Little Salmon River Subbasin Assessment and Total Maximum Daily Load

2012 Addendum

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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

§ section (usually a section of federal or state rules or statutes)

BMP best management practice

BURP Beneficial Use Reconnaissance Program

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

cfs cubic feet per second

cfu colony-forming unit

CGP Construction General Permit

DEQ Idaho Department of Environmental Quality

DNA deoxyribonucleic acid

E. coli *Escherichia coli*

EPA United States Environmental Protection Agency

IDAPA Refers to citations of Idaho administrative rules

LA load allocation

LC load capacity

mL milliliter

MOS margin of safety

NB natural background

NPDES National Pollutant Discharge Elimination System

SVAP stream visual assessment protocol

SWPPP Stormwater Pollution Prevention Plan

TMDL total maximum daily load

USFS United States Forest Service

WAG watershed advisory group

WLA wasteload allocation

Executive Summary

The federal Clean Water Act 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 Clean Water Act, 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 Clean Water Act 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 is published every 2 years as the list of Category 5 water bodies in *Idaho's 2010 Integrated Report* (DEQ 2011). 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 two water bodies in the Little Salmon River subbasin that have been placed in Category 5 of Idaho's most recent federally approved Integrated Report (DEQ 2011). The TMDL (section 5) 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 (40 CFR 130). Consequently, a TMDL is water body- and pollutant-specific.

This TMDL analysis has been developed to comply with Idaho's TMDL schedule and in accordance with federal and state regulations. These are described in more detail in the *Little Salmon River Subbasin Assessment and TMDL* (DEQ 2006).

Key Findings

The *Little Salmon River Subbasin Assessment and Total Maximum Daily Load Five-Year Review* (DEQ 2012) presented data showing that East Branch Goose Creek (ID17060210SL010_04) exceeded state water quality standards for bacteria and that the lowermost reach of Mud Creek (ID17060210SL008_03) had impaired water quality due to sediment from streambank erosion. Tables A and B summarize the TMDL and water body assessment outcomes.

This document shows the level of pollutant reduction necessary to support beneficial uses and meet water quality standards for each of these assessment units. These reductions represent very conservative calculations to ensure beneficial uses will be supported when pollutant loading is at its highest. Water quality standards should be met within a 5–15 year time period, depending on implementation strategies chosen for these assessment units.

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

Stream	Pollutant(s)	Pollutant Reduction (%)
Mud and Little Mud Creek	Sediment (bank stability)	22
East Branch Goose Creek	Bacteria (*E. coli*)	57

Table B. Summary of assessment outcomes.

Water Body/ Assessment Unit Number	§303(d) Listing	TMDL(s) Completed	Recommended Changes to 2014 Integrated Report	Justification for Listing Change
Mud/Little Mud Creek ID17060210SL008_03	Benthic–macroinvertebrate/ bioassessments	Sediment	Move Mud Creek to category 4a for sediment.	BURP, SVAP data (erosion inventory)
East Branch Goose Creek ID17060210SL010_04	Combined biota/ habitat bioassessments	Bacteria	Move East Branch Goose Creek to category 4a for bacteria. Delist for biota and habitat bioassessments. Move to category 4c for flow alteration.	BURP, SVAP, nutrient, and bacteria data

Note: Beneficial Use Reconnaissance Program (BURP); stream visual assessment protocol (SVAP)

Public Participation

The Little Salmon River Watershed Advisory Group met on December 19, 2011, March 19, 2012, and August 30, 2012. They discussed the Little Salmon River 5-year review and TMDL addendum, which included East Branch Goose Creek and Mud Creek. The Watershed Advisory Group was given an opportunity to comment on the draft document until the middle of January 2012, however, no comments were received.

The general public will have an opportunity to comment on this draft document during the public comment period.

Introduction

The purpose of this subbasin assessment and total maximum daily load (TMDL) addendum is to characterize and document pollutant loads within tributaries of the Little Salmon River subbasin. This document addresses East Branch Goose Creek (ID17060210SL010_04) and Mud and Little Mud Creek (ID17060210SL008_03), which have been placed in Category 5 of Idaho's 2010 Integrated Report (DEQ 2011) and complies with federal and state regulatory requirements pursuant to Section 303 of the Clean Water Act.

1 Subbasin Assessment and Characterization

Information on the Little Salmon River subbasin is found in the *Little Salmon River Subbasin Assessment and TMDL* (*http://www.deq.idaho.gov/media/455095-_water_data_reports_surface_water_tmdls_little_salmon_river_little_salmon_river_entire.pdf*) (DEQ 2006), *Little Salmon River Total Maximum Daily Load Implementation Plan for Agriculture, Forestry, and Urban/Suburban Activities* (*http://www.deq.idaho.gov/media/455123-_water_data_reports_surface_water_tmdls_little_salmon_river_little_salmon_river_imp_plan_entire.pdf* (DEQ 2008) and *Little Salmon River Subbasin Assessment and Total Maximum Daily Load Five-Year Review* (*http://www.deq.idaho.gov/media/841208-little-salmon-river-sba-assessment-tmdl-five-year-review-0412.pdf*) (DEQ 2012). Figure 1 shows the assessment units for TMDLs developed in this document.

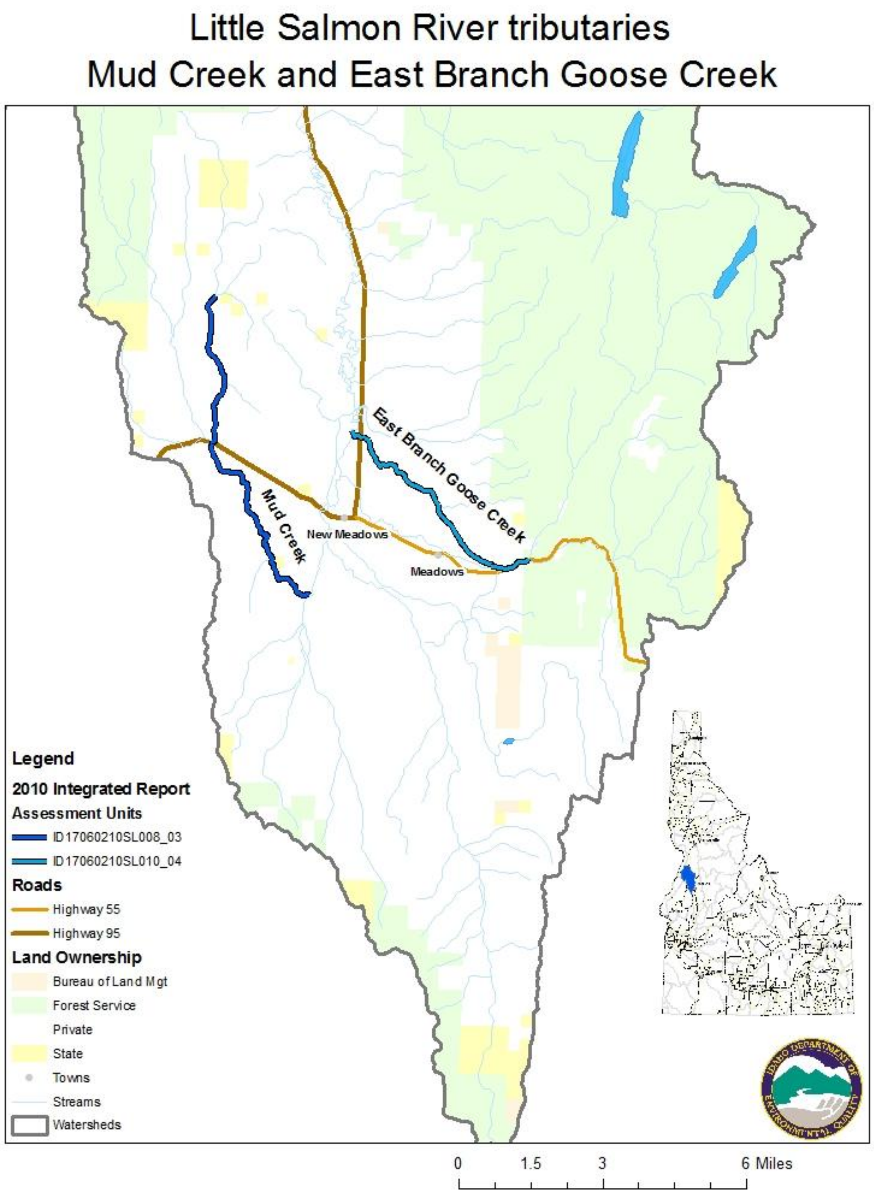

Figure 1. Mud Creek and East Branch Goose Creek TMDL assessment units.

2 Subbasin Assessment—Water Quality Concerns and Status

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

The Little Salmon River subbasin 5-year review (DEQ 2012) presented data showing that East Branch Goose Creek (ID17060210SL010_04) exceeded state standards for bacteria. The Idaho water quality standard for *Escherichia coli* (*E. coli)* bacteria is a geometric mean concentration of 126 colony-forming units per 100 milliliters (cfu/100 mL), derived from 5 sample concentrations taken at evenly spaced intervals over a 30-day period (IDAPA 58.01.02.251.01) and further discussed in section 5.1.1.1. *E. coli* sampling data are summarized in section 5.1.1.4 (Table 2).

The 5-year review also indicated that the lowermost reach of Mud Creek (ID17060210SL008_03) had impaired water quality due to sediment. Sediment load data are summarized in section 5.1.2.3 (Table 6). Appendix A provides data sources for the Little Salmon River subbasin assessment. Idaho's sediment standard (IDAPA 58.01.02. 200.08) is narrative in nature:

> Sediment shall not exceed quantities specified in Sections 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Section 350. (4-5-00)

Section 303(d) of the Clean Water Act states that waters that are unable to support their beneficial uses and do not meet water quality standards must be listed as water-quality limited. Subsequently, these waters are required to have TMDLs developed to bring them into compliance with water quality standards. Table 1 shows the beneficial uses of the §303(d)-listed assessment units.

Table 1. Beneficial uses of 2010 §303(d)-listed water bodies.

Assessment Unit	Beneficial Uses	Type of Use (designated, existing, presumed)
Mud and Little Mud Creek ID17060210SL008_03	Cold water aquatic life Salmonid spawning Secondary contact recreation	Presumed Presumed Presumed
East Branch Goose Creek ID17060210SL010_04	Cold water aquatic life Salmonid spawning Secondary contact recreation	Presumed Presumed Presumed

3 Subbasin Assessment—Pollutant Source Inventory

3.1 Sources of Pollutants of Concern

3.1.1 Point Sources

There are no point sources in the East Branch Goose Creek or Mud Creek watersheds.

3.1.2 Nonpoint Sources

The original Little Salmon River TMDL indicates that sediment may originate from natural causes such as bank erosion, landslides, forest or brush fires, high flow events; or anthropogenic sources such as urban/suburban stormwater runoff or erosion from roadways, agricultural lands, and construction sites. Sediment loads within the system are highest in the spring when high flow volumes and velocities result from snowmelt in the higher elevations.

Wolman pebble counts were done as part of the stream visual assessment protocol (SVAP) and indicated that sediment was impairing beneficial uses. A streambank erosion inventory was also done as part of SVAP, and it indicated that the primary source of the sediment to the stream was from the streambanks. A streambank erosion inventory quantifies covered and uncovered banks and their stability. The data are then extrapolated across the assessment unit to give percent bank stability. It is assumed that beneficial uses are supported at or above 80% bank stability.

Bacteria enter water bodies in a number of ways. In rural and agricultural areas, the most common sources are usually domestic animals and wildlife, although failing septic systems can also be a significant source if they are situated adjacent to a water body. Studies have shown that per pound, human waste has higher concentrations of phosphorus than domestic animal waste.

High levels of bacteria in East Branch Goose Creek are likely the result of wildlife, livestock, and other domestic animals. Poorly functioning septic systems may also contribute to the bacteria load in East Branch Goose Creek. The Little Salmon River Watershed Advisory Group (WAG) discussed the possibility of using deoxyribonucleic acid (DNA) typing to identify the exact source of *E. coli*, but concluded it was cost prohibitive and unwarranted.

4 Subbasin Assessment—Summary of Past and Present Pollution Control Efforts

The 2008 implementation plans (DEQ 2008) for forestry, agriculture, and urban/suburban activities lists various objectives (*http://www.deq.idaho.gov/media/455123-_water_data_reports_surface_water_tmdls_little_salmon_river_little_salmon_river_imp_plan_entire.pdf*). The progress made toward meeting the implementation objectives are described in the Little Salmon River subbasin 5-year review (*http://www.deq.idaho.gov/media/841208-little-salmon-river-sba-assessment-tmdl-five-year-review-0412.pdf*) (DEQ 2012, pages 27–31).

Pollution control efforts on Mud Creek have been focused on the upstream assessment unit (ID17060210SL008_02) on United States Forest Service (USFS) and Idaho Department of Lands-managed land in regards to timber harvesting and grazing and have included road closure, road rerouting, and fencing projects. The lower assessment unit of Mud Creek (ID1706021SL008_03), which is the subject of this TMDL, has not been the focus of restoration projects in the watershed as it was not previously on the §303(d) list. It is anticipated that it will now qualify for §319 grants and other pollution control efforts to restore beneficial uses.

Within the Goose Creek watershed, pollution control efforts have focused on the mainstem portion of Goose Creek (ID17060210SL010_02), just upstream of East Branch Goose Creek on USFS-managed land. The efforts are in response to grazing, recreation, and timber harvesting and have low priority ranking. Pollution control efforts have not been implemented on the East Branch Goose Creek (ID17060210SL010_03). It will likely become eligible for pollution control efforts and §319-funded projects to improve water quality as the TMDL takes effect.

5 Total Maximum Daily Load(s)

A TMDL prescribes an upper limit (i.e., load capacity) on discharge of a pollutant from all sources to ensure water quality standards are met. The TMDL further allocates this load capacity among the various pollutant sources. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation, and nonpoint sources, each of which receives a load allocation. Natural background contributions, when present, are considered part of the load allocation but are often treated separately because they represent a part of the load not subject to control. Because of uncertainties about quantifying loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (40 CFR 130) require a margin of safety (MOS) be included in the TMDL. Practically, the MOS and natural background are both reductions in the load capacity available for allocation to pollutant sources.

Load capacity can be summarized by the following equation:

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

where:

LC = load capacity
MOS = margin of safety
NB = natural background
LA = load allocation
WLA = wasteload allocation

The equation is written in this order because it represents the logical order in which a load analysis is conducted. First, the load capacity is determined. Then the load capacity is broken down into its components. After the necessary MOS and natural background, if relevant, are quantified, the remainder is allocated among pollutant sources (i.e., the load allocation and wasteload allocation). When the breakdown and allocation are complete, the result is a TMDL, which must equal the load capacity.

The load capacity must be based on critical conditions—the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both load capacity and pollutant source loads vary, and not necessarily in concert, determining critical conditions can be more complicated than it may initially appear.

Another step in a load analysis is quantifying current pollutant loads by source. This step allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary for pollutant trading to occur (DEQ 2010). A load is fundamentally a quantity of 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, the United States Environmental Protection Agency (EPA) allows for seasonal or annual loads.

5.1 Total Maximum Daily Loads for East Branch Goose Creek and Mud Creek

Since no point sources exist in the East Branch Goose Creek subwatershed or Mud Creek watershed, a wasteload allocation is not needed. Background is considered part of the load allocation, but it is not available for distribution. A MOS is required to account for uncertainties used in the measurement, analysis, or calculation of the load capacity. The MOS may consist of conservative assumptions, or may be added as a separate quantity in the TMDL calculation.

5.1.1 *E. coli* Bacteria TMDL for East Branch Goose Creek (ID17060210SL010_04)

5.1.1.1 Instream Water Quality Targets

Target Selection

E. coli bacteria concentrations in East Branch Goose Creek are currently above the concentration allowed by Idaho water quality standards during the summer, based on the data presented in the Little Salmon subbasin 5-year review (DEQ 2012) and summarized in Table 2 of this document. East Branch Goose Creek has presumed beneficial uses of salmonid spawning, cold water aquatic life, and secondary contact recreation. This TMDL is meant to be protective of secondary contact recreation by regulating the instream bacteria load. The beneficial use being protected in this assessment unit of East Branch Goose Creek is secondary contact recreation.

The Idaho water quality standard for *E. coli* bacteria, used as the target for developing the TMDL, is a geometric mean concentration of 126 cfu/100 mL, derived from 5 sample concentrations taken at evenly spaced intervals over a 30-day period (IDAPA 58.01.02.251.01). A single water sample in which either the primary or secondary recreation use criterion is exceeded does not in itself constitute a violation of water quality standards; rather, it requires that additional samples be taken every 3 to 7 days over a 30-day period. Those 5 sample concentrations are then used to calculate a geometric mean concentration to compare against the criterion. A geometric mean is applied to minimize random variability in data associated with surface waters prone to short-term episodic spikes in bacteria concentrations.

Monitoring Points

Monitoring took place for East Branch Goose Creek at its intersection with Highway 95, which is slightly upstream of its confluence with the Little Salmon River (Figure 1). Future compliance monitoring for bacteria is recommended at this location since it is in the more downstream portion of the reach and is easily accessible.

5.1.1.2 Load Capacity

The *E. coli* bacteria load capacity for East Branch Goose Creek is expressed as the geometric mean concentration of 126 cfu/100 mL. The load capacity is expressed as a concentration (in cfu/100 mL) because it is difficult to calculate a mass load due to several variables (i.e., temperature, moisture conditions, and flow) that influence the die-off rate of *E. coli* bacteria in the environment.

5.1.1.3 Estimates of Existing Pollutant Loads

Water column bacteria samples were taken on several events on East Branch Goose Creek and indicate high bacteria loads. Table 2 summarizes the geomean of individual sampling events on East Branch Goose Creek. The existing load is calculated to be 264 cfu/100 mL and requires a 57% reduction (Table 3). Mass flow estimates are summarized in Table 4.

5.1.1.4 Load Allocation

Load allocations have not been developed for specific sources. An instream allocation has been developed for East Branch Goose Creek, based on bacteriological data collected during August and September 2011, whereby the geometric mean was computed and assessed against Idaho's numeric criterion set forth to protect the primary and secondary contact recreation beneficial uses. The load was calculated based on the time in which the highest concentrations were found to ensure that the loading estimates are conservative.

Table 2 lists the existing *E. coli* bacteria concentrations found in 2011 at the monitoring station. Table 3 shows the secondary contact recreation geometric mean capacity (load capacity), load allocation, and reduction in *E. coli* bacteria concentrations that must occur to meet the load allocation. No point sources are in the watershed, thus no wasteload allocations were calculated.

The *E. coli* bacteria TMDL for East Branch Goose Creek allocates a geometric mean concentration calculated from 5 samples taken over any 30-day period to all nonpoint sources of *E. coli* bacteria upstream from the monitoring location and adds a 10% MOS to the required load reduction to ensure the secondary contact beneficial use is supported throughout the year (Table 3). As such, sources extending upstream from this location must be managed to reduce the instream *E. coli* bacteria concentrations by 151 cfu/100 mL, or 57%. To ensure that the criterion is not exceeded, this allocation will apply daily throughout the year.

Seasonable variation is accounted for by calculating loads during the critical summer months. The loading analysis is based on sampling events that occurred in August and September 2011. The TMDL requires a reduction in these levels that is 10% below the current water quality criteria of 126 cfu/100 mL. It is during the summer months that *E. coli* concentrations will be at their highest due to low flows and increased water temperatures. Summer is also the period of the year that secondary contact recreation is most likely to occur. Because the target is meant to be protective during the most critical period of the year, it will be protective throughout the remaining months of the year.

To illustrate how bacteria loading needs to be controlled on a daily basis, Table 4 presents a flow-based, instantaneous mass-loading analysis. First, the flow is converted from cubic feet per second to milliliters per second. Then, the number of cfu/100 mL measured during each monitoring event in the month-long geometric mean sampling effort is multiplied by the measured flow for that monitoring event. A 10% MOS is subtracted to ensure necessary reductions account for uncertainties in the sampling process. The results illustrate how bacteria loads tend to fluctuate over the course of a month's time.

Table 2. East Branch Goose Creek (ID17060210SL010_04) 2011 *E. coli* results.

Date	*E. coli* (cfu)
8/30/11	146.7
9/5/11	290.9
9/11/11	387.3
9/18/11	117.8
9/22/11	663
Geometric mean	264

Note: colony-forming unit (cfu)

Table 3. East Branch Goose Creek (ID17060210SL010_04) *E. coli* load allocation.

Location	Existing Load (cfu/100 mL)	30-day Load Capacity (cfu/100 mL)	30-day Load Allocation (cfu/100 mL)	Explicit Margin of Safety (%)	Required Load Reduction (cfu/100 mL)
East Branch Goose Creek	264	126	113	10	57% or 151

Notes: colony-forming units (CFU); milliliters (mL)

Table 4. East Branch Goose Creek (ID17060210SL010_04) mass flow.

Date	*E. coli* (cfu/100 mL)	30-day Geometric Mean	Flow (cfs)	Existing Load (cfu/day)	Load Capacity including MOS (cfu/day)	Load Reduction (cfu/day)	Reduction (%)
8/30/11	146.7		8.6	35,725,118	27,615,735	8,109,383	23
9/5/11	290.9		3.67	30,231,201	11,784,868	18,446,333	61
9/11/11	987.3	264	6.94	1.94E+08	22,285,255	1.72E+08	89
9/18/11	117.8		2.36	7,872,338	7,578,295	294,043	3.7
9/22/11	663		2.66	49,939,149	8,541,628	41,397,521	83

Notes: colony-forming unit (cfu); milliliter (mL); cubic feet per second (cfs); margin of safety (MOS)

Margin of Safety

Establishing a TMDL requires that a MOS be identified to account for uncertainty. A MOS is expressed as either an implicit or explicit portion of a water body's loading capacity that is reserved to allow for uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. The MOS is not allocated to any sources of a pollutant. DEQ has added an explicit MOS (10%) to the required load reduction to ensure the secondary contact beneficial use is supported throughout the year.

Critical Time Period

The *E. coli* bacteria allocations apply on a daily basis throughout the year, since secondary contact recreation (i.e., wading) may occur at any time of year. Monitoring data from the 5-year review (DEQ 2012) showed that bacteria concentrations were highest in the summer, so this TMDL was developed based on summer monitoring data. Meeting this allocation ensures water quality standards are attained for the protection of public health. Given the limited sample results, it is difficult to establish a critical flow or time period, although it is likely to be during low flow conditions. Additional sampling is needed to better characterize bacteria loading.

Background

Background levels of bacteria have been incorporated with all other sources into the gross nonpoint source allocation.

Reserve for Growth

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

5.1.2 Sediment TMDL for Mud Creek (ID17060210SL008_03)

The following sections describe the sediment TMDL necessary to support the cold water aquatic life beneficial use in Mud Creek. The information used to determine that Mud Creek did not support beneficial uses and to identify sediment as the pollutant of concern is found in the Little Salmon River subbasin 5-year review (DEQ 2012, pages 7–11). In summary, data in the 5-year review found that Mud Creek (ID17060210SL008_03) had 71% bank stability with many sections characterized as severely eroding. Wolman pebble count data indicated that 61% of the instream substrate from all sample reaches consisted of fine particles, such as silt and clay. Support of cold water aquatic life is generally found at a percent fine level of 28% or less.

5.1.2.1 Instream Water Quality Targets

Water quality targets are based on a surrogate of 80% bank stability, which is presumed to be close to natural background loading rates. These targets are presumed to meet the goal of the TMDL to restore full support of designated beneficial uses on all §303(d)-listed streams. Full support shall be established by demonstrating a declining trend in sediment in conjunction with Beneficial Use Reconnaissance Program (BURP) scores that indicate full support of beneficial uses. A TMDL was developed for Mud and Little Mud Creek (ID17060210SL008_03) because

BURP scores indicated that beneficial uses were not supported and bank stability was determined to be less than 80%.

Design Conditions

The Mud Creek watershed is part of the Weiser River Embayment and Idaho Batholith. The lower portion of Mud Creek runs through Quaternary alluvial deposits.

Annual erosion and sediment delivery are functions of climatic variability where above average water years typically produce higher erosion and subsequently higher sediment loads from unstable streambanks. Stable streambanks that allow peak flow access to the floodplain are able to withstand extreme hydrologic events without becoming unstable. The annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months during spring runoff when bank-full (high) flow occurs.

Target Selection

Sediment targets are selected to accomplish the narrative criterion of Idaho's water quality standards (IDAPA 58.01.02. 200.08):

> Sediment shall not exceed quantities specified in Sections 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Section 350. (4-5-00)

It is assumed that natural background sediment loading rates from bank erosion equate to 80% or greater bank stability as described in Overton et al. (1995). Therefore, 80% has been selected as the target for streambank stability. Eroding streambanks of the §303(d)-listed streams were measured and rated for stability using Natural Resources Conservation Service methods. The length and height of an eroding streambank is measured for at least 10% of the total stream length. The erosion rate is developed by qualitative measures of bank condition. The soil type erosivity is entered into the calculation for a total evaluation of eroding area, rate of erosion, and soil erosivity.

The current state of science does not allow precise statement of a sediment load or load capacity that would translate into characteristics (e.g., percent depth fines) known to support beneficial uses for cold water aquatic life and salmonid spawning and thus meet Idaho's narrative criterion for sediment. The load capacity lies somewhere between current loading and levels that relate to natural streambank erosion levels. It is assumed that beneficial uses would be fully supported at natural background sediment loading rates. These rates are assumed to equate to 80% bank stability regimes, thereby meeting state water quality standards.

By monitoring bank stability targets as well as stream biota (biomonitoring), the relationship between 80% bank stability and full support of beneficial uses can be ascertained. Targets and TMDLs can be modified if necessary based on monitoring results. If it is established that aquatic life beneficial uses are supported at an intermediate sediment load above natural background levels, then Idaho's narrative sediment standard is met and the TMDL will be revised accordingly.

Monitoring Points

Monitoring locations for the §303(d)-listed streams were based on where access was granted by landowners, as most of the land was privately owned. Future monitoring would ideally take place at the same location and would focus on streambank stability evaluation.

5.1.2.2 Load Capacity

A load capacity is ". . .the greatest loading a water body can receive without violating water quality standards" (40 CFR 130.2). This load capacity must be at a level to meet ". . .water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge. . ." (Clean Water Act §303(d)(C)). Likely sources of uncertainly include lack of knowledge of assimilative capacity, uncertain relation of selected target(s) to beneficial use(s), and variability in target measurement.

The load capacity of sediment from streambank erosion shall be based on assumed natural streambank stability of greater than or equal to 80% (Overton et al. 1995). It is presumed that beneficial uses would be supported with natural background loading rates. Therefore, the loading capacity lies somewhere between the current conditions and sediment loading from natural streambank erosion. An adaptive management approach will provide reductions in sediment loading based on best management practice (BMP) implementation. Further monitoring will determine the loading rate at which beneficial uses are supported. Load capacities are presented in Table 5**.**

Table 5. Calculated load capacities for Mud Creek.

Assessment Unit	Load Capacity (tons/day)	Estimation Method
Mud Creek	2.8	Calculated at 80% stability

Load capacities are calculated using an erosion rate that would be equivalent to 20% erosion of the sampled reach per year. In other words, the load capacity is based on 80% stable and covered streambanks. Eighty percent bank stability has been described as a natural background sediment loading rate in Overton et al. (1995).

5.1.2.3 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)). Current sediment delivery in this watershed has been calculated by measuring the eroding streambanks and evaluating their condition (Table 6).

Table 6. Current loads from nonpoint sources in Mud Creek.

Assessment Unit	Current Sediment Delivery (tons/day)	Estimation Method
Mud Creek	3.23	Measured bank erosion data

Mud Creek is entirely on private land used mainly for agriculture. Eroding streambanks had a lateral recession rate of 0.28 feet per year. Most of the streambed consists of silt.

5.1.2.4 Load Allocation

The entire load allocation is allocated to nonpoint sources and includes natural background. A 10% MOS is added to the load reduction to ensure beneficial use restoration (Table 7). The load capacity is back calculated from the assumption that beneficial uses will be met at 80% bank stability. Current sediment delivery is calculated from the streambank erosion inventory. The methods for these calculations are provided in Appendix B.

Table 7. Load allocations for Mud Creek (ID17060210SL008_03).

Assessment Unit	Current Sediment Delivery (tons/day)	Load Capacity (tons/day)	Margin of Safety (MOS)	Load Allocation (tons/day)	Load Reduction (tons/day)	Percent Reduction (%)
Mud Creek	3.23	2.8	.28	2.52	0.71	22

Margin of Safety

A 10% MOS is applied to ensure that beneficial uses will be restored. This MOS is applied by reducing the load capacity by 10%, which was determined using 80% bank stability.

Seasonal Variation

It is recognized that most of the total annual sediment load erodes from the streambanks during the spring high flow caused by snowmelt or rain-on-snow events when the streams are at or near bank-full. Streambank erosion inventory measures erosive streambanks at their bank-full level to account for this sediment load. Streambank erosion monitoring is done during base flow conditions. Appendix C provides the Mud Creek streambank erosion inventory worksheet.

Natural Background

Natural background is assumed to be 80% stable.

Reserve for Growth

No reserve for growth is incorporated into this load because future activities should not impact the stream channel.

Construction Stormwater Requirements

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

If a construction project disturbs more than 1 acre of land (or is part of larger common development that will disturb more than 1 acre), the operator is required to apply for a Construction General Permit (CGP) from EPA after developing a site-specific Stormwater Pollution Prevention Plan (SWPPP).

To obtain the CGP, operators must develop a site-specific SWPPP. Operators must document the erosion, sediment, and pollution controls they intend to use; inspect the controls periodically; and maintain BMPs throughout the life of the project.

When a stream is on Idaho’s §303(d) list and has a TMDL developed, DEQ may incorporate a gross wasteload allocation for anticipated construction stormwater activities. TMDLs developed in the past that did not have a wasteload allocation for construction stormwater 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 BMPs.

Typically, operators must follow specific requirements to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for post-construction stormwater management. Sediment is usually the main pollutant of concern in stormwater from construction sites. The application of specific BMPs from Idaho’s *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* (DEQ 2005) is generally sufficient to meet the standards and requirements of the CGP, unless local ordinances have more stringent and site-specific standards that are applicable.

5.2 Implementation Strategies for Bacteria and Sediment TMDLs

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

5.2.1 Time Frame

A schedule for implementing BMPs, pollution control strategies, assessment reporting dates, and progress evaluation will be developed with appropriate designated management agencies. The expected time frame for meeting water quality standards and/or beneficial uses is within 5–15 years, depending on how quickly implementation projects are started. Participation in implementation is voluntary so implementation can take longer if participation is limited.

5.2.2 Approach

The TMDLs developed in this document focus on implementing load allocations for bacteria and sediment.

Instream channel erosion will be remedied using riparian restoration and bank stabilization techniques. If the stream channel is healing on its own, then ensuring that recovery continues is a viable management option.

Determining the primary source(s) of bacteria will define the approach used to reduce bacteria loads. Further riparian area improvements may act as a filter strip, which could reduce bacteria concentrations in East Branch Goose Creek.

5.2.3 Responsible Parties

Idaho Code 39-3612 states designated management agencies are to use TMDL processes for achieving water quality standards. DEQ will rely on the designated management agencies to implement pollution control measures or BMPs for those pollutant sources identified as priorities.

DEQ also recognizes the authorities and responsibilities of city and county governments as well as applicable state and federal agencies and will enlist their involvement and authorities for protecting water quality.

The designated state agencies listed below are responsible for assisting and providing technical support for developing specific implementation plans as well as other appropriate support for water quality projects. General responsibilities for Idaho-designated management agencies are as follows:

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

5.2.4 Monitoring Strategy

Idaho Code 39-3611 requires DEQ to review and evaluate each Idaho TMDL, supporting assessment, implementation plan, and all available data periodically, at intervals no greater than 5 years. Such reviews are to be conducted using the BURP protocol and *Water Body Assessment Guidance* (Grafe et al. 2002) methodology to determine beneficial use attainability and status and whether state water quality standards are being achieved. A channel erosion analysis will be done in the next 5-year review process.

5.2.5 Reasonable Assurance

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the wasteload allocation is based on an assumption that nonpoint source load reductions will occur, then the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions.

Load allocations were developed to reduce sediment and bacteria from nonpoint source activities. Bacteria load allocations were calculated from existing bacteria monitoring results, and gross sediment load allocations were calculated from streambank erosion inventories. A basic implementation strategy to address nonpoint source sediment reduction is outlined in the Little Salmon River implementation plan (DEQ 2008). In addition, the Clean Water Act §319 program provides an avenue for nonpoint source pollution reduction project funding.

Future monitoring will include bacteria monitoring and streambank erosion inventories to assess changes in the bacteria and sediment loads in East Branch Goose Creek and Mud Creek, respectively. The combination of implementation activities and monitoring to determine progress toward reducing sediment loads provides reasonable assurance that the targets will be met in a 5–15 year period.

5.3 Conclusions

The TMDLs developed as part of this report are shown in Table 8. Depending on the pollutant reduction strategies implemented, the streams may take 5–15 years to meet water quality standards and support beneficial uses.

Table 8. Total maximum daily load summary.

Water Body Name/Assessment Unit	§303(d) Listing	TMDL(s) Completed	Reduction Required (%)	Recommended Changes to the Next Integrated Report
Mud/Little Mud Creek (ID17060210SL008_03)	Benthic macroinvertebrate/ bioassessments	Sediment	22	Move to Category 4a
East Branch Goose Creek (ID17060210SL010_04)	Combined biota and habitat bioassessments	Bacteria	57	Move to Category 4a

Public Participation

The Little Salmon River WAG met on December 19, 2011, March 19, 2012 and August 30, 2012. They discussed the Little Salmon River 5-year review and TMDL addendum, which included East Branch Goose Creek and Mud Creek. The WAG was given an opportunity to comment on the draft document until the middle of January 2012, however, no comments were received.

The general public will have the opportunity to comment on this draft document during the public comment period. In the final version of this addendum, a distribution list and summary of public comments will be included as Appendix D and Appendix E.

References Cited

CFR (Code of Federal Regulation). 1995. “Water Quality Planning and Management.” 40 CFR 130.

DEQ (Idaho Department of Environmental Quality). 2005. *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties.* Boise, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2006. *Little Salmon River Subbasin Assessment and TMDL*. Boise, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2008. *Little Salmon River Total Maximum Daily Load Implementation Plan for Agriculture, Forestry and Urban/Suburban Activities.* Boise, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2010. *Water Quality Pollutant Trading Guidance.* Boise, ID: DEQ. Available at: *http://www.deq.idaho.gov/media/488798-water_quality_pollutant_trading_guidance_0710.pdf*.

DEQ (Idaho Department of Environmental Quality). 2011. *Idaho's 2010 Integrated Report*. Boise, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2012. *Little Salmon River Subbasin Assessment and Total Maximum Daily Load Five-Year Review*. 2012. Boise, ID: DEQ.

Grafe, C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandt, and D.T. Mosier. 2002. *Water Body Assessment Guidance*. 2nd ed. Final. Boise, ID: Department of Environmental Quality.

Idaho Code. 2011. "Integration of Total Maximum Daily Load Processes with Other Programs." Idaho Code 39-3612.

Idaho Code. 2011. "Development and Implementation of Total Maximum Daily Load or Equivalent Processes." Idaho Code 39-3611.

IDAPA. 2012. "Idaho Water Quality Standards." Idaho Administrative Code. IDAPA 58.01.02.

Overton, C.K., J.D. McIntyre, R. Armstrong, S.L. Whitwell, and K.A. Duncan. 1995. *User's Guide to Fish Habitat: Descriptions that Represent Natural Conditions in the Salmon River Basin, Idaho*. Ogden, UT: US Forest Service, Intermountain Research State, General Technical Report INT-GTR-322.

Strahler, A.N. 1957. "Quantitative Analysis of Watershed Geomorphology." *Transactions American Geophysical Union* 38:913–920.

US Congress. 1972. Clean Water Act (Federal Water Pollution Control Act). 33 USC §1251–1387.

GIS Coverages

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Glossary

§303(d)

Refers to section 303 subsection "d" of the Clean Water Act. Section 303(d) requires states to develop a list of water bodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to United States Environmental Protection Agency approval.

Assessment Unit (AU)

A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources of pollutant must be applied to the entirety of the unit.

Beneficial Use

Any of the various uses of water—including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics—that are recognized in water quality standards.

Beneficial Use Reconnaissance Program (BURP)

A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers.

E. coli

Short for *Escherichia coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans, but their presence in water is often indicative of fecal contamination. *E. coli* are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.

Exceedance

A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.

Fully Supporting

In compliance with water quality standards and within the range of biological reference conditions for all designated and existing beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

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.

Load Allocation (LA)

A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).

Load(ing)

The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. A load is the product of flow (discharge) and concentration.

Load Capacity (LC)

How much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, a margin of safety, and natural background contributions, it becomes a total maximum daily load.

Margin of Safety (MOS)

An implicit or explicit portion of a water body's load capacity set aside to allow for uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. The margin of safety 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 margin of safety is not allocated to any sources of pollution.

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 discernible point or origin and include, but are not limited to, irrigated and nonirrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.

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).

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 plants.

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 that alter the functioning of natural processes and produce undesirable environmental and health effects. Pollution includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.

Stream Order

Hierarchical ordering of streams based on the degree of branching. A 1st-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher-order streams result from two streams of the same order.

Total Maximum Daily Load (TMDL)

A TMDL is a water body's load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual basis. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Wasteload Allocation (WLA)

The portion of receiving water's load capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.

Water Body

A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.

Water Quality Standards

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

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Appendix A. Data Sources

Table A-1. Data sources for Little Salmon River subbasin assessment.

Water Body	Data Source	Type of Data	Collection Date
East Branch Goose Creek	Idaho Department of Environmental Quality	Bacteria, SVAP	2010 2011
Mud Creek	Idaho Department of Environmental Quality	Erosion inventory (SVAP)	2010

Note: stream visual assessment protocol (SVAP)

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Appendix B. Streambank Erosion Inventory Methods

Streambank Erosion Inventory

The streambank erosion inventory used to estimate background and existing streambank erosion followed methods outlined in the proceedings from the Natural Resource Conservation Service (NRCS) Channel Evaluation Workshop (NRCS, 1983). Using the direct volume method, sub-sections of 1996 §303(d) watersheds were surveyed to determine the extent of chronic bank erosion and estimate the needed reductions.

The NRCS Stream Bank Erosion Inventory is a field based methodology, which measures streambank/channel stability, length of active eroding banks, and bank geometry (Stevenson, 1994). The streambank/channel stability inventories were used to estimate the long-term lateral recession rate. The recession rate is determined from field evaluation of streambank characteristics that are assigned a categorical rating ranging from 0 to 3. The categories of rating the factors and rating scores are:

Bank Stability:

Do not appear to be eroding – 0
Erosion evident – 1
Erosion and cracking present – 2
Slumps and clumps sloughing off – 3

Bank Condition:

Some bare bank, few rills, no vegetative overhang – 0
Predominantly bare, some rills, moderate vegetative overhang – 1
Bare, rills, severe vegetative overhang, exposed roots – 2
Bare, rills and gullies, severe vegetative overhang, falling trees – 3

Vegetation/Cover On Banks:

Predominantly perennials or rock-covered – 0
Annuals/perennials mixed or about 40% bare – 1
Annuals or about 70% bare – 2
Predominantly bare – 3

Bank/Channel Shape:

V-shaped channel, sloped banks – 0
Steep V-shaped channel, near vertical banks – 1
Vertical Banks, U-shaped channel – 2
U-shaped channel, undercut banks, meandering channel – 3

Channel Bottom:

Channel in bedrock/noneroding – 0
Soil bottom, gravels or cobbles, minor erosion – 1
Silt bottom, evidence of active downcutting – 2

Deposition:

No evidence of recent deposition – 1
Evidence of recent deposits, silt bars – 0

Cumulative Rating:

Slight (0-4) Moderate (5-8) Severe (9+)

From the Cumulative Rating, the lateral recession rate is assigned.

0.0–0.05 feet per year **Slight**
0.06–0.15 feet per year **Moderate**
0.16–0.3 feet per year **Severe**
0.5+ feet per year **Very Severe**

Streambank stability can also be characterized through the following definition and the corresponding streambank erosion condition rating from Bank Stability or Bank Condition above are included in italics. Streambanks are considered stable if they do not show indications of any of the following features:

- **Breakdown—**Obvious blocks of bank broken away and lying adjacent to the bank breakage. *Bank Stability Rating 3*
- **Slumping or False Bank—**Bank has obviously slipped down, cracks may or may not be obvious, but the slump feature is obvious. *Bank Stability Rating 2*
- **Fracture—**A crack is visibly obvious on the bank indicating that the block of bank I about to slump or move into the stream. *Bank Stability Rating 2*
- **Vertical and Eroding—**The bank is mostly uncovered and the bank angle is steeper than 80 degrees from the horizontal. *Bank Stability Rating 1*

Streambanks are considered covered if they show any of the following features:

- Perennial vegetation ground cover is greater than 50%. *Vegetation/Cover Rating 0*
- Roots of vegetation cover more than 50% of the bank (deep rooted plants such as willows and sedges provide such root cover). *Vegetation/Cover Rating 1*
- At least 50% of the bank surfaces are protected by rocks of cobble size or larger. *Vegetation/Cover Rating 0*
- At least 50% of the bank surfaces are protected by logs of 4 inch diameter or larger. *Vegetation/Cover Rating 1*

Streambank stability is estimated using a simplified modification of Platts, Megahan, and Minshall (1983, p. 13) as stated in Monitoring Protocols to Evaluate Water Quality Effects of Grazing Management on Western Rangeland Streams (Bauer and Burton, 1993). The modification allows for measuring streambank stability in a more objective fashion. The lengths of banks on both sides of the stream throughout the entire linear distance of the representative reach are measured and proportioned into four stability classes as follows:

- **Mostly covered and stable (non-erosional).** Streambanks are Over 50% Covered as defined above. Streambanks are Stable as defined above. Banks associated with gravel bars having perennial vegetation above the scourline are in this category. *Cumulative*

Rating 0–4 (slight erosion) with a corresponding lateral recession rate of 0.01–0.05 feet per year.

- **Mostly covered and unstable (vulnerable).** Streambanks are Over 50% Covered as defined above. Streambanks are Unstable as defined above. Such banks are typical of false banks" observed in meadows where breakdown, slumping, and/or fracture show instability yet vegetative cover is abundant. *Cumulative Rating 5–8 (moderate erosion) with a corresponding lateral recession rate of 0.06–0.2 feet per year.*
- **Mostly uncovered and stable (vulnerable).** Streambanks are less than 50% Covered as defined above. Streambanks are Stable as defined above. Uncovered, stable banks are typical of streambanks trampled by concentrations of cattle. Such trampling flattens the bank so that slumping and breakdown do not occur even though vegetative cover is significantly reduced or eliminated. *Cumulative Rating 5–8 (moderate erosion) with a corresponding lateral recession rate of 0.06–0.2 feet per year*.
- **Mostly uncovered and unstable (erosional).** Streambanks are less than 50% Covered as defined above. They are also Unstable as defined above. These are bare eroding streambanks and include ALL banks mostly uncovered, which are at a steep angle to the water surface. *Cumulative Rating 9+ (severe erosion) with a corresponding lateral recession rate of over 0.5 feet per year*.

Streambanks were inventoried to quantify bank erosion rate and annual average erosion. These data were used to develop a quantitative sediment budget to be used for TMDL development.

Site Selection

The first step in the bank erosion inventory is to identify key problem areas. Streambank erosion tends to increase as a function of watershed area (NRCS, 1983). As a result, the lower stream segment of larger watersheds tend to be problem areas. These stream segments tend to be alluvial streams commonly classified as response reaches (Rosgen B and C channel types) (Rosgen,1996).

Because it is often unrealistic to survey every stream segment, sampled reaches were used and bank erosion rates are extrapolated over a larger stream segment. The length of the sampled reach is a function of stream type variability where streams segments with highly variable channel types need a large sample, whereas segments with uniform gradient and consistent geometry need less. Typically a minimum of 10 and 30 percent of streambank needs to be inventoried. Often, the location of some stream inventory reaches is more dependent on land ownership than watershed characteristics. For example, private land owners are sometimes unwilling to allow access to stream segments within their property. Stream reaches are subdivided into *sites* with similar channel and bank characteristics. Breaks between sites are made where channel type and/or dominate bank characteristics change substantially. In a stream with uniform channel geometry there may be only one site per stream reach, whereas in an area with variable conditions there may be several sites. Subdivision of stream reaches is at the discretion of the field crew leader.

Field Methods

Streambank erosion or channel stability inventory field methods were originally developed by the USDA USFS (Pfankuch, 1975). Further development of channel stability inventory methods are outlined in Lohrey (1989) and NRCS (1983). As stated above, the NRCS (1983) document outlines field methods used in this inventory. However, slight modifications to the field methods were made and are documented.

Field crews typically consist of two to four people and are trained as a group to ensure quality control or consistent data collection. Field crews survey selected stream reaches measuring bank length, slope height, bank-full width and depth, and bank content. In most cases, a Global Positioning System (GPS) is used to locate the upper and lower boundaries of inventoried stream reaches. Additionally, while surveying field crews photograph key problem areas.

Bank Erosion Calculations

The direct volume method is used to calculate average annual erosion rates for a given stream segment based on bank recession rate determined in the survey (NRCS, 1983). The erosion rate (tons/mile/year) is used to estimate the total bank erosion of the selected stream corridor.

The direct volume method is summarized in the following equations:

$$E = [A_E * R_{LR} * \_{B}]/2000 \text{ (lbs/ton)}$$

where:

E = bank erosion over sampled stream reach (tons/yr/sample reach)

A_E = eroding area (ft^2)

R_{LR} = lateral recession rate (ft/yr)

$\_{B}$ = bulk density of bank material (lbs/ft^3)

The bank erosion rate (E_R) is calculated by dividing the sampled bank erosion (E) by the total stream length sampled:

$$E_R = E/L_{BB}$$

where:

E_R = bank erosion rate (tons/mile/year)

E = bank erosion over sampled stream reach (tons/yr/sample reach)

L_{BB} = bank to bank stream length over sampled reach

Total bank erosion is expressed as an annual average. However, the frequency and magnitude of bank erosion events are greatly a function of soil moisture and stream discharge (Leopold et al, 1964). Because channel erosion events typically result from above average flow events, the annual average bank erosion value should be considered a long term average. For example, a 50 year flood event might cause five feet of bank erosion in one year and over a ten year period this event accounts for the majority of bank erosion. These factors have less of an influence where bank trampling is the major cause of channel instability.

The *eroding area* (A_E) is the product of linear horizontal bank distance and average bank slope height. Bank length and slope heights are measured while walking along the stream channel. Pacing is used to measure horizontal distance, and bank slope heights are continually measured and averaged over a given reach or site. The horizontal length is the length of the right or left bank, not both. Typically, one bank along the stream channel is actively eroding for example, the bank on the outside of a meander. However, both banks of channels with severe headcuts or gullies will be eroding and are to be measured separately and eventually summed. Determining the *lateral recession rate* (R_{LR}) is one of the most critical factors in this methodology (NRCS, 1983). Several techniques are available to quantify bank erosion rates: for example, aerial photo interpretation, anecdotal data, bank pins, and channel cross sections.

To facilitate consistent data collection, the NRCS developed rating factors used to estimate lateral recession rate. Similar to methods developed by Pfankuch (1975), the NRCS method measures bank and channel stability, and then uses the ratings as surrogates for bank erosion rates.

The *bulk density* ($_B$) of bank material is measured visually in the field. Soil bulk density is the weight of material divided by its volume, including the volume of its pore spaces. A table of typical soil bulk densities can be used, or soil samples can be collected and soil bulk density measured in the laboratory.

References

Compton, R.R. 1996. Interpretation of aerial photos.

Flanagan, D.C., and M.A. Nearing (Editors). USDA Water Erosion Prediction Project Hillslope Profile and Watershed Model Documentation. NSERL Report No. 10. USDA-ARS National Soil Erosion Laboratory, W. Lafayette IN. 9.1-9.16

Hall, T.J. 1986. A laboratory study of the effects of fine sediments on survival of three species of Pacific salmon from eyed egg to fry emergence. National Council of the Paper Industry for Air and Stream Improvement. Technical Bulletin 482. New York.

IDEQ. 1999b. 1998 303(d) List. Idaho Division of Environmental Quality. Surface Water Program. January. 473 pp.

Leopold, L.B., M.G. Wolman and J.P. Miller. 1964. Fluvial processes in geomorphology. Freeman. San Francisco, CA.

Lohrey, M.H. 1989. Stream channel stability guidelines for range environmental assessment and allotment management plans. U.S. Forest Service, Northwest Region (unpublished).

McNeil W.J. and W.H. Ahnell. 1964. Success of pink salmon spawning relative to size of spawning bed materials. US Fish and Wildlife Service, Special Scientific Report-Fisheries No. 469.

National Resources Conservation Service. 1983. Erosion and sediment yield. In: proceedings from the channel evaluation workshop. Ventura, CA. 54 p.

Pfankuch, D.J. 1975. Stream reach inventory and channel stability evaluation. U.S. Forest Service, Northern Region. Missoula, MT.

Reiser, D.W. and R.G. White. 1988. Effects of two sediment size-classes on survival of steelhead and Chinook salmon eggs. North American Journal of Fisheries Management. 8: 432-437.

Rosgen, D.L. 1996 Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO. 378 pp.

Stevenson, T.K. 1994. USDA-NRCS, Idaho. Channel erosion condition inventory description. Memorandum to Paul Shelton, District Conservationist, Montpelier FO, Idaho, 5/24/94: describing estimation of streambank, road and gully erosion. USDA NRCS. 1983. Channel evaluation Workshop, Ventura, California, November 14-18, 1983. Presented at U.S. Army Corps of Engineers Hydrologic Engineering Center training session by Lyle J. Steffen, Geologist, Soil Conservation Service, Davis, CA. December 14,1982.

USDA FS. 1997. Challis Creek Watershed Analysis. Salmon-Challis National Forest, Challis Ranger District. June 1997.

Appendix C. Mud Creek Data

Table C-1. Mud Creek streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

Stream:	Mud Creek	**Stream Segment Location (DD)**	**Elevation (ft)**
Section:	3rd Order	*Upstream:*	
Date Collected:	Jun-10	*Downstream:*	
Field Crew:	Pappani/Holloway/Freeman	**Landuse and Notes:**	
Data Reduced By:			

Streambank Erosion Calculations

Average Bank Height	6.9	ft
Total Inventoried Bank Length	31078	ft
Inventoried Bank to Bank Length	62156	ft
Erosive Bank Length	7176	ft
Bank to Bank Eroding Segment Length	14352	ft
Percent Eroding Bank	0.23090289	%
Eroding Area	99028.8	ft^2
Recession Rate	0.28	
Bulk Density	85	lb/ft^2
Bank Erosion over Sampled Reach (E)	1178.44272	tons/year/sample reach
Erosion Rate (Er)	200.211647	tons/mile/year
Feet of similar stream type		ft
Eroding Bank Extrapolation	14352	ft
Total Streambank Erosion	1178.44272	tons/year

Streambank Erosion Reduction Calculatio

Eroding Area With Load Reductions	85775.28
Erosion over sampled reach (with load reduction (20%)	1020.726
Erosion Rate	173.4163
Feet of Similar Stream Type	0
Eroding Bank Extrapolation (with reduction)	12431.2
Total Streambank Erosion	1020.726

Recession Rate Calculation Worksheet

Slope Factor	**Rating**
Bank Stability (0-3)	
Bank Condition (0-3)	
Vegetative/cover on Banks (0-3)	
Bank/Channel Shape - downcutting (0-3)	
Channel Bottom (0-2)	
Deposition (0-1)	
Total = Slight (0-4); Moderate (5-8); Severe (9+)	0
Recession Rate	**0.01**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
200.2116469	1178.4427	173	1020.72583	13.59144051
0.54852506	3.2286102	0.4739726	2.79650913	

Streambank Erosion Calculations

Average Bank Height	6.9	ft
Total Inventoried Bank Length	31078	ft
Inventoried Bank to Bank Length	62156	ft
Erosive Bank Length	7176	ft
Bank to Bank Eroding Segment Length	14352	ft
Percent Eroding Bank	0.23090289	%
Eroding Area	99028.8	ft^2
Recession Rate	0.1	
Bulk Density	85	lb/ft^2
Bank Erosion over Sampled Reach (E)	420.8724	tons/year/sample reach
Erosion Rate (Er)	71.5041596	tons/mile/year
Feet of similar stream type		ft
Eroding Bank Extrapolation	14352	ft
Total Streambank Erosion	420.8724	tons/year

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Appendix D. Distribution List

[To be inserted following public comment period.]

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Appendix E. Public Comments

[To be inserted following public comment period.]