

Flow data for the 303(d)-listed stream primarily came from the DEQ-LRO-IASCD monitoring effort. The USGS maintains a continuous flow gage on the mainstem Palouse River, near the town of Potlatch. The CNF has a continuous flow on the Palouse River in the upper part of the Palouse River Subbasin. As part of the DEQ-LRO-IASCD monitoring effort, staff gauges were placed at some monitoring sites.

All of the staff gauges were placed at a bridge and were compared to the actual flows taken in the field. Flow measurements were collected by wading and using a Marsh McBirney flow meter for all the sites. The six-tenth-depth method (0.6 of the total depth below water surface) was used when the depth of water was less than or equal to three feet. For depths greater than three feet, the two-point method (0.2 and 0.8 of the total depth below the water surface) was used to determine stream discharge. At each sampling station, a transect line was established across the width of the creek at an angle perpendicular to the flow. The mid-section method was used to compute cross-sectional area and the velocity-area method was used to determine discharge. The discharge was computed by summing the products of the partial areas (partial sections) of the flow cross-sections and the average velocities for each of those sections. Together, cross-sections and average velocities were used to calculate cubic feet per second at each of the monitoring stations.

In some instances, the field crew was unable to access a site because of snow, and on other occasions high flows prevented them from collecting a flow measurement. At the sites with staff gauges, the flows were estimated using calculations comparing the gauge height with the actual flow or by comparing flow data and data trends in neighboring watershed on the dates with incomplete flow data. At the other sites, flows were estimated based on the other monitoring sites in that particular sub-watershed.

Table 2-5. Fish Data for the Palouse River Subbasin.

Water Body (Creek)	BURP Data 1996	BURP Data 2002	CNF	Other
Big – upper	RB-2+j(2), D(4), SC(45)	D(31), RS (36), SC(14)	SC(13) D(18)	CT-(UN), BT-(UN) [b] RB 1(1), SC (14)- [c]
Big – lower	D(59), RS (16), SC(12)	D(49), RS (9), SC(4)		
Deep Creek – east fork	Dry	D(20), RS (2)	ND	ND
Deep – middle fork	Dry	D(35), RS (48)	ND	ND
Deep – lower	D(259), RS (180), PS(2), SQ(17), SU(16)	UN	ND	ND
Flannigan – upper	RB-2+j(3), D(48), RS (3) SC(45)	Dry	ND	ND
Flannigan – lower	D(290), SU (13), NPM(22)	UN	ND	ND
Gold – upper	RB-3+j(13)	RB-3+j(12)	RB-3+j(UN)	ND
Gold – lower	D(529), RS(66) CF (2)	RS(29), SU(2), NPM(17), D(23)	ND	ND
Gold – Crane tributary	BT-1+j(16), SC(5)	UN	ND	ND
Hatter – upper	RB-1+j(2), BT-1+j(2), SC(6)	BT-2+j(3), SC(1)	ND	ND
Hatter – lower	D(126), RS(24), SC (11)	RB-3+j(6), D(8), RS(14), SU(3) SC(6)	ND	ND
West Fork Rock – upper	Dry	Dry	ND	ND
West Fork Rock – lower	Dry	Dry	ND	ND
Palouse River-middle	RB-3+j(15), BT 2+j(4)	UN	BT 3+j(16), SC-(UN)	CT-(UN) [b]
Palouse River-upper	RB-1(1), BT 3+j(12)			BT-(UN) [b]

CT-Cutthroat
RB-Rainbow
BT-Brook Trout
D-Dace-total
PS-Pumpkin Seed
RS-Redside Shiner
S-Shiner-non-species specific
NPM-Northern Pike Minnow
SU-Sucker
SC-Sculpin-total numbers only-non species specific
( )-Total number of fish
UN-Unknown
CF-Crawfish
#+j-number of ages classes including young-of-the-year juvenile
[a] No data
[b] St Joe National-1938

[c] 1998 Potlatch Corporation data (Last Chance Cr. T41N, R3W, sec 16)

Clearwater National Forest Service Contracted Services

The CNF contracted comprehensive surveys for many streams. Isabella Wildlife Works performed field work in the summer of 1998 on the Palouse River and several other tributaries on the CNF. This study included a survey of the whole stream divided into numerous reaches, surveys and calculations of substrate embeddedness, riffle stability, fish and stream flow calculations. These surveys included Rosgen channel types and major hydrologic features determination. The physical and hydrological data is fairly extensive and thorough. Fish surveys performed in these reports are typically performed by snorkeling. A survey was performed in the Gold Creek and Big Creek watersheds. The results are shown in Table 2-5.

Gradient, bank stability index, length of raw banks, width and depth, percent pools, and acting and potential woody debris were some of the indicators selected out of those reports to help assess sediment conditions. These measures were used to assess the level of water quality impairment. For example, length of raw banks, and bank stability were looked at as an indicator of in-stream erosion. Acting and potential woody debris tell a lot about fish habitat and canopy cover for each stream, while percent pools, gradient, and width and depths are important habitat parameters to evaluate over an extended period of time. Collectively this data was used to help determine the level of water quality impairment and beneficial use status. Data from these reports was not used directly for beneficial use determination in this report, but for background physical and biological information for the upper portion of the Palouse River Subbasin.

2.4 Subwatershed Characteristics

This section determines which water bodies are water quality limited by a pollutant, and hence will need a TMDL, and which water bodies are not water quality limited. The physical, chemical and biological parameters and associated data are shown within the tables and figures and are described within this section to help determine beneficial use status of the 303(d)-listed water bodies. Recommended additions to the 303(d) list are also included in this section.

Big Creek

Big Creek is 303(d)-listed for sediment; the boundaries are defined as headwaters to Palouse River. The designated beneficial uses for Big Creek include salmonid spawning, cold water aquatic life, and secondary contact recreation. Big Creek is a third order stream at its confluence with the Palouse River and the headwaters originate off the east side of Gold Hill and Prospect Peak. The entire basin is shown on Map 2-1.

The Big Creek Watershed is 16.11 square miles in size (10,311 acres). Most of the land in Big Creek is owned and managed by Potlatch Corporation. The uppermost headwaters are managed by the CNF. The lower mile and a half is under private land ownership. The state of Idaho also manages a few small portions within the watershed.

The primary land uses in the watershed are forestry, grazing, and recreational activities. Some non-cultivated croplands are present in the very lowest portion of the watershed. Big Creek generally flows from the northwest to the southeast, and the basic drainage pattern could be described as dendritic. Elevations range from 2,611 feet to 4,138 feet. The geology of the watershed is highly weathered metasediments with some areas of highly weathered granitics. The valley bottom of the lower main stem Big Creek and tributaries are underlain by coarse textured alluvium.

Several major tributaries flow into Big Creek within the forested areas. Big Creek and most of its largest tributaries are perennial streams. Some of these tributaries are classified as intermittent by the USGS quad map. For example, the upper monitoring site (PR-10a) was on a tributary classified as intermittent, and it went dry (below five cubic feet per second) in early May and dry in mid-July. The lower site is about a half-mile from the mouth and had perennial flows. So the stream classification by the USGS matched the data collected for this TMDL.

During the winter the upper sites (PR-10a, and PR-10b) were inaccessible from mid January through the first part of April due to snow. The lower site (PR-11) was accessible all year.

Monitoring was performed from November 2001 through mid January 2002 at PR-10a. Deep snow prevented monitoring at PR-10a from January 2002 through early April 2002. Monitoring resumed in early April 2002 through mid July 2002 at PR-10a. In the summer the monitored crew realized this site was on an intermittent stream called Lost Creek, a tributary to Big Creek. From July 2001 through September 2001 site PR-10a remained dry, and no data was collected at PR-10a. A decision to move the site was made by the collaborators of the monitoring plan in September 2002. A new site on a perennial section of Big Creek was located and established in September 2002. Monitoring at this new site (PR-10b), which represents the upper portion of the Big Creek watershed, resumed near the end of September 2001 and continued through November 2002.

The locations of these sites are identified on Map 2-1. Fish information for Big Creek is displayed in Table 2-5. Rainbow trout and sculpin have been observed in the upper Big Creek and in Last Chance Creek. Big Creek has the fewest anthropogenic impacts of all the 303(d) streams in the Palouse River Subbasin.

Status of beneficial uses

Results from the 2001-2002 field season are displayed in Figures 2-1 through 2-7. Beneficial uses are being impaired by temperature in Big Creek. DEQ recommends that Big Creek be de-listed for sediment, bacteria and nutrients.

No violations of a state bacteria standard occurred within the Big Creek watershed from November 2001 though November 2002. Some e-coli was present but at levels below the standard. Limited cattle grazing does occur with this watershed, however, the secondary contact recreational beneficial use standard was never violated. Based on this data DEQ recommends that Big Creek be de-listed for bacteria.

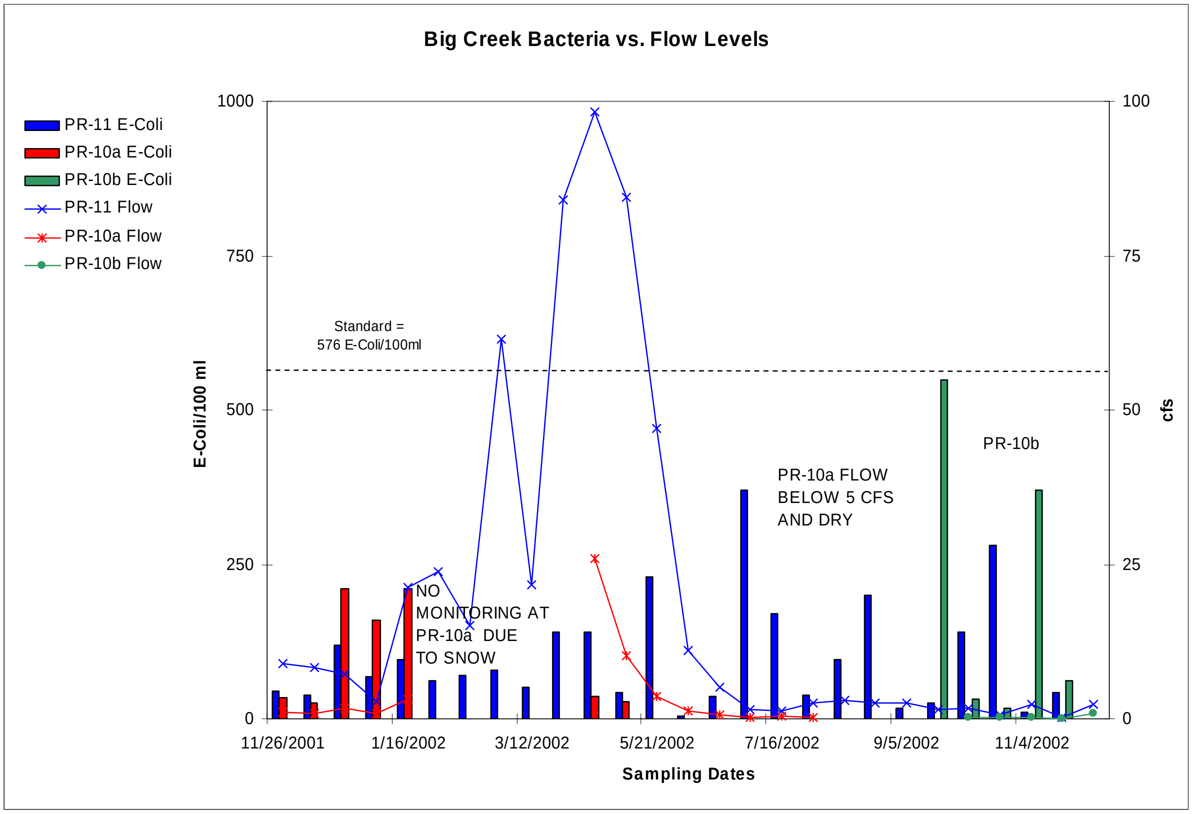
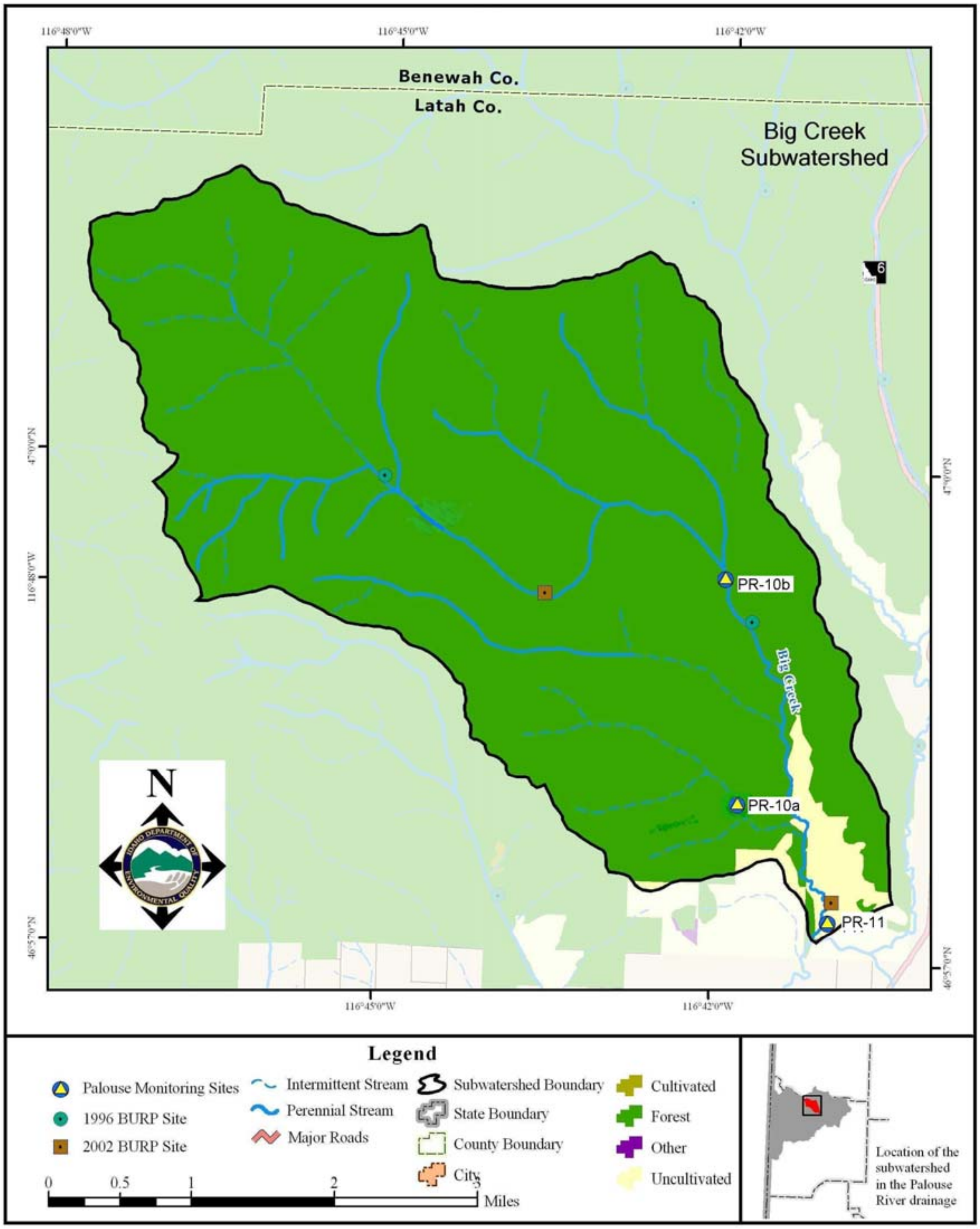


Figure 2-1. Big Creek Bacteria Levels



Map 2-1. Big Creek Subwatershed

A continuous temperature data-logger probe was placed near the lower monitoring site of Big Creek. The probe recorded temperature readings every hour from mid-May 2002 through early October 2002. The results are display in Figure 2-2. During this period, temperatures exceeded the Idaho cold water aquatic life daily average (ICWB-Ave) of 19^{o} C, and the Idaho salmonid spawning daily average (ISS-Ave) of 9° C. Based on this information, a temperature TMDL will be developed for Big Creek.

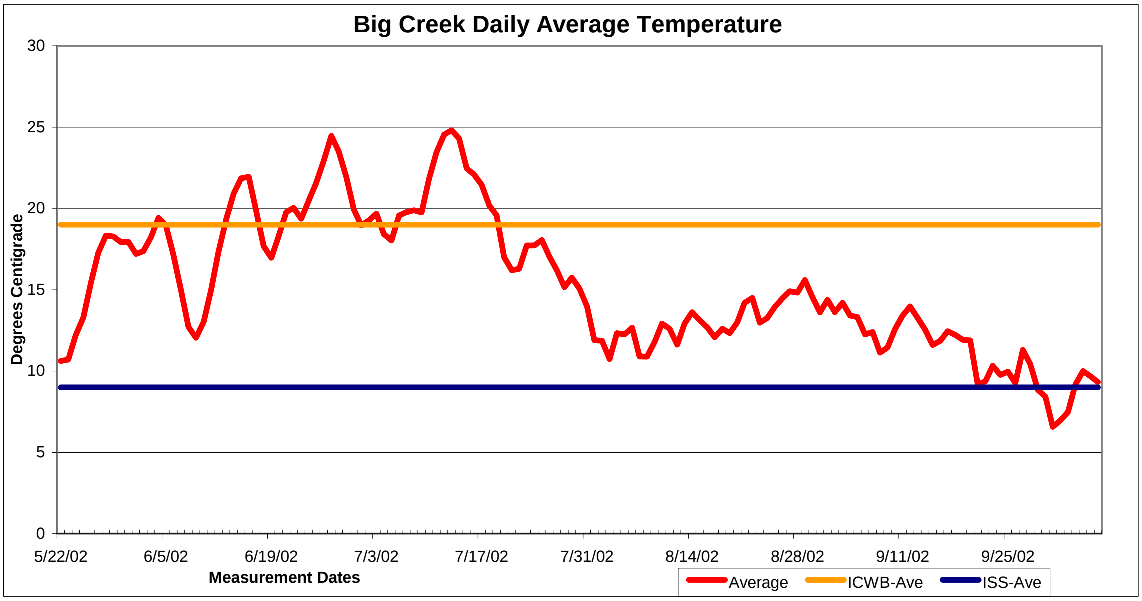


Figure 2-2. Big Creek Temperature

The nutrient data are displayed in Figures 2-3 through 2-5 and Table 2-6. Total nitrogen (NO2+NO3) levels were at or below the minimum detection limit of 0.1 mg/L for the entire monitoring season. Ammonia levels were at the minimum detection limit except for two very small increases at the lower site. A target of 0.10 mg/L for total phosphorus (TP) and a dissolved oxygen level below 6.0 mg/L during the growing season (May-October) was established for this TMDL.

The nutrient target is based on the numeric state standard for dissolved oxygen requiring level to be greater than 6.0 mg/L at all times, and a narrative target stating that surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.

The monitoring site in lower Big Creek (PR-11) violated the DO standard on two occasions in July when measured flow was about 2.5 cfs, however, this monitoring site becomes more of a stagnant pool during low flows. The gradient is flat and there is no visible water moving but flow was measured anyway. Later in the season, when flows were lower and when temperatures were cooler, the DO levels were above 6.0 mg/L.

Table 2-6 displays the TP, DO and flow for both sites. Additionally, table 2-6 displays the time and instantaneous temperature for the lower monitoring site (PR-11). On the July 16th and July 29th 2001 dates the instantaneous temperatures at 0930 and 0900 (typically the coolest time in a stream) were 17.9 and 16.6° C. Continuous temperature data showed that temperature rose to over 25° C on the same day in Big Creek. DEQ believes the high temperature, low gradient condition of the lower monitoring site was the cause of the DO exceedances, not nuisance algae.

Based on sites visits and field crew reports there is not a nuisance aquatic growth problem in Big Creek. Big Creek has minimal anthropogenic impacts and very few nutrient sources. The single TP violation was one tenth above the target set for these nutrient TMDLs and occurred once, on 6/18/02, when the DO reading was 6.74 mg/L.

Table 2-4 displays the WBAG II assessments, which show that Big Creek, is meeting beneficial uses. If the data in Table 2-4 was the only information available for Big Creek, Big Creek would be removed from the 303(d) list for sediment, bacteria, and nutrients as it shows it is meeting beneficial uses.

A TMDL for temperature will be written for Big Creek. The implementation plan should focus on some of the some possible remedies which would be increasing shade and limiting livestock access to the stream. These were thought to have some effect on the low DO readings in Big Creek. In conclusion, because of the absence of nuisance algae, good overall condition of the watershed with few anthropogenic impacts, the infrequent occasion of the DO exceedances, and the one TP exceedance just barely over 0.1 mg/L, WAG input, the temperature TMDL, and DEQ best professional judgment, DEQ recommends that Big Creek be de-listed for nutrients.

Table 2-6. Big Creek TP and DO Monitoring Results during growing season

Date	PR-11 (TP)[1]	PR-11 (DO)[1]	PR-11 Time[2]	PR-11 Temp[3]	PR-11 (discharge)[4]	PR-10 (TP)[1]	PR-10 (DO)[1]	PR-10 (discharge)[4]
5/7/2002	0.02	11.85	1015	3.60	47.10	0.04	12.13	3.72
5/21/2002	0.04	8.06	1000	8.70	11.07	0.05	9.69	1.17
6/4/2002	0.04	8.29	1420	15.40	5.14	cfs<1	cfs<1	cfs<1
6/18/2002	0.11	6.74	1515	17.90	1.56	cfs<1	cfs<1	cfs<1
7/3/2002	0.06	6.57	900	13.40	1.22	cfs<1	cfs<1	cfs<1
7/16/2002	0.08	4.30	930	17.90	2.54	cfs<1	cfs<1	cfs<1
7/29/2002	0.09	4.78	900	16.60	2.90	DRY	DRY	DRY
8/18/2002	0.08	6.64	900	15.00	2.51	DRY	DRY	DRY
8/28/2002	0.07	6.39	830	14.00	2.50	DRY	DRY	DRY
9/5/2002	0.09	6.21	940	13.30	1.43	DRY	DRY	DRY
9/24/2002	0.09	7.54	1100	7.90	1.68	cfs<1	cfs<1	cfs<1

[1] mg/L
[2] 24 hour clock
[3] °C
[4] cfs

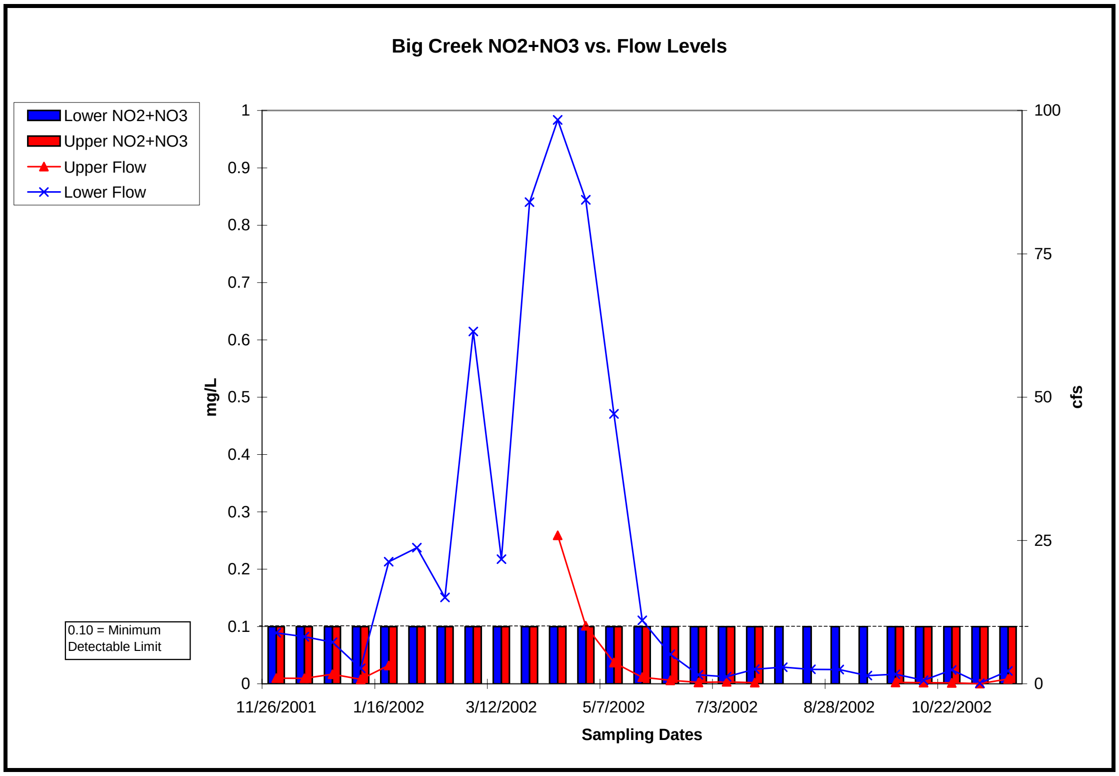


Figure 2-3. Big Creek Total Nitrogen (NO2 + NO3) Levels

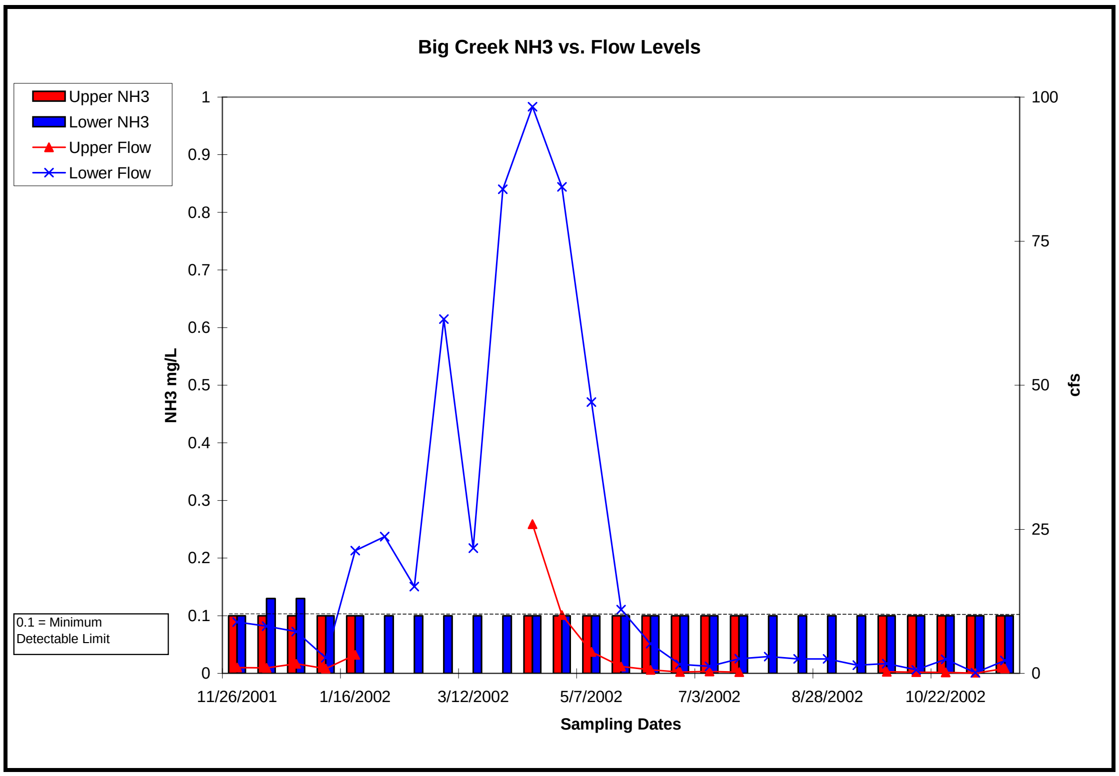


Figure 2-4. Big Creek Ammonia (NH3) Levels

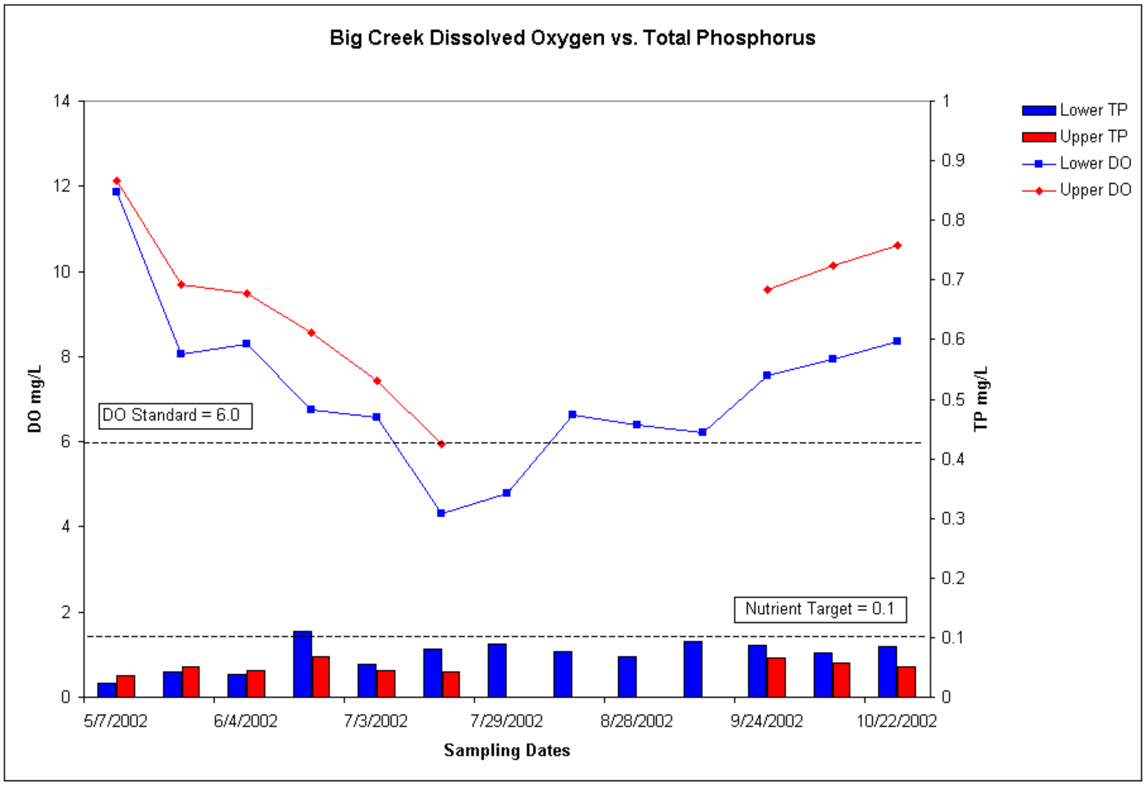


Figure 2-5. Big Creek DO versus Phosphorus (TP) Levels

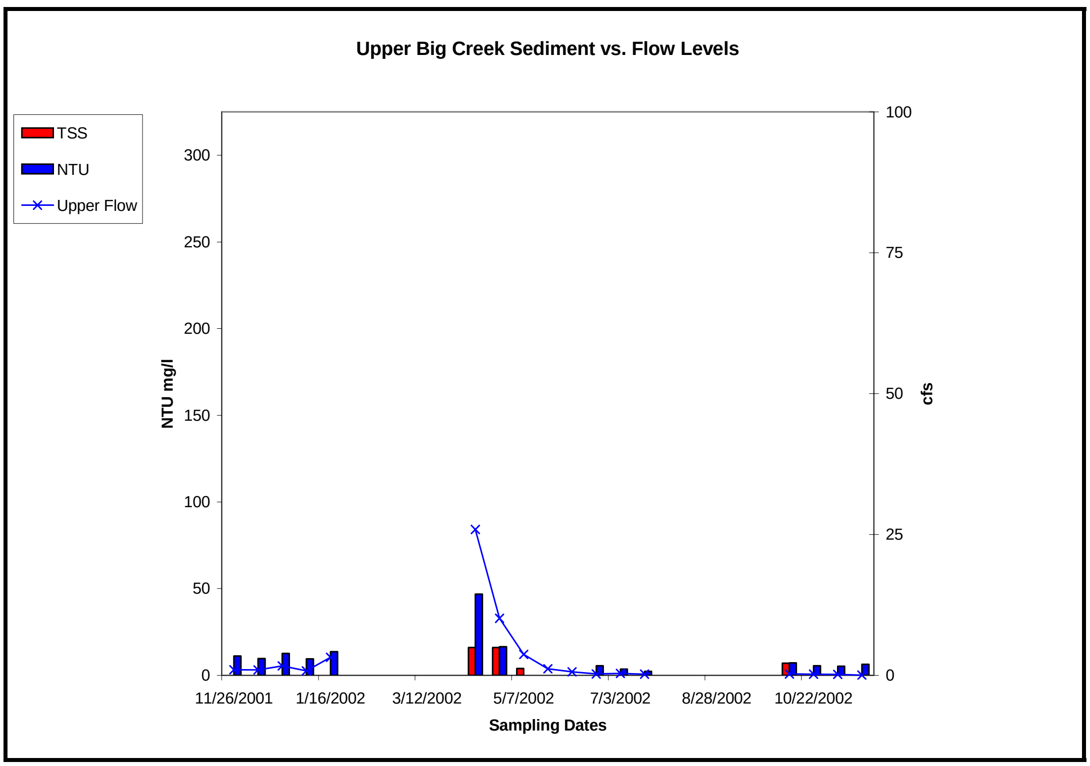


Figure 2-6. Big Creek-Upper- Sediment Levels.

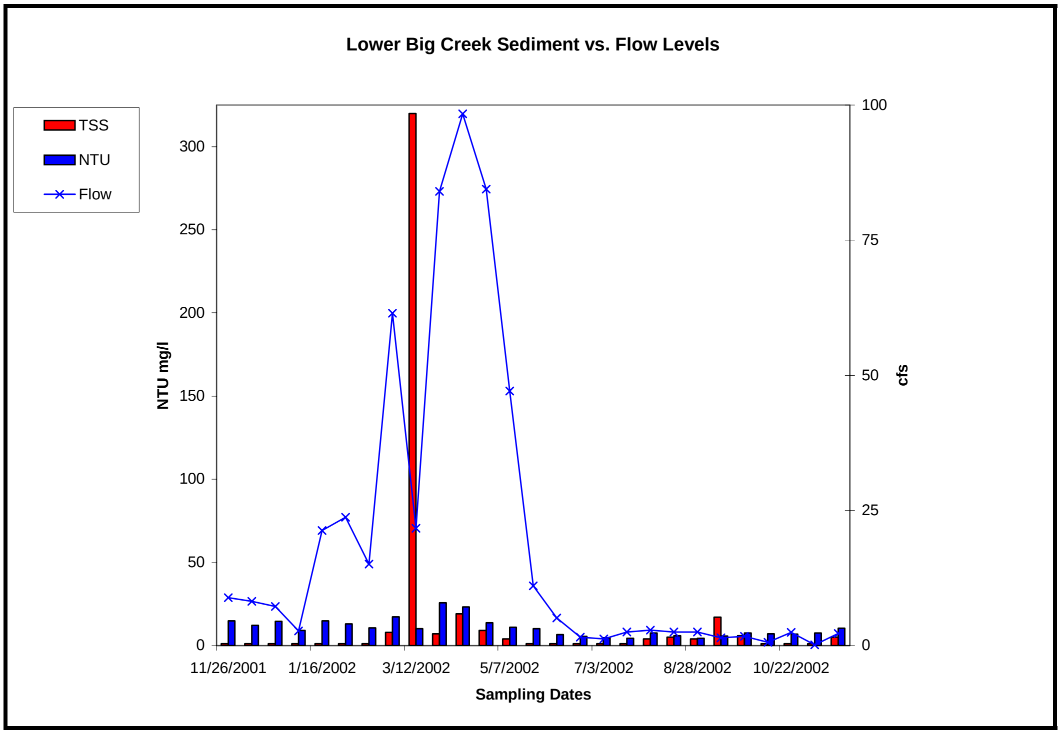


Figure 2-7. Big Creek-Lower- Sediment Levels

Total suspended solids (TSS), expressed in mg/L, turbidity expressed in nephlometric turbidity units (NTU), and discharge expressed in cubic feet per second (cfs), for the upper and lower monitoring sites, are displayed in Figures 2-6 through 2-7.

TSS is a weighted measure of the total solid concentrations in the water, whether the particles are mineral (such as soil particles) or organic (such as plants). An NTU is a measure of turbidity based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions. These two measures are the standard indicators for sediment level concentration in surface water applications nationwide. Idaho State Standards for sediment state that sediment levels shall not impair designated beneficial uses and that turbidity shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more then ten consecutive days.

Figures 2-6 and 2-7 display data that was collected approximately every two weeks, for the period November 2001-November 2002. To determine if sediment levels were above state standards and impairing beneficial uses, additional calculations and assumptions were made. First, a more thorough discharge profile for Big Creek was developed. This profile is based on ten years of data collected at the USGS Palouse River gage site, watershed size differences between Big Creek and the Palouse River, and in-stream flows collected for Big Creek during November 2001-November 2002.

The data shown displays numeric relationships between discharge and NTU, discharge and TSS, and NTU and TSS. These relationships can be expressed as mathematical equations, called regression equations. The regression equations used to calculate values for TSS, NTU, background TSS, background NTU and TSS levels over background are located in Appendix B.

Based on the sediment data collected, the mathematical relationships established in this TMDL there are no sediment loads over background therefore DEQ recommends that Big Creek be removed for sediment.

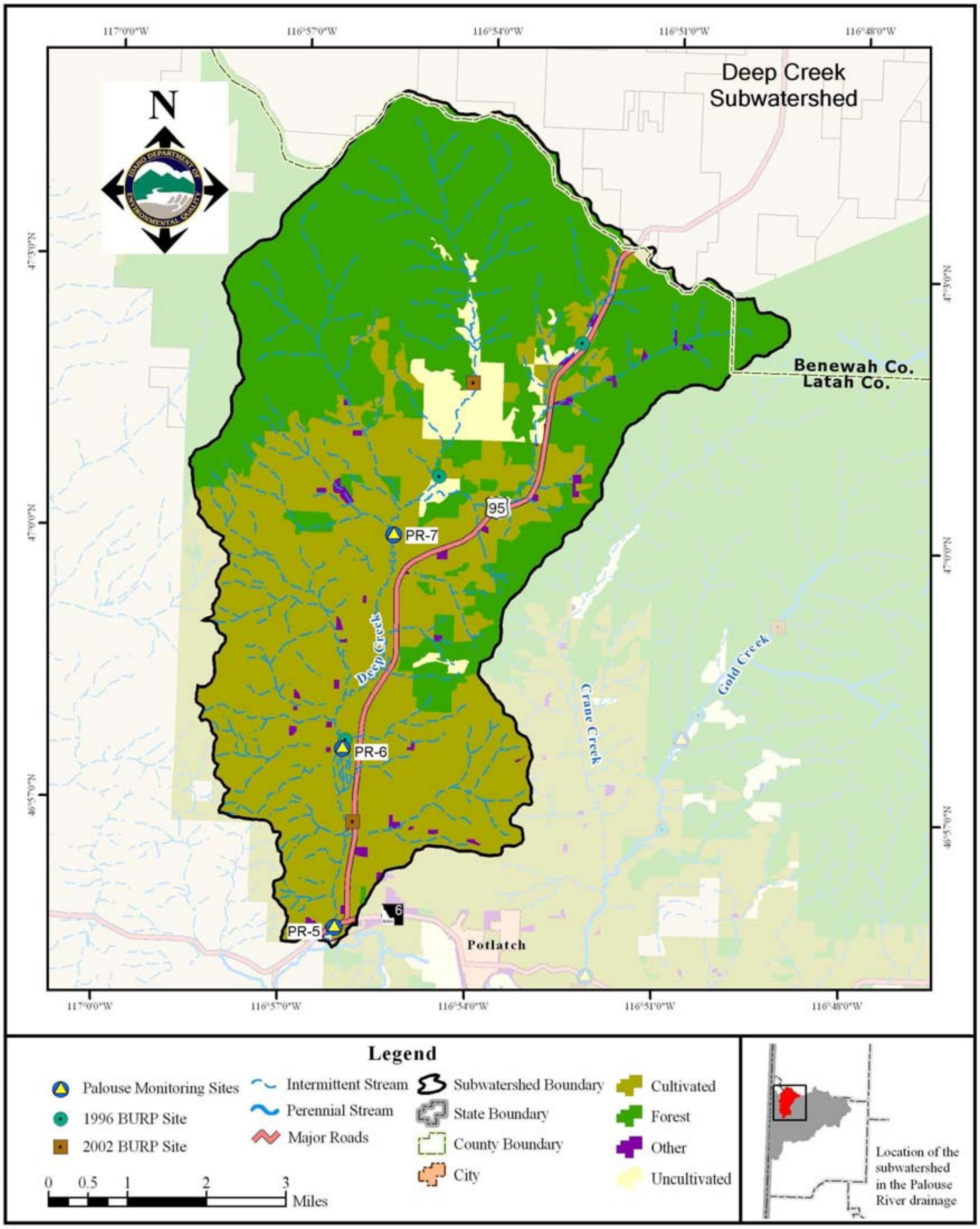
Deep Creek

Deep Creek is 303(d)-listed for sediment, temperature, nutrients and bacteria. The boundaries are defined as headwaters to Palouse River. Deep Creek beneficial uses include cold water aquatic life and secondary contact recreation.

Deep Creek is a fourth order stream at its confluence with Palouse River. The headwaters originate off the south side of Mission and Mineral Mountains. The entire basin is shown on Map 2-2.

The Deep Creek Watershed is 42.75 square miles in size (27,357 acres). Most of the land in Deep Creek is under private land ownership although the uppermost portion has some IDL, CNF and Bennett Lumber ownership. McCroskey State Park, a 5,300 acre state park is located along the Mission and Mineral Mountain ridgeline.   Deep Creek generally flows from the north to the south and the basic drainage pattern could be described as dendritic.

Elevations range from 2,483 feet to 4,320 feet. The geology of the upper watershed and upper elevations are of weathered metasediments with a few granite outcrops along the ridgeline. Palouse Loess is the dominant surface geology in the mid to lower elevations. Basalt outcroppings underlay the Palouse Loess in the lower half of the watershed, and in the valley bottoms along the main stem Deep Creek, coarse textured alluvium is present.



Map 2-2. Deep Creek Subwatershed

Three major tributaries of Deep Creek—the *west,* the *middle,* and the *east* forks—come together around the forest to agriculture interface. Just downstream from there is the upper monitoring site (PR-7). Between the upper (PR-7) and middle site (PR-6), agriculture and grazing are the major land uses. Between the middle (PR-6) and mouth site (PR-5), several homes are located within the extended floodplain of Deep Creek. The major land uses along this stretch are agriculture, grazing, and some residential homes. State highway 95 also parallels Deep Creek for several miles in the lower and middle portions of the watershed.

The USGS quad map and field data collected for this TMDL indicate that Deep Creek is an intermittent stream.. All three sites on Deep Creek were completely dry from the later half of July through October 2002. In early August 1996, the east and middle fork of Deep Creek were dry. In 2003, the middle-monitoring site was dry in July and August.

IDAPA 58.01.02.070.06 states, "numeric standards only apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. For recreation, the optimum flow is equal to or greater than five cfs. For aquatic life uses, optimum flow is equal to or greater than 1 cfs." The data collected for Deep Creek was analyzed with the intermittent stream use classifications. The current fish data that has been collected in the lower section of Deep Creek supports a seasonal cold water fishery rather than cold water aquatic life; dace, red-side shiners, suckers, and the north pike minnow are the species present. Although not document by DEQ the upper tributaries probably support a cold water aquatic life fishery with pockets of salmonids and sculpin.

Status of beneficial uses

Results from the 2001-2002 field season are displayed in Figures 2-8 through 2-16. Sediment, temperature, nutrients, and bacteria in Deep Creek are impairing beneficial uses. For reasons described in the following, sediment, temperature, nutrient, and bacteria TMDLs are required.

Bacteria data displayed in Figure 2-8 indicate several exceedances of the state bacteria standard for secondary contact recreation. The lower two sites exceeded this value several times during the 2001-2002 monitoring season, even when flows were greater than 5 cfs. The upper site exceeded the instantaneous standard once when flows were less than 5 cfs. Based on these exceedances, Deep Creek is water quality impaired by bacteria; therefore, a bacteria TMDL will be written for Deep Creek.

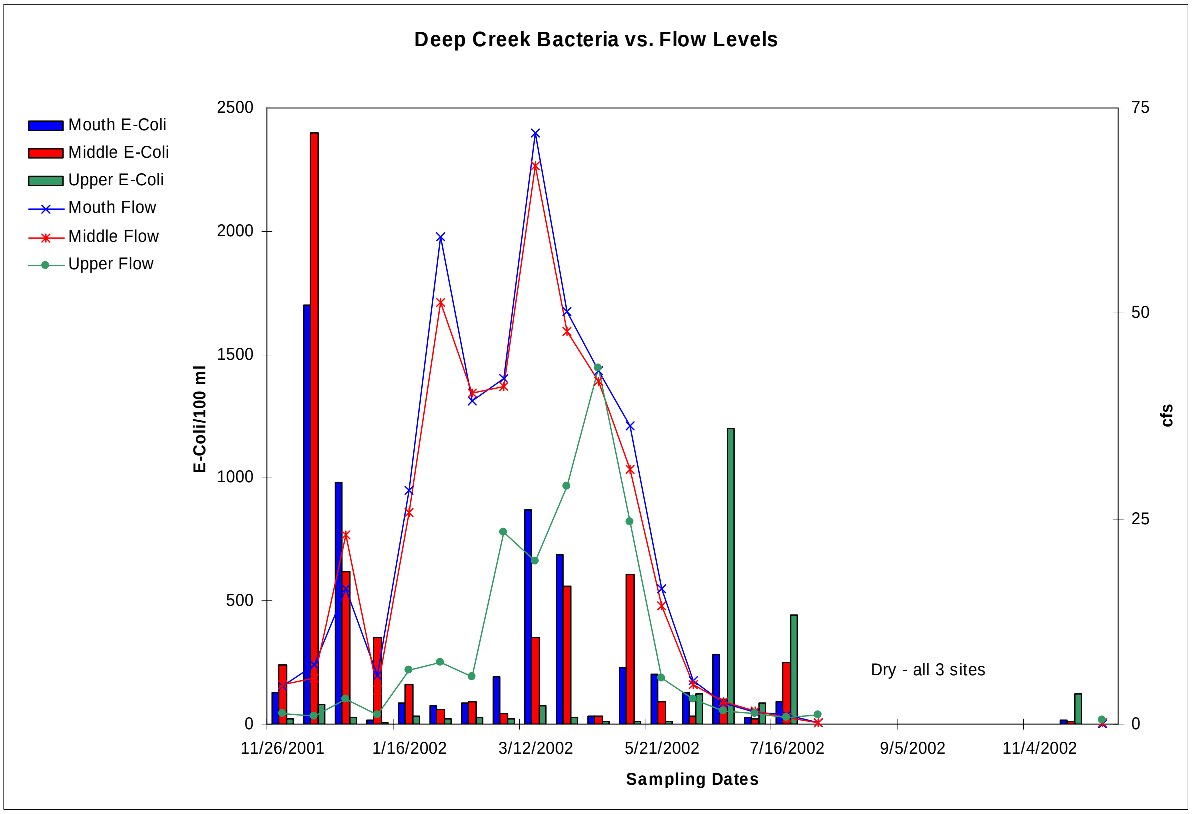


Figure 2-8. Deep Creek Bacteria Levels

A continuous temperature data-logger probe was placed near the middle-monitoring site (PR-6) of Deep Creek. The probe recorded temperature readings every hour from mid-May 2002 to late July 2002. Deep Creek is an intermittent stream and went dry in late July 2002. Figure 2-9 displays the results of Deep Creek only when discharges were greater than one cfs. During this period, temperatures exceed the Idaho cold water aquatic life daily average (ICWB-Ave) of 19^{o} C. No salmonids are present in Deep Creek; therefore, the Idaho salmonid spawning daily average (ISS-Ave) of 9^{o} C does not apply. Deep Creek monitoring resumed with measurable flows in mid November 2002 when measured instantaneous temperatures were well below the ICWB-Ave. Based on this information a temperature TMDL will be developed for Deep Creek during when flows are greater than 1 cfs and above the ICWB-average.

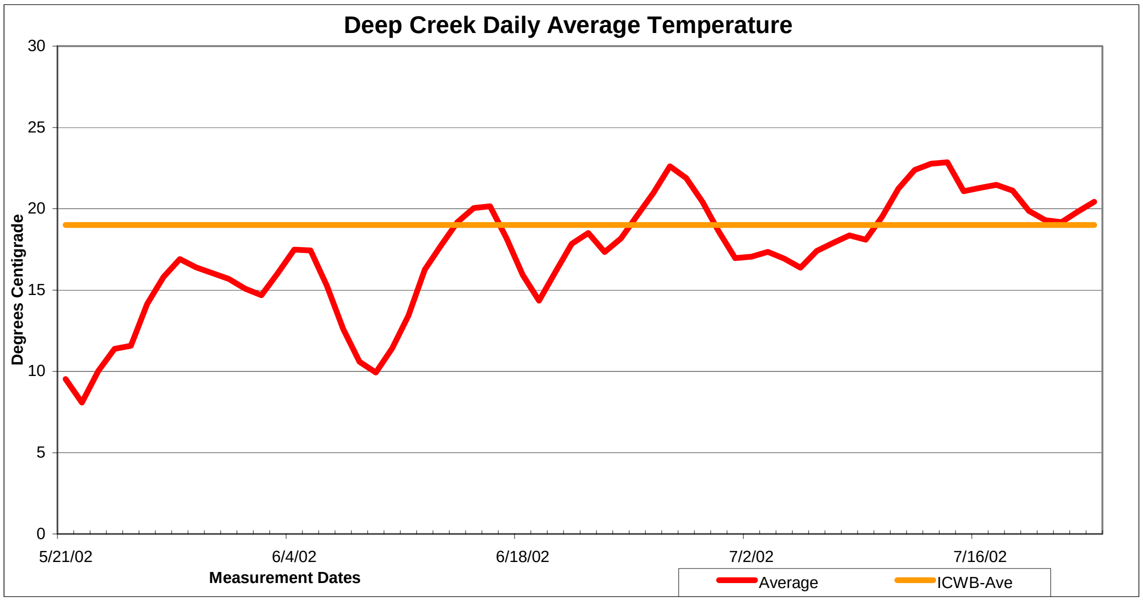


Figure 2-9. Deep Creek Temperature

The nutrient data are displayed in Figures 2-10 through 2-12. DEQ recommends that Deep Creek be de-listed for nutrients. A target of 0.10 mg/L TP and/or a dissolved oxygen level below 6.0 mg/L during the growing season was established for this TMDL. The nutrient target is based on a numeric state standard for dissolved oxygen to be greater than 6.0 mg/L at all times and a narrative target stating that surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.

Due to Deep Creek's intermittent classification, there were no DO or TP violations when flows were greater than 1 cfs. Deep Creek probably does have some nutrient sources; these included septic systems close to the stream, cattle feeding operations and agricultural uses, but the DO oxygen standard was only violated after flows dropped below 1 cfs. Total nitrogen (NO2+NO3) and ammonia levels are somewhat elevated but within surface water guidelines. Ammonia levels are elevated on the lower two sites during the winter and spring months but are well within state standards. In conclusion, DEQ recommends that Deep Creek be de-listed for nutrients.

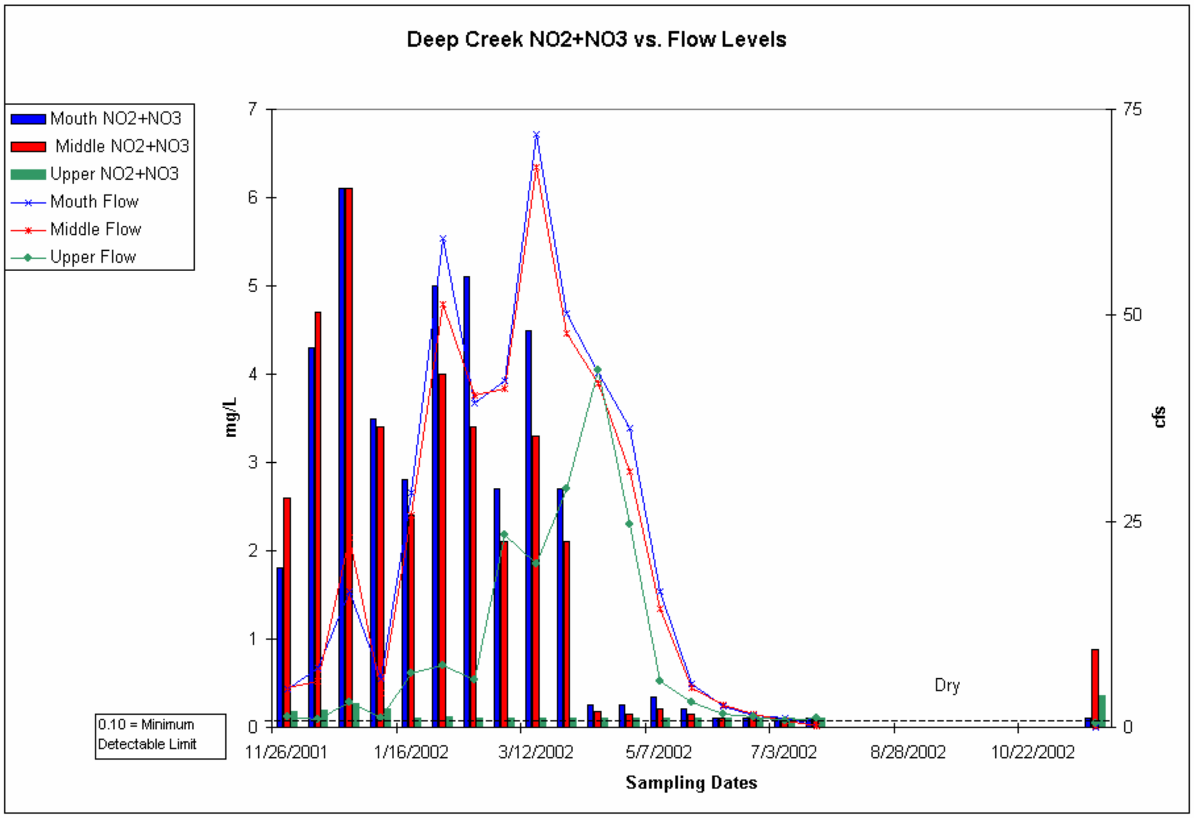


Figure 2-10. Deep Creek Total Nitrogen Levels

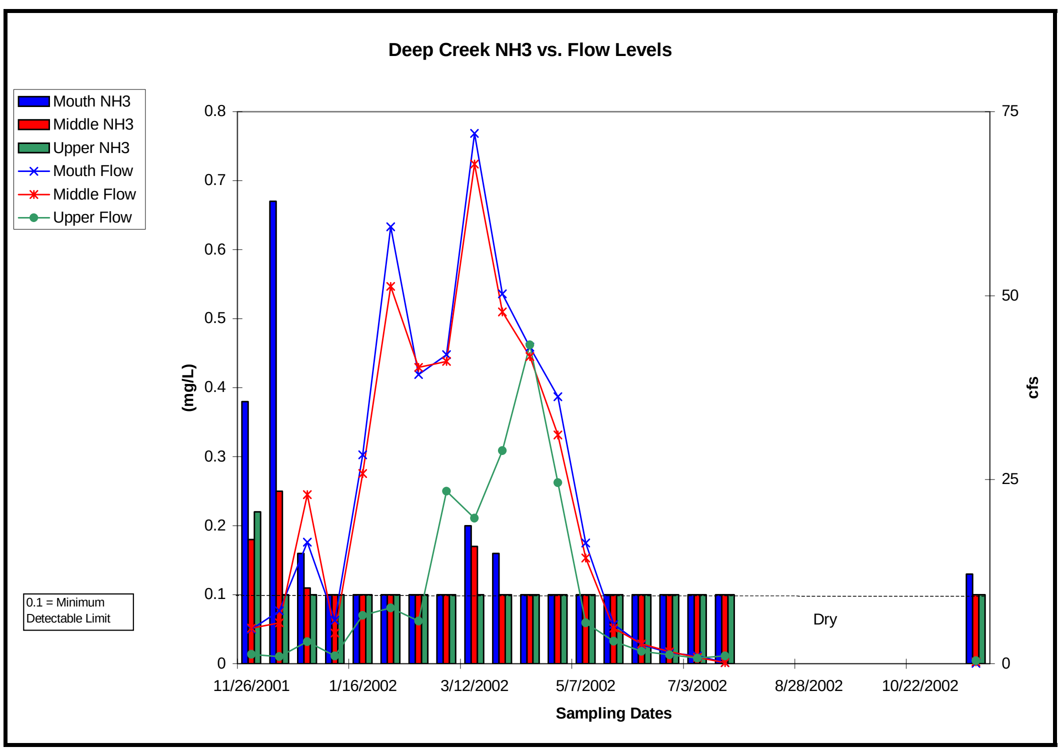


Figure 2-11. Deep Creek Ammonia Levels

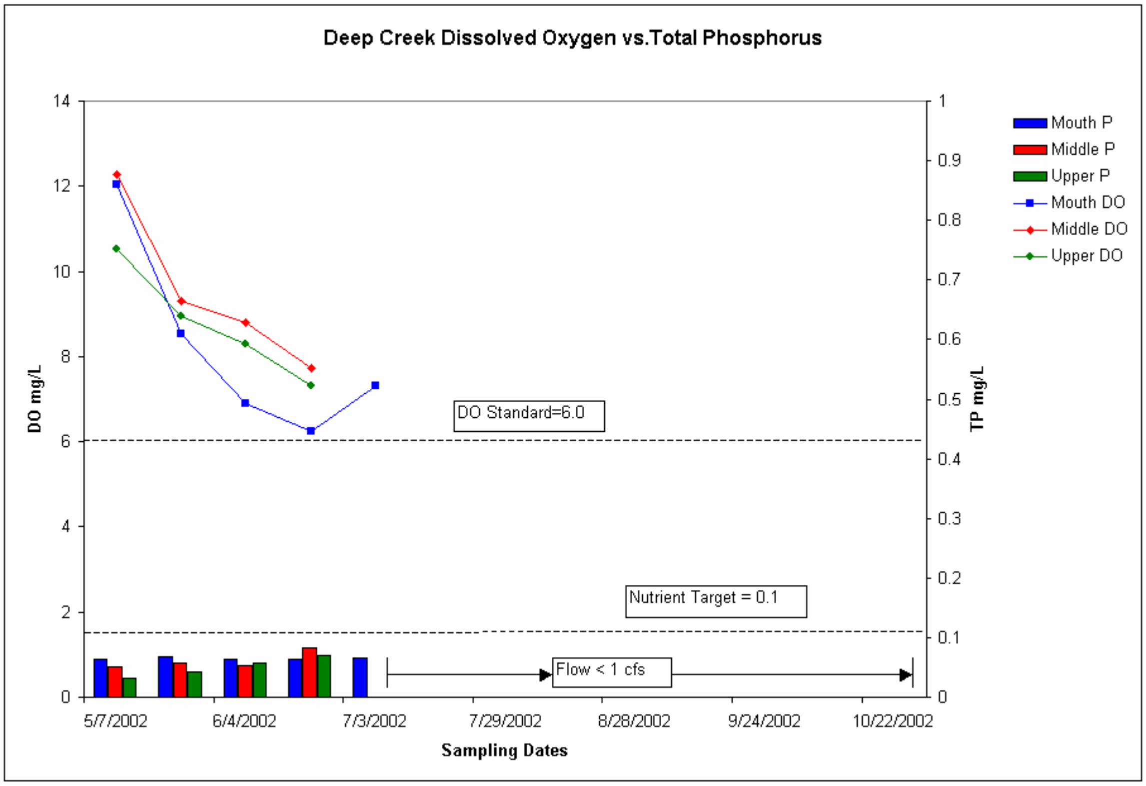


Figure 2-12. Deep Creek DO versus Phosphorus Levels

Total suspended solids (TSS), expressed in mg/L, turbidity, expressed in nephlometric turbidity units (NTU), and discharge, expressed in cubic feet per second (cfs), for all three monitoring sites, are displayed in Figures 2-13 through 2-15. TSS is a weighted measure of the total solid concentrations in the water, whether the particles are mineral (such as soil particles) or organic (such as plants). An NTU is a measure of turbidity based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions. These two measures are the standard indicators for sediment level concentration in surface water applications nationwide. Idaho State Standards for sediment state that sediment levels shall not impair designated beneficial uses and that turbidity shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more then ten consecutive days.

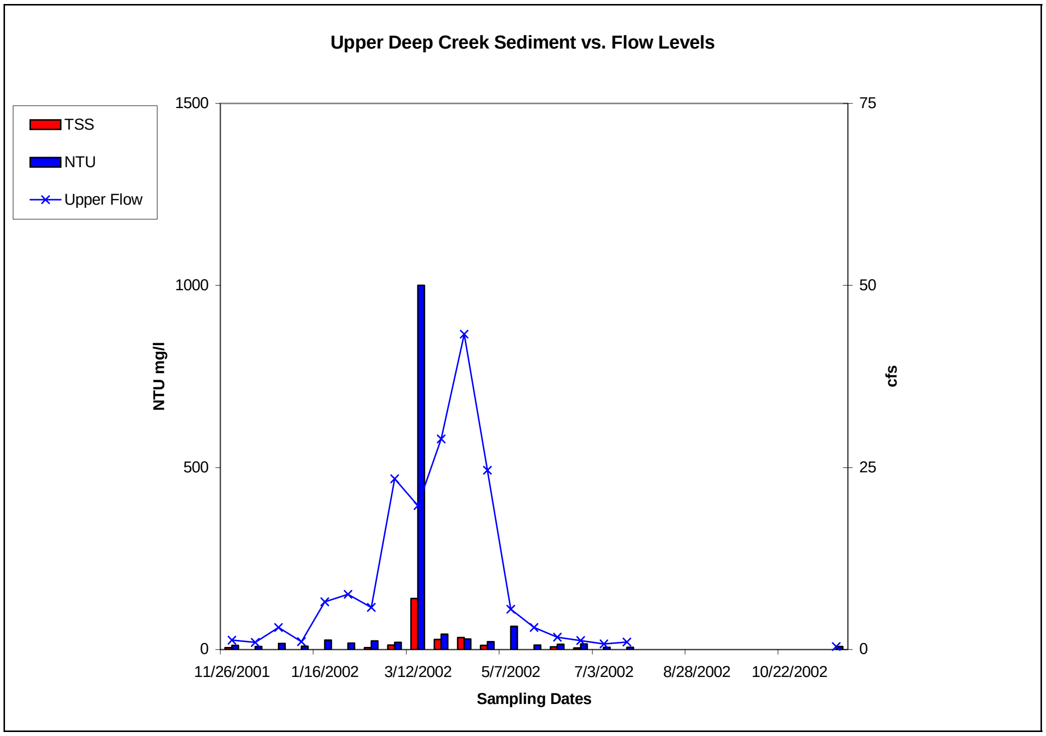


Figure 2-13. Deep Creek–Upper Sediment Levels

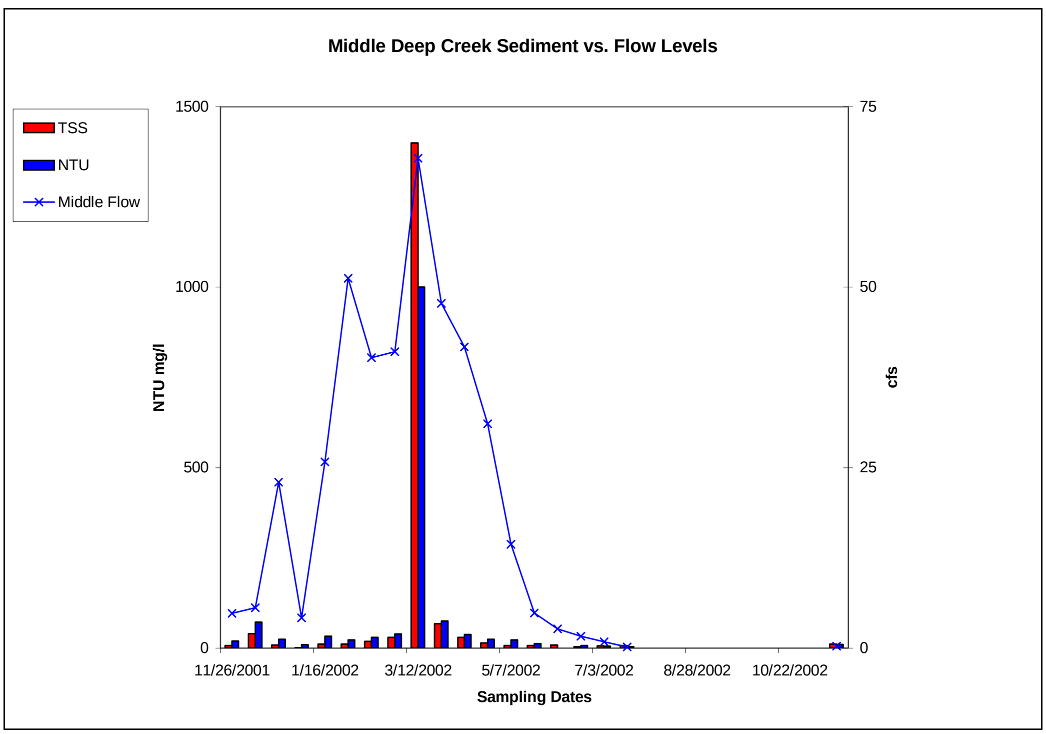


Figure 2-14. Deep Creek-Middle Sediment Levels

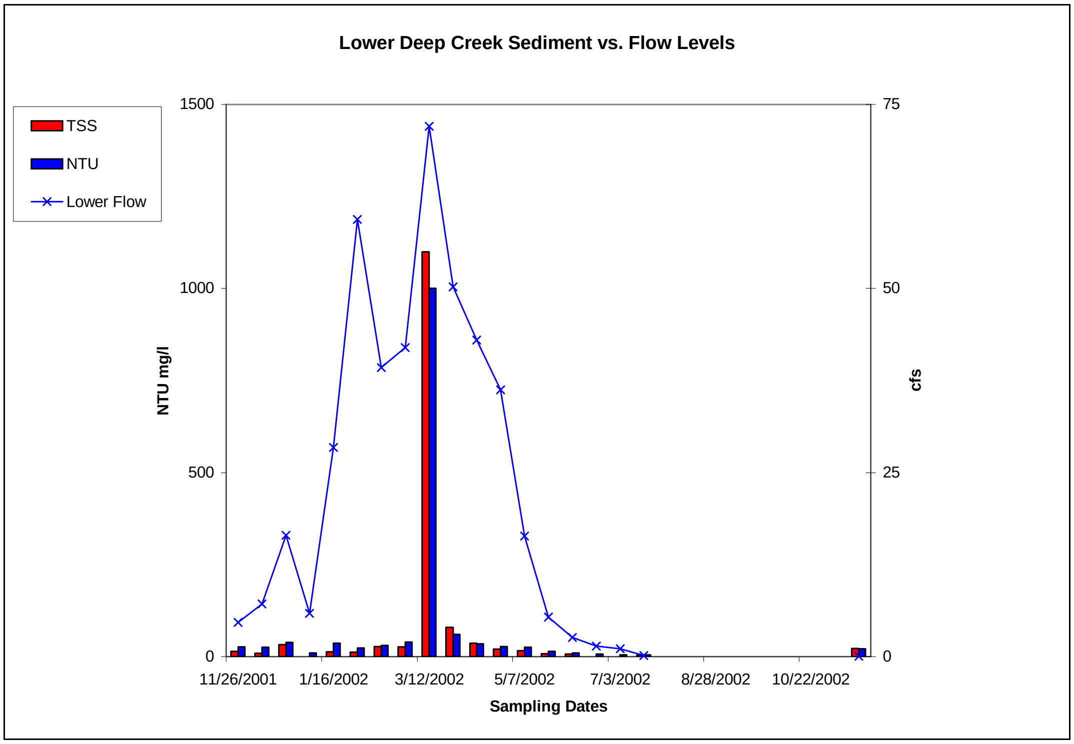


Figure 2-15. Deep Creek -Lower- Sediment Levels

Figures 2-13 through 2-15 display data from one point in time, repeated approximately every two weeks, for the period November 2001-November 2002. To determine if sediment levels were above state standards and impairing beneficial uses, additional calculations and assumptions were made, and a more thorough discharge profile for Deep Creek was developed. This profile is based on ten years of data collected at the USGS Palouse River gage site, watershed size differences between Deep Creek and the Palouse River, and in-stream flows collected for Deep Creek during November 2001-November 2002.

Figures 2-13 through 2-15 display numeric relationships between discharge and NTU, discharge and TSS, and NTU and TSS. These relationships can be expressed as mathematical equations, called regression equations. The regression equations used to calculate values for TSS, NTU, background TSS, background NTU and TSS levels over background are located in Appendix B. Figure 2-16 is a graph of the sediment level amounts over background for Deep Creek over a ten-year period. Based on the sediment data collected, the mathematical relationships established in this TMDL, and previous BURP data, sediment levels over background are impairing beneficial uses; therefore a sediment TMDL will be developed for Deep Creek.

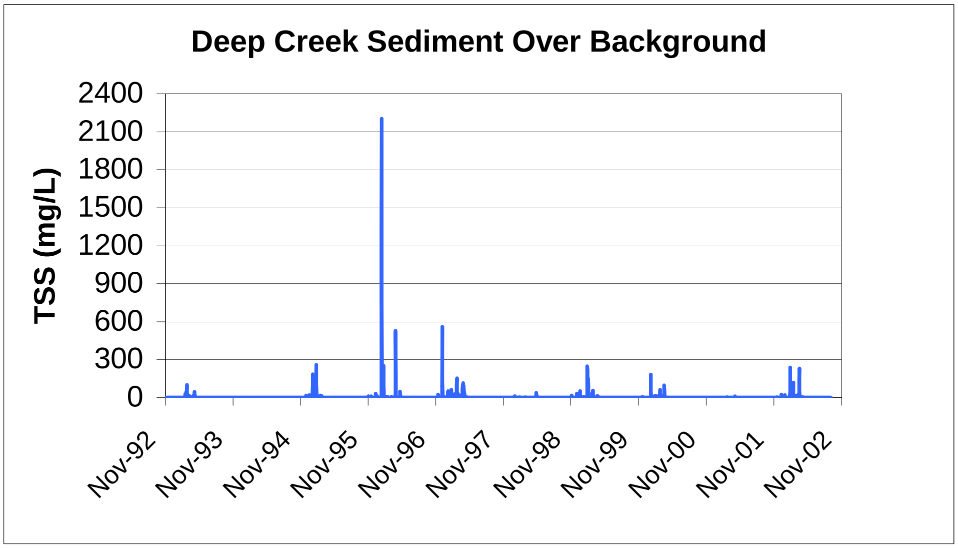


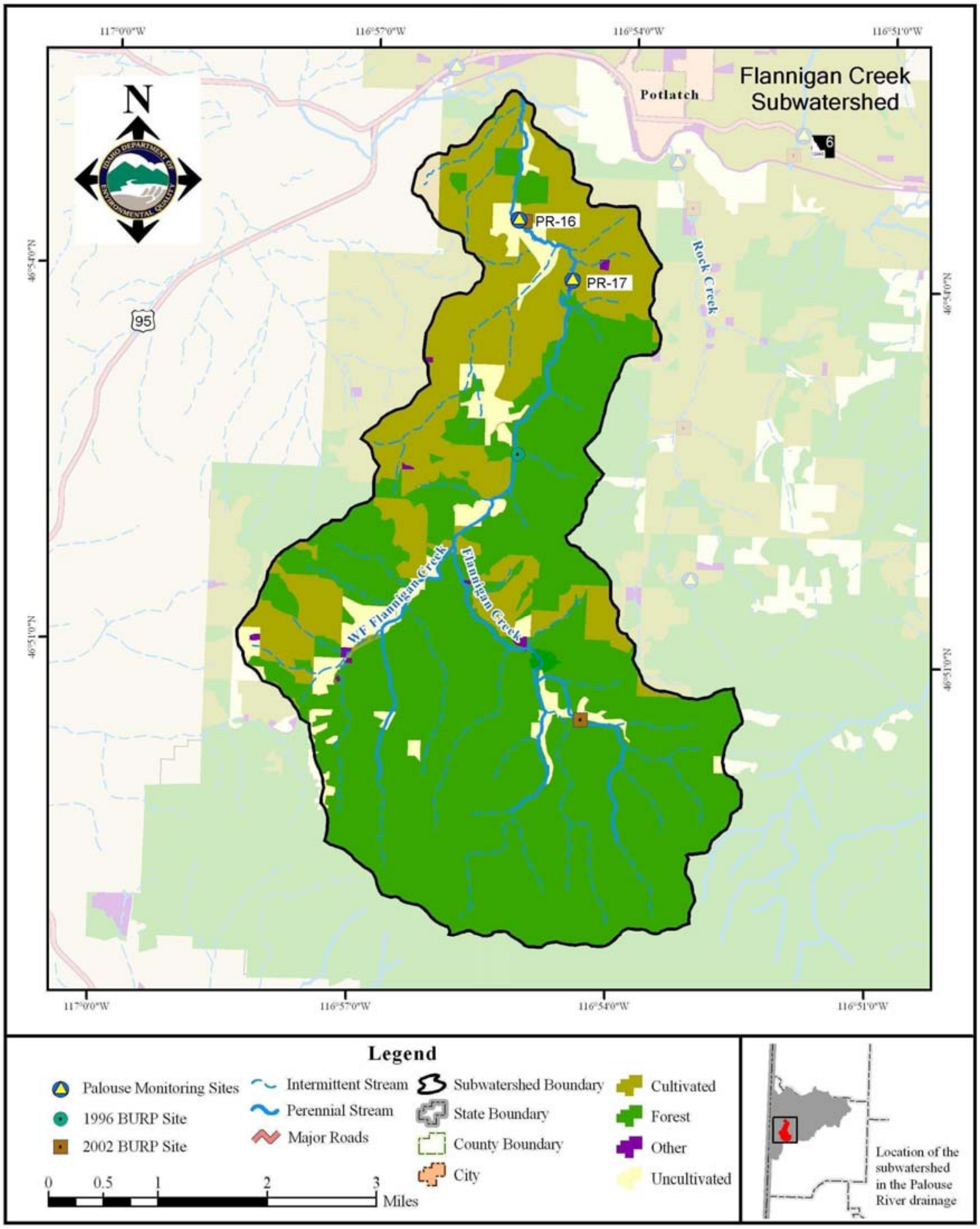
Figure 2-16. Deep Creek over background

Flannigan Creek

Flannigan Creek is 303(d)-listed for sediment, temperature, nutrients, and bacteria. The boundaries are defined as headwaters to Palouse River. Flannigan Creek is a third order stream at its confluence with Palouse River, and the headwaters originate off the north side of Moscow Mountain and the Palouse Range Mountains. The entire basin is shown on Map 2-3.

The Flannigan Creek Watershed is 19.16 square miles in size (12,261 acres). Most of the land in Flannigan Creek is under private ownership. Bennett Lumber owns and manages the land in the headwaters and the state of Idaho manages some small areas as well. The primary land uses in the watershed are agriculture, grazing, forestry, urbanization and recreation.

Flannigan Creek generally flows from south to north, and the basic drainage pattern could be described as dendritic. Elevations range from 2,484 feet to 4,553 feet. The geology of the upper watershed is weathered granitics while the mid to lower portions of the watershed is dominated by the Palouse Loess. The valley bottom of the lower main stem Flannigan Creek and tributaries are underlain by coarse textured alluvium. Basalt outcroppings underlay the Palouse Loess in the lower half of the watershed, and in the valley bottoms, along the lowest portion of Flannigan Creek, coarse textured alluvium is present.



Map 2-3. Flannigan Creek Subwatershed

Two major tributaries, the West Fork of Flannigan Creek and the main stem Flannigan Creek, join about mid-way in the watershed. Landownership with the Flannigan Creek watershed is almost entirely private. The lower monitoring site (PR-16) is about a mile from the mouth and the upper monitoring site (PR-17) is about another mile upstream.

Agricultural, grazing, and forestry are the major land uses in the watershed. Several homes within the watershed are located near a stream and there are probably more homes within the Flannigan Creek watershed than the other 303(d) listed watersheds. Flannigan Creek itself is a perennial stream; however, some of the tributary streams in the headwaters are intermittent. Rainbow trout, dace, suckers, shiners, and northern pike minnows are some the species found in Flannigan Creek.

Status of beneficial uses

Results from the 2001-2002 field season are displayed in Figures 2-17 through 2-24. Sediment, temperature, nutrients, and bacteria in Flannigan Creek are impairing beneficial uses. The next few paragraphs will help illustrate why sediment, temperature, nutrient, and bacteria TMDLs are required for Flannigan Creek.

Bacteria data displayed in Figure 2-17 shows numerous exceedances of the state bacteria standard for secondary contact recreation. Both sites exceeded this value several times during the 2001-2002 monitoring season. Flannigan Creek is water quality impaired by bacteria; therefore, a bacteria TMDL will be written for Flannigan Creek.

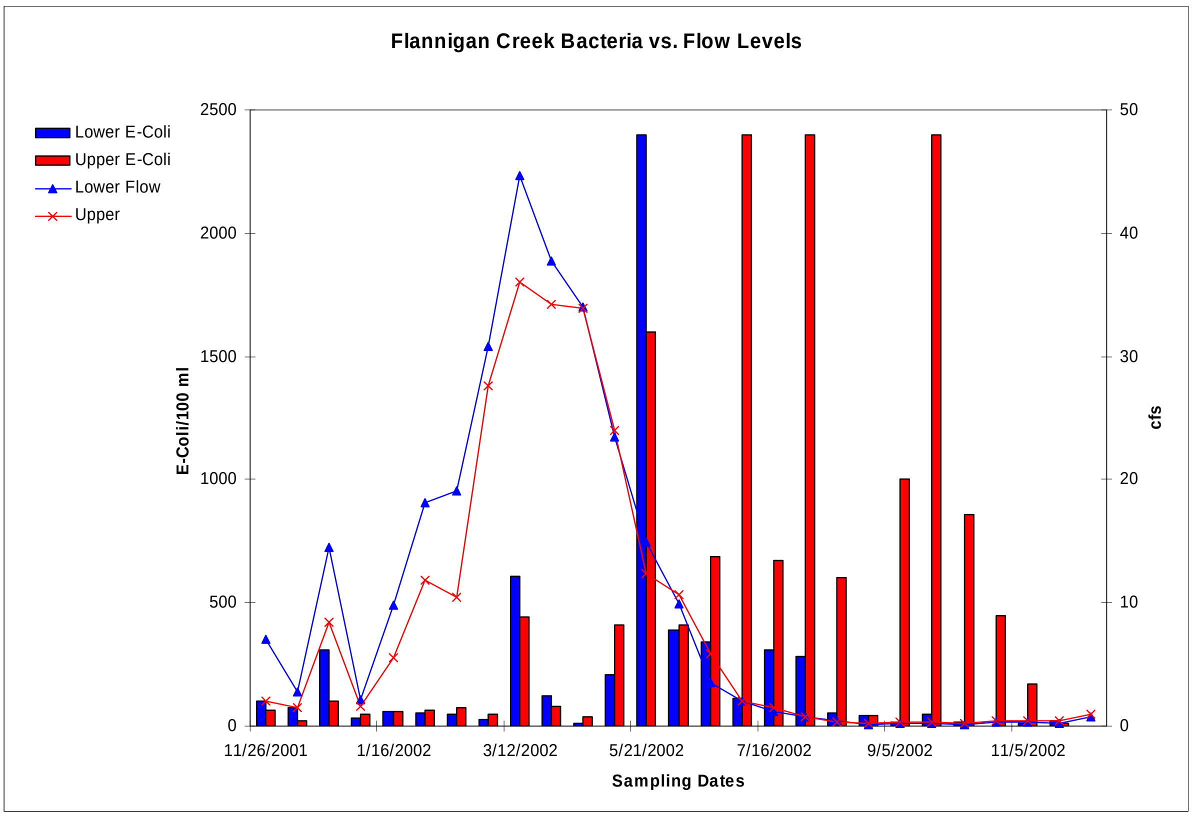


Figure 2-17. Flannigan Creek Bacteria Levels

A continuous temperature data logger probe was placed near the lower monitoring site (PR-16). The probe recorded temperature readings every hour from mid-May 2002 through early

November 2002. The results are displayed in Figure 2-18. During this period, temperatures exceeded the Idaho cold water aquatic life daily average (ICWB-Ave) of 19 ^{o} C and the Idaho salmonid spawning daily average (ISS-Ave) of 9 ^{o} C. Based on this information a temperature TMDL will be developed for Flannigan Creek.

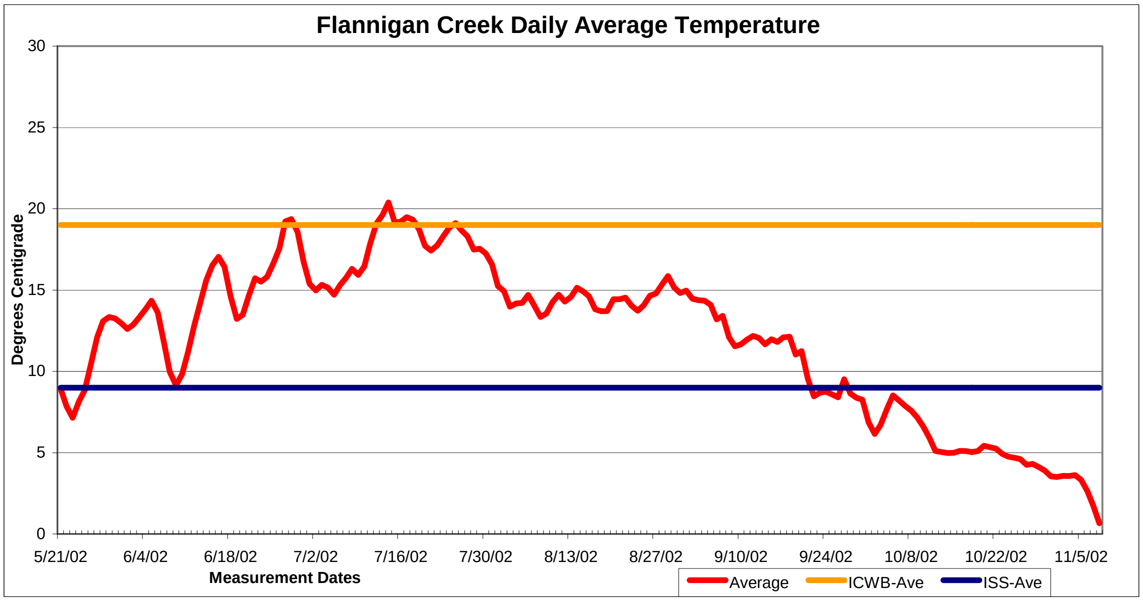


Figure 2-18. Flannigan Creek Temperature

The nutrient data are displayed in Figures 2-19 through 2-21 and Table 2-7.

A nutrient TMDL will be developed for Flannigan Creek. High total nitrogen (NO2+NO3) levels were recorded during the late fall, winter, and early spring months during the time of winter fertilizer application. Ammonia levels were at the minimum detection limit except for two relatively small increases at the lower site.

A background level of 0.035 mg/L was established based on data collected at four reference watersheds. Based on background levels, DO trends, and other regional nutrient TMDL targets, a value of 0.10 mg/L total phosphorus (TP) was established as the load capacity for this TMDL during the growing season. In addition to the TP target, DO levels must remain above 6.0 mg/L during the growing season. The nutrient target is also based on a numeric state standard for dissolved oxygen requiring the level to be greater than 6.0 mg/L at all times, and a narrative target stating that surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. DEQ believes that by keeping TP levels below 0.10 mg/L, and by increasing stream flows, DO levels should remain above 6.0 mg/L and thereby not impair beneficial uses. Low summer flows contributed to the low DO readings in Flannigan Creek. To improve the low summer flow condition, water could be retained during the spring runoff in new or improve wetlands and riparian corridors. The water would then be stored at the surface or in shallow groundwater areas and released during the low summer flow periods and thereby improving the DO situation.

The nutrient target was violated a total of eleven times between both monitoring sites. The phosphorus target was violated a total of ten times, five at each site. Samples were collected from both upper (PR17) and lower (PR16) monitoring sites as outlined in the monitoring plan (Appendix A). Data from the lower site revealed six consecutive bi-weekly exceedances of the nutrient target, five TP reading above 0.10 mg/L and one DO level reading below 6.0 mg/L (Table 2-21). Data from the upper site revealed four consecutive bi-weekly exceedances of the nutrient target including four consecutive TP reading above 0.10 mg/L. Some aquatic plant growth was noted in Flannigan Creek. Based on the frequency and duration of the TP and DO exceedances a TMDL for nutrients will be written for Flannigan Creek.

Table 2-7. Flannigan Creek TP and DO BI-weekly monitoring results during growing season

Date	PR-16 (TP)[1]	PR-16 (DO)[1]	PR-16 (discharge)[2]	PR-17 (TP)[1]	PR-17 (DO)[1]	PR-17 (discharge)[2]
5/7/2002	0.07	12.43	14.91	0.07	11.99	12.42
5/21/2002	0.10	9.92	9.91	0.07	8.34	10.62
6/4/2002	0.09	8.63	3.48	0.09	10.15	5.84
6/18/2002	**0.16**	**7.81**	**2.03**	**0.14**	**8.50**	**2.02**
7/3/2002	**0.13**	**7.05**	**1.21**	**0.19**	**6.74**	**1.50**
7/16/2002	**0.12**	**7.36**	**0.72**	**0.14**	**8.28**	**0.77**
7/29/2002	**0.11**	**6.30**	**0.38**	**0.14**	**6.97**	**0.36**
8/18/2002	**0.10**	**5.70**	**0.10**	0.07	6.79	0.17
8/28/2002	**0.11**	**6.58**	**0.21**	0.08	7.00	0.34
9/5/2002	**0.10**	**6.82**	**0.22**	**0.22**	**6.82**	**0.33**
9/24/2002	0.07	8.23	0.08	0.05	7.90	0.18

Exceedance shown in **bold**
[1] mg/L
[2] cfs

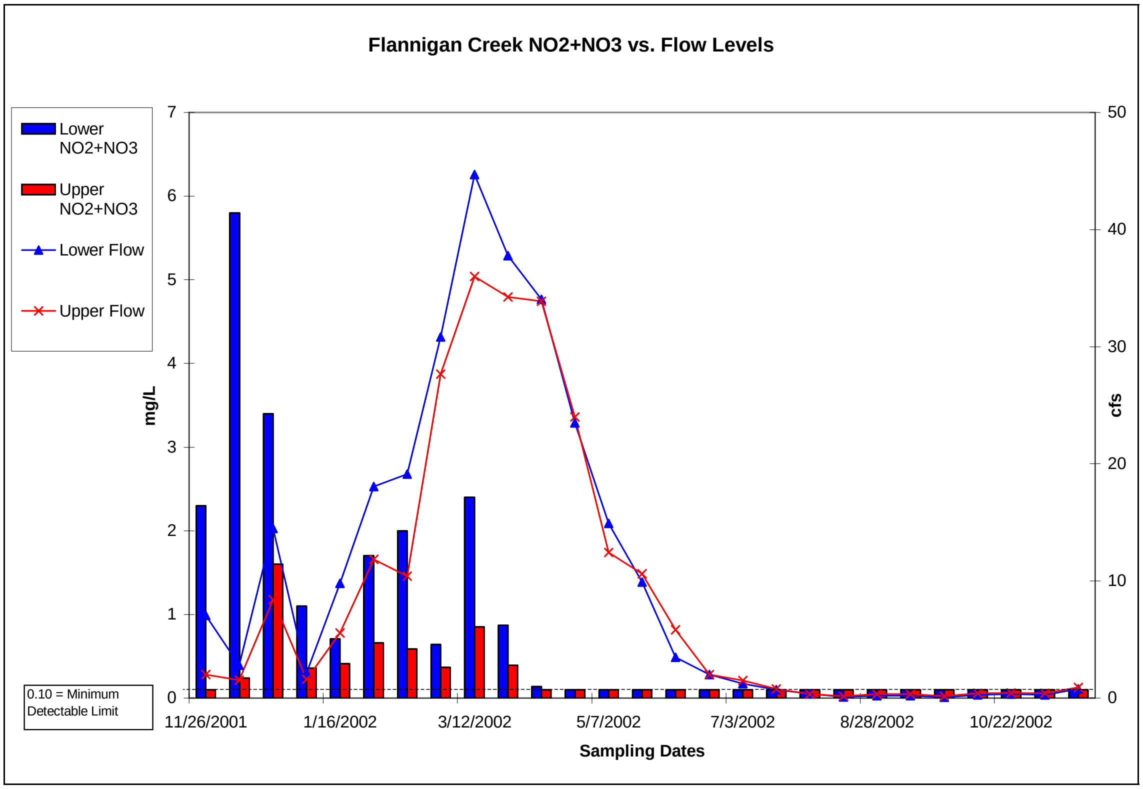


Figure 2-19. Flannigan Creek Total Nitrogen Levels

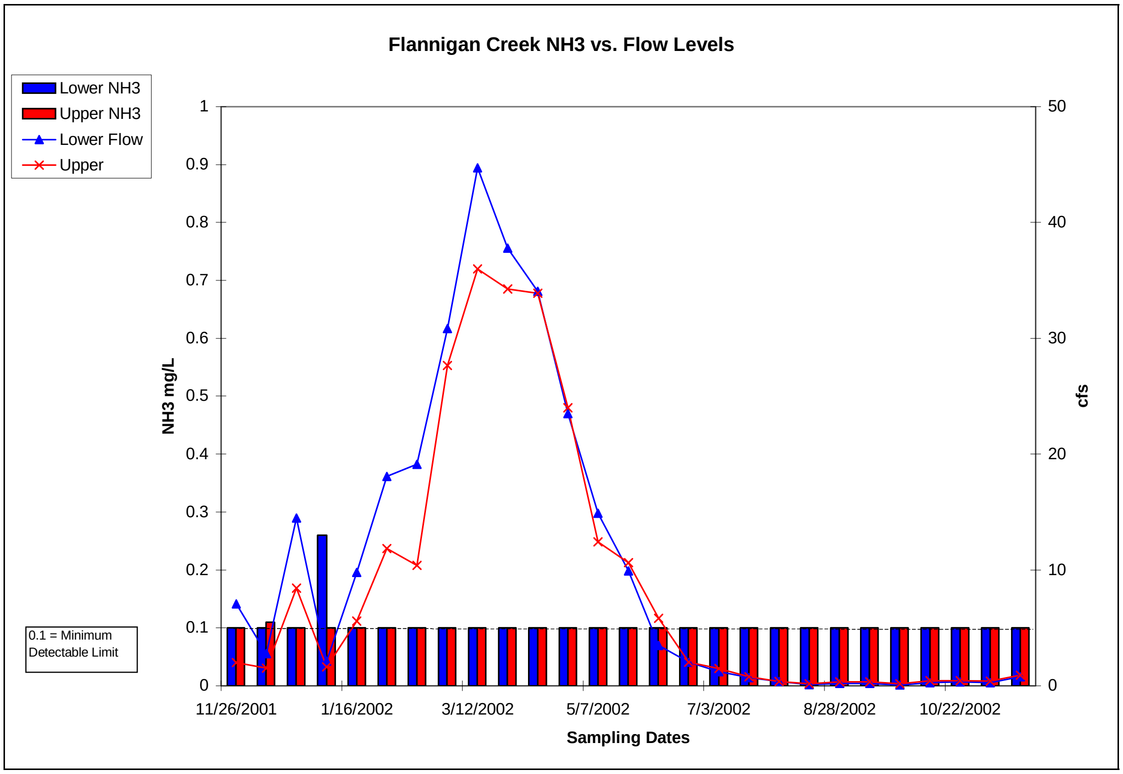


Figure 2-20. Flannigan Creek Ammonia Levels

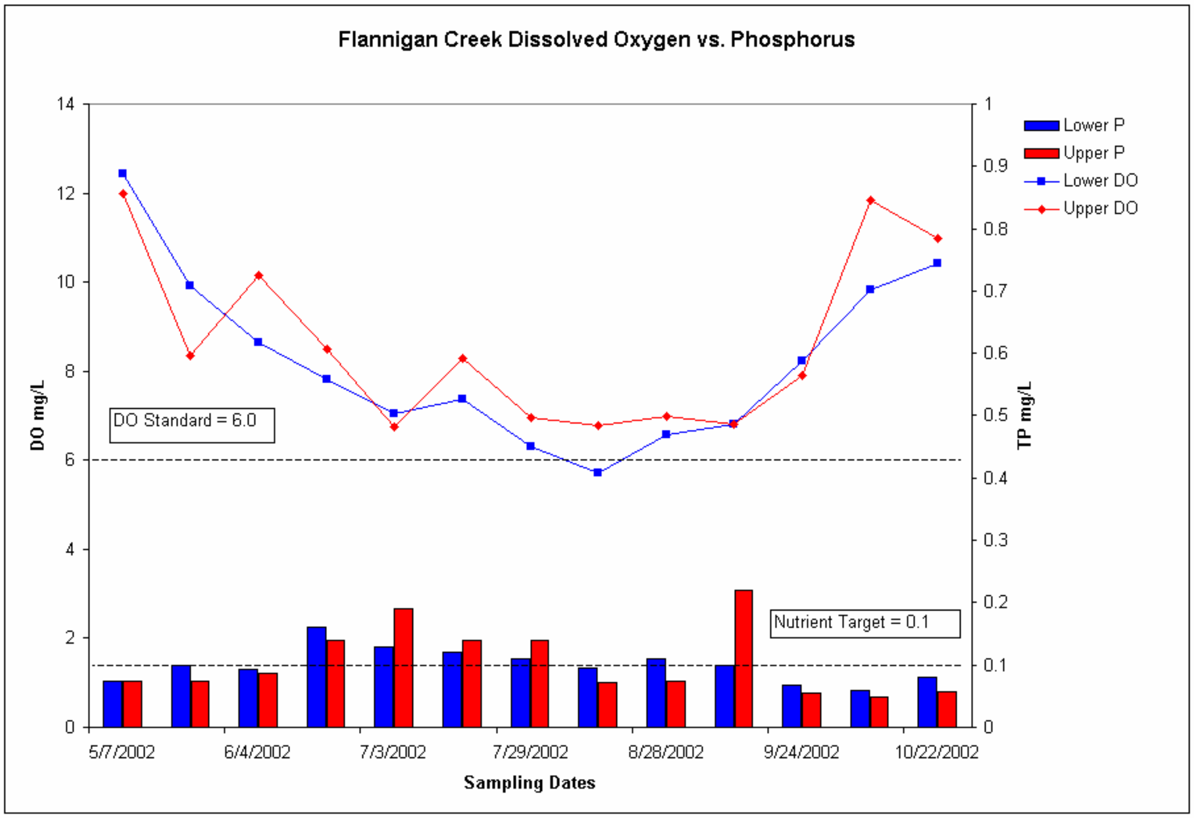


Figure 2-21. Flannigan Creek Phosphorus Levels

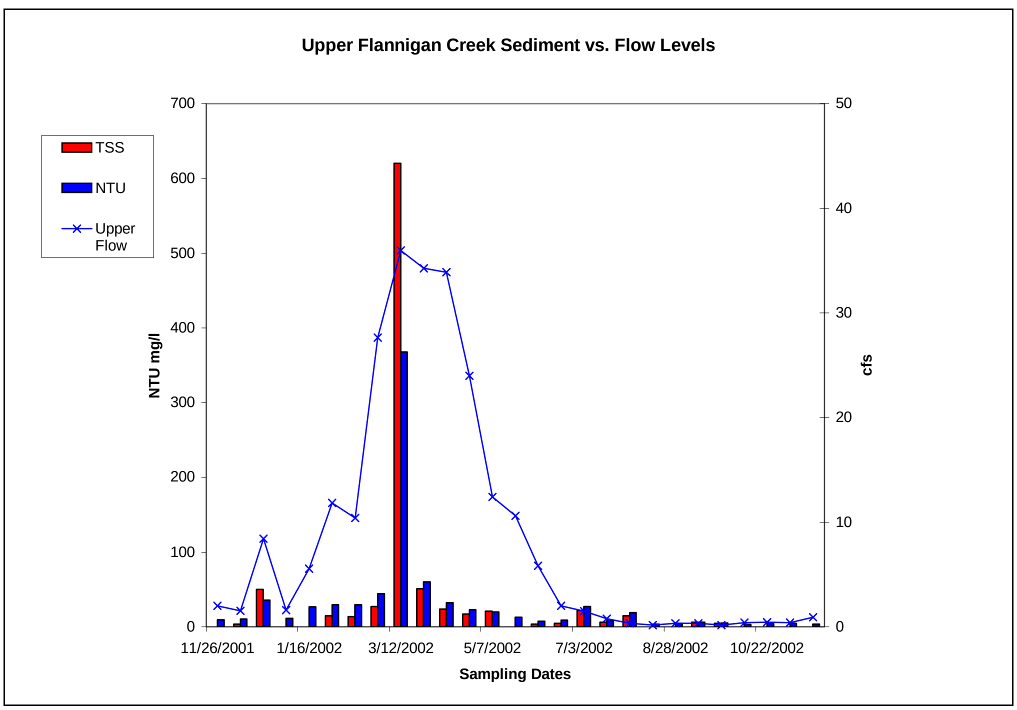


Figure 2-22. Flannigan Creek –Upper- Sediment Levels

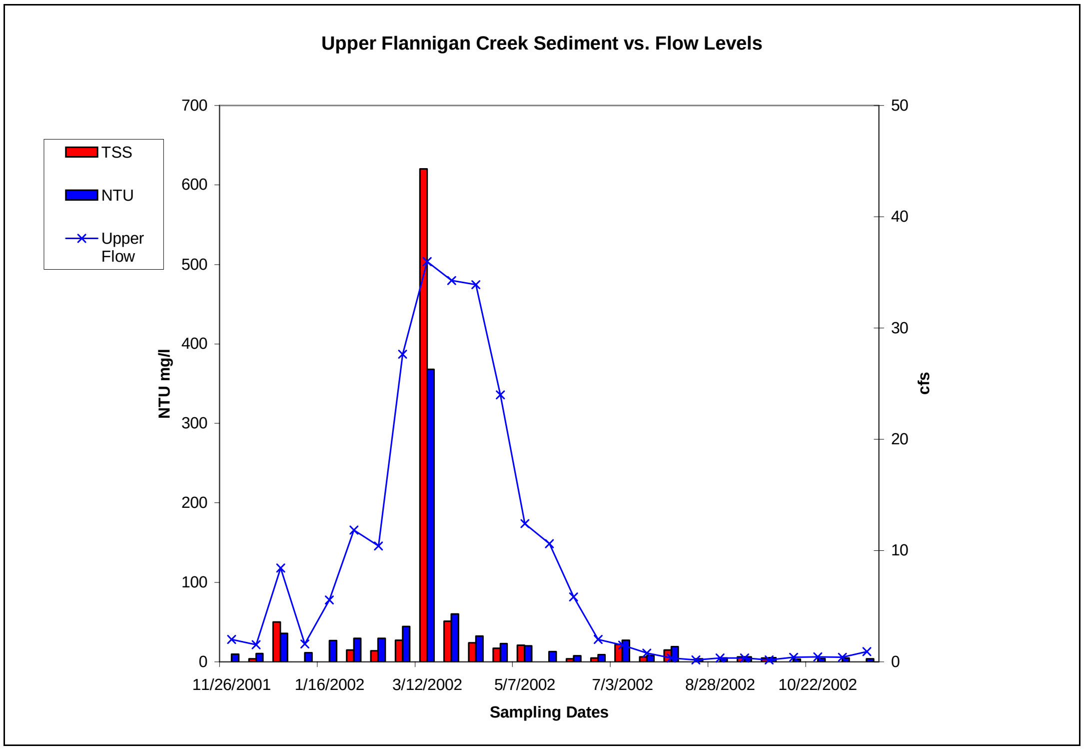


Figure 2-23. Flannigan Creek –Lower- Sediment Levels

Total suspended solids (TSS), expressed in mg/L, turbidity, expressed in nephelometric turbidity units (NTU), and discharge, expressed in cubic feet per second (cfs), for the upper and lower monitoring sites, are displayed in Figures 2-22 and 2-23. TSS is a weighted measure of the total solid concentrations in the water, whether the particles are mineral (such as soil particles) or organic (such as plants). An NTU is a measure of turbidity based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions. These two measures are the standard indicators for sediment level concentration in surface water applications nationwide. Idaho State Standards for sediment state that sediment levels shall not impair designated beneficial uses and that turbidity shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more then ten consecutive days.

Figures 2-22 and 2-23 display data from one point in time, repeated approximately every two weeks for the period November 2001-November 2002. To determine if sediment levels were above state standards and impairing beneficial uses, additional calculations and assumptions were made. First, a more thorough discharge profile for Flannigan Creek was developed. This profile is based on ten years of data collected at the USGS Palouse River gage site, watershed size differences between Flannigan Creek and the Palouse River, and in-stream flows collected for Flannigan Creek during November 2001-November 2002.

The data shown displays numeric relationships between discharge and NTU, discharge and TSS, and NTU and TSS. These relationships can be expressed as mathematical equations, called regression equations. The regression equations used to calculate values for TSS, NTU, background TSS, background NTU and TSS levels over background are located in Appendix B. Figure 2-24 is a graph of the sediment level amounts over background for Flannigan Creek over a ten-year period. Based on the sediment data collected, the mathematical relationships established in this TMDL, and previous BURP data, sediment levels over background are impairing beneficial uses; therefore a sediment TMDL will be developed for Flannigan Creek.

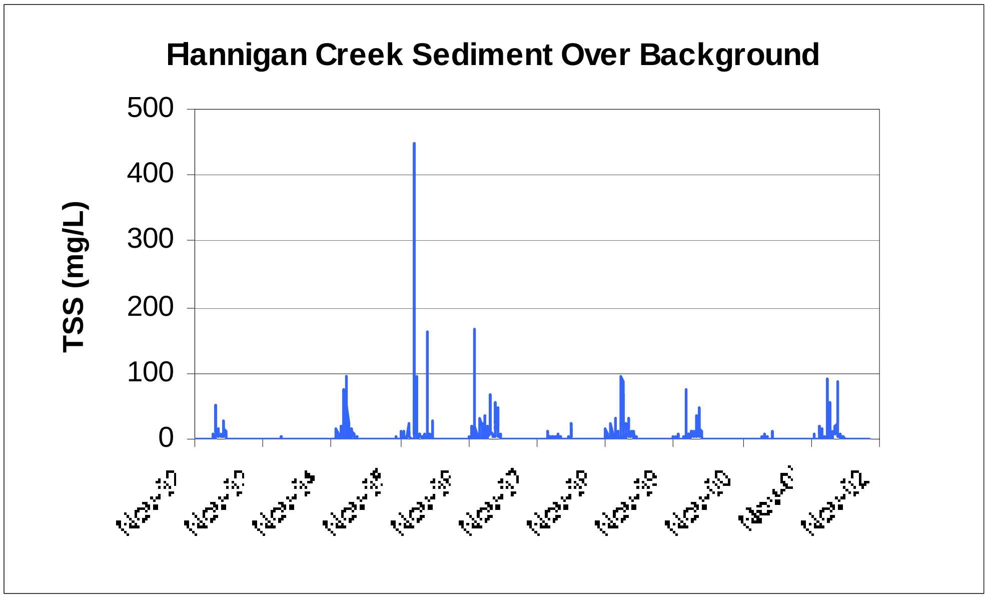


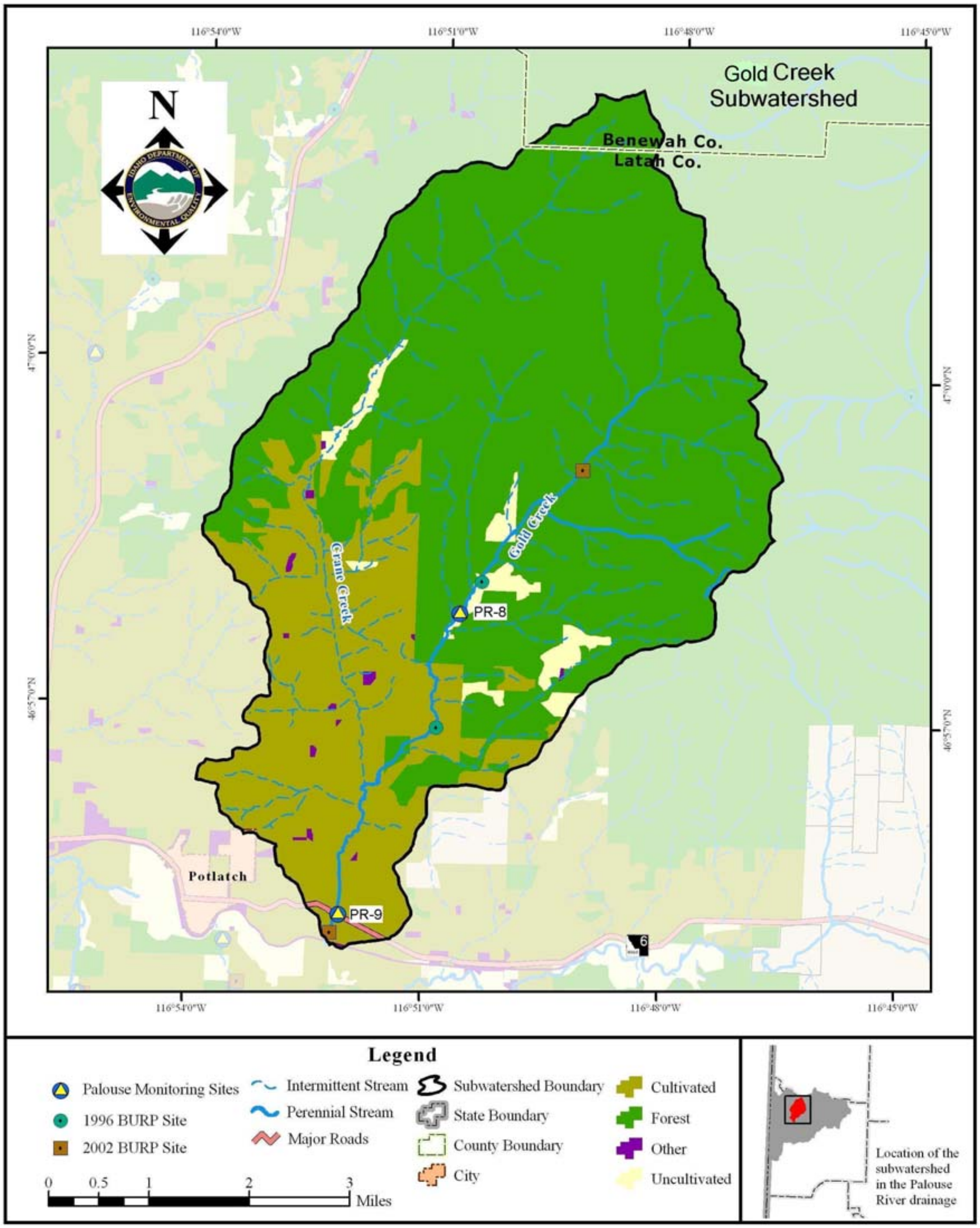
Figure 2-24. Flannigan Creek –Sediment Levels Over Background

Gold Creek

Gold Creek is 303(d)-listed for sediment, temperature, nutrients, and bacteria. The boundaries are defined as headwaters to Palouse River. Gold Creek is a fourth order stream at its confluence with the Palouse River. The headwaters originate off Crane Point and the west sides of Gold Hill and Prospect Peak. The entire basin is shown on Map 2-4.

The Gold Creek Watershed is 28.26 square miles in size (18,089 acres). Land ownership is mixed in this watershed. The upper most portion of the watershed is managed by the CNF. Bennett Corporation owns the uppermost portion of Crane Creek, a main tributary to Gold Creek. Potlatch Corporation owns the middle section of the watershed and the lower portion of the watershed is under private ownership. The major land uses in upper portion of this watershed are forestry and recreation while the major land uses the lower portion are agriculture, grazing, urbanization, forestry and recreation.

Gold Creek generally flows from north to south and the basic drainage pattern could be described as dendritic. Elevations range from 2,504 feet to 4,677 feet. Most of the upper watershed is of highly weathered metasediments although Gold Mountain, which occupies the upper eastern portion of the watershed, is a weathered granitic outcrop. The surface geology of the lower half of the watershed is of Palouse Loess. Basalt outcroppings appear underneath the Palouse Loess in the lower portions of the watershed. The valley bottoms along the lower Gold and Crane Creek have coarse textured alluvium sediment deposition present.



Map 2-4. Gold Creek Subwatershed

Crane Creek is the largest tributary to Gold Creek, while Hoteling Creek, Waterhole Creek, and the east fork of Gold Creek are other major tributaries to Gold Creek. The upper monitoring site (PR-8) is located just upstream of the forest-to-agriculture land-use boundary. Upstream from the upper monitoring site, forestry is the dominant land use while below the site agriculture is the dominant land use. The lower monitoring site is only a few feet from the mouth near the Gold Creek Seed/Totem Feeds business. Several homes in the lower half of the watershed are located near a stream.

Gold Creek itself is a perennial stream; however, some of the tributary streams in the headwaters are intermittent. Rainbow trout, brook trout and sculpin inhabit the upper half of the watershed while dace, suckers, shiners, and northern pike minnows inhabit the lower portion of the watershed.

Status of beneficial uses

Results from the 2001-2002 field season are displayed in Figures 2-25 through 2-32. Beneficial uses are being impaired by sediment, bacteria and temperature in Gold Creek. DEQ will write a TMDLs for sediment, temperature, bacteria for Gold Creek. DEQ recommends that Gold Creek be de-listed for nutrients, as conclusions drawn from the in-stream water quality data indicate nutrient levels are not impairing beneficial uses.

Bacteria data displayed in Figure 2-25 show numerous exceedances of the state bacteria standard for secondary contact recreation. Both sites exceeded this value several times during the 2001-2002 monitoring season. Gold Creek is water quality impaired by bacteria; therefore, a bacteria TMDL will be written for Gold Creek.

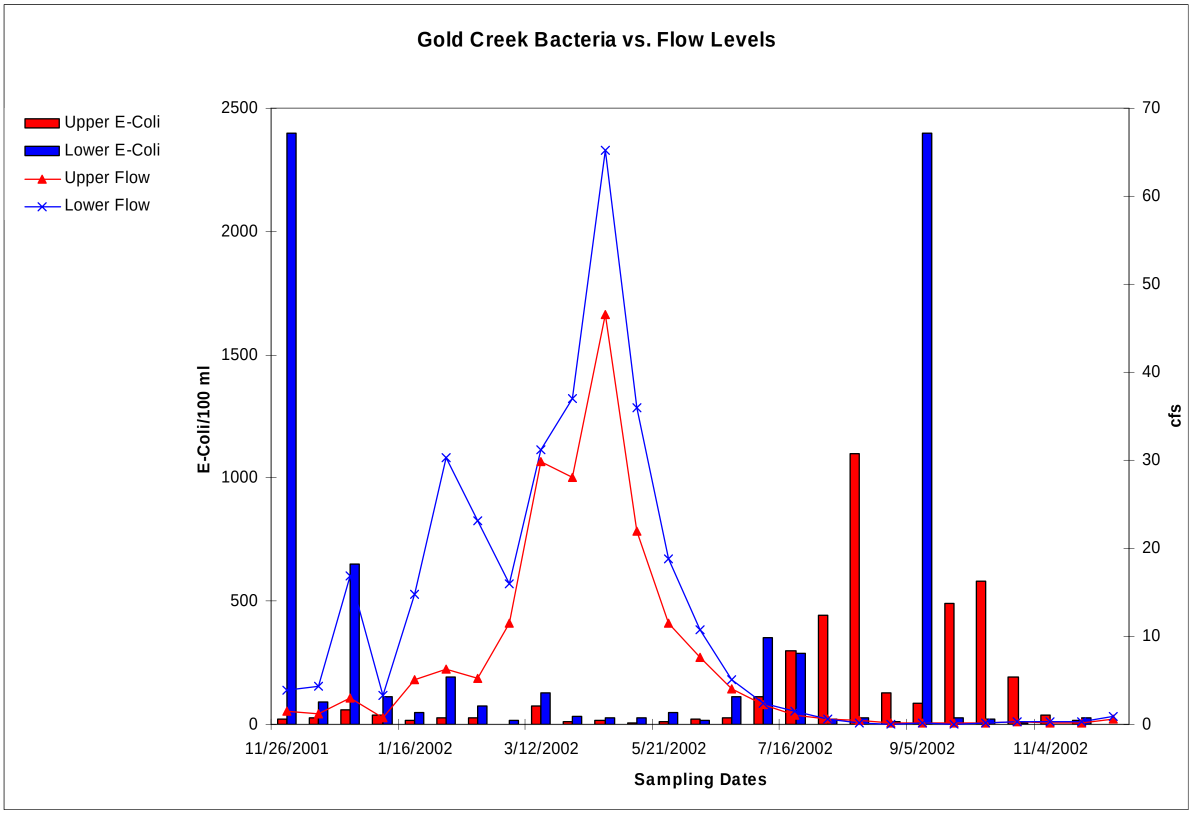


Figure 2-25. Gold Creek Bacteria Levels

A continuous temperature data-logger probe was placed near the upper monitoring site (PR-8). The probe recorded temperature readings every hour from mid-May 2002 through early October 2002; however, the probe was knocked out of the water in mid-July and not discovered until October. The results from mid-May through mid-July are displayed in Figure 2-26. During this period, temperatures exceeded the Idaho cold water aquatic life daily average (ICWB-Ave) of 19^{o} C, and the Idaho salmonid spawning daily average (ISS-Ave) of 9^{o} C. Based on this information, a temperature TMDL will be developed for Gold Creek.

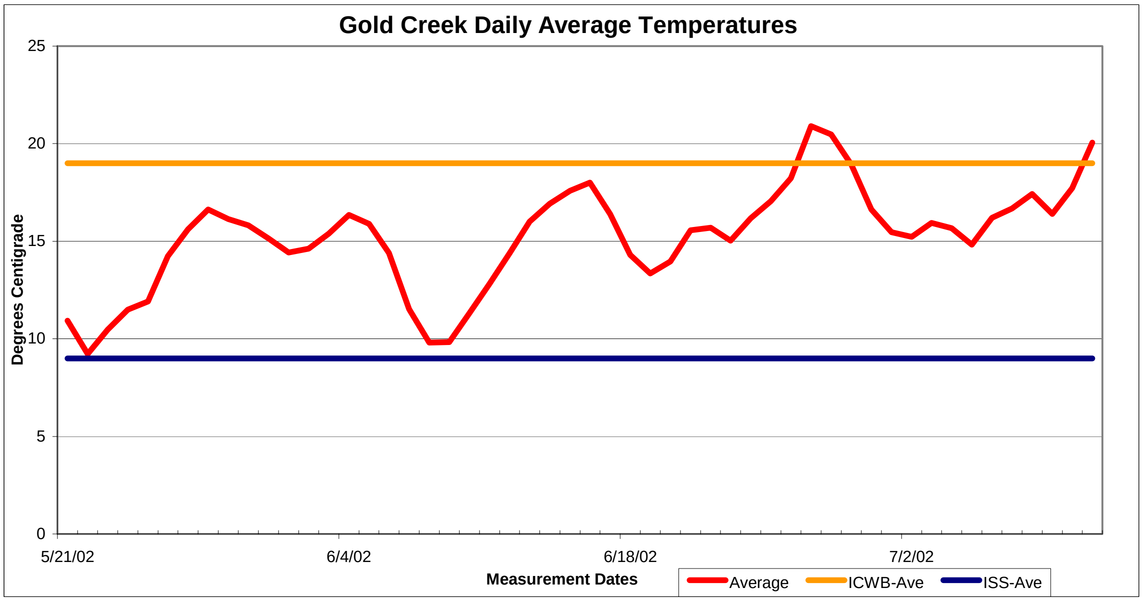


Figure 2-26. Gold Creek Temperature

The nutrient data are displayed in Figures 2-27 through 2-29. A target of 0.10 mg/L total phosphorus (TP) and/or a dissolved oxygen level below 6.0 mg/L during the growing season was established for this TMDL. Ammonia levels were at the minimum detection limit except for a few minor increases. Nitrogen levels were below surface water guidelines, although some nitrogen levels were detected in the lower site.

The nutrient target is based on a numeric state standard for dissolved oxygen requiring the level to be greater than 6.0 mg/L at all times, and a narrative target stating that surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. The lower site had one violation of the DO standard.

The upper site had one exceedance of the TP target; however, the exceedance seems somewhat of an anomaly for the upper site. The violation was in September and was an order of magnitude larger than the other results. This could have been an error at the lab after collection, an error sometime during the preparation (perhaps in the sample container), during collection in the field, or during the transportation and transfer of the sample. DEQ believes this reading to be an error, and although it is displayed in Figure 2-29 and in Table 2-1, we are not including that point for TMDL analysis.

Within the Water Body Assessment Guidance (Grafe etc, 2002), section 5.2.1, DEQ guidance allows for some exceedances provided if the exceedances are less than 10 percent of the total data set and there is no other measurable impairment. Gold Creek (lower) violated the DO standard on one occasion, when flow was less than one-tenth (0.1) cubic feet per second (cfs)—a very small trickle.

The nutrient standard is narrative and states that waters should be free of nuisance aquatic growth. Based on sites visits and field crew report, DEQ believes there is not a nuisance aquatic growth problem in Gold Creek. DEQ believes that a lack of flow (minimum flow) is the cause of the low DO reading on 8/18/2002 (Table 2-8). Based on DEQ guidance and field conditions, DEQ recommends that Gold Creek be removed for nutrients as a pollutant.

Table 2-8 Gold Creek TP and DO bi-weekly monitoring results during growing season

Date	PR-9 (TP)[1]	PR-9 (DO)[1]	PR-9 (discharge)[2]	PR-8 (TP)[2]	PR-8 (DO)[1]	PR-8 (discharge)[2]
5/7/2002	0.05	13.15	18.86	0.05	11.58	11.44
5/21/2002	0.06	10.83	10.72	0.04	10.30	7.64
6/4/2002	0.06	11.06	5.14	0.06	10.13	3.96
6/18/2002	0.09	9.88	2.40	0.09	9.04	2.26
7/3/2002	0.06	8.52	1.42	0.06	8.49	1.11
7/16/2002	0.08	9.21	0.53	0.08	7.86	0.62
7/29/2002	0.08	7.03	0.19	0.06	9.00	0.43
8/18/2002	**0.08**	**5.55**	0.03	0.06	7.16	0.10
8/28/2002	0.08	6.62	0.21	0.06	8.65	0.17
9/5/2002	0.06	6.88	0.07	0.19	8.02	0.14
9/24/2002	0.07	8.97	0.09	0.09	9.55	0.14

Exceedance shown in **bold**

[1] mg/L

[2] cfs

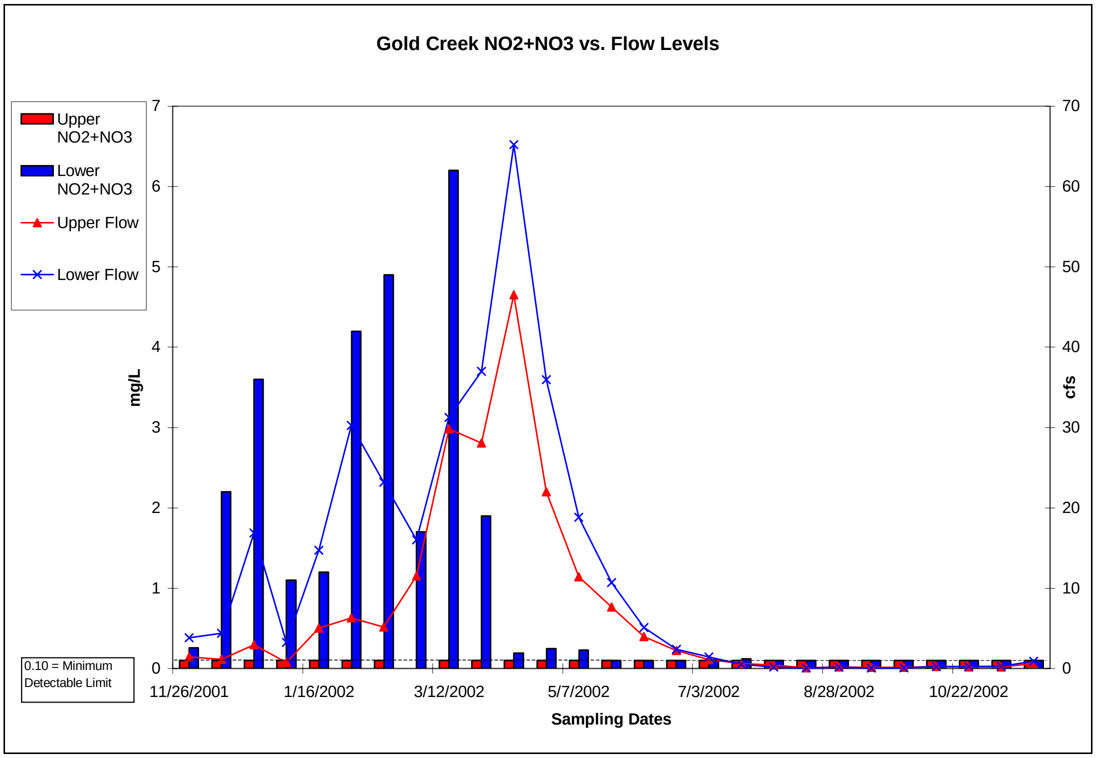


Figure 2-27. Gold Creek Total Nitrogen Levels

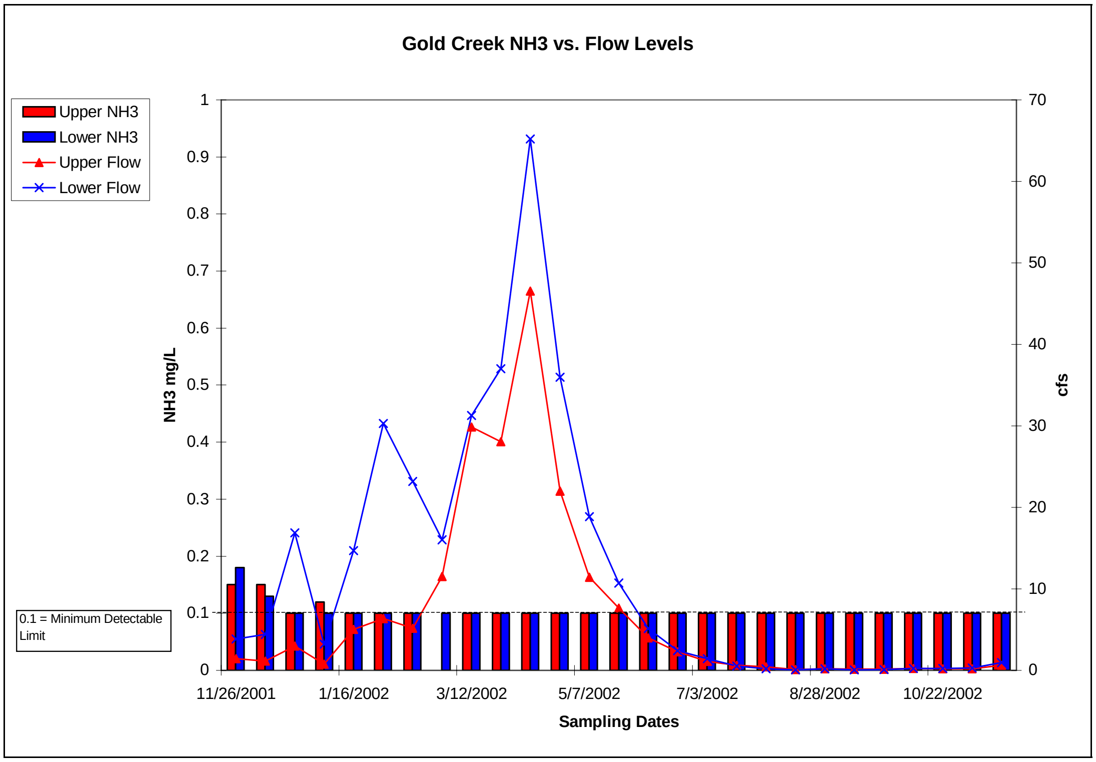


Figure 2-28. Gold Creek Ammonia Levels

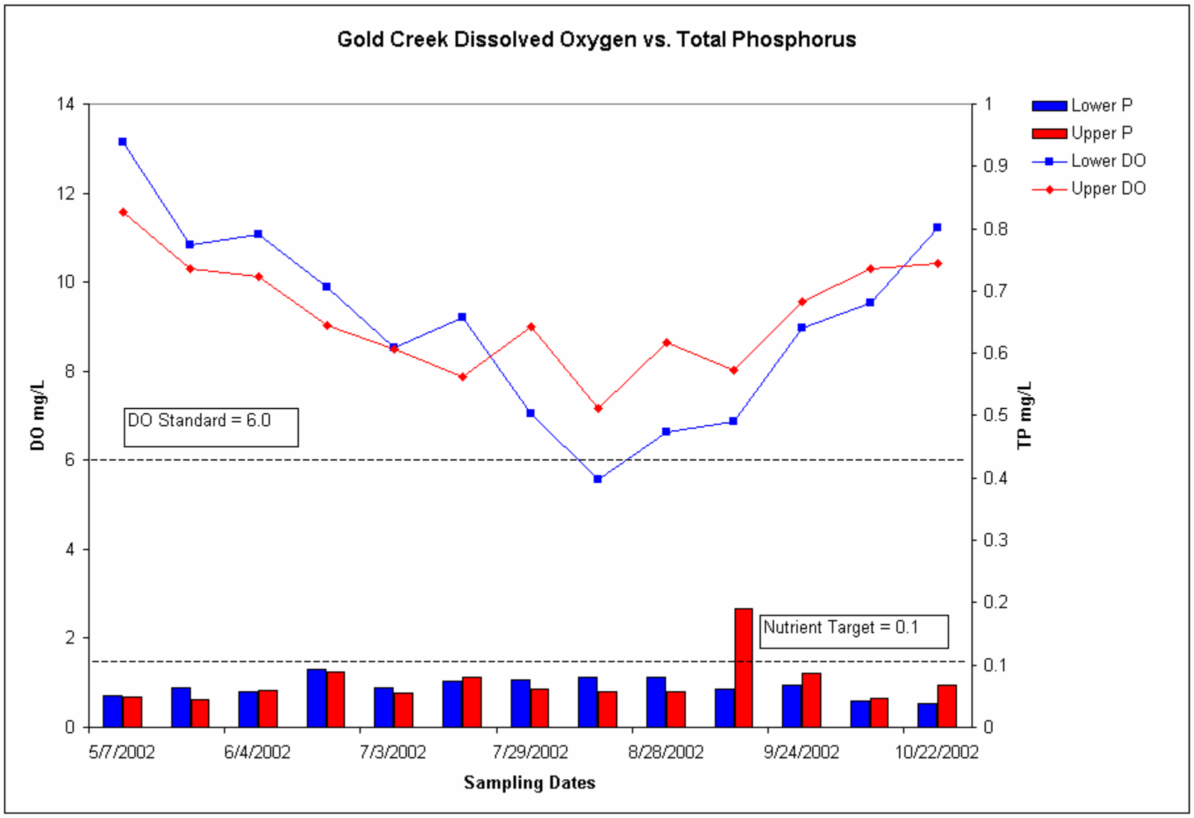


Figure 2-29. Gold Creek DO versus Phosphorus Levels

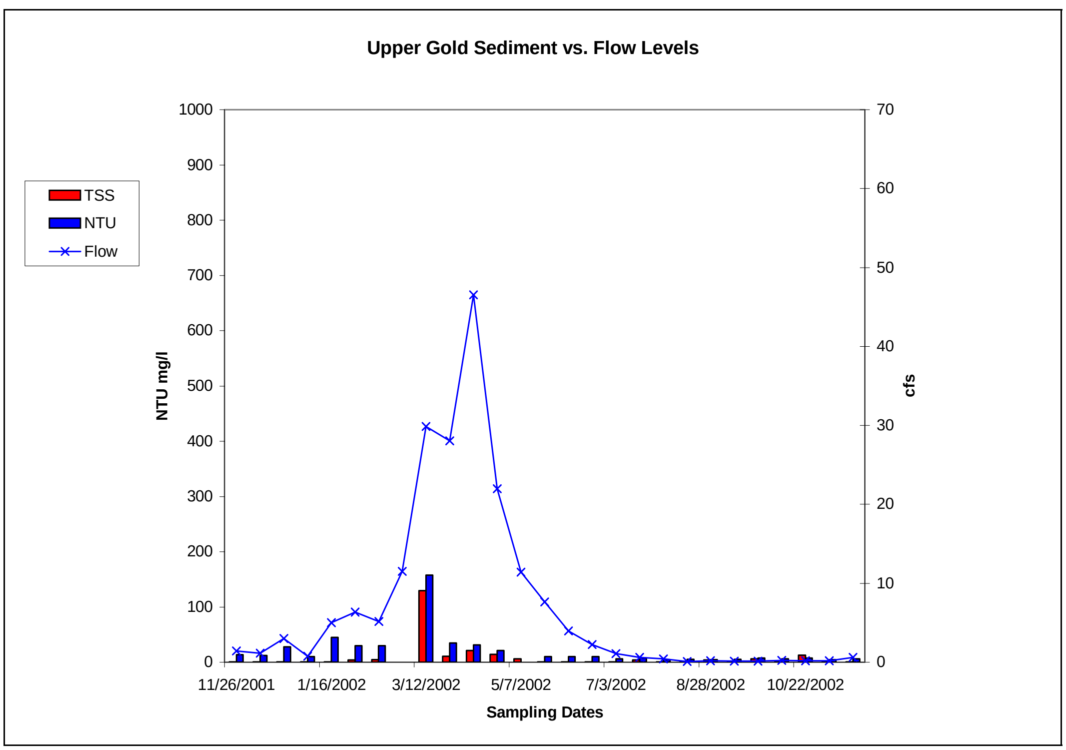


Figure 2-30. Gold Creek –Upper- Sediment Levels

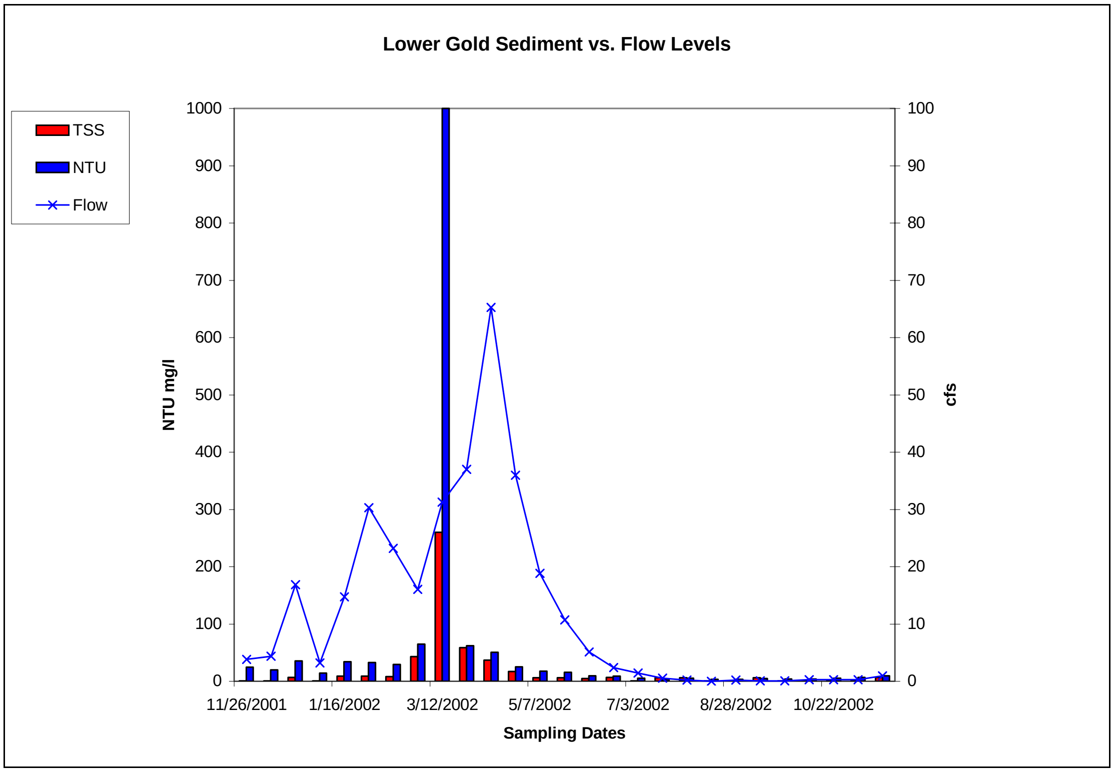


Figure 2-31. Gold Creek –Lower- Sediment Levels

Total suspended solids (TSS), expressed in mg/L, turbidity, expressed in nephelometric turbidity units (NTU), and discharge, expressed in cubic feet per second (cfs), for the upper and lower monitoring sites, are displayed in Figures 2-30 through 2-31. TSS is a weighted measure of the total solid concentrations in the water, whether the particles are mineral (such as soil particles) or organic (such as plants). An NTU is a measure of turbidity based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions. These two measures are the standard indicators for sediment level concentration in surface water applications nationwide. Idaho State Standards for sediment state that sediment levels shall not impair designated beneficial uses and that turbidity shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more then ten consecutive days.

Figures 2-30 and 2-31 display data from one point in time, repeated approximately every two weeks for the period November 2001-November 2002. To determine if sediment levels were above state standards and impairing beneficial uses, additional calculations and assumptions were made. First, a more thorough discharge profile for Gold Creek was developed. This profile is based on ten years of data collected at the USGS Palouse River gage site, watershed size differences between Gold Creek and the Palouse River, and in-stream flows collected for Gold Creek during November 2001-November 2002.

The data shown display numeric relationships between discharge and NTU, discharge and TSS, and NTU and TSS. These relationships can be expressed as mathematical equations, called regression equations. The regression equations used to calculate values for TSS, NTU, background TSS, background NTU and TSS levels over background are located in Appendix B. Figure 2-32 is a graph of the sediment level amounts over background for Gold Creek over a ten-year period. Based on the sediment data collected, the mathematical relationships established in this TMDL, and previous BURP data, sediment levels over background are impairing beneficial uses; therefore a sediment TMDL will be developed for Gold Creek.

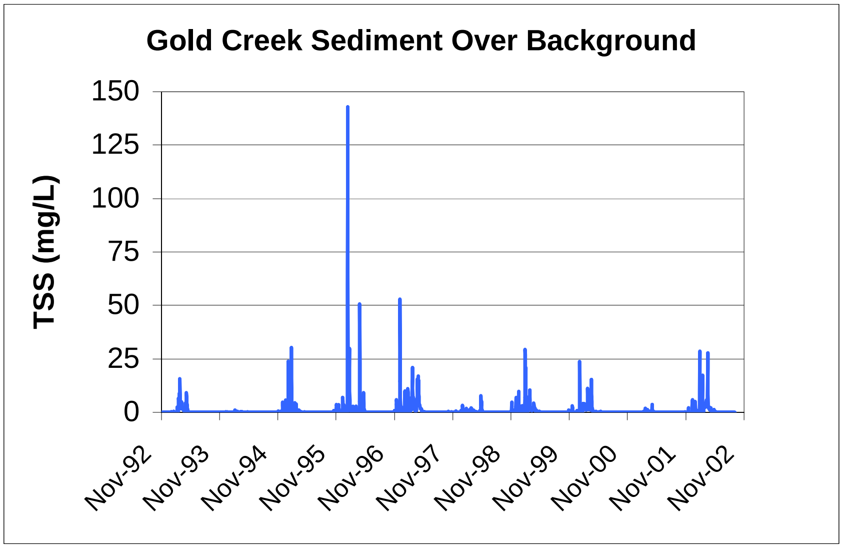


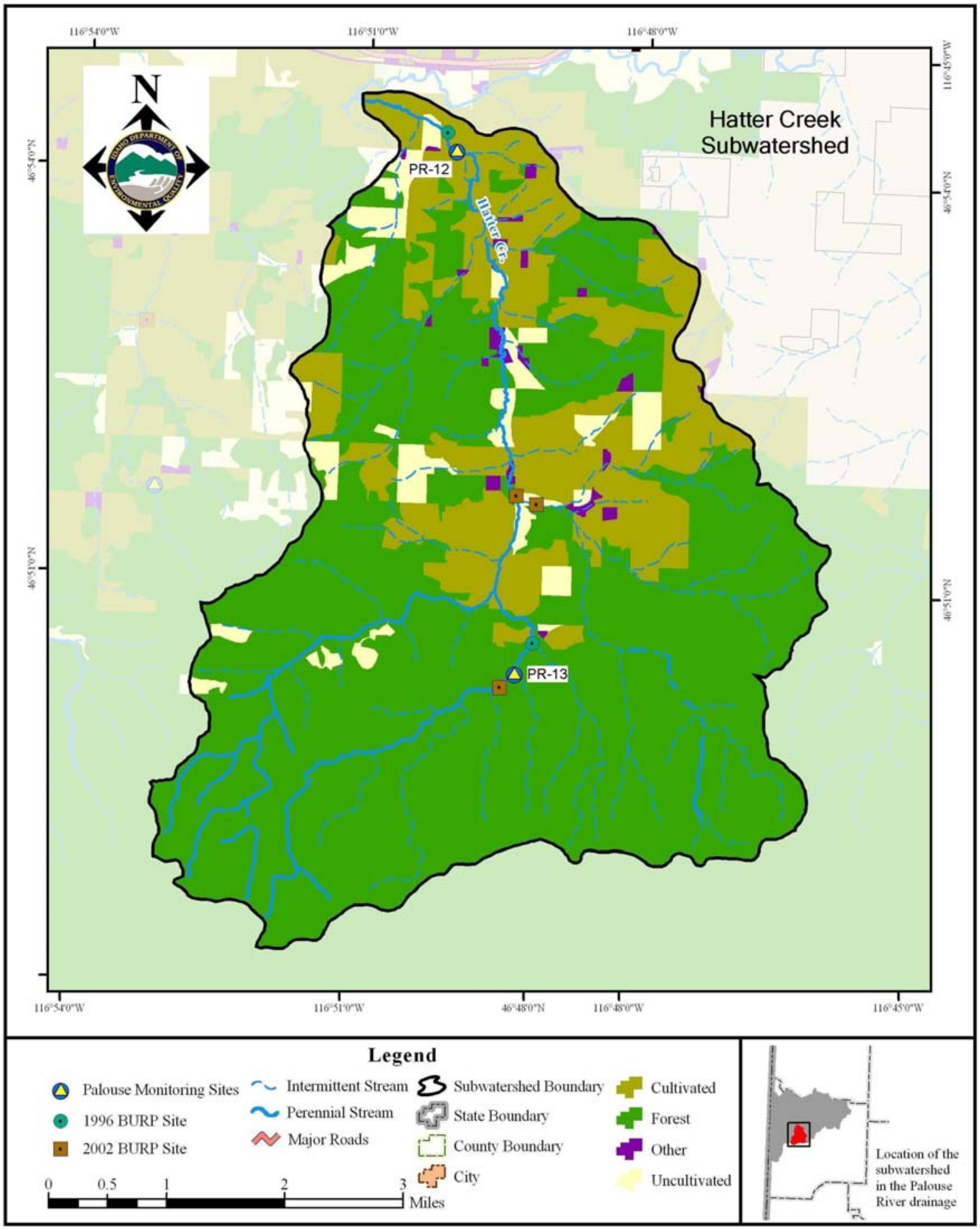
Figure 2-32. Gold Creek –Sediment Levels over Background

Hatter Creek

Hatter Creek is 303(d)-listed for sediment, temperature, nutrients, and bacteria. The boundaries are defined as headwaters to Palouse River. Hatter Creek is a fourth order stream at its confluence with Palouse River. The headwaters originate off the north side of Moscow Mountain. The entire basin is shown on Map 2-5.

The Hatter Creek Watershed is 25.28 square miles in size (16,181 acres). Most of the land in Hatter Creek is under private ownership. A significant portion of the uppermost watershed is the University of Idaho Experimental Forest managed by the University of Idaho. Bennett Lumber owns the uppermost portion of the watershed. The primary land uses in the upper watershed are forestry, agriculture, grazing and recreational activities, while the lower watershed land uses are agriculture, grazing and recreational activities.

Hatter Creek generally flows from south to north and the basic drainage pattern could be described as dendritic. Elevations range from 2,511 feet to 4,983 feet. The geology of the upper watershed is weathered granitics while the mid to lower portions of the watershed are dominated by the Palouse Loess. In the lower portion of the watershed metaphoric rocks underlay the Palouse Loess formations. In the valley bottoms along lower Hatter Creek, coarse textured alluvium sediment deposition is present.



Map 2-5. Hatter Creek Subwatershed

Long Creek and the main stem Hatter Creek join in the upper-mid section of the watershed, which is also close to the forest-agricultural land use boundary. Just upstream from there, on the main stem Hatter creek, is the upper monitoring site (PR-13). Upstream from the upper monitoring site, forestry is the dominant land use, while below the site agriculture is the dominant land use. The lower monitoring site (PR-12) is about a mile from the mouth. The main stem Hatter Creek has several grazing pastures between the upper and lower sites. The main road into this watershed parallels the main stem Hatter Creek for many miles. This road in particular has several cut slope and fill slope failures directly into Hatter Creek. There are several homes along Hatter Creek from the middle to lower portion of the watershed.

Hatter Creek itself is a perennial stream; however, some of the tributary streams in the watershed are intermittent. Rainbow trout, brook trout, dace, and shiners are some the species found in Hatter Creek. Based on stream fish data Hatter Creek has the potential to be a productive recreational fishery; however, based on field observations this watershed has several problem areas that are polluting Hatter Creek. During implementation, DEQ recommends that this watershed be looked at closely and promptly for possible BMPs to improve water quality.

Status of beneficial uses

Results from the 2001-2002 field season are displayed in Figures 2-33 through 2-40. Beneficial uses are being impaired by sediment, bacteria, and temperature in Hatter Creek. In addition, the lower half of Hatter Creek is also impaired by nutrients. DEQ will write TMDLs for sediment, temperature, and bacteria for Hatter Creek, and a nutrient TMDL will be written for the lower half of Hatter Creek. DEQ recommends that the upper half of Hatter Creek be de-listed for nutrients, as conclusions drawn from the in-stream water quality data indicate nutrient levels are not impairing beneficial uses.

Bacteria data displayed in Figure 2-33 shows numerous exceedances of the state bacteria standard for secondary contact recreation. Both sites exceeded this value several times during the 2001-2002 monitoring season. On a yearly average, Hatter Creek has the highest bacteria readings of any of the 303(d) streams. Hatter Creek is water quality impaired by bacteria; therefore, a bacteria TMDL will be written.

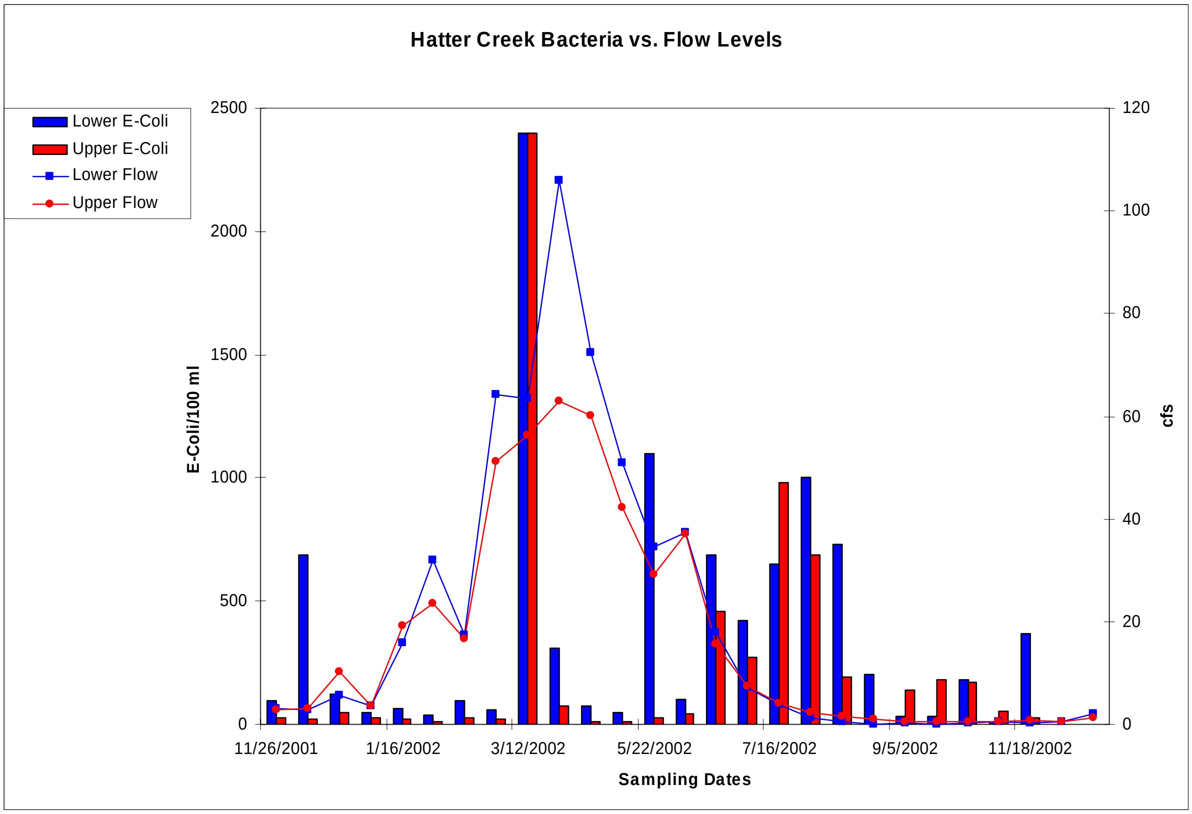


Figure 2-33. Hatter Creek Bacteria Levels

A continuous temperature data-logger probe was placed near the lower monitoring site (PR-12). The probe recorded temperature readings every hour from mid-May 2002 through the first part of November 2002. The results are displayed in Figure 2-34. During this period, temperatures exceed the Idaho cold water aquatic life daily average (ICWB-Ave) of 19° C, and the Idaho salmonid spawning daily average (ISS-Ave) of 9° C. Based on this information, a temperature TMDL will be developed for Hatter Creek.

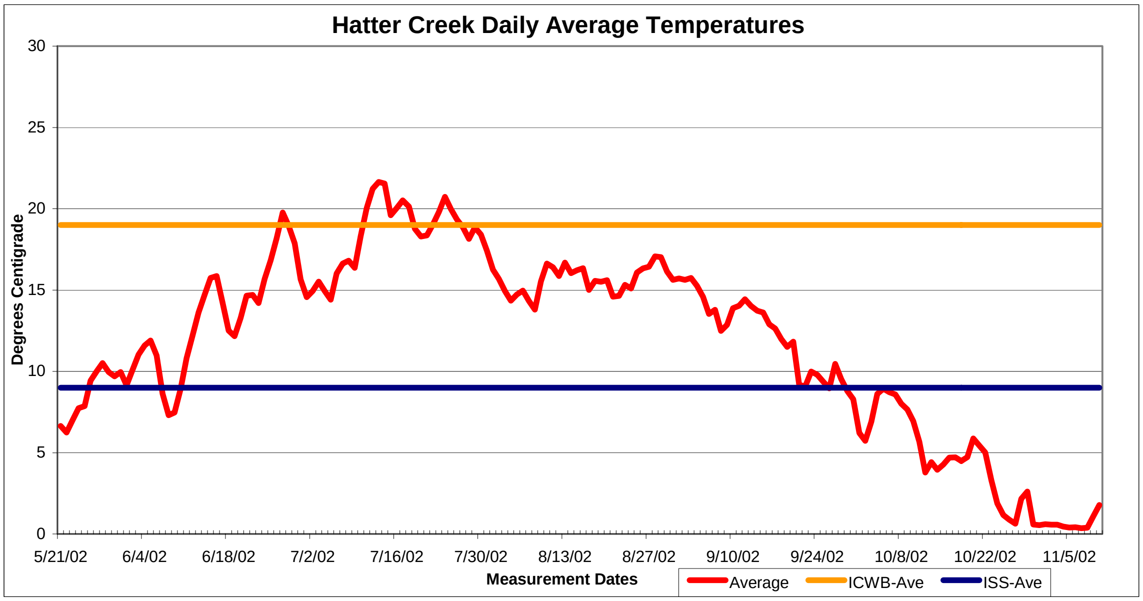


Figure 2-34. Hatter Creek Temperature

The nutrient data are displayed in Figures 2-35 through 2-37 and Table 2-9. NO2+NO3 levels were very slightly elevated during the winter and early spring months. Ammonia levels were at the minimum detection limit except for a few increases, which were all below the state standard. A target of 0.10 mg/L TP and/or a dissolved oxygen level below 6.0 mg/L during the growing season was established for this TMDL. Field crews observed some algae growth in the lower sections of Hatter Creek.

"A background level of 0.035 mg/L was established based on data collected at four reference watersheds. Based on background levels, DO trends, and other regional nutrient TMDL targets, a value of 0.10 mg/L TP was established as the load capacity for this TMDL during the growing season. In addition to the TP target, DO levels must remain above 6.0 mg/L during the growing season. The nutrient target is also based on a numeric state standard for dissolved oxygen requiring the level to be greater than 6.0 mg/L at all times, and a narrative target stating that surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. DEQ believes that by keeping TP levels below 0.10 mg/L, and by increasing stream flows, DO levels should remain above 6.0 mg/L and thereby not impair beneficial uses. Low summer flows contributed to the low DO readings in Hatter Creek. To improve the low summer flow condition, water could be retained during the spring runoff in new or improve wetlands and riparian corridors. The water would then be stored at the surface or in shallow groundwater areas and released during the low summer flow periods and thereby improving the DO situation.

The nutrient target was violated a total of five times between at the lower monitoring site. The phosphorus target was violated a total of three times consecutively and the DO target twice. The violation of 0.8 mg/L on 6/18/2002 is several orders of magnitude larger than the other results, and this could have been an error at the lab after collection or an error committed sometime during the preparation (perhaps in the sample container) during collection or during the transportation and transfer of the sample. DEQ does not consider this to an accurate reading. Even without this reading, there were two other consecutive bi-weekly exceedances of the TP target and three continuous bi-weekly DO exceedances. Based on the frequency and duration of the TP and DO, field reports, and site visits, DEQ believe a nutrient problem exists in Hatter Creek-lower and will write a nutrient TMDL for the lower section of Hatter Creek.

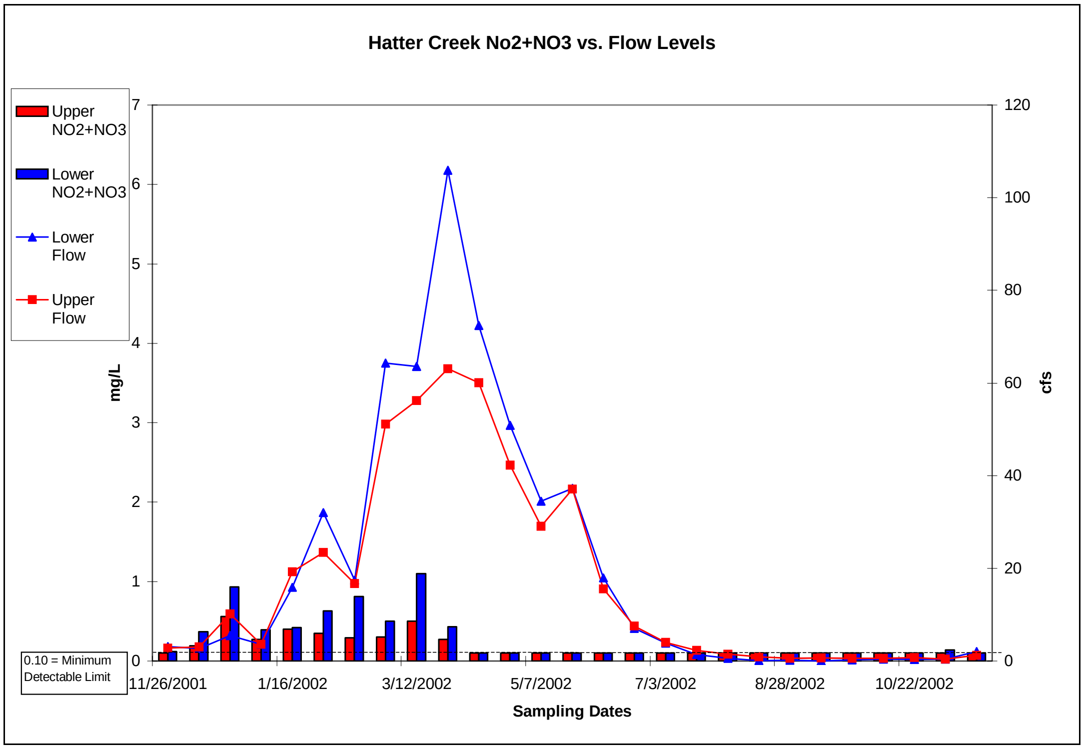


Figure 2-35. Hatter Creek Total Nitrogen Levels

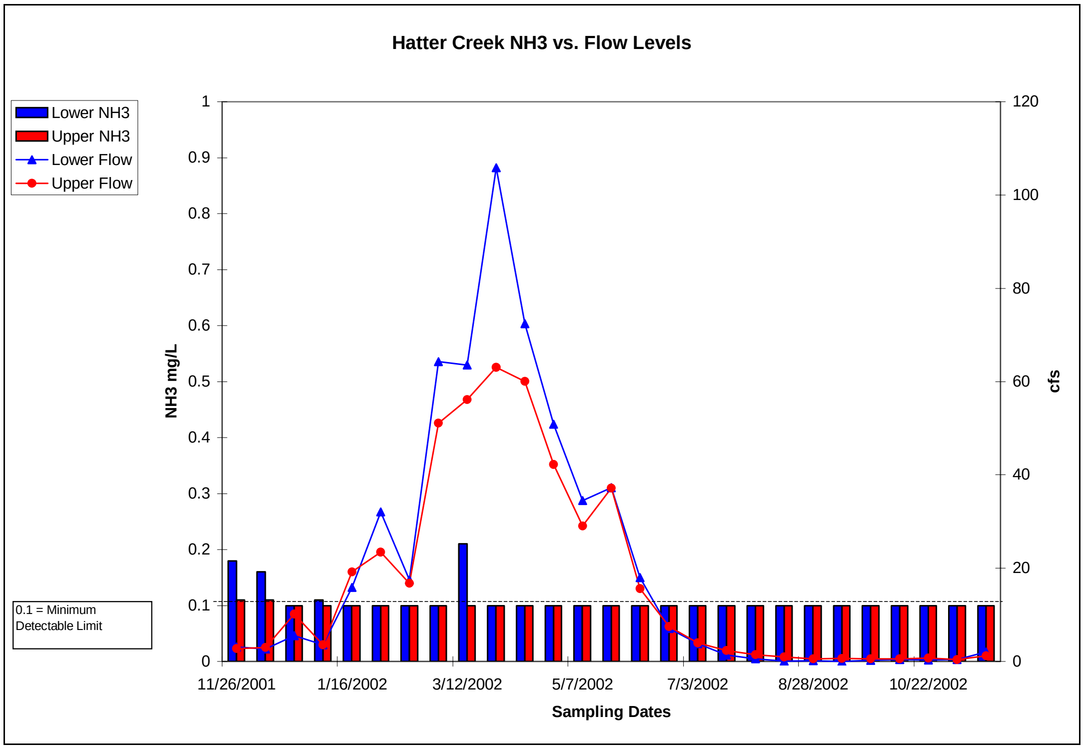


Figure 2-36. Hatter Creek Ammonia Levels

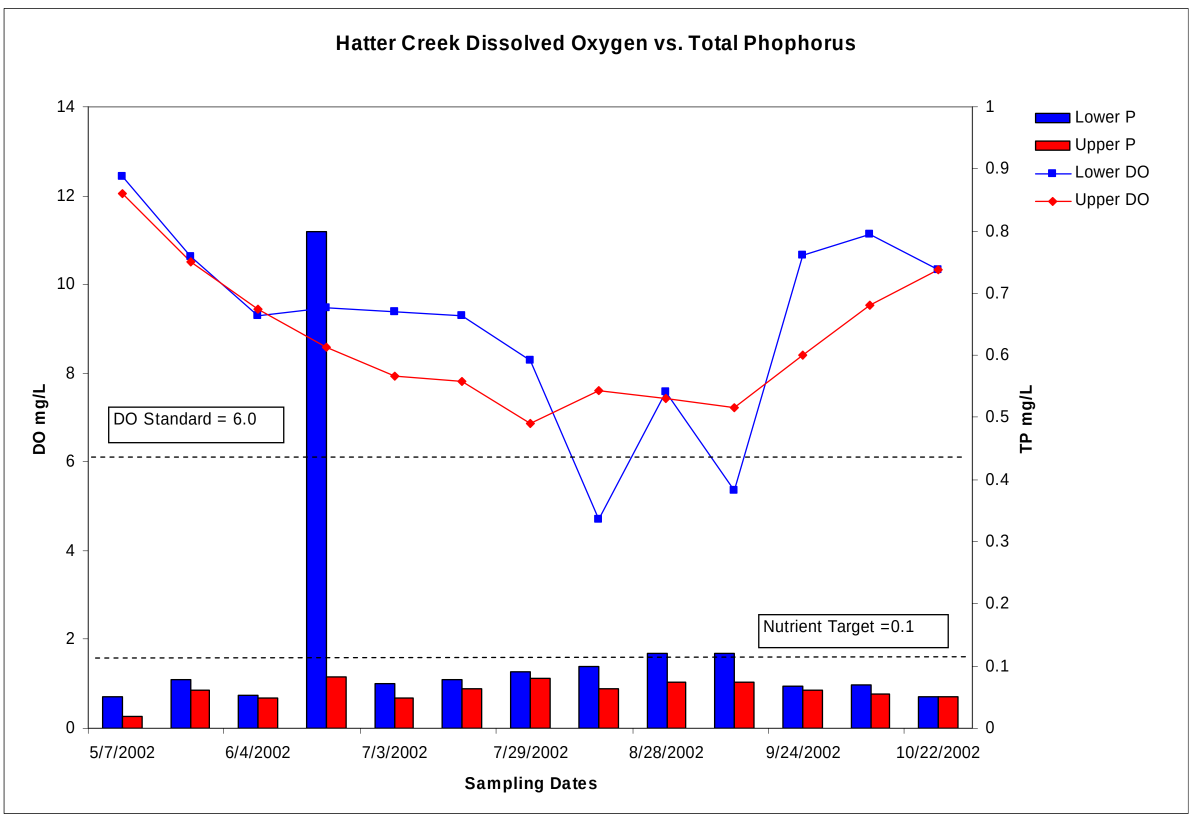


Figure 2-37. Hatter Creek DO versus Phosphorus Levels

Table 2-9. Hatter Creek TP and DO bi-weekly monitoring results growing season

Date	PR-12 (TP)[1]	PR-12 (DO)[1]	PR-12 (discharge)[2]	PR-13 (TP)[1]	PR-13 (DO)[1]	PR-13 (discharge)[2]
5/7/2002	0.05	12.42	34.46	0.02	12.06	29.08
5/22/2002	0.08	10.62	37.30	0.06	10.50	37.15
6/4/2002	0.05	9.30	17.94	0.05	9.45	15.58
6/18/2002	**0.80**	**9.46**	**7.06**	0.08	8.58	7.52
7/3/2002	0.07	9.38	3.84	0.05	7.93	4.02
7/16/2002	0.08	9.28	1.39	0.06	7.81	2.33
7/29/2002	0.09	8.28	0.59	0.08	6.87	1.44
8/18/2002	**0.10**	**4.70**	**0.09**	0.06	7.60	0.94
8/28/2002	**0.12**	**7.58**	**0.18**	0.07	7.43	0.55
9/5/2002	**0.12**	**5.35**	**0.01**	0.07	7.23	0.63
9/24/2002	0.07	10.66	0.25	0.06	8.42	0.60

Exceedance shown in **bold**
[1] mg/L
[2] cfs

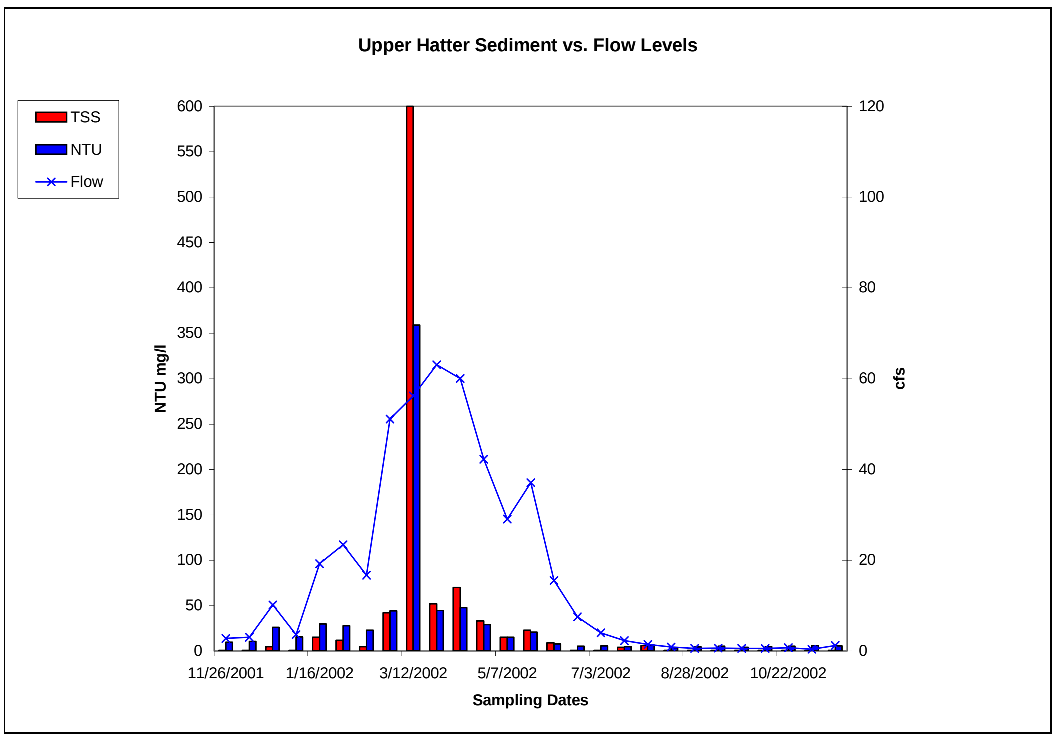


Figure 2-38. Hatter Creek –Upper- Sediment Levels

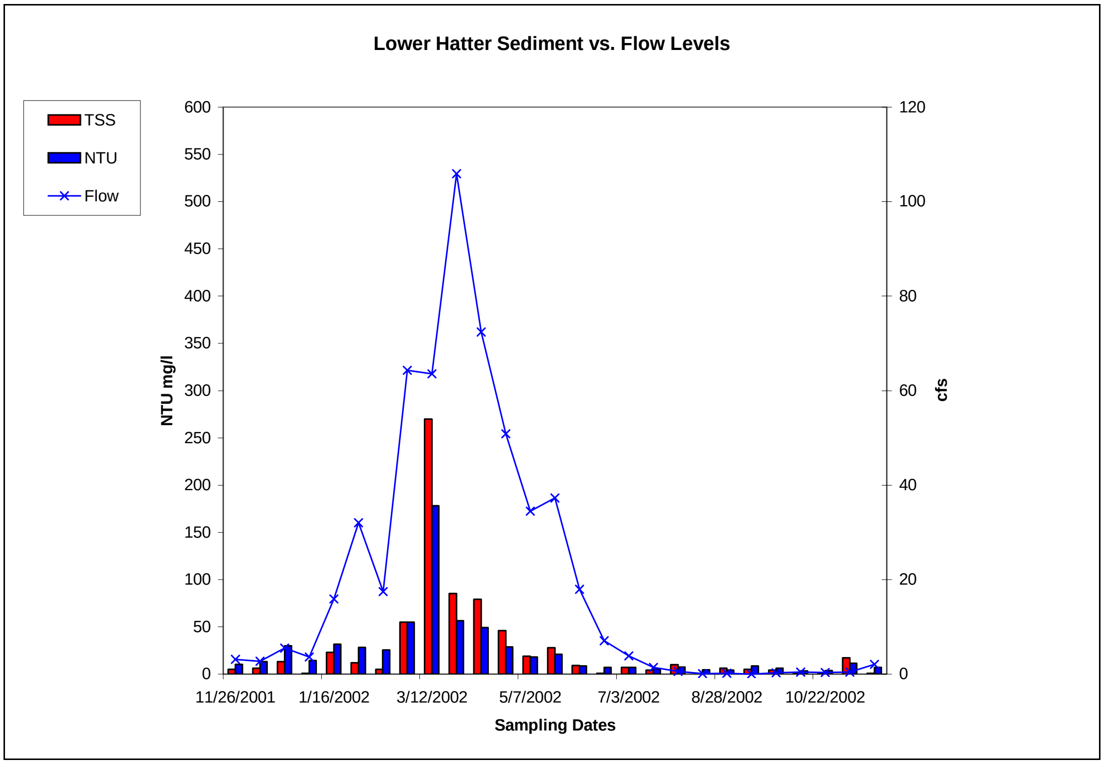


Figure 2-39. Hatter Creek –Lower- Sediment Levels

Total suspended solids (TSS), expressed in mg/L, turbidity, expressed in nephelometric turbidity units (NTU), and discharge, expressed in cubic feet per second (cfs), for the upper and lower monitoring sites, are displayed in Figures 2-38 and 2-39. TSS is a weighted measure of the total solid concentrations in the water, whether the particles are mineral (such as soil particles) or organic (such as plants). An NTU is a measure of turbidity based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions. These two measures are the standard indicators for sediment level concentration in surface water applications nationwide. Idaho State Standards for sediment state that sediment levels shall not impair designated beneficial uses and that turbidity shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more then ten consecutive days.

Figures 2-38 and 2-39 display data that was collected approximately every two weeks for the period November 2001-November 2002. To determine if sediment levels were above state standards and impairing beneficial uses, additional calculations and assumptions were made. First, a more thorough discharge profile for Hatter Creek was developed. This profile is based on ten years of data collected at the USGS Palouse River gage site, watershed size differences
between Hatter Creek and the Palouse River, and in-stream flows collected for Hatter Creek during November 2001-November 2002.

The data shown displays numeric relationships between discharge and NTU, discharge and TSS, and NTU and TSS. These relationships can be expressed as mathematical equations, called regression equations. The regression equations used to calculate values for TSS, NTU, background TSS, background NTU, and TSS levels over background, are located in Appendix B. Figure 2-40 is a graph of the sediment level amounts over background for Hatter Creek over a ten-year period. Based on the sediment data collected, the mathematical relationships established in this TMDL, and previous BURP data, sediment levels over background are impairing beneficial uses; therefore a sediment TMDL will be developed for Hatter Creek.

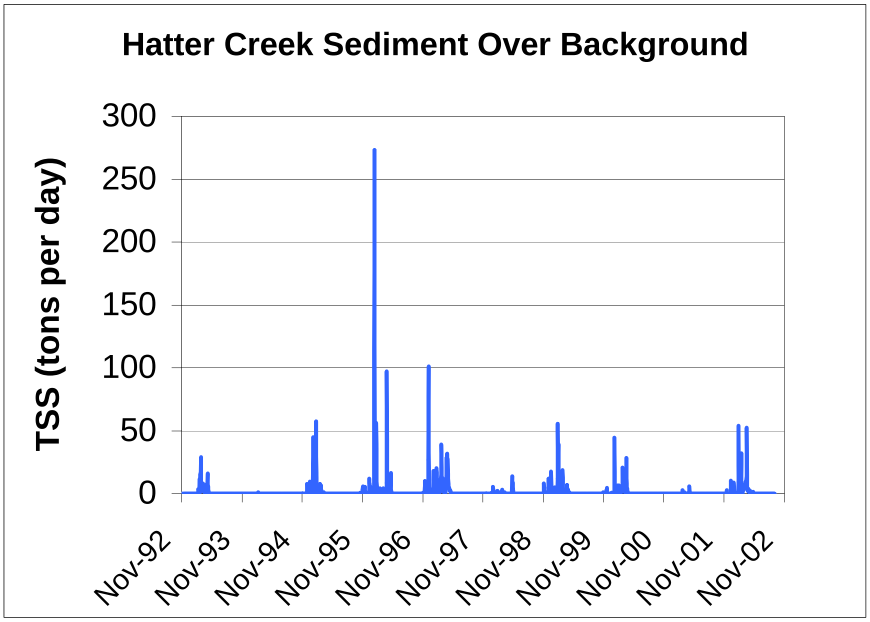


Figure 2-40. Hatter Creek –Sediment Levels over Background

<u>West Fork Rock Creek</u>

The West Fork Rock Creek (WFRC) is 303(d)-listed for sediment, temperature, nutrients, and bacteria. The boundaries are defined as headwaters to Palouse River. Technically this includes only the WFRC and the lower section of Rock Creek. For this report, the entire Rock Creek Watershed was evaluated. Therefore, for this report, the WFRC is called Rock Creek and includes the entire watershed, the West Fork of Rock Creek, the East Fork Rock and Rock Creek.

Rock Creek is a third order stream at its confluence with Palouse River. The headwaters originate off the north side of Rocky Point. The entire basin is shown on Map 2-6. The Rock Creek Watershed is 8.09 square miles in size (5,180 acres) and is the smallest 303(d) listed watershed.

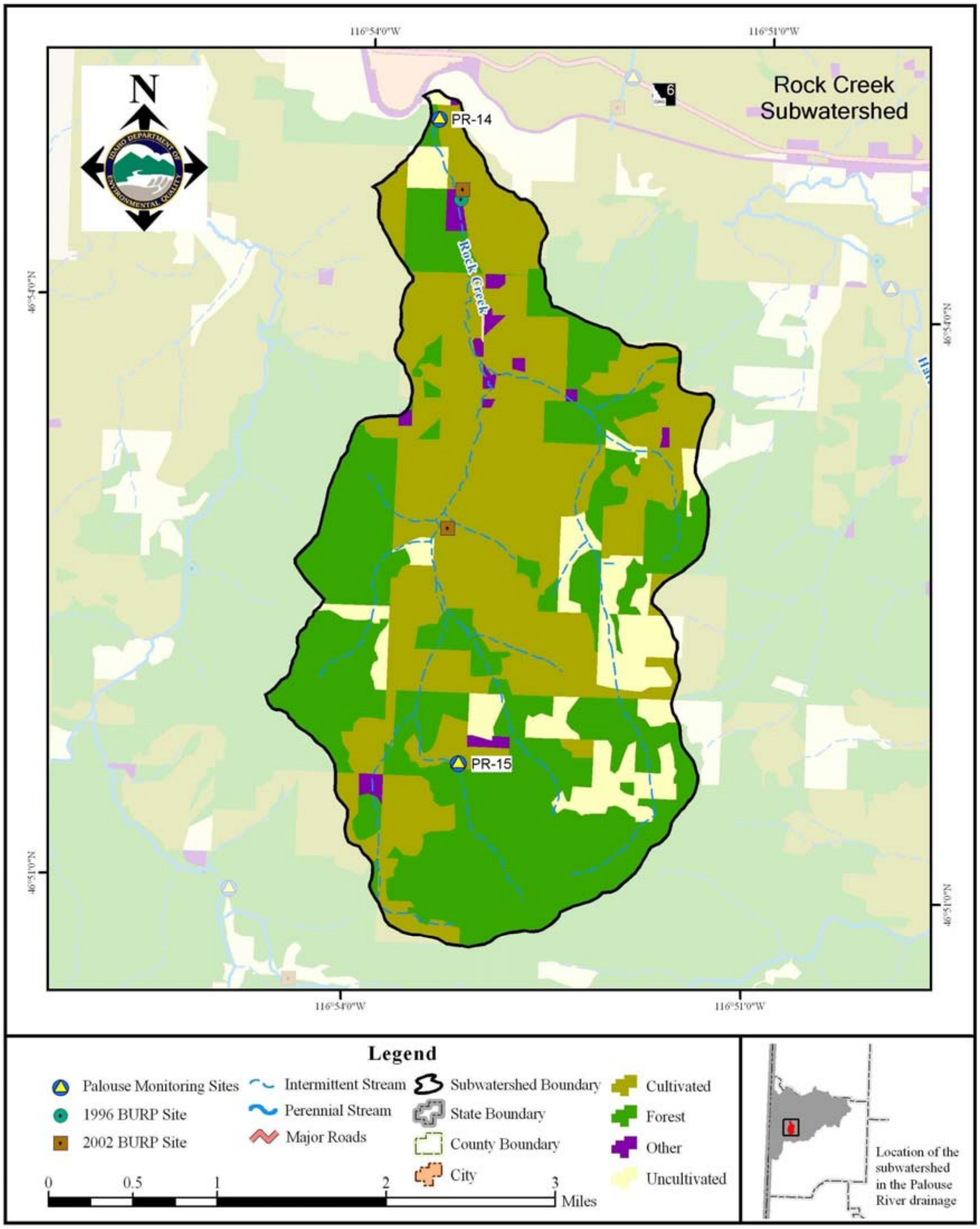
Most of the land in Rock Creek is under private land ownership. The State of Idaho and Bennett Lumber own and manage very small portions along the western watershed boundary. The primary land uses are agriculture, forestry, grazing, and recreational activities. Rock Creek generally flows from the south to the north, and the basic drainage pattern could be described as dendritic. Elevations range from 2,503 feet to 3,737 feet. The geology of the upper watershed is weathered granitics while the mid to lower portions of the watershed is dominated by the Palouse Loess. Metaphorized granitics underlay the Palouse Loess in the lower half of the watershed. In the valley bottoms, along the Rock Creek, coarse textured alluvium sediment deposition is present.

The WFRC and EFRC join together in the middle of the watershed to form Rock Creek. The upper monitoring site (PR-15) is in the headwaters of the WFRC, near the forest-to-agricultural land use boundary. The lower monitoring site (PR-14) is less than a mile from the mouth. The main road for access into this watershed parallels the main stem Rock Creek for many miles.

Based on the flow data that has been collected on Rock Creek, Rock Creek is an intermittent stream that goes completely dry during a period of the year. Both sites on Rock Creek were completely dry from the latter half of July through October 2002. In early August 1996, and again in early July 2002, both BURP sites were dry. In 2003, the lower site was dry in July and August.

Rock Creek is classified as an intermittent stream according to the USGS quad map. IDAPA 58.01.02.070.06 states “numeric standards only apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. For recreation, the optimum flow is equal to or greater than five cfs. For aquatic life uses, optimum flow is equal to or greater than 1 cfs.”

DEQ was unable to find any fish data for Rock Creek although it is suspected that Rock Creek supports dace, red-side shiners, and suckers. In the upper tributaries, there may be pockets of salmonids and sculpin



Map 2-6. Rock Creek Subwatershed

Status of beneficial uses

Results from the 2001-2002 field season are displayed in Figures 2-41 through 2-48. Sediment and bacteria in Rock Creek are impairing beneficial uses. Temperature and nutrients were found not to be impairing beneficial uses, primarily based on the intermittent classification of Rock Creek. When temperature and nutrient levels exceeded state standards or TMDL proposed targets, stream flows were below 1 cfs. Aquatic life beneficial uses do not apply for flows below 1 cfs on intermittent streams. Based on these facts, DEQ is proposing to de-list Rock Creek for temperature and nutrients and write TMDLs for sediment and bacteria. An informational temperature TMDL was included in Appendix F for use as a reference and for guidance during implementation.

Bacteria data displayed in Figure 2-41 shows four exceedances (two at each site) of the state bacteria standard for secondary contact recreation during the 2001-2002 monitoring season. The exceedances in December of 2001 and in March of 2002 occurred when flows were greater than 5 cfs. The latter two exceedances occurred when flows were less than 5 cfs, and were not included for the TMDL reduction calculations in Chapter Five. Based on this data and field observations, Rock Creek is water quality impaired by bacteria and will have a bacteria TMDL written.

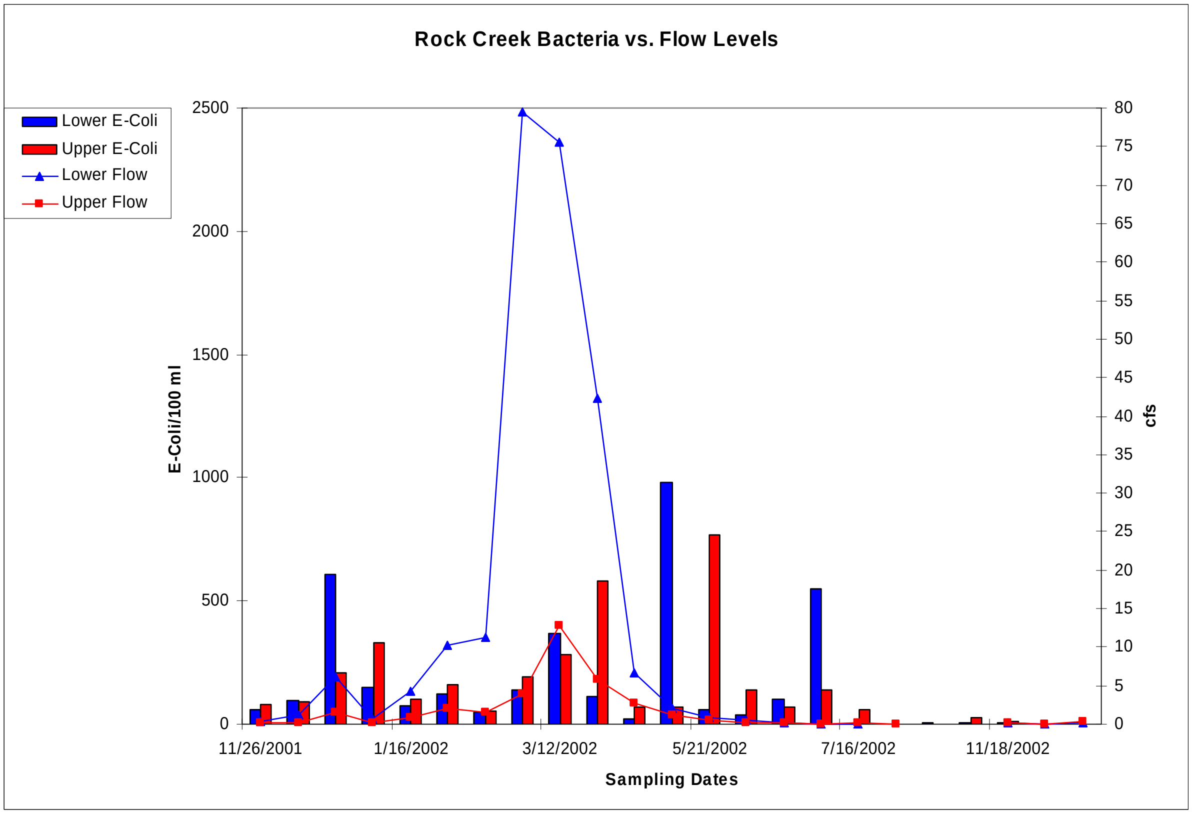


Figure 2-41. Rock Creek Bacteria Levels

A continuous temperature data-logger probe was placed near the lower-monitoring site (PR-14). The probe recorded temperature readings every hour from mid-May 2002 through late July 2002.

Rock Creek is an intermittent stream that went dry in late July 2002. Flows went below 1 cfs on or before May 7, 2002 and remained below 1 cfs through the end of our monitoring on November 18, 2002. No salmonids are present in Rock Creek, therefore the Idaho salmonid spawning daily average (ISS-Ave) of 9° C does not apply. Figure 2-42 displays the results of Rock Creek when water was flowing. The probe was removed after Rock Creek went completely dry in late July 2002. During June and July, temperatures exceed the Idaho cold water aquatic life daily average (ICWB-Ave) of 19° C; however, it was after flows went below 1 cfs. Therefore DEQ will not write a temperature TMDL for Rock Creek and recommends that Rock Creek be de-listed for temperature as a possible pollutant.

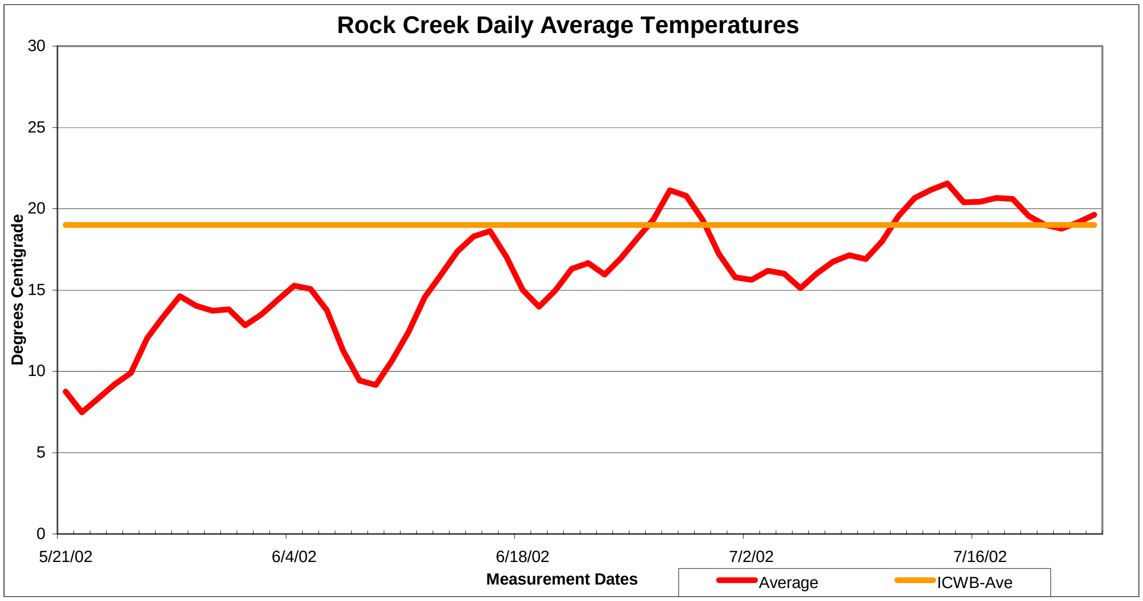


Figure 2-43. Rock Creek Temperature

The nutrient data are displayed in Figures 2-43 through 2-45. High nitrogen levels were recorded during the late fall, winter, and early spring months at both sites. Nutrient levels at the lower site were higher than that of the upper site, which would correlate to the change in land use from forestry to agriculture. Ammonia levels were at the minimum detection limit except for one time when the value was 0.01 mg/L above the minimum detectable limit. These values are well within state standards for ammonia. During the growing season, May through October, the discharge (flow) for Rock Creek is below 1 cfs; therefore, aquatic life uses do not apply. Based on the intermittent status of Rock Creek, a nutrient TMDL is not required, and DEQ recommends that Rock Creek be de-listed from the 303(d) list for nutrients.

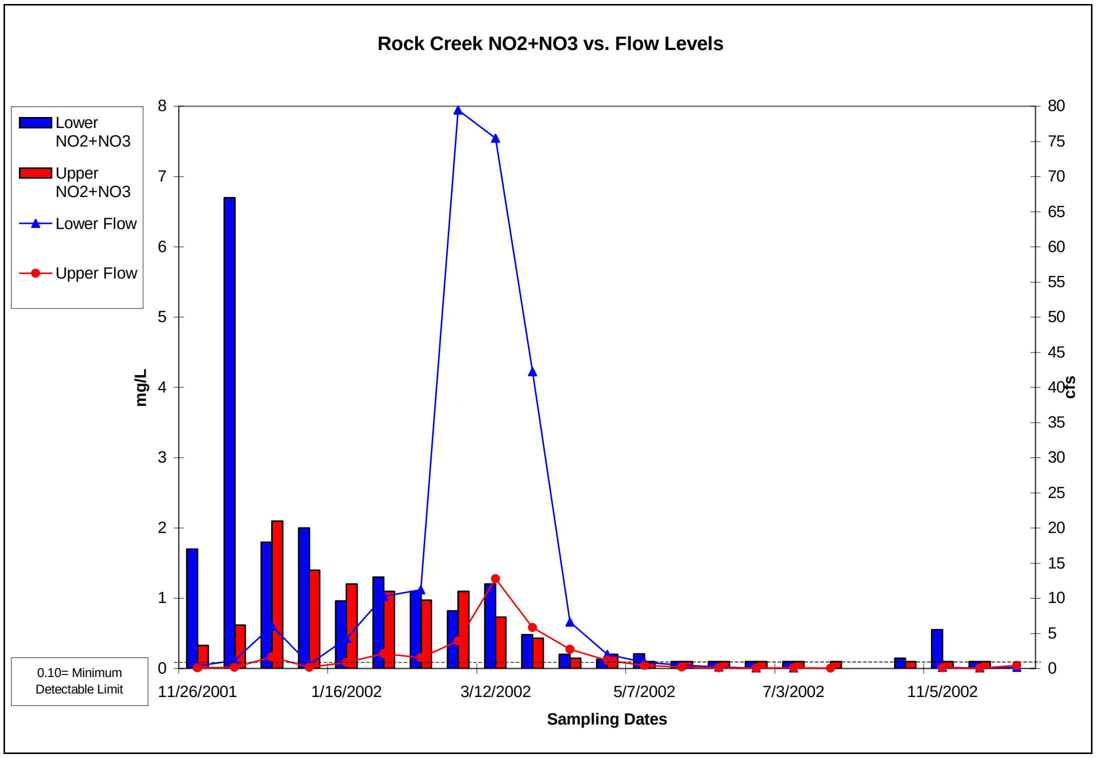


Figure 2-43. Rock Creek Total Nitrogen Levels

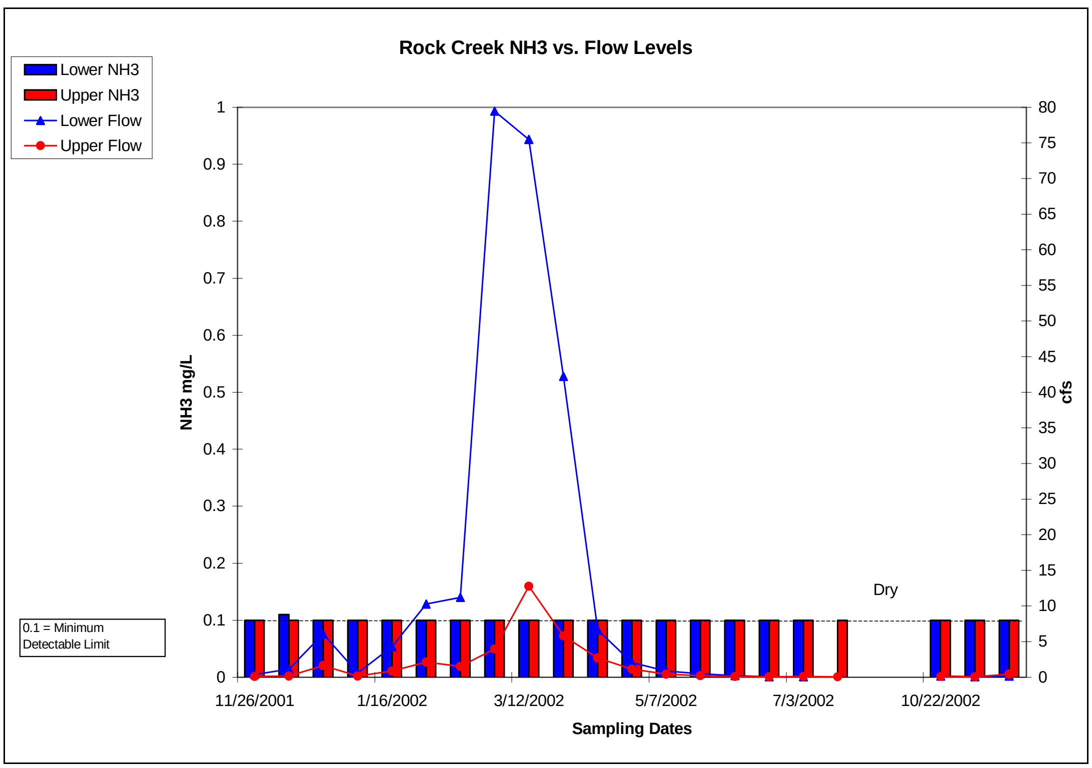


Figure 2-44. Rock Creek Ammonia Levels

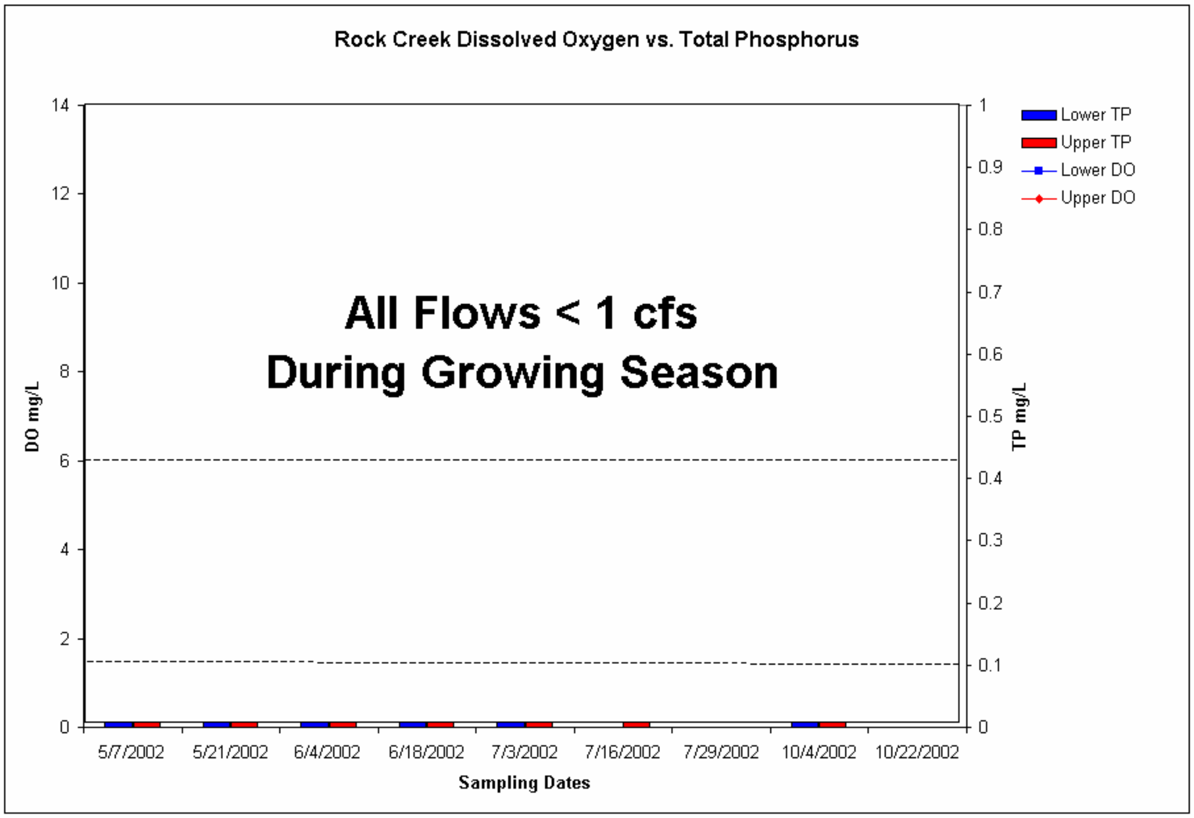


Figure 2-45. Rock Creek DO versus Phosphorus Levels

Total suspended solids (TSS), expressed in mg/L, turbidity, expressed in nephelometric turbidity units (NTU), and discharge, expressed in cubic feet per second (cfs), for the upper and lower monitoring sites, are displayed in Figures 2-46 and 2-47. TSS is a weighted measure of the total solid concentrations in the water, whether the particles are mineral (such as soil particles) or organic (such as plants). An NTU is a measure of turbidity based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions. These two measures are the standard indicators for sediment level concentration in surface water applications nationwide. Idaho State Standards for sediment state that sediment levels shall not impair designated beneficial uses and that turbidity shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more then ten consecutive days.

Figures 2-46 and 2-47 display data that was collectedapproximately every two weeks for the period November 2001-November 2002. To determine if sediment levels were above state standards and impairing beneficial uses, additional calculations and assumptions were made. First, a more thorough discharge profile for Rock Creek was developed. This profile is based on ten years of data collected at the USGS Palouse River gage site, watershed size differences between Rock Creek and the Palouse River, and in-stream flows collected for Rock Creek during November 2001-November 2002.

The data shown displays numeric relationships between discharge and NTU, discharge and TSS, and NTU and TSS. These relationships can be expressed as mathematical equations, called regression equations. The regression equations used to calculate values for TSS, NTU, background TSS, background NTU, and TSS levels over background are located in Appendix B. Figure 2-46 is a graph of the sediment level amounts over background for Rock Creek over a ten-year period. Based on the sediment data collected, the mathematical relationships established in this TMDL, and previous BURP data, sediment levels over background are impairing beneficial uses; therefore a sediment TMDL will be developed for Rock Creek.

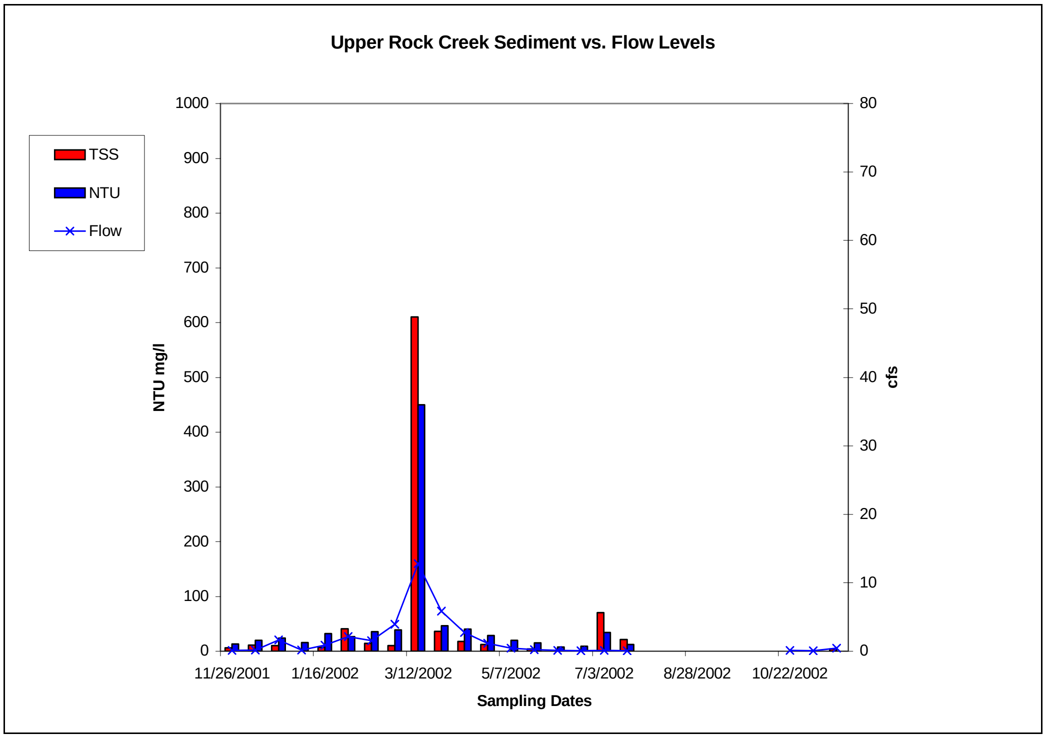


Figure 2-46. Rock Creek–Upper Sediment Levels

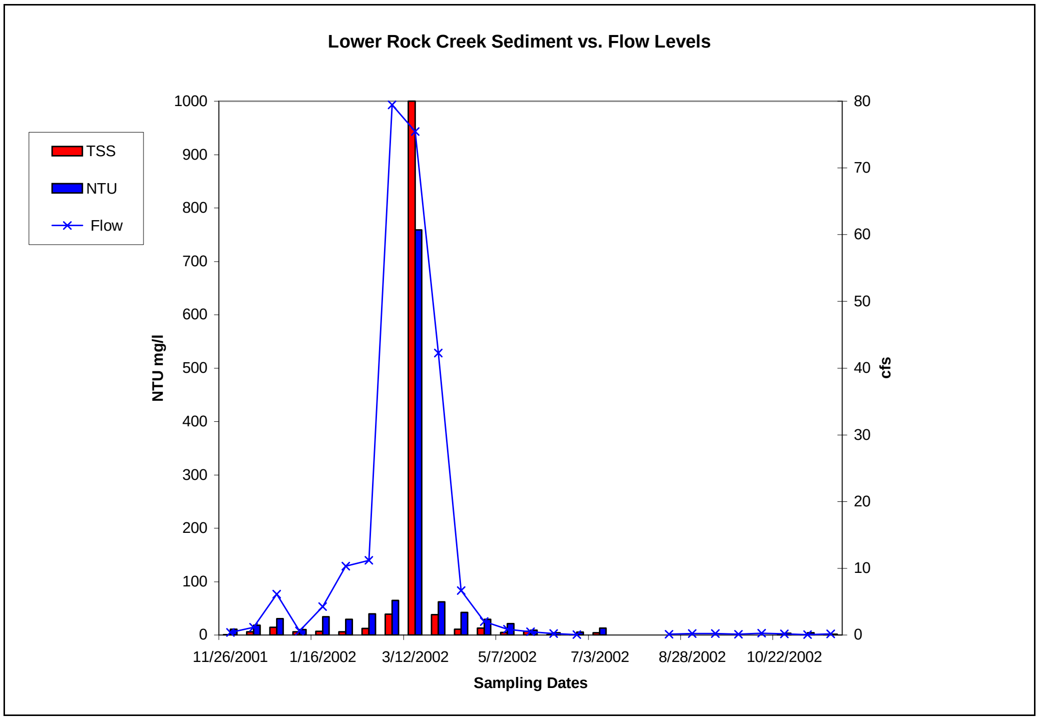


Figure 2-47. Rock Creek–Lower-Sediment Levels

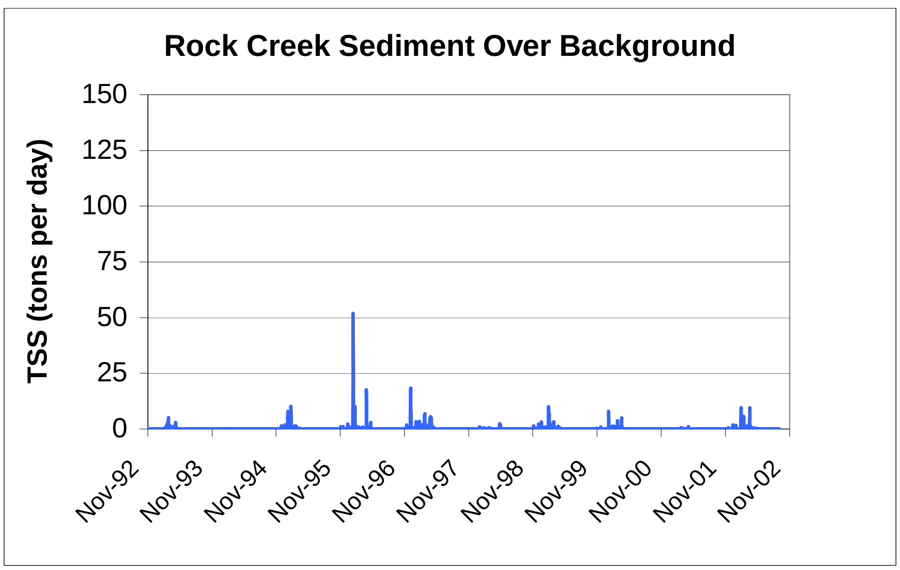


Figure 2-48. Rock Creek–Sediment Levels over Background

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3. Subbasin Assessment – Pollutant Source Inventory

The sources of the pollutants cited as causing water quality standards exceedances for the 303(d)-listed water bodies are identified and discussed in detail in this section. Pollutant sources may occur as point sources, which are regulated by the National Pollutant Discharge Elimination System (NPDES) program or as nonpoint sources of pollutants, which are not subject to NPDES or any other permitting programs. Point sources have a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water while nonpoint sources are pollutants coming off the landscape having no one exact point of discharge. Common point sources of pollution are industrial and municipal wastewater facilities. Examples of nonpoint sources include logging activities, roads, grazing activities, agricultural activities, and landslides (mass failures). There are several point sources in the basin; however, none of these occur on any of the 303(d) listed water bodies. Since these point sources do not contribute to the 303(d) listed water bodies they were not factored into TMDL development.

3.1 Sources of Pollutants of Concern

All of the 303(d) listed water bodies have sediment, temperature, nutrients, and bacteria listed as a possible pollutants. Potential sources of sediment, excluding natural background in the basin, include in-stream erosion, roads, agriculture, logging, and grazing activities. The source for temperature is solar radiation, i.e., the sun. Possible sources for nutrients include natural background, agricultural sources, grazing sources, septic systems, and storm run-off. Potential sources of bacteria include grazing activities, septic systems, wildlife, and humans. These sources and the cause of these pollutants will be discussed in more detail in the following section.

Point Sources

There are no point sources on the 303(d) water bodies in this report.

Nonpoint Sources

The primary reason that streams in the Palouse River Subbasin were 303(d)-listed was because of nonpoint source pollutants. One way to classify nonpoint sources would be to divide them into two categories: anthropogenic (human caused) and non-anthropogenic (non-human caused). Anthropogenic sources include road building, logging activities, construction activities, agricultural activities, grazing, recreational activities, and fire. Non-anthropogenic sources include natural mass failures and other erosional processes, wildlife impacts and fire. Fire can be both anthropogenic and non-anthropogenic.

In the following section, sediment, heat, nutrients, dissolvedoxygen (DO), and bacteria loading sources are discussed. A discussion of transport mechanisms for these pollutants is also included.

.

Sediment

All six listed water bodies in the Palouse River Subbasin are listed with sediment as a pollutant. Nonpoint sources of sediment in the Palouse River Subbasin include forest management activities, road and trail construction and maintenance activities, agricultural activities, grazing activities, landslides, in-stream erosion, fires, other past and present land management activities, and air deposition. The precise amount of pollutant contribution from each of these nonpoint sources to the subbasin is unknown, as it is nearly impossible to determine the exact amount from each source. However, all the significant sources of sediment— agriculture, grazing, forestry, roads, and in-stream erosion—were quantified for TMDL loading calculations. More specifically, activities such as tilling, grazing, plowing, construction, road construction, road reconstruction, road maintenance, timber harvesting, thinning, fertilization, and fire suppression affect the erosion rates that would occur naturally in the basin. These activities may result in increased erosion and sedimentation. At the same time, some activities like road obliteration and road re-construction may reduce the amount of sediment to water bodies.

Sediment is transported by numerous methods:

- The majority of sediment transport occurs during precipitation events, when bare soil is eroded and water moves sediment off the landscape into and through natural and man-made ephemeral areas and into intermittent and perennial streams.
- Mass failures tend to occur during or after storm events, as supersaturated soil becomes mobile.
- Roads can be the primary paths for transporting exposed sediments into water bodies.
- In urban areas, during and after precipitation events, water typically does not get absorbed into the ground due to compacted or paved areas. This water drains into some kind of drainage system and typically, but not always, flows into nearby empheral, intermittent or perennial streams.

Any new construction activities over one acre in size are required to obtain a National Permit Discharge Eliminate System (NPDES) permit from the Environmental Protection Agency (EPA). This permit ensures that Best Management practices (BMPs) are followed to minimize excess sedimentation into water bodies.

In the Palouse River Subbasin sediment within streams comes primarily from three sources: the landscape, roads, and bank/ in-stream erosion. Determining the quantity of sediment that comes from these sources was accomplished via modeling and measurement:

- The RUSLE model was used to quantify sediment amounts off the landscape. Erosion off the landscape includes agricultural production, urbanization, silviculture activities, and grazing.

- The WEPP model was used to quantify sediment amounts from roads.

- The NRCS in-stream erosion field estimate protocol was used to quantify in-stream erosion from the banks. Some in-stream erosion is natural; however, anthropogenic activities in the Palouse River Subbasin have accelerated this process. Activities such as grazing, structural riparian changes such as dredging and straightening channels, recreational activities, and road building have all altered in-stream erosion in some fashion.

- In the end, the sediment numbers used for TMDL loading calculations were based on the sediment physically collected at the established monitoring sites on a bi-weekly basis from November 2001 through November 2002. The sediment data was then added to a stochastic flow model based on ten years of flow data collected on the Palouse River near the town of Potlatch by the USGS. This model as well as the other sediment models can be used as a references or starting points after implementation of the sediment TMDL.

- Some general notes on modeling, including sediment modeling. All models inherently have some range of error associated with them, some even around 50% or more. The exact output or end result of a model are not necessarily the most important feature, but observing trends over a unspecified period of time are perhaps more important. For water quality, streams must meet beneficial uses regardless of the output or percent reduction the model(s) predicted. It could be possible to meet the beneficial uses and not meet the exact percent reduction within a model, and conversely the reverse is true. Models were used in a fairly reliable and repeatable process to obtain an estimate of the amount of a specific pollutant in order to create a TMDL. DEQ believes the models used in this report can be used again after an unspecified period of time or several times in the future to observe trends in a pollutant. As with all technologies and within the field of science itself, new ideals, principles and beliefs will inevitable come, therefore new models or new methods will probably be used to solve issues addressed within this document.

Map 1-6 (page 25) shows the distribution of roads in the subbasin, most of which are unpaved. Roads contribute to sediment in the Palouse River Subbasin in the following ways:

- Within timber management areas, road erosion is known to be the primary source of sediment to water bodies. Roads directly affect natural sediment and hydrologic regimes by changing the landscape. For example, road prisms near a stream have the potential to alter stream flow by confining the channel, reducing the floodplain storage, increasing sediment input to the stream, removing riparian vegetation, changing channel morphology, decreasing channel stability, and altering substrate composition.

- Culverts also impact the landscape, as they tend to confine the stream channel, and, without proper maintenance or if improperly installed or improperly sized, can fail during high flows and deliver large amounts of sediment to the stream. These failures, along with road-related surface erosion and mass failures can continue for decades after the roads are constructed.

- Road-stream crossings can also be major sources of sediment to streams, resulting from channel fill around culverts, road surface drainage to crossing areas, and crossing failures. Road construction techniques have improved tremendously over the past few decades and will continue to improve. Roads engineered and constructed properly with these new techniques have significantly decreased sedimentation inputs to water bodies from roads, and older roads are typically obliterated.

Mass failures are the other sediment source in the subbasin, but no large mass failures were observed. Smaller road slumps and failures were noted and taken into consideration using the WEPP and in-stream erosion models.

Field observations conclude that grazing activities contribute to riparian area denudation and, possibly, to the overall sediment load within the Palouse River Subbasin. Potlatch Corporation and IDL have grazing leases throughout the Palouse River Subbasin. All of the 303(d)-listed water bodies have some grazing impacts to their riparian areas.

Gravel is mined for road construction and surfacing at several sites within the subbasin. Most of these sites are away from riparian areas and streams; however, there are some sites that could use improvement.

There are no current permitted mining activities in the subbasin. Most sediment from mining activities resulted from placer mines in the last half of the nineteenth century. The result is cobble-sized material along the banks of some streams as stream channels reestablish their normal meander patterns.

Recreational activities like hiking, camping, hunting, horseback riding, bicycling, off-road vehicle use, fishing, swimming, cross country skiing, snowmobiling, and scenery and wildlife viewing may contribute to erosion and sedimentation. Most of these activities do not produce significant amounts of sediment. Determination of the specific amount of sedimentation caused by these activities would be very difficult, time consuming, and costly—they were therefore not calculated. However, the NRCS in-stream field estimate methodology does account for recreational activities within the riparian areas. The collection of TSS and NTU data in the field also addresses recreation activities impacting streams. (It is noted that litter from recreational activities can be significant, at times, in many areas in the Palouse River Subbasin.)

Some sediment comes from air deposition in the form of fine particle dust from fires, roads, and administrative activities in the subbasin. Some of these contributors, such as large fires, produce significant amounts of airfall at times, but for sediment assessment purposes in this document, DEQ concluded sedimentation from air deposition is insignificant.

Erosion in some areas of the rolling hills of the Palouse within the Palouse River Subbasin is enormous. The Palouse has been called one of the most erosive areas in the United States (Beus, 1990). The USDA estimated that from 1939 through 1977, the average annual rate of soil erosion in the Palouse was 14 tons/acre on cultivated cropland. This is not the amount that reaches a waterbody—just the amount displaced from the slopes.

In the 1930s and 40s, as much as 100 tons of soil could be washed from an acre in one storm (Sorensen, 2002). Some researchers believe that 40% of the soils have been lost to erosion (Pimentel and others, 1995). It takes 300 to 1,000 years to create one inch of topsoil, but the average loss on the Palouse since the 1920s is one inch per twelve years (Soule and Piper, 1992).

Another way to look at background soil erosion rates on agricultural lands is to run the revised universal soil loss equation (RUSLE) model, using a vegetation community that resembles a natural vegetation community. Table 3-1 displays the average background rate that was used in TMDL loading calculations.

Table 3-1. Sediment background numbers

Watershed	Size (acres)	Size ($mile^2$)	Amount (tons/acre/yr)	Amount ($tons/mile^2$ /yr)	Amount (tons/yr)
Big	10300.72	16.09	0.11	72.96	1174.28
Deep	27315.56	42.68	0.09	58.05	2477.52
Flannigan	12246.82	19.14	0.12	79.55	1522.28
Gold	18069.78	28.23	0.11	71.17	2009.36
Hatter	16163.44	25.26	0.10	66.18	1671.30
Rock	5174.76	8.09	0.12	74.50	602.34

Forested natural background erosion rates tend to be lower than erosion rates for prairie areas. Forested areas will only erode above the natural background when there are ground disturbances such as logging, road building, fires, off road vehicle traffic, trail riding, etc. The Clearwater National Forest uses a background rate of 25 tons per square mile (0.039 tons per acre) (Wilson et al 1982). The Nez Perce National Forest uses background rates of 10-80 tons per square mile. Some researchers think these rates are too low, as they do not account for large pulses due to fires and major mass failure events. (The rates in Table 3-1 seem reasonable, as these are close to the rates used by the Clearwater National Forest and the Nez Perce National Forest.)

Measurements indicate that conventional background measurements may be 17 times lower than what is actually happening on certain mountainous landscapes in the Idaho Batholith on a geological time scale (periods of at least 10,000 years) (Kirchner et al 2001). Incremental erosion prevails most of the time, but accounts for very little of the overall sediment yield. Catastrophic erosion events, although extremely rare, dominate the long-term sediment yield. In fact, 70% to 97% of sediment delivery must occur during these episodes. Conventional sediment yield measurements are ineffective at measuring these catastrophic events due to the enormous size and infrequency of these events. With these recent discoveries, it would appear that human activities have contributed very little to the long-term sediment yield, but, as has been suggested by the research, human activities can still alter the frequency or size of these catastrophic events.

In conclusion, the major sources of sediment in the Palouse River Subbasin considered significant for this assessment are *off the landscape*, which includes natural background, agricultural activities and grazing activities, roads, and in-stream erosion sources. The effects of increased sedimentation to water bodies from mining, recreation, administrative activities, and air deposition are observable at times, but many orders of magnitude less significant; therefore, would not be given a loading amount if it is determined a TMDL is necessary.

Temperature (Heat Sources)

All six water bodies in the Palouse River Subbasin are 303(d)-listed for temperature, and the heat source is solar radiation from the sun. This is a natural condition. The question in point is what amount of additional solar radiation is occurring due to anthropogenic activities. Additional heat being absorbed by a water body, beyond background in forested environments, is usually a function of shade reduction. The water bodies that are listed for temperature have been altered by land use changes that suggest the following:

- A reasonable conclusion would be that an additional heat load to these streams has resulted from decreased stream shading by removing the canopy cover from these water bodies.
- Another reasonable conclusion is that the snow pack is decreased each spring season, earlier than what occurred naturally because of land-use changes.

Some evidence exists that canopy removal over broad sections of a watershed may increase flows in the early part of the season and result in lower flows in the latter part of the season when air temperatures are highest. Other evidence exists in watersheds, with deep, permeable vadose zones and vegetative covers with large evapotranspiration potentials, that canopy removal may result in increased flows throughout the year. If flows are lower in the summer, following the removal of the watershed canopy, higher stream temperatures could be the one of the results.

However, flow modification is not a pollutant under the CWA; therefore, lower flows and possible flow modifications are not fully addressed. A recommendation for land managers to possibly reduce stream temperatures would be to include methods to increase late season flows thereby reducing temperatures.

Higher early season flows could possibly result in channel widening and subsequent increased heat loading. This results in an increase of the surface area of the water to receive solar radiation. In most cases within the Palouse River Subbasin, where higher width to depth ratios are thought to have developed as a result of human activity, the altered ratios are primarily the result of road construction, mining alteration, or the removal of streamside vegetation that kept the channel narrow and sinuous.

Temperature data from streams that are not 303(d)-listed for temperature in Palouse River Subbasin indicates that water temperature exceedances are very common in the summer months. A recent report about water temperatures in the Lochsa watershed concluded that restoration strategies to generate full potential canopy cover in riparian areas throughout the Lochsa River Watershed would decrease average and maximum water temperatures—but not enough to satisfy Idaho cold water aquatic life temperature criteria (HDR, 2001). This is likely the same case in the Palouse River Subbasin. Therefore, DEQ used the Potential Natural Vegetation (PNV) model for the temperature TMDLs. This methodology, described in detailed in Chapter 5, will use the narrative natural condition state standard as a temperature target instead numeric criteria.

Nutrients

All six listed water bodies in the Palouse River Subbasin are 303(d)-listed for nutrients. Nutrient sources for these water bodies include fertilization from various source but mainly agriculture, grazing activities, residential sources and natural sources. The Idaho general surface water quality criteria states that, “Surface waters must be free of excess nutrients that cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.” A numeric standard for DO of 6.0 mg/L applies as well. A nutrient target of 0.1mg/L and DO levels above the 6.0 mg/L was established for the growing season (May-October).

Nutrients are essential for life, especially for the primary plant growth nutrients, and are ubiquitous in the environment. Because of their key role in ecosystem function, excessive levels of nutrients affect aquatic systems in a wide range of ways. Many types of human activities, particularly those associated with human or animal waste disposal or fertilizer application, can result in excessive loading of nutrients to water bodies and, for this reason, nutrient-related impairment is a widespread problem.

Excessive inputs of nitrogen and phosphorus have been known to impair aquatic life and/or salmonid spawning beneficial uses. These excessive nutrient inputs lead to excess growth of algae, which can deplete oxygen in the water that is needed by other organisms. Potential nutrient sources include faulty septic systems, agricultural and urban runoff, and livestock.

Phosphorus is one of the key elements necessary for growth of plants and animals. Phosphorus, in elemental form, is very toxic and is subject to bioaccumulation. Phosphates, such as PO_4, are formed from this element. Phosphates exist in three forms: orthophosphate, metaphosphate (or polyphosphate) and organically bound phosphate. Each compound contains phosphorous in a different chemical formula. *Ortho* forms are produced by natural processes and are found in sewage. *Poly* forms are used for treating boiler waters and in detergents. In water, they change into the ortho form. *Organic* phosphates are important in nature; their occurrence may result from the breakdown of organic pesticides, which contain phosphates. They may exist in solution, as particles, loose fragments, or in the bodies of aquatic organisms.

Phosphorus can be soluble or particulate in water. Two forms of phosphorus commonly measured in laboratories include soluble reactive phosphorus, which is dissolved in water, and total phosphorus, which includes both soluble and particulate forms. Unlike nitrogen, there is no atmospheric (vapor) form of phosphorus, and for this reason phosphorus is often a limiting nutrient in aquatic systems; when large amounts of phosphorus enter a lake or stream, plant growth is greatly increased, which can create water quality problems. Increased plant growth is coupled with increased decomposition, which depletes dissolved oxygen concentrations. Unlike nitrogen, phosphorus does not form any toxic by-products as phosphorus recycles through the ecosystem.

Dissolved oxygen (DO) concentration refers to the amount of oxygen contained in water. Fish and other aquatic organisms require oxygen for respiration, and oxygen dissolves in water mainly by two methods: directly from the atmosphere and as a by-product from plant photosynthesis.

Dissolved oxygen concentrations are generally controlled by six factors:

1) Temperature – warmer water holds less dissolved oxygen.
2) Atmospheric pressure – water at higher atmospheric pressure holds more dissolved oxygen.
3) Turbulence – increased turbulence or mixing will increase dissolved oxygen concentrations.
4) Plant growth – increased photosynthesis will result in increased dissolved oxygen concentrations.
5) Decomposition – increased decomposition uses dissolved oxygen from the water.
6) Ammonia concentrations – high ammonia concentrations in the water can also lead to low dissolved oxygen levels, as bacteria oxidize the ammonia to nitrate during a process known as nitrification.

Low dissolved oxygen concentrations in lakes and streams can result in the death of aquatic organisms, including insects and fish. When oxygen is lacking in the water column, a chemical reaction can occur that “unlocks” phosphorus from sediments where it would otherwise be tightly held. Released phosphorus can become re-suspended in the water column and fuel additional algal production.

The water column may also become *supersaturated* with oxygen (greater than 100% saturation). Supersaturation occurs as a result of excessive algae and plant growth. Supersaturation can indirectly result in low dissolved oxygen levels when the plant matter dies and bacteria consume oxygen to decompose the plant matter.

Oxygen depletion can be prevented by: keeping organic materials, like yard and pet waste, out of the water, using phosphorus-free fertilizer, using best management practices, like filter strips and grassed swales, to filter nutrients in runoff water, and properly maintaining septic systems.

Once absorbed, oxygen is either incorporated throughout the water body via internal currents or is lost from the system. Flowing water is more likely to have high dissolved oxygen levels than is stagnant water because of the water movement at the air-water interface. In flowing water, oxygen-rich water at the surface is constantly being replaced by water containing less oxygen as a result of turbulence, creating a greater potential for exchange of oxygen across the air-water interface. Because stagnant water undergoes less internal mixing, the upper layer of oxygen-rich water tends to stay at the surface, resulting in lower dissolved oxygen levels throughout the water column. Oxygen losses readily occur when water temperatures rise, when plants and animals respire, and when microbes aerobically decompose organic matter.

The background TP amount was determined by examining monitoring data from four watershed that have relatively few anthropogenic impacts with similar geologies, soil types and land-uses. Nutrient data was collected within the four watersheds during 2001 and 2002 as shown below in Table 3-2. The yearly TP average of these watershed ranged from 0.0314 to 0.0398 mg/L with a combined average of 0.035. This is the background value that was used in the TMDL loading calculation. A load allocation of 0.075 mg/L was established for these TMDLs.

Table 3-2. TP monitoring results used for as background.

Dates	Moose lower	Moose upper	WF Potlatch Cr	Big Creek-upper Dates	Value
12/27/2001	0.031	0.035	DNS	11/26/2001	0.047
1/8/2002	0.032	0.031	DNS	12/5/2001	0.036
1/22/2002	0.032	0.023	DNS	12/19/2001	0.057
2/4/2002	0.021	0.019	DNS	1/2/2002	0.047
2/19/2002	0.032	0.025	DNS	1/16/2002	0.043
3/4/2002	0.031	0.029	DNS	1/29/2002	DNS
3/18/2002	0.032	0.028	DNS	2/12/2002	DNS
4/1/2002	0.029	0.021	DNS	2/26/2002	DNS
4/14/2002	0.027	0.021	DNS	3/12/2002	DNS
4/30/2002	0.017	0.012	0.013	3/26/2002	DNS
5/13/2002	0.014	0.013	0.017	4/8/2002	0.1
5/30/2002	0.027	0.029	0.029	4/22/2002	0.042
6/11/2002	0.028	0.031	0.035	5/7/2002	0.036
6/25/2002	0.025	0.042	0.031	5/22/2002	0.051
7/10/2002	0.033	0.05	0.036	6/4/2002	0.044
7/24/2002	0.062	0.081	0.047	6/18/2002	0.067
8/7/2002	0.024	0.042	0.033	7/3/2002	0.044
8/21/2002	0.043	0.046	0.032	7/16/2002	0.042
9/4/2002	0.29	0.046	0.037	7/29/2002	0
9/19/2002	0.093	0.05	0.037	8/18/2002	0
10/3/2002	0.031	0.042	0.036	8/28/2002	0
10/15/2002	0.024	0.041	0.028	9/5/2002	0
10/30/2002	0.023	0.042	0.031	9/24/2002	0.066
11/14/2002	0.019	0.037	0.052	10/7/2002	0.058
11/26/2002	0	0.021	0.021	10/22/2002	0.05
12/11/2002	0.014		0.019	11/5/2002	0.12
				11/18/2002	0.062
	Moose -lower	**Moose-upper**	**WF Potlatch**		**Big Creek**
Averages	**0.0398**	**0.03428**	**0.0314**		**0.0365**
All 4 averaged	**0.035**				

[a] t/yr = tons per year
DNS = Did not sample

Bacteria

All six listed water bodies in the Palouse River Subbasin are 303(d)-listed for bacteria.

There are various types of bacteria in water:

- Harmful bacteria are found in within other bacteria microorganisms, virus and protozoa, and when ingested into body can cause sickness or even death.
- Other bacteria are able to cause illness by entering the body through abrasions in the skin; therefore, state standards are set at a level to protect human health.
- Some types of natural bacteria exist in the stream year round, these bacteria are fairly benign.
- *E-coli* bacterium is used by IDEQ as an indicator of these harmful bacteria organisms in a waterbody. All humans, and most warm-blooded animals, carry *E-coli* in the intestinal tract, making *E-coli* a good indicator of the more harmful types of bacteria to humans. *E-coli* and other harmful bacterium have a lifespan outside of the warm-blooded digestional tracks of about 24-30 hours, which is enough time for bacteria sources in the headwaters of a stream to move downstream throughout the entire stream and into other water bodies like the Palouse River. Therefore it is critical that all sources of bacteria be reduced and maintained within state standard to ensure the contract recreational beneficial use is protected.

Sources for bacteria include livestock, wildlife (especially waterfowl), humans, septic tank drain fields, and other domesticated warm-blooded animals. The 303(d)-listed water bodies for bacteria were sampled from November 2001 through November 2002 for *E-coli* organisms and total fecal coliform. Five out of the six 303(d) stream were in violation of the secondary contact recreational standard.

3.2 Data Gaps

This section discusses where additional monitoring to gather data could help clarify questions about water quality impairment. At the beginning of this subbasin assessment, a large data gap loomed in the forefront. Little or no data existed for nutrients, bacteria, sediment, or temperature. Some supporting data was available with the *Clearwater Biostudies* reports, and other flow and sediment data from the Forest Service but in limited areas. Therefore, a monitoring plan to gather baseline data for nutrients, bacteria, sediment and temperature was created, and data was collected from November 2001 through November 2002.

Collecting data during the above time frame was at times challenging, as access to the sites was limited during the winter due to weather conditions and snow levels. Getting samples to the laboratory was challenging, as well, as the bacteria samples had to be at a laboratory within 30 hours of sampling. Budget constraints also limited the extent of the sampling to one year and frequency (bi-weekly) of the sampling. In spite of these limitations, DEQ believes a credible database was established to adequately assess the condition of the 303(d)-listed water bodies with a reasonable degree of certainty.

Nonpoint Sources

Long term data on sediment, which originated from historic fires and mass failures, would be helpful. Gathering this data would be challenging, but understanding overall effects—specifically how these events affected the life histories of major fish species—could provide key information regarding sedimentation levels and fish conditions prior to European settlement. For example, there is very little data on the sediment condition of streams before the early 20^{th} century fires or the large 1975-76 rain-on-snow event.

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

This section describes some of the past and present water pollution control efforts in the subbasin.

Agricultural BMP Implementation

The Idaho Soil Conservation Commission contributed the following (Dansart 2004):

> The Soil Conservation Service (SCS) became active in the Palouse River Basin in 1935, five years before the first conservation districts in the area were organized. Major SCS activities included technical assistance to individual farmers and farmer groups planning and applying conservation on the land through Soil and Water Conservation Districts (SWCDs). The SCS (now NRCS) have worked in the North Fork of the Palouse Watershed through the Latah SWCD to assist with conservation planning and assistance. The Latah Soil Survey, which encompasses the watershed, was published in 1981; a new soil survey for the area is in progress and almost complete.
>
> The Agricultural Research Service (ARS) has conducted research to provide new agronomic alternatives for farmers in the Palouse and develop data to revise the Universal Soil Loss Equation (USLE). The Agricultural Stabilization and Conservation Service which later became the Farm Service Agency (FSA) has cost-shared, through various farm programs, implementation of selected conservation practices with landowners and operators in the watershed.
>
> According to DEQs 2003 survey of land uses in the North Fork Palouse watershed, an estimated 62,874 acres are in cropland, 18,361 acres are in hayland and 4,661 acres in pasture.
>
> The common crop rotation in the Idaho portion of the watershed today is either a winter wheat/spring cereal grain rotation, a winter wheat/spring cereal grain/spring legume (pea or lentil) rotation, or a winter wheat/spring legume rotation. Research has shown that maximizing residues from the previously harvested crop reduces erosion potential on the farm fields (RPU, 2004).
>
> Conventional tillage, which involves inverting much of the soil surface during multiple field passes, has been traditionally practiced on cropland in the watershed. No-till farming is gradually becoming utilized in the watershed. No-till farming includes using specialized equipment to place the fertilizer and seed directly into the previous year's crop residue without performing prior tillage operations. At least in one leg of the rotation, it is common to see a no-till operation replace conventional practices. For example, winter wheat is often no-tilled into lentil, pea, or spring grain stubble, where the fertilizer is applied during the same operation as seeding. A few producers are implementing no-till operations for every leg of the rotation, which is

referred to as direct seed. This evolution of crop residue management throughout the subbasin has increased the over-winter crop stubble throughout the agricultural areas and decreased vulnerability of the soil surface to erosion. It is becoming more common for a no-till seeding operation to follow the low residue crop (lentils or spring wheat). Minimum tillage operations, designed to minimize ground disturbance and maximize surface residue cover, are used throughout the watershed (RPU, 2004).

USDA Farm Services Administration (FSA) and the Natural Resources Conservation Service (NRCS) administer and implement the federal Conservation Reserve Program (CRP) and Continuous Conservation Reserve Program (CCRP).

Agricultural lands with a previous cropping history are enrolled into CRP to remove highly erodable land from production. The land is converted into herbaceous or woody vegetation to reduce soil and water erosion. CRP contracts are for a minimum of 10 years. Practices that occur under CRP include planting vegetative cover such as introduced or native grasses, wildlife cover plantings, conifers, filter strips, grassed waterways, riparian forest buffers, and field windbreaks (RPU, 2004). Within the North Fork Palouse watershed, approximately 6350 acres have been removed from production and placed into permanent vegetative cover under the Conservation Reserve Program (CRP).

The CCRP focuses on the improvement of water quality and riparian areas. Practices include shallow water areas, riparian forest buffers, filter strips, grassed waterways and field windbreaks. Enrollment for these practices is not limited to highly erosive land, as is required for the CRP, and carries a longer contract period (10-15 years), higher installation reimbursement rate, and higher annual annuity rate (RPU, 2004). CCRP acres within the watershed are unknown at this time but are assumed to be fairly low.

The NRCS administers and implements the Environmental Quality Incentives Program. (EQIP) provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers to comply with federal, state, and tribal environmental laws, and encourages environmental enhancement. The purposes of the program are achieved through the implementation of a conservation plan that includes structural, vegetative, and land management practices on eligible land. Five- to ten-year contracts are made with eligible producers. Cost-share payments may be made to implement one or more eligible structural or vegetative practices, such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat (RPU, 2004). Several EQUIP projects are active in the watershed.

The Latah SWCD serves as the lead in administering the Section 319 funded AFO project which identifies problem areas and implements best management practices on confined animal feeding operations. The project was initiated in 2001 and continues to present; it involves five north-central Idaho Conservation Districts. Currently, only one project has been implemented within the North Fork watershed.

The Idaho Association of Soil Conservation Districts (IASCD), has performed water quality monitoring within the watershed under an agreement with DEQ through the Latah SWCD to assist in development of this TMDL.

The Idaho Soil Conservation Commission (SCC) staff provides technical and administrative support to Conservation Districts in Idaho. SCC has provided financial incentives under the Water Quality Program for Agriculture (WQPA) to supplement EPA 319 funds on agricultural lands. The intent of WQPA is to contribute to protection and enhancement of the quality and value of Idaho's waters by controlling and abating water pollution from agricultural lands. The program provides financial assistance to Soil Conservation Districts who conduct water quality planning studies and implement water quality projects.

Habitat Improvement

More people living on the Palouse are becoming interested in preserving native sites, and in reestablishing native environments in places where they have been destroyed. Some people are creating wetlands, performing stream side restoration projects and planting native plant species. Such restoration can involve a good deal of work and in time these sites will improve water quality, improve habitat and flow conditions, and help reestablish native habitats within the Palouse River Subbasin.

Forestry

The Idaho Forest Practices Act (FPA) is state policy and is legislatively mandated. A Forest Practices Advisory Committee composed of various interest groups has been established with the specific responsibility to review and improve forestry BMPs such that forest practices will be conducted using the latest economically sound information and practices to protect water quality. The committee conducts research into forest practice questions and gathers information from various sources, effectively providing a feedback loop for continuous improvement of forest practices. Many of the activities now being implemented in the Palouse River Subbasin to improve water quality are the direct result of improved practices and BMPs put in place by the FPA.

The FPA was codified during the mid-1970s to comply with Section 208 of the federal CWA. The FPA established mandatory rules and regulations leading to BMPs to be used during forest practices to protect surface water quality (IDL 1998). Espinosa et al. (1997) described estimated sediment delivery above USFS management plan goals from the 1950s through the 1970s, and noted that the awareness of watershed and habitat degradation problems helped to initiate a moderation of timber and road construction impacts in the early 1980s. On-site audits of FPA compliance were conducted in 1978, 1984, 1988, 1992, 1996, 2000, and 2004. Because of these audits, BMPs have been revised to promote better water quality protection.

Under the FPA, the forest industry and the state of Idaho have developed and are implementing a CWE process for forest lands in the state. The goal of this methodology is to systematically examine forested watersheds and identify on-the-ground cases where management may be contributing to water quality problems as defined by the CWA and state standards. When problems are identified, the process leads directly to corrective management prescriptions where the problem is occurring. CWE assessments have been completed on a significant portion of the state and private managed land in the Palouse River Subbasin. CWE reports define corrective management actions for each watershed where actual on-the-ground-conditions have been documented. These actions include BMPs based on FPA guidelines to ensure that forestry activities are not impairing water quality conditions. DEQ has been working closely with the FPA committee, IDL, and private industry to ensure BMPs are implemented, and will continue to do so.

Idaho Department of Lands (IDL)

The IDL has contributed the following:

> The Idaho Department of Lands performs a variety of pollution control efforts in the Palouse Headwaters. These efforts include efforts include enforcement of Forest Practice Act rules, Forest Practices Act education, Stewardship Forestry Assistance, Stewardship Cost-Share Programs, general forestry education, State endowment land management, and Minerals Act administration and enforcement.
>
> The State Forest Practices Act (FPA) requires forest landowner compliance with forestry best management practices. Approximately 300 logging compliances are issued out of the Ponderosa Area office in Deary, Idaho. Approximately 120 inspections of logging operations are performed each year to ensure compliance with the FPA. These on-site inspections include review of road construction and maintenance, stream crossing construction, stream protection zone (SPZ) encroachment by equipment, and road/skidtrail locations.
>
> Stewardship Forestry Assistance includes on site visits with landowners providing education, information and technical transfer of forestry and stream side best management practices. The state administers the Stewardship Program which includes assistance to landowners through cost sharing forestry, riparian, and agro-forestry practices. The department also supports the Logger Education and Professionalism (LEAP) Program and Pro-Logger Program by providing workshops and training in the areas of logging bmp and Forest Practices rules. Topics presented in 2003 included “Installing Culverts to Meet Fish Passage Guidelines”. In 2004 presentations to logger groups covered Forest Practices rules regarding skid trail location and maintenance.
>
> The Idaho Department of Lands administers approximately 5,900 acres of endowment lands and McCroskey State Park within the Headwaters Palouse River watersheds. Administration of this land meets and exceeds the Forest Practices rules.

> Stream crossing structures are engineered to meet 50 year peak flows. Roads are inventoried and inspected on a periodic basis. Pollution (sediment and erosion) Management problems are identified and repaired as soon as weather conditions permit.
>
> Road maintenance activities performed in 2004, in the Headwaters Palouse drainages included road grading and cross-ditch maintenance of approximately 2.5 miles of road on the state ownership in Flannigan and Rock Creek. Timber sales in the Last Chance and Big Creek drainages in the mid and late 19990's maintained roads and installed new culverts to meet updated 50 year peak flow requirements and fish stream passage guidelines. Recent (2002, 2003, and 2004) active management of McCroskey State Park has resulted in maintenance of 7 miles of road including installation of additional culverts (Barkley 2004).

Clearwater National Forest, Palouse Ranger District

The federal Inland Native Fish Strategy (INFISH) standards were adopted in1995 and have been implemented on the federal forest lands within the Palouse River Subbasin. INFISH standards increased streamside buffer widths, improved trail and road construction practices, and required land managers to review grazing situations.

The CNF has contributed the following:

> Between 1992 and 2003, 21.2 miles of road have been obliterated on the Palouse, 16.1 miles abandoned and 1.5 put in intermittent storage. The majority of roads obliterated were high sediment producers, with high potential for mass failures, or streamside adjacent. Twenty-two miles were constructed during that time, frequently on ridge locations. BMP audits through 2003 had about 3500 BMP checks, with the most recent year showing 98% implementation and 99% effectiveness. Temperature monitoring sites number 11 in the Palouse drainage (Foltz 2004).

Potlatch Corporation

Potlatch Corporation has contributed the following:

> The most significant effort Potlatch Corporation has made to control pollution in the Palouse River sub-basin is in the form of sediment reduction and erosion control. Potlatch Corporation has recently implemented a comprehensive transportation plan. Road assessments are conducted in order to identify, prioritize, and schedule short-term and long-term needs for road maintenance, reconstruction, new construction, culvert replacement, abandonment, and obliteration. Cut and fill slopes are grass-seeded on all newly constructed roads to stabilize disturbed soil. Some of the new roads are temporary spur roads for harvest and silvicultural activities, and are abandoned or obliterated once the activities are complete. Access is controlled to most of the secondary dirt roads. Gated roads are only open to ATVs and non-motorized traffic during the wet-weather months. Since 2000, Potlatch Corporation

has obliterated 2.25 miles of road and abandoned 3 miles of road within the Palouse River watershed.

Potlatch has developed an environmental management system, which has earned ISO 14001 certification. Potlatch Corporation holds itself to a high standard of forest management and stewardship, and is also certified under the Sustainable Forestry Initiative (SFI) and the Forest Stewardship Council (FSC). Key to these standards are the requirements for stream management zones. Potlatch identifies and manages Class I riparian stands, which exceed Idaho FPA standards for best management practices (Watkins 2004).

5. Total Maximum Daily Loads

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

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

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

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

In the following sections, TMDLs are presented for bacteria, temperature, nutrients, and sediment. For each category of impairment and each water quality limited segment (Table 7, page 32), in-stream water quality targets are defined, as are design conditions/target selection, and monitoring points, followed by load analyses for each impaired water body. In addition to bacteria, temperature, nutrients, and sediment, Big Creek, Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek and Rock Creek are also impaired due to a lack of flow and habitat alteration.

(Note: EPA does not consider flow [or lack of flow] or habitat alteration a pollutant as defined by CWA Section 502(6), but rather pollution. Since TMDLs are not required to be established for waterbodies impaired by pollution but not pollutants, a TMDL will not be completed for Big Creek, Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek, and Rock Creek for flow and habitat alteration, even though these waterbodies are certainly negatively altered by flow and habitat alteration.)

5.1 Bacteria TMDLs

Bacteria TMDLs were developed for five out of the six 303(d) listed streams in this report: Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek and Rock Creek.

In-Stream Water Quality Targets for Bacteria

The in-stream water quality target for bacteria was developed to restore full support of the recreational beneficial use for each stream. The in-stream load reduction target is based on the collected values of *E. Coli* organisms per 100 ml during November 2001 through November 2002.

Design Conditions/Target Selection

State standards for waters designated for secondary contact recreation are not to contain E. coli bacteria significant to the public health in concentrations exceeding:

- A single sample of 576 E. coli organisms per one hundred 100 ml;

  or
- A geometric mean of 126 *E.Coli* organisms per 100 ml based on a minimum of five samples taken every three to five days over a 30 day period at any 30 day period throughout the year.

E-coli and other harmful bacterium have a life span of about 24-30 hours outside of warm-blooded digestive tracks ,which is enough time for bacteria sources in the headwaters of a stream to move downstream and into other waterbodies like the Palouse River. Therefore, it is critical that all sources of bacteria be reduced and maintained within state standards to ensure contact recreational beneficial use is protected throughout the Palouse River Subbasin.

The load capacity is the amount of pollutant a water body can receive without violating water quality standards. The load capacity for Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek, and Rock Creek is set at a level that fully supports beneficial uses. Seasonal variations, background levels, and a Margin of Safety (MOS) to account for any uncertainties in the load are calculated within the load capacity.

Monitoring Points

The TMDL compliance points for the bacteria TMDLs are the established monitoring sites, which include the mouths of each stream. Since bacteria can travel throughout the entire stream, beneficial uses must be met throughout each 303(d) stream; therefore, each monitoring site is a compliance point for the bacteria TMDLs.

Deep Creek Load Analysis

Samples collected from the upper (PR7), middle (PR6), and lower (PR5) monitoring sites during the 2002 monitoring season revealed several instantaneous exceedances of the state secondary contact standard for bacteria. These exceedances occurred during December, March, May, and June.

Deep Creek is an intermittent stream; therefore, bacteria TMDLs were only written when discharges were greater than 5 cfs. The mass per unit volumes for the current load, load capacity, load reduction amount, and percentages were calculated based on the discharge data for each exceedance.

An MOS of 10% was applied to the load reduction to ensure the goals of the bacteria TMDL are met.

Until bacteria levels are within state water quality standards, DEQ recommends no Animal Unit Months (AUMs) over the current allotment amount be allowed in the watershed. Table 5-1 displays the bi-weekly monitoring results for bacteria; Table 5-2 displays the current load, load allocations, and load reductions.

Table 5-1. Deep Creek bacteria bi-weekly monitoring results.

Date	PR-5 (E-coli)[1]	PR-6 (E-coli)[1]	PR-7 (E-coli)[1]	PR-5 (discharge)[2]	PR-6 (discharge)[2]	PR-7 (discharge)[2]
11/26/2001	130	240	23	4.67	4.82	1.28
12/5/2001	1700	2400	82	7.17	5.57	0.98
12/19/2001	980	620	26	16.48	23.00	3.01
1/2/2002	16	350	3	5.89	4.20	1.08
1/16/2002	84	160	33	28.39	25.82	6.55
1/29/2002	72	60	23	59.36	51.26	7.58
2/12/2002	84	90	28	39.26	40.24	5.81
2/26/2002	190	40	22	42.00	41.06	23.42
3/12/2002	870	350	73	72.04	67.89	19.75
3/26/2002	690	560	24	50.24	47.77	28.92
4/22/2002	32	30	11	36.26	31.08	24.62
5/7/2002	230	610	11	16.40	14.37	5.54
5/21/2002	200	88	11	5.35	4.85	3.03
6/4/2002	130	31	120	2.61	2.68	1.67
6/18/2002	280	100	1200	1.45	1.65	1.24
7/3/2002	26	20	86	1.09	0.85	0.79
7/16/2002	89	250	440	0.17	0.14	1.05
7/29/2002	DRY[3]	DRY	DRY	DRY	DRY	DRY
8/18/2002	DRY	DRY	DRY	DRY	DRY	DRY
8/28/2002	DRY	DRY	DRY	DRY	DRY	DRY
9/5/2002	DRY	DRY	DRY	DRY	DRY	DRY
9/24/2002	DRY	DRY	DRY	DRY	DRY	DRY
10/7/2002	DRY	DRY	DRY	DRY	DRY	DRY
10/22/2002	DRY	DRY	DRY	DRY	DRY	DRY
11/4/2002	DRY	DRY	DRY	DRY	DRY	DRY
11/18/2002	15	9	120	0.04	0.24	0.42

[1] E-coli Organisms per 100/ml
[2] Cubic feet per second (cfs)
[3] Dry = Dry Creek

Table 5-2. Bacteria nonpoint sources load allocations for Deep Creek.

Source	Month	Current Load (*E.coli* organisms/day)	Load Allocation (*E.coli* organisms/day)	MOS (10%)	Load Reduction (*E.coli* organisms/day)
Unknown (PR5)	Dec	2.99×10^{11}	1.01×10^{11}	1.98×10^{10}	2.18×10^{11}
Unknown (PR6)	Dec	3.26×10^{11}	7.83×10^{10}	2.48×10^{10}	2.73×10^{11}
Unknown (PR5)	Dec	3.95×10^{11}	2.32×10^{11}	1.63×10^{10}	1.79×10^{10}
Unknown (PR6)	Dec	3.49×10^{11}	3.24×10^{11}	2.5×10^{9}	2.75×10^{10}
Unknown (PR5)	Mar	1.53×10^{12}	1.01×10^{12}	5.2×10^{10}	5.72×10^{11}
Unknown (PR5)	Mar	8.49×10^{11}	7.08×10^{11}	1.41×10^{10}	1.55×10^{11}
Unknown (PR6)	May	2.15×10^{11}	2.03×10^{11}	1.2×10^{9}	1.32×10^{10}
Unknown (PR7)	June	3.64×10^{10}	1.75×10^{10}	1.89×10^{9}	2.08×10^{10}

Flannigan Creek Load Analysis

Samples collected from the upper (PR17) and lower (PR16) monitoring sites during the 2002 monitoring season revealed eleven instantaneous exceedances of the state secondary contact standard for bacteria. These exceedances occurred during the months of March, May, June, July, August, September, and October.

The mass per unit volumes for the current load, load capacity, load reduction amount, and percentages were calculated based on the discharge data for each exceedance. An MOS of 10% was applied to the load reduction to ensure the goals of the bacteria TMDL are met.

Until bacteria levels are within state water quality standards, DEQ recommends no AUMs over the current allotment amount be allowed in the watershed. Table 5-3 displays the bi-weekly monitoring results for bacteria; Table 5-4 displays the current load, load allocations, and load reductions.

Table 5-3. Flannigan Creek bacteria bi-weekly monitoring results.

Date	PR-16 (E-coli)[1]	PR-17 (E-coli)[1]	PR-16 (discharge)[2]	PR-17 (discharge)[2]
11/26/2001	100	64	7.07	2.01
12/5/2001	74	19	2.79	1.53
12/19/2001	310	100	14.48	8.42
1/2/2002	30	46	2.14	1.62
1/16/2002	56	58	9.79	5.58
1/29/2002	53	63	18.07	11.85
2/12/2002	50	73	19.12	10.41
2/26/2002	28	46	30.84	27.66
3/12/2002	610	440	44.72	35.99
3/26/2002	120	81	37.78	34.25
4/22/2002	10	38	23.50	24.00
5/7/2002	210	410	14.91	12.42
5/21/2002	2400	1600	9.91	10.62
6/4/2002	390	410	3.48	5.84
6/18/2002	340	690	2.03	2.02
7/3/2002	110	2400	1.21	1.50
7/16/2002	310	670	0.72	0.77
7/29/2002	280	2400	0.38	0.36
8/18/2002	54	600	0.10	0.17
8/28/2002	43	43	0.21	0.34
9/5/2002	17	1000	0.22	0.33
9/24/2002	46	2400	0.08	0.18
10/7/2002	16	860	0.27	0.42
10/22/2002	1	450	0.33	0.46
11/5/2002	11	170	0.26	0.40
11/18/2002	20	13	0.78	0.91

[1] E-coli Organisms per 100/ml
[2] Cubic feet per second (cfs)

Table 5-4. Bacteria nonpoint sources load allocations for Flannigan Creek.

Source	Month	Current Load (*E.coli* organisms/day)	Load Allocation (*E.coli* organisms/day)	MOS (10%)	Load Reduction (*E.coli* organisms/day)
Unknown (PR16)	Mar	6.65×10^{11}	6.28×10^{11}	3.7×10^{9}	4.07×10^{10}
Unknown (PR16)	May	5.81×10^{11}	1.39×10^{11}	4.42×10^{10}	4.86×10^{11}
Unknown (PR17)	May	4.16×10^{11}	1.50×10^{11}	2.66×10^{10}	2.93×10^{11}
Unknown (PR17)	Jun	3.35×10^{10}	2.79×10^{10}	5.6×10^{8}	6.16×10^{9}
Unknown (PR17)	Jul	8.83×10^{10}	2.12×10^{10}	6.71×10^{9}	7.38×10^{10}
Unknown (PR17)	Jul	1.27×10^{10}	1.09×10^{10}	1.8×10^{8}	1.98×10^{9}
Unknown (PR17)	Jul	2.09×10^{10}	5.02×10^{9}	1.59×10^{9}	1.75×10^{10}
Unknown (PR17)	Aug	2.44×10^{9}	2.34×10^{9}	1.00×10^{7}	1.10×10^{8}
Unknown (PR17)	Sep	8.17×10^{9}	4.71×10^{9}	3.46×10^{8}	3.81×10^{9}
Unknown (PR17)	Sep	1.04×10^{10}	2.51×10^{9}	7.89×10^{8}	8.68×10^{9}
Unknown (PR17)	Oct	8.94×10^{9}	5.99×10^{9}	2.95×10^{8}	3.25×10^{9}

Gold Creek Load Analysis

Samples collected from the upper (PR8) and lower (PR9) monitoring sites during the 2002 monitoring season revealed five instantaneous exceedances of the state secondary contact standard for bacteria. These exceedances occurred during the months of November, December, August, September, and October.

The mass per unit volumes for the current load, load capacity, load reduction amount, and percentages were calculated based on the discharge data for each exceedance. An MOS of 10% was applied to the load reduction to ensure the goals of the bacteria TMDL are met.

Until bacteria levels are within state water quality standards, DEQ recommends no AUMs over the current allotment amount be allowed in the watershed. Table 5-5 displays the bi-weekly monitoring results for bacteria; Table 5-6 displays the current load, load allocations, and load reductions.

Table 5-5. Gold Creek bacteria bi-weekly monitoring results.

Date	PR-8 (E-coli)[1]	PR-9 (E-coli)[1]	PR-8 (discharge)[2]	PR-9 (discharge)[2]
11/26/2001	21	2400	7.07	2.01
12/5/2001	28	91	2.79	1.53
12/19/2001	60	650	14.48	8.42
1/2/2002	38	110	2.14	1.62
1/16/2002	15	46	9.79	5.58
1/29/2002	26	190	18.07	11.85
2/12/2002	24	75	19.12	10.41
2/26/2002	0	16	30.84	27.66
3/12/2002	74	130	44.72	35.99
3/26/2002	13	32	37.78	34.25
4/22/2002	15	27	23.50	24.00
5/7/2002	4	24	14.91	12.42
5/21/2002	11	46	9.91	10.62
6/4/2002	19	15	3.48	5.84
6/18/2002	24	110	2.03	2.02
7/3/2002	110	350	1.21	1.50
7/16/2002	300	290	0.72	0.77
7/29/2002	440	23	0.38	0.36
8/18/2002	1100	28	0.10	0.17
8/28/2002	130	13	0.21	0.34
9/5/2002	84	2400	0.22	0.33
9/24/2002	490	27	0.08	0.18
10/7/2002	580	22	0.27	0.42
10/22/2002	190	3	0.33	0.46
11/4/2002	35	1	0.26	0.40
11/18/2002	15	28	0.78	0.91

[1] E-coli Organisms per 100/ml
[2] Cubic feet per second (cfs)

Table 5-6. Bacteria nonpoint sources load allocations for Gold Creek.

Source	Month	Current Load (*E.coli* organisms/day)	Load Allocation (*E.coli* organisms/day)	MOS (10%)	Load Reduction (*E.coli* organisms/day)
Unknown (PR9)	Nov	1.18×10^{11}	2.82×10^{10}	8.98×10^{9}	9.88×10^{10}
Unknown (PR9)	Dec	1.34×10^{11}	1.19×10^{11}	1.5×10^{9}	1.65×10^{10}
Unknown (PR8)	Aug	2.59×10^{9}	1.35×10^{9}	1.24×10^{8}	1.36×10^{9}
Unknown (PR9)	Sep	1.96×10^{10}	4.71×10^{9}	1.49×10^{9}	1.64×10^{10}
Unknown (PR8)	Oct	3.80×10^{9}	3.78×10^{9}	2.0×10^{6}	2.20×10^{7}

Hatter Creek Load Analysis

Samples collected from the upper (PR13) and lower (PR12) monitoring sites during the 2002 monitoring season revealed ten instantaneous exceedances of the state secondary contact standard for bacteria. These exceedances occurred during the months of December, March, May, June, July, and August.

The mass per unit volumes for the current load, load capacity, load reduction amount, and percentages were calculated based on the discharge data for each exceedance. An MOS of 10% was applied to the load reduction to ensure the goals of the bacteria TMDL are met.

Until bacteria levels are within state water quality standards, DEQ recommends no AUMs over the current allotment amount be allowed in the watershed. Table 5-7 displays the bi-weekly monitoring results for bacteria; Table 5-8 displays the current load, load allocations, and load reductions.

Table 5-7. Hatter Creek bacteria bi-weekly monitoring results.

Date	PR-12 (E-coli)[1]	PR-13 (E-coli)[1]	PR-12 (discharge)[2]	PR-13 (discharge)[2]
11/26/2001	94	28	3.0986	2.7976
12/5/2001	690	23	2.6914	2.9981
12/19/2001	120	46	5.5202	10.156
1/2/2002	49	28	3.5889	3.5733
1/16/2002	66	20	15.905	19.215
1/29/2002	38	10	32.0286	23.4525
2/12/2002	96	24	17.4595	16.7424
2/26/2002	60	19	64.30035	51.1126
3/12/2002	2400	2400	63.54815	56.1715
3/26/2002	310	73	105.872	63.0497
4/22/2002	74	10	50.8434	42.25325
5/7/2002	50	12	34.464	29.07615
5/22/2002	1100	28	37.2967	37.1462
6/4/2002	100	40	17.9404	15.5809
6/18/2002	690	460	7.06365	7.52475
7/3/2002	420	270	3.8408	4.02485
7/16/2002	650	980	1.3881	2.3304
7/29/2002	1000	690	0.5935	1.4368
8/18/2002	730	190	0.0858	0.93575
8/28/2002	200	0	0.1755	0.5451
9/5/2002	33	140	0.0124	0.6269
9/24/2002	34	180	0.245175	0.5986
10/7/2002	180	170	0.42465	0.562
10/22/2002	12	55	0.3372	0.74795
11/18/2002	370	28	2.0538	1.2122

[1] E-coli Organisms per 100/ml
[2] Cubic feet per second (cfs)

Table 5-8. Bacteria nonpoint sources load allocations for Hatter Creek.

Source	Month	Current Load (*E.coli* organisms/day)	Load Allocation (*E.coli* organisms/day)	MOS (10%)	Load Reduction (*E.coli* organisms/day)
Unknown (PR12)	Dec	4.54×10^{10}	3.79×10^{10}	7.50×10^{8}	8.25×10^{9}
Unknown (PR12)	Mar	3.72×10^{12}	8.93×10^{11}	2.83×10^{11}	3.11×10^{12}
Unknown (PR13)	Mar	3.29×10^{12}	7.89×10^{11}	2.5×10^{11}	2.75×10^{12}
Unknown (PR12)	May	1.00×10^{12}	5.25×10^{11}	4.75×10^{10}	5.23×10^{11}
Unknown (PR12)	Jun	1.19×10^{11}	9.96×10^{10}	1.94×10^{9}	2.13×10^{10}
Unknown (PR12)	Jul	2.21×10^{10}	1.96×10^{10}	2.5×10^{8}	2.75×10^{10}
Unknown (PR13)	Jul	5.59×10^{10}	3.28×10^{10}	2.31×10^{9}	2.54×10^{10}
Unknown (PR12)	Jul	1.45×10^{10}	8.35×10^{9}	6.15×10^{8}	6.77×10^{9}
Unknown (PR13)	Jul	2.43×10^{10}	2.03×10^{10}	4.0×10^{8}	4.4×10^{9}
Unknown (PR12)	Aug	1.53×10^{9}	1.21×10^{9}	3.2×10^{7}	3.52×10^{8}

Rock Creek Load Analysis

Samples collected from both upper (PR15) and lower (PR14) monitoring sites during the 2002 monitoring season revealed two instantaneous exceedances of the state secondary contact standard for bacteria. These exceedances occurred during December and March.

Rock Creek is an intermittent stream; therefore, bacteria TMDLs were only written when discharges were greater than 5 cfs. The mass per unit volumes for the current load, load capacity, load reduction amount, and percentages were calculated based on the discharge data for each exceedance. An MOS of 10% was applied to the load reduction to ensure the goals of the bacteria TMDL are met.

Until bacteria levels are within state water quality standards, DEQ recommends no AUMs over the current allotment amount be allowed in the watershed. Table 5-9 displays the bi-weekly monitoring results for bacteria; Table 5-10 displays the current load, load allocations, and load reductions.

Table 5-9. Rock Creek bacteria bi-weekly monitoring results.

Date	PR-14 (E-coli)[1]	PR-15 (E-coli)[1]	PR-14 (discharge)[2]	PR-15 (discharge)[2]
11/26/2001	59	81	0.39775	0.1302
12/5/2001	96	91	1.1429	0.1662
12/19/2001	610	210	6.09075	1.61325
1/2/2002	150	330	0.6228	0.1788
1/16/2002	74	100	4.2712	0.8833
1/29/2002	120	160	10.2939	2.127
2/12/2002	50	55	11.1844	1.5474
2/26/2002	140	190	79.4793	3.9408
3/12/2002	370	280	75.49	12.79365
3/26/2002	110	580	42.24	5.8307
4/22/2002	20	69	2.0422	1.1373
5/7/2002	980	70	0.87415	0.4435
5/21/2002	56	770	0.4686	0.2012
6/4/2002	36	140	0.203625	0.1197
6/18/2002	99	68	0.068	0.058
7/3/2002	550	140	0.052275	0.091
7/16/2002	0	56	0	0.0699
10/22/2002	4	0	0.13805	0.0966
11/5/2002	4	25	0.0559	0.0523
11/18/2002	3	9	0.1396	0.4115

[1] E-coli Organisms per 100/ml
[2] Cubic feet per second (cfs)

Table 5-10. Bacteria nonpoint sources load allocations for Rock Creek.

Source	Month	Current Load (*E.coli* organisms/day)	Load Allocation (*E.coli* organisms/day)	MOS (10%)	Load Reduction (*E.coli* organisms/day)
Unknown (PR14)	Dec	8.91×10^{10}	8.41×10^{10}	5.0×10^{8}	5.5×10^{9}
Unknown (PR15)	Mar	8.29×10^{10}	8.24×10^{10}	5.0×10^{7}	5.5×10^{8}

Margin of Safety

A ten- percent margin of safety was used in this report for the bacteria TMDLs.

Seasonal Variation

Each 303(d)-listed stream has a different seasonal variation for bacteria exceedances , as shown in the load analyses. Since harmful bacteria have a relatively short life span, it made sense to specify the month for load reductions. Bacteria, unlike sediment, does not stay in a stream network for weeks, months or years; it stays within a stream network for about a day and then dies.

Estimates of Background Bacteria Loading

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)). There are no point sources within the 303(d) watersheds assessed within this report. Harmful bacteria that occur naturally within these streams are minimal; therefore, no estimate of background was attempted.

Time Frame

The goal of this TMDL is to reduce the bacteria loads by the load reduction amount for the waterbodies identified in Tables 5-2, 5-4, 5-6, 5-8, and 5-10. An implementation plan will be completed within 18 months of EPA approval of this TMDL document. Specific actions to comply with this TMDL will be identified within that implementation plan.

5.2 Temperature TMDLs

In-stream Water Quality Targets for Temperature

The temperature targets, in addition to water quality standards for temperature, are based on riparian plant cover over the stream. In this TMDL, *potential natural vegetation* cover (PNV) represents the minimum heat load. Existing vegetative cover represents existing loads of heat to the streams. Those segments with the largest differential between PNV and existing cover (existing cover less than potential cover) are assumed to cause the most heating.

This analysis contains an implicit margin of safety, as all streams are assumed to be at maximum PNV at loading capacity, when in reality natural cover can be more variable due to natural forces (fire, wind throw, drought).

Temperature Load Analysis Techniques

Analysis of temperature loads requires assessments of potential natural riparian vegetation and potential natural aerial cover for the subbasin.

Potential Natural Riparian Vegetation

The natural vegetation of the upper Palouse River region in Latah County, Idaho can best be described as "bunchgrass-dominated steppe (i.e. grassland) of the Palouse Prairie meets the conifer forest." Early botanist and explorer to the region, Charles Geyer (1846), described the higher elevation grasslands of the Palouse region as bunchgrass prairie bordered by "spacious, open, grassy woods" of large widely spaced Ponderosa pine in "elegant parks" dotted with seasonally wet "spongy meadows" or "gamass" (camas) (Weddell 2000). Later, I.I. Stevens, while performing railroad surveys for the Army in 1853-1855, wrote that the Palouse region was "very fertile rolling country," "a most beautiful prairie country, the whole of it adapted to agriculture," "rolling table-land," "comparable to that of the prairie of Illinois" (Weddell 2000). Stevens indicated that the bottomland of the Palouse "has great resources," "it is heavily timbered with pine, but with very little underbrush" (Weddell 2000). Both of these explorers captured two very important images of the Palouse River region: the prairie steppe was extensively dominated by bunchgrasses, and valley bottoms and stream corridors may have been in open timber.

Rexford Daubenmire, one of the West's best-known plant ecologists, worked on explaining forest types for this region. His forest classification for northern Idaho and adjacent Washington (Daubenmire 1952) showed fescue grassland meeting forest in western Latah County. Weaver (1917) on the other hand, showed the entire Palouse River region east of the Idaho-Washington border as coniferous woodland (see *Figure 1* of Weaver 1917). Idaho fescue (*Festuca idahoensis*) /snowberry (*Symphoricarpus albus*) association (Franklin and Dryness 1973) probably dominated western Latah County, near the Idaho-Washington border. How far up the Palouse River this vegetation type existed is perhaps debatable; most authors suggest it occurred as far as Potlatch, or even beyond, according to maps in Black et al. (1998). Fescue grasslands also dominated most of the South Fork Palouse River and Cow Creek areas. This fescue/low shrub grassland met up with lower elevation Ponderosa pine (*Pinus ponderosa*) forest in an open, parkland setting described by the early explorers.

Daubenmire (1952) described forest habitat types that vary with elevation and other factors, such as soil type, moisture and aspect. He described several predominant zones of vegetation that follow roughly a moisture/elevation gradient. The Ponderosa pine zone occupies the lowest and driest zone, then, as one continues up the elevational/moisture gradient, comes 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 Ponderosa pine zone, lodgepole pine (*Pinus contorta*) zone, Douglas fir zone, grand fir (*Abies grandis*) zone, western hemlock zone (with western redcedar), and finally the 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 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 Dyrness 1973).

The native vegetation on the grasslands of the Palouse region is largely gone. Most of these lands have long since been converted to agriculture cropland, hay, and pastureland. Very few remnants of the native Palouse Prairie vegetation survive. However, it is generally recognized that these grasslands were dominated by perennial bunchgrasses, either bluebunch wheatgrass (*Psuedoregneria spicata*) as the dominant in drier portions, or Idaho fescue dominant in more moist parts of the prairie (Black et al. 1998, Weddell 2000, 2001). In western Latah County, covering much of the landscape from the border with Washington to east of Moscow and Potlatch, the Palouse prairie was probably dominated by the Idaho fescue/snowberry zone of Franklin and Dryness (1973). This zone is described as the moistest of the steppe zones with a mosaic of herbaceous and woody species. Grasses included Idaho fescue, bluebunch wheatgrass, and prairie junegrass (*Koeleria cristata*), and shrubs included low growth forms of snowberry, Wood's rose (*Rosa woodsii*) and Nootka rose (*Rosa nutkana*).

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 life form; in others, dense thickets of pure hawthorn and serviceberry became dominant. Weaver (1917) described wet meadows in both the mountains and in 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 Dyrness 1973, Weaver 1917). In fact, Franklin and Dyrness (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 Dyrness 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 formed a narrow gallery forest of plains cottonwood (*Populus deltoides*), aspens, mountain maple (*Acer glabrum*), and red alder (*Alnus rubra*).

There may have been some confusion on exact species over the years; however, 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. In terms of vegetation height, hawthorns and aspens are relatively small trees (3-12m), alders are of intermediate heights (10-25m), and cottonwoods can be very tall (25-30m). We anticipate vegetative cover over a small (<5m wide) stream to vary from about 60-80% for mature hawthorn or aspen dominated communities, to about 70-100% cover for mature alder and cottonwood dominated communities.

Potential Natural Aerial Cover

The amount of aerial cover over a stream is a function of stream width (bankfull), the type of vegetation in the riparian community (whether it is trees, shrubs, or grasses or it’s height and width), and the density or condition of plants in the riparian community. All streams in this TMDL (Deep, Gold, Big, Flannigan, and Hatter Creeks) are less than 5 meters wide. A very dense plant community with plants that have large lateral spread (conifers, for example, can have overhangs of three meters) can provide 100% cover on a small stream. Based on our experience with mapping aerial cover on streams in forested regions of Idaho, typical aerial cover for small streams (less than five meters wide) in forested regions can vary from 70 to 100% depending on the density of the trees in the riparian zone. Drier, more open pine/grass communities are on the low end of that scale while wetter spruce/fir communities can have 100% aerial cover on a small stream. Cottonwood, aspen, alder, and hawthorn riparian communities can be more open than conifer dominated systems and may have a wider array of cover values (60-100%).

Shrub (or small tree) dominated riparian communities have lesser cover because of their smaller stature. Shrub dominated, mature riparian communities in southern Idaho have aerial cover as high as 65% (Shumar 2003). We anticipate that typical shrub aerial cover on a small 5-meter wide stream in northern Idaho will vary from 40 to 80%, depending on the species present. Large shrubs or small trees, such as water birch, alders, hawthorn, and aspen can have overhangs up to 2 meters, providing significant stream cover up to 80%. Smaller shrubs (willows, serviceberry, rose, bramble, and snowberry) may have lesser amounts of cover.

Grass dominated riparian areas along stream courses are not common. Usually, because of significant moisture supply, woody vegetation predominates these areas. However, grass dominated riparian areas can persist at high elevation mountain meadows and where camas wetlands existed. Large grasses, such as tufted hairgrass and giant wildrye, probably provided significant cover (up to 40%) over 5-meter wide streams. Many grass-dominated meadows develop highly braided stream systems, where each individual braid may be deep and narrow with significant bank overhang. Such natural systems may have provided even greater cover.

As stream widths increase, aerial cover provided by riparian vegetation decreases. Based on potential overhang of branches and plant material, a tree dominated riparian community can provide 100% cover on a stream up to 6 meters wide at bankfull (3-meter overhang). For shrub dominated communities (2 meter overhang), a 4-meter wide stream may experience 100% cover. And a stream 2-meter wide stream may receive 100% cover from grasses (1-meter overhang).

Palouse Region Potential Cover based on Soils

In addition to historical records and work of scientists in plant classification schemes for the region, potential natural vegetation was also described by soil scientists in county soil surveys. We mapped the soils associated with narrow riparian corridors for the eight streams in question from the Latah County Soil Survey (Barker 1981). Table 5-11 shows those soils, in order of their map unit number in the survey, not necessarily their distribution on the ground. Lower number units (7-28) tend to be restricted to narrow bands along streams. Higher number soil units (31-64, but not 65) tend to cover large headwater areas of forest and are not restricted to riparian corridors. Soil unit 65 appears to be related to larger river floodplain soils.

Following Table 5-11 is a list of the vegetation types (forest and non-forest) associated with the soils found along streams in Latah County.

Table 5-11. Soil units and associated potential natural vegetation description for soils found along streams in Latah County (Barker 1981).

Soil Unit Number	Name and % slope	PNV Cover	Potential Natural Vegetation (PNV)
5	Bluesprin-Flybow 35-65	50%	Mainly grasses
7	Crumarine silt loam 0-3%	70%	Grasses, shrubs, and a few conifers
9	Farber/Minaloosa assoc., very steep	70%	Mainly coniferous trees (Doug fir, Ponderosa pine)
11	Hampson silt loam 0-3%	50%	Grasses, shrubs, and a few trees
18	Joel silt loam 35-60%	70%	Mainly coniferous trees (Doug fir, Ponderosa pine)
25	Latah silt loam 0-3%	50%	Mainly grasses and shrubs
26	Latahco silt loam 0-3%	70%	Mainly coniferous trees (Ponderosa pine)
27	Latahco-Lovell silt loam 0-3%	70%	Mainly coniferous trees (Ponderosa pine)
28	Latahco/Thutuna silt loam 0-3%	70%	Mainly grasses and coniferous trees (Ponderosa pine)
30	Minaloosa loam 35-65%	80%	Mainly coniferous trees (grand fir, Doug fir)
31	Minaloosa-Huckleberry assoc. very deep	80%	Mainly coniferous trees (grand fir, Doug fir, Ponderosa pine)
33	Naff-Palouse silt loam 7-25%	50%	Mainly grasses
35	Palouse silt loam 3-7%	50%	Mainly grasses
37	Palouse/Latahco silt loam 0-3%	70%	Mainly grasses and coniferous trees (Ponderosa pine)
38	Porrett silt loam 0-3%	50%	Tufted hairgrass, sedges, Douglas (black) hawthorn
39	Santa silt loam 2-5%	80%	Mainly coniferous trees (grand fir, Doug fir)
40	Santa silt loam 5-20%	80%	Mainly coniferous trees (grand fir, Doug fir, western white pine)
41	Santa silt loam, 20-35%	80%	Mainly coniferous trees (grand fir, Doug fir)
45	Southwick silt loam 12-25%	70%	Mainly coniferous trees (Ponderosa pine)
48	Spokane loam 15-35%	70%	Mainly coniferous trees (Doug fir, Ponderosa pine)
49	Spokane/rock outcrop 35-65%	70%	Mainly coniferous trees (Doug fir, Ponderosa pine)
50	Taney silt loam 3-7%	70	Mainly coniferous trees (Doug fir, Ponderosa pine)

51	Taney silt loam 7-25%	70%	Mainly coniferous trees (Doug fir, Ponderosa pine)
52	Taney silt loam 25-35%	70%	Mainly coniferous trees (Doug fir, Ponderosa pine)
58	Uvi loam 5-20%	80%	Mainly coniferous trees (grand fir, Doug fir, Ponderosa pine, western larch)
59	Uvi loam 20-35%	80%	Mainly coniferous trees (grand fir, Doug fir, Ponderosa pine, western larch)
60	Uvi/Spokane assoc. very steep	80%	Mainly coniferous trees (grand fir, Doug fir, Ponderosa pine, western larch/ Ponderosa pine, Doug fir)
61	Uvi/Vassar assoc. very deep	90%	Mainly coniferous trees (grand fir, Doug fir, Ponderosa pine/western white pine, grand fir, western redcedar, Doug fir, western larch)
63	Vassar silt loam 20-35%	90%	Mainly coniferous trees (western white pine, grand fir, western redcedar, Doug fir, western larch)
64	Vassar silt loam 35-65%	90%	Mainly coniferous trees (western white pine, grand fir, western redcedar, Doug fir, western larch)
65	Westlake/Latahco silt loam 0-3%	50%	Mainly grasses

Riparian Forest Types based on Latah County Soil Survey

Ponderosa Pine/Grassland/Parkland

Soils: 7, 28, 37, 45, 26, 27

grasses ←——→ trees

The Ponderosa pine grassland/parkland type occurred on a number of lower elevation, valley bottom soils. The density of trees varied with soil type from a few trees on Crumarine silt loam, 0-3% slope (7) to mainly coniferous tree dominated on Latahco-Lovell silt loam, 0-3% slope (27) (Barker 1981). It is unknown to what extent deciduous shrubs and trees (hawthorns, aspens, cottonwoods, alders) played a part in the streamside plant community. We estimate canopy cover to be about 70% on a 5-meter wide stream based on the presence of open Ponderosa pine canopy.

Ponderosa pine/Douglas fir

Soils: 9, 18, 48, 49, 50, 51, 52

The Ponderosa pine/Douglas fir type occurred on four soil groups (Joel, Spokane, Taney, and Farber/Minaloosa association) mapped in this exercise. The understory potential for Joel, Spokane and Taney soils included bluebunch wheatgrass, Idaho fescue, pine reedgrass (*Calamagrostis rubescens*), mallow ninebark (*Physocarpus malvaceus*) and/or snowberry (Barker 1981). The Farber/Minaloosa association has a mallow ninebark and creambush oceanspray (*Holodiscus discolor*) understory. These soils are described as having natural vegetation that is mainly coniferous trees. Because of the presence of coniferous forest, regardless of what streamside vegetation there was, aerial cover was likely to be at least as high as 70% on a 5-meter wide stream, and probably higher.

Grand fir/Douglas fir

Soils: 30, 31, 39, 40, 41, 58, 59, 60

The soils where grand fir and Douglas fir predominate include Minaloosa, Minaloosa/Huckleberry association, Santa, and Uvi. These mountainside soils are well suited for the production of timber. Western redcedar may occur on more moist northwest facing slopes and drier south facing slopes may contain some Ponderosa pine. Because these soils were largely dominated by coniferous forests, potential natural cover was likely in excess of 80%.

Western White pine/Grand fir/Western Redcedar

Soils: 61, 63, 64

Vassar soils have potential natural vegetation that was dominated by western redcedar, western white pine, pachystima, and mountain blueberry. These soils are steep mountainsides at the tops of drainages. Small, first-order streams that emanate from these mountains were probably completely covered (90-100%) with vegetation.

Non-forest Riparian Types

Grass dominated lands

Soils: 5, 11, 25, 33, 35, 65

Soils in valley bottoms along the Palouse River (Hampson), the South Fork Palouse River (Westlake/Latahco), and Cow Creek are described in the Latah County Soil Survey (Barker 1981) as being mainly grassland soils. The Bluesprin-Flybow soil complex is in Idaho fescue/snowberry vegetation on south-facing canyon hillsides. No evidence is given on what the streamside vegetation may have been. It seems logical that these low elevation areas would harbor the fescue/snowberry habitat type of the Palouse steppe region. However, the stream and river corridors themselves probably had cottonwood, maples, alders, and hawthorns as described by Black et al. (1998). In addition to the two larger rivers, lower Deep Creek soils are essentially dominated by Hampson silt loam (11). The riparian area along Deep Creek may have been too small or intermittent to support woody vegetation, but might have been dominated by the smaller riparian species, such as tufted hairgrass or cow-parsnip. The Bluesprin-Flybow complex occurs in one small location in the Crane Creek watershed in this analysis. On a small stream (5 meters wide), we anticipate that cover may have been highly variable (30-70%). Therefore, we have selected an average cover of 50% to reflect the low cover potential of shrub and grass dominated riparian areas.

Black hawthorn/tufted hairgrass (*Deschampsia cespitosa*)

Soils: 38

The Porrett soil type occurs on valley floors and has a potential natural vegetation of mainly tufted hairgrass, sedges (*Carex sp.*), and black hawthorn (Barker 1981). Porrett soils dominate the middle portions of Flannigan Creek and Rock Creek. It is possible that portions of these streams may have had tufted hairgrass meadow vegetation in the riparian area, which provides substantially less cover than hawthorn thickets, especially for streams wider than 2 meters. For grass dominated riparian areas, we have selected an aerial cover of 30-40% on a 5-meter wide stream. Otherwise, cover in hawthorn dominated riparian communities can be as high as 70%. Therefore, we have selected an average cover of 50% to reflect the low cover potential of shrub and grass dominated riparian areas. This analysis suggests that there will likely be more incompatibility between existing cover and potential cover on this soil type. Areas that are hawthorn dominated will have cover greater than this average of 50%. Where that occurs, potential natural cover is likely to be closer to 70%. Likewise, grass dominated areas are likely to have potential cover less than 50%. Thus, the over-estimation and the under-estimation balance each other out.

Aerial Photo Interpretation

Existing cover on 1:100K hydrography streams in each watershed (Deep, Gold, Big, Flannigan, Rock, and Hatter Creeks) was visually estimated from aerial photographs taken in 1998 and displayed at terraserver-usa.com. Photographs were observed at one-meter resolution.

Streams were divided into segments based on natural changes in their riparian cover. Each segment received a single value representing a cover class of 10% (see Appendix E for results). Cover classes ranged from 0% (0-9% cover) to 90% (90-100% cover) in 10% intervals. In general, coniferous forest riparian areas were in cover classes from 70% to 90%. Large shrub/small deciduous tree cover classes ranged from 50% to 70%, and small shrub and grass riparian areas could have cover classes from 10% to 50%. The cover class for any one segment depended on vegetation type and density of cover.

In addition to existing cover, soil map units were recorded for all streams seen at 1:100K hydrography. Corresponding potential natural cover for each map unit from the discussion above was used to compare existing cover to potential cover (see Appendix E for results). In some cases, especially on any National Forest areas, soil units were not mapped in the Latah County Soil Survey (Barker 1981). In such cases, the soil unit was estimated based on neighboring mapped watersheds.

Load Capacity

As described above, the Load Capacity for temperature TMDLs on Deep, Gold, Big, Flannigan, Rock, and Hatter Creeks in the Palouse River subbasin is based on potential natural vegetation cover over the streams. Thus, potential cover as a percentage represents the heat loading permitted to achieve water quality standards and maximum possible heat reduction.

Descriptions of potential natural vegetation are based on literature research and best professional judgment about how much cover a given vegetation type will provide. These estimates are not exact. Additionally, existing cover is based on aerial photo interpretation, which also has its limitations on accuracy. Estimated differences between existing and potential cover within a range of 20% are within the range of sampling variability in our opinion. Therefore, we have described the cover differences in terms of a condition class rating from *Very Good* cover to *Poor* cover:

- Those stream locations that have existing and potential cover differences between zero and any positive value have *Very Good* cover, which we would expect to duplicate potential natural vegetation.
- Cover differences between 0.1% and –20% may be slightly affected but are still within the sampling variability to be considered in *Good* condition in our estimation.
- Cover differences between –20.1% and –40% result from vegetation that has been affected by perturbation and are in *Fair* condition.
- Cover differences more substantial than –40% are in *Poor* condition.

Stream reaches in *Fair* or *Poor* condition lack obvious cover and are potentially detrimental to stream temperature. These two condition classes are the center of attention in this TMDL and will require load reductions to improve temperature conditions.

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 type of sources (land use) and area (such as a subwatershed), but may be aggregated by type of source or land area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

As described above in *Temperature Load Allocation Techniques* (page 139), existing loads are based on existing aerial cover from riparian vegetation visually estimated from aerial photographs. Existing cover represents the current heat loading to the streams; the least cover causes the most heat loading. To our knowledge, there are no point sources of heat in these watersheds. Thus, there are no WLAs in this temperature TMDL.

Tables 5-12 through 5-16 show loads from nonpoint sources for the affected watersheds.

Table 5-12. Loads from nonpoint sources in Flannigan Creek Watershed.

Stream Segment	Average Existing Cover (Existing Load)	Estimation Method
Lower Flannigan (AU #ID17060108CL011b_03)	43%	Aerial Photo Interpretation
Upper Flannigan (AU #ID17060108CL011a_03)	58.3%	Aerial Photo Interpretation
Tributary to Lower Flannigan (AU #ID17060108CL011b_02)	35.7%	Aerial Photo Interpretation
Tributary to Upper Flannigan (AU #ID17060108CL011a_02)	73.3%	Aerial Photo Interpretation
Tributary to Upper Flannigan (AU #ID17060108CL011a_02)	78%	Aerial Photo Interpretation
Tributary to Upper Flannigan (AU #ID17060108CL011a_02)	70%	Aerial Photo Interpretation
West Fork Flannigan (AU #ID17060108CL011a_02)	62.2%	Aerial Photo Interpretation
Tributary to WF Flannigan (AU #ID17060108CL011a_02)	75%	Aerial Photo Interpretation
Tributary to WF Flannigan (AU #ID17060108CL011a_02)	75%	Aerial Photo Interpretation

Table 5-13. Loads from nonpoint sources in Hatter Creek Watershed.

Stream Segment	Average Existing Cover (Load)	Estimation Method
Lower Hatter (AU #ID17060108CL015b_03)	38.7%	Aerial Photo Interpretation
Tributary to Lower Hatter (AU #ID17060108CL015b_02)	47%	Aerial Photo Interpretation
Tributary to Lower Hatter (AU #ID17060108CL015b_02)	59.2%	Aerial Photo Interpretation
Tributary to Lower Hatter (AU #ID17060108CL015b_02)	58.6%	Aerial Photo Interpretation
Tributary Complex to Lower Hatter (AU#ID17060108 CL015b_02)	64.5%	Aerial Photo Interpretation
Tributary to Lower Hatter (AU #ID17060108CL015b_02)	58.6%	Aerial Photo Interpretation
Upper Hatter and Tributaries (AU #ID17060108CL015a_02)	72.5%	Aerial Photo Interpretation
Long Creek (AU #ID17060108CL015a_02)	68.6%	Aerial Photo Interpretation

Table 5-14. Loads from nonpoint sources in Gold Creek Watershed.

Stream Segment	Average Existing Cover (Load)	Estimation Method
Lower Gold & Lowest Tributary (AU #ID17060108CL029_03)	23.3%	Aerial Photo Interpretation
Upper Gold (AU #ID17060108CL030_02)	63.1%	Aerial Photo Interpretation
Nelson Creek (AU #ID17060108CL030_02)	70%	Aerial Photo Interpretation
Tributary to Upper Gold (AU #ID17060108CL030_02)	66%	Aerial Photo Interpretation
Waterhole Creek (AU #ID17060108CL030_02)	75%	Aerial Photo Interpretation
Tributary to Upper Gold (AU #ID17060108CL030_02)	75%	Aerial Photo Interpretation
Tributaries to Upper Gold (AU #ID17060108CL030_02)	83.3%	Aerial Photo Interpretation
Lower Crane Creek (AU #ID17060108CL031b_02)	55%	Aerial Photo Interpretation
Tributaries to Lower Crane (AU #17060108CL031b_02)	31.3%	Aerial Photo Interpretation
Upper Crane Creek (AU #ID17060108CL031a_02)	72%	Aerial Photo Interpretation

Table 5-15. Loads from nonpoint sources in Big Creek Watershed.

Stream Segment	Average Existing Cover (Load)	Estimation Method
Lower Big Creek (AU #ID17060108CL027b_02)	56.7%	Aerial Photo Interpretation
Lost Creek (AU #ID17060108CL027b_02)	63.3%	Aerial Photo Interpretation
Last Chance Creek (AU #ID17060108CL027b_02)	80%	Aerial Photo Interpretation
Tributaries to Lower Big (AU #ID17060108CL027b_02)	61.7%	Aerial Photo Interpretation
Upper Big Creek (AU #ID17060108CL027a_02)	80%	Aerial Photo Interpretation
Tributaries to Upper Big (AU #ID17060108CL027a_02)	73.8%	Aerial Photo Interpretation

Table 5-16. Loads from nonpoint sources in Deep Creek Watershed.

Stream Segment	Average Existing Cover (Load)	Estimation Method
Lower Deep Creek (AU #ID17060108CL032b_03)	15.6%	Aerial Photo Interpretation
Tributaries to Lower Deep (AU #ID17060108CL032b_02)	21.2%	Aerial Photo Interpretation
Upper Deep Creek (AU #ID17060108CL032a_03)	25%	Aerial Photo Interpretation
East Fork Deep Creek (AU #ID17060108CL032a_02)	47.7%	Aerial Photo Interpretation
Middle Fork Deep & Tribs (AU #ID17060108CL032a_02)	54%	Aerial Photo Interpretation
West Fork Deep & Trib (AU #ID17060108CL032a_02)	62.9%	Aerial Photo Interpretation
Tributary to Upper Deep (AU #ID17060108CL032a_02)	43.3%	Aerial Photo Interpretation

Load Allocation

Each stream segment has many cover estimations, both existing and potential, occurring at natural breaks in the vegetation or soils (see Appendix E). These estimations have been averaged for each segment for presentation here. Thus, a single existing cover value for a segment in the load allocation tables below represents an average existing cover value for the entire stream segment. Some of these segments have areas of poor cover and areas of good cover, which tends to ameliorate the size of the average cover somewhat. However, heat load on the stream is an integration of the stream's entire cover, and some areas may provide refuge from direct solar radiation while other areas do not.

Load allocations are based on the average cover deficiency experienced by each creek segment. In this case, cover deficiency is defined as the average existing cover minus the average potential natural cover (PNV) divided by PNV, and then converted to a percentage by multiplying by 100. In this fashion, segments with average existing cover less than average PNV will show up as a negative percent cover. Those segments with zero deficiency or positive percentage values are meeting their PNV.

A negative percent load allocation means that the average cover on the stream segment needs to increase by that amount in order to come into compliance with water quality standards. It is assumed that meeting PNV will result in maximum possible shading or minimum possible heat load, and will result in stream temperatures equivalent to appropriate criteria.

As stated previously, those cover differences of –20% or less are in cover condition classes of *Good* and *Very Good* and do not require load reductions.

We have not included a load allocation for those streams in the following load allocation tables. However, actual differences can be viewed for individual segments in the tables in the Appendix. Those cover differences more negative than –20% are in 'Fair' to 'Poor' condition and will require load reductions consistent with the magnitude of their deficiency.

Margin of Safety

A margin of safety is considered implicit in the design of the loading capacity. The PNV is considered the maximum amount of shading that is possible and does not take into account that natural cover often varies as the result of resource partitioning, fire and other natural forces, and drought.

Seasonal Variation

Stream cover is usually highest when air temperatures are highest. Because much of the riparian vegetation is deciduous, it reaches maximum cover in the summer when air temperatures are at their highest. In coniferous forested reaches, cover persists year-round; however, there is still considerable deciduous vegetation in the riparian area under the forest canopy which makes these areas high in cover. Although cover is lower at other times of the year, there usually is not a problem with stream temperatures during these times.

Background

There are no additional background loads to be considered. Background is considered implicit in both the PNV (which essentially is background) and water quality standards.

Reserve

There is no reserve capacity. Streams need to attain PNV to achieve water quality standards. In stream segments that are meeting PNV, no reduction in cover should be allowed.

Table 5-17. Load nonpoint source allocations for Flannigan Creek Watershed.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class	Average Load Allocation #
Lower Flannigan (AU #ID17060108CL011b_03)	68%	43%	Fair	-36.3%
Upper Flannigan (AU #ID17060108CL011a_03)	56.7%	58.3%	Very Good	See Appendix for stream segment analysis
Tributary to Lower Flannigan (AU#ID17060108CL011b_02)	70%	35.7%	Poor	-49%
Tributary to Upper Flannigan (AU#ID17060108CL011a_02)	76.7%	73.3%	Good	See Appendix for stream segment analysis
Tributary to Upper Flannigan (AU#ID17060108CL011a_02)	76%	78%	Very Good	See Appendix for stream segment analysis
Tributary to Upper Flannigan (AU#ID17060108CL011a_02)	76.7%	70%	Good	See Appendix for stream segment analysis
West Fork Flannigan (AU #ID17060CL011a_02)	62.2%	62.2%	Very Good	See Appendix for stream segment analysis
Tributary to WF Flannigan (AU#ID17060108CL011a_02)	80%	75%	Good	See Appendix for stream segment analysis
Tributary to WF Flannigan (AU#ID17060108CL011a_02)	87.5%	75%	Good	See Appendix for stream segment analysis

LA= ((Existing cover – Potential cover)/Potential cover) x 100. All *Very Good* and *Good* cover condition classes meet potential natural vegetation within limits of variability. See Appendix E for specific stream segments that may or may not meet these conditions.

Table 5-18. Load nonpoint source allocations for Hatter Creek Watershed.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class	Average Load Allocation #
Lower Hatter (AU #ID17060108CL015b_03)	63.3%	38.7%	Fair	-37.6%
Tributary to Lower Hatter (AU #ID17060108CL015b_02)	70%	47%	Fair	-35.1%
Tributary to Lower Hatter (AU#ID17060108CL015b_02)	72.3%	59.2%	Good	See Appendix for stream segment analysis
Tributary to Lower Hatter (AU #ID17060108CL015b_02)	78.6%	58.6%	Fair	-25%
Tributary Complex to Lower Hatter (AU#ID17060108 CL015b_02)	77.9%	64.5%	Good	See Appendix for stream segment analysis
Tributary to Lower Hatter (AU #ID17060108CL015b_02)	77.1%	58.6%	Fair	-24%
Upper Hatter and Tributaries (AU#ID17060108CL015a_02)	84.3%	72.5%	Good	See Appendix for stream segment analysis
Long Creek (AU #ID17060108CL015a_02)	85.7%	68.6%	Good	See Appendix for stream segment analysis

LA= ((Existing cover – Potential cover)/Potential cover) x 100. All *Very Good* and *Good* cover condition classes meet potential natural vegetation within limits of variability. See Appendix E for specific stream segments that may or may not meet these conditions.

Table 5-19. Load nonpoint source allocations for Gold Creek Watershed.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class	Average Load Allocation #
Lower Gold & Lowest Trib (AU #ID17060108CL029_03)	60%	23.3%	Poor	-60.8%
Upper Gold (AU #ID17060108CL030_02)	67.7%	63.1%	Good	See Appendix for stream segment analysis
Nelson Creek (AU #ID17060108CL030_02)	71.1%	70%	Very Good	See Appendix for stream segment analysis
Tributary to Upper Gold (AU #ID17060108CL030_02)	78%	66%	Good	See Appendix for stream segment analysis
Waterhole Creek (AU #ID17060108CL030_02)	75%	75%	Very Good	See Appendix for stream segment analysis
Tributary to Upper Gold (AU #ID17060108CL030_02)	80%	75%	Good	See Appendix for stream segment analysis
Tributaries to Upper Gold (AU #ID17060108CL030_02)	83.3%	83.3%	Very Good	See Appendix for stream segment analysis
Lower Crane Creek (AU #ID17060108CL031b_02)	70%	55%	Fair	-21.5%
Tributaries to Lower Crane (AU #17060108CL031b_02)	70%	31.3%	Poor	-53.2%
Upper Crane Creek (AU #ID17060108CL031a_02)	76%	72%	Good	See Appendix for stream segment analysis

LA= ((Existing cover – Potential cover)/Potential cover) x 100. All *Very Good* and *Good* cover condition classes meet potential natural vegetation within limits of variability. See Appendix E for specific stream segments that may or may not meet these conditions.

Table 5-20. Load nonpoint source allocations for Big Creek Watershed.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class	Average Load Allocation #
Lower Big Creek (AU #ID17060108CL027b_02)	70%	56.7%	Good	See Appendix for stream segment analysis
Lost Creek (AU #ID17060108CL027b_02)	73.3%	63.3%	Good	See Appendix for stream segment analysis
Last Chance Creek (AU #ID17060108CL027b_02)	80%	80%	Very Good	See Appendix for stream segment analysis
Tributaries to Lower Big (AU #ID17060108CL027b_02)	71.7%	61.7%	Good	See Appendix for stream segment analysis
Upper Big Creek (AU #ID17060108CL027a_02)	80%	80%	Very Good	See Appendix for stream segment analysis
Tributaries to Upper Big (AU #ID17060108CL027a_02)	82.5%	73.8%	Good	See Appendix for stream segment analysis

LA= ((Existing cover – Potential cover)/Potential cover) x 100. All *Very Good* and *Good* cover condition classes meet potential natural vegetation within limits of variability. See Appendix E for specific stream segments that may or may not meet these conditions.

Table 5-21. Load nonpoint source allocations for Deep Creek Watershed.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class	Average Load Allocation #
Lower Deep Creek (AU #ID17060108CL032b_03)	54.4%	15.6%	Poor	-70.2%
Tributaries to Lower Deep (AU#ID17060108CL032b_02)	65.2%	21.2%	Poor	-69.3%
Upper Deep Creek (AU #ID17060108CL032a_03)	50%	25%	Poor	-50%
East Fork Deep Creek (AU #ID17060108CL032a_02)	68.5%	47.7%	Fair	-30%
Middle Fork Deep & Tribs (AU#ID17060108CL032a_02)	69.5%	54%	Fair	-23.7%
West Fork Deep & Trib (AU #ID17060108CL032a_02)	71.8%	62.9%	Good	See Appendix for stream segment analysis
Tributary to Upper Deep (AU #ID17060108CL032a_02)	68.9%	43.3%	Fair	-37.3%

LA= ((Existing cover – Potential cover)/Potential cover) x 100. All *Very Good* and *Good* cover condition classes meet potential natural vegetation within limits of variability. See Appendix E for specific stream segments that may or may not meet these conditions.

5.3 Nutrient TMDLs

Nutrient TMDLs were developed for the entire watershed of Flannigan Creek, and the lower section of Hatter Creek. The nutrient target is based on a numeric state standard for dissolved oxygen requiring the level to be greater than 6.0 mg/L at all times, and a narrative target stating that surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses

In-Stream Water Quality Targets for Nutrients

The in-stream water quality target for nutrients was developed to restore full support of designated beneficial uses. The in-stream load reduction amount is based on measured total phosphorus (TP) amounts above the load capacity of 0.1 mg/L TP during the growing season of May through October, and on the measured dissolved oxygen (DO) concentration below the state standard of 6.0 mg/L.

Design Conditions/Target Selection

TMDLs for nutrients, specifically TP, present several challenges, including the fact that relationships between nutrient concentrations and environmental responses are complex and variable. Temperature, pH, flow, nutrient levels, sediment, conductivity, and dissolved oxygen are interrelated parameters. This is compounded by the fact that there is no generally agreed upon framework for evaluating nutrient impacts on streams and rivers. The data supporting the nutrient TMDLs demonstrate a significant consecutive period of elevated TP levels and low DO levels.

Phosphorus is the essential plant nutrient that most often controls aquatic plant (algae and rooted plant) growth. Phosphorus can be soluble or particulate in water. Two forms of phosphorus commonly measured in laboratories include soluble reactive phosphorus, which is dissolved in water, and total phosphorus, which includes both soluble and particulate forms. Unlike nitrogen, there is no atmospheric (vapor) form of phosphorus, and for this reason phosphorus is often a limiting nutrient in aquatic systems. This means that when large amounts of phosphorus enter a lake or stream, plant growth is greatly increased which can create water quality problems. Increased plant growth is coupled with increased decomposition, which depletes dissolved oxygen concentrations.

Dissolved oxygen (DO) refers to the volume of oxygen contained in water. Oxygen enters the water by photosynthesis of aquatic biota and the transfer of oxygen across the air-water interface. The amount of oxygen that can be held by the water depends on water temperature, salinity, and pressure. Gas solubility increases with decreasing temperature (colder water holds more oxygen). Gas solubility increases with decreasing salinity (freshwater holds more oxygen than does saltwater). Both the partial pressure and the degree of saturation of oxygen change with altitude. Finally, gas solubility decreases as pressure decreases. Thus, the amount of oxygen absorbed in water decreases as altitude increases because of the decrease in relative pressure (Smith, 1990).

Once absorbed, oxygen is either incorporated throughout the water body via internal currents or is lost from the system. Flowing water is more likely to have high dissolved oxygen levels than is stagnant water because of the water movement at the air-water interface. In flowing water, oxygen-rich water at the surface is constantly being replaced by water containing less oxygen because of turbulence, creating a greater potential for exchange of oxygen across the air-water interface. Because stagnant water undergoes less internal mixing, the upper layer of oxygen-rich water tends to stay at the surface, resulting in lower dissolved oxygen levels throughout the water column. Oxygen losses readily occur when water temperatures rise, when plants and animals respire, and when microbes aerobically decompose organic matter. Oxygen has a very short retention time in water as its soluble form of PO_4 (phosphate or ortho-phosphate) is readily taken up by plants. Unlike nitrogen, phosphorus does not form any toxic by-products as it recycles through the ecosystem.

For this TMDL, a value 0.1 mg/L total phosphorus (TP) and a dissolved oxygen level of at least 6.0 mg/L were used as the base for the load capacities for these nutrient TMDLs. By maintaining TP levels below 0.1 mg/L and DO levels above 6.0 mg/L during the growing season DEQ believes this will ensure that nuisance algae will not impair beneficial uses. DO is easy to monitor and track for implementation and 6.0mg/L is the state standard, meaning that DO readings below 6.0 mg/L will impair beneficial uses by stressing fish and other aquatic organisms. TP was chosen as a target as TP is also fairly easy to monitor and track for implementation. It is usually in very short supply in aquatic ecosystems and is therefore a limiting nutrient and easier than nitrogen to manage.

Monitoring Points

The monitoring points for TMDL compliance for the nutrient TMDLs are the mouths of each stream; however, beneficial uses must be met throughout each 303(d) watershed. DEQ recommends that the upper monitoring site in Flannigan Creek (PR-17) be an additional compliance point. In most cases the lowest downstream monitoring site is the mouth. In the case of Flannigan Creek and Hatter Creek we were not able to access the actual mouth, but the lowest downstream monitoring sites are within a mile of the mouth. During the planning phase of the monitoring for this TMDL an attempt was made to get a site as close as possible to the mouth.

Nutrient Load Analysis Methodology

The load capacity is the amount of pollutant a water body can receive without violating water quality standards. The load capacity for Flannigan Creek and Hatter Creek is set at a level that fully supports beneficial uses. Seasonal variation, a background amount, and an MOS were all considered to determine the load capacity.

For Flannigan and Hatter Creeks the load capacity (LC) was calculated based on the relationship between background TP, a TP load allocation and a margin of safety represented in the following equation:

$$LC=MS+BK+LA.$$

Where MS = Margin of Safety = (-0.005 mg/L)
BK = Background = 0.035 mg/L
LA = Load Allocation = 0.070 mg/L
LC = Load Capacity = 0.10 mg/L

Background

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)). There are no point sources within the 303(d) watersheds assessed within this report. The background TP amount was determined by examining monitoring data from four watershed that have relatively few anthropogenic impacts with similar geologies, soil types and land-uses.

Nutrient data was collected within the following four watersheds, Big Creek, Moose Creek-upper and lower, and the west fork Potlatch River, during 2001 and 2002 as shown in Table 5-22. The yearly TP average of these watershed ranged from 0.0314 to 0.0398 mg/L, with a combined average of 0.035. This is the background value that was used in the TMDL loading calculation. A load allocation of 0.055 mg/L was established for these TMDLs..

Table 5-22. TP monitoring results used for as background.

Dates	Moose lower	Moose upper	WF Potlatch Cr	Big Creek-upper Dates	Value
12/27/2001	0.031	0.035	DNS	11/26/2001	0.047
1/8/2002	0.032	0.031	DNS	12/5/2001	0.036
1/22/2002	0.032	0.023	DNS	12/19/2001	0.057
2/4/2002	0.021	0.019	DNS	1/2/2002	0.047
2/19/2002	0.032	0.025	DNS	1/16/2002	0.043
3/4/2002	0.031	0.029	DNS	1/29/2002	DNS
3/18/2002	0.032	0.028	DNS	2/12/2002	DNS
4/1/2002	0.029	0.021	DNS	2/26/2002	DNS
4/14/2002	0.027	0.021	DNS	3/12/2002	DNS
4/30/2002	0.017	0.012	0.013	3/26/2002	DNS
5/13/2002	0.014	0.013	0.017	4/8/2002	0.1
5/30/2002	0.027	0.029	0.029	4/22/2002	0.042
6/11/2002	0.028	0.031	0.035	5/7/2002	0.036
6/25/2002	0.025	0.042	0.031	5/22/2002	0.051
7/10/2002	0.033	0.05	0.036	6/4/2002	0.044
7/24/2002	0.062	0.081	0.047	6/18/2002	0.067
8/7/2002	0.024	0.042	0.033	7/3/2002	0.044
8/21/2002	0.043	0.046	0.032	7/16/2002	0.042
9/4/2002	0.29	0.046	0.037	7/29/2002	0
9/19/2002	0.093	0.05	0.037	8/18/2002	0
10/3/2002	0.031	0.042	0.036	8/28/2002	0
10/15/2002	0.024	0.041	0.028	9/5/2002	0
10/30/2002	0.023	0.042	0.031	9/24/2002	0.066
11/14/2002	0.019	0.037	0.052	10/7/2002	0.058
11/26/2002	0	0.021	0.021	10/22/2002	0.05
12/11/2002	0.014		0.019	11/5/2002	0.12
				11/18/2002	0.062
	Moose -lower	**Moose-upper**	**WF Potlatch**		**Big Creek**
Averages	**0.0398**	**0.03428**	**0.0314**		**0.0365**
All 4 averaged	**0.035**				

[a] t/yr = tons per year
DNS = Did not sample

Margin of Safety

Load calculations are assigned by water body for this report. A margin of safety of approximately 5% was applied to the equation to arrive at 0.10 mg/L TP as a load capacity for nutrient TMDLs in the Palouse River Subbasin.

Surrogate Target

In addition to the TP target, the DO readings within Flannigan Creek and Hatter Creek-lower will need to stay above 6.0 mg/L, especially during the growing season.

Seasonal Variation

These nutrient TMDLs only apply during the growing season, May-October of each year. Typically this is the critical period when low DO levels are present because of excess nutrients. BMPs should be applied on the landscape throughout the year as to ensure excessive nutrients do not get into a stream and to ensure the goal of these nutrient TMDLs are achieved.

Flannigan Creek

The nutrient load capacity for Flannigan Creek must meet water quality standards that protect the beneficial uses of salmonid spawning and cold water aquatic life. Samples were collected from both upper (PR17) and lower (PR16) monitoring sites as outlined in the monitoring plan (Appendix A). Data from the lower site revealed six consecutive bi-weekly exceedances of the nutrient target, five TP readings above 0.10 mg/L, and one DO level reading below 6.0 mg/L (Table 5-23). Data from the upper site revealed four consecutive bi-weekly exceedances of the nutrient target, including four consecutive TP readings above 0.10 mg/L.

Hatter Creek

The nutrient load capacity for Hatter Creek must meet water quality standards that protect the beneficial uses of salmonid spawning and cold water aquatic life. Samples were collected from both upper (PR17) and lower (PR161) monitoring sites, as outlined in the monitoring plan (Appendix A). Data from the lower site revealed three consecutive bi-weekly exceedances of the nutrient target, three TP readings at or above 0.10 mg/L and two DO level readings below 6.0 mg/L (Table 5-24). There were no exceedances of the nutrient target at the upper site, therefore the nutrient TMDL is being developed only for the lower section of Hatter Creek.

Table 5-23. Flannigan Creek TP, DO and discharge bi-weekly monitoring results.

Date	PR-16 (TP)[1]	PR-16 (DO)[1]	PR-16 (Discharge)[2]	PR-17 (TP)	PR-17 (DO)	PR-17 (discharge)
5/7/2002	0.07	12.43	14.91	0.07	11.99	12.42
5/21/2002	**0.10**	**9.92**	9.91	0.07	8.34	10.62
6/4/2002	0.09	8.63	3.48	0.09	10.15	5.84
6/18/2002	**0.16**	**7.81**	2.03	**0.14**	**8.50**	2.02
7/3/2002	**0.13**	**7.05**	1.21	**0.19**	**6.74**	1.50
7/16/2002	**0.12**	**7.36**	0.72	**0.14**	**8.28**	0.77
7/29/2002	**0.11**	**6.30**	0.38	**0.14**	**6.97**	0.36
8/18/2002	**0.10**	**5.70**	0.10	0.07	6.79	0.17
8/28/2002	**0.11**	**6.58**	0.21	0.08	7.00	0.34
9/5/2002	**0.10**	**6.82**	0.22	**0.22**	**6.82**	0.33
9/24/2002	0.07	8.23	0.08	0.05	7.90	0.18

Exceedances are in **bold.**
[1] mg/L = milligrams per liter
[2] cfs = cubic feet per second

Table 5-24. Hatter Creek TP, DO and discharge bi-weekly monitoring results.

Date	PR-12 (TP) [1]	PR-12 (DO) [1]	PR-12 (discharge) [2]	PR-13 (TP)	PR-13 (DO)	PR-13 (discharge)
5/7/2002	0.05	12.42	34.46	0.02	12.06	29.08
5/22/2002	0.08	10.62	37.30	0.06	10.50	37.15
6/4/2002	0.05	9.30	17.94	0.05	9.45	15.58
6/18/2002	0.80	9.46	7.06	0.08	8.58	7.52
7/3/2002	0.07	9.38	3.84	0.05	7.93	4.02
7/16/2002	0.08	9.28	1.39	0.06	7.81	2.33
7/29/2002	0.09	8.28	0.59	0.08	6.87	1.44
8/18/2002	**0.10**	**4.70**	0.09	0.06	7.60	0.94
8/28/2002	**0.12**	**7.58**	0.18	0.07	7.43	0.55
9/5/2002	**0.12**	**5.35**	0.01	0.07	7.23	0.63
9/24/2002	0.07	10.66	0.25	0.06	8.42	0.60

Exceedances are in **bold.**
[1] mg/L = milligrams per liter
[2] cfs = cubic feet per second

Flannigan Creek Load Analysis

For Flannigan Creek, the mass per unit volumes for the current load, load capacity and load reduction amounts were calculated based on the discharge data averaged over a period of one month. The first load reduction calculation will occur in June at both sites, followed by load reductions for both sites in July, and a load reduction for the lower site only occurring in August. These load reductions are shown in Table 5-25,and were calculated as follows:

- The existing load was calculated by multiplying the average TP levels in Table 5-23 by the average flows for the monthly time frames shown in Table 5-25.

- The load capacity was calculated by multiplying the TP target (0.1 mg/L) by the average flows in Table 5-23 for the monthly time frame in Table 5-25.

- The load allocation was calculated by subtracting the natural background (0.035 mg/L) from the load capacity. The load reduction was calculated by subtracting the load capacity from the existing load.

Hatter Creek Load Analysis

For Hatter Creek, the mass per unit volumes for the current load, load capacity and load reduction amounts were calculated based on the discharge data for each exceedance averaged over a period of one month. The exceedances in Hatter Creek were between August 15 through Sept 15. This load reduction for Hatter Creek-lower is shown in Table 5-25, and the calculations were done as follows:

- The existing load was calculated by multiplying the average TP levels in Table 5-24 by the average flows in Table 5-24 for the monthly time frame shown in Table 5-25.
- The load capacity was calculated by multiplying the TP target (0.1 mg/L) by the average flows in Table 5-24 for the monthly time frame in Table 5-25.
- The load allocation was calculated by subtracting the natural background (0.035 mg/L) from the load capacity. The load reduction was calculated by subtracting the load capacity from the existing load.

Load Allocation

Load allocations were assigned to Flannigan and Hatter Creek-lower. The load allocation is the load capacity minus the natural background. The values calculated for each 303(d) listed waterbody are displayed in Table 5-25.

Time Frame

The goal of the this TMDL is to reduce the TP load by the load reduction amount and increase DO for those waterbodies identified in Table 5-25. An implementation plan will be completed within 18 months of EPA approval of this TMDL document. Specific actions to comply with this TMDL will be identified within that implementation plan.

Table 5-25. Nutrient loading allocations, existing load and load reductions for Palouse River Subbasin.

Source (Creek)	Month	Pollutant	Existing Load	Load Capacity	Load Allocation	Load Reduction
Flannigan (PR-16)	6/1-6/30	Total Phosphorus	1.883 lbs/day	1.487 lbs/day	1.368 lbs/day	0.396 lbs/day
Flannigan (PR-17)	6/1-6/30	Total Phosphorus	2.397 lbs/day	2.122 lbs/day	1.655 lbs/day	0.275 lbs/day
Flannigan (PR-16)	7/1-7/31	Total Phosphorus	0.501 lbs/day	0.418 lbs/day	0.355 lbs/day	0.083 lbs/day
Flannigan (PR-17)	7/1-7/31	Total Phosphorus	0.743 lbs/day	0.474 lbs/day	0.578 lbs/day	0.269 lbs/day
Flannigan (PR-16)	8/1-8/31	Total Phosphorus	0.087 lbs/day	0.083 lbs/day	0.083 lbs/day	0.004 lbs/day
Hatter (PR-12)	8/15-9/15	Total Phosphorus	0.061 lbs/day	0.051 lbs/day	0.051 lbs/day	0.011 lbs/day

5.4 Sediment TMDLs

Sediment TMDLs were developed for five of the six 303(d) listed streams in this report: Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek, and Rock Creek. The target for the sediment TMDLs was based on the turbidity standard, which states that waters shall not exceed 25 NTU over background levels for greater than 10 days and shall not exceed 50 NTU over background at any time.

In-Stream Water Quality Targets for Sediment

The in-stream water quality target for sediment was developed to restore full support of designated beneficial uses. The in-stream load reduction amount is based on a TSS load measured and calculated in tons per year in the stream, and represented as a load reduction percentage. The TSS load amounts for each 303(d) listed stream were derived from the turbidity standard and from the equations found in Appendix C.

The sediment target (the load capacity) is the state standard of turbidity levels not to exceed 25 NTU above background turbidity levels for a period greater than 10 consecutive days or no more than 50 NTU above background turbidity levels instantaneously. Tables 5-26 through 5-30 display the calculations performed to determine the existing load quantities, background load quantities, load capacity, excess load and load reductions. The next section details how these steps were accomplished.

Design Conditions/Target Selection

The design of a stochastic flow model requires a more thorough discharge profile for each stream than was collected during November 2001 and November 2002 as outlined in the monitoring plan (Appendix A). Ten years of data from USGS Palouse River gage site near the town of Potlatch was gathered and compiled. Modifications were then made to the flows based on watershed size differences between each stream and the Palouse River, elevation, precipitation, geology, land cover, basin slope, and channel characteristics, following the Lipscomb 1998 methodology for each 303(d) listed stream.

Based on the collected data in the monitoring year November 2001-November 2002, numeric relationships between discharge and NTU, discharge and TSS, and NTU and TSS were developed by plotting the values on a graph. These relationships can be expressed as mathematical equations, called regression equations, which were used to calculate values for TSS, NTU, background TSS, background NTU, and TSS levels over background. These regression equations are displayed for Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek and Rock Creek in Appendix C.

These equations were then used to determine existing TSS and NTU values on a daily basis for a ten-year period. The minimum, maximum and average values are displayed in Tables 5-26 through 5-30. A background ratio was calculated by dividing the background erosion value from the total sediment erosion value within the RUSLE model:

1. The background TSS value is calculated by multiplying the background ratio and the existing TSS value.
2. The load capacity is calculated by taking the TSS value equal to 25 NTU, multiplying by daily flow and a conversion factor (to express the load capacity in tons per day), and then adding the background TSS in tons per day.
3. Once the load capacity is determined, the excess load or load reduction is calculated by subtracting the load capacity from the exiting TSS load.
4. The excess load is then expressed in tons per year and a percentage is calculated.

These steps were performed for each 303(d) listed stream. The values showing in Tables 5-26 through 5-30 were calculated on an excel spreadsheet using daily averages over a ten year period, not by taking the average values displayed in Tables 5-26 through 5-30 and placing those values in the equations shown.

Monitoring Points

The monitoring points for TMDL compliance for the sediment TMDLs are the mouths of each stream; however, beneficial uses must be met throughout each 303(d) watershed. During the planning phase of the monitoring for this TMDL, an attempt was made to get a site as close as possible to the mouth, and, in most cases, the lowest downstream monitoring site is the mouth.

Lowest downstream monitoring sites for Deep Creek, and Gold Creek are at the mouth. For Flannigan Creek and Hatter Creek we were not able to access the actual mouth, but the lowest downstream monitoring sites are within a mile of the mouth. Rock Creek's lowest downstream monitoring site is approximately a quarter mile from the mouth. Data from other monitoring points were collected and used to assist with the sediment model calculations but are not the compliance point for the sediment TMDLs.

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Table 5-26. Deep Creek Existing Load, Load Capacity, Load Allocation and Loading Calculations for Sediment.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Derived from Palouse River USGS gage, Lipscomb (1998)correction	0.00	930.52	20.20
Existing TSS, Daily Average (mg/L) [c]	(3.6158 * flow-53.653)	-53.50	3310.92	19.39
Existing TSS (t/day)	TSS (mg/L)* 0.0027 * flow	0.00	8318.38	19.29
Existing TSS, Yearly Average (t/y)	TSS (t/day) * 365	n.a.	n.a.	7040.85
Existing Turbidity (NTU)	3.7602 *flow-40.501	-40.36	2993.18	25.36
Background Ratio [d]	(2477.52 t/y/WB) / (74484.08 t/y/WB)	n.a.	n.a.	0.03 (3%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	-1.78	110.13	0.64
Background TSS (t/day)	TSS (t/day) * background ratio	0.00	276.69	0.64
Background TSS (t/yr)	0.64 * 365	n.a.	n.a.	233.60
Load Capacity (t/day)	(19.01 mg/L * daily flow * 0.0027) + background TSS (t/day)	0.00	324.44	1.68
Load Capacity (t/yr) Average	1.68 * 365	n.a.	n.a.	613.20
Load Reduction(Excess Load) (t/day)	TSS (t/day) – load capacity	0	7993.94	17.92
Load Reduction(Excess Load) (t/yr)	Excess load TSS (t/day)*365	n.a.	n.a.	6541.15
Load Reduction (%)	Excess load / (TSS – background TSS) yearly average	n.a.	n.a.	0.96 (96%)

a cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
b t/y/WB = tons per year per water body
c From sediment yield curves in Appendix M
d Derived from RUSLE background and total detached numbers for entire watershed
Deep Creek watershed area = 27,315.56 acres or 42.68 square miles
Deep Creek sediment yield equation: 25 NTU Idaho WQS criterion = 23.36 mg/L = (1.1087 * 25 NTU –8.7099)

Table 5-27. Flannigan Creek Existing Load, Load Capacity, Load Allocation and Loading Calculations for Sediment.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Derived from Palouse River USGS gage, Lipscomb (1998)correction	0.04	834.09	18.12
Existing TSS, Daily Average (mg/L)[c]	$(1.3589 * 11.757 * flow^{0.4051}) – 8.0531$	0.00	234.98	30.12
Existing TSS (t/day)	(TSS) * (flow) * (0.0027)	0.00	529.20	3.98
Existing TSS, Yearly Average (t/y)	TSS (t/day) * 365	n.a.	n.a.	1452.70
Existing Turbidity (NTU)	$11.757 * flow^{0.4051}$	3.12	178.84	28.09
Background Ratio[d]	(1522.28 t/y/WB) / (35,499.63 t/y/WB)	n.a.	n.a.	0.04 (4%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	0.00	10.09	1.29
Background TSS (t/day)	TSS (t/day) * background ratio	0.00	22.72	0.17
Background TSS (t/yr) Average	0.17 * 365	n.a.	n.a.	62.10
Load Capacity (t/day)	(25.91 mg/L * daily flow * 0.0027) + background TSS (t/day)	0.001	81.09	1.44
Load Capacity (t/yr) Average	1.44 * 365	n.a.	n.a.	525.60
Load Reduction(Excess Load) (t/day)	TSS (t/day) – load capacity	0	448.11	2.56
Load Reduction(Excess Load) (t/yr)	Excess load TSS (t/day)*365	n.a.	n.a.	937.69
Load Reduction (%)	Excess load / (TSS – background TSS) yearly average	n.a.	n.a.	0.67 (67%)

a cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
b t/y/WB = tons per year per water body
c From sediment yield curves in Appendix M
d Derived from RUSLE background and total detached numbers for entire watershed
Flannigan Creek watershed area = 12,2246.82 acres or 19.14 square miles
Flannigan Creek sediment yield equation: 25 NTU Idaho WQS criterion = 25.91 mg/L = (25 NTU * 1.3589 – 8.0531).

Table 5-28. Gold Creek Existing Load, Load Capacity, Load Allocation and Loading Calculations for Sediment.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Derived from Palouse River USGS gage, Lipscomb (1998) correction	0.05	1045.71	22.70
Existing TSS, Daily Average (mg/L)[c]	$(0.265*(10.629 * flow^{0.4292})) + 8.7604$	9.57	68.46	17.26
Existing TSS (t/day)	(TSS) * (flow) * (0.0027)	0.00	193.28	1.81
Existing TSS, Yearly Average (t/y)	TSS (t/day) * 365	81.99	1359.74	661.65
Existing Turbidity (NTU)	$10.629 * flow^{0.4292}$	3.07	225.28	32.08
Background Ratio[d]	(2009.36 t/y/WB) / (55783.22 t/y/WB)	n.a.	n.a.	0.04 (4%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	0.34	2.47	0.62
Background TSS (t/day)	TSS (t/day) * background ratio	0.00	6.96	0.07
Background TSS (t/yr)	0.07 * 365	n.a.	n.a.	25.55
Load Capacity (t/day)	(15.39 mg/L * daily flow * 0.0027) + background TSS (t/day)	0.00	50.00	1.01
Load Capacity (t/yr) Average	1.01 * 365	n.a.	n.a.	368.65
Load Reduction(Excess Load) (t/day)	TSS (t/day) – load capacity	0	142	0.81
Load Reduction(Excess Load) (t/yr)	Excess load TSS (t/day)*365	n.a.	n.a.	294.47
Load Reduction (%)	Excess load / (TSS – background TSS) yearly average	n.a.	n.a.	0.46 (46%)

a cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
b t/y/WB = tons per year per water body
c From sediment yield curves in Appendix M
d Derived from RUSLE background and total detached numbers for entire watershed
Gold Creek watershed area = 18,069.78 acres or 28.23 square miles
Gold Creek sediment yield equation: 25 NTU Idaho WQS criterion = 23.36 mg/L = (0.265 * 25 NTU +8.7604)

Table 5-29. Hatter Creek Existing Load, Load Capacity, Load Allocation and Loading Calculations for Sediment.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Derived from Palouse River USGS gage, Lipscomb (1998)correction	0.05	1045.49	22.70
Existing TSS, Daily Average (mg/L)[c]	$(1.6737 * 9.5351 * flow^{0.3361}) – 16.032$	0.00	149.09	18.25
Existing TSS (t/day)	(TSS) * (flow) * (0.0027)	0.00	420.85	3.35
Existing TSS, Yearly Average (t/y)	TSS (t/day) * 365	n.a.	n.a.	1222.75
Existing Turbidity (NTU)	$9.5351 * flow^{0.3361}$	3.41	98.66	20.48
Background Ratio[d]	(1671.30 t/y/WB) / (9387.73 t/y/WB)	n.a.	n.a.	0.18 (18%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	0.00	26.54	3.25
Background TSS (t/day)	TSS (t/day) * background ratio	0.00	74.92	0.60
Background TSS (t/yr)-Average	0.60 * 365	n.a.	n.a.	219.00
Load Capacity (t/day)	(25.81 mg/L * daily flow * 0.0027) + background TSS (t/day)	0.00	147.78	2.18
Load Capacity (t/yr)	2.18 * 365	n.a.	n.a.	795.7
Load Reduction(Excess Load) (t/day)	TSS (t/day) – load capacity	0	273.06	1.28
Load Reduction(Excess Load) (t/yr)	Excess load TSS (t/day)*365	n.a.	n.a.	466.77
Load Reduction (%)	Excess load / (TSS – background TSS) yearly average	n.a.	n.a.	0.46 (46%)

a cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
b t/y/WB = tons per year per water body
c From sediment yield curves in Appendix M
d Derived from RUSLE background and total detached numbers for entire watershed
Hatter Creek watershed area = 16,181.00 acres or 25.28 square miles
Hatter Creek sediment yield equation: 25 NTU Idaho WQS criterion = 25.81 mg/L = (25 NTU * 1.6737 – 16.032)

Table 5-30. Rock Creek Existing Load, Load Capacity, Load Allocation and Loading Calculations for Sediment.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Derived from Palouse River USGS gage, Lipscomb (1998)correction	0.00	211.31	4.59
Existing TSS, Daily Average (mg/L)[c]	7.5262 * flow $^{0.5005}$	0.00	109.70	11.88
Existing TSS (t/day)	(TSS) * (flow) * (0.0027)	0.00	62.59	0.41
Existing TSS, Yearly Average (t/y)	TSS (t/day) * 365	n.a.	n.a.	147.88
Existing Turbidity (NTU)	20.708 * flow $^{0.3939}$	0.00	170.58	27.95
Background Ratio[d]	(602.34 t/y/WB) / (7218.27 t/y/WB)	n.a.	n.a.	0.08 (8%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	0.00	9.15	0.99
Background TSS (t/day)	TSS (t/day) * background ratio	0.00	5.22	0.03
Background TSS (t/yr) Average	0.03 * 365	n.a.	n.a.	12.34
Load Capacity (t/day)	(9.36 mg/L * daily flow * 0.0027) + background TSS (t/day)	0.00	10.67	0.15
Load Capacity (t/yr) Average	0.15 * 365	n.a.	n.a.	54.75
Load Reduction(Excess Load) (t/day)	TSS (t/day) – load capacity	0	51.92	0.26
Load Reduction(Excess Load) (t/yr)	Excess load TSS (t/day)*365	n.a.	n.a.	94.90
Load Reduction (%)	Excess load / (TSS – background TSS) yearly average	n.a.	n.a.	0.69 (69%)

a cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
b t/y/WB = tons per year per water body
c From sediment yield curves in Appendix M
d Derived from RUSLE background and total detached numbers for entire watershed
Rock Creek watershed area = 5174.76 acres or 8.09 square miles
Rock Creek sediment yield equation: 25 NTU Idaho WQS criterion = 9.36 mg/L = (1.3586 *25 NTU –24.601)

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Load Capacity

The load capacity is the amount of pollutant a water body can receive without violating water quality standards. The load capacity for Deep Creek, Flannigan Creek, Gold Creek, Hatter Creek, and Rock Creek is also set at a level that fully supports beneficial uses. Seasonal variations, background levels, and an MOS to account for any uncertainty are calculated within the load capacity.

The load capacity was calculated based on the relationship between turbidity in NTUs and the TSS in milligrams per liter (mg/L), resulting in a calculation of the amount of TSS, in milligrams per liter, that 25 NTUs from the state water quality standards represent. For example, in Deep Creek, 25 NTUs is equivalent to 23.36 mg/L TSS. The load capacity is represented in tons per day averaged over a period of ten years. The load capacity varies with flow, as does the background load. The flow is highest in the period January through May. Tables 5-26-5-30 display the load capacities for each sediment TMDL.

Estimates of Background Sediment Loading

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)). There are no point sources within the 303(d) watersheds assessed within this report. The nonpoint sources were estimated using a stochastic flow model. Background sediment loading was developed from the flow model, regression equations, and a background ratio. The background ratio was calculated using the routed background erosion for all areas upstream of the mouth divided by the total tons of sediment routed from a watershed within the RUSLE model. Tables 5-26 through 5-30 display the background loads.

Load Allocation

Load allocations are assigned by waterbody for this report. Individual sources were identified and quantified using various methodologies and are presented in Appendix D but are not part of the sediment TMDL. The load allocation is based on the flow model and loading calculations; it is the load capacity minus the natural background. A value was calculated for each 303(d) listed waterbody and is displayed in Table 5-31.

Margin of Safety

The loading calculations in Tables 5-26 through 5-30 used 25 NTU over background. A standard violation occurs when sediment levels exceed 25 NTU over background for a period greater than 10 consecutive days. DEQ used the 25 NTU over background instead of the 50 NTU because each 303(d) stream was in violation of the 25 NTU standard for at least 10 days. But DEQ is applying this approach to the sediment TMDLs on a daily basis over the course of a year, not a ten-day basis within a year. Mathematically this is could be represented as almost a 50% margin of safety.

Twenty-five NTUs was also used because increased sediment levels over background has the potential to negatively effect beneficial uses. This methodology has been used in several other approved TMDLs, such as the South Fork Clearwater River TMDL and the Cottonwood Creek TMDL. By using the 25 NTU—not 50 NTU—above background, a very significant MOS has all ready been supplied; therefore, no further load allocation to MOS has been built into the TMDLs. The use of the 25 NTU standard in the loading calculations is also justified because it is the standard for the current situation; however, as compliance with the TMDL is accomplished, the 50 NTU over background instantaneous criterion is the only one that can be applied if there are no exceedances greater than 10 days duration.

Seasonal Variation

All of the exceedances took place from January through May of each year (spring runoff). The sediment TMDL is shown as an annual load reduction. BMPs to reach the sediment reductions should be applied throughout the year as erosion occurring in the uplands in the fall could eventually reach a running stream in the winter or spring.

Reserve

By making a sediment load capacity based on the state standard, any future growth will have been in compliance with the state standards. The relationships between TSS and NTU that have been established in this TMDL will be applicable to any future non-point or point source loads.

Load Reduction

The load reductions are displayed as total tons per year and as a percentage in Table 5-31. To reach the load reductions stated below, the amount of TSS measured in the streams will have to be lowered during the winter and spring seasons, as this is when the majority of the sediment is being transported. This reduction needs to be applied throughout the entire watershed.

Table 5-31. Sediment allocations, existing load and load reductions for Palouse River Subbasin.

Source (Creek)	Existing Load[a]	Load Capacity[a]	Back-ground[a]	Load Allocation[a]	Load Reduction[a]	Load Reduction (%)
Deep	7040.85 t/yr	613.20 t/yr	233.60 t/yr	379.60 t/yr	6541.15 t/yr	96%
Flannigan	1452.70 t/yr	525.60 t/yr	62.10 t/yr	463.55 t/yr	937.69 t/yr	67%
Gold	661.65 t/yr	368.65 t/yr	25.55 t/yr	343.10 t/yr	294.47 t/yr	46%
Hatter	1222.75 t/yr	795.70 t/yr	219.00 t/yr	546.70 t/yr	466.77 t/yr	46%
Rock	147.88 t/yr	54.75 t/yr	12.34 t/yr	42.41 t/yr	94.90 t/yr	69%

[a] t/yr = tons per year

Time Frame

The goal of this TMDL is to reduce the sediment loads by the load reduction percentages in Table 5-31. An implementation plan will be completed within 18 months of EPA approval of this TMDL document. Specific actions to comply with this TMDL will be identified within that implementation plan.

Construction Storm Water and TMDL Waste Load Allocations

Construction Storm Water

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

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

Storm Water Pollution Prevention Plan (SWPPP)

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

Construction Storm Water Requirements

By making a sediment load capacity based on the state standard, any future growth will have to comply with the TMDL target. TMDLs developed in the past that did not have a WLA for construction storm water activities will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement the appropriate Best Management Practices.

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

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

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GIS Coverages:

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Other Related Documents:

Resource Planning Unlimited, Inc.. 2002. South Fork Palouse River Watershed Characterization and Implementation Plan. 33p+App.

Resource Planning Unlimited, Inc. 2002 North Fork Palouse River Watershed Characterization. 2 Chapters+App.

Glossary

305(b) Refers to section 305 subsection "b" of the Clean Water Act. 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 waterbodies 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.

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 waterbodies, 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.

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 waterbody, 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. 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 (Armantrout 1998, EPA 1996).

Anadromous Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the salt water 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 58.01.02.003.56).

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 waterbody; for example, a fish assemblage, or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).

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 biota, 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 waterbodies 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 waterbody

Benthic Organic Matter. The organic matter on the bottom of a waterbody.

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 waterbodies 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).
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/cm 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. EPA 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).

Cyclonic An area of low pressure in the Northern Hemisphere with winds blowing in the counterclockwise direction.

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 mm depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 cm).

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. Their presence is often indicative of fecal contamination.

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 waterbody.
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 Geologic 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).
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 (EPA 1997).

Fully Supporting but Threatened An intermediate assessment category describing waterbodies 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 Indian 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 waterbody'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.

Loading Capacity (LC) A determination of how much pollutant a waterbody 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 waterbody, 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 waterbody's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving waterbody. 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; and 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, 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 waterbody.
Mouth	The location where flowing water enters into a larger waterbody.
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	A condition indistinguishable from that without human-caused disruptions.
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 waterbodies that have been studied, but are missing critical information needed to complete an assessment.
Not Attainable	A concept and an assessment category describing waterbodies 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 (EPA 1997).
Nuisance	Anything which 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 waterbody 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	Disease-producing organisms (e.g., bacteria, viruses, parasites).
Perennial Stream	A stream that flows year-around in most years.
Periphyton	Attached microflora (algae and diatoms) growing on the bottom of a waterbody 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 waterbody. 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 terms “physical/chemical” and “physicochemical.”

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. The goal of QA is to assure the data provided are of the quality needed and claimed (Rand 1995, 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. QC is implemented at the field or bench level (Rand 1995, 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 waterbody that is minimally impaired and is representative of reference conditions for similar waterbodies.
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 waterbody.

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 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 waterbody.

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.

Stochastic 1) Generally, stochastic (pronounced stow-KAS-tik, from the Greek *stochastikos,* or "skilled at aiming," since *stochos* is a target) describes an approach to anything that is based on probability.
2) In mathematics, a stochastic approach is one in which values are obtained from a corresponding sequence of jointly distributed random variables. Classic examples of the stochastic process are guessing the length of a queue at a stated time given the random distribution over time of a number of people or objects entering and leaving the queue and guessing the amount of water in a reservoir based on the random distribution of rainfall and water usage.

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 mm 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 waterbody's loading 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. TMDL = Loading Capacity = Load Allocation + Wasteload Allocation + Margin of Safety. 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 waterbodies 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 (Greenborg, Clescevi, and Eaton 1995) call for using a filter of 2.0 micron or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

Toxic Pollutants Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.

Tributary A stream feeding into a larger stream or lake.

Trophic State The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.

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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 waterbody.

Waterbody 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 waterbodies 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 EPA-approved ambient standards for waterbodies. The standards prescribe the use of the waterbody 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 waterbody.
Waterbody Identification Number (WBID)	A number that uniquely identifies a waterbody in Idaho ties in to the Idaho Water Quality Standards and GIS information.
Wetland	An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.
Young of the Year	Young fish born the year captured, evidence of spawning activity.

Appendix A. Palouse Monitoring Plan

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Palouse River
Monitoring Program 2001-2002

A Water Quality Sampling Project for the 303 (d) listed tributaries of the Palouse River within the State of Idaho.

February 4, 2002

Developed for:	**Latah Soil and Water Conservation District (LSWCD)** **Idaho Department of Environmental Quality (DEQ)** **Idaho Soil Conservation Commission (SCC)** **Idaho State Department of Agriculture (ISDA)**
Prepared by:	**Cary Myler, Idaho Association of Soil Conservation Districts**
Approved by:	______________________________ **Latah Soil and Water Conservation District Chairperson**
Approved by:	______________________________ **Idaho Department of Environmental Quality Representative**
Approved by:	______________________________ **Idaho Soil Conservation Commission Representative**
Approved by:	______________________________ **Idaho State Department of Agriculture Representative**

Introduction:

The Palouse River Watershed is comprised of two major forks: the South Fork and North Fork. Each of these segments originate in forest regions in Idaho and flow independently into Washington where they later combine.

The South Fork of the Palouse River is 303 (d) listed from the headwaters to the Idaho-Washington border for bacteria, flow alteration, habitat alteration, nutrients, sediment, and temperature. South Fork Palouse River is a small watershed with 13.42 stream miles from the headwaters to the Idaho-Washington border. This stream flows through forest and agricultural lands southeast of the city of Moscow. Several small farmsteads lie along the watershed providing a sub-urban aspect to the drainage. The South Fork Palouse originates on the southwest slope of Moscow Mountain from five main tributaries: headwaters South Fork Palouse, Howard Creek, Gnat Creek, Crumarine Creek, and Twin Creek. These tributaries are very small in size and combine near the intersection of Robinson Lake Road and Olsen Road.

The North Fork of the Palouse River originates on the western side of the Hoodoo Mountains in the St. Joe National Forest and then flows adjacent to the towns of Harvard, Princeton, and Potlatch before the river crosses into the State of Washington. The North Fork of the Palouse itself is not a 303 (d) listed waterbody but Deep, Gold, Big, Flannigan, West Fork of Rock and Hatter Creeks are 303 (d) impaired streams that are listed for bacteria, flow alteration, habitat alteration, nutrients, and sediment.

Monitoring Program:

This water quality monitoring program is intended to provide background data on the 303 (d) listed tributaries of the Palouse River for TMDL development. This monitoring plan was designed in coordination with the Lewiston Regional Office of the Idaho Department of Environmental Quality (DEQ), Latah Soil and Water Conservation District (LSWCD), and Soil Conservation Commission (SCC) and the Idaho Association of Soil Conservation Districts (IASCD) to fill data gaps that exist in the watershed. Monitoring near the headwaters, the agriculture-forest boundary and near the Idaho-Washington State line will enable managers to determine where loads are entering the stream to allow prioritization for the implementation of Best Management Practices (BMPs).

Specific parameters to be tested are total phosphorus (TP), bacteria (*Escherichia coli* and total coliform), nitrate+nitrite (NO_3+NO_2-N), ammonia (NH_3), turbidity, total suspended solids (TSS), instantaneous water temperature, continuous water temperature, dissolved oxygen (DO), and percent (%) saturation. With the exception of continuous temperature monitoring, the remaining parameters will be monitored on an instantaneous basis with sampling occurring every two weeks. This project is scheduled to begin November 2001 and continue through June 2002, at which time monitoring may continue contingent upon funding availability.

The University of Idaho Analytical Science Laboratory (ASL) will conduct all inorganic parameter testing. Bacteria analysis will be performed by the State of Idaho Health and Welfare Laboratory in Coeur d'Alene. All other measurements will be performed by Cary Myler of the IASCD, or other personnel under supervision. Continuous temperature dataloggers will be installed at representative sites.

This project is a cooperative effort between IASCD, ISDA, DEQ, and SCC. ISDA and IASCD will provide the personnel, sampling equipment, and technical expertise. DEQ will pay all laboratory costs incurred at the U of I ASL for NO_3+NO_2/NH_3, TP, and TSS as well as bacteria costs from the state bacteria laboratory in Coeur d'Alene for the duration of the project and will fund a position at the LSWCD to collect the data. IASCD personnel will conduct the monitoring, perform data entry, and provide a summary report after the data has been gathered.

Program Objectives:

IASCD will cooperate with the (DEQ), (ISDA), (LSWCD) and local landowners in an attempt to complete the following goals:

1. Evaluate the water quality and discharge rates at selected locations on each 303 (d) listed tributary.

2. Attempt to determine which areas contribute to water quality exceedances or degradation.

3. Prioritize loading areas that may require BMP implementation or other possible management strategies.

4. Determine relationship between turbidity and total suspended solids.

5. Make data available to the public.

Site Description:

These sites are shown on the map on page 214.

PR-1 Located at the headwaters on Cedar Grove Lane.

PR-2 Located at Robinson Park.

PR-3 Located at bridge crossing of Mountain view Rd. near Palouse River Drive.

PR-4 Located at the Idaho-Washington State line.

PR-5 Lower Deep Creek at Potlatch (Irelands Café).

PR-6 Middle Deep Creek, located bridge crossing of Freeze Road.

PR-7 Upper Deep Creek.

PR-8 Upper Gold Creek.

PR-9 Lower Gold Creek.

PR-10 Upper Big Creek.

PR-11 Lower Big Creek.

PR-12 Lower Hatter Creek.

PR-13 Upper Hatter Creek.

PR-14 Lower West Fork Rock Gold Creek.

PR-15 Upper West Fork Rock Creek.

PR-16 Lower Flannigan Creek.

PR-17 Upper Flannigan Creek.

Sampling Methods
Water Quality

With the exception of bacteriological samples, each grab sample will be composited into a 2.5-gallon polyethylene churn sample splitter. The resultant composite sample will then be thoroughly homogenized and poured off into properly prepared sample containers. Nutrients water samples that require preservation will be obtained in preserved (H_2SO_4 pH <2) 500 mL. sample containers. The polyethylene churn splitter will be thoroughly rinsed with ambient water at each location prior to sample collection. Bacteriological samples will be collected directly from mid-stream flow into properly prepared sterile sample bottles. Refer to Table A-1 for a list of parameters, analytical methods, preservation, and holding times.

All sample containers will be equipped with sample labels that will be filled out using water proof markers with the following information: station location, sample identification, date of collection, and time of collection. Clear packing tape will be wrapped around each sample bottle and its label to insure that moisture from the coolers does not cause the loss of sample labels. All resultant samples will be placed within a cooler, on ice, to await shipment to the laboratory. Chain-of-Custody forms will accompany each sample shipment. All samples, except bacteria, will be shipped to the University of Idaho ASL for analyses. Bacteria samples will be sent to the State of Idaho Health and Welfare Laboratory in Couer d’Alene for analysis. Samples will be shipped either the same day or early the next morning to meet 30-hour holding time.

Table A-1. Water Quality Parameters

Parameters	Sample Size	Preservation	Holding Time	Method
Non Filterable Residue (TSS)	1L	Cool 4°C	7 Days	EPA 160.2
Nitrogen(NO_3+NO_2) Ammonia (NH_3)	60 mL	Cool 4°C, H_2SO_4 pH < 2	28 Days	EPA 353.2 EPA 350.1
Total Phosphorus (TP)	100 mL	Cool 4°C, H_2SO_4 pH < 2	28 Days	EPA 365.4
Escherichia coli (E. coli)	100 mL	Cool 4°C	30 Hours	MPN

Field Measurements

At each location, field parameters of dissolved oxygen, specific conductance, pH, temperature and total dissolved solids will be measured. These measurements will be taken, when possible, from a well-mixed section, near mid-stream at approximately mid-depth. Calibration of all field equipment will be in accordance with the manufacturer's specifications. Refer to Table A-2 for a listing of field measurements, equipment and calibration techniques.

Table A-2. Field Measurements

Parameters	Instrument	Calibration
Dissolved Oxygen	YSI Model 55	Ambient air calibration
Temperature	YSI Model 55 StowAway temperature logger Model XTI 02	Centigrade thermometer Centigrade thermometer
Conductance & TDS	Orion Model 115	Specific Conductance (25^{o}C)
PH	Orion Model 210A	Standard buffer (7,10) bracketing for linearity
Turbidity	Hach Model 2100P	Formazin Primary Standard

All field measurements will be recorded in a bound log book along with any pertinent observations about the site, including weather conditions, flow rates, personnel on site or any potential problems observed that may affect the quality of data.

Flow Measurements

Flow measurements will be collected by wading and using a Marsh McBirney Flow Mate Model 2000 flow meter. The six-tenth-depth method (0.6 of the total depth below water surface) will be used when the depth of water is less than or equal to three feet. For depths greater than three feet the two-point method (0.2 and 0.8 of the total depth below the water surface) will be employed. At each gauging station, a transect line will be established across the width of the drain/creek at an angle perpendicular to the flow. The mid-section method for computing cross-sectional area along with the velocity-area method will be used for discharge determination. The discharge is computed by summation of the products of the partial areas (partial sections) of the flow cross-sections and the average velocities for each of those sections. This method will be used to calculate cubic feet per second at each of the monitoring stations.

Quality Assurance and Quality Control (QA/QC)

The ASL utilizes methods approved and validated by EPA. A method validation process, including precision and accuracy performance evaluations and method detection limit studies, are required of all of ASL Standard Methods. Method performance evaluations include quality control samples, analyzed with a batch to ensure sample data integrity. Internal laboratory spikes and duplicates are all part of ASL's quality assurance program. Laboratory QA/QC results generated from this project can be provided upon request.

QA/QC procedures from the field-sampling portion of this project will consist of duplicates (at 10% of the sample load) along with blank samples (one set per sampling day). The field blanks will consist of laboratory-grade deionized water, transported to the field and poured off into a prepared sample container. The blank sample is used to determine the integrity of the field teams handling of samples, the condition of the sample containers supplied by the laboratory and the accuracy of the laboratory methods. Duplicates consist of two sets of sample containers filled with the same composite water from the same sampling site. The duplicates are used to determine both field and laboratory precision. The duplicate and blank samples will not be identified as such and will enter the laboratories blindly for analyses. Both the duplicates and blank samples will be stored and handled with the normal sample load for shipment to the laboratory.

Bacteria water samples will be shipped from the Idaho Department of Health and Welfare building in Moscow to the laboratory in Couer d’Alene where the samples will be run within the 30 hour holding time. Their procedures use MPN (most probable number) by Quantitray test to determine *E. coli* and total coliform concentrations. The laboratory in Couer d’Alene is certified by the State of Idaho to conduct laboratory analysis of bacteria.

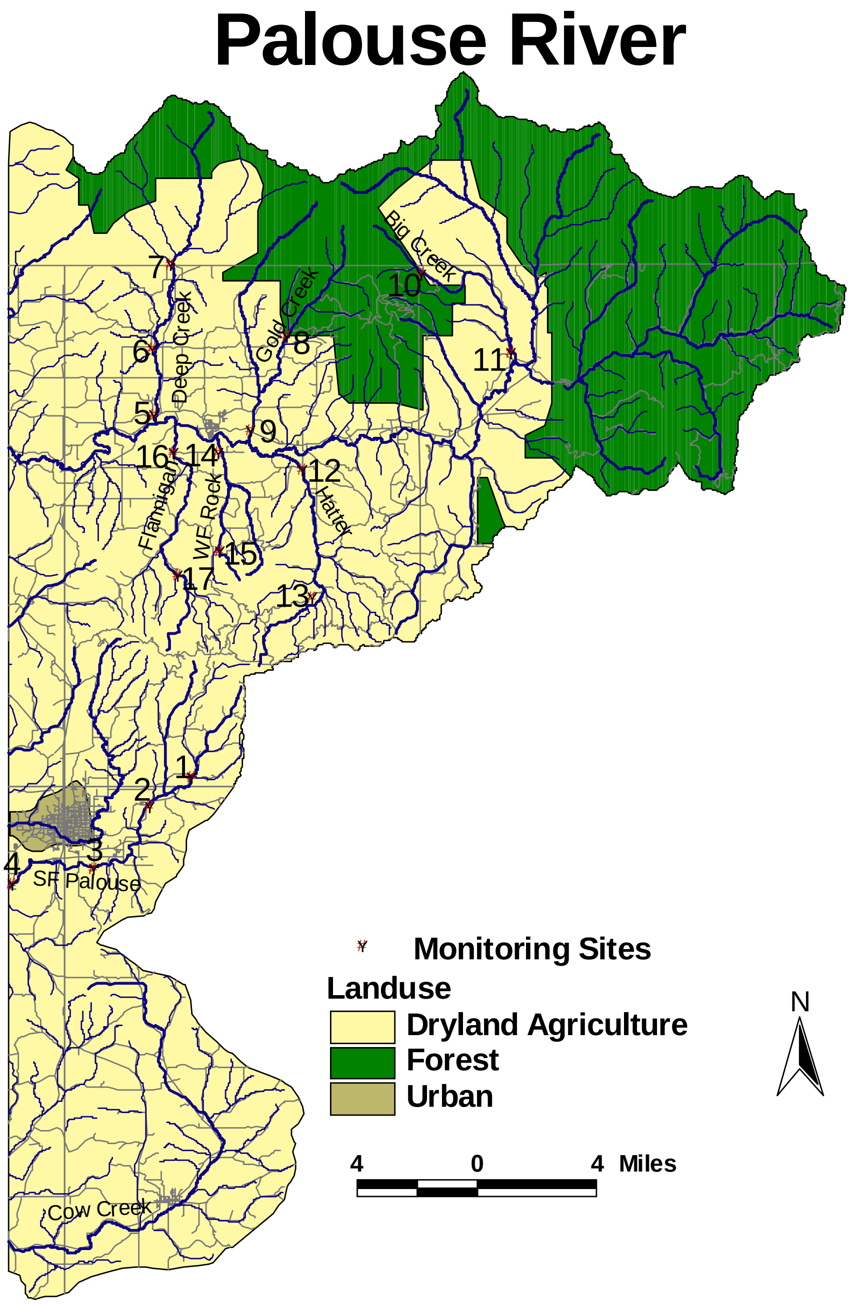
Data Handling

All of the field data and analytical data generated from each survey will be submitted to ISDA for review. Each batch of data from a survey will be reviewed to insure that all necessary observations, measurements, and analytical results have been properly recorded.

The analytical results will be reviewed for completeness and quality control results. Any suspected errors will be investigated and resolved, if possible. The data will then be stored electronically and made available to any interested entity. Monthly progress reports will be sent from the IASCD to the DEQ. These reports will include: a status report of the field monitoring, an electronic copy of the data, and an overall update of the project.

Data use

The data generated from this monitoring program will be used by IASCD, DEQ, SCC, and the LSWCD to determine loads within the stream, identify areas where BMPs would have the greatest benefit, provide baseline data prior to TMDL development, and identify changes as BMPs are implemented. Data will also be available to other agencies and the general public. This data will specifically be used by the DEQ for TMDL development for the Palouse River Watershed.



Map A-1. Monitoring Sites

Appendix B. Sediment TMDL Regression Tables

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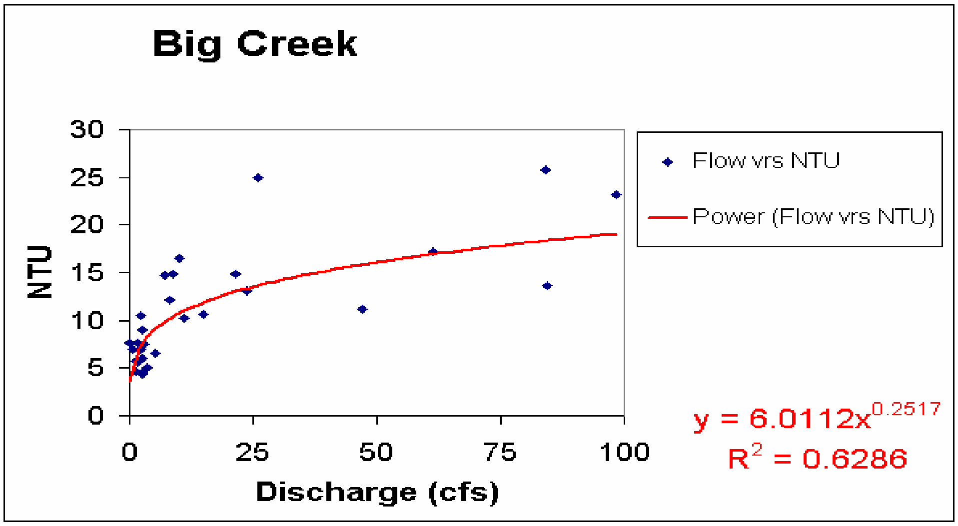
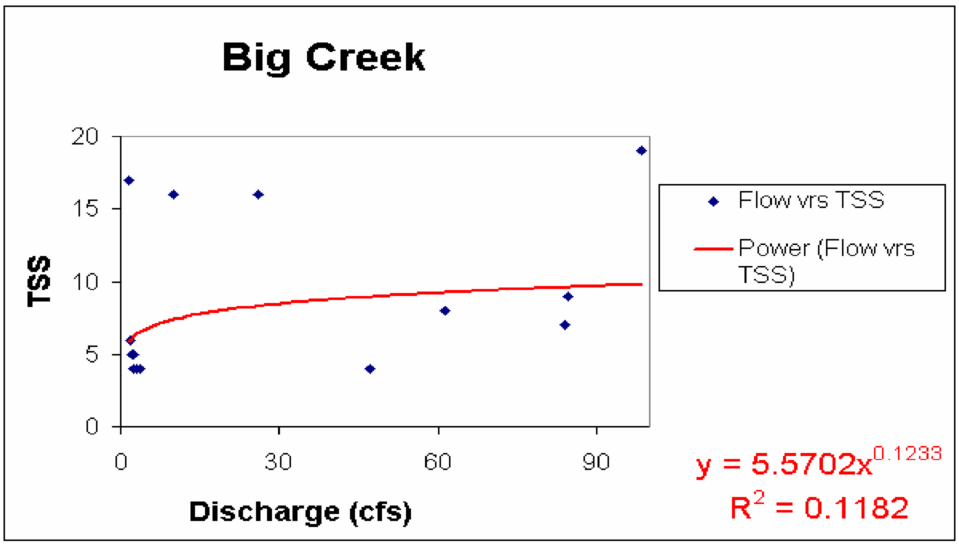

Big Creek
NTU
30
25
20
15
10
5
0
0
25
50
75
100
Discharge (cfs)
Flow vrs NTU
Power (Flow vrs NTU)
y = 6.0112x^0.2517
R^2 = 0.6286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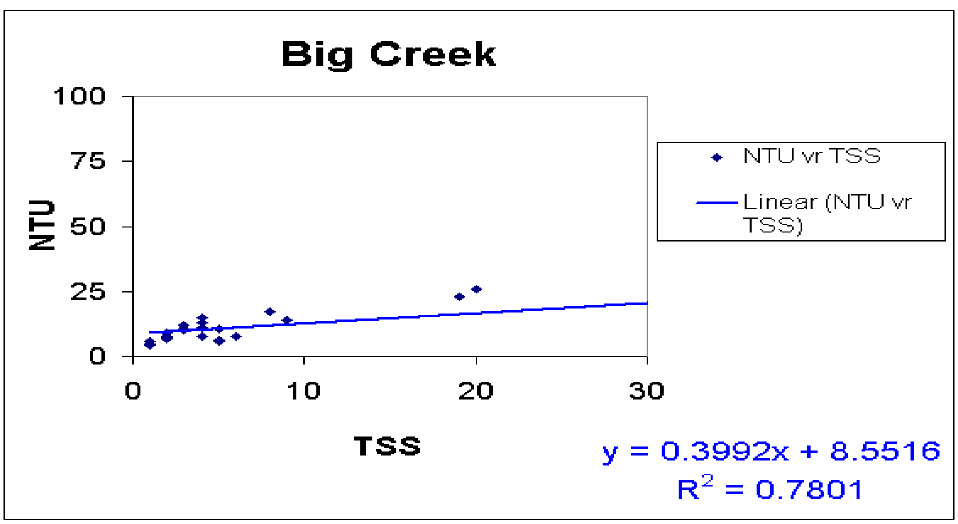
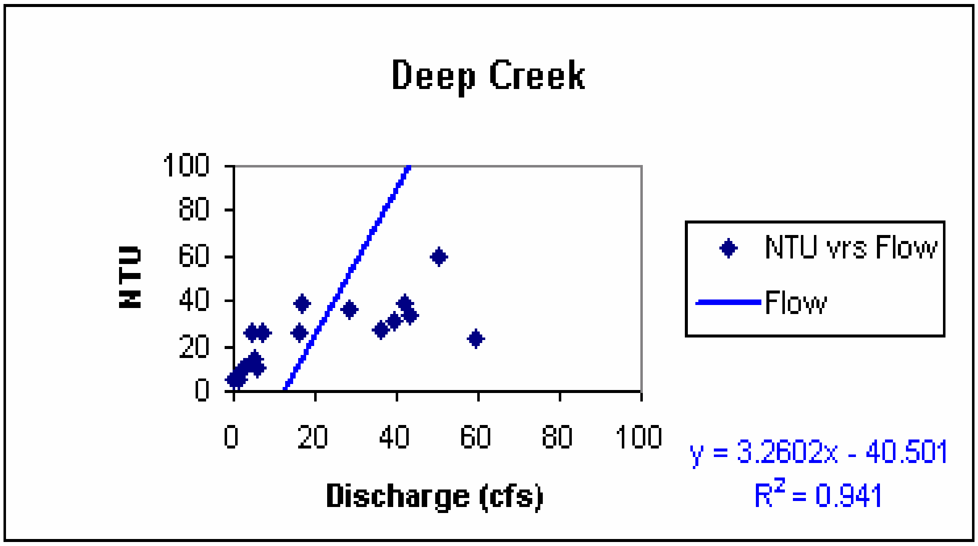
TSS
20
15
10
5
0
0
30
60
90
Discharge (cfs)
Flow vrs TSS
Power (Flow vrs TSS)
y = 5.5702x^0.1233
R^2 = 0.1182


Big Creek
NTU
100
75
50
25
0
0
10
20
30
TSS
NTU vr TSS
Linear (NTU vr TSS)
y = 0.3992x + 8.5516
R^2 = 0.7801


Deep Creek
NTU
100
80
60
40
20
0
0
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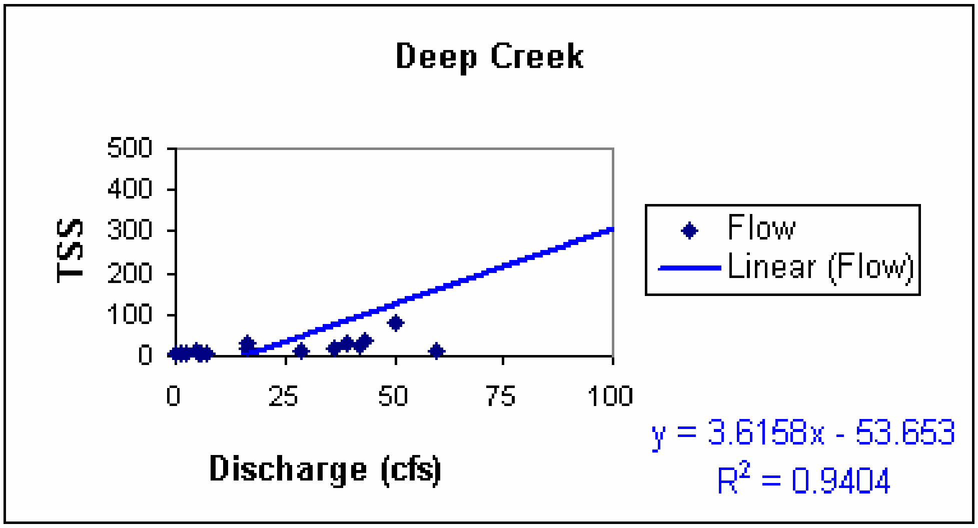
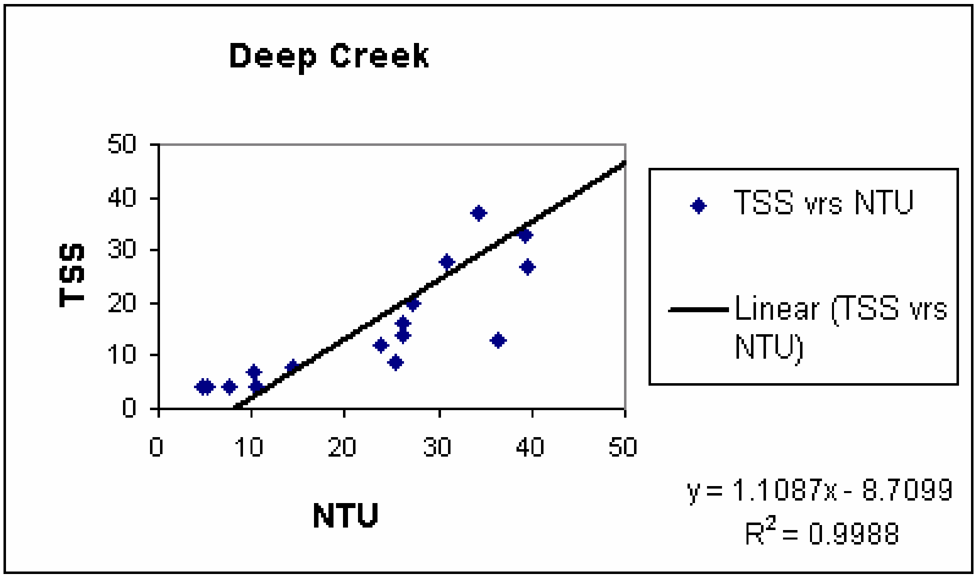
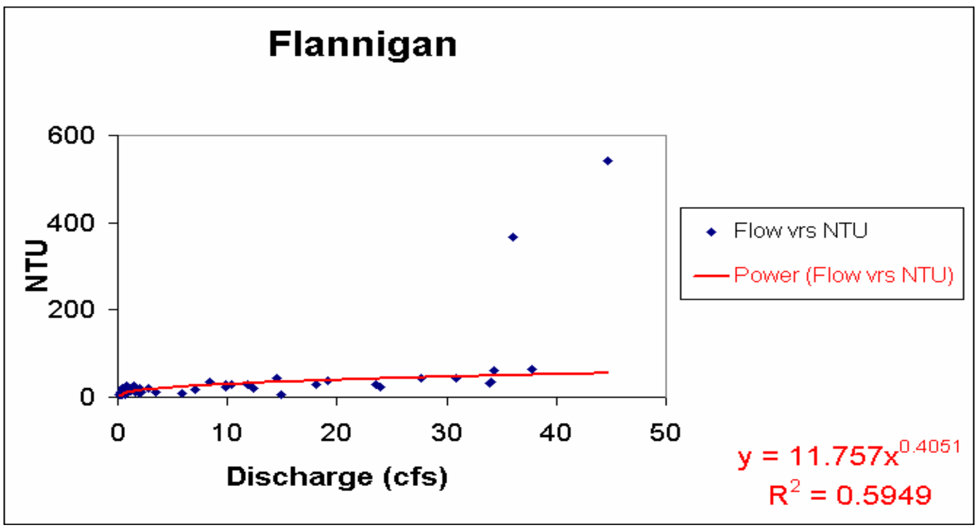
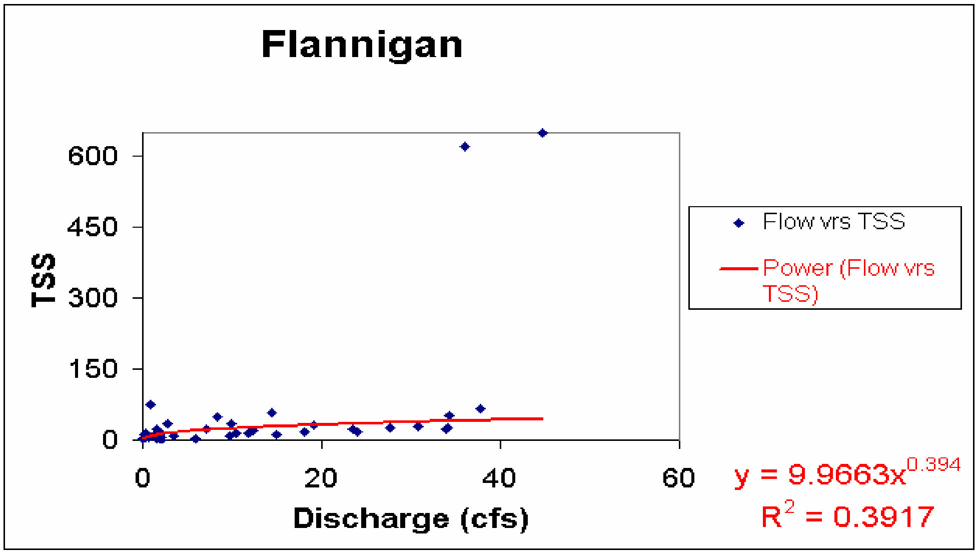
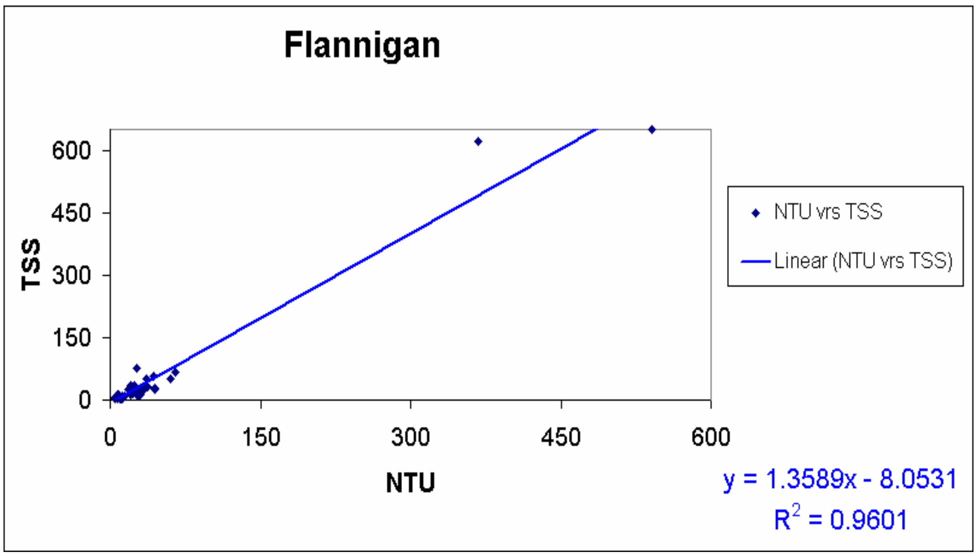
40
60
80
100
Discharge (cfs)
NTU vrs Flow
Flow
y = 3.2602x - 40.501
R2 = 0.941

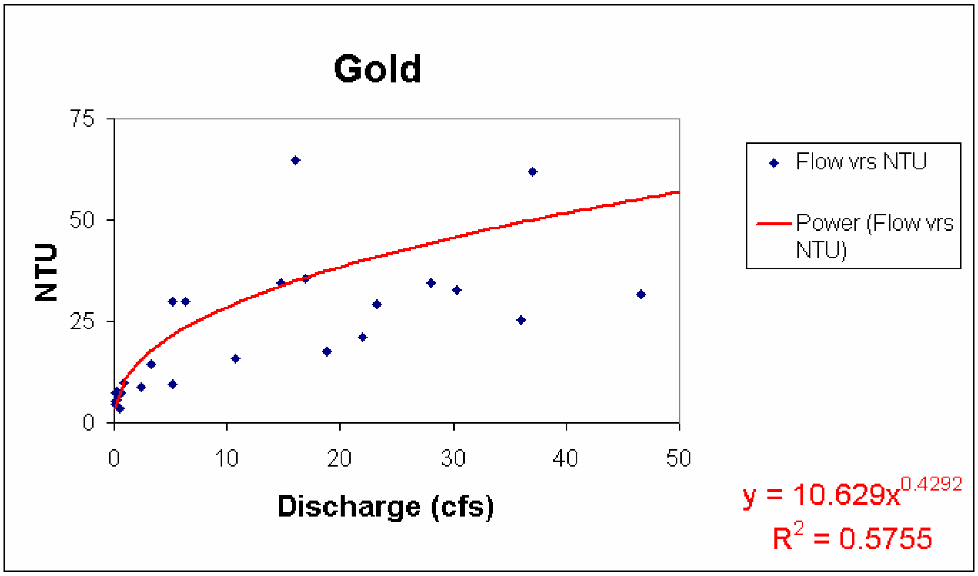

Deep Creek
TSS
500
400
300
200
100
0
0
25
50
75
100
Discharge (cfs)
Flow
Linear (Flow)
y = 3.6158x - 53.653
R2 = 0.9404

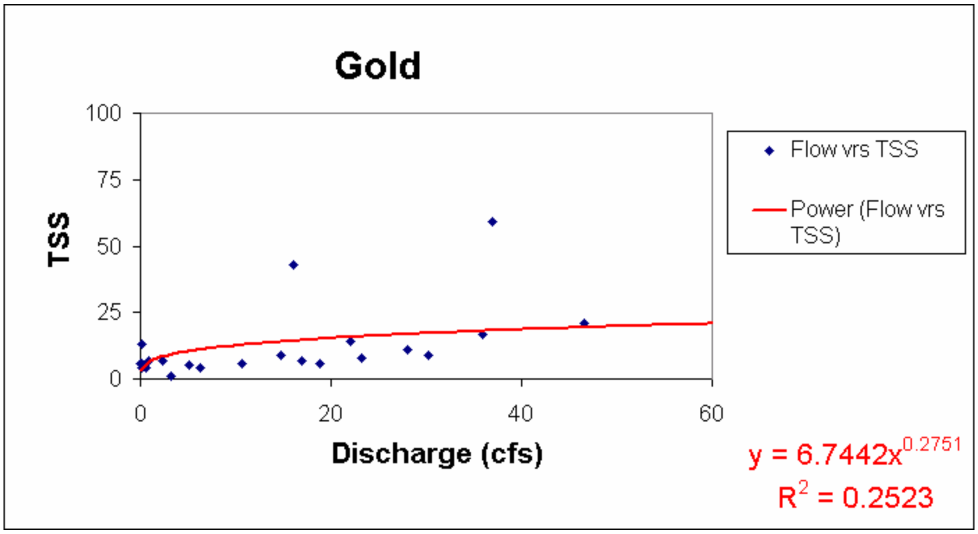

Deep Creek
TSS
NTU
50
40
30
20
10
0
0
10
20
30
40
50
TSS vrs NTU
Linear (TSS vrs NTU)
y = 1.1087x - 8.7099
R2 = 0.9988

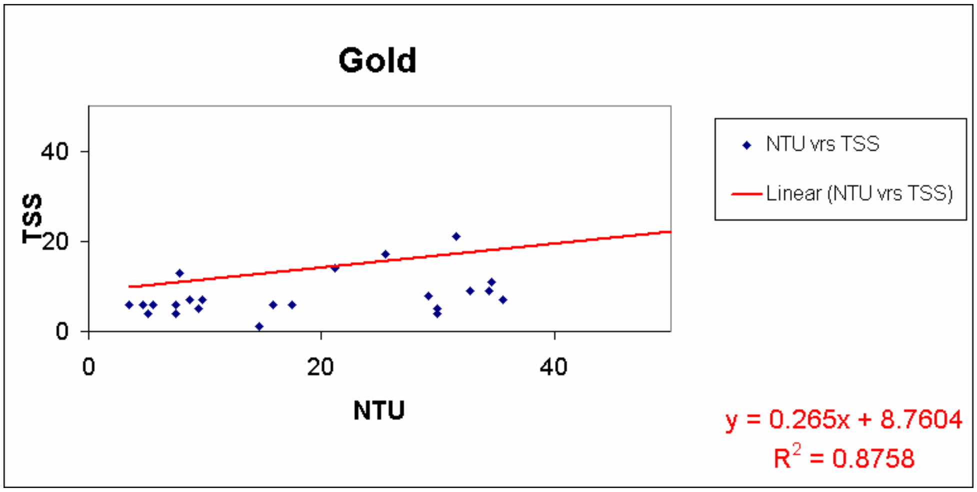

Flannigan
NTU
Discharge (cfs)
600
400
200
0
0
10
20
30
40
50
Flow vrs NTU
Power (Flow vrs NTU)
y = 11.757x0.4051
R2 = 0.5949

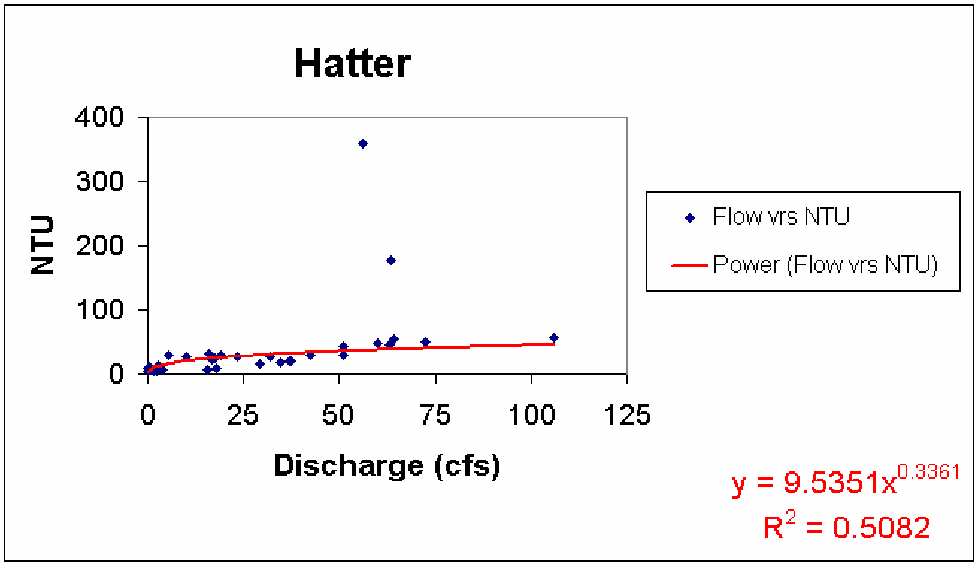

Flannigan
600
450
300
150
0
TSS
0
20
40
60
Discharge (cfs)
Flow vrs TSS
Power (Flow vrs TSS)
y = 9.9663x^0.394
R^2 = 0.3917

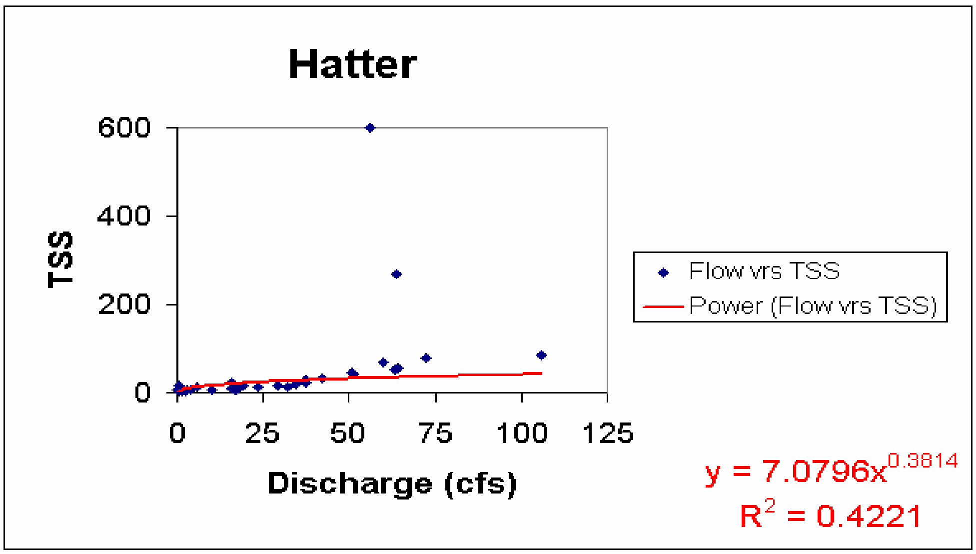

Flannigan
600
450
300
150
0
TSS
0
150
300
450
600
NTU
NTU vrs TSS
Linear (NTU vrs TSS)
y = 1.3589x - 8.0531
R^2 = 0.9601

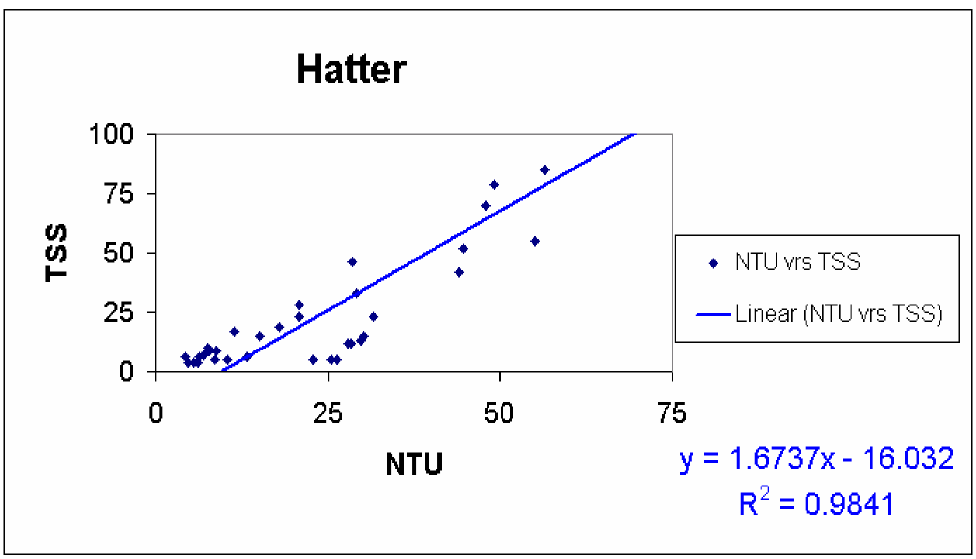

Gold
NTU
Discharge (cfs)
Flow vrs NTU
Power (Flow vrs NTU)
y = 10.629x^0.4292
R^2 = 0.5755

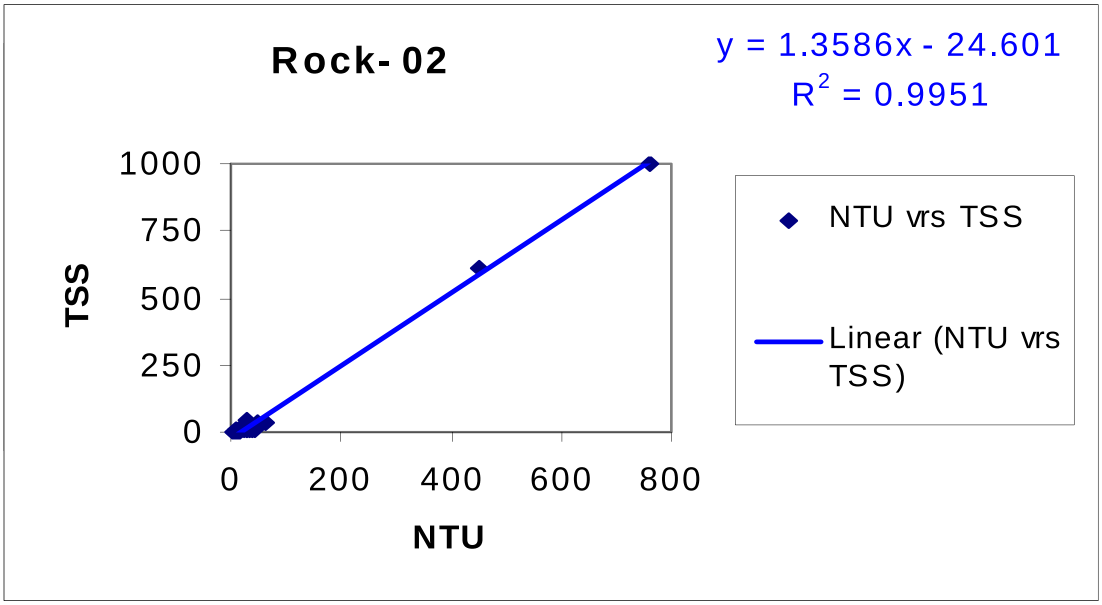

Gold
TSS
Discharge (cfs)
Flow vrs TSS
Power (Flow vrs TSS)
y = 6.7442x^0.2751
R^2 = 0.2523


Gold
TSS
NTU
NTU vrs TSS
Linear (NTU vrs TSS)
y = 0.265x + 8.7604
R^2 = 0.8758


Hatter
NTU
400
300
200
100
0
0 25 50 75 100 125
Discharge (cfs)
Flow vrs NTU
Power (Flow vrs NTU)
y = 9.5351x^0.3361
R^2 = 0.5082


Hatter
TSS
600
400
200
0
0 25 50 75 100 125
Discharge (cfs)
Flow vrs TSS
Power (Flow vrs TSS)
y = 7.0796x^0.3814
R^2 = 0.4221


Hatter
TSS
100
75
50
25
0
0 25 50 75
NTU
NTU vrs TSS
Linear (NTU vrs TSS)
y = 1.6737x - 16.032
R^2 = 0.9841


Rock- 02
y = 1.3586x - 24.601
R2 = 0.9951
TSS
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750
500
250
0
0
200
400
600
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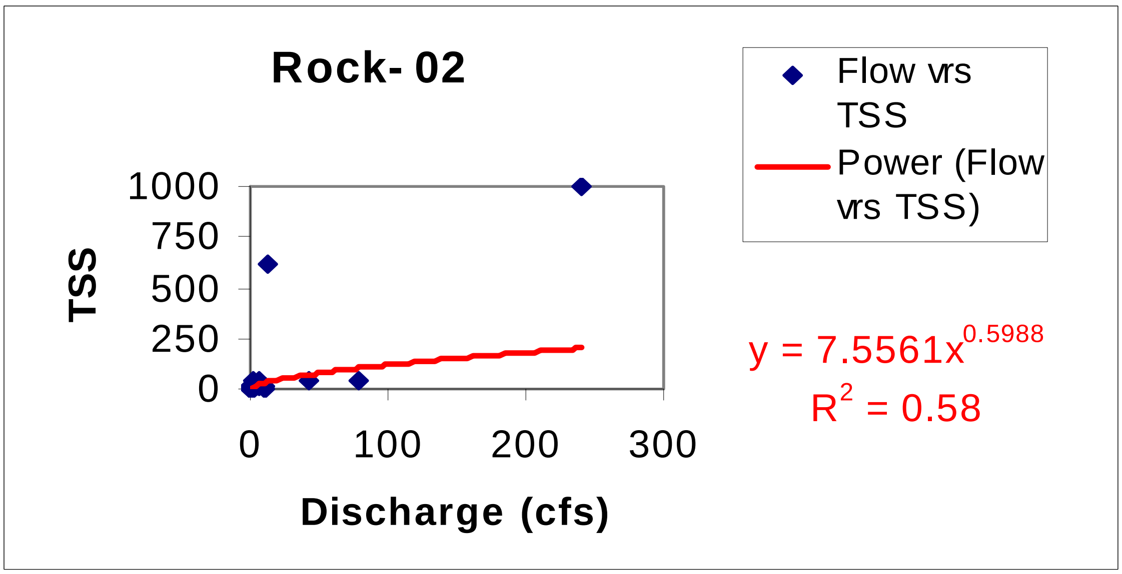
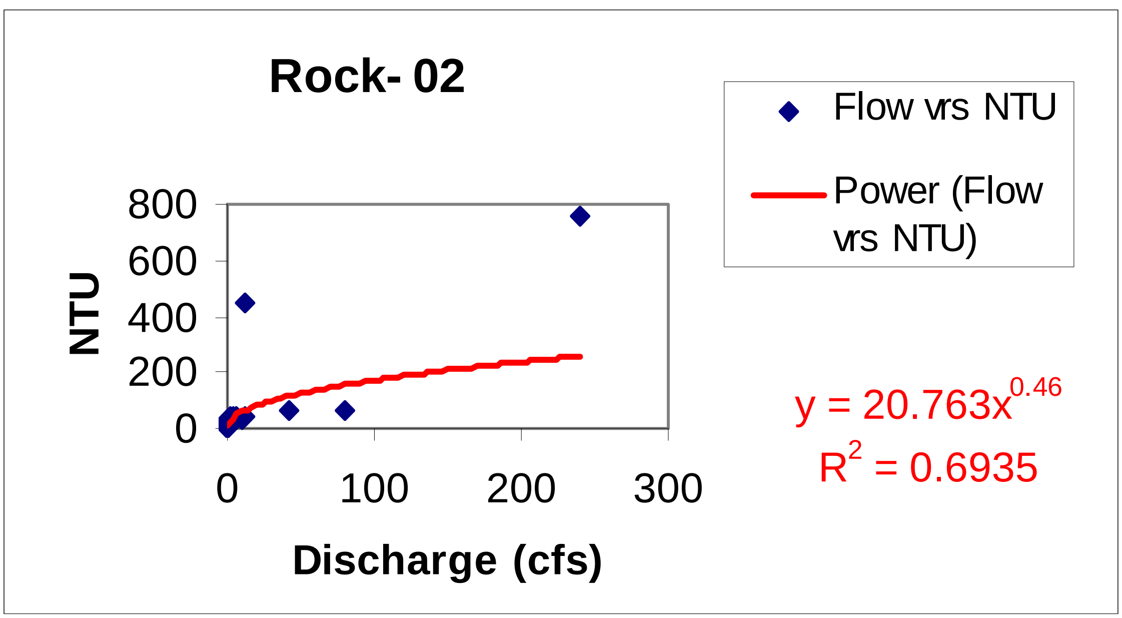
NTU
NTU vrs TSS
Linear (NTU vrs TSS)


Rock- 02
Flow vrs TSS
Power (Flow vrs TSS)
TSS
1000
750
500
250
0
0
100
200
300
Discharge (cfs)
y = 7.5561x0.5988
R2 = 0.58


Rock- 02
Flow vrs NTU
Power (Flow vrs NTU)
NTU
800
600
400
200
0
0
100
200
300
Discharge (cfs)
y = 20.763x0.46
R2 = 0.6935

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Appendix C. Climate Data

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Table C-1. Climate data for stations in and around the Palouse River Subbasin.

Moscow Mountain, Idaho (16c02s), NRCS
Elevation = 4700 Feet
Period of Record = 1/1/2001 to 12/31/2002

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Mean Temperature (°F)	24.8	24.8	35.6	41.0	50.0	56.3	56.3	65.3	46.4	39.9	28.4	29.3	41.5
Avg. Max. Temperature (°F)	30.2	34.7	48.2	50.9	60.8	67.1	66.2	76.1	57.2	46.4	32.9	32.9	50.3
Avg. Min. Temperature (°F)	21.2	16.7	31.1	33.8	41.0	49.1	48.2	58.1	40.1	36.5	24.8	26.6	35.6
Avg. Total Precipitation (in.)	6.2	4.7	2.8	3.3	2.7	2.1	0.5	0.9	0.3	3.5	5.5	7.7	40.1
Avg. Number of days 90 (°F) and Above	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	0.0	0.0	0.0	0.0	3.0

Moscow U of I, Idaho (106152), Idaho State Climate Services
Elevation = 2660 Feet
Period of Record = 1/1/1971 to 12/31/2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Mean Temperature (°F)	29.4	34.1	40.1	46.5	53.3	59.2	65.5	66.4	58.7	48.3	36.5	29.6	47.3
Avg. Max. Temperature (°F)	35.6	41.3	49.0	57.5	65.9	73.1	82.6	84.0	74.4	60.5	43.1	35.5	58.5
Avg. Min. Temperature (°F)	23.2	26.8	31.2	35.4	40.6	45.2	48.4	48.7	42.9	36.0	29.9	23.6	36.0
Avg. Total Precipitation (in.)	3.0	2.5	2.6	2.5	2.6	1.9	1.1	1.2	1.3	2.0	3.5	3.1	27.4
Avg. Number of days 90 (°F) and Above	0.0	0.0	0.0	0.0	0.2	1.8	8.8	11.1	3.5	0.0	0.0	0.0	25.4

Potlatch 3 NNE, Idaho (107301), Idaho State Climate Services
Elevation = 2600 Feet
Period of Record = 1/1/1971 to 12/31/2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Mean Temperature (°F)	29.0	33.5	38.8	45.0	51.4	57.1	62.6	62.8	55.1	45.5	35.7	29.2	45.5
Avg. Max. Temperature (°F)	36.0	41.7	48.5	56.8	64.8	71.6	80.4	81.9	72.8	59.8	43.2	36.1	57.8
Avg. Min. Temperature (°F)	21.9	25.2	29.1	33.1	37.9	42.6	44.7	43.7	37.3	31.2	28.2	22.3	33.1
Avg. Total Precipitation (in.)	2.9	2.7	2.5	2.3	2.7	1.8	1.2	1.1	1.3	1.8	3.3	3.2	26.6
Avg. Number of days 90 (°F) and Above	0.0	0.0	0.0	0.0	0.0	0.5	4.3	5.4	1.0	0.0	0.0	0.0	11.2

Pullman 2 NW, Washington (456789) Western Regional Climate Center
Elevation = 2550 Feet
Period of Record = 1/1/1971 to 12/31/2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Mean Temperature (°F)	29.6	34.0	39.9	46.2	53.2	59.2	65.9	66.8	58.7	48.5	36.8	29.9	47.4
Avg. Max. Temperature (°F)	35.3	40.8	48.3	56.5	64.7	71.8	81.6	83.2	73.5	60.4	43.3	35.5	57.9
Avg. Min. Temperature (°F)	23.8	27.2	31.5	35.9	41.6	46.5	50.1	50.3	43.9	36.5	30.3	24.2	36.8
Avg. Total Precipitation (in.)	2.5	2.1	2.0	1.7	1.8	1.3	0.8	0.9	0.9	1.5	2.8	2.8	21.0
Avg. Number of days 90 (°F) and Above	0.0	0.0	0.0	0.0	0.2	2.2	9.8	11.9	3.5	0.0	0.0	0.0	27.6

Sherwin, Idaho (16c01s) Natural Resources Conservation Service
Elevation = 3200 ft (Lat 47.0Long 116.3)
Period of Record = 1/1/1971 to 12/31/2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Mean Temperature (°F)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Avg. Max. Temperature (°F)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Avg. Min. Temperature (°F)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Avg. Total Precipitation (in.)	5.6	4.6	4.0	3.0	3.2	2.4	1.4	1.4	1.8	3.0	5.7	6.1	42.2
Avg. Number of days 90 (°F) and Above	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Appendix D. Supplemental Sediment Data

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Supplemental Sediment Data

The sediment TMDLs are based on a stochastic flow model and actual data collected described within the Palouse Monitoring Plan (Appendix A). The sediment TMDLs give a gross yearly allocation and reduction for each stream, they do not necessarily identify sources of sediment pollution.

DEQ believes the three main anthropogenic sources of sediment pollution in the Palouse River Subbasin are erosion off the landscape above background levels (sheet and rill erosion), erosion from roads, and erosion occurring within the stream channel itself. DEQ has quantified amounts from each of these sources using specific models designed to describe and quantify sediment from each particular source. The Revised Universal Soil Loss Equation (RUSLE) was used to determine erosion off the landscape. The Water Erosion Prediction Project (WEPP)-Road module, an interface to the WEPP soil erosion model, was used to quantify erosion from roads. The National Resource Conservation Service (NRCS) field estimate procedure for channel erosion was conducted on all of the 303(d) listed streams to quantify instream channel erosion and describe stream characteristics and conditions. The methodology for each model is described in this appendix. The results calculated from each model are displayed in Table D-3. DEQ is providing this information as a possible starting point for implementation for landowners and the designated land management agencies. The data can then be compared to data collected in the future after implementation has taken place to see if and how much erosion from these sources has decreased as a result of BMP implementation. The data within this appendix is not the sediment TMDL, but supplemental sediment data.

RUSLE Data

The Revised Universal Soil Loss Equation (RUSLE) is a set of mathematical equations that estimate average annual soil loss and sediment yield resulting from interrill and rill erosion. It does not estimate erosion in channels or erosion from roads, it merely computes erosion from the soil surface. It is derived from the theory of erosion processes, with more than 10,000 plot-years of data from natural rainfall plots, and numerous rainfall-simulation plots. RUSLE is an exceptionally well-validated and documented equation. A strength of RUSLE is that it was developed by a group of nationally recognized scientists and soil conservationists who had considerable experience with erosional processes. RUSLE retains the structure of its predecessor, the Universal Soil Loss Equation (USLE).

RUSLE resulted from a 1985 workshop of government agency and university soil-erosion scientists. The workshop participants concluded that the USLE should be updated to incorporate the considerable amount of erosion information that had accumulated since the publication of Agriculture Handbook 537 (in 1978) and to specifically address the application of the USLE to land uses other than agriculture. This effort resulted in the computerized technology of RUSLE.

Current surface erosion rates and background surface erosion within this appendix were calculated using a GIS version of the RUSLE model. RUSLE is expressed as follows:

A = R * K * LS * C * P

Where
A = estimated average soil loss (tons per acre per year)
R = rainfall-runoff erosivity factor (feet*100*tonf*inch/acre/hour/year)
K = soil erodibility factor (tons*acre*hour/acre/100/feet/tonf/inch)
L = slope length factor (dimensionless)
S = slope steepness factor (dimensionless)
C = cover-management factor (dimensionless)
P = support practice factor (dimensionless)

The R factor is derived from the PRISM data.

The S and L factors are derived from the 10 DEMs using a set of equations developed by Boll and Brooks (2002).

The K factor was derived from the SSURGO data set for those parts of the Palouse River Subbasin covered by the SSURGO data set and from the STATSGO data set for the remainder.

The P factor was assigned a value of 0.84 for agricultural cropland, and 1.0 for all other land uses.

A land use map was developed for the project based on 1:24,000 scale county parcel maps, overlaid on NRCS digital orthophoto maps, and field verified in 2003, resulting in a 1:24,000 scale land use map of the Palouse River Subbasin.

The C factor (cropping factor) was developed in two ways: one for estimating natural background erosion rates, and the second for estimating current erosion rates based on the 2003 land use map. The C factor is the most critical component with the equation as different land, habitat, precipitation and vegetation types change the C factor.

Table D-1 lists the various soil mapping units within the Latah County Soil Survey (Barker 1979), with their associated mean annual precipitation and overstory habitat types.

Table D-1. Latah County Soil Survey mapping units with associated mean annual precipitation, habitat type overstory, and assigned C factor.

Soil Series	Precipitation	Habitat Type	C Factor
Latah Soil Survey	(inches)	(overstory)	(ground cover)
Athena	18	grass	0.0030
Bluesprin Flybow	18	grass	0.0030
Athena/Palouse	20	grass	0.0030
Bluesprin/Keuterville	21	grass/Ponderosa pine	0.0020

Garfield	21	grass(e)	0.0030
Latah*	21	grass	0.0060
Naff/Palouse	21	grass	0.0030
Naff/Thatuna	21	grass	0.0030
Palouse	21	grass	0.0030
Palouse/Latahco*	21	grass/Ponderosa pine	0.0040
Schumacher	21	grass	0.0030
Thatuna	21	grass	0.0030
Thatuna/Naff	21	grass	0.0030
Tilma/Garfield	21	grass	0.0030
Tilma/Naff	21	grass	0.0030
Tilma/Thatuna	21	grass	0.0030
Klickson/Bluesprin	22	Douglas fir/grass	0.0009
Latahco*	22	Ponderosa pine/shrubs	0.0020
Latahco/Lovell*	22	Ponderosa pine/shrubs	0.0020
Latahco/Thatuna*	22	Ponderosa pine/shrubs	0.0020
Lovell	22	Ponderosa pine	0.0010
Westlake/Latahco*	22	grass/ Ponderosa pine	0.0020
Driscoll/Larkin	23	Ponderosa pine	0.0010
Larkin	23	Ponderosa pine	0.0010
Southwick	23	Ponderosa pine	0.0010
Spokane	24	Douglas fir	0.0007
Hampson*	25	Douglas fir /shrubs(e)	0.0014
Joel	25	Douglas fir	0.0007
Klickson	25	Douglas fir	0.0007
Taney	25	Douglas fir	0.0007
Farber/Minaloosa	26	Douglas fir /grand fir	0.0005
Agatha	27	Douglas fir	0.0007
Crumarine*	28	grand fir /shrubs	0.0008
Minaloosa	28	grand fir	0.0004
Santa	28	grand fir	0.0004
Uvi	28	grand fir	0.0004
Uvi/Spokane	28	grand fir / Douglas fir	0.0005
Minaloosa/Huckleberry	30	grand fir /cedar	0.0003
Porrett*	30	hawthorn/sedge	0.0006

Huckleberry	32	cedar	0.0002
Molly	32	cedar	0.0002
Helmer	33	cedar	0.0002
Uvi/Vassar	36	grand fir /cedar	0.0005
Vassar	45	cedar	0.0002
Aquic xerofluvents*		shrubs	0.0014

* Indicates mapping units occurring as stream flood plains.

Background Erosion Rates

The C factors used to estimate natural background erosion rates using the RUSLE equation are shown in Table D-2. The C values used to determine background erosion rates are explained in this paragraph. The CNF has assigned background erosion rates to watersheds based on USFS research.

The CNF estimates that the background erosion rate for the West Fork Potlatch River is approximately 8 tons/mi^2/year. A C factor value of 0.0002 in the RUSLE model, and sediment routing using the Vanoni (1975) equation, results in a routed sedimentation rate of approximately 8 tons/mi^2/year. Such a C factor value is in the range of values reported for dense forests (Dechert 2004). For the prarie/grasslands, bunch grass was a natural vegetation dominant in the Palouse River Subbasin before major land use alterations. Assuming that bunch grasslands have a natural erosion rate somewhat similar to modern day hay land or grass lands, the C factor for grasslands within the Palouse River Subbasin is 0.003 (Dechert 2004).

Table D-2. Assignment of C factor values based on vegetation and precipitation.

Vegetation	Precipitation	C Factor
(overstory climax)	(inches)	
Grass	<=21	0.003
Ponderosa pine/grass	21-22	0.002
Ponderosa pine	22-23	0.001
Douglas fir/grass	22	0.0009
Douglas fir	25-27	0.0007
Grand fir/Douglas fir	26	0.0005
Grand fir	28	0.0004
Cedar/Grand fir	30	0.0003
Cedar	>30	0.0002

The asterisks in Table D-1 represent C factors that were doubled because the soil mapping units have greater erosional rates than other soil units. These mapping units have 1-3%

slopes, and occur within the floodplain along streams. These soil units are located in areas that have excessive stream channel meandering and repetitive precipitation events eroding these soils, more so than other soil mapping units. This in turn, increases the erosion potential for these units, therefore, the C factors were doubled to capture this phenomena (USDA 1997).

Estimating Surface Erosion Rates

Based on the land use map created by DEQ, C factors for current erosion rates were applied to the various land-uses in Table D-2. C factors were assigned based on reported values used in other modeling efforts, and assessment of the relative erosivity of the various land uses (Dechert 2004). The calculated background, detached, delivered erosion rates from the RUSLE model are presented by 303(d) watershed in Table D-3 (USDA 1997).

Table D-3. C factors assigned to the different land uses mapped in the Palouse River Subbasin.

Land Use	Precipitation	C Factor
(in 2003)	(inches)	
For (forestry)	38 +/- 5	0.0004
TS (timber/shrub)	27 +/- 3	0.0009
TG (timber/grass)	23 +/- 2	0.002
Grass (grasslands)	21 +/- 3	0.003
Meadow	36 +/- 5	0.006
CRP	29 +/- 2	0.006
Hay	31 +/- 3	0.009
Pasture	31 +/- 4	0.009
Grass Seed	29 +/- 2	0.009
Ag (2-yr rotation)	28 +/- 3	0.15
Ag (3-yr rotation)	25 +/- 3	0.1

Table D-4. Sediment results from RUSLE, WEPP, Channel Erosion.

	Big Cr Watershed	Deep Cr Watershed	Flannigan Cr Watershed	Gold Cr. Watershed	Hatter Cr Watershed	Rock Cr Watershed
Area (Acres)	10300.72	27315.56	18069.78	18069.78	16163.44	5174.76
Area (mi^2)	16.09	42.68	19.14	28.23	25.26	8.09
Background (tons/ac)	0.11	0.09	0.12	0.11	0.10	0.12
Background- (tons/mi^2)	72.96	58.05	79.55	71.17	66.18	74.50

Background Total (tons/yr)	1174.28	2477.52	1522.28	2009.36	1671.30	602.34
RUSLE detached (tons/ac)	0.17	2.73	2.89	3.09	0.58	1.39
RUSLE detached (tons/ mi^2)	107.07	1745.15	1852.54	1975.74	371.71	892.72
RUSLE detached Total (tons/yr)	1723.31	74484.08	35449.63	55783.22	9387.73	7218.27
RUSLE detached Backgrd (tons/yr)	549.03	72006.56	33927.35	53773.86	7716.43	7218.27
RUSLE Delivered (tons/yr)	163.06	18937.72	9838.93	14895.36	2186.32	2136.95
WEPP Delivered (tons/yr)	32.50	93.28	62.78	70.43	61.73	44.43
Channel Erosion NRCS (tons/yr)	8.92	398.23	177.06	162.12	218.99	24.88
Total model sources (tons/yr)	204.48	19429.23	10078.77	15127.91	2449.04	2206.26

Road Erosion

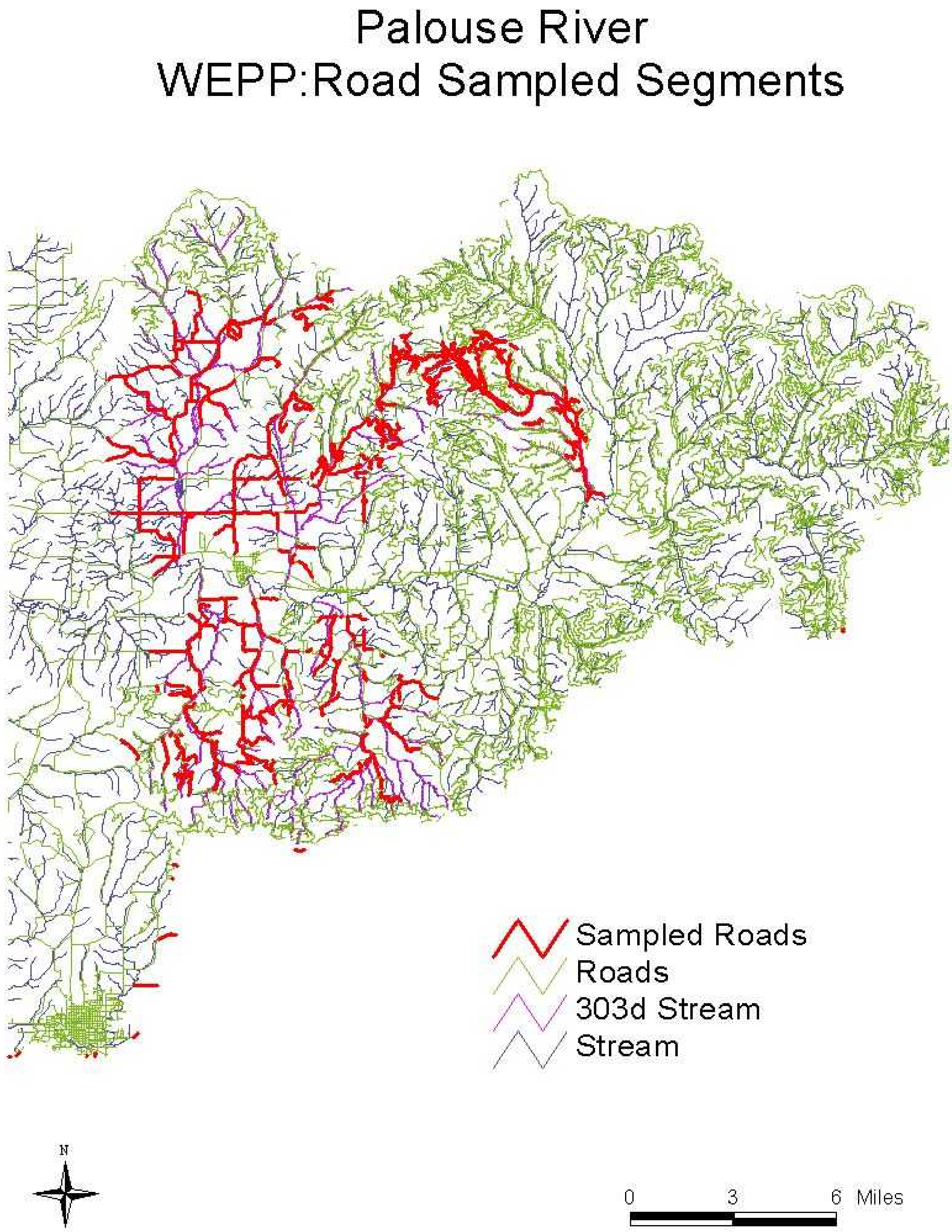
Based on field visits, discussion with land management agencies, reports and papers, and best professional judgment, erosion from roadways is significant in the Palouse subwatershed. To quantify these processes, the road analysis portion of the WEPP model was performed.

WEPP is a physically based soil erosion model that can provide estimates of soil erosion and sediment yield considering specific soil, climate, ground cover, and topographic conditions. It was developed by an interagency group of scientists, including the U.S. Department of Agriculture’s Agriculture Research Service (ARS), Forest Service and Natural Resources Conservation Service. and the U.S. Department of Interior's Bureau of Land Management and Geological Survey.

WEPP simulates the conditions that impact erosion - such as the amount of vegetation canopy, the surface residue, and the soil water content for every day in a multiple-year run. For each day that has a precipitation event, WEPP determines whether the event is rain or snow, and calculates the infiltration and runoff. If there is runoff, WEPP routes the runoff over the surface, calculating erosion or deposition rates for at least 100 points on the hillslope. It then calculates the average sediment yield from the hillslope.

WEPP-Road is an interface to the Water Erosion Prediction Project (WEPP) soil erosion model that allows users to easily describe numerous road erosion conditions and quantify erosion amounts. The WEPP-Road template has three overland flow elements: a road, a fillslope, and a forested buffer. The WEPP model allows a hillslope to be divided into segments with similar soils and vegetation called overland flow elements.

Roads in the Palouse were slowly driven in order to input geographically linked (GIS) information regarding the road and erosional conditions. Information like the type of road, surface of road, ditch information, cross-drain locations, buffer types and lengths to a stream channel with a bed and bank, and fillslope information were entered onto a Global Position System device (GPS). The information was downloaded into GIS for analysis. The data is arranged to show total sediment delivered to a waterbody within each 303(d) watershed and displayed in table D-3.



Map D-1. Palouse River WEPP:Road Sampled Segments

Channel Erosion

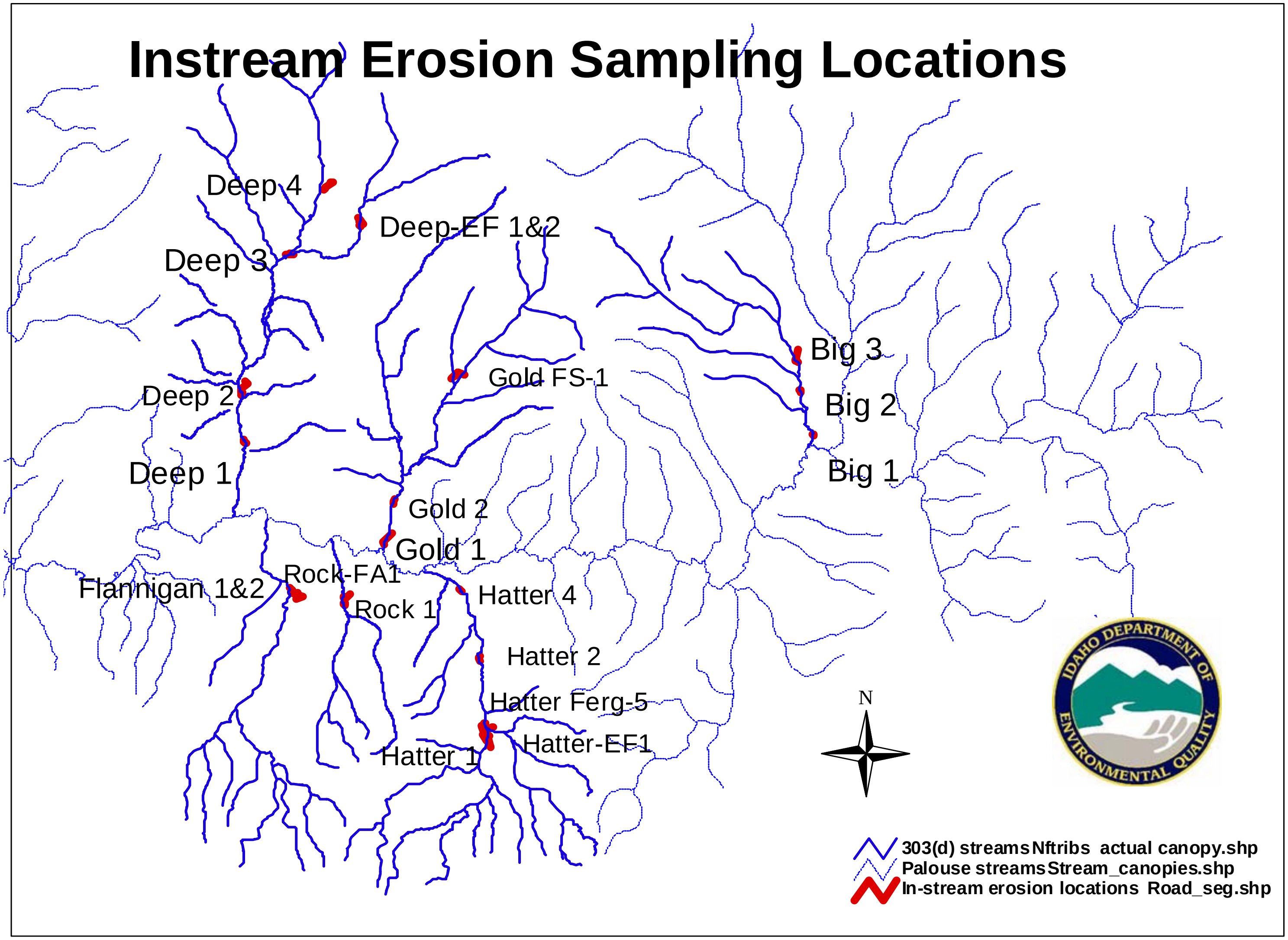
A significant amount of erosion occurs in the stream banks and all channels naturally erode to some degree. It is significant enough that several studies have attempted to quantify this phenomenon. For this TMDL, the National Resource Conservation Service (NRCS) field estimate procedure for channel erosion was conducted on all of the 303(d) listed streams to quantify instream channel erosion above natural conditions caused by anthropogenic effects. It has been proposed that a stream is in constant search of equilibrium and four forces control this equilibrium: sediment load, size of sediment particle, water quantity and slope of stream channel (NRCS 1983). These forces can be changed by natural and/or anthropogenic events.

Several sites were evaluated for each 303(d)-listed stream. Sites were selected based primarily on riparian and stream banks conditions and accessibility. Some sites that have significant amounts of erosion were not sampled because DEQ was not able to obtain access. In general the riparian areas along the entire length of each 303(d)-listed stream were grouped together based on their condition-good, fair or poor.

This judgment was used to describe the riparian and stream bank conditions for the entire stream. This very basic approach revealed that riparian areas with good conditions have no measurable amount of erosion above background while those with fair conditions have minimal amount of erosion above background and those with poor conditions have significant amounts of erosion above background. Therefore an attempt was made to sample the fair and poor reaches. The reach samples are shown on Map D-2.

Again this information is a good starting point and will provide a reference site for future analysis after implementation has began. At each site sampled, distances, stream widths, sinuosity, streambed particle size, and canopy observations were recorded.

In addition, a stream erosion condition inventory was completed. The stream erosion condition inventory describes the following factors: bank erosion evidence, bank stability condition, bank cover/vegetation, lateral channel stability, channel bottom stability and in-channel deposition. This inventory report was used to help determine the lateral recession rate. The total amount of sediment eroded from each reach was calculated using the above equation based on the field data (see Table D-3).



Map D-2. In-stream Erosion Sampling Locations.

Field Methods

The NRCS (1983) document outlines field methods used in this inventory. DEQ followed this methodology with the following exceptions. Additional data was collected to describe stream and riparian area conditions (see sample reach summary form and stream erosion condition inventory worksheet). The recession rate was determined for the entire reach rather than each eroding bank.

Within the sample reach, the field crews surveyed both right and left banks for eroding length and non-eroding length. Within a given sample reach, 100% of both banks were surveyed and documented on the field forms. The average annual lateral recession rate is the thickness of soil eroded from a bank surface (perpendicular to the face) in an average year. Recession rates are measured in feet per year. Channel erosion often occurs as “chunk” or “blowout” type erosion. A channel bank may not erode for a period of years when no major runoff events occur. When a major storm does occur, the bank may be cut back tens of feet for short distances. It is necessary to assign recession rates to banks with such processes in mind. When a bank is observed after a flood and ten feet of bank have been eroded, that ten feet must be averaged with the years when no erosion occurred. This will result in a much lower average annual lateral recession rate than a recession rate for one storm. The field crew estimated average annual recession rates by considering evidence of what had happened in the stream over the last 10 years and projecting what might happen in the stream over the next 10 years based on data and statistics of long term flows and extreme events (Dechert 2004).

The recession rate is critical to completing the calculations and a measurement was attempted in the field. On a few occasions the recession rate was modified in the office based on the scores on the scores of the stream erosion condition inventory worksheet.

Bank Erosion Calculations

The direct volume method is the procedure used to measure on-the-ground eroding bank surface area, coupled with estimates of recession rate and eroding bank particle size to calculate the total tons of eroding material over a given length of stream. The direct volume method is summarized in the following equation:

$$\frac{(eroding\ area)(lateral\ recession\ rate)(density)}{2000 lbs/ton} = E$$

E = erosion rate in tons/year

The eroding area is the product of the length of the eroding bank and the eroding bank height. Eroding bank length and bank heights were measured while walking along the stream channel. The eroding areas for all the eroding banks within a sample reach were summed and multiplied by the lateral recession rate for the sample reach to get the total volume of eroding bank material.

The following conversion rates were used to convert eroded bank material volume to eroded bank material weight in pounds. When eroding banks had significant differences in texture from top to bottom and the field crew recorded such, the texture volume-weights were calculated separately and summed.

Soil Texture	Volume-Weight (pounds/cubic foot)
Clay	60-70
Silt	75-90
Sand	90-110
Gravel	110-120
Loam	80-100
Sandy loam	90-110
Gravelly loam	110-120
Very gravelly sands/loams	120-130
Cobbles, boulders, etc.	120-130

STREAM EROSION CONDITION INVENTORY WORKSHEET

Stream Name______________________________________Reach Number________________________
Left or Right Bank (circle)
Average Bank Height__________________Sample Length______________________________________
Non-Eroding Length__________________________Bank Material Classes (see reverse side)___________

RATED FACTORS RATING

1. BANK EROSION EVIDENCE
   - Does not appear to be eroding 0
   - Erosion evident 1
   - Surface of bank eroding and top of bank has cracking present 2
   - Slumps and clumps sloughing off into stream (SIZE) 3

2. BANK STABILITY CONDITION (Ability to withstand erosion from streamflows)
   - Very little unprotected bank, no undercut vegetation, **AND/OR** bank materials non-erosive 0
   - Predominantly bare and unprotected, some rills, moderate undercut vegetation 1
   - Almost completely bare, unprotected bank, rills, severely undercut vegetation, exposed roots 2
   - Bare, numerous rills/gullies, very severely undercut vegetation, falling trees and/or fences 3

3. BANK COVER/VEGETATION
   - Predominantly covered with perennials **AND/OR** stable rock/bedrock 0
   - 40% or less bare/erodible, **AND/OR** cover is annual and perennials mixed 1
   - 40% to 70% bare/erodible, **AND/OR** cover is mostly annual vegetation 2
   - Predominantly bare and erodible/no cover 3

4. LATERAL CHANNEL STABILITY
   - No evidence of significant lateral movement of channel 0
   - Active lateral movement of channel 1

5. CHANNEL BOTTOM STABILITY
   - Channel in bedrock **OR** not eroding (Stable) 0
   - Minor channel bed degradation/downcutting 1
   - Significant evidence of downcutting, active headcuts 2

6. IN-CHANNEL DEPOSITION
   - No evidence of recent deposition (includes all sizes of bedload type materials) 0
   - Mobile material in recent deposition, deposits will probably move down channel in next high flow 1
   - Deposition is stable **AND/OR** vegetated (more than this growing season) channel is aggrading .... -1

TOTAL________

Factors contributing to erosion (concentrated flows, animal access-trampling, grazing impacts to vegetation, fire return flows, roads, bridges, culverts)____
____
____
Other notes____
____
____
____

(Over)

Bank Material Classes

(Circle best Choice/s)

Soil Classes

<15% coarse fragments, just use the fine soil class
(15-35%) Gravelly (gr), Cobbley (co), Bouldery (b)
(35-60%) Very gravelly (vgr), very cobbley (vco), very bouldery (vb)
(>60%) Extremely gravelly (exgr) extremely cobbley (exco), extremely bouldery (exbo)

sand – sa
sandy loam – sal
loamy sand – lsa
clayey sand – csa
silt – si
loamy silt – lsi
silt loam – sil
clayey silt – csi
loam – l
clay – c
loamy clay – lc
sandy clay – sac
silty clay – sic

Notes____
____
____
____
____
____

SAMPLE REACH SUMMARY FORM

Stream Name ____
Reach Number____
Hydrological Unit____________________________________
GPS Coordinate: Start_________________________________
End________________________________
WBID____
Rosgen Channel Type __________________________________
Slope/Gradient_______________________________________
Bank Full Width______________________________________
Bank Full Depth______________________________________
Floodplain Width_____________________________________
Average Wetted Width (ft.)_____________________________
Average Wetted Depth (ft.) ___________________________
Average Surface Velocity (ft/sec)_______________________
Sinuosity____
Dominant Particle Size_________________________________
Adjacent Land Use____________________________________
Canopy Shade Height (ft.)______________________________
Canopy Shade Crown Width (ft.)_________________________
Canopy Offset (from waters edge) (ft.)___________________
Canopy Density
Topographic Altitude: Rt.______________ & Lft.____________
Mannings "n"____
Recession Rate (Field Estimate)______________________________________

Field Crew____

Canopy Density Examples

Open Pine	65%	
Closed Pine	75%	X % Covered
Tight Spruce/Fir	85%	
Dense Emergent Vegetation	90%	

Bed Particle Size

Clay	.001
Silt	.004 to .06 .03 median
Sand	.06 (Fine) to 2mm
Gravel	4mm (Pea Size) to 64mm (tennis Ball size)
Cobble	> 64mm to 250mm (Volleyball size)
Boulder	> 250mm
Bedrock	

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Appendix E. Temperature Cover Analysis

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This appendix list for each stream segment, the soil map unit number, the potential cover determined for each soil unit, the existing cover interpreted from aerial photos, and the difference between the two covers. Data are in order from the downstream end of the segment (usually the mouth) to the upstream end (usually the headwaters). The difference between the two covers is calculated by subtracting the potential cover from the existing cover, dividing the result by the potential cover, and converting to a percentage. The result reflects the difference between the two covers with a negative representing existing covers less than potential and a positive shows existing covers greater than potential. In some cases soils were not known, but were estimated based on surrounding watershed patterns. These soil units are marked with an "*". Map E-1 displays the existing canopy cover for each of the stream segments with landownership. Map E-2 displays the deficit cover in percentage and in condition classes with landownership.

Riparian Vegetative Cover Analysis for Flannigan Creek

Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
Lower Flannigan Creek (AU# ID17060108CL011b_03)				
11	50	40	Good	-20
27	70	30	Poor	-57
27	70	50	Fair	-29
27	70	30	Poor	-57
27	70	10	Poor	-86
27	70	20	Poor	-71
27	70	50	Fair	-29
27	70	60	Good	-14
27	70	70	Very Good	0
7	70	70	Very Good	0
Average	**68**	**43**	**Fair**	**-36.3**
Upper Flannigan Creek (AU# ID17060108CL011a_03)				
38	50	70	Very Good	40
38	50	60	Very Good	20
38	50	50	Very Good	0
38	50	70	Very Good	40
38	50	60	Very Good	20
38	50	30	Fair	-40
38	50	20	Poor	-60
38	50	30	Fair	-40
38	50	60	Very Good	20
38	50	70	Very Good	40
61	90	90	Very Good	0
64	90	90	Very Good	0
Average	**56.7**	**58.3**	**Very Good**	**3.33**
First Tributary to Lower Flannigan Creek (AU# ID17060108CL011b_02)				
27	70	50	Fair	-29
27	70	30	Poor	-57

27	70	20	Poor	-71
27	70	50	Fair	-29
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
27	70	30	Poor	-57
27	70	10	Poor	-86
27	70	60	Good	-14
Average	**70**	**35.7**	**Poor**	**-49**
First Tributary to Upper Flannigan Creek (AU# ID17060108CL011a_02)				
38	50	50	Very Good	0
38	50	70	Very Good	40
61	90	70	Fair	-22
61	90	80	Good	-11
64	90	80	Good	-11
64	90	90	Very Good	0
Average	**76.7**	**73.3**	**Good**	**-0.67**
Second Tributary to Upper Flannigan Creek (AU# ID17060108CL011a_02)				
38	50	70	Very Good	40
38	50	30	Fair	-40
38	50	70	Very Good	40
East Fork				
61	90	80	Good	-11
64	90	90	Very Good	0
48	70	90	Very Good	29
64	90	90	Very Good	0
West Fork				
61	90	80	Good	-11
61	90	90	Very Good	0
64	90	90	Very Good	0
Average	**76**	**78**	**Very Good**	**4.7**
Third Tributary to Upper Flannigan Creek (AU# ID17060108CL011a_02)				
38	50	30	Fair	-40
38	50	70	Very Good	40
61	90	70	Fair	-22
61	90	80	Good	-11
64	90	80	Good	-11
64	90	90	Very Good	0
Average	**76.7**	**70**	**Good**	**-7.33**
West Fork Flannigan Creek (AU# ID17060108CL011a_02)				
38	50	50	Very Good	0
38	50	70	Very Good	40
38	50	60	Very Good	20
38	50	60	Very Good	20
38	50	30	Fair	-40
38	50	70	Very Good	40

40	80	70	Good	-12.5
61	90	80	Good	-11
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
61	90	70	Fair	-22
Average	**62.2**	**62.2**	**Very Good**	**3.8**

First Tributary to West Fork Flannigan Creek (AU# ID17060108CL011a_02)				
40	80	80	Very Good	0
60	80	70	Good	-12.5
60	80	70	Good	-12.5
60	80	80	Very Good	0
Average	**80**	**75**	**Good**	**-6.3**
Second Tributary to West Fork Flannigan Creek (AU# ID17060108CL011a_02)				
40	80	70	Good	-12.5
61	90	70	Fair	-22
61	90	80	Good	-11
64	90	80	Good	-11
Average	**87.5**	**75**	**Good**	**-14.1**

Riparian Vegetative Cover Analysis for Hatter Creek

Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
Lower Hatter Creek (AU# ID17060108CL015b_03)				
11	50	30	Fair	-40
26	70	40	Poor	-43
38	50	50	Very Good	0
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
38	50	60	Very Good	20
38	50	30	Fair	-40
38	50	20	Poor	-60
7	70	10	Poor	-86
7	70	50	Fair	-29
7	70	60	Good	-14
7	70	50	Fair	-29
7	70	60	Good	-14
7	70	40	Poor	-43
7	70	30	Poor	-57
7	70	10	Poor	-86
7	70	40	Poor	-43
Average	**63.3**	**38.7**	**Fair**	**-37.6**
First Tributary to Lower Hatter Creek (AU# ID17060108CL015b_02)				
11	50	10	Poor	-80
26	70	10	Poor	-86

26	70	60	Good	-14
26	70	10	Poor	-86
26	70	50	Fair	-29
26	70	60	Good	-14
27	70	50	Fair	-29
27	70	70	Very Good	0
40	80	70	Good	-12.5
40	80	80	Very Good	0
Average	**70**	**47**	**Fair**	**-35.1**
Second Tributary to Lower Hatter Creek (AU# ID17060108CL015b_02)				
38	50	10	Poor	-80
38	50	70	Very Good	40
38	50	10	Poor	-80
40	80	70	Good	-12.5
9	70	70	Very Good	0
7	70	50	Fair	-29
40	80	30	Poor	-62.5
40	80	60	Fair	-25
41	80	60	Fair	-25
58	80	90	Very Good	12.5
41	80	90	Very Good	12.5
41	80	80	Very Good	0
61	90	80	Good	-11
Average	**72.3**	**59.2**	**Good**	**-20**
Third Tributary to Lower Hatter Creek (AU# ID17060108CL015b_02)				
7	70	70	Very Good	0
40	80	70	Good	-12.5
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
40	80	60	Fair	-25
40	80	50	Fair	-37.5
40	80	30	Poor	-62.5
41	80	60	Fair	-25
41	80	70	Good	-12.5
Average	**78.6**	**58.6**	**Fair**	**-25**
Fourth Tributary Complex to Lower Hatter Creek (AU# ID17060108CL015b_02)				
7	70	50	Fair	-29
48	70	50	Fair	-29
48	70	70	Very Good	0
40	80	70	Good	-12.5
40	80	50	Fair	-37.5
40	80	60	Fair	-25
40	80	70	Good	-12.5
41	80	70	Good	-12.5
41	80	80	Very Good	0

7	70	60	Good	-14
7	70	50	Fair	-29
40	80	50	Fair	-37.5
40	80	60	Fair	-25
49	70	60	Good	-14
7	70	70	Very Good	0
40	80	70	Good	-12.5
41	80	70	Good	-12.5
41	80	40	Poor	-50
41	80	70	Good	-12.5
7	70	60	Good	-14
7	70	70	Very Good	0
7	70	60	Good	-14
7	70	70	Very Good	0
59	80	70	Good	-12.5
59	80	40	Poor	-50
64	90	70	Fair	-22
63	90	80	Good	-11
64	90	80	Good	-11
63	90	80	Good	-11
7	70	60	Good	-14
7	70	70	Very Good	0
64	90	70	Fair	-22
64	90	80	Good	-11
Average	**77.9**	**64.5**	**Good**	**-16.9**
Fifth Tributary to Lower Hatter Creek (AU# ID17060108CL015b_02)				
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
7	70	50	Fair	-29
7	70	60	Good	-14
40	80	60	Fair	-25
40	80	40	Poor	-50
40	80	60	Fair	-25
40	80	70	Good	-12.5
59	80	70	Good	-12.5
Average	**77.1**	**58.6**	**Fair**	**-24**
Upper Hatter Creek and Tributaries (AU# ID17060108CL015a_02)				
7	70	50	Fair	-29
60	80	70	Good	-12.5
59	80	70	Good	-12.5
59	80	40	Poor	-50
59	80	50	Fair	-37.5
59	80	70	Good	-12.5
63	90	70	Fair	-22

63	90	80	Good	-11
64	90	80	Good	-11
64	90	90	Very Good	0
63	90	70	Fair	-22
59	80	40	Poor	-50
59	80	70	Good	-12.5
59	80	80	Very Good	0
64	90	80	Good	-11
59	80	80	Very Good	0
59	80	70	Good	-12.5
59	80	80	Very Good	0
64	90	90	Very Good	0
59	80	80	Very Good	0
59	80	70	Good	-12.5
64	90	70	Fair	-22
64	90	80	Good	-11
59	80	70	Good	-12.5
64	90	80	Good	-11
64	90	70	Fair	-22
64	90	90	Very Good	0
63	90	90	Very Good	0
Average	**84.3**	**72.5**	**Good**	**-14.2**
Long Creek (AU# ID17060108CL015a_02)				
7	70	50	Fair	-29
7	70	60	Good	-14
58	80	70	Good	-12.5
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
58	80	60	Fair	-25
61	90	60	Fair	-33.3
61	90	70	Fair	-22
64	90	60	Fair	-33.3
64	90	70	Fair	-22
64	90	80	Good	-11
64	90	90	Very Good	0
64	90	70	Fair	-22
63	90	70	Fair	-22
64	90	70	Fair	-22
64	90	80	Good	-11
Average	**85.7**	**68.6**	**Good**	**-19.9**

Riparian Vegetative Cover Analysis for Gold Creek Watershed.

Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**

Lower Gold Creek and Lowest Tributary (AU# ID17060108CL029_03)				
11	50	10	Poor	-80
11	50	20	Poor	-60
11	50	30	Fair	-40
26	70	30	Poor	-57
50	70	30	Poor	-57
28	70	20	Poor	-71
Average	**60**	**23.3**	**Poor**	**-60.8**
Upper Gold Creek (AU# ID17060108CL030_02)				
26	70	40	Poor	-43
27	70	40	Poor	-43
27	70	50	Fair	-29
38	50	50	Very Good	0
38	50	60	Very Good	20
38*	50	50	Very Good	0
38*	50	60	Very Good	20
7*	70	70	Very Good	0
7*	70	80	Very Good	14
7*	70	70	Very Good	0
31*	80	80	Very Good	0
63*	90	90	Very Good	0
63*	90	80	Good	-11
Average	**67.7**	**63.1**	**Good**	**-5.5**
Nelson Creek (AU# ID17060108CL030_02)				
27	70	30	Poor	-57
38	50	70	Very Good	40
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
38	50	60	Very Good	20
38	50	70	Very Good	40
40	80	80	Very Good	0
30	80	70	Good	-12.5
30	80	80	Very Good	0
63	90	80	Good	-11
63*	90	90	Very Good	0
Average	**71.1**	**70**	**Very Good**	**2.2**
First Unnamed Tributary to Upper Gold Creek (AU# ID17060108CL030_02)				
7*	70	40	Poor	-43
7*	70	70	Very Good	0
30*	80	80	Very Good	0
30*	80	50	Fair	-37.5
64*	90	90	Very Good	0
Average	**78**	**66**	**Good**	**-16.1**
Waterhole Creek (AU# ID17060108CL030_02)				
7*	70	70	Very Good	0

30-31*	80	80	Very Good	0
Average	**75**	**75**	**Very Good**	**0**
Second Unnamed Tributary to Upper Gold Creek (AU# ID17060108CL030_02)				
30-31*	80	80	Very Good	0
30-31*	80	80	Very Good	0
30-31*	80	60	Fair	-25
30-31*	80	80	Very Good	0
30-31*	80	70	Good	-12.5
30-31*	80	80	Very Good	0
Average	**80**	**75**	**Good**	**-6.25**
Upper Most Tributaries (2) to Upper Gold Creek (AU# ID17060108CL030_02)				
30-31*	80	80	Very Good	0
30-31*	80	80	Very Good	0
63*	90	90	Very Good	0
Average	**83.3**	**83.3**	**Very Good**	**0**
Lower Crane Creek (AU# ID17060108CL031b_02)				
26	70	30	Poor	-57
26	70	40	Poor	-43
26	70	60	Good	-14
26	70	70	Very Good	0
7	70	80	Very Good	14
7	70	50	Fair	-29
Average	**70**	**55**	**Fair**	**-21.5**
Tributaries (3) to Lower Crane Creek (AU# ID17060108CL031b_02)				
28	70	20	Poor	-71
28	70	20	Poor	-71
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
26	70	30	Poor	-57
5	50	50	Very Good	0
27	70	40	Poor	-43
27	70	20	Poor	-71
39	80	50	Fair	-37.5
39	80	20	Poor	-75
Average	**70**	**31.3**	**Poor**	**-53.2**
Upper Crane Creek (AU# ID17060108CL031a_02)				
7	70	60	Good	-14
7	70	70	Very Good	0
30-31*	80	80	Very Good	0
30-31*	80	70	Good	-12.5
30-31*	80	80	Very Good	0
Average	**76**	**72**	**Good**	**-5.3**

Riparian Vegetative Cover Analysis for Big Creek Watershed.

Soil #	Potential Cover %	Existing Cover %	Cover Condition Class	E – P / P * 100 (%)
Lower Big Creek (AU# ID17060108CL027b_02)				
7	70	50	Fair	-29
7	70	70	Very Good	0
7	70	60	Good	-14
7	70	70	Very Good	0
7*	70	60	Good	-14
7*	70	60	Good	-14
7*	70	60	Good	-14
7*	70	60	Good	-14
7*	70	20	Poor	-71
Average	**70**	**56.7**	**Good**	**-18.9**
Lost Creek (AU# ID17060108CL027b_02)				
7	70	70	Very Good	0
7	70	60	Good	-14
30	80	60	Fair	-25
Average	**73.3**	**63.3**	**Good**	**-13**
Last Chance Creek (AU# ID17060108CL027b_02)				
7	70	70	Very Good	0
63	90	90	Very Good	0
Average	**80**	**80**	**Very Good**	**0**
Two Unnamed Tributaries to Lower Big Creek (AU# ID17060108CL027b_02)				
7*	70	60	Good	-14
7*	70	60	Good	-14
7*	70	70	Very Good	0
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
7*	70	60	Good	-14
7*	70	60	Good	-14
30*	80	60	Fair	-25
Average	**71.7**	**61.7**	**Good**	**-13.5**
Upper Big Creek (AU# ID17060108CL027a_02)				
7*	70	70	Very Good	0
30*	80	80	Very Good	0
30*	80	80	Very Good	0
63*	90	90	Very Good	0
Average	**80**	**80**	**Very Good**	**0**
Two Unnamed Tributaries to Upper Big Creek (AU# ID17060108CL027a_02)				
30*	80	80	Very Good	0
30*	80	70	Good	-12.5
30*	80	80	Very Good	0
30*	80	50	Fair	-37.5
30*	80	70	Good	-12.5

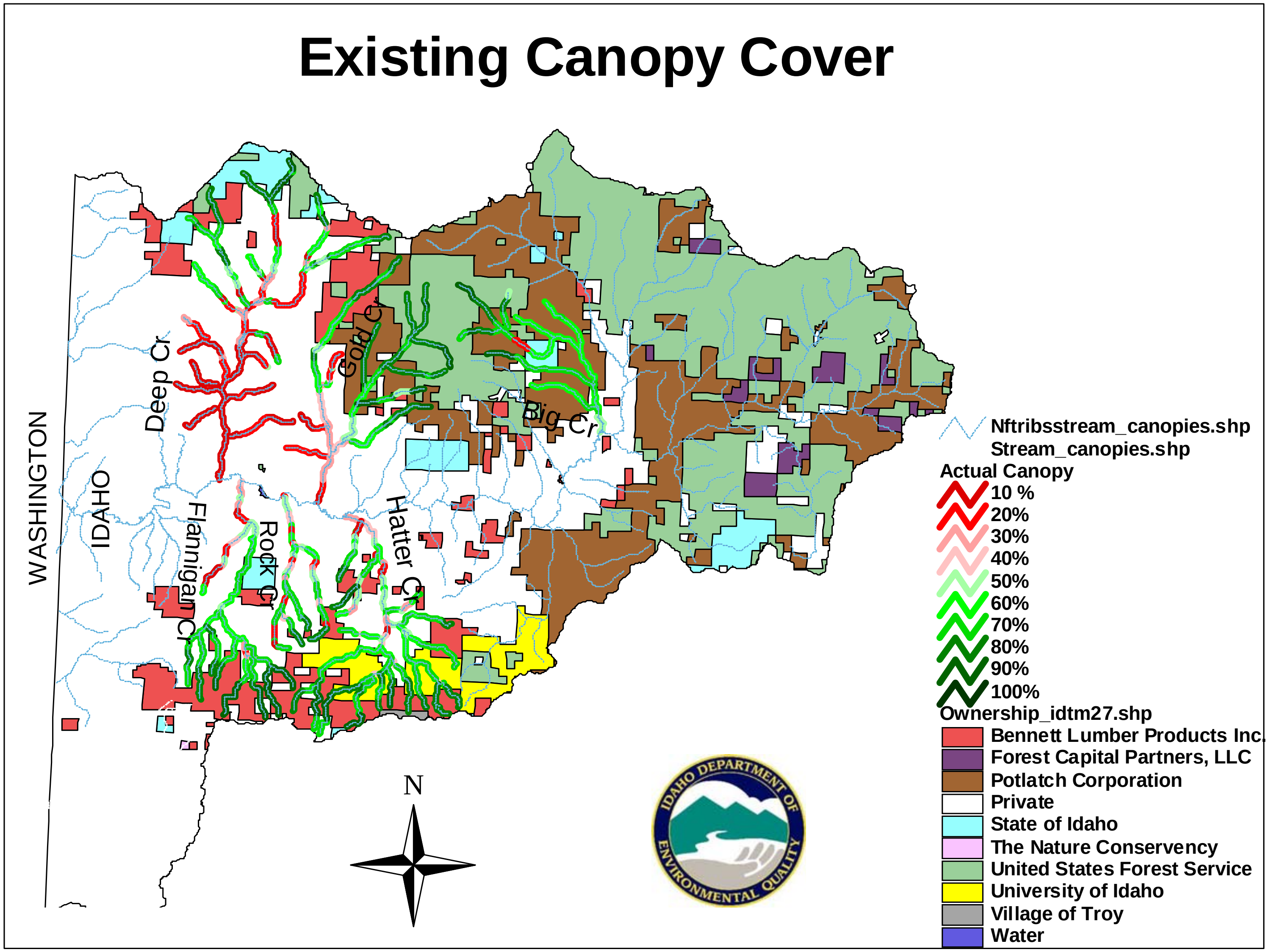
30*	80	80	Very Good	0
63*	90	90	Very Good	0
63*	90	70	Fair	-22
Average	**82.5**	**73.75**	**Good**	**-10.6**

Riparian Vegetative Cover Analysis for Deep Creek Watershed.

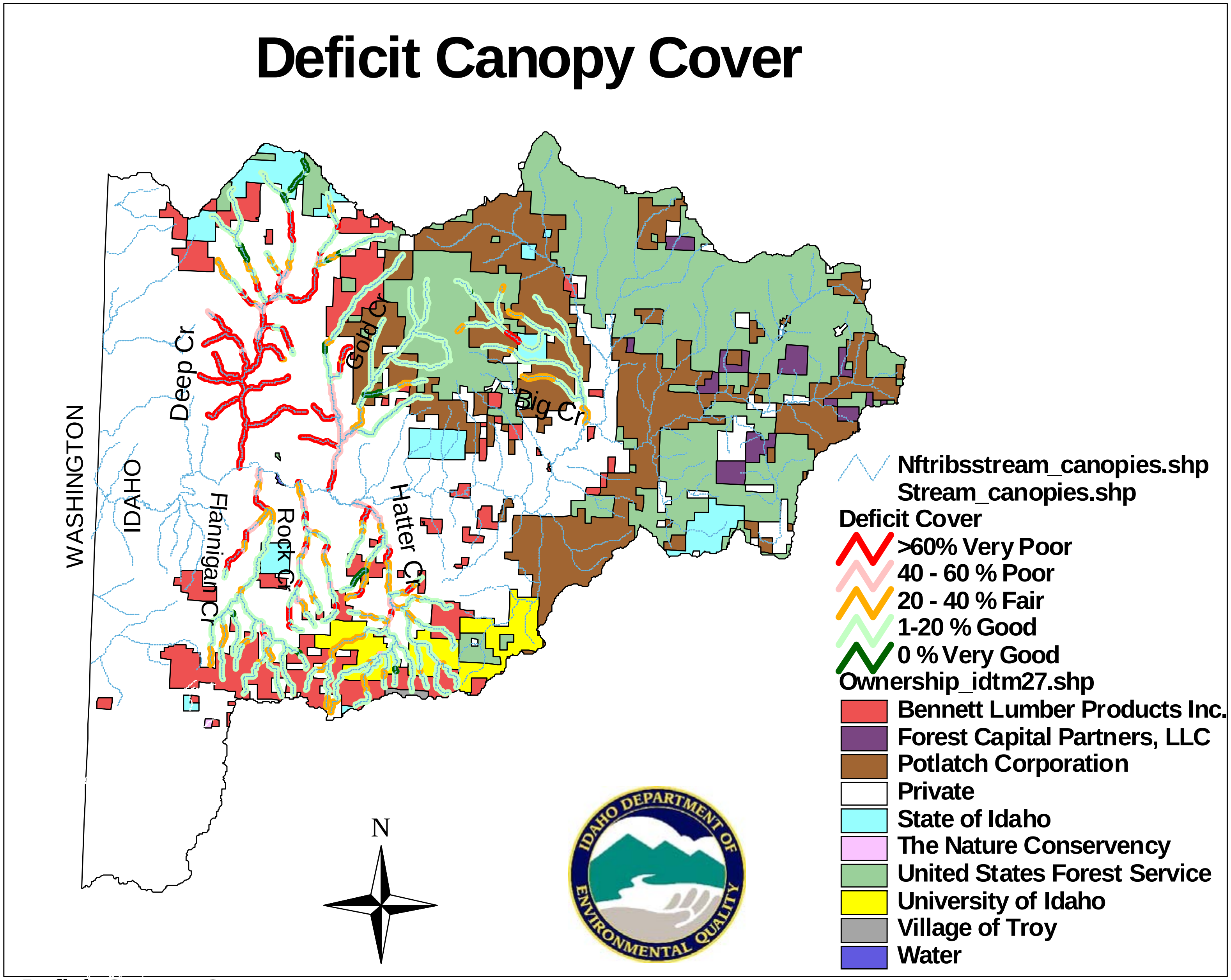
Soil #	Potential Cover %	Existing Cover %	Cover Condition Class	E – P / P * 100 (%)
Lower Deep Creek (AU# ID17060108CL032b_03)				
11	50	10	Poor	-80
11	50	10	Poor	-80
27	70	10	Poor	-86
27	70	10	Poor	-86
11	50	10	Poor	-80
11	50	10	Poor	-80
11	50	30	Fair	-40
11	50	20	Poor	-60
11	50	30	Fair	-40
Average	**54.4**	**15.6**	**Poor**	**-70.2**
Tributaries (8) to Lower Deep Creek (AU# ID17060108CL032b_02)				
27	70	10	Poor	-86
27	70	20	Poor	-71
27	70	10	Poor	-86
28	70	10	Poor	-86
27	70	10	Poor	-86
27	70	20	Poor	-71
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
27	70	10	Poor	-86
28	70	10	Poor	-86
28	70	10	Poor	-86
27	70	20	Poor	-71
28	70	10	Poor	-86
28	70	30	Poor	-57
28	70	10	Poor	-86
28	70	20	Poor	-71
28	70	30	Poor	-57
38	50	10	Poor	-80
38	50	20	Poor	-60
40	80	20	Poor	-75
40	80	60	Fair	-25
11	50	10	Poor	-80
9	70	70	Very Good	0
38	50	10	Poor	-80

38	50	20	Poor	-60
38	50	10	Poor	-80
38	50	70	Very Good	40
Average	**65.2**	**21.2**	**Poor**	**-69.3**
Upper Deep Creek (AU# ID17060108CL032a_03)				
38	50	30	Fair	-40
38	50	20	Poor	-60
Average	**50**	**25**	**Poor**	**-50**
East Fork Deep Creek (AU# ID17060108CL032a_02)				
38	50	30	Fair	-40
38	50	70	Very Good	40
38	50	20	Poor	-60
7	70	20	Poor	-71
7	70	60	Good	-14
7	70	30	Poor	-57
7	70	70	Very Good	0
7	70	10	Poor	-86
7	70	60	Good	-14
40	80	30	Poor	-62.5
31	80	80	Very Good	0
31	80	60	Fair	-25
31	80	80	Very Good	0
Average	**68.5**	**47.7**	**Fair**	**-30**
Middle Fork Deep Creek Including Tributaries (2) (AU# ID17060108CL032a_02)				
38	50	30	Fair	-40
7	70	20	Poor	-71
7	70	30	Poor	-57
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
7	70	50	Fair	-29
7	70	60	Good	-14
7	70	10	Poor	-86
7	70	20	Poor	-71
7	70	70	Very Good	0
7	70	80	Very Good	14
31	80	80	Very Good	0
7	70	40	Poor	-43
38	50	10	Poor	-80
38	50	70	Very Good	40
41	80	50	Fair	-37.5
41	80	70	Good	-12.5
38	50	60	Very Good	20
31	80	80	Very Good	0
31	80	90	Very Good	12.5
31	80	70	Good	-12.5

31	80	90	Very Good	12.5
Average	**69.5**	**54**	**Fair**	**-23.7**
West Fork Deep Creek and Tributary (AU# ID17060108CL032a_02)				
38	50	60	Very Good	20
7	70	70	Very Good	0
7	70	10	Poor	-86
7	70	50	Fair	-29
7	70	60	Good	-14
7	70	50	Fair	-29
7	70	80	Very Good	14
7	70	60	Good	-14
7	70	50	Fair	-29
7	70	60	Good	-14
7	70	70	Very Good	0
31	80	70	Good	-12.5
31	80	80	Very Good	0
31	80	70	Good	-12.5
7	70	70	Very Good	0
31	80	80	Very Good	0
31	80	80	Very Good	0
Average	**71.8**	**62.9**	**Good**	**-12.1**
Unnamed Tributary to Upper Deep Creek (AU# ID17060108CL032a_02)				
11	50	30	Fair	-40
7	70	30	Poor	-57
7	70	50	Fair	-29
7	70	20	Poor	-71
7	70	60	Good	-14
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
7	70	10	Poor	-86
7	70	70	Very Good	0
7	70	60	Good	-14
31	80	60	Fair	-25
Average	**68.9**	**43.3**	**Fair**	**-37.3**



Map E-1. Existing Canopy Cover



Map E-2. Deficit Canopy Cover

Appendix F. Rock Creek Informational Temperature TMDL

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Rock Creek Informational Temperature TMDL

Rock Creek is an intermittent stream and the only exceedance of the cold water aquatic life temperatures were after stream flows were below 1 cfs, therefore Rock Creek is meeting state standards for temperature. DEQ will propose to remove temperature as a possible pollutant for Rock Creek. DEQ included the temperature TMDL for Rock Creek as an informational TMDL only in this appendix. DEQ recommends that where possible the Rock Creek temperature TMDL be implemented. It is include in this document as a reference for future implementation work

Tables F-1 through F-3 display the existing load and load allocations for Rock Creek. Table F-3 list for each stream segment, the soil map unit number, the potential cover determined for each soil unit, the existing cover interpreted from aerial photos, and the difference between the two covers. Data are in order from the downstream end of the segment (usually the mouth) to the upstream end (usually the headwaters). The difference between the two covers is calculated by subtracting the potential cover from the existing cover, dividing the result by the potential cover, and converting to a percentage. The result reflects the difference between the two covers with a negative representing existing covers less than potential and a positive shows existing covers greater than potential. In some cases soils were not known, but were estimated based on surrounding watershed patterns. These soil units are marked with an "*". Map E-1 displays the existing canopy cover for each of the stream segments with landownership. Map E-2 displays the deficit cover in percentage and in condition classes with landownership. The main text of this informational temperature TMDL is located in Chapter Five of this document-temperature TMDLs.

Table F-1. Loads from nonpoint sources in Rock Creek Watershed.

Stream Segment	Average Existing Cover (Load)	Estimation Method
Lower Rock (AU #ID17060108CL012_03)	38.6%	Aerial Photo Interpretation
Lower East Fork Rock (AU #ID17060108CL014b_02)	41.7%	Aerial Photo Interpretation
Upper East Fork Rock (AU #ID17060108CL014a_02)	57.1%	Aerial Photo Interpretation
Lower West Fork Rock (AU #ID17060108CL013b_03)	44.3%	Aerial Photo Interpretation
Upper West Fork Rock (AU #ID17060108CL013a_02)	58.3%	Aerial Photo Interpretation
Lower Tributary to WF Rock (AU #ID17060108CL013a_02)	72.5%	Aerial Photo Interpretation
Upper Tributary to WF Rock (AU #ID17060108CL013a_02)	51.7%	Aerial Photo Interpretation

Table F-2. Load nonpoint source allocations for Rock Creek Watershed.

Segment	Average PNV (Load Capacity)	Average Existing Cover (Existing Load)	Average Cover Condition Class	Average Load Allocation #
Lower Rock (AU #ID17060108CL012_03)	55.7%	38.6%	Fair	-30.3%
Lower East Fork Rock (AU #ID17060108CL014b_02)	50%	41.7%	Good	See Appendix for stream segment analysis
Upper East Fork Rock (AU #ID17060108CL014a_02)	72.8%	57.1%	Good	See Appendix for stream segment analysis
Lower West Fork Rock (AU #ID17060108CL013b_03)	50%	44.3%	Good	See Appendix for stream segment analysis
Upper West Fork Rock (AU #ID17060108CL013a_02)	68.3%	58.3%	Good	See Appendix for stream segment analysis
Lower Tributary to WF Rock (AU#ID17060108CL013a_02)	77.5%	72.5%	Good	See Appendix for stream segment analysis
Upper Tributary to WF Rock (AU#ID17060108CL013a_02)	70%	51.7%	Fair	-24.2%

LA= ((Existing cover – Potential cover)/Potential cover) x 100. All 'Very Good' and 'Good' cover condition classes meet potential natural vegetation within limits of variability. See table F-3x for specific stream segments that may or may not meet these conditions.

Table F-3 Riparian Vegetation Cover

Riparian Vegetative Cover Analysis for Rock Creek

Soil #	Potential Cover %	Existing Cover %	Cover Condition Class	E – P / P * 100 (%)
Lower Rock (mouth to forks) (AU# ID17060108CL012_03)				
11	50	20	Poor	-60
7	70	50	Fair	-29
7	70	40	Poor	-43
38	50	60	Very Good	20
38	50	20	Poor	-60
38	50	60	Very Good	20
38	50	20	Poor	-60

Average	**55.7**	**38.6**	**Fair**	**-30.3**
Lower East Fork Rock Creek (AU# ID17060108CL014b_02)				
38	50	40	Good	-20
38	50	50	Very Good	0
38	50	60	Very Good	20
38	50	20	Poor	-60
38	50	30	Fair	-40
38	50	50	Very Good	0
Average	**50**	**41.7**	**Good**	**-16.7**
Upper East Fork Rock Creek (AU# ID17060108CL014a_02)				
38	50	50	Very Good	0
38	50	70	Very Good	40
59	80	70	Good	-12.5
59	80	40	Poor	-50
59	80	70	Good	-12.5
Soil #	**Potential Cover %**	**Existing Cover %**	**Cover Condition Class**	**E – P / P * 100 (%)**
59	80	20	Poor	-75
61	90	80	Good	-11
Average	**72.8**	**57.1**	**Good**	**-17.3**
Lower West Fork Rock Creek (AU# ID17060108CL013b_03)				
38	50	60	Very Good	20
38	50	50	Very Good	0
38	50	20	Poor	-60
38	50	40	Good	-20
38	50	50	Very Good	0
38	50	60	Very Good	20
38	50	30	Fair	-40
Average	**50**	**44.3**	**Good**	**-11.4**
Upper West Fork Rock Creek (AU# ID17060108CL013a_02)				
38	50	70	Very Good	40
38	50	20	Poor	-60
59	80	70	Good	-12.5
38	50	40	Good	-20
64	90	70	Fair	-22
64	90	80	Good	-11
Average	**68.3**	**58.3**	**Good**	**-14.3**
Lower Tributary to West Fork (AU# ID17060108CL013a_02)				
38	50	70	Very Good	40
59	80	70	Good	-12.5
61	90	70	Fair	-22
61	90	80	Good	-11
Average	**77.5**	**72.5**	**Good**	**-1.4**
Upper Tributary to West Fork (AU# ID17060108CL013a_02)				
59	80	70	Good	-12.5

38	50	70	Very Good	40
38	50	20	Poor	-60
60	80	70	Good	-12.5
60	80	10	Poor	-87.5
60	80	70	Good	-12.5
Average	**70**	**51.7**	**Fair**	**-24.2**

Appendix G. Unit Conversion Chart

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Table G-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

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Appendix H. Distribution List

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Distribution List

Department of Environmental Quality – Lewiston Regional Office 1118 F St, Lewiston, ID 83501
Department of Environmental Quality – Grangeville Office, 300 W. Main St. Grangeville, ID 83530
Clearwater Basin Advisory Group (CBAG) members
Palouse River Tributaries Watershed Advisory Group (WAG) members
University of Idaho Library, Government Documents, University of Idaho, Moscow ID 83844
Lewis Clark State College Library, Lewis Clark State College, Lewiston ID 83501
Latah County Public Library, 110 S Jefferson Moscow, ID 83843
Palouse Clearwater Environmental Institute, P.O. Box 8596, Moscow, ID 83843
Potlatch City Library Potlatch, ID 83855
Marti Bridges DEQ- State Office 1410 N. Hilton Boise, ID 83706
Bill Stewart – EPA 1435 N. Orchard, Boise, ID 83706

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Appendix I. Public Comments

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Public Comments

Table I-1 summaries the public comments received. The public comment period was announced in two local newspapers- Lewiston Morning Tribune, and the Moscow-Pullman Daily News, and the was posted on the following websites:

http://www.deq.state.id.us/Applications/NewsApp/shownews.cfm?event_id=979

http://10.220.22.44/water/data_reports/surface_water/tmdls/palouse_river_tribs/palouse_river_tribs.cfm

The official public comment period ran from November 10, 2004 to December 10, 2004. A copy of the TMDL was sent to the following locations, groups and individuals for public review:

Department of Environmental Quality – Lewiston Regional Office 1118 F St, Lewiston, ID 83501
Department of Environmental Quality – Grangeville Office, 300 W. Main St. Grangeville, ID 83530
Clearwater Basin Advisory Group (CBAG) members
Palouse River Tributaries Watershed Advisory Group (WAG) members
University of Idaho Library, Government Documents, University of Idaho, Moscow ID 83844
Lewis Clark State College Library, Lewis Clark State College, Lewiston ID 83501
Latah County Public Library, 110 S Jefferson Moscow, ID 83843
Palouse Clearwater Environmental Institute, P.O. Box 8596, Moscow, ID 83843
Potlatch City Library Potlatch, ID 83855
Marti Bridges DEQ- State Office 1410 N. Hilton Boise, ID 83706
Bill Stewart – EPA 1435 N. Orchard, Boise, ID 83706

Four commentators submitted approximately 40 written comments. These comments were grouped for appropriate responses into technical, social and legal, and text comments.

Table I-1. Summary of Public Comments.

Commentator	Type of Comment	Date of Comment
Meg Foltz Hydrologist Palouse Ranger District Clearwater National Forest 1770 Hwy 6 Potlatch, ID 83855	Internet e-mail	November 18, 2004
William C. Stewart Environmental Protection Specialist EPA-Region 10 Idaho Operations Office 1435 N. Orchard St. Boise, ID 83706	Letter	December 7, 2004
Bill Dansart Latah Soil and Water Conservation District 220 E. 5th Street, Room 212A Moscow, Idaho 83843	e-mail- word attachment	December 10, 2004
Ken Clark Water Quality Analyst Idaho Association of Soil Conservation Districts 220 E. 5th Street, Room 212A Moscow, Idaho 83843	e-mail- word attachment	December 10, 2004

Technical Comments

Comment 1: Table C-G show temperature allocations, giving an average for each reach. This can be misleading by indicating some reaches are okay, when certain portions do have excessive temperatures. Appendix E gives more specific information. There should be a sentence or two in the Executive Summary indicating that the averages are given, but specific reaches may have different needs. Pages 148-152 do have footnotes with references to Appendix E but may need more work.

Response 1. The discussion in the executive summary and on pages 148-152 was re-worded to clarify the above point.

Comment 2: Could you explain how the targets for the bacteria were set.

Response 2. The target for the bacteria TMDLs is IDAPA 58.01.02.251.02 which states that, "Waters designated for secondary contact recreation not to contain *E. coli* bacteria significant to the public health in concentrations exceeding: a single sample of five hundred seventy-six (576) *E. coli* organisms per one hundred (100) ml; or a geometric mean of one hundred twenty -six (126) per one hundred (100) ml based on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period." The bacteria TMDLs were written for the month when an exceedance(s) occurred.

Comment 3. The analysis of potential natural vegetation in the document appears to be thorough and seems to give a good representation of natural shade potential. I was wondering if ground truthing of existing shade estimates was conducted and what the results of any ground truthing effort were?

Response 3. Ground truthing efforts were conducted at two stream segment locations within the Palouse River Subbasin. Using a spherical densitometer designed by Lemmon (1956) and following the modification by Strichler (1959), shade estimates were calculated and were within 10% of the existing shade estimates.

Comment 4: How was it determined that cover differences of up to twenty percent from potential natural vegetation would be considered good condition? How will this relate to attainment of water quality standards or a natural condition for temperature?

Response 4: The cover differences are averages for an Assessment Unit (AU) or major tributary within an AU, so cover differences in a ‘good’ condition still have reaches within them that have load reductions (shade increases). Another change was to call cover difference from zero to twenty percent a ‘fair’ condition. ‘Good’ conditions have reaches within an AU or major tributary within a AU, that averaged a positive difference above background, however, there are certain reach sections within these ‘good’ averages that received a load reduction, just as ‘poor’ AUs could have some reaches that meet shade requirements. See discussion on page xxiii in the executive summary for a more complete description.

Comment 5. In the margin of safety discussion on page 147 it is stated that the MOS is implicit because the design doesn’t take into account natural variation of the shading. Explain.

Response 5. The MOS is implicit because the shade targets that are in the TMDL are maximum shade percentages in a natural environment. For example in a natural environment there are fires, severe wind storms, and extended droughts that could decrease the amount of shade over a stream. Aspect, surface topography, precipitation zones (rain shadows) and other natural factors which could reduce the maximum shade potential were also not considered. In addition the shade targets were based on vegetation communities at their climax, (when trees, shrubs and grasses) were at their maximum potential shade. In a natural condition vegetation communities are not always at their maximum potential because of growth and other natural disturbances like fire. DEQ believes that for the above reasons the MOS is implicit, as the targets are set at the maximum natural potential.

Comment 6. What is the problem being caused by slightly elevated total phosphorus (TP) for Flannigan Creek and lower Hatter Creek? The same types of Best Management Practices that maybe needed to address the bacteria problem should be adequate to address the nutrient problem, if it exists, so perhaps a nutrient TMDL is not really necessary from a practical point of view.

Response 6. From a practical point of view you maybe correct, similar types of Best Management Practices (BMPs) will have to employed to achieve the bacteria, and nutrient TMDLs. In fact some of these BMPs will have a positive impact on the temperature and sediment TMDLs. However federal law requires DEQ to set a total maximum daily load for pollutants impairing beneficial uses. Elevated TP levels (two to three times above background) were recorded for extended period of time in Flannigan Creek and lower Hatter Creek which we believe is impairing beneficial uses

To answer your question the following is an excerpt from the nutrient discussion of beneficial uses for Flannigan Creek and lower Hatter Creek (pages 73 and 92):

A background level of 0.035 mg/L was established based on data collected at four reference watersheds. Based on background levels, DO trends, and other regional nutrient TMDL targets, a value of 0.10 mg/L total phosphorus (TP) was established as the load capacity for this TMDL during the growing season. In addition to the TP target, DO levels must remain above 6.0 mg/L during the growing season. The nutrient target is also based on a numeric state standard for dissolved oxygen requiring the level to be greater than 6.0 mg/L at all times, and a narrative target stating that surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. DEQ believes that by keeping TP levels below 0.10 mg/L, and by increasing stream flows, DO levels should remain above 6.0 mg/L and thereby not impair beneficial uses. Low summer flows contributed to the low DO readings in Flannigan and lower Hatter Creek. To improve the low summer flow condition, water could be retained during the spring runoff in new or improve wetlands and riparian corridors. The water would then be stored at the surface or in shallow groundwater areas and released during the low summer flow periods and thereby improving the DO situation.

In Flannigan Creek the nutrient target was violated a total of eleven times between both monitoring sites. The phosphorus target was violated a total of ten times, five at each site. Samples were collected from both upper (PR17) and lower (PR16) monitoring sites as outlined in the monitoring plan (Appendix A). Data from the lower site revealed six consecutive bi-weekly exceedances of the nutrient target, five TP reading above 0.10 mg/L and one DO level reading below 6.0 mg/L (Table 2-21). Data from the upper site revealed four consecutive bi-weekly exceedances of the nutrient target including four consecutive TP reading above 0.10 mg/L. Some aquatic plant growth was noted in Flannigan Creek. Based on the frequency and duration of the TP and DO exceedances a TMDL for nutrients will be written for Flannigan Creek.

In Hatter Creek the nutrient target was violated a total of five times between at the lower monitoring site. The phosphorus target was violated a total of three times consecutively and the DO target twice. The violation of 0.8 mg/L on 6/18/2002 is several orders of magnitude larger than the other results, and this could have been an error at the lab after collection or an error committed sometime during the preparation (perhaps in the sample container) during collection or during the transportation and transfer of the sample. DEQ does not consider this to an accurate reading. Even without this reading, there were two other consecutive bi-weekly exceedances of the TP target and three continuous bi-weekly DO exceedances.

Based on the frequency and duration of the TP and DO, field reports, and site visits, DEQ believe a nutrient problem exists in Hatter Creek-lower and will write a nutrient TMDL for the lower section of Hatter Creek.

Comment 7. Page 107 under sediment. Immediately following this paragraph, within the section that discusses the various models used, it would be useful to discuss the uncertainty and limitations of modeling (accuracy, variability, requirements for calibration and verification, and ranges of acceptable error in the results) in a general way to allow readers who don't have direct experience with modeling to put the results reported in proper context relative to actual or observed watershed conditions. For example, without that perspective, some load reductions called for in the TMDL, such as the 96% reduction in sediment called for in the Deep Creek watershed, may strike some readers as odd, at best, as well as unobtainable.

It would also be useful to point out throughout the document that the ultimate measure of whether a TMDL Implementation effort is successful is determined by the in-stream determination that the water quality standards and/or targets are met, not whether the load reduction targets are met. Also point out that load allocations and targeted reductions are based on very limited actual in-stream water quality data collection and will vary from year to year depending on the annual discharge rates.

Response 7. The following discussion regarding the use of models was added to page 107. "Some general notes on modeling, including sediment modeling. All models inherently have some range of error associated with them, some even around 50% or more. The exact output or end result of a model are not necessarily the most important feature, but observing trends over a unspecified period of time are perhaps more important. For water quality, streams must meet beneficial uses regardless of the output or percent reduction the model(s) predicted. It could be possible to meet the beneficial uses and not meet the exact percent reduction within a model, and conversely the reverse is true. Models were used in a fairly reliable and repeatable process to obtain an estimate of the amount of a specific pollutant in order to create a TMDL. DEQ believes the models used in this report can be used again after an unspecified period of time or several times in the future to observe trends in a pollutant. As with all technologies and within the field of science itself, new ideals, principles and beliefs will inevitable come, therefore new models or new methods could possible be used to solve issues addressed within this document."

Comment 8. . Please explain why the C-factors used from meadow, CRP, hay, and pasture are higher than those for grass?

Response 8. A USDA and NRCS report was referenced for the C factors for meadow, CRP, hay and pasture and believes these C factors more accurately describe the conditions of the ground.

Comment 9. Please discuss the uncertainties in the sediment model.

Response 9. The following discussion regarding the use of models was added to page 107. "Some general notes on modeling, including sediment modeling. All models inherently have some range of error associated with them, some even around 50% or more. The exact output or end result of a model are not necessarily the most important feature, but observing trends over a unspecified period of time are perhaps more important. For water quality, streams must meet beneficial uses regardless of the output or percent reduction the model(s) predicted. It could be possible to meet the beneficial uses and not meet the exact percent reduction within a model, and conversely the reverse is true. Models were used in a fairly reliable and repeatable process to obtain an estimate of the amount of a specific pollutant in order to create a TMDL. DEQ believes the models used in this report can be used again after an unspecified period of time or several times in the future to observe trends in a pollutant. As with all technologies and within the field of science itself, new ideals, principles and beliefs will inevitable come, therefore new models or new methods could possible be used to solve issues addressed within this document."

Social and Legal Comments

Comment 1: Page 27 under livestock and grazing: delete this portion of the first sentence, 'that are too small to be called an Animal Feeding Operation (AFO) or a Confined Animal Feeding Operation (CAFO). Add this instead, 'In addition several animal feeding operations (AFOs) exist. These AFOs are used primarily for winter feeding and calving of livestock that graze other areas during the remainder of the year.'

Response 1: We agree, your suggestions more accurately describe the condition on the ground. Changes made.

Text Comments

Comment 1. Page 13 under Erosion, second paragraph, Reference is to Table 1-2, but it should be Table 1-3.

Response 1. Correction has been made.

Comment 2. Page 22 under Land Use, first paragraph, misspelled barley, and reference is to Map 1-6, it should be Map 1-5.

Response 2. Corrections have been made.

Comment 3. Page 23 under Forestry, Reference is to Table 1-3 but should be Table 1-4. (which gives board feet).

Response 3. Correction has been made.

Comment 4 Page 28 under Transportation, reference is to Map 1-7, it should be Map 1-6.

Response 4. Correction has been made.

Comment 5. Page 29 under Land ownership, reference is to Map 1-8, it should be Map 1-7.

Response 5. Correction has been made.

Comment 6. Page 80 map is labeled Big Creek (on the map), should be Gold Creek as the stream is named on the map.

Response 6: Correction has been made.

Comment 7. Page 3, sec 1.1 paragraph 2, line 3: Replace cold water with cold water aquatic life.

Response 7. Correction has been made

Comment 8: Page 16, Map 1-4. Add a 303(d) listed stream symbol in the legend. On the northeast portion of the map it appears that the quaritize and schist geologies end in an unnatural manner (straight line), please explain.

Response 8. This is the geology GIS layer that DEQ has, and we believe the unnatural look, represents where a soil or geology survey may have ended.

Comment 9: Page 22, sec 1.3 Land use paragraph 2, last line: Insert year for (Cook and Hufford) reference. Line 8: Replace comma after ‘ground’ with a semicolon.

Response 9. Inserted the year and reworded for clarification.

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