Little Salmon River Subbasin Assessment and Total Maximum Daily Load

2013 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

IDL Idaho Department of Lands

LA load allocation

LC load capacity

mL milliliter

MOS margin of safety

MS4 municipal separate storm sewer system

MSGP multi-sector general permit

NB natural background

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resources Conservation Service

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

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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, which 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 Creeks	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 (bank stability)	Move Mud Creek to Category 4a for sediment. Delist benthic-macroinvertebrate bioassessments.	BURP, SVAP data (erosion inventory); sediment determined to be pollutant.
East Branch Goose Creek ID17060210SL010_04	Combined biota/ habitat bioassessments	Bacteria (*E.coli*)	Move East Branch Goose Creek to Category 4a for bacteria. Delist for combined biota habitat bioassessments. List in Category 4c for flow alteration.	BURP, SVAP, nutrient, and bacteria data; unlisted but impaired for *E.coli* bacteria; no nutrient or sediment sources/pathways

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

During the development of this addendum, the original *Little Salmon River Subbasin Assessment and TMDL* and *Little Salmon River Subbasin Assessment and Total Maximum Daily Load Five-Year Review* were reviewed and found to contain the following errors (Table C). The five-year review listed a nonexistent assessment unit (ID17060210SL008_02a) for Little Mud Creek; this has been updated to reflect the actual assessment unit ID17060210SL008_02.

Table C. Errors and corrections.

Error	Document	Original Error	Correction
Incorrect assessment unit (AU) for Little Mud Creek	Five-year review	17060210SL008_02a	17060210SL008_02
Incorrectly reported percent fines	Five-year review	Little Mud Creek 51% Mud Creek 61%	Little Mud Creek 52% Mud Creek 54% AU average 53%

Public Participation

The Little Salmon River Watershed Advisory Group (WAG) met on December 19, 2011, March 19, 2012, and August 30, 2012. They discussed the Little Salmon River five-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 document was open for comment from the general public for a 30-day period during December 2012 and January 2013.

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) assessment units, 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.

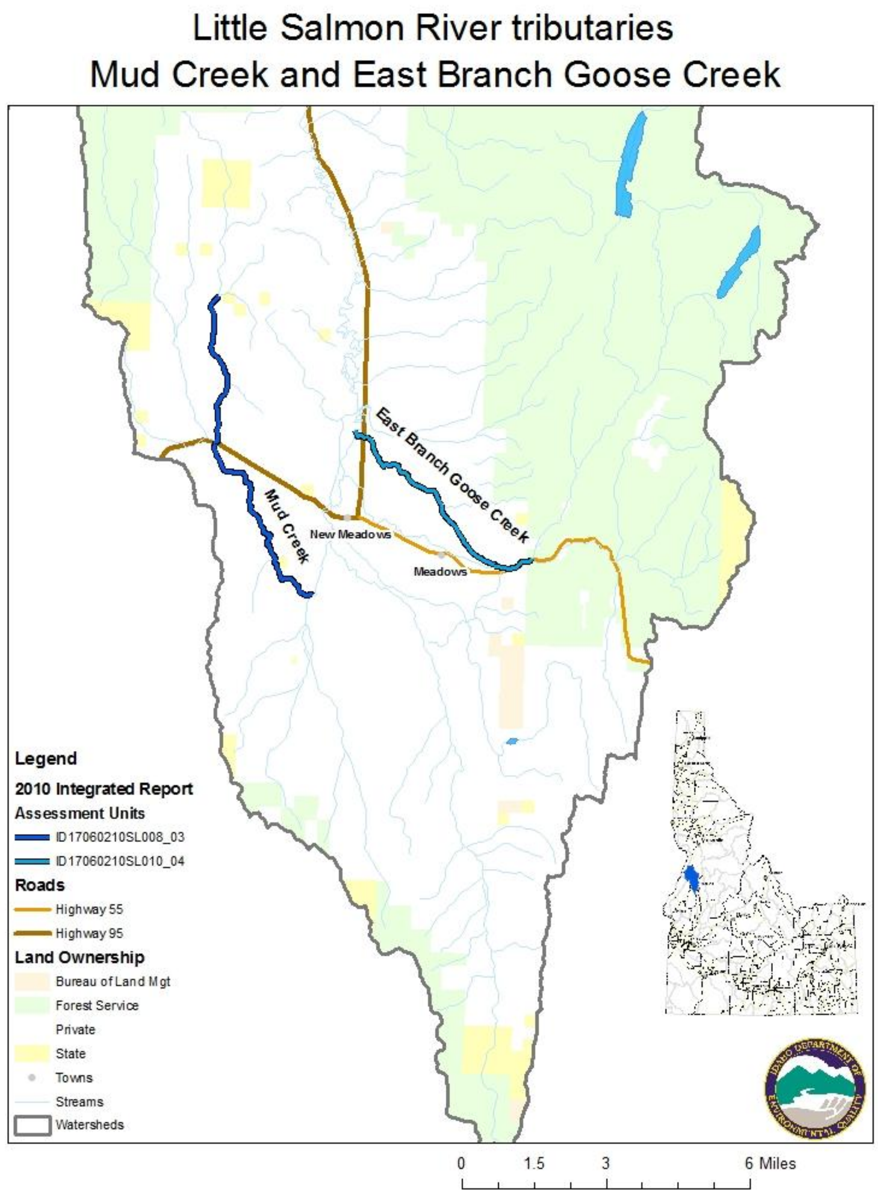

Figure 1. Mud Creek and East Branch Goose Creek TMDL assessment units.

2 Subbasin Assessment—Water Quality Concerns and Status

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

The Little Salmon River subbasin five-year review (DEQ 2012) presented data showing that East Branch Goose Creek (ID17060210SL010_04) exceeded state standards for bacteria. No nutrient or sediment sources or pathways were identified to East Branch Goose Creek. 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 five-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. East Branch Goose Creek and Mud Creek are tributaries of the Little Salmon River.

No municipal separate storm sewer systems (MS4) or Multi-Sector General Permits (MSGPs) were identified to exist in either Mud Creek or East Branch Goose Creek or upstream tributaries.

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, grazing, 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 in Mud Creek. A streambank erosion inventory was also done as part of SVAP on Mud and Little Mud Creeks, 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, therefore bank stability will be used as a surrogate for sediment.

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 five-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 (IDL) managed land. This effort has been in response to timber harvesting and grazing and has 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, past pollution control efforts have focused on the mainstem portion of Goose Creek (ID17060210SL010_02), just upstream of East Branch Goose Creek on USFS land. These efforts were in response to grazing, recreation, and timber harvesting, although this assessment unit has a low priority ranking. Recently, pollution control efforts have been implemented on the East Branch Goose Creek (ID17060210SL010_03), which include riparian fences and riparian vegetation. It will likely become eligible for pollution control efforts and §319-funded projects to improve water quality as the TMDL takes effect and its priority ranking changes.

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 five-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. In an effort to protect secondary contact recreation beneficial use, this TMDL will regulate the instream bacteria load.

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 geometric mean 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. The Idaho Department of Environmental Quality (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 five-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 five-year review (DEQ 2012, pages 7–11). In summary, data in the five-year review found that Mud Creek (ID17060210SL008_03) had on average 77% bank stability with many sections characterized as severely eroding. The five-year review incorrectly reported percent fines as 61% for Mud Creek and 51% for Little Mud Creek. The revised data indicate that the average percent fines for Mud Creek are 54%, Little Mud Creek are 52%. The average percent fines for ID17060210SL008_03 (Mud and Little Mud Creek assessment unit) are 53%. 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 assessment unit (ID17060210SL008_03) because BURP scores indicated that beneficial uses were not supported, bank stability was determined to be less than 80%, and percent fines were significantly above 28%.

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 selected 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	1.39	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). A measured 80% bank stability in the field will result in a sediment load of 1.39 tons/day and is supportive of beneficial uses.

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	1.61	Measured bank erosion data

Mud Creek is entirely on private land. The primary land use consists of farming and grazing. Eroding streambanks had an average lateral recession rate of 0.105 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 are supported at 80% bank stability. Current sediment delivery is calculated from the streambank erosion inventory. The methods for these calculations are provided in Appendix B. The data are provided in Appendix C.

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	1.61	1.39	0.139	1.25	0.36	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 is determined using 80% bank stability.

Seasonal Variation

To qualify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. The sediment analysis characterizes loads using average annual or seasonal rates determined from empirical characteristics that develop over time within the influence of peak and base flow conditions. It is difficult to account for seasonal and annual variation within a particular time frame; however, the seasonal and annual variation is accounted for over the longer time frame under which observed conditions have developed. The annual average sediment load is not distributed equally throughout the year. Annual erosion and sediment delivery are functions of climate, where wet water years typically produce the highest sediment loads.

Additionally, most of the erosion typically occurs during a few critical months. For example, most streambank erosion occurs during spring runoff. The sediment analysis uses empirically derived hydrologic concepts to help account for variation and critical time periods. First, field-based methods consider critical hydrologic mechanisms. For example streambank erosion inventories account for the fact that most bank recession occurs during peak flow events when banks are saturated. Second, the estimated annual average sediment delivery from a given watershed is a function of bank-full discharge or the average annual peak flow event.

Reduction of streambank erosion prescribed within this TMDL is directly linked to the improvement of riparian vegetation density and structure to armor streambanks, reduce lateral recession, trap sediment, and reduce the erosive energy of the stream, thus reducing sediment loading. In reaches that are down-cut, or that have vertical erosive banks, continued erosion may be necessary to re-establish a functional floodplain that would subsequently be colonized with stabilizing riparian vegetation, a process that often takes many years.

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.

5.1.3 Stormwater Runoff as Wasteload Allocations

Stormwater runoff is water from rain or snowmelt that does not immediately infiltrate into the ground and flows over or through natural or man-made storage or conveyance systems. When undeveloped areas are converted to land uses with impervious surfaces—such as buildings, parking lots, and roads—the natural hydrology of the land is altered and can result in increased surface runoff rates, volumes, and pollutant loads. Certain types of stormwater runoff are considered point source discharges for Clean Water Act purposes, including stormwater that is associated with municipal separate storm sewer systems (MS4s), industrial stormwater covered under the Multi-Sector General Permit (MSGP), and construction stormwater covered under the Construction General Permit (CGP).

A review of EPA's website indicated that there are no MS4 or MSGP in either the East Branch Goose Creek, Little Mud or Mud Creek watersheds.

5.1.3.1 Municipal Separate Storm Sewer Systems

Polluted stormwater runoff is commonly transported through MS4s, from which it is often discharged untreated into local water bodies. An MS4, according to (40 CFR 122.26(b)(8)), is a conveyance or system of conveyances that meets the following criteria:

- Owned by a state, city, town, village, or other public entity that discharges to waters of the United States
- Designed or used to collect or convey stormwater (including storm drains, pipes, and ditches)
- Not a combined sewer
- Not part of a publicly owned treatment works (sewage treatment plant)

To prevent harmful pollutants from being washed or dumped into an MS4, operators must obtain a National Pollutant Discharge Elimination System (NPDES) permit from EPA, implement a comprehensive municipal stormwater management program, and use BMPs to control pollutants in stormwater discharges to the maximum extent practicable.

5.1.3.2 Industrial Stormwater Requirements

Stormwater runoff picks up industrial pollutants and typically discharges them into nearby water bodies directly or indirectly via storm sewer systems. When facility practices allow exposure of industrial materials to stormwater, runoff from industrial areas can contain toxic pollutants (e.g., heavy metals and organic chemicals) and other pollutants such as trash, debris, and oil and grease. This increased flow and pollutant load can impair water bodies, degrade biological habitats, pollute drinking water sources, and cause flooding and hydrologic changes, such as channel erosion, to the receiving water body.

Multi-Sector General Permit and Stormwater Pollution Prevention Plans

In Idaho, if an industrial facility discharges industrial stormwater into waters of the United States, the facility must be permitted under EPA’s most recent MSGP. To obtain an MSGP, the facility must prepare a stormwater pollution prevention plan (SWPPP) before submitting a notice of intent for permit coverage. The SWPPP must document the site description, design, and installation of control measures; describe monitoring procedures; and summarize potential pollutant sources. A copy of the SWPPP must be kept on site in a format that is accessible to workers and inspectors and be updated to reflect changes in site conditions, personnel, and stormwater infrastructure.

Industrial Facilities Discharging to Impaired Water Bodies

Any facility that discharges to an impaired water body must monitor all pollutants for which the water body is impaired and for which a standard analytical method exists (40 CFR 136).

Also, because different industrial activities have sector-specific types of material that may be exposed to stormwater, EPA grouped the different regulated industries into 29 sectors, based on their typical activities. Part 8 of EPA’s MSGP details the stormwater management practices and monitoring that are required for the different industrial sectors. EPA anticipates issuing a new MSGP in December 2013. DEQ anticipates including specific requirements for impaired waters as a condition of the 401 certification. The new MSGP will detail the specific monitoring requirements.

TMDL Industrial Stormwater Requirements

When a stream is on Idaho’s §303(d) list and has a TMDL developed, DEQ may incorporate a wasteload allocation for industrial stormwater activities under the MSGP. However, most load analyses developed in the past have not identified sector-specific numeric wasteload allocations for industrial stormwater activities. Industrial stormwater activities are considered in compliance with provisions of the TMDL if operators obtain an MSGP under the NPDES program and implement the appropriate BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The next MSGP will have specific monitoring requirements that must be followed.

5.1.3.3 Construction Stormwater

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge stormwater to a water body or municipal storm sewer. In Idaho, EPA has issued a general permit for stormwater discharges from construction sites.

Construction General Permit and Stormwater Pollution Prevention Plans

If a construction project disturbs more than 1 acre of land (or is part of a larger common development that will disturb more than 1 acre), the operator is required to apply for a CGP from EPA after developing a site-specific SWPPP. The SWPPP must provide for the erosion, sediment, and pollution controls they intend to use; inspection of the controls periodically; and maintenance of BMPs throughout the life of the project. Operators are required to keep a current copy of their SWPPP on site or at an easily accessible location.

TMDL Construction Stormwater Requirements

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. Most loads developed in the past did not have a numeric wasteload allocation for construction stormwater activities. Construction stormwater activities are considered in compliance with provisions of the TMDL if operators obtain a CGP under the NPDES program and implement the appropriate BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The CGP has monitoring requirements that must be followed.

Postconstruction Stormwater Management

Many communities throughout Idaho are currently developing rules for postconstruction stormwater management. Sediment is usually the main pollutant of concern in construction site stormwater. DEQ's *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* (DEQ 2005) should be used to select the proper suite of BMPs for the specific site, soils, climate, and project phasing in order to sufficiently meet the standards and requirements of the CGP to protect water quality. Where local ordinances have more stringent and site-specific standards, those 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 (bank stability)	22	Move Mud Creek to Category 4a for sediment. Delist benthic macroinvertebrate bioassessments.
East Branch Goose Creek (ID17060210SL010_04)	Combined biota and habitat bioassessments	Bacteria (*E.coli*)	57	Move East Branch Goose Creek to Category 4a for bacteria. Delist for combined biota habitat bioassessments. List in Category 4c for flow alteration.

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 five-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 document was open to public comment for 30 days for the general public during December 2012 and January 2013. A distribution list and summary of public comments is included as Appendix D and Appendix E.

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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.

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Appendix C. Mud Creek Data

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

Stream:	Little Mud and Mud Creek	**Stream Segment Location (DD)**			**Elevation (ft)**
Section:		*Upstream:*			
Date:	6/1/2010	*Downstream:*			
Field Cre	Pappani/Holloway/Freeman	**Landuse and Notes:**			
Reduced	Josh Schultz	**Soil Type:**	**Blackwell clay loam/ Gestrin loam**		

Streambank Erosion Calculations	
Average Erosive Bank Height	5.87 ft
Total Inventoried Bank Length	15539.33 ft
Inventoried Bank to Bank Length	31078.66 ft
Erosive Bank Length	7176 ft
Bank to Bank Eroding Segment Length	7176 ft
Percent Eroding Bank	23.09%
Eroding Area	42123.12 ft^2
Recession Rate	0.105
Bulk Density	95.98 lb/ft^3
Bank Erosion over Sampled Reach (E)	212.26 tons/yr/reach
Erosion Rate (Er)	72.12 tons/mile/yr
Feet of similar stream type	27387.07 ft
Eroding Bank Extrapolation	19823.24 ft
Total Streambank Erosion (existing	586.34 tons/yr

Recession Rate Calculation Worksheet	
Slope Factor	**Rating**
Bank Erosion(0-3)	2.375
Bank Stability(0-3)	0.75
Bank Cover(0-3)	1
Lateral Stablity (0-3)	0.875
Channel Bottom(0-3)	0.75
In-Channel Deposition (0-1)	0.75
Total = Slight (0-4); Moderate (5-8); Severe (9+)	6.5
Recession Rate	**0.105**

Streambank Erosion Reduction Calculations	
Eroding area with load reductions	36486.35 ft^2
Allowed Erosoin over sample reach (with reduction)	183.85 tons/yr/sample
Allowed Erosion Rate	62.47 tons/mile/year
Eroding Bank Extraploation (with reduction)	3964.65 feet
Total Streambank Erosion	507.88 tons/year

Summary for Load Reductions				
Existing		Proposed		
Erosion Rate (tons/mi/yr)	Existing Load/Total Erosion (tons/yr)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	Reduction
72.12	586.34	62.47	507.88	13.38%

Summary for Load Reductions				
Existing		Proposed		
Erosion Rate (tons/mi/day)	Existing Load/Total Erosion (tons/day)	Erosion Rate (ton/mi/day)	Total Erosion (t/day)	Reduction
0.20	1.61	0.17	1.39	13.38%

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Appendix D. Distribution List

Little Salmon River Watershed Advisory Group
Victor Armacost
Bill Brown
Brian O'Morrow
Loretta Strickland
Karrie Pappani
Wendy Green
Jim Paradiso, USFS
Dale Allan, Idaho Fish and Game
Kim Apperson, Idaho Fish and Game
Craig Johnson, BLM
Russ Manwaring, West Central Highlands Resource Conservation District
Jayne Carlin, EPA

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Appendix E. Public Comments

Name:

Marshall Dean Dryden

Affiliation:

Rancher on East branch of Goose Creek

I want to know what else could be required to reduce E coli count and other concerns that are brought up in your document.

Nonpoint sources of E. coli that are related to grazing and agriculture are typically reduced by limiting domestic animal access to water bodies. This can be accomplished by using fencing to exclude animal access, limiting animal access, or providing alternative watering sites. A benefit of limiting access is the establishment of a healthy riparian area, which also serves to filter pasture runoff that may contain high levels of E. coli.

I am wondering about some of the data collection and how it is determining the actions of this DEQ document.

E. coli levels were found to exceed levels that are supportive of secondary contact recreation. The E. coli samples are as follows: 8/30/11 146.7 cfu/100mL, 9/5/11 290.9 col/100mL, 9/11/11 387.3 col/100mL, 9/18/11 117.8 col/100mL, 9/22/11 663 col/100mL. The geometric mean is 264 col/100mL. The State of Idaho water quality standard for E. coli is 126 col/100mL. DEQ is required to develop a TMDL to improve water quality. In order to meet the E. coli standards DEQ applies a 10% margin of safety.

Name:

Charles D. Clarke

Affiliation:

Citizen

PAGE 4, 3.1.2, FIRST PARAGRAPH and PAGE 13, 5.1.2.3: The omission of grazing as an influence on accelerated erosion and its byproduct, sediment loading, leaves questions. Particularly, is there grazing on the watershed? If grazing is included in "agricultural lands", it should be so stated. Although the document indicates that streambank erosion is the only significant source of sediment, that conclusion is highly questionable. Sheet and rill erosion on uplands, while not as dramatic and noticeable as channel erosion, are

typically significant sources of sediment yield to channels, and grazing normally increases sediment yield.

Grazing occurs on both East Branch Goose Creek and Mud Creek and is categorized as agricultural lands. Agricultural lands have been further defined in the document to clarify this. At this time DEQ suspects that streambank erosion is the primary source of sediment to this assessment unit.

PAGE 4, 3.1.2, LAST PARAGRAPH: If DNA is not used, what method is used to determine the relative significance of septic systems, livestock, and wildlife? Further, how are treatment priorities to be set?

Under natural circumstances E. coli loading from wildlife constitutes background. The WAG and DEQ recognize the contributions from livestock and have implemented fencing projects and will pursue additional implementation that will reduce loading by limiting access. Failing septic systems are addressed on a case-by-case basis and are typically replaced as they fail over time.

PAGE 5, LAST PARAGRAPH: The reason(s) for the low ranking of grazing on the East Branch Goose Creek should be given.

This ranking is specific to the water body assessment unit regarding implementation and section 319 funding for water quality improvement projects. It is based on current water quality status, and since upper Goose Creek (ID17060210SL010_02) does not have a TMDL nor is it impaired, it is ranked as a low priority. East Branch Goose Creek will have a higher priority ranking for water quality improvement projects due to its status and TMDL. The ranking is not specific to grazing or any other activity. This paragraph has been clarified to express this ranking.

PAGE 6, FIRST PARAGRAPH: The paragraph implies that any grazing on uplands does not increase sediment loading above natural background levels. How was this determination made?

Upland grazing occurs in a separate assessment unit, which is fully supporting beneficial uses. Unless evidence suggests otherwise and no other sources of sediment exist, it is assumed that a fully supporting assessment unit is not contributing significant amounts of sediment downstream. At this time, DEQ believes that the likely source of sediment is from streambank erosion.

Was there inventory and analysis of upland erosion conditions including calculations based on vegetative cover, slope characteristics, soil erodibility, snowmelt runoff, rainfall erosive power, mass wasting, etc.?

No there was not. A field visit indicated that the most likely source of sediment to the stream was eroding streambanks, resulting from an apparent lack of riparian vegetation and subsequent trampling.

Upland steepness ranges from 3 to 100 percent (45°) on the Mud Creek Watershed. Loss of vegetative cover on such topography would result in major increases of erosion and sediment yield. For example, according to research by the Agricultural Research Service, a loss of ground cover from 80% to 60% would result in more than a threefold increase in erosion. There is no doubt that erosion and sediment yield exceed background levels on

this watershed where logging and grazing have occurred and will continue. Also, the sediment loading derived from the drainage area of the main stem Mud Creek upstream from the confluence with Little Mud Creek appears to have been disregarded. This involves both stream channel erosion and upland erosion and must be included in analyses for the sake of accuracy.

The TMDL is for the assessment unit ID17060210SL008_03, which includes the 3rd order portion of Mud Creek and Little Mud Creek. Mainstem Mud Creek, upstream of the confluence with Little Mud Creek, including upper Little Mud Creek is a 2nd order stream. These streams belong to the assessment unit ID17060210SL008_02, which is fully supporting beneficial uses. At this point DEQ does not believe this 2nd order portion of Mud Creek is contributing a significant amount of sediment to the lower, impaired portion of Mud Creek.

PAGES 10 and 11, 5.1.2.1 and PAGE 12, 5.1.2.3: There are multiple clear implications in the document that streambank erosion is the only significant source of sediment loading in Mud Creek. There is nothing in the document supporting this conclusion. It is essential that the sediment yield from upland erosion be addressed before selecting the appropriate actions to bring sediment loading to the stated goal.

The upstream assessment unit ID17060210SL008_02 includes all 1st and 2nd order tributaries of Mud and Little Mud Creeks and is fully supporting its beneficial uses. This assessment unit was monitored in 1995, 1997, and 2008; it received passing scores of 2.0, 3.0 and 2.5, respectively. Because this assessment unit has been shown to be supporting beneficial uses, the majority of sediment is assumed to be coming from streambank erosion within the impaired assessment unit, rather than upstream. A streambank erosion inventory was performed on the impaired assessment unit of Mud Creek. The results of the streambank erosion inventories performed at multiple representative reaches throughout the assessment unit indicate that the streambank stability is below the 80% level, which is deemed to be supportive of beneficial uses.

Percent fines for the impaired assessment unit (ID17060210SL008_03) were on average 53%, which for the reasons mentioned are believed to be coming from eroding streambanks. Little Mud Creek had average percent fines of 52%, and downstream Mud Creek had an average of 54%, showing a slight increase that indicates increasing sedimentation downstream.

TMDLs are an iterative process and if a response is not measured and beneficial uses are not being met within an appropriate time period after meeting the 80% bank stability, DEQ will reexamine the sources of sediment to this assessment unit.

PAGE 13, 5.1.2.3, PARAGRAPH FOLLOWING TABLE 6: The second sentence states only one lateral recession rate (0.28 ft. /yr.). Possibly, this is a weighted average. If so, it should be clarified, and the range of recession rates should be given.

The lateral recession rate is indeed an average of 4 separate reaches. This has been clarified in the document. The lateral recession rate has been revised to 0.105 ft/yr.

PAGE 13, 5.1.2.4, RESERVE FOR GROWTH: The statement is made indicating that future activities should not impact the stream channel. Please take into account that any loss of watershed health would impact stream channels by increasing volumes and rates of surface runoff, whether due to grazing, logging, fire, or earth disturbance. This situation

would, in turn, increase flow velocities and frequencies of higher flows in stream channels. Increased erosive stresses are imposed on the channel bed and banks, and increased erosion is potentially the result in earth channels.

Duly noted. No reserve for growth is allocated. This requires all future growth in the watershed to meet the requirements of the TMDL.

PAGE 14, 5.1.2.4, CONSTRUCTION STORMWATER REQUIREMENTS: Regardless of which method of conventional stormwater management is used, increased rates of runoff will reach the downstream Mud Creek channel if vegetative cover conditions on the watershed are diminished. Regardless of the volume of sediment trapped, this would be the case unless impoundment structures are designed and built to retain runoff water and release it at rates which would not exceed existing rates of runoff from disturbed areas reaching Mud Creek.

The sediment TMDL for Mud Creek is based on an 80% streambank stability target. Streambank stability is generally achieved through encouraging and promoting a healthy, vibrant riparian area. A healthy, functioning riparian serves as a filter, slowing runoff water velocities and trapping sediment.

Stormwater management and discharge is managed by federal, state, and local regulations. Businesses, industry, and landowners are responsible for stormwater runoff from their property and may need to obtain a stormwater NPDES permit from EPA and/or comply with their city's municipal stormwater NPDES permit. Compliance with a stormwater permit may require the use of stormwater best management practices; their use is recommended although not required.

Many modern stormwater management practices trap water, in addition to sediment, allowing the water to absorb into the soil locally as it was intended. Best management practices (BMPs) are prescribed in the Catalog of Stormwater Best Management Practices for Idaho Cities and Counties. These practices are generally sufficient to meet the requirements of a TMDL.

PAGE 26, DEPOSITION: Deposition should not be included in the cumulative rating for the lateral recession rate without qualification. Severe bank erosion can occur in concert with recent deposits. Frequently, bars formed on the insides of bends direct greater erosive forces to the opposite bank (outside bank). Of course, if a channel is losing capacity to sediment deposits so that bank heights are decreased, channel erosion could be reduced because of reduced velocities as greater proportions of water discharges are out of bank and on the flood plain.

Duly noted.

PAGE 26, BREAKDOWN, SLUMPING, FRACTURES, AND VERTICAL BANKS: The timing of observation of stream banks is critical. Slumping, fractures, and breakdown are all indications of very unstable banks. For example, tension cracks (only) could be observed one day, and shortly afterward, complete bank failure could occur. In this case, nothing has changed except continuation of a failure process.

The streambank erosion inventory surveys significant reaches and is assumed to be representative of the stream and assessment unit as a whole. At any given time streambanks will *exist in various states of stability and instability, which can depend on land use. While streambank erosion is a dynamic process, the inventory captures this across the entire reach.*

PAGE 26, COVERED STREAMBANKS: Crediting logs with protection of streambanks has pitfalls. There are plentiful examples of logs having the opposite effect by creating turbulence which exacerbates bank stability. It is logical, however, to count logs if they are in total contact with bank soil.

Correct, when a log is serving to stabilize a bank it is counted as such, however; if a log is creating turbulence and visible erosion is occurring the bank is then inventoried as unstable.

PAGE 27, SITE SELECTION, FIRST PARAGRAPH and PAGE 28, LAST FULL PARAGRAPH, LEOPOLD ET AL REFERENCE: There appears to be an assumption that stream channel erosion generally increases with increasing drainage area. While a relationship of stream channel erosion to drainage area size (a surrogate for water discharge), singling out one variable leads to inaccuracies. This is a very complex matter. Stream channel erosion is also a function of stream gradient, cover conditions on the watershed, topography, inherent erosion resistance of bank perimeter material, and soil moisture. It is not unusual for the lowest rates of channel erosion per mile to occur in the lower reaches where the drainage area is the greatest. The flatter channel gradients in lower reaches play major roles in such cases.

Duly noted.

PAGE 28, LAST FULL PARAGRAPH, REFERENCE TO BANK TRAMPLING: The reference to bank trampling seems to fail to recognize that there is an interrelationship between the destabilizing influence of bank trampling and sediment loading by major runoff events. If banks are trampled, sediment loading is increased as soils are made readily available for entrainment into stream flow.

The streambank erosion inventory is focused on bank stability and cover. Trampling is an obvious sign of instability. Sediment loading from bank instability derives from two sources: direct input from the bank itself and from increased runoff that occurs when the riparian area is no longer functional.

The reference to bank stability here indicates that on an annual basis trampling of the banks may contribute substantially more sediment to the stream than a 50-year flood. Not only do trampled banks contribute more sediment on an annual basis, but they also increase sediment loading during high flow events.

PAGE 31, APPENDIX C: The example shows that "bank erosion over sampled reach" is the same as "total streambank erosion". If these two values are equal, it follows that the sample rate was 100%. The document shows sample rates ranging from 10% to 30%.

It is unrealistic to inventory an entire stream for various reasons including landowner's access issues. Therefore, a representative reach of stream is chosen and a minimum of 10%–30% of the stream length is surveyed. A sample of 10%–30% of the stream is assumed to be representative and therefore extrapolated to the entire stream. The calculations in Appendix C have been revised and loads throughout the document have been updated to reflect this.

Name:

Karie Pappani

Affiliation:

Idaho Soil and Water Conservation Commission

SVAP, SECI, Wolman Pebble Count, and Solar Pathfinder Data Analysis

The following is a summary of results from field data collected by Leslie Freeman (DEQ), Lance Holloway (SWC), and Karie Pappani (SWC) during the summer of 2010.

SVAP scores indicate a poor rating for the E.F. Goose Creek reaches 1 and 3, W.F. Goose Creek reach 1, Big Creek reaches 1, 2, 3, and 4, Fourmile Creek reaches 1, 2, and 3, and the Little Salmon River reach 2.

Streambank erosion measurements demonstrate that Mud Creek reach 1 (32%), Mud Creek reach 2 (24%), Little Mud Creek reach 1 (22%), Big Creek reach 2 (44%), and Big Creek reach 4 (23%) have less than 80% bank stability. These reaches have the largest percent eroding banks of the streams assessed in the subbasin.

Wolman Pebble Count data shows that fine particle (0- 2.5 mm) percentages ranged from 30% to 62% for Mud Creek reaches 1 and 2, Little Mud Creek reaches 1, 2, 3, and 4, W.F. Goose Creek reach 1, Big Creek reach 1, Fourmile Creek reaches 1, 2, 3, and 4, and Little Salmon River reaches 2 and 3. The LSR SBA-TMDL addendum states that "Support of cold water aquatic life is generally found at a percent fine level of 28% or less." Fine particles were less than 28% for all of the E.F. Goose Creek reaches, W.F. Goose Creek reach 2, Little Salmon River reach 1, Big Creek reaches 2-6, and Fourmile Creek reach 6.

Solar Pathfinder percent shade values exceed 20% lack of shade for Little Mud Creek reaches1, 3 and 4, Middle Mud Creek reach1, E.F. Goose Creek reach 5, Fourmile Creek reaches 1 and 2, and Big Creek reaches 4 and 5.

These results are also summarized in watershed summaries available from the ISWCC.

<u>Little Salmon River SBA-TMDL Addendum, Section 5.1.2.</u>

DEQ reports that… "61% of the instream substrate from all sample reaches consisted of fine particles, such as silt and clay." This information was taken from the Little Salmon River SBA-TMDL Five Year Review. Mud Creek reaches 1 and 2 and Little Mud Creek reaches 1 and 2 are included in Assessment Unit ID17060210SL008_03. The average percent fines (0-2.5 mm) for these reaches combined equals 55%. This value was generated by determining the percent fines for each cross section and then taking an average of the three cross sections within a reach. Similarly, the percent fines calculated (described above) for Little Mud Creek (17060210SL008_02A) is 46% rather than 51%. Could you please explain how percent fines was calculated.

Percent fines are calculated by summing the following categories: silt/clay (0-1 mm) and sand (1.1-2.5 mm) for all 3 transect at both sites and dividing this by the total number of samples for all 3 transects at both sites. This was done incorrectly in the Little Salmon River SBA-TMDL Five Year Review and therefore it miscalculated percent fines. This will be corrected.

The average percent fines (0-2.5 mm) for all transects on both reaches (1 and 2) for Mud Creek should read 54%. The percent fines (0-2.5 mm) for Little Mud Creek should read 52%. The total average percent fines for the Mud and Little Mud Creek assessment unit is 53%.

The referenced assessment unit for Little Mud creek is incorrect. This section of Little Mud Creek belongs to the same assessment unit as Mud Creek ID17060210SL008_03. The assessment unit 17060210SL008_02A does not exist. The document and the five- year review have been updated to reflect this correction.

<u>Appendix C. Mud Creek Data</u>

Please clarify some of the calculations in the worksheet, Table C-1. In the following discussion, data from Mud Creek reaches 1 and 2 and Little Mud Creek reaches 1 and 2 were used because these four reaches comprise one AU (see above). This same question would also apply to the remaining AUs assessed in the subbasin.

Average Bank Height = 6.9 ft for Mud Creek reach 1. Mud Creek reach 2 is 6.5 ft. Little Mud Creek reach 1 is 3.9 ft. Little Mud Creek reach 2 is 4.7 ft. It appears that the calculations in the spreadsheet use the Bank Height for Mud Creek reach 1 only to calculate streambank erosion for all four reaches.

The weighted average bank height for all reaches, based on the number of measurements in each reach is 5.87 feet. This adjustment has been made and accounted for in sediment TMDL for Mud Creek.

Please explain the need for Bank to Bank Length. Total Bank Length, which is the total measure of right and left bank lengths within the reach, equals 31,078.7 ft.

This particular number is not used in this particular calculation, but quantifies the right and left streambank lengths

Please explain the need for Bank to Bank Eroding Segment Length. Total Eroding Length equals 7,176 ft.

Both banks contribute sediment to the stream, the bank-to-bank eroding length is multiplied by the average bank height of 5.87 feet to give an area in square feet.

Eroding Area is incorrectly calculated using the average Bank Height for Mud Creek reach 1 multiplied by the Bank to Bank Eroding Segment Length, which is derived from incorrectly doubling the Erosive Bank Length.

> ***The average Eroding Area equals 42,702.4 ft^2. This was calculated by multiplying the Eroding Length and the Average Eroding Bank Height for each reach and then summing these areas for the reaches in the Assessment Unit. Bank Erosion is intended to be calculated for each given reach.**

The correct weighted average bank height is 5.87 feet. The eroding stream length is indeed meant to be doubled to account for sediment loading from both banks. The average eroding area is 42,123.12 ft^2.

Bulk density is mass/unit volume of soil in cubic units (lbs/ft^3). Bulk Density is incorrectly shown as lb/ft^2.

Bulk density has been corrected to read lbs/ft^3.

How was 85 chosen as the number for Bulk Density? Blackwell clay loam soil is approximately 93.64 lbs/ft^3.

A bulk density of 95.98 lbs/ft^3 was used, which is an average of the 2 soils present in both Mud and Little Mud Creek SEI data forms (Blackwell Clay Loam and Gestrin Loam)

The above information impacts the Erosion Rate and the Load Reduction calculations.

Yes, erosion rates and load reductions have all been revised downward, although the 80% bank stability target is unaffected.