Salt River Subbasin Assessment and Total Maximum Daily Loads

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Table of Contents

List of Tables

List of Figures

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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)
AU	assessment unit
BLM	United States Bureau of Land Management
BMP	best management practice
BURP	Beneficial Use Reconnaissance Program
C	Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liabilities Act
CFR	Code of Federal Regulations (refers to citations in the federal administrative rules)
cfs	cubic feet per second
cfu	colony forming units
CGP	Construction General Permit
cm	centimeters
CWAL	cold water aquatic life
DEQ	Idaho Department of Environmental Quality
DO	dissolved oxygen
E coli	*Escherichia coli*
EPA	United States Environmental Protection Agency
GIS	geographic information system
HUC	hydrologic unit code
IDAPA	Refers to citations of Idaho administrative rules
mg/L	milligrams per liter
mL	milliliter
mm	millimeter
MS4	municipal separate storm sewer system
MSGP	Multisector General Permit
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
ODA	overburden disposal area
PCR	primary contact recreation
SCR	secondary contact recreation
SEI	streambank erosion inventory
SFI	DEQ’s Stream Fish Index
SHI	DEQ’s Stream Habitat Index
SMI	DEQ’s Stream Macroinvertebrate Index
SS	salmonid spawning
SWPPP	stormwater pollution prevention plan
TMDL	total maximum daily load

TSS	total suspended solids
US	United States
USC	United States Code
USFS	United States Forest Service
USGS	United States Geological Survey
WAG	watershed advisory group

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 Integrated Report. 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 17 water bodies (35 assessment units [AUs]) in the Salt River subbasin that have been placed in Category 5 of Idaho’s most recent federally approved Integrated Report (DEQ 2014a).

This analysis describes the key physical and biological characteristics of the subbasin; water quality concerns and status; pollutant sources; and recent pollution control actions in the Salt River subbasin, located in southeastern Idaho.

The TMDL analysis establishes water quality targets and load capacities, estimates existing pollutant loads, and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards. It also identifies implementation strategies—including reasonable time frames, approach, responsible parties, and monitoring strategies—necessary to achieve load reductions and meet water quality standards.

Sediment, bacteria, habitat modifications, and selenium are stressors affecting beneficial uses in the subbasin. Much of the basin is grazed by livestock on US Forest Service (USFS), Bureau of Land Management (BLM), and private lands. This activity can impact streams by destabilizing banks, reducing riparian vegetation, and widening the stream channel (Belsky et al. 1999). Livestock grazing can also impact the beneficial use of contact recreation by increasing bacterial concentrations in streams. The Salt River subbasin contains historic and active phosphate mines. Waste rock dumps and open pits have the potential to pollute nearby water and impact beneficial uses of aquatic life. Other suspected stressors include erosion caused by recreation and roads.

Assessments identified sediment as the pollutant source in 16 assessment units (AUs) in the subbasin, and TMDLs were developed for each of these AUs. In the Salt River subbasin, excess sediment is primarily the result of bank erosion initiated by livestock grazing on public and private lands. Excess sediment (i.e., above natural) also may make its way to streams through erosion from roads and trails and through field erosion of agricultural lands. However, the Idaho Department of Environmental Quality (DEQ) determined that roads and trails were not the primary stressors but rather streambank erosion caused by livestock grazing. Streambank erosion inventories (SEIs) were conducted on streams where sediment was the suspected stressor. Typically, natural streambank stability is greater than 80%. Where stability was below 80%, a conservative TMDL of 80% streambank stability was applied. Additionally, DEQ measured fine subsurface sediments with McNeil core samples in areas where salmonid spawning occurs. To protect the beneficial use of salmonid spawning, TMDLs for subsurface fines was set for areas where salmonid spawning is likely an existing use. Target limits have been set so that fine sediments (>6.25 millimeters [mm]) are not to exceed 25% of the total volume of sediment, and ultrafine sediments (>0.85 mm) are not to exceed 10%.

Five AUs, Rich Creek (ID17040105SK003_02a), Whiskey Creek (ID17040105SK003_02b), Lau Creek (ID17040105SK003_02c), Houtz Creek (ID17040105SK003_02d), and Chicken Creek (ID17040105SK003_02g), were assessed by the Beneficial Use Reconnaissance Program (BURP) in 1999 and 2004. All five AUs are small tributaries to Tincup Creek, and in 1999 had scores that indicated full support of cold water aquatic life (CWAL). In 2004, however, scores indicated that these AUs were not fully supporting CWAL. All streams are fully contained on USFS land, and land use in these AUs did not change during this time. Rather, 2004 assessments were conducted during the fifth year of a severe drought in the subbasin, and all AUs had flows ≤0.5 cubic feet per second (cfs). Whiskey and Chicken Creeks had flows below 0.1 cfs. BURP indices were developed from assessments conducted on wadeable, perennial, freestone streams. The stream macroinvertebrate index (SMI), stream habitat index (SHI), and stream fish index (SFI) were developed based on reference conditions that describe persistent aquatic habitats, which allow full development of aquatic communities. During this extended drought when stream flows were so meager, it was not valid to compare these tributaries to reference conditions. Therefore, 2004 scores were disregarded. Further evidence demonstrates that sediment was not impairing these AUs. SEIs indicated that each AU had streambank stabilities above 90%, and there are no additional sources of sediment. Increased fine sediment and substrate embeddedness levels observed in the 2004 BURP assessment were likely the result of drought-inhibiting flushing of fines from the streambed, rather than from excess bank erosion. Assessing these AUs with BURP protocols was not valid at such low flows, and other evidence (1999 BURP assessments, an SEI for each AU, and full support of beneficial uses in the downstream segment ID17040105SK003_03) indicates that these AUs are fully supporting beneficial uses when there is sufficient water to do so. These AUs should be delisted for cause unknown, combined biota/habitat bioassessments, and habitat assessment and moved to Category 2 as fully supporting CWAL in the next Integrated Report.

Cabin Creek (ID17040105SK002_02c) is listed in Category 5 for Idaho’s 2012 Integrated Report for sedimentation/siltation and is in Category 4c for physical substrate habitat alterations. BURP assessments were conducted in or near beaver ponds, producing invalid data. A SEI conducted in 2010 indicates that banks are highly stable (95%). Cabin Creek should be placed in Category 3 of the next Integrated Report as unassessed and delisted for sedimentation/siltation until valid assessment data are available. The Category 4c listing should be removed as the physical substrate is not altered.

West Fork Boulder Creek (ID17040105SK006_02d) was mistakenly listed in Category 5 of the 2012 Integrated Report for cause unknown. A 2001 BURP assessment indicates that this stream is fully supporting CWAL. This AU should be moved to Category 2 in the next Integrated Report.

White Canyon (ID17040105SK006_02f) was listed in Category 5 for sedimentation/siltation and is also in Category 4c for physical substrate habitat alterations. This stream is intermittent (as evidenced by site visits and stream invertebrate taxa) and BURP protocols produce invalid data. During the BURP assessment in 1999, the stream had a flow of 0.11 cfs and was dry in 2004 and

2012. This AU should be moved to Category 3 as unassessed and removed from Category 4c as the physical substrate is not altered.

Sage Creek (ID17040105SK009_02c) and South Fork Sage Creek (ID17040105SK009_02e) were both listed for combined biota/habitat bioassessments based on failed BURP scores when sampled in 2006. Both of these BURP surveys did not include electrofishing and both failed because of SHI condition ratings of 1. SMI condition ratings were both a passing 2. In 2014, both AUs were sampled with an SEI and additional Wolman pebble count. SEIs indicated that both AUs had stable banks, and surface fine sediments were not elevated. South Fork Sage Creek was surveyed by BURP in an unrepresentative reach where grazing pressures are concentrated. DEQ recommends that an additional BURP survey be completed on both AUs. Surveys should include electrofishing that will generate an SFI score to better assess the biological state of these AUs.

Assessments by DEQ and the Wyoming Star Valley Conservation District identified five AUs—Bear Canyon (ID17040105SK003_02e), Lower Stump (ID17040105SK006_04), Smoky (ID17040105SK007_02c), Draney (ID17040105SK007_02f), and Crow (ID17040105SK008_04) Creeks—that were not meeting their beneficial use of secondary contact recreation (SCR) because of high levels of *Escherichia coli* (*E. coli*) bacteria. Lower Stump Creek was not listed in the Integrated Report for *E. coli* but was found to be impaired. Bacteria TMDLs were calculated for each of these AUs based on meeting the criteria of 126 colony forming units (cfu) per 100 milliliter (mL) of water. Nonpoint sources of *E. coli* in the subbasin include feces of livestock and wildlife. *E. coli* is transported to streams when warm-blooded animals defecate in water or when overland flow moves fecal particles to streams. *E. coli* bacteria can reach high levels especially during low flow when water is warm and animals are concentrated near streams.

In Idaho's 2012 Integrated Report, three AUs (Crow Creek ID17040105SK008_02, ID17040105SK008_02d, and ID17040105SK008_03b) were mistakenly listed in Category 5 for *E. coli*. These three Crow Creek AUs were listed in error based on misapplied data from the 4th-order segment of Crow Creek. Two AUs (ID17040105SK008_02d and ID17040105SK008_03b) are meeting water quality standards for SCR and should be moved to Category 2. Crow Creek ID17040105SK008_02 has not been assessed for SCR and should be moved to Category 3 as unassessed.

Four AUs in the subbasin—North Fork Sage (ID17040105SK009_02), Pole Canyon (ID17040105SK009_02d), South Fork Sage (ID17040105SK009_02e), and Sage (ID17040105SK009_03) Creeks—are listed in Category 5 for selenium. These AUs drain areas of the Smoky Canyon Mine Site including waste rock dumps. Selenium listings will not be addressed as part of this subbasin assessment and TMDL. Rather, these listings are being addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a mine reclamation program.

Subbasin at a Glance

The Salt River subbasin is located in southeastern Idaho and western Wyoming (Figure A). Streams located in the Idaho portion of the drainage flow east off the Caribou Mountains to the Salt River, which in turn, joins the Snake River at Palisades Reservoir. Major tributaries in Idaho include Jackknife, Tincup, Stump, Tygee, and Crow Creeks. The USFS owns 80% of the land, while private holdings account for 17%. Other landholders include BLM and the State of Idaho, possessing 1.8% and 0.5%, respectively. Economic activity in the subbasin includes phosphate mining, sheep and cattle grazing, agriculture, and recreation. The basin is sparsely populated and includes no incorporated towns in Idaho.

Historically, Salt River water bodies sustained several beneficial uses. All streams supported CWAL, agricultural water supply, and SCR. Some streams also maintained populations of spawning salmonids. Current data indicate that some beneficial uses, such as CWAL and SCR, are impaired and are not fully supported in several streams in the basin. In Idaho's 2012 Integrated Report, 35 AUs in the Salt River subbasin were listed in Category 5 as impaired waters (Figure B) (DEQ 2014a).

Subbasin:	Salt River
HUC:	17040105
Beneficial Uses:	Cold water aquatic life, salmonid spawning, primary/secondary contact recreation, agricultural water supply
Uses Affected:	Cold water aquatic life, salmonid spawning, secondary contact recreation
Pollutants:	Sediment, bacteria, selenium
Sources:	Point sources: none
	Nonpoint sources: Agriculture,grazing, mining, recreation, roads

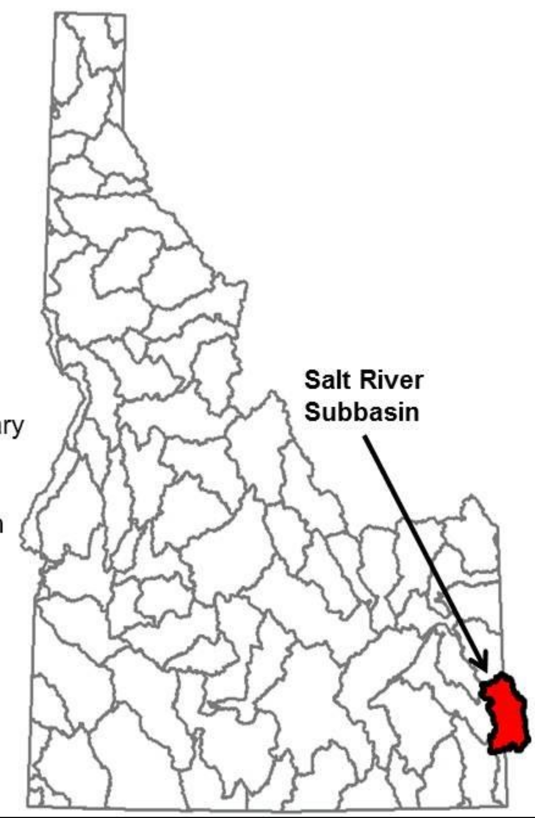

Figure A. Salt River subbasin.

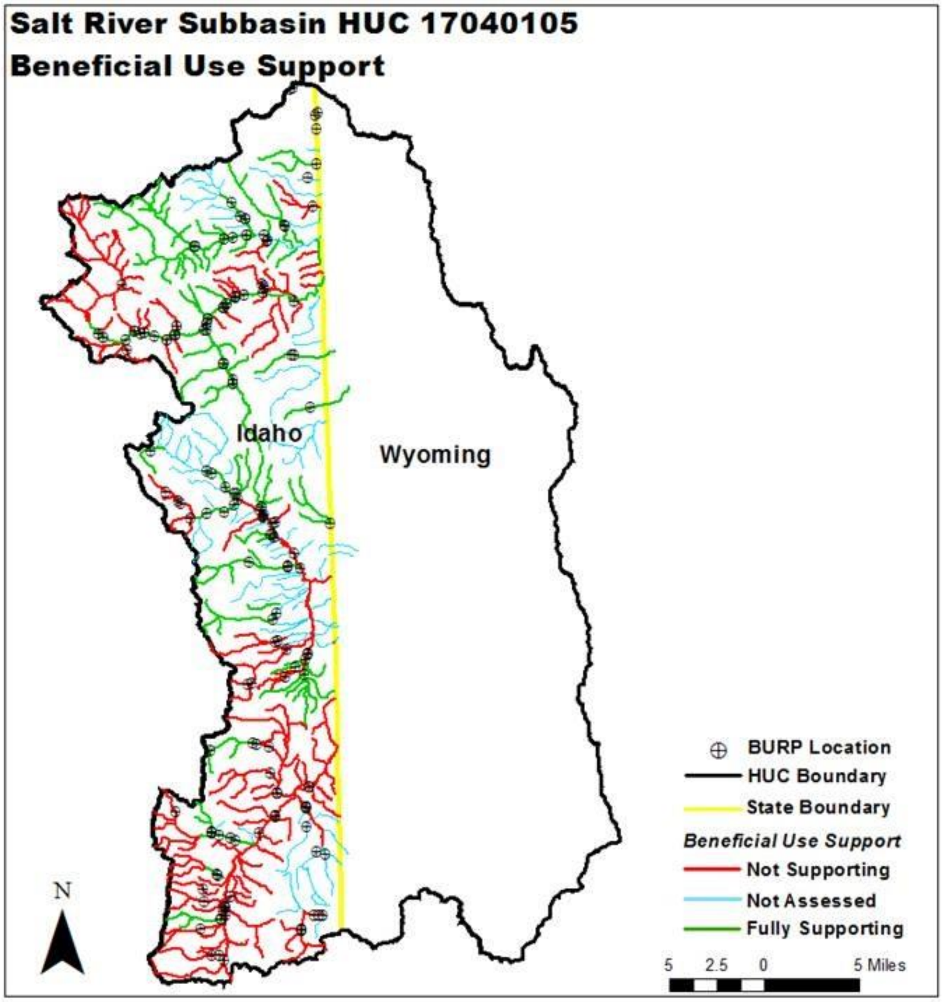

Figure B. The 2012 Integrated Report beneficial use support status and BURP locations.

Key Findings

Category 5 of the 2012 Integrated Report includes 35 AUs in the Salt River subbasin. Twelve AUs are listed for sediment, 7 for *E. coli* or fecal coliform, 16 for cause unknown, habitat assessments, and combined biota/habitat bioassessments, and 4 for selenium. TMDLs are listed by pollutant in Table A. Assessment outcomes for listed pollutants in the 2012 Integrated Report are contained in Table B. Lower Stump Creek was unlisted but impaired for *E. coli* and received a TMDL. Selenium listings will not be addressed as part of this subbasin assessment and TMDL. Rather, these listings are being addressed under CERCLA, a mine reclamation program. Through this process, efforts will be taken to return these waters to meeting water quality standards, at which time they will be moved to Category 2.

Sediment, bacteria, habitat modifications, and selenium are stressors affecting beneficial uses in the subbasin. Much of the basin is grazed by livestock on USFS, BLM, and private lands. This activity can impact streams by destabilizing banks, reducing riparian vegetation, and widening the stream channel (Belsky et al. 1999). Livestock grazing can also impact the beneficial use of contact recreation by increasing bacterial concentrations in streams. The Salt River subbasin contains historic and active phosphate mines. Waste rock dumps and open pits have the potential to pollute nearby water and impact beneficial uses of aquatic life. Other suspected stressors include erosion caused by recreation and roads.

Beneficial use support in the subbasin was determined on an AU-by-AU basis by DEQ's BURP. If a particular AU was determined to not be meeting its presumed or designated beneficial uses, an assessment was conducted to determine the appropriate pollutant. Sediment was the source of pollution for the majority of AUs placed in Category 5. DEQ conducted SEIs on AUs where sediment was the suspected pollutant. This method measures eroding streambanks at bankfull width because most excess erosion occurs during snowmelt and early spring runoff when the channel is at a bankfull stage. Targets for streambank stability were set at ≥80%, which is presumed to be close to natural background-loading rates for streams with A, B, or C channel types in plutonic, volcanic, metamorphic, and sedimentary geology types (Overton et al. 1995). TMDLs were developed to achieve that target where beneficial uses are assumed to be supported. For AUs listed in Category 5 where salmonid spawning is likely an existing use, McNeil core samples were taken in salmonid spawning habitat, if it was encountered and accessible. To protect the beneficial use of salmonid spawning, TMDLs for subsurface fines was set so that fine sediments (>6.25 mm) are not to exceed 25% of the total volume of sediment, and ultrafine sediments (>0.85 mm) are not to exceed 10%. Bacteria TMDLs were developed for AUs that exceeded Idaho's water quality standards for the pollutant (IDAPA 58.01.02.251). *E. coli* is not to exceed 126 cfu/100 mL of water based on the geometric mean of five samples taken over a 30-day period. This criterion applies to both primary and secondary contact recreation. Bacteria TMDLs are based on meeting this criterion at all times.

Table A. Water bodies and pollutants for which TMDLs were developed.

Water Body	Assessment Unit Number	Pollutant(s)
Newswander Canyon	ID17040105SK001_02b	Sediment
Tincup Creek	ID17040105SK003_02	Sediment
Bear Canyon	ID17040105SK003_02e	*Escherichia coli (E. coli)*
Luthi Canyon	ID17040105SK003_02i	Sediment
Haderlie Creek	ID17040105SK003_02j	Sediment
Upper Boulder Creek	ID17040105SK006_02c	Sediment
Graehl Canyon	ID17040105SK006_02g	Sediment
Lower Stump Creek	ID17040105SK006_04	*E. coli*, sediment
Smoky Creek	ID17040105SK007_02c	*E. coli*, sediment
Draney Creek	ID17040105SK007_02f	*E. coli*, sediment
Tygee Creek	ID17040105SK007_03	Sediment
White Dugway Creek	ID17040105SK008_02a	Sediment
Beaver Dam Creek	ID17040105SK008_02c	Sediment
Crow Creek	ID17040105SK008_04	*E. coli*, sediment
Rock Creek	ID17040105SK011_03	Sediment
Little Elk Creek	ID17040105SK012_02a	Sediment
Spring Creek	ID17040105SK012_03	Sediment

Table B. Summary of assessment outcomes for evaluated assessment units.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Newswander Canyon	ID17040105SK001_02b	Sedimentation/ siltation (physical substrate habitat alterations)	Yes	List in Category 4a for sedimentation/siltation. Keep listed in Category 4c for physical substrate habitat alterations.	Sediment TMDL completed based on streambank stability of 80%. Stream is dammed below BURP site for irrigation and should not be expected to be fully supporting beneficial uses in this portion of the AU.
Cabin Creek	ID17040105SK002_02c	Sedimentation/ siltation (physical substrate habitat alterations)	No	List in Category 3 as unassessed, delist for sedimentation/siltation, and remove from Category 4c for physical substrate habitat alterations.	BURP assessments conducted within or near beaver ponds, producing invalid data. SEI shows no impairment of streambank stability. Physical substrate has not been altered.
Tincup Creek	ID17040105SK003_02	Sedimentation/ siltation	Yes	List in Category 4a for sedimentation/siltation. Change SCR to assessed and full support.	Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitat. *E. coli* data indicate support of SCR.
Rich Creek	ID17040105SK003_02a	Habitat assessments and cause unknown	No	Delist for habitat assessments and cause unknown, and move to Category 2.	Assessed by BURP during 2004 drought at flow of 0.3 cfs. Not valid comparison to reference conditions. Other data (1999 BURP, 2010 SEI) indicate no impairment.
Whiskey Creek	ID17040105SK003_02b	Combined biota/habitat bioassessments	No	Delist for combined biota/ habitat bioassessments, and move to Category 2.	Assessed by BURP during 2004 drought at flow of 0.09 cfs. Not valid comparison to reference conditions. Other data (1999 BURP, 2010 SEI) indicate no impairment.
Lau Creek	ID17040105SK003_02c	Habitat assessments and cause unknown	No	Delist for habitat assessments and cause unknown, and move to Category 2.	Assessed by BURP during 2004 drought at flow of 0.2 cfs. Not valid comparison to reference conditions. Other data (2010 SEI, 1999 and 2004 SMI) indicate no impairment.
Houtz Creek	ID17040105SK003_02d	Cause unknown	No	Delist for cause unknown, and move to Category 4c for habitat alteration.	Bottom 100 meters of this AU is channelized and should be listed for habitat alteration. Bank erosion not contributing excess sediment as documented in 2010 SEI with bank stability of 99%. 1999 BURP assessment above channelization indicates no impairment.
Bear Canyon	ID17040105SK003_02e	*E. coli*	Yes	List in Category 4a for *E. coli.*	*E. coli* TMDL completed based on meeting geometric mean criteria of 126 cfu/100 mL.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Chicken Creek	ID17040105SK003_02g	Combined biota/habitat bioassessments	No	Delist for combined biota/habitat bioassessments, and move to Category 2.	Assessed by BURP during 2004 drought at flow of 0.08 cfs. Not valid comparison to reference conditions. Other data (1999 BURP assessment, 2010 SEI) indicate no impairment.
Luthi Canyon	ID17040105SK003_02i	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80%.
Haderlie Creek	ID17040105SK003_02j	Sedimentation/ siltation (physical substrate habitat alterations)	Yes	List in Category 4a for sedimentation/siltation, and keep listed in Category 4c for physical substrate habitat alterations.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitat. Much of AU is in a ditch through fields.
Upper Boulder Creek	ID17040105SK006_02c	Cause unknown	Yes	List in Category 4a for sedimentation/siltation, and delist for cause unknown.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats.
West Fork Boulder Creek	ID17040105SK006_02d	Cause unknown	No	List in Category 2, and delist for cause unknown.	2001 BURP assessment indicates full support of CWAL and 2012 SEI calculated 100% streambank stability. Listed in error.
White Canyon	ID17040105SK006_02f	Sedimentation/ siltation (physical substrate habitat alterations)	No	List in Category 3 as unassessed, and delist for sedimentation/siltation and physical substrate habitat alterations in Category 4c.	Stream is intermittent and BURP protocols are not appropriate for nonperennial streams. Stream is not physically altered.
Graehl Canyon	ID17040105SK006_02g	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80%.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Lower Stump Creek	ID17040105SK006_04	Sedimentation/ siltation	Yes	List in Category 4a for sedimentation/siltation and *E. coli.*	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts and high subsurface fines documented by McNeil core samples in salmonid spawning habitat. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. Exceedances of *E. coli* criteria documented by Wyoming Star Valley Conservation District. *E. coli* TMDL completed based on geometric mean criteria of 126 cfu/100 mL. Unlisted but impaired by *E. coli.*
Smoky Creek	ID17040105SK007_02c	*E. coli* and sedimentation/ siltation (physical substrate habitat alterations)	Yes	List in Category 4a for *E. coli* and sedimentation/siltation, and keep listed in Category 4c for physical substrate habitat alterations.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. *E. coli* TMDL completed based on geometric mean criteria of 126 cfu/100 mL. Drains Smoky Canyon Mine, and physical habitat is altered.
Draney Creek	ID17040105SK007_02f	Sedimentation/ siltation and fecal coliform (physical substrate habitat alterations)	Yes	List in Category 4a for sedimentation/siltation and *E. coli*. Remove from Category 4c for physical substrate habitat alterations.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. *E. coli* TMDL completed based on geometric mean criteria of 126 cfu/100 mL. AU habitat is not physically altered.
Roberts Creek	ID17040105SK007_02g	Combined biota/habitat bioassessments	No	List in Category 3 as unassessed, and delist for combined biota/habitat bioassessments.	BURP assessments took place in marshy reach and do not represent entire AU. Data from Formation Environmental indicate no impairments.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Tygee Creek	ID17040105SK007_03	Sedimentation/ siltation (low-flow alterations and physical substrate habitat alterations)	Yes	List in Category 4a for sedimentation/siltation, and keep listed in Category 4c for low-flow alterations and physical substrate habitat alterations.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. Stream is channelized and rerouted around a pond used for milling ore and is diverted for agriculture.
Crow Creek (source to Idaho/Wyoming border)	ID17040105SK008_02	*E. coli*	No	Delist *E. coli,* and move to Category 3.	Data on 4th-order segment misapplied to this AU. SCR and CWAL have not been assessed.
White Dugway Creek	ID17040105SK008_02a	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts and high subsurface fines measured in McNeil core samples. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats.
Beaver Dam Creek	ID17040105SK008_02c	Sedimentation/ siltation (physical substrate habitat alterations)	Yes	List in Category 4a for sedimentation/siltation, and remove from Category 4c for physical substrate habitat alterations.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. Stream is not impacted by channelization or other active channel manipulation.
Crow Creek	ID17040105SK008_02d	*E. coli*	No	Delist *E. coli,* and move to Category 2. Only SCR was assessed.	Listed in error. Data misapplied from 4th-order segment of Crow Creek. Data from 2014 indicate no impairment.
Crow Creek	ID17040105SK008_03b	*E. coli*	No	Delist *E. coli*, change SCR to fully supporting, and move AU to Category 2.	2001 *E. coli* sample meets criteria for SCR. Listed in error. Data misapplied from 4th-order segment of Crow Creek.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Crow Creek (Deer Creek to border)	ID17040105SK008_04	*E. coli* and sedimentation/ siltation	Yes	List in Category 4a for *E. coli* and sedimentation/siltation.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. *E. coli* TMDL completed based on geometric mean criteria of 126 cfu/100 mL.
North Fork Sage Creek	ID17040105SK009_02	Selenium	No	Keep in Category 5 for selenium.	Selenium remediation under CERCLA.
Sage Creek	ID17040105SK009_02c	Combined biota/habitat bioassessments	No	Keep in Category 5 and combined biota/habitat bioassessments.	Impairment documented because of failing habitat score in 2006. Revisit indicated that banks are stable and fine sediments are not elevated. Recommend BURP resample AU and electroshock for fish.
Pole Canyon Creek	ID17040105SK009_02d	Selenium	No	Keep in Category 5 for selenium.	Selenium remediation under CERCLA.
South Fork Sage Creek	ID17040105SK009_02e	Combined biota/habitat bioassessments and selenium	No	Keep in Category 5 for selenium and combined biota/habitat bioassessments.	Impairment documented by a BURP assessment in an unrepresentative reach. Revisit indicated surface fines are not elevated and banks are stable. Recommend BURP resample AU in a more representative reach and electroshock for fish. Selenium remediation under CERCLA.
Sage Creek (confluence with North Fork Sage Creek to mouth)	ID17040105SK009_03	Selenium	No	Keep in Category 5 for selenium.	Selenium remediation under CERCLA.
South Fork Deer Creek	ID17040105SK010_02a	Sedimentation/ siltation (physical substrate habitat alterations)	No	Move to Category 2, delist for sedimentation/siltation, and remove from Category 4c for physical substrate habitat alterations.	BURP assessment was misapplied and conducted in beaver pond. SEI indicated very stable banks. Data from Formation Environmental indicates AU is meeting CWAL beneficial use. Stream habitat is not altered.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Rock Creek	ID17040105SK011_03	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.	BURP data indicates unstable and sloughing banks. The 2014 SEI indicates that banks are unstable (49%) on USFS land. In this reach, banks are trampled, and stream is widened by livestock. Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats.
Little Elk Creek	ID17040105SK012_02a	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments. Change SCR to assessed and full support.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80%. *E. coli* data indicate support of SCR.
Spring Creek	ID17040105SK012_03	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats.

Notes: TMDL = total maximum daily load; BURP = Beneficial Use Reconnaissance Program; AU = assessment unit; SEI = streambank erosion inventory; cfs = cubic feet per second; cfu = colony forming unit; mL = milliliter; CWAL = cold water aquatic life; *E. coli* = *Escherichia coli*; SCR = secondary contact recreation; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

Public Participation

This TMDL was sent to members of the watershed advisory group (WAG) on October 27, 2014. WAG members were given until December 15, 2014, to raise comments or concerns about the document before the public comment period. A reminder of the upcoming deadline was sent on December 8, 2014. No comments from WAG members were received.

Public comment was taken from April 28, 2015, through May 20, 2015. Two comments were received and are found in 0.

Introduction

This document addresses 35 assessment units (AUs) in the Salt River subbasin that have been placed in Category 5 of Idaho's most recent federally approved Integrated Report (DEQ 2014a). The purpose of this total maximum daily load (TMDL) is to characterize and document pollutant loads within the Salt River subbasin. The first portion of this document presents key characteristics or updated information for the subbasin assessment, which is divided into four major sections: subbasin characterization (section 1), water quality concerns and status (section 2), pollutant source inventory (section 3), and a summary of past and present pollution control efforts (section 4). While the subbasin assessment is not a requirement of the TMDL, the Idaho Department of Environmental Quality (DEQ) performs the assessment to ensure impairment listings are up-to-date and accurate.

The subbasin assessment is used to develop a TMDL for each pollutant of concern for the Salt River subbasin. 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. The TMDL also allocates allowable discharges of individual pollutants among the various sources discharging the pollutant.

Regulatory Requirements

This document was prepared in compliance with both federal and state regulatory requirements. The federal government, through the U.S. Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. DEQ implements the Clean Water Act in Idaho, while EPA oversees Idaho and certifies the fulfillment of Clean Water Act requirements and responsibilities.

Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act, in 1972. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 USC §1251). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The Clean Water Act has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to ensure "swimmable and fishable" conditions. These goals relate water quality to more than just chemistry.

The 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. DEQ must review those standards every 3 years, and EPA must approve Idaho's water quality standards. Idaho adopts water quality standards to protect public health and welfare, enhance water quality, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

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 waters in Idaho's Integrated Report. For waters identified on this list, states and tribes must develop a TMDL for the pollutants, set at a level to achieve water quality standards.

DEQ monitors waters, and for those not meeting water quality standards, DEQ must establish a TMDL for each pollutant impairing the waters. However, some conditions that impair water quality do not require TMDLs. EPA considers certain unnatural conditions—such as flow alteration, human-caused lack of flow, or habitat alteration—that are not the result of discharging a specific pollutant as "pollution." TMDLs are not required for water bodies impaired by pollution, rather than a specific pollutant. A TMDL is only required when a pollutant can be identified and in some way quantified.

1 Subbasin Assessment—Subbasin Characterization

The Salt River subbasin is located in southeastern Idaho and western Wyoming. Streams located in the Idaho portion of the drainage flow east off the Caribou Mountains to the Salt River, which in turn, joins the Snake River at Palisades Reservoir (Figure 1). Major tributaries in Idaho include Jackknife, Tincup, Stump, Tygee, and Crow Creeks. US Forest Service (USFS) land comprises 80% of the watershed, while private holdings account for 17%. Other landholders include the Bureau of Land Management (BLM) and State of Idaho with 1.8% and 0.5%, respectively (Figure 2). Economic activities in the basin include phosphate mining, grazing, agriculture, and recreation.

In Idaho, the Salt River subbasin lies mostly in Caribou County with a smaller portion of the northern basin in Bonneville County. The basin is sparsely populated and includes no incorporated towns. A portion of the border community of Freedom lies within the Idaho portion of the subbasin.

Elevations in the Salt River subbasin of Idaho range from above 8,500 feet on mountain tops of the Caribou Mountains to near 5,600 feet at the Palisades Reservoir. Mean annual precipitation varies from over 41 inches in the highest mountains to less than 21 inches at the lowest elevations. Most of the basin receives between 23 and 33 inches of precipitation annually. Climate is characterized by cold winters and warm summers.

The majority of the basin in Idaho Falls into the Partly Forested category under Level IV Ecoregions with a smaller portion of High Elevation Valleys. Vegetation cover includes aspen/conifer, mixed conifer, aspen, bigtooth maple, and grass/shrub types (Caribou-Targhee National Forest 2003). Geologically, the basin is mostly of sedimentary origins including Mesozoic and Paleozoic sedimentary rocks and Holocene-Pliocene sediments (Lewis et al. 2012).

Native fishes in the Salt River subbasin include speckled and longnose dace (*Rhinichthys cataeactae* and *R. osculus*), redside shiner (*Richardsonius balteatus*), bluehead, Utah, and mountain sucker (*Catostomus discobolus, C. ardens, and C. platyrhynchus*), northern leatherside chub (*Lepidomeda copei*), mottled and Paiute sculpin (*Cottus bairdii* and *C. beldingii*), mountain whitefish (*Prosopium williamsoni*), and cutthroat trout (*Oncorhynchus clarkii*) (Meyer et al. 2013, Schill and Heimer 1988). Introduced species include brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), and rainbow trout (*Oncorhynchus mykiss*) (Meyer et al. 2003). A study that compared the Salt River to the Portneuf, Raft, and Teton River drainages indicated that genetic diversity of Yellowstone cutthroat trout was highest and genetic differentiation was low in the Salt River basin, likely because migration corridors were largely intact (Cegelski et al. 2006). The fishery in Tincup Creek has been augmented by releases of hatchery cutthroat trout (IDFG 1996).

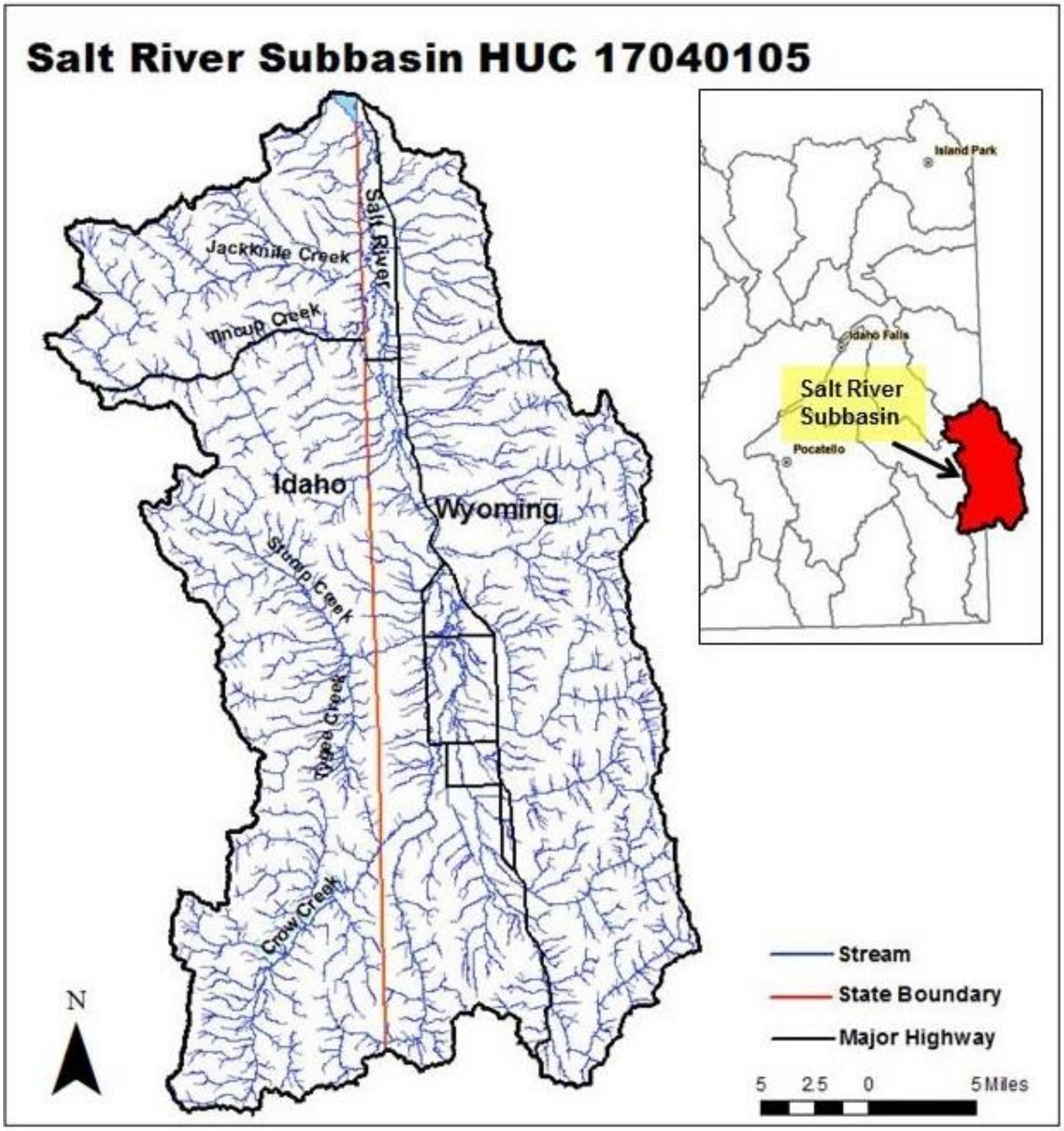

Figure 1. Salt River subbasin.

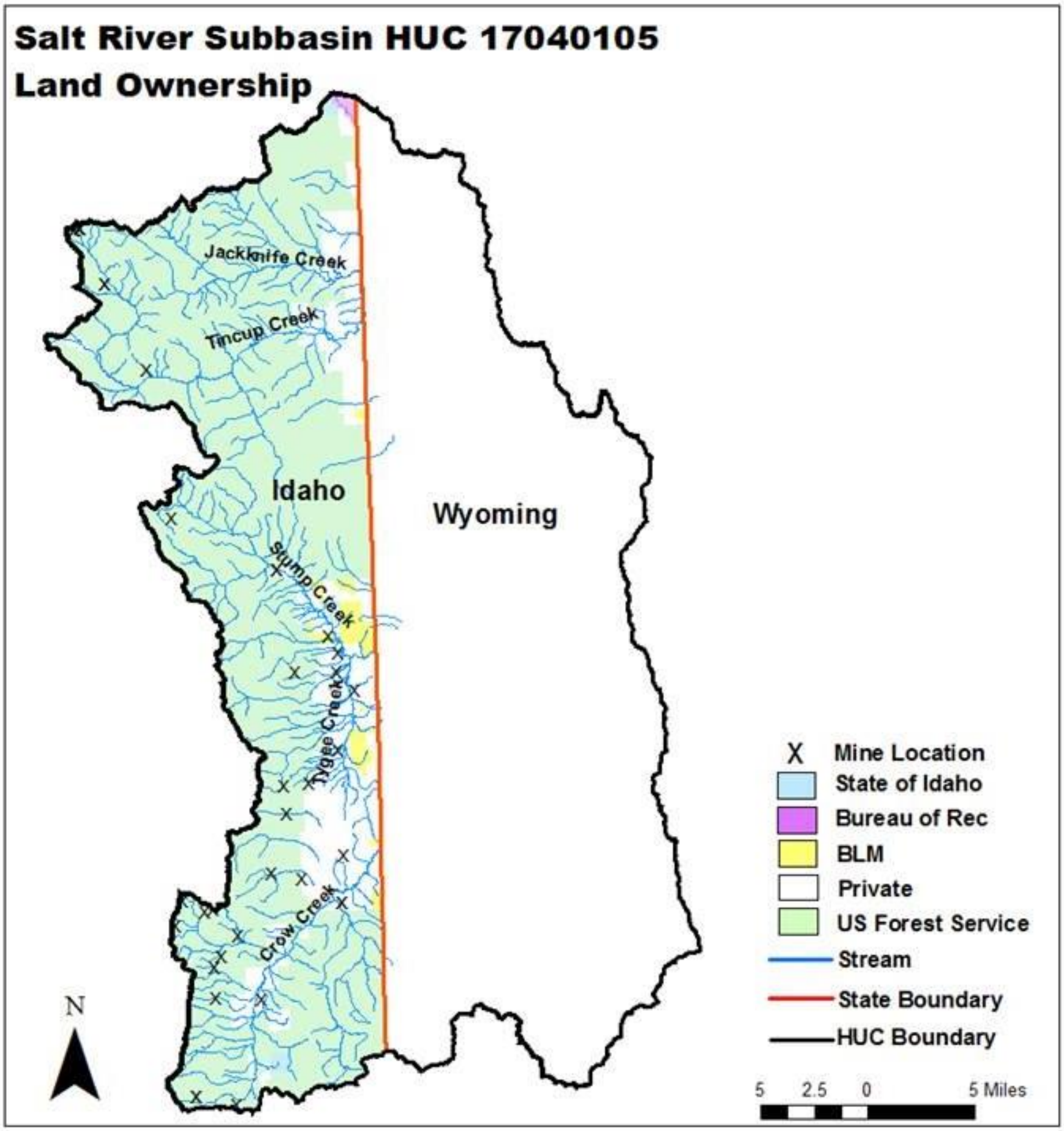

Figure 2. Landownership and mine locations in the Salt River subbasin.

2 Subbasin Assessment—Water Quality Concerns and Status

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

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 (Appendix A).

2.1.1 Assessment Units

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

Using AUs to describe water bodies offers many benefits primarily that all waters of the state are defined consistently. AUs are a subset of water body identification numbers, which allows them to relate directly to the water quality standards.

2.1.2 Listed Waters

Table 1 shows the pollutants listed and the basis for listing for each §303(d)-listed AU in the subbasin (i.e., AUs in Category 5 of the Integrated Report).

Table 1. Salt River §303(d)-listed assessment units in the subbasin.

Assessment Unit Name	Assessment Unit Number	Listed Pollutants	First Time Listed
Newswander Canyon	ID17040105SK001_02b	Sedimentation/siltation	2002 Integrated Report
Cabin Creek	ID1704015SK002_02c	Sedimentation/siltation	2002 Integrated Report
Tincup Creek	ID17040105SK003_02	Sedimentation/siltation	2008 Integrated Report
Rich Creek	ID17040105SK003_02a	Habitat assessment, cause unknown	2008 Integrated Report
Whiskey Creek	ID17040105SK003_02b	Combined biota/habitat bioassessments	2010 Integrated Report
Lau Creek	ID17040105SK003_02c	Habitat assessment, cause unknown	2008 Integrated Report
Houtz Creek	ID17040105SK003_02d	Cause unknown	2008 Integrated Report
Bear Canyon	ID17040105SK003_02e	*Escherichia coli (E. coli)*	2008 Integrated Report
Chicken Creek	ID17040105SK003_02g	Combined biota/habitat bioassessments	2002 Integrated Report
Luthi Canyon	ID17040105SK003_02i	Combined biota/habitat bioassessments	2002 Integrated Report
Haderlie Creek	ID17040105SK003_02j	Sedimentation/siltation	2008 Integrated Report
Upper Boulder Creek	ID17040105SK006_02c	Cause unknown	2008 Integrated Report
West Fork Boulder Creek	ID17040105SK006_02d	Cause unknown	2008 Integrated Report
White Canyon	ID17040105SK006_02f	Sedimentation/siltation	2002 Integrated Report
Graehl Canyon	ID17040105SK006_02g	Combined biota/habitat bioassessments	2008 Integrated Report
Lower Stump Creek	ID17040105SK006_04	Sedimentation/siltation	2008 Integrated Report
Smoky Creek	ID17040105SK007_02c	*E. coli*, sedimentation/siltation	2002 Integrated Report for sediment and the 2008 Integrated Report for *E. coli*
Draney Creek	ID17040105SK007_02f	Sedimentation/siltation, fecal coliform	2002 Integrated Report
Roberts Creek	ID17040105SK007_02g	Combined biota/habitat bioassessments	2010 Integrated Report

Assessment Unit Name	Assessment Unit Number	Listed Pollutants	First Time Listed
Tygee Creek	ID17040105SK007_03	Sedimentation/siltation	2008 Integrated Report
White Dugway Creek	ID17040105SK008_02a	Combined biota/habitat bioassessments	2010 Integrated Report
Beaver Dam Creek	ID17040105SK008_02c	Sedimentation/siltation	2002 Integrated Report
Crow Creek	ID17040105SK008_02d	*E. coli*	2010 Integrated Report
Crow Creek	ID17040105SK008_03b	*E. coli*	2010 Integrated Report
Crow Creek (Deer Creek to border)	ID17040105SK008_04	*E. coli*, sedimentation/ siltation	2008 Integrated Report for sediment and the 2010 Integrated Report for *E.coli*
North Fork Sage Creek	ID17040105SK009_02	Selenium	2002 Integrated Report
Sage Creek	ID17040105SK009_02c	Combined biota/habitat bioassessments	2010 Integrated Report
Pole Canyon Creek	ID17040105SK009_02d	Selenium	2008 Integrated Report
South Fork Sage Creek	ID17040105SK009_02e	Combined biota/habitat bioassessments, selenium	2008 Integrated Report for selenium and the 2010 Integrated Report for combined biota
Sage Creek (confluence with North Fork Sage Creek to mouth)	ID17040105SK009_03	Selenium	2008 Integrated Report
South Fork Deer Creek	ID17040105SK010_02a	Sedimentation/siltation	2002 Integrated Report
Rock Creek	ID17040105SK011_03	Combined biota/habitat bioassessments	2002 Integrated Report
Little Elk Creek	ID17040105SK012_02a	Combined biota/habitat bioassessments	2010 Integrated Report
Spring Creek	ID17040105SK012_03	Combined biota/habitat bioassessments	2010 Integrated Report

2.2 Applicable Water Quality Standards and Beneficial Uses

Idaho water quality standards (IDAPA 58.01.02) list beneficial uses and set water quality goals for waters of the state. Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses as described briefly in the following paragraphs. The *Water Body Assessment Guidance* (Grafe et al. 2002) provides a more detailed description of beneficial use identification for use assessment purposes.

Beneficial uses include the following:

- Aquatic life support—cold water, seasonal cold water, warm water, salmonid spawning, and modified
- Contact recreation—primary (swimming) or secondary (boating)
- Water supply—domestic, agricultural, and industrial
- Wildlife habitats
- Aesthetics

2.2.1 Existing Uses

Existing uses under the Clean Water Act are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards" (40 CFR 131.3). The existing instream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.051.01). Existing uses need to be protected, whether or not the level of water quality to fully support the uses currently exists. A practical application of this concept would be to apply the existing use of salmonid spawning to a water that supported salmonid spawning since November 28, 1975, but does not now due to other factors, such as blockage of migration, channelization, sedimentation, or excess heat.

2.2.2 Designated Uses

Designated uses under the Clean Water Act are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained" (40 CFR 131.3). Designated uses are simply uses officially recognized by the state. In Idaho, these include uses such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Multiple uses often apply to the same water; in this case, water quality must be sufficiently maintained to meet the most sensitive use (designated or existing). Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life (CWAL) or salmonid spawning. Designated uses are described in the Idaho water quality standards (IDAPA 58.01.02.100) and specifically listed by water body in sections 110–160.

2.2.3 Undesignated Surface Waters

In Idaho, due to a change in scale of cataloging waters in 2000, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations (IDAPA 58.01.02.110–160). These undesignated surface waters ultimately need to be designated for appropriate uses. In the interim, and absent information on existing uses, DEQ presumes most of these waters will support CWAL and either primary or secondary contact recreation (PCR/SCR) (IDAPA 58.01.02.101.01). To protect these so-called *presumed uses*, DEQ applies the cold water and recreation use criteria to undesignated waters. If in addition to *presumed uses*, an additional existing use (e.g., salmonid spawning) exists, then the additional numeric criteria for salmonid spawning would also apply (e.g., intergravel dissolved oxygen (DO), temperature) because of the requirement to protect water quality for that existing use. However, if some other use that requires less stringent criteria for protection (such as seasonal CWAL) is found to be an existing use, then a use designation (rulemaking) is needed before that use can be applied in lieu of cold water criteria.

2.2.4 Beneficial Uses in the Subbasin

The Salt River subbasin contains no AUs with designated beneficial uses. Therefore, all beneficial uses assigned to AUs are presumed or existing (Table 2). It is assumed that streams in the Salt River subbasin in Idaho support SCR as opposed to PCR because their small size makes swimming, water skiing, or skin diving unlikely.

Within the Salt River subbasin, no streams are designated for salmonid spawning. However, DEQ (2014b) recently generated a report titled *Geography and Timing of Salmonid Spawning in Idaho.* This report and associated geographic information system (GIS) layers identifies areas for potential salmonid spawning designations. DEQ is planning on designating new salmonid spawning habitat statewide beginning in 2015 based on this report. Because designations are likely to change in the near future, areas where salmonid spawning is being considered as a beneficial use are indicated in Table 2. Areas that already have data (BURP, USFS) showing salmonid spawning as an existing use are identified as such. Table 3 reports beneficial uses of assessed but unlisted streams.

Table 2. Salt River subbasin beneficial uses of §303(d)-listed streams.

Assessment Unit Name	Assessment Unit Number	Beneficial Uses[a]	Type of Use	Type of Use for SS
Newswander Canyon	ID17040105SK001_02b	CW, SCR	Presumed	
Cabin Creek	ID1704015SK002_02c	CW, SCR	Presumed	
Tincup Creek	ID17040105SK003_02	CW, SCR, SS	Presumed	Existing[b]
Rich Creek	ID17040105SK003_02a	CW, SCR	Presumed	
Whiskey Creek	ID17040105SK003_02b	CW, SCR	Presumed	
Lau Creek	ID17040105SK003_02c	CW, SCR, SS	Presumed	Existing[b]
Houtz Creek	ID17040105SK003_02d	CW, SCR	Presumed	
Bear Canyon	ID17040105SK003_02e	CW, SCR	Presumed	
Chicken Creek	ID17040105SK003_02g	CW, SCR	Presumed	
Luthi Canyon	ID17040105SK003_02i	CW, SCR	Presumed	
Haderlie Creek	ID17040105SK003_02j	CW, SCR, SS	Presumed	Existing[c]
Upper Boulder Creek	ID17040105SK006_02c	CW, SCR, SS	Presumed	Existing[b]
West Fork Boulder Creek	ID17040105SK006_02d	CW, SCR	Presumed	
White Canyon	ID17040105SK006_02f	CW, SCR	Presumed	
Graehl Canyon	ID17040105SK006_02g	CW, SCR	Presumed	
Lower Stump Creek	ID17040105SK006_04	CW, SCR, SS	Presumed	Existing[d]
Smoky Creek	ID17040105SK007_02c	CW, SCR, SS	Presumed	Existing[b]
Draney Creek	ID17040105SK007_02f	CW, SCR, SS	Presumed	Existing[d]
Roberts Creek	ID17040105SK007_02g	CW, SCR, SS	Presumed	Existing[b]
Tygee Creek	ID17040105SK007_03	CW, SCR, SS	Presumed	Existing[b]
White Dugway Creek	ID17040105SK008_02a	CW, SCR, SS	Presumed	Existing[b]
Beaver Dam Creek	ID17040105SK008_02c	CW, SCR, SS	Presumed	Existing[b]
Crow Creek	ID17040105SK008_02d	CW, SCR, SS	Presumed	Existing[c]
Crow Creek	ID17040105SK008_03b	CW, SCR, SS	Presumed	Existing[b]
Crow Creek (Deer Creek to border)	ID17040105SK008_04	CW, SCR, SS	Presumed	Existing[b]
North Fork Sage Creek	ID17040105SK009_02	CW, SCR	Presumed	
Sage Creek	ID17040105SK009_02c	CW, SCR, SS	Presumed	Existing[b]
Pole Canyon Creek	ID17040105SK009_02d	CW, SCR	Presumed	
South Fork Sage Creek	ID17040105SK009_02e	CW, SCR, SS	Presumed	Existing[b]
Sage Creek (confluence with North Fork Sage Creek to mouth)	ID17040105SK009_03	CW, SCR, SS	Presumed	Existing[c]
South Fork Deer Creek	ID17040105SK010_02a	CW, SCR, SS	Presumed	Existing[c]
Rock Creek	ID17040105SK011_03	CW, SCR, SS	Presumed	Existing[d]
Little Elk Creek	ID17040105SK012_02a	CW, SCR	Presumed	
Spring Creek	ID17040105SK012_03	CW, SCR, SS	Presumed	Existing[b]

[a] CW = cold water; SCR = secondary contact recreation; SS = salmonid spawning
[b] Salmonid spawning areas identified from ArcGIS layer generated from DEQ (2014b); no additional data documenting salmonid spawning is an existing use.
[c] Salmonid spawning existing use based on Beneficial Use Reconnaissance Program (BURP) data reporting salmonids <100 millimeters (mm).
[d] Salmonid spawning existing use based on US Forest Service (USFS) fish survey data reporting salmonids <100 mm.
[e] Explain * here

Table 3. Salt River subbasin beneficial uses of assessed but unlisted streams.

Assessment Unit Name	Assessment Unit Number	Beneficial Uses	Type of Use
Clear Creek	ID17040105SK008_02b	CW, SCR	Presumed

Notes: CW = cold water; SCR = secondary contact recreation

2.2.5 Water Quality Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of water quality criteria, which include *numeric* criteria for pollutants such as bacteria, DO, pH, ammonia, temperature, and turbidity, and *narrative* criteria for pollutants such as sediment and nutrients (IDAPA 58.01.02.250–251).

Narrative criteria for excess sediment are described in the water quality standards:

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

In this document, sediment TMDLs are based on meeting the narrative water quality criteria above. TMDLs for *Escherichia coli* (*E. coli*) are based on meeting Idaho's numeric water quality standards below (Table 4).

Table 4. Selected numeric criteria supportive of designated beneficial uses in Idaho water quality standards (IDAPA 58.01.02.250–251).

Parameter	Primary Contact Recreation	Secondary Contact Recreation	Cold Water Aquatic Life	Salmonid Spawning[a]
Bacteria				
• Geometric mean	<126 *E. coli*/100 mL[b]	<126 *E. coli*/100 mL	—	—
• Single sample	≤406 *E. coli*/100 mL	≤576 *E. coli*/100 mL	—	—

[a] During spawning and incubation periods for inhabiting species
[b] *Escherichia coli* per 100 milliliters

DEQ's procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.050.02. The procedure relies heavily upon biological parameters and is presented in detail in the *Water Body Assessment Guidance* (Grafe et al. 2002). This guidance requires DEQ to use the most complete data available to make beneficial use support status determinations (Figure 3).

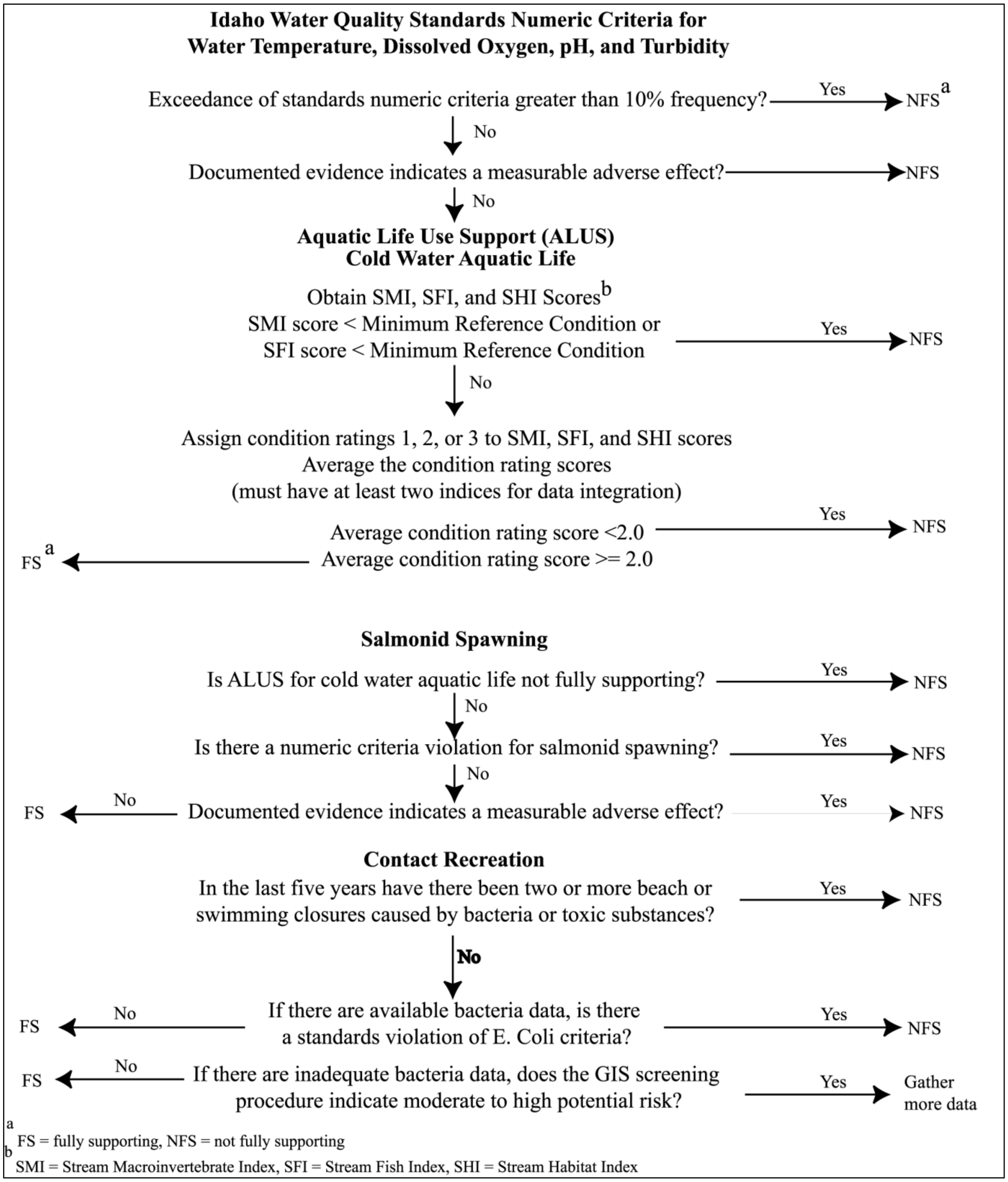

Figure 3. Determination steps and criteria for determining support status of beneficial uses in wadeable streams (Grafe et al. 2002).

2.3 Summary and Analysis of Existing Water Quality Data

Most of the data used to generate TMDL and listing recommendations originated from BURP investigations conducted in the subbasin from 1996 through 2014. Additionally, DEQ completed streambank erosion inventories (SEIs) in 2010, 2012, and 2014 on streams where sediment was the suspected stressor (Appendix B). McNeil core samples were collected by DEQ in 2012 and

2014 in areas were salmonid spawning is likely to be designated as a beneficial use and where SEIs were completed (Appendix C). Other available data considered included *E. coli* studies conducted by the Wyoming Star Valley Conservation District and studies of water quality, stream macroinvertebrates, and stream habitat conditions conducted by Formation Environmental, LLC for the J.R. Simplot Company (Appendix D). Additionally, Formation Environmental, LLC and HabiTech, Inc. collected core samples from spawning habitats and measured many habitat variables from streams in the Crow Creek drainage to generate supporting documentation for J.R. Simplot Company's proposed site-specific selenium criteria.

The Star Valley Conservation District followed a sampling and analysis plan approved for use by the Wyoming Department of Environmental Quality (Wyoming DEQ) (Appendix E). This plan outlined quality control samples (both duplicates and blanks), included appropriate holding times, and identified methods to be used. Wyoming DEQ's methods for generating a geometric mean are slightly different from methods outlined in Idaho's water quality standards. While Idaho requires that the five samples collected over a 30-day period be spaced 3 to 7 days apart, Wyoming required that the five samples be spaced no closer than 24 hours apart (Kevin Hyatt, pers. comm.). Current requirements to evaluate the support status of the recreation beneficial use require that a 60-day geometric mean be calculated based on a minimum of five samples separated by a minimum of 10 days (WDEQ 2014). This change in approved methodology has prompted the Star Valley Conservation District to adopt the new procedure for their sampling efforts in 2014 (Brenda Ashworth, pers. comm.). A field audit by the Wyoming DEQ in 2007 revealed that the Star Valley Conservation District was collecting valid *E. coli* data following appropriate protocols (Appendix F).

Data collected by Formation Environmental, LLC and HabiTech, Inc. were outlined in a work plan that included a quality assurance project plan that was reviewed by DEQ (NewFields 2007). Formation Environmental followed DEQ's BURP protocols for calculating stream macroinvertebrate and habitat indices. Measures of physiochemical properties of surface waters included duplicates and blanks at a minimum frequency of 5%. Water samples were shipped under chain of custody and were analyzed within appropriate holding times.

The subbasin has seven AUs listed for bacteria (six for *E. coli* and one for fecal coliform): Bear Canyon (ID17040105SK003_02e), Smoky (ID17040105SK007_02c), and Draney (ID17040105SK007_02f) Creeks, and four AUs on Crow Creek (ID17040105SK008_02, ID17040105SK008_02d, ID17040105SK008_03b, and ID17040105SK008_04). Available bacteria sampling data for the subbasin are shown in Table 5.

Table 5. *E. coli* sampling data.

Stream Name	Assessment Unit Number	*E. coli* Results (cfu/100 mL or mpn/100 mL)	Date Sampled
Deep Creek	ID17040105SK002_02a	12	8/31/2004
Jackknife Creek	ID17040105SK002_03	59	8/31/2004
Squaw Creek	ID17040105SK002_03a	66	8/21/2007
Tincup Creek	ID17040105SK003_02	390	8/17/2005
Bear Canyon	ID17040105SK003_02e	580	8/31/2004
		250	9/3/2004
		36	9/7/2004
		160	9/10/2004
		170	9/14/2004
	Geometric mean of sample set	170	
Tincup Creek	ID17040105SK003_03	12	8/27/2002
		11	8/21/2007
		4	8/21/2007
South Fork Tincup Creek	ID17040105SK004_02	10	9/7/1999
Horse Creek	ID17040105SK006_02i	4	8/31/2004
Lower Stump Creek	ID17040105SK006_04	10	9/7/1999
Lower Stump Creek[a]	ID17040105SK006_04	254.9[b]	7/8/2009
		387.3	7/14/2009
		298.7	7/21/2009
		360.9	7/23/2009[c]
		166.4	7/29/2009
	Geometric mean of sample set	281.6	
Lower Stump Creek[a]	ID17040105SK006_04	83.6[b]	6/4/2010
		579.4	6/8/2010
		84.5	6/14/2010
		261.3	6/22/2010[c]
		179.3	6/24/2010[c]
	Geometric mean of sample set	180.5	
Lower Stump Creek[a]	ID17040105SK006_04[a]	284.5[b]	7/6/2010
		613.1	7/11/2010
		248.1	7/20/2010[c]
		248.1	7/27/2010
		193.5	8/2/2010
	Geometric mean of sample set	290.7	
Lower Stump Creek[a]	ID17040105SK006_04	48.7[b]	6/14/2011
		71.7	6/16/2011
		121.1	6/21/2011
		648.8	7/5/2011[c]
		135.4	7/11/2011
	Geometric mean of sample set	130	

Stream Name	Assessment Unit Number	*E. coli* Results (cfu/100 mL or mpn/100 mL)	Date Sampled
Lower Stump Creek[a]	ID17040105SK006_04	192.3[b]	7/20/2011
		248.9	7/27/2011
		159.7	8/9/2011[c]
		103.4	8/11/2011[c]
		547.5	8/16/2011
	Geometric mean of sample set	212.4	
Lower Stump Creek[a]	ID17040105SK006_04	706.9	7/5/2012
		325.5	7/24/2012[c]
		179.7	7/26/2012[c]
		307.6	7/30/2012
		344.8	8/1/2012
	Geometric mean of sample set	337.6	
Lower Stump Creek[a]	ID17040105SK006_04	235.9[b]	9/11/2012
		98.7	9/18/2012
		2,419.6	9/25/2012
		47.1	9/29/2012
		47.3	10/2/2012
	Geometric mean of sample set	165.9	
Lower Stump Creek[a]	ID17040105SK006_04	727	5/29/2013
		86.5	6/5/2013
		285.1	6/12/2013
		416	6/19/2013
		770	6/26/2013
	Geometric mean of sample set	356.3	
Lower Stump Creek[a]	ID17040105SK006_04	1,013.3	7/1/2013
		461.1	7/10/2013 [c]
		613.1	7/17/2013
		365.4	7/23/2013
		488.4	7/31/2013 [c]
	Geometric mean of sample set	551.7	
Lower Stump Creek[a]	ID17040105SK006_04	435.2[b]	8/5/2013
		145	8/12/2013
		435.2	8/14/2013[c]
		344.8	8/20/2013
		172.3	8/27/2013
	Geometric mean of sample set	277	
Webster Creek[a]	ID17040105SK007_02a	1,769.7	8/30/2007
		240	9/7/2007[c]
		147.7	9/12/2007
		55.2	9/26/2007[c]
		58.3	9/28/2007[c]
	Geometric mean of sample set	182.4	

Stream Name	Assessment Unit Number	*E. coli* Results (cfu/100 mL or mpn/100 mL)	Date Sampled
Webster Creek	ID17040105SK007_02a	261	8/12/2014
Smoky Creek	ID17040105SK007_02c	>2,420	8/27/2002
		790	9/3/2002
		1,300	9/9/2002
		490	9/16/2002
		1,100	9/19/2002
	Geometric mean of sample set	1,060	
Draney Creek	ID17040105SK007_02f	4,600	9/7/1999
		2,000	9/15/1999[c]
		5,800	9/21/1999
		990	9/22/1999[c]
		3,600	9/27/1999
	Geometric mean of sample set	4,527	
Draney Creek	ID17040105SK007_02f	16	8/12/2014
Tygee Creek[a]	ID17040105SK007_03	1,120	8/30/2007
		109.9	9/7/2007[c]
		44.1	9/12/2007
		68.4	9/26/2007[c]
		48.2	9/28/2007[c]
	Geometric mean of sample set	112.3	
Tygee Creek	ID17040105SK007_03	261	8/12/2014
Clear Creek	ID17040105SK008_02b	150	8/21/2001
Crow Creek	ID17040105SK008_02d	37	8/12/2014
Crow Creek	ID17040105SK008_03b	150	8/21/2001
Crow Creek	ID17040105SK008_04	1,553	8/5/2008
		613	8/11/2008
		488	8/14/2008
		192	8/19/2008
		727	8/25/2008
	Geometric mean of sample set	579	
Sage Creek	ID17040105SK009_03	38	8/21/2001
Deer Creek	ID17040105SK010_03	11	8/27/2002
		37	8/17/2005
Little Elk Creek	ID17040105SK012_02a	101	8/31/2006
Spring Creek	ID17040105SK012_03	313	8/31/2006

[a] Data obtained from the Wyoming Star Valley Conservation District.
[b] No further sampling by DEQ was warranted.
[c] Samples did not strictly follow DEQ's 3-to 7-day window between samples.
Notes: cfu = colony forming units; mL = milliliter; mpn = most probable number

DEQ *E. coli* sampling protocols were not followed exactly during the sampling effort at Draney Creek (ID17040105SK007_02f) in 1999. The sample collected on September 15, 1999, was not taken within 7 days of the previous sample as outlined in IDAPA 58.01.02.251.01.a. Also, the sample on September 22, 1999, was collected one day after the previous; the water quality standards state that samples must be taken at least 3 days apart. The impact of these errors was examined by substituting values of 1 colony forming unit (cfu) and recalculating the geometric mean for the sample set. The resulting value of 157 cfu/100 mL still exceeds the standard and indicates that the protocol violations had no effect in determining whether the AU was attaining its beneficial use of recreational contact at this time.

Draney Creek (ID17040105SK007_02f) was resampled by DEQ in August 2014 to reevaluate if it was meeting water quality standards for SCR. Results indicate that this AU is currently meeting water quality standards, so additional samples were not collected to generate a 5-sample geometric mean. A TMDL was developed for *E. coli* in this AU because we do not have sufficient evidence to delist. In the future, more *E. coli* data should be collected to assess if SCR is supported in Draney Creek.

Crow Creek (ID17040105SK008_02) is unassessed for contact recreation and should be moved to Category 3 in the next Integrated Report. Data for Crow Creek (ID17040105SK008_02d and ID17040105SK008_03b) indicate that these AUs are meeting the standard for SCR and the listings should be removed. These three AUs were listed for *E. coli* based on the misapplied data from the 4th-order segment. ID17040105SK008_02d and ID17040105SK008_03b should be moved to Category 2 in the next Integrated Report for PCR/SCR. When the 3rd-order segment of Crow Creek was assessed in 2001, the sample contained 150 cfu/100 mL. According to Idaho's water quality standards, waters designated for PCR must have a single sample above 406 cfu /100 mL to warrant further sampling to evaluate the geometric mean criteria. Waters designated for SCR must have a single sample above 576 cfu /100 mL (IDAPA58.01.02. 251.01.a and b). Since this sample was not exceeding the trigger, DEQ did not initiate further sampling efforts. Crow Creek (ID17040105SK008_02d) was assessed for contact recreation in 2014, and the sample contained 37 cfu/100 mL, indicating no impairment.

Lower Stump Creek (ID17040105SK006_04) was tested for bacteria by DEQ in 1999 and was meeting the standard for contact recreation. Subsequent sampling efforts by the Wyoming Star Valley Conservation District, however, indicated violations of the geometric mean criteria for recreational contact on several occasions within the past 5 years. Many times, the conservation district did not follow DEQ protocols regarding the distribution of samples taken over a 30-day time period as outlined in IDAPA 58.01.02.251.01.a (Table 5, footnote c, shows subsequent samples not taken within the 3- to 7-day time frame). Later samples were always taken by the conservation district to generate a geometric mean, whereas DEQ requires the first sample to exceed 576 cfu/100 mL for SCR to warrant further sampling (Table 5, footnote b, shows primary samples that did not meet this criteria). On two occasions (2012 and 2013), DEQ sampling protocols were followed and geometric means of 356.3 and 551.7 cfu/100 mL were observed, demonstrating a clear violation of Idaho's standard for contact recreation. Other geometric means calculated by the conservation district within the past 5 years, although not strictly following DEQ protocols, show that bacteria has been a chronic problem in Lower Stump Creek. Therefore, this AU is unlisted but impaired for *E. coli* and an associated TMDL is presented.

Webster (ID17040105SK007_02a) and Tygee Creeks (ID17040105SK007_03) were assessed for *E. coli* by the Wyoming Star Valley Conservation District in 2007. These data are greater than 5 years old and should not be used in §303(d) listing or delisting. These data were not taken in strict accordance with DEQ protocol regarding the distribution of samples within the 30-day time frame for generating a geometric mean. Data collected by DEQ in 2014 indicate that these AUs are meeting water quality standards for contact recreation as the trigger to initiate further sampling was not reached. These AUs should be shown as fully supporting the beneficial use of recreation in the next Integrated Report.

Tincup (ID17040105SK003_02), Clear (ID17040105SK008_02b), Little Elk (ID17040105SK012_02a), and Spring Creeks (ID17040105SK012_03) were not listed for *E. coli*, and sampling data indicate that they are meeting the water quality standard for recreation. None of these AUs exceeded the trigger for contact recreation and are considered to be fully supporting this beneficial use. These AUs should be listed in Category 2 for SCR. Tincup Creek is currently listed for sediment, but SCR should be changed from unassessed to assessed and full support. Little Elk Creek should also be changed from unassessed for SCR to assessed and shown to be in full support.

The subbasin has 12 AUs listed for sedimentation/siltation and 16 AUs listed for combined biota/habitat bioassessments, habitat assessments or cause unknown.

Newswander Canyon (ID17040105SK001_02b), Tincup (ID17040105SK003_02), Haderlie (ID17040105SK003_02j), Lower Stump (ID17040105SK006_04), Smoky (ID17040105SK007_02c), Draney (ID17040105SK007_02f), Tygee (ID17040105SK007_03), Beaver Dam (ID17040105SK008_02c), and Crow (ID17040105SK008_04) Creeks were listed for sediment with SEI documented stabilities at or below the 80% standard, confirming that sediment was the appropriate pollutant (Table 6). Calculations of current loads were estimated with equations explained in Section 5.1.2, Target Selection. SEI data and selected photos are included in Appendix B. McNeil core data (Table 7) and available BURP data (Table 8) indicate that fine sediment is elevated in these AUs.

Crow Creek (ID17040105SK008_04) was at 80% bank stability within the SEI reach. The reach was contained within USFS land and included a section where the stream had been channelized. The stream was returned to its original channel by a USFS restoration effort in 2009, meanders were restored, and the banks were stabilized with plantings. Below this reach, bank conditions deteriorate on private land. A TMDL is needed even though bank stability targets were being met within the SEI reach. For this AU to meet beneficial uses, bank conditions along the entire AU need to improve.

Table 6. SEI data for AUs listed for sediment.

Water Body	Assessment Unit Number	SEI Year	Current Bank Stability (%)	Current Load (tons/year)
Newswander Canyon	ID17040105SK001_02b	2012	52	66.3
Cabin Creek	ID17040105SK002_02c	2010	95	1.7
Tincup Creek	ID17040105SK003_02	2012	61	230
Haderlie Creek	ID17040105SK003_02j	2010	79	41.5
White Canyon	ID17040105SK006_02f	2012	87	5.1
Lower Stump Creek	ID17040105SK006_04	2012	62	535
Smoky Creek	ID17040105SK007_02c	2012	10	256
Draney Creek	ID17040105SK007_02f	2012	61	59.6
Tygee Creek	ID17040105SK007_03	2012	55	1,010
Beaver Dam Creek	ID17040105SK008_02c	2012	17	70.6
Crow Creek	ID17040105SK008_04	2014	80	107.2
South Fork Deer Creek	ID17040105SK010_02a	2012	98	0.4

Note: SEI =streambank erosion inventory

Table 7. McNeil core data for AUs listed for sediment.

Water Body	Assessment Unit Number	Sample Year	% Fines <6.25 mm	% Fines <0.85 mm	Standard Deviation % Fines <6.25 mm	Standard Deviation % Fines <0.85 mm
Tincup Creek	ID17040105SK003_02	2014	No spawning habitat			
Haderlie Creek	ID17040105SK003_02j	2014	No spawning habitat			
Lower Stump Creek	ID17040105SK006_04	2014	41.8	12.3	18.9	7.3
Smoky Creek	ID17040105SK007_02c		No spawning habitat			
Draney Creek	ID17040105SK007_02f	2012	62.5	22.2	4.4	4.6
Beaver Dam Creek	ID17040105SK008_02c	2014	No spawning habitat			
Crow Creek	ID17040105SK008_04	2014	38.5	12.7	4.8	3.3

Notes: mm = millimeter

Table 8. BURP data (Wolman pebble counts and bank stability) for AUs listed for sediment.

Water Body	Assessment Unit Number	BURP Year	% Fines ≤ 2.5 mm	% Fines ≤ 6 mm	% Left Bank Stable	% Right Bank Stable	Average % Stable
Newswander Canyon	ID17040105SK001_02b	1999	29	40	25	10	18
Cabin Creek	ID17040105SK002_02c	1999	82	86	75	85	80
		2004	70	77	100	100	100
Tincup Creek	ID17040105SK003_02	2005	36	38	80	92	86
		2007	46	63	100	98	99
		2013	45	62	80	81	81
Haderlie Creek	ID17040105SK003_02j	1996	25	52	82	23	53
		2002	52	62	74	84	79
		2011	47	69	41	44	43
Lower Stump Creek	ID17040105SK006_04	1996	10	12	0	0	0
		2002	12	14	89	87	88
Smoky Creek	ID17040105SK007_02c	1997	38	56	95	98	97
		1997	60	72	96	97	97
		2002	78	85	76	86	81
Draney Creek	ID17040105SK007_02f	1998	35	44	95	75	85
		2003	52	56	95	83	89
		2013	40	44	82	60	71
Tygee Creek	ID17040105SK007_03	1996	35	55	100	100	100
		2002	66	72	95	98	97
Beaver Dam Creek	ID17040105SK008_02c	1998	67	78	79	85	82
		2003	96	97	60	72	66
Crow Creek	ID17040105SK008_04	1996	14.3	27	100	100	100
		2002	31	32	97	94	96
		2006	31	40	80	76	78
		2008	76	85	96	97	97
		2012	32	33	18	29	24
South Fork Deer Creek	ID17040105SK010_02a	1998	37	42	100	100	100
		2013	25	32	100	100	100

Notes: BURP = Beneficial Use Reconnaissance Program; mm = millimeter

Newswander Canyon (ID17040105SK001_02b) is also in Category 4c for physical substrate habitat alterations, which is appropriate because this stream is dammed and physically altered (Figure 4).

Figure 4. Dam and pond on Newswander Canyon (ID17040105SK001_02b).

Haderlie Creek (ID17040105SK003_02j) is also in Category 4c for physical substrate habitat alterations. All of the BURP surveys took place on USFS land and on one fork of the creek (Figure 5). Below the BURP locations, the creek flows onto private land where it is channelized and used for irrigation (Figure 6). Since this AU is physically altered and not likely to support beneficial uses in the channelized portion, it should remain in Category 4c for physical substrate habitat alterations.

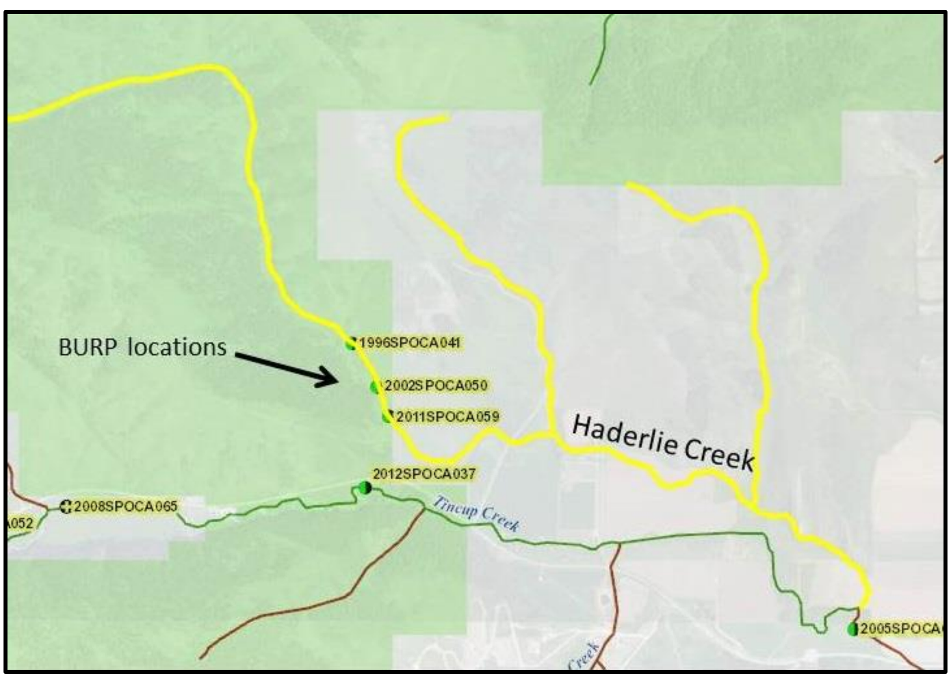

Figure 5. BURP locations on Haderlie Creek (ID17040105SK003_02j) AU (highlighted in yellow). Green represents US Forest Service land, and private land is highlighted in white.

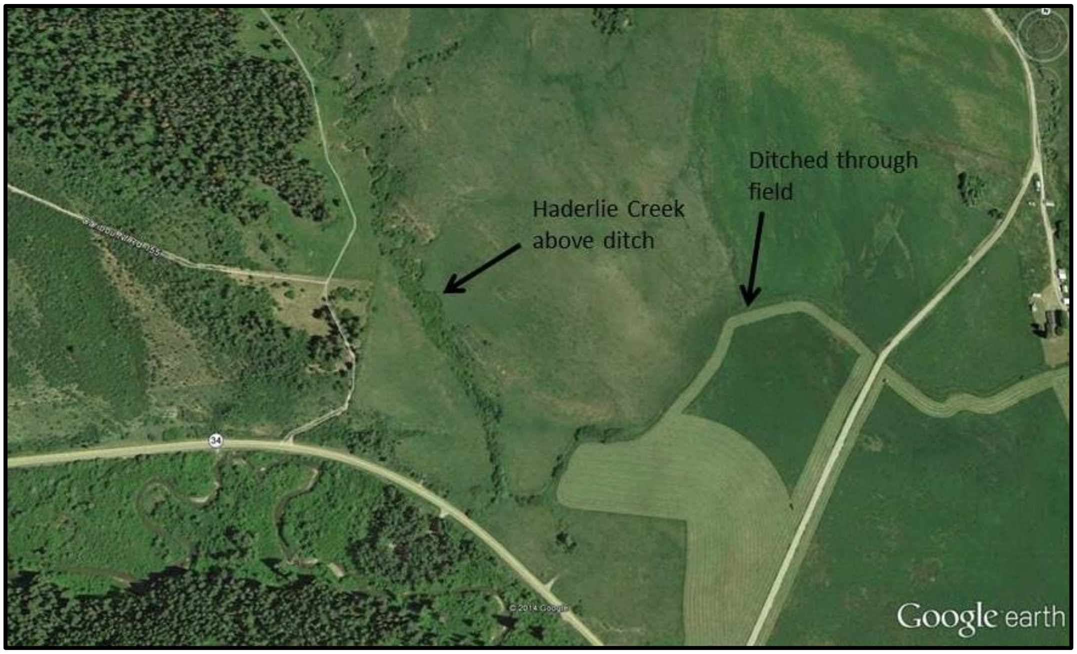

Figure 6. Haderlie Creek (ID17040105SK003_02j) above and below channelization.

Smoky Creek (ID17040105SK007_02c) is in Category 4c for physical substrate habitat alterations, which is appropriate as the upper portion of the drainage is altered by the Smoky Canyon Mine (Figure 7). This AU should remain in Category 4c for physical substrate habitat alterations.

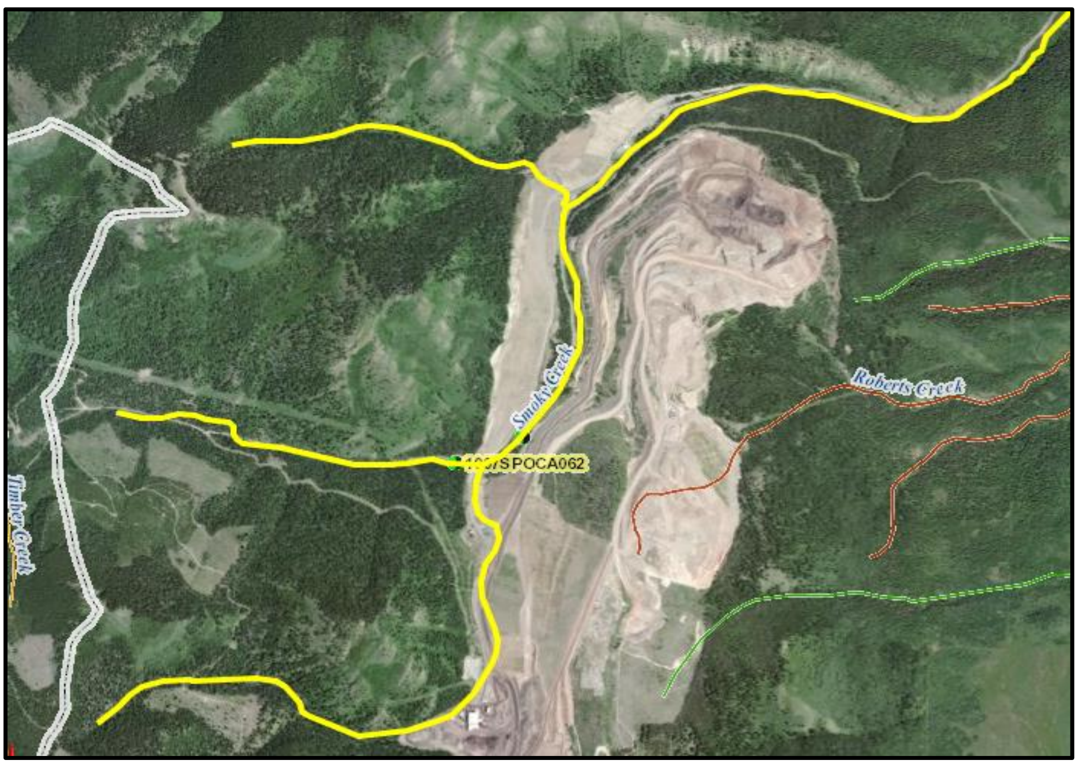

Figure 7. Smoky Creek (ID17040105SK007_02c) in its upper reaches. Smoky Canyon Mine has altered the physical habitat of this AU.

Draney Creek (ID17040105SK007_02f) is in Category 4c for physical substrate habitat alterations, which is inappropriate as the channel has not been physically altered. This listing should be removed in the next Integrated Report. Currently, the AU ends at the USFS boundary. During the summer, however, much of the water is diverted from the creek into a ditch. The point of diversion is on USFS land and significantly reduces the flows below. All BURP sites were above the diversion and do not represent the reduced flow conditions below. DEQ recommends that the boundary between upper Draney (ID17040105SK007_02f) and lower Draney (ID17040105SK007_02b) Creeks be changed to the point of diversion to better represent both AUs.

Tygee Creek (ID17040105SK007_03) is in Category 4c for physical substrate habitat alterations and low-flow alterations. These listings are appropriate. At the very upper portion of the AU, the creek is channelized and diverted around a man-made pond used in milling of phosphate ore at the Smoky Canyon Mine (Figure 8). Lower in the AU, the creek is diverted for agriculture.

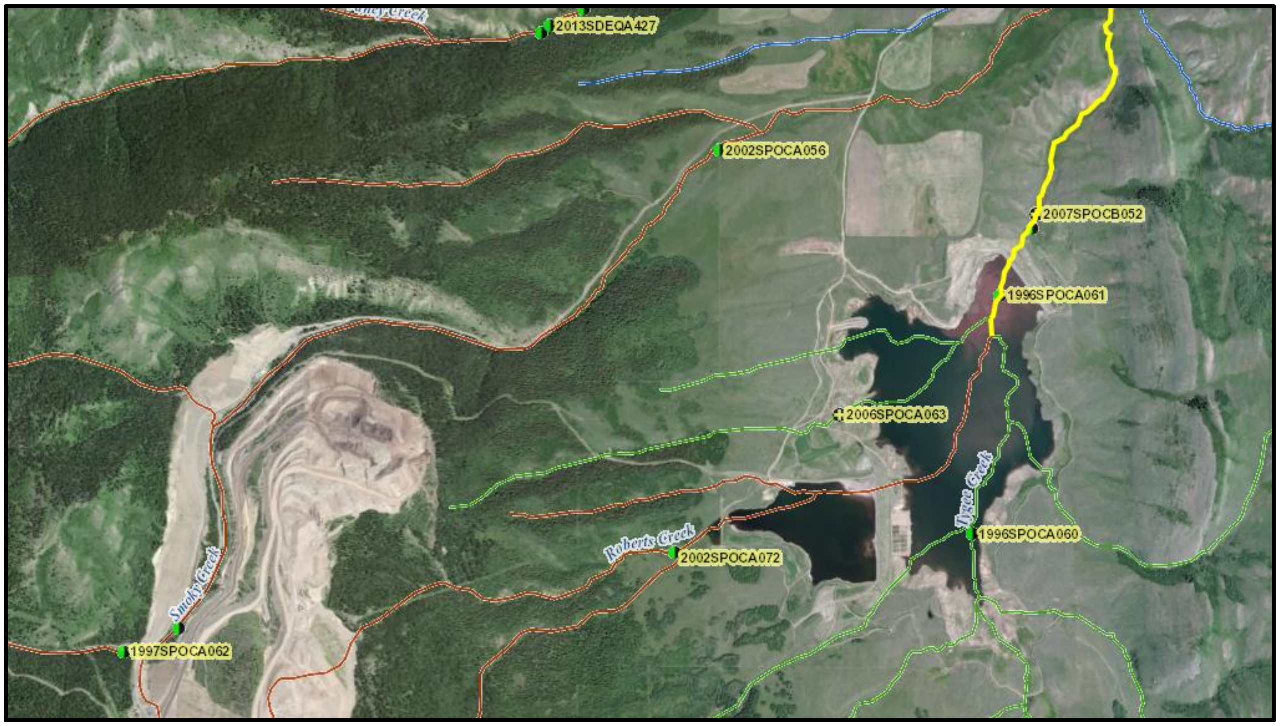

Figure 8. Tygee Creek (ID17040105SK007_03) is highlighted in yellow. Originally, the 3rd-order segment of Tygee Creek began at the confluence of Roberts Creek and the 2nd-order segment of Tygee Creek. This area is now under a pond used for milling of phosphate ore at the Smoky Canyon Mine. Tygee Creek is channelized around the pond.

Beaver Dam Creek (ID17040105SK008_02c) is in Category 4c for physical substrate habitat alterations; however, Beaver Dam Creek is not impacted by active channel alterations. Rather, it is heavily grazed and is impacted by unstable banks (17% bank stability). Beaver Dam Creek should be removed from Category 4c because a TMDL for bank stability addresses the major pollutant impairing beneficial uses in this AU.

Additional data on Crow Creek (ID17040105SK008_04) collected as supporting documentation for developing site-specific criteria for selenium indicate low bank stability scores and high levels of fine sediments in salmonid spawning habitats (Formation Environmental, LLC and HabiTech, Inc. 2012). During this effort, the 4th-order segment of Crow Creek was monitored at three locations (Figure 9). In two of the three sampling sites, average bank stability was below the 80% target (Table 9). While sieves of slightly different sizes than DEQ uses were implemented by this study, results indicate that fines are elevated above targets recommended for salmonid spawning (Table 10). DEQ measures percent fines <6.25 mm. This study used sieves with 9.5 and 3.35 mm openings, therefore values for percent fines <6.25 mm are between those values. For brown trout redds, values of fines <6.25 mm were above 30% of the total sample. Fines <0.85 mm are known to be particularly detrimental to survival of salmonid embryos and should not exceed 10% of total sample volume (Rowe et al. 2003). In areas adjacent to brown trout redds, this target was exceeded. In contrast to sites next to brown trout redds, core samples collected next to cutthroat trout redds in 2007 indicated that fine sediments were not elevated above recommended targets.

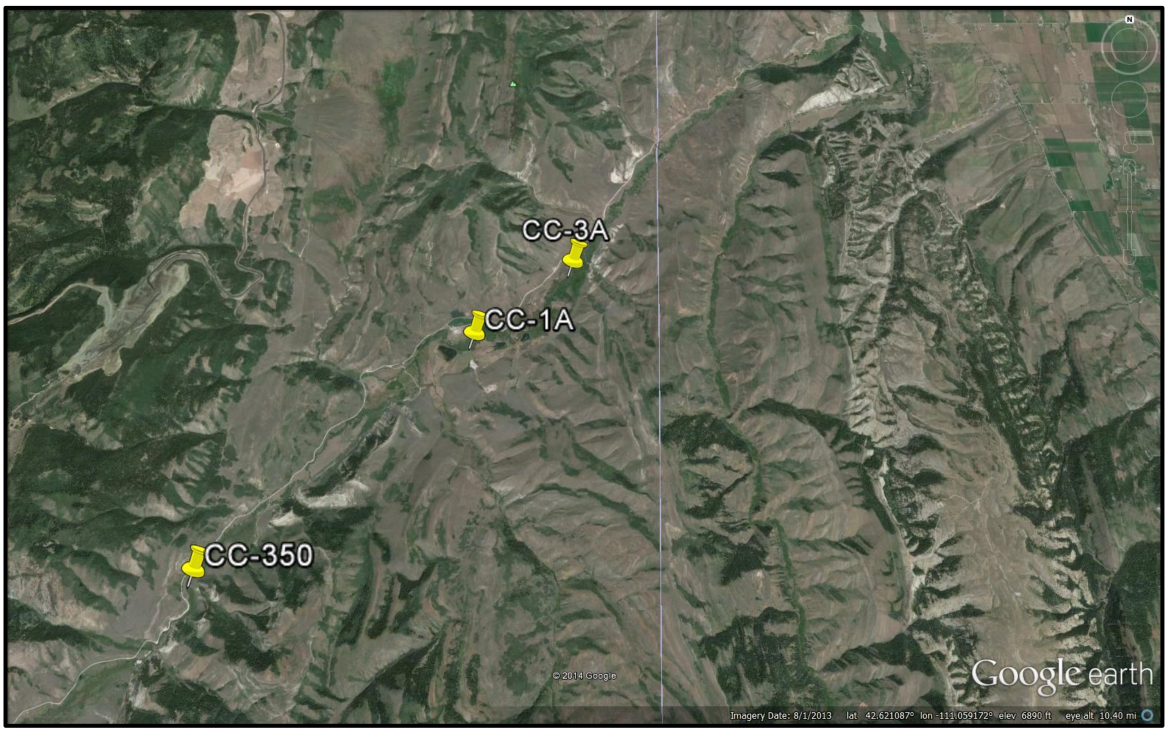

Figure 9. Locations of sampling sites along Crow Creek (ID17040105SK008_04).White line indicates Wyoming/Idaho state line. Smoky Canyon Mine is visible in the upper left.

Table 9. Bank stability scores for Crow Creek (ID17040105SK008_04) collected by Formation Environmental, LLC and HabiTech, Inc. from 2006 to 2008.

Location	Reach	Fall 2006 Bank Stability (%)	Fall 2007 Bank Stability (%)	Fall 2008 Bank Stability (%)	Average Bank Stability (%)
CC-350	Crow Creek downstream of Deer Creek	65	76	54	65
CC-1A	Crow Creek downstream of Sage Creek	89	92	86	89
CC-3A	Crow Creek downstream of Sage Creek and CC-1A	57	75	50	61

Table 10. McNeil core results for Crow Creek (ID17040105SK008_04) collected by Formation Environmental, LLC and HabiTech, Inc. in 2006 and 2007.

Location	Reach	Sampling Date and Species	% Fines <9.5 mm	% Fines <3.35 mm	% Fines <1 mm	% Fines <0.5 mm
CC-1A	Crow Creek downstream of Deer Creek	10/26/2006, brown trout	45.6	31.2	16.62	11.9
		5/10/2007, cutthroat trout	35.1	20.16 (<4 mm)	6.46	4.71
CC-3A	Crow Creek downstream of Sage Creek	10/26/2006, brown trout	56.3	37.1	21.6	16.9

Note: mm= millimeter

Cabin Creek (ID17040105SK002_02c) was originally listed for sediment, based on two BURP assessments (1999 and 2004) that exhibited stable streambanks but elevated fine sediment in the Wolman pebble counts. An SEI conducted in 2010 at Cabin Creek confirmed the status of the streambanks, with stability at 95%. The 1999 BURP assessments were conducted within a beaver complex, as stated in Table B, and the 2004 BURP was just 60 meters downstream of the 1999 site. Beaver complexes retain large amounts of sediment (Butler and Malanson 2005). Wolman pebble counts performed within or below a beaver complex inherently result in high fine sediment numbers that are not representative of the entire stream. Other aspects of this stream appear to be supportive of its beneficial uses, and it is likely that the beaver complex skewed the results of the assessments. In 2013, the AU was revisited by BURP. There was no flow, and the site was not assessed. Site notes indicate, “Stream was about 0.2 meters wide and 1 cm deep. It was barely moving. A large beaver dam was present closer to the road.” A proper assessment of this AU has not been completed. In this case, the calculation of a TMDL is not appropriate. In the next Integrated Report, this AU should be delisted for sediment and moved to Category 3 as unassessed because proper BURP protocols were not followed. Cabin Creek is also listed in Category 4c for physical substrate habitat alterations. This listing should be removed as this AU is not physically altered by human damming or channelization.

South Fork Deer Creek (ID17040105SK010_02a) was assessed by the BURP in 1998 and, similarly to Cabin Creek, showed elevated fine sediments in the Wolman pebble counts. Like

Cabin Creek, a 2012 SEI demonstrated that Deer Creek had very stable streambanks (98%). Seventeen total suspended solids (TSS) samples taken at four other sites in the Deer Creek watershed between 2002 and 2012 resulted in only two samples above 9 milligrams per liter (mg/L) (21 and 27 mg/L), four samples between 5 and 9 mg/L, and 11 samples below the minimum detection level (Formation Environmental 2013), indicating that excess suspended sediment is not a problem in this AU.

The 1998 BURP assessment was conducted in a beaver complex, likely resulting in data that are not representative of the AU. BURP metrics and indices were developed and calibrated against free-flowing streams with little human impact. Since this BURP assessment was conducted in a beaver pond, it is not valid to compare results to reference conditions. Recent data from Formation Environmental indicates that this AU is meeting its beneficial uses. Three habitat assessments conducted according to DEQ protocols produced SHI scores of 2, 3, and 3 in 2009, 2010, and 2011, respectively. Invertebrates collected in 2011, produced a passing SMI score of 2. The average of the SHI and SMI for 2011 is 2.5, indicating no impairment of this AU as scores greater than 2 indicate full support according to DEQ's *Water Body Assessment Guidance* (Grafe et al. 2002, Formation Environmental 2012). In 2013, BURP reassessed the AU. Although condition ratings are not yet available, fines sediment < 2.5 mm constituted 25% of the substrate in the Wolman pebble counts compared to 37% fines in 1998 within the beaver ponds. The 2013 assessment, like the 1998 assessment, indicated that streambanks were 100% covered and stable within the site. Furthermore, the downstream segment of Deer Creek (ID17040105SK010_03) is fully supporting beneficial uses, demonstrating that the upper segment is not likely contributing excess fine sediment to the downstream segment. The 1998 BURP assessment was invalid because it included old beaver ponds, and the newer Formation Environmental and DEQ data should be used instead to delist this AU for sedimentation/siltation and place this AU under Category 2 in the next Integrated Report. South Fork Deer Creek is not channelized or dammed and should be removed from Category 4c for physical substrate habitat alterations.

Rich (ID17040105SK003_02a), Whiskey (ID17040105SK003_02b), Lau (ID17040105SK003_02c), Houtz (ID17040105SK003_02d), and Chicken (ID17040105SK003_02g) Creeks share many similarities. They are all small tributaries (1 to 2 miles in length) within 5 miles of each other along Tincup Creek. They were monitored using BURP protocols in 1999 and again between August 2 and 4, 2004. All were listed for *cause unknown* or some similar nonspecific pollutant and had streambank stabilities above 90% when assessed with an SEI in 2010. They are all fully contained on USFS land and possess no other sources of sediment except for streambank erosion. Furthermore, they all flow into Tincup Creek (ID17040105SK003_03) that is fully supporting beneficial uses.

Annual flows of the Salt River at the US Geological Survey (USGS) gage 13027500 near Etna, Wyoming, are shown in Figure 10. This gage lies roughly 4 miles below the confluence of Tincup Creek and has a 59-year period of record. In 2004, it was the fifth consecutive year of below average stream flows in the Salt River. Flow in the Salt River during that 5-year period was 64% of the 59-year period-of-record average. Table 11 compares flows of the five Tincup tributaries in both assessment years. On average, stream flows in 2004 for these five streams were 61% below 1999 flows.

At the time of the 2004 assessments, stream flow at Chicken Creek was only 0.08 cfs, and Whiskey Creek was 0.09 cfs. Meteorological records show precipitation in the area from August 1–3, 2004 (NOAA 2013), suggesting that the meager flow in the streams may have been less if not augmented by that precipitation. Notes from the 1999 BURP and 2010 SEI at Chicken Creek suggest that the stream likely goes dry each year, and it was dry in August 2012 when the AU was revisited by DEQ.

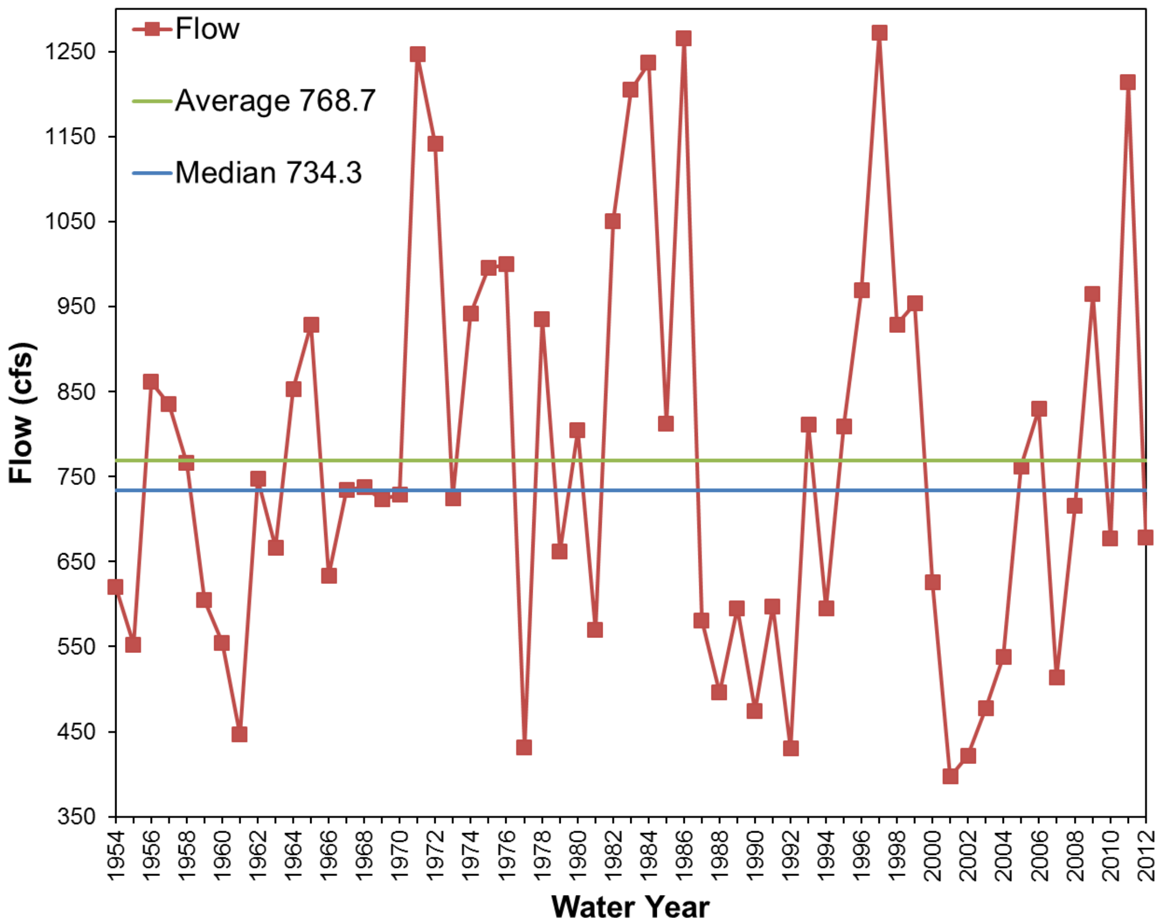

Figure 10. Annual flows of the Salt River near Etna, Wyoming (USGS 2013).

Table 11. Streamflows in 1999 and 2004.

Water Body	Assessment Unit Number	Flow (cubic feet per second)		% Reduction
		1999	2004	
Rich Creek	ID17040105SK003_02a	0.68	0.30	56
Whiskey Creek	ID17040105SK003_02b	0.49	0.09	83
Lau Creek	ID17040105SK003_02c	0.82	0.20	76
Houtz Creek	ID17040105SK003_02d	0.65	0.50	23
Chicken Creek	ID17040105SK003_02g	0.26	0.08	69

In addition to the decreased flows displayed in Figure 10 and Table 11, further analyses indicate that this string of dry years may have had other impacts on some streams. These low water years (2000–2004) may have significantly impacted these streams and also likely impacted both the habitat and macroinvertebrate scores derived from the 2004 data. Although land use did not change between 1999 and 2004, for five AUs—Rich (ID17040105SK003_02a), Whiskey (ID17040105SK003_02b), Lau (ID17040105SK003_02c), Houtz (ID17040105SK003_02d), and Chicken (ID17040105SK003_02g) Creeks—SMI scores dropped from an average of 2.6 to an average of 1. SHI scores also dropped from an average of 2 in 1999 to an average of 1 in 2004.

The average score at Rich Creek (ID17040105SK003_02a) dropped from 2.5 in 1999 to 1 in 2004. BURP indices were developed from assessments conducted on wadeable, perennial, freestone streams. The stream macroinvertebrate index (SMI), stream habitat index (SHI), and stream fish index (SFI) were developed based on reference conditions that describe persistent aquatic habitats, which allow full development of aquatic communities. During this extended drought when stream flow was so meager (0.30 cfs), it was not valid to compare Rich Creek to reference conditions. Further evidence demonstrates that sediment was not impairing this AU. A 2010 SEI indicated that this AU had streambank stability of 94%. Increased fine sediment and substrate embeddedness levels observed in the 2004 BURP assessment were likely the result of drought-inhibiting flushing of fines from the streambed, rather than from excess bank erosion. Additionally, no other sources of excess sediment contribute to the watershed. Other potential pollutants are not present. Assessing this AU with BURP protocols was not valid at such a low flow and other evidence (1999 BURP assessment, SEI, and fully supporting downstream segment) indicates that this AU is fully supporting beneficial uses when there is sufficient water to do so. This AU should be delisted for habitat assessment and cause unknown and moved to Category 2 as fully supporting CWAL in the next Integrated Report.

Whiskey Creek (ID17040105SK003_02b) flows within an extremely narrow, steep-sided canyon. Vegetation is very sparse on some areas of the slopes and appears to be limited by local geology. When assessed at a flow of 0.49 cfs in 1999, this AU had an average score of 2.5 with an SMI of 3 and an SHI of 2, even given its small size. The *disruptive pressures* score was a 10 on a 1–10 point scale indicating that "vegetation disruption minimal or not evident. Almost all potential biomass at present stage of development remains" (DEQ 2013). When reassessed in 2004, this AU received an average score of 1. This assessment took place at a flow of under 0.1 cfs and should not be compared to reference conditions. Therefore, the 2004 score was disregarded. A 2010 SEI indicated that bank erosion was not contributing excess sediment to the stream, recording a bank stability of 91%. Additionally, no other known sources of sediment or other pollutants contribute to the watershed. Since the 2004 BURP assessment should not be compared to reference conditions, and other data indicate that this AU is supporting beneficial uses, this AU should be moved to Category 2 in the next Integrated Report and delisted for combined biota/habitat bioassessments.

The 1999 assessment at Lau Creek (ID17040105SK003_02c) produced a habitat score of 55, falling just short of a passing 58. Both habitat and macroinvertebrate scores fell in 2004. Much of the streambed is bedrock, negatively impacting BURP scores. In late October 2012, the lowest 100 meters of the bed were dry despite the fact that snow was present and melting. Fine sediment levels were much higher in 2004 (55%) than in 1999 (16%), perhaps reflecting the 76% reduction in flows and corresponding reduction in the stream's ability to flush fines from the bed. The AU has little human impact as noted in the 1999 BURP field site notes: "Riparian zone is small due to narrow valley, few disturbances if any." Bank erosion is not contributing to excess sedimentation as indicated by a 2010 SEI that measured bank stability at 97%. It is not valid to compare this AU to reference conditions as it likely intermittent. The SMI score was 2 in 1999 and 2004, even given its habitat ratings of 1. The downstream segment of Tincup Creek (ID17040105SK003_03) is fully supporting beneficial uses. Since there is no apparent pollutant source and macroinvertebrates scores and SEI bank stability indicate support of beneficial uses, this AU should be delisted for habitat assessment and cause unknown and moved to Category 2 in the next Integrated Report.

BURP scores at Houtz Creek (ID17040105SK003_02d) dropped from an average of 2.5 in 1999 to 0 in 2004. Macroinvertebrate data from 2004 indicate that the drought had strong implications for life in this stream. Fine sediments were elevated in 2004, resulting in highly embedded gravels. A 2010 SEI, however, indicates that this AU has stable banks (99%) that are not contributing excess sediment. BURP assessments and the 2010 SEI document that the lower 100 meters have been channelized. Therefore, this AU should also be listed in Category 4c for habitat alteration and delisted for cause unknown.

In 1999 at a flow of 0.26 cfs, Chicken Creek (ID17040105SK003_02g) received a condition rating of 2.5, indicating full support of CWAL. Disruptive pressures and zone of influence scores were high (10 and 9, respectively), demonstrating that this creek was largely unaffected by human influence. In 2004, this AU was reassessed at a flow of 0.08 cfs. Fine sediment and embeddedness levels were higher than observed in 1999. At such a meager flow, however, this AU should not be compared to reference conditions. A 2010 SEI indicated that bank erosion was not contributing excess sediment to the stream, with a bank stability of 96%. No other known sources of excess sediment or other pollutants exist, and the downstream segment is fully supporting beneficial uses. Since the 2004 BURP assessment should not be compared to reference conditions, and other data indicate that this AU is supporting beneficial uses, this AU should be moved to Category 2 in the next Integrated Report and delisted for combined biota/habitat bioassessments.

In contrast to the abnormally dry conditions observed in 2004, 1999 was the fifth in a series of wet years (Figure 10). In 1999, an assessment of White Canyon (ID17040105SK006_02f) was conducted at a flow of 0.11 cfs and produced a failing score. During this time, the left bank at the BURP site was 70% stable and the right bank was 84% stable, indicating minor bank instability. In 2012 when the stream was assessed with an SEI that incorporated a longer and more representative stream length, a bank stability of 87% was documented. Excess bank erosion was unlikely contributing excess sediment to the stream.

Macroinvertebrates received a condition rating of 1; however, only 151 individuals were identified. Normally, macroinvertebrate samples have a target subsample of 500 individuals. Protocols call for identifying at least 500 individuals from a sample or all individuals in a sample if there are less than 500 total individuals. Samples are flagged as *low bugs* when the number identified is less than 150. Generally sites flagged with *low bugs* result from sampling errors, such as improper net placement or insufficient time spent disturbing the substrate. In this case, the sample was not flagged as *low bugs* because it barely exceeded the threshold. When less than 150 macroinvertebrates are identified, one can expect spurious results that are not indicative of water quality and do not represent the real macroinvertebrate community at the site. This low count, however, likely resulted from low aquatic invertebrate density associated with this stream's low flow condition. The 1999 BURP field site notes stated that "immediately above reach, creek is dry […] Creek will be dry in a week?" The stream was dry in 2004 and again in 2012, and no perennial indicator taxa were collected during the 1999 assessment. IDAPA 58.01.02.10.53 defines intermittent waters:

> A stream, reach, or water body which naturally has a period of zero (0) flow for at least one (1) week during most years. Where flow records are available, a stream with a 7Q2 hydrologically-based unregulated flow of less than one-tenth (0.1) cubic feet per second (cfs) is considered intermittent. Streams with natural perennial pools containing significant aquatic life uses are not intermittent.

BURP indices (stream macroinvertebrate, fish, and habitat indices) were developed and calibrated using data from wadeable, perennial, freestone streams. Because of this, intermittent waters, springs, lake outlets, water bodies below culverts or on or below beaver complexes, nonwadeable streams, or high-flow streams should not be monitored; if monitored, they should not be assessed using just the BURP metrics and indices. The SMI was developed based on community composition and function typical of an expected reference condition. Reference conditions describe persistent aquatic habitats that allow full development of aquatic communities and have few impacts from human activities. Because White Canyon has been observed dry on two occasions and was dry immediately above the sampled reach in 1998, it is unlikely that persistent aquatic habitats have been able to develop. This assessment data should not have been compared to reference conditions. White Canyon should be delisted for sedimentation/siltation in the next Integrated Report and placed in Category 3 as unassessed. White Canyon is also under Category 4c for physical habitat substrate alterations and should be removed as this AU is not physically altered by damming or channelization.

Luthi Canyon (ID17040105SK003_02i), Graehl Canyon (ID17040105SK006_02g), White Dugway (ID17040105SK008_02a), Little Elk (ID17040105SK012_02a), and Spring (ID17040105SK012_03) Creeks all have combined biota/habitat bioassessments as the listed pollutant. BURP assessments for these streams demonstrate excessive levels of fine sediment ≤6 mm (between 63% and 79% in most recent survey; Table 12) and grazing impacts. SEIs conducted in 2010 and 2012 reflected bank stabilities ranging from 48% to 75% (Table 13). McNeil core samples indicate high levels of fine sediment in spawning habitats in White Dugway Creek (ID17040105SK008_02a; Table 14). Excess sediment from bank erosion is the pollutant of concern for these streams and should replace the combined biota/habitat bioassessments listing. No other known sources of excess sediment or other pollutants exist.

Assessments of Upper Boulder Creek (ID17040105SK006_02c) in 1996 and 2001 produced failing scores of 0. An assessment in 2006, an SEI in 2012, and a site visit in 2014 indicated that the bed was dry. The SEI returned a bank stability of 29%. Ground cover vegetation is sparse in the valley and adjacent slopes and appears to be geologically limited, particularly by the Triassic-Jurassic Nugget sandstone that outcrops locally (Oriel and Platt 1980), although the mechanism of this limitation is unknown. The natural tendency of this AU toward rapid weathering is intensified by the lack of cover, filling the valley with silt deposits, which are then re-eroded by the stream. Sediment is clearly impacting the stream, but the role of historical land use in this watershed is unclear. The listing should be changed to sediment as the pollutant. Table 13 shows SEI results for AUs listed for combined biota/habitat bioassessments or other nonspecific pollutants. More information on the calculation of current loads is included in Section 5.1.2, Target Selection.

Table 12. BURP data (Wolman pebble counts and bank stability) for AUs listed for combined biota/habitat bioassessments and cause unknown.

Water Body	Assessment Unit Number	BURP Year	% Fines ≤ 2.5 mm	% Fines ≤ 6 mm	% Left Bank Stable	% Right Bank Stable	Average % Stable
Rich Creek	ID17040105SK003_02a	1999	20	29	88	93	91
		2004	52	65	82	88	85
Whiskey Creek	ID17040105SK003_02b	1999	36	42	85	80	83
		2004	59	67	100	86	93
Lau Creek	ID17040105SK003_02c	1999	31	38	85	93	89
		2004	66	72	100	100	100
Houtz Creek	ID17040105SK003_02d	1999	44	47	84	92	88
		2004	58	61	100	100	100
Chicken Creek	ID17040105SK003_02g	1999	59	70	98	100	99
		2004	75	77	75	100	88
Luthi Canyon	ID17040105SK003_02i	1999	51	76	87	91	89
		2004	73	78	94	97	96
Upper Boulder Creek	ID17040105SK006_02c	1996	28.2	52	85	87	86
		2001	65	70	100	100	100
West Fork Boulder Creek	ID17040105SK006_02d	2001	13	16	100	100	100
Graehl Canyon	ID17040105SK006_02g	1999	30	35	91	93	92
		2004	68	71	85	92	89
Roberts Creek	ID17040105SK007_02g	2002	71	82	100	97	99
White Dugway Creek	ID17040105SK008_02a	1998	32	41	95	76	86
		2004	72	79	86	100	93
		2012	33	43	100	82	91
Sage Creek	ID17040105SK009_02c	2006	38	42	76	73	75
South Fork Sage Creek	ID17040105SK009_02e	2006	57	59	64	67	66
Rock Creek	ID17040105SK011_03	1998	18	24	26	25	26
		2003	70	76	44	67	56
Little Elk Creek	ID17040105SK012_02a	1999	30	40	60	39	50
		2006	53	65	97	97	97
		2013	45	67	96	84	90
Spring Creek	ID17040105SK012_03	1999	18	27	100	98	99
		2006	47	63	95	82	89

Notes: BURP = Beneficial Use Reconnaissance Program; mm = millimeter

Table 13. SEI data for AUs listed for combined biota/habitat bioassessments and cause unknown.

Water Body	Assessment Unit Number	SEI Year	Current Bank Stability (%)	Current Load (tons/year)
Rich Creek	ID17040105SK003_02a	2010	94	1.27
Whiskey Creek	ID17040105SK003_02b	2010	91	1.01
Lau Creek	ID17040105SK003_02c	2010	97	0.233
Houtz Creek	ID17040105SK003_02d	2010	99	0.106
Chicken Creek	ID17040105SK003_02g	2010	96	3.03
Luthi Canyon	ID17040105SK003_02i	2010	75	55.8
Upper Boulder Creek	ID17040105SK006_02c	2012	29	86.2
Graehl Canyon	ID17040105SK006_02g	2012	50	17.4
White Dugway Creek	ID17040105SK008_02a	2012	74	51.2
Sage Creek	ID17040105SK009_02c	2014	96	1.1
South Fork Sage Creek	ID17040105SK009_02e	2014	83	22.6
Rock Creek	ID17040105SK011_03	2014	81	57.4
Little Elk Creek	ID17040105SK012_02a	2012	64	27.9
Spring Creek	ID17040105SK012_03	2012	48	23.1

Note: SEI = streambank erosion inventory

Table 14. McNeil core data for AUs listed for combined biota/habitat bioassessments and cause unknown.

Water Body	Assessment Unit Number	Sample Year	% Fines <6.25 mm	% Fines <0.85 mm	Standard Deviation % Fines <6.25 mm	Standard Deviation % Fines <0.85 mm
Upper Boulder Creek	ID17040105SK006_02c	2014	No spawning habitat			
White Dugway Creek	ID17040105SK008_02a	2014	45.0	20.4	12.4	16.1
Sage Creek	ID17040105SK009_02c	2014	35.1	7.3	4.3	3.2
South Fork Sage Creek	ID17040105SK009_02e	2014	53.7	25.9	13.8	6.2
Rock Creek	ID17040105SK011_03	2014	45.0	23.4	5.6	2.5
Spring Creek	ID17040105SK012_03	2014	No spawning habitat			

Note: mm = millimeter

West Fork Boulder Creek (ID17040105SK006_02d) received a passing average BURP score of 2.5 in 2001. The downstream segment (ID17040105SK006_03a) is also fully supporting CWAL. This AU was apparently listed in error and should be delisted for cause unknown and moved to Category 2 for fully supporting beneficial uses in the next Integrated Report.

The only BURP assessment at Roberts Creek (ID17040105SK007_02g) was conducted in 2002 at a flow of 0.09 cfs and took place during a rain storm. In 2002, it was the second driest year on record (Figure 10), exceeded only by 2001, and was the third year of the worst drought on record in the watershed. Assessment data indicate that the quantity of fine sediment encountered during the Wolman pebble count was excessive (over 70%). Streambanks, however, were very stable (99%; Table 12). In contrast to the Wolman pebble count, 40 TSS and 35 turbidity samples[1] were collected from three sites[2] upstream of the BURP location between June 2000 and 2012 (Formation Environmental 2013). TSS samples were low, with an average concentration of 5.5 mg/L with a maximum value of 10 mg/L. Similarly, TSS averaged 2.6 mg/L with a maximum value of 16.08 mg/L and all others below 6 mg/L. The inconsistency between the Wolman count and the long-term sediment data suggests that the drought and low-flow conditions under which the BURP assessment was performed may have negatively influenced the results. In addition, median selenium (0.00023 mg/L) and total phosphorus values[3] (0.045 mg/L) are quite low, and available temperature data show no exceedances (Formation Environmental 2013). Median nitrogen (nitrate + nitrite) concentration is also relatively low (0.09 mg/L) and DO values do not reflect any DO depletions associated with excessive aquatic vegetation that might indicate excess concentrations of nutrients (Formation Environmental 2013).

Notes from the 2002 BURP assessment indicate that the assessment was conducted in a marshy reach and that sedges were growing in the streambed. Retention of fine sediment would be greater in these locations and an assessment performed at such a locality is not representative of the rest of the stream. Because of the lack of clear evidence of impairment, the calculation of a TMDL is not appropriate. Roberts Creek should be in Category 3 as unassessed and delisted for combined biota/habitat bioassessments.

Sage Creek (ID17040105SK009_02c) was assessed in 2006. Unstable streambanks (75%; Table 12), highly embedded gravels, and evidence of grazing impacts indicate that high fine sediment levels might be responsible for the failing habitat score. A site visit in 2014, however, documented that streambanks were mostly stable (96%) along a longer stream reach. A Wolman pebble count indicated that sediments <2.5 mm composed 15% of the substrate in riffles and sediment <6 mm composed 19%. Since there is no clear evidence of impairment in the biological metrics (SMI = 2 and SFI = not conducted), DEQ recommends that this AU be resampled by BURP to generate a more reliable score that uses fish data. Until those scores become available, DEQ recommends that this AU remain listed in Category 5 for combined biota/habitat bioassessments.

[1] Two TSS duplicate samples and one turbidity duplicate sample were not used because of data inconsistencies.
[2] Data from the site listed as LR (Lower Roberts) were not included in the analysis because of their age (1970s and 1980s) and location in the present-day tailings pond.
[3] Data limited to six sampling events in 2000, 2002, and 2003.

South Fork Sage Creek (ID17040105SK009_02e) was characterized in its 2006 assessment as having unstable, slumping banks (66% stable) due to grazing activity. Fines in the Wolman pebble counts were also high (Table 12). A site visit in 2014 revealed that the BURP assessment was conducted in an area that is not representative of this AU. The BURP survey was conducted in the most-impacted reach of the AU where two fences concentrate cows in a small area. An 2010 SEI documented bank stability of 83% in a longer and more representative reach. A 2014 Wolman pebble count indicated that 6% of sediments were <2.5 mm and 7% were <6 mm, demonstrating that excessive surface fines are not impacting this AU. Additionally, spring TSS sampling beginning in 1992 documented that only five of 21 years had values >100 mg/L (Formation Environmental 2013). The 2006 BURP survey did not include electrofishing. Therefore, the AU failed because of a low habitat scores—the SMI was 2. Electrofishing surveys in the downstream section (ID17040105SK009_03) documented brown and cutthroat trout as well as sculpin. During the 2014 site visit, large numbers of salmonids were observed in South Fork Sage Creek. BURP should reassess this AU in a more representative reach and include an electrofishing survey. This AU should remain in Category 5.

Rock Creek (ID17040105SK011_03) was assessed in 1998 and 2003 and was dry in 2008. Bank stability was 26% in 1998 and 56% in 2003 (Table 12). The 1998 BURP assessment notes sloughing, very unstable banks, and both assessments cite evidence of heavy grazing. The 2014 SEI indicated that overall within the reach surveyed, bank stability was 81%. However, on USFS land above a fence line, bank stability was only 51%. In this section, banks were heavily trampled, and the stream was overwidened as a result. Average bankfull width was 3.9 meters in the heavily grazed area compared to 2.6 meters in the segment downstream. McNeil core sampling indicated that sediment <6.3 mm accounted for 45% of the total volume of sediment in spawning habitats and sediment <0.85 mm accounted for 23%. The listing for Rock Creek should be changed to reflect sediment as the pollutant. Unstable streambanks on USFS land appear to be a significant source of sediment in this stream. Therefore, a target of 80% streambank stability is set to reduce that input.

2.3.1 Status of Beneficial Uses

Sediment, bacteria, habitat modifications, and selenium are stressors affecting beneficial uses in this subbasin. Much of the basin is grazed by livestock on USFS, BLM, and private lands. This activity can impact streams by destabilizing banks, reducing riparian vegetation, and widening the stream channel (Belsky et al. 1999). Livestock grazing can also impact the beneficial use of contact recreation by increasing bacterial concentrations in streams. The Salt River subbasin contains historic and active phosphate mines. Waste rock dumps and open pits have the potential to pollute nearby water and impact the aquatic life beneficial use. Other suspected stressors include erosion caused by recreation and roads.

2.3.2 Assessment Unit Summary

A summary of the data analysis, literature review, and field investigations and a list of conclusions for AUs included in Category 5 of the 2012 Integrated Report follows. This section includes recommended changes that will be documented in the next Integrated Report once the TMDLs in this document have been approved by EPA.

Newswander Canyon (ID17040105SK001_02b)

- Listed in Category 5 for sedimentation/siltation and listed in Category 4c for physical substrate habitat alterations.
- Data indicates banks are not meeting target for stability (52% stable). Load allocation is set in section 5.
- Stream is dammed, so listing in Category 4c for physical substrate habitat alterations is appropriate.
- Move to Category 4a for sedimentation/siltation.

Cabin Creek (ID17040105SK002_02c)

- Listed in Category 5 for sedimentation/siltation and in Category 4c for physical substrate habitat alterations.
- The 1999 BURP assessment was conducted within a beaver complex, and the 2004 assessment was just 60 meters downstream from the 1999 site. Wolman pebble counts performed within or below a beaver complex result in high fine sediment numbers that are not representative of the entire stream. Other aspects of this stream appear to support its beneficial uses, and it is likely that the beaver complex skewed the results of the assessments. In this case, the calculation of a TMDL is not appropriate.
- Stream is not altered by active channelization or damming; remove the Category 4c listing for physical substrate habitat alterations.
- Move to Category 3 as unassessed, and delist for sedimentation/siltation.

Tincup Creek (ID17040105SK003_02)

- Listed for sedimentation/siltation.
- Data indicates banks are not meeting target for stability (61% stability). Load allocation is set in section 5.
- This AU is likely to be designated for salmonid spawning in the near future so an additional target for subsurface fine sediments is set in section 5.
- Currently unassessed for SCR. *E. coli* data indicate full support of SCR, so SCR should be changed to assessed and full support.
- Move to Category 4a for sedimentation/siltation.

Rich Creek (ID17040105SK003_02a)

- Listed for habitat assessments and cause unknown.
- Changes that may have led to the failing BURP score in 2004 include a reduction in streambank stability, an increase in fine sediments, a decrease in cover vegetation, and a narrowing of the riparian zone. These changes were likely linked to the natural conditions during the time of the survey. The 2004 BURP site only had a flow of 0.3 cfs and was conducted during the fifth year of a severe drought. The stream likely went dry during the drought, impacting the taxa observed in the creek. The ability of the stream to flush fine sediment was likely reduced during these low water years.
- The 1999 BURP assessment and 2010 SEI indicate support of CWAL.
- Delist for habitat assessment and cause unknown, and move to Category 2.

Whiskey Creek (ID17040105SK003_02b)

- Listed for combined biota/habitat bioassessments.
- Whiskey Creek flows within an extremely narrow, steep-sided canyon. Vegetation is very sparse on some areas of the slopes and appears to be limited by local geology. The 2004 BURP data indicate excessive level of fine sediment (59%) in the Wolman pebble count. Accumulation of fine sediment was caused by the drought under which the 2004 survey was conducted. The streambanks were not the cause of excess sediment as indicated by a 2010 SEI recording bank stability of 91%. In 2004, the flow in Whiskey Creek was 0.09 cfs, and this measure was likely augmented by recent precipitation. It is likely that this stream is intermittent and did not have the power to flush fine sediment during the drought.
- The 1999 BURP assessment and 2010 SEI indicate support of CWAL.
- Delist for combined biota/habitat bioassessments, and move to Category 2.

Lau Creek (ID17040105SK003_02c)

- Listed for habitat assessments and cause unknown.
- The 1999 assessment at Lau Creek indicates the stream was not fully supporting aquatic life with an average score of 1.5. Both habitat and macroinvertebrate scores fell in 2004. Much of the streambed is bedrock, negatively impacting BURP scores. In late October 2012, the lowest 100 meters of the bed were dry although snow was present and melting. Fine sediment levels were much higher in 2004 than in 1999, perhaps reflecting the 76% reduction in flows and corresponding reduction in the ability of the stream to flush fines out of the bed. Fine sediment accumulated because of the low flows associated with the drought. In contrast to the high levels of fine sediment observed in the 2004 Wolman pebble counts, the streambanks were very stable when measured in 2010. SMI scores of 2 in 1999 and 2004 indicate support of CWAL. Furthermore, the downstream segment of Tincup Creek (ID17040105SK003_03) is fully supporting beneficial uses.
- In such a small AU, it is not appropriate to compare habitat scores to reference conditions.
- Delist for habitat assessments and cause unknown, and move to Category 2.

Houtz Creek (ID17040105SK003_02d)

- Listed for cause unknown.
- BURP scores at Houtz Creek dropped from an average of 2.5 in 1999 to 0 in 2004. Macroinvertebrate data from 2004 indicate that the drought had strong implications for life in this stream. Fine sediments were elevated in 2004, resulting in highly embedded gravels. An SEI, however, indicates that bank erosion is not contributing excess sediment to this stream. Notes from both BURP assessments and the 2010 SEI indicate that the lower 100 meters have been channelized. Therefore, the AU should be listed under Category 4c for habitat alteration.
- Delist for cause unknown, and list in Category 4c for habitat alteration.

Bear Canyon (ID17040105SK003_02e)

- Listed for *E. coli*.
- The 1999 and 2004 BURP site comments document a corral 0.1 miles downstream from the start of the reach and reports sheep grazing in the area. *E. coli* is exceeding the limit for contact recreation.
- Move to Category 4a for *E. coli*.

Chicken Creek (ID17040105SK003_02g)

- Listed for combined biota/habitat bioassessments.
- Notes from the 1999 BURP and 2010 SEI at Chicken Creek suggest that the stream likely goes dry each year, and it was dry when visited by DEQ in August 2012. Fine sediment levels were higher in 2004 than in 1999. Excess sediment was not a result of unstable streambanks; rather it was likely the result of the stream's inability to flush sediment during the drought.
- It is not valid to compare an assessment at 0.08 cfs to reference conditions. The 1999 BURP assessment and 2010 SEI indicate support of CWAL.
- Delist for combined biota/habitat bioassessments, and move to Category 2.

Luthi Canyon (ID17040105SK003_02i)

- Listed for combined biota/habitat bioassessments.
- BURP assessments of this stream demonstrate excessive levels of fine sediment, and the streambanks were verified as the main source of excess sediment (75% streambank stability calculated from the 2010 SEI). Sediment should be listed as the pollutant.
- List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.

Haderlie Creek (ID17040105SK003_02j)

- Listed in Category 5 for sedimentation/siltation and listed in Category 4c for physical substrate habitat alterations.
- BURP assessments of this stream document high levels of fine sediment. A 2010 SEI calculated a bank stability of 79%, just below the target of 80%.
- This AU is likely to be designated for salmonid spawning. A site visit in 2014 observed no spawning habitat to sample.
- Stream is channelized for irrigation on private land below BURP and SEI sampling locations. Keep listed in Category 4c for physical substrate habitat alterations.
- List in Category 4a for sedimentation/siltation.

Upper Boulder Creek (ID17040105SK006_02c)

- Listed for cause unknown.
- Assessments of Upper Boulder Creek (ID17040105SK006_02c) in 1996 and 2001 produced failing scores of 0. An assessment in 2006 and an SEI in 2012 documented that the bed was dry. The 2012 SEI recorded bank stability of 29%. Ground cover vegetation is sparse in the valley and adjacent slopes and appears to be geologically limited. The natural tendency of this stream toward rapid weathering is intensified by the lack of cover, filling the valley with silt deposits that are then re-eroded by the stream. Logging

was noted in the 1996 BURP survey and both the 1996 and 2006 surveys observed that the stream is braided with several dry channels and then flows underground below the surveyed site. Sediment is clearly impacting the stream, but the role of historical land use in this watershed is unclear.

- Upper Boulder Creek will likely be designated for salmonid spawning. A site visit in 2014 observed that the creek was dry with no salmonid spawning habitat to sample.
- List in Category 4a for sedimentation/siltation, and delist for cause unknown.

West Fork Boulder Creek (ID17040105SK006_02d)

- Listed for cause unknown.
- A 2001 BURP assessment indicated that this AU was fully supporting CWAL. This AU was listed in error.
- Delist for cause unknown, and move to Category 2.

White Canyon (ID17040105SK006_02f)

- Listed in Category 5 for sedimentation/siltation and listed in Category 4c for physical substrate habitat alterations.
- In 1999, an assessment of White Canyon was conducted at a flow of 0.11 cfs and produced a failing score. The 1999 BURP field site notes stated that “immediately above reach, creek is dry […] Creek will be dry in a week?” The stream was dry in 2004 and again in 2012, and no perennial indicator taxa were collected during the 1999 assessment. Streambank stability was 87% as measured from a 2012 SEI. This AU meets the IDAPA 50.01.02 definition of intermittent water; BURP protocols were misapplied and not appropriate/designed for nonperennial streams.
- Delist for sedimentation/siltation and move to Category 3 as unassessed.
- Remove listing in Category 4c for physical substrate habitat alterations. This AU has not been physically altered.

Graehl Canyon (ID17040105SK006_02g)

- Listed for combined biota/habitat bioassessments.
- The 1999 BURP survey noted that the area was grazed, had stomped streambanks, and the water was somewhat cloudy. The 2004 survey recorded that cattle were currently in the area and 68% fine sediment in the Wolman pebble counts. An SEI in 2012 confirmed that the streambanks were largely unstable with 50% bank stability.
- List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.

Lower Stump Creek (ID17040105SK006_04)

- Listed for sedimentation/siltation.
- Both 1996 and 2002 surveys cite evidence of heavy grazing by cattle and highly embedded gravels. *E. coli* sampling by the Wyoming Star Valley Conservation District indicates that this AU is not meeting beneficial use for contact recreation. A 2012 SEI confirmed that excess sediment is being contributed to the stream through bank erosion, as banks are not meeting their stability target of 80%.

- This AU is likely to be designated for salmonid spawning. McNeil cores collected in 2014 indicate high levels of subsurface fines. Targets for subsurface fines are presented in section 5.
- List in Category 4a for sedimentation/siltation and *E. coli* (unlisted but impaired).

Smoky Creek (ID17040105SK007_02c)

- Listed in Cateogry 5 for *E. coli* and sedimentation/siltation and listed in Category 4c for physical substrate habitat alterations.
- The 1997 BURP survey noted that tailing ponds from Smoky Canyon Mine drain into the creek, and these ponds blew out that spring dumping large amounts of sediment into the creek. The 2002 BURP survey recorded evidence of heavy grazing, streambank trampling, and cattle feces near and in the stream. The 2012 SEI confirmed that the banks are highly unstable.
- This AU is likely to be designated for salmonid spawning. A site visit in 2014 documented no salmonid spawning habitat to sample.
- Keep in Category 4c for physical substrate alterations as upper portion of AU is significantly altered by mining activities at Smoky Canyon Mine.
- List in Category 4a for sedimentation/siltation and *E. coli*.

Draney Creek (ID17040105SK007_02f)

- Listed in Category 5 for sedimentation/siltation and fecal coliform and listed in Category 4c for physical substrate habitat alterations.
- The 1998 and 2003 BURP assessments noted that the area was actively grazed, and the creek was diverted for irrigation below the reach. The 2012 SEI confirmed that banks were below the 80% target for bank stability.
- The 2014 *E. coli* data indicate no impairment (16 cfu/100 mL).
- Additional data are needed to assess if SCR is currently supported.
- This AU is likely to be designated for salmonid spawning. The 2012 McNeil core sampling data indicate high levels of subsurface fines. Targets for subsurface fines are presented in section 5.
- List in Category 4a for sedimentation/siltation and *E. coli*.
- Remove from Category 4c for physical substrate habitat alterations as stream is not channelized or dammed.

Roberts Creek (ID17040105SK007_02g)

- Listed for combined biota/habitat bioassessments.
- The only BURP assessment at Roberts Creek was conducted in 2002 at a flow of 0.09 cfs and took place during a rain storm. In 2002, it was the second driest year on record, exceeded only by 2001, and was the third year of the worst drought on record in the watershed. Assessment data indicate that the quantity of fine sediment encountered during the Wolman pebble count was excessive (over 70%). Streambanks, however, were very stable (99%). In contrast to the Wolman pebble count, 40 TSS and 35 turbidity samples were collected from three sites upstream of the BURP location between June 2000 and 2012 (Formation Environmental 2013). TSS samples were low, with an average concentration of 5.5 mg/L with a maximum value of 10 mg/L. Similarly, turbidities averaged 2.6 mg/L with a maximum value of 16.08 mg/L and all others below 6 mg/L.

The inconsistency between the Wolman count and the long-term sediment data suggests that the drought and low-flow conditions under which the BURP assessment was performed may have negatively influenced the results. In addition, median selenium (0.00023 mg/L) and total phosphorus values (0.045 mg/L) are quite low, and available temperature data show no exceedances. Median nitrogen (nitrate + nitrite) concentration is also relatively low (0.09 mg/L), and DO values do not reflect any depletions associated with excessive aquatic vegetation that might indicate excess nutrients. Notes from the 2002 BURP assessment indicate that the survey was conducted in a marshy reach and sedges were growing in the streambed. Retention of fine sediment would be greater in this location, and such an assessment is not representative of the rest of the stream. Because of the lack of clear evidence of impairment, the calculation of a TMDL is not appropriate.

- List in Category 3 as unassessed, and delist for combined biota/habitat bioassessments.

Tygee Creek (ID17040105SK007_03)

- Listed in Category 5 for sedimentation/siltation and listed in Category 4c for low-flow alterations and physical substrate habitat alterations.
- The 2012 SEI indicates that streambanks are contributing excess sediment to the stream.
- This AU is likely to be designated for salmonid spawning. Targets for subsurface fines are presented in section 5.
- Keep in Category 4c for physical substrate habitat alterations and low-flow alterations. Stream is channelized and diverted around ponds used in milling ore and is also diverted for irrigation.
- List in Category 4a for sedimentation/siltation.

Crow Creek (ID17040105SK008_02)

- Listed in Category 5 for *E. coli*.
- Listed in error. Data were misapplied from the 4th-order segment of Crow Creek (ID17040105SK008_04).
- Delist for *E. coli*, and move to Category 3 as unassessed for SCR.

White Dugway Creek (ID17040105SK008_02a)

- Listed for combined biota/habitat bioassessments.
- The 2004 BURP survey notes evidence of heavy grazing and shows high levels of fine sediment. The 2012 SEI confirmed that bank instability is likely impacting this AU.
- This AU is likely to be designated for salmonid spawning. McNeil core sampling data from 2014 indicate high levels of subsurface fine sediment. Targets for subsurface sediments are documented in section 5.
- List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.

Beaver Dam Creek (ID17040105SK008_02c)

- Listed in Category 5 for sedimentation/siltation and listed in Category 4c for physical substrate habitat alterations.
- Comments from 1998 and 2003 BURP assessments indicate that the area is heavily

grazed, and the stream has a large sediment load. The 2012 SEI confirms that streambank erosion is likely contributing excess fine sediment to the stream as streambanks are highly unstable.
- This AU is likely to be designated for salmonid spawning. A 2014 site visit found no spawning habitat to sample.
- Remove from Category 4c for physical substrate habitat alterations as the channel is not actively manipulated, and a TMDL for sediment addresses major source of fine sediment to this AU.
- List in Category 4a for sedimentation/siltation.

Crow Creek (ID17040105SK008_02d)

- Listed for *E. coli*.
- Listed in error. Data were misapplied from the 4th-order segment of Crow Creek (ID17040105SK008_04).
- The 2014 *E. coli* sample was 37 cfu/100 mL, indicating no impairment.
- Delist for *E. coli*. Move to Category 2 as assessed for contact recreation and full support.

Crow Creek (ID17040105SK008_03b)

- Listed for *E. coli*.
- The 2001 *E. coli* sample was 150 cfu/100 mL, less than the trigger for contact recreation. Listed in error. Data were misapplied from the 4th-order segment of Crow Creek (ID17040105SK008_04).
- Delist for *E. coli*. Move to Category 2 as assessed for contact recreation and full support.

Crow Creek (ID17040105SK008_04)

- Listed for *E. coli* and sedimentation/siltation.
- Formation Environmental and HabiTech (2012) data indicate that banks are not meeting 80% stability target. Excessive levels of fine sediments in brown trout redds are documented by this study.
- The 2008 *E. coli* geometric mean was 579 cfu/100 mL.
- The 2014 SEI confirmed that streambanks are unstable (80% bank stability) and contributing excess sediment to stream.
- This AU is likely to be designated for salmonid spawning. McNeil core sampling data from 2014 indicate high levels of subsurface fine sediment in spawning habitats. Targets for subsurface sediments are documented in section 5.
- List in Category 4a for *E. coli* and sedimentation/siltation.

North Fork Sage Creek (ID17040105SK009_02)

- Listed for selenium.
- Keep listed in Category 5 for selenium.

Sage Creek (ID17040105SK009_02c)

- Listed for combined biota/habitat bioassessments due to failing SHI in 2006.
- The 2006 BURP assessment indicates high levels of fine sediments (38%) and high embeddedness of substrate.
- The 2014 SEI indicates that streambanks are highly stable (96%) and fine surface sediments are not elevated in riffles (15% of sediments <2.5 mm and 19% <6 mm).
- Keep listed in Category 5 for combined biota/habitat bioassessments.
- DEQ recommends that a BURP survey be conducted again including electrofishing to better describe this AU and perform an appropriate assessment.

Pole Canyon Creek (ID17040105SK009_02d)

- Listed for selenium.
- Keep listed in Category 5 for selenium.

South Fork Sage Creek (ID17040105SK009_02e)

- Listed for combined biota/habitat bioassessments and selenium.
- South Fork Sage Creek (ID17040105SK009_02e) was characterized in its 2006 assessment as having unstable, slumping banks (66% stable) due to grazing activity. Wolman pebble counts also indicated high levels of surface fines. Spring TSS samples beginning in 1992 indicated that only five of the 21 years had values over 100 mg/L.
- A 2014 site visit indicated that the 2006 BURP survey was conducted in an unrepresentative reach. An SEI that was more representative and incorporated a longer stream length had a streambank stability of 83%. A Wolman pebble count indicated low levels of surface fines. Many salmonids were observed.
- Keep listed in Category 5 for combined biota/habitat bioassessments and selenium.
- DEQ recommends that a BURP survey be conducted in a more representative reach including electrofishing to better describe this AU and perform an appropriate assessment.

Sage Creek (ID17040105SK009_03)

- Listed for selenium.
- Keep listed in Category 5 for selenium.

South Fork Deer Creek (ID17040105SK010_02a)

- Listed in Category 5 for sedimentation/siltation and listed in Category 4c for physical substrate habitat alterations.
- South Fork Deer Creek was assessed by BURP in 1998 and documented elevated fine sediments in the Wolman pebble counts. A 2012 SEI demonstrated that South Fork Deer Creek had very stable streambanks (98%), and no other sources of excess sediment contribute to this AU. Seventeen TSS samples taken at four other sites in the Deer Creek watershed between 2002 and 2012 resulted in only two samples above 9 mg/L (21 and 27 mg/L) and 11 samples below the minimum detection level, indicating that excess suspended sediment is not a problem in this AU according to the *Water Body Assessment Guidance,* Section 6 (Grafe et al. 2002). The 1998 BURP assessment was conducted in a beaver complex, likely biasing results. Recent data from Formation Environmental (2012) indicate that this AU is meeting its beneficial uses. Three habitat assessments

conducted according to DEQ protocols produced SHI scores of 2, 3, and 3 in 2009, 2010, and 2011, respectively. Invertebrates collected in 2011, produced a passing SMI score of 2. The average for 2011 was 2.5, indicating no impairment of this AU. The downstream segment, ID17040105SK010_03, is fully supporting beneficial uses. The 1998 BURP assessment was invalid because it included old beaver ponds, and more recent data presented by Formation Environmental (2012) should be used instead. A 2013 BURP survey also documents lower levels of fine sediment than those observed in 1998.

- Remove from Category 4c for physical substrate habitat alterations. Stream is not channelized or dammed.
- Delist for sedimentation/siltation and move to Category 2.

Rock Creek (ID17040105SK011_03)

- Listed for combined biota/habitat bioassessments.
- BURP assessments indicate that the area is heavily grazed, and banks are unstable and sloughing. Sediment is the appropriate pollutant.
- The 2014 SEI indicates that within the reach surveyed, 81% of banks were stable. However in a segment on USFS land above a fence, bank stability was only 51% stable. This segment was heavily grazed and overwidened. In the lower portion of the AU, average bankfull width was 2.6 meters. In the heavily grazed reach, banks were trampled, and average bankfull width was 3.9 meters.
- This AU is likely to be designated for salmonid spawning. Targets for subsurface fine sediments are documented in section 5.
- List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.

Little Elk Creek (ID17040105SK012_02a)

- Listed for combined biota/habitat bioassessments.
- Notes from 2006 assessment document very murky water, a fine layer of silt on substrate, and the stream is in a grazing area. The 2012 SEI confirms that streambanks are contributing excess sediment to the stream and are not meeting the 80% stability target.
- Listed as unassessed for SCR, but *E. coli* data indicated full support. SCR should be changed to assessed and full support.
- List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.

Spring Creek (ID17040105SK012_03)

- Listed for combined biota/habitat bioassessments.
- The 2006 comments from the BURP assessment document that a road had washed out and deposited sediment into the creek, and cows had access to the stream and affected banks. The 2012 SEI confirms that streambanks are likely contributing excess sediment to the stream as banks are highly unstable.
- This AU is likely to be designated for salmonid spawning. A 2014 site visit observed no spawning habitats to sample.
- List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.

3 Subbasin Assessment—Pollutant Source Inventory

Pollution within the Salt River subbasin is primarily from sediment, *E. coli*, and selenium.

3.1 Point Sources

No point sources of *E. coli* or sediment were identified in the subbasin except for Smoky Canyon Mine, which currently operates under the National Pollutant Discharge Elimination System (NPDES) Multisector General Permit (MSGP) NPDES No. IDR050000 for stormwater discharges associated with industrial activity. Smoky Canyon Mine has the potential to discharge into three streams with sediment TMDLs: Smoky (ID17040105SK007_02c), Tygee (ID17040105SK007_03), and Crow (ID17040105SK008_04) Creeks. Smoky (ID17040105Sk007_02c) and Crow (ID17040105SK008_04) Creeks also have TMDLs for *E. coli*.

The major source of sediment to waterbodies covered by sediment TMDLs is excess streambank erosion caused mostly from streambank trampling due to livestock grazing and natural hydrological and geomorphic processes that contribute sediment to streams. While Smoky Canyon Mine has discharged sediment periodically (primarily to the intermittent reach of Smoky Creek adjacent to panels A and C), it is not a major source of streambank erosion derived sediment as determined in the TMDL based on BURP sites and on-site evaluations. Simplot must follow their Storm Water Pollution Prevention Plan (SWPPP) at the Smoky Canyon Mine and use BMPs to comply with Idaho’s Water Quality Standards. Stormwater discharges are highly variable in frequency and duration and are not easily characterized. Wasteload allocations for stormwater discharges in the Idaho phosphate mining district are unprecedented. Furthermore, development of realistic numeric wasteload allocations would require data not currently available and would not be practicably implemented. Smoky Canyon Mine is required to use BMPs and an adaptive management process to evaluate, maintain, and, as necessary, upgrade BMPs.

TMDLs for *E. coli* were developed for Smoky and Crow Creeks and are included in this document. However, mining operations at Smoky Canyon are not an *E. coli* source of pollution to the lands within their boundaries and the Smoky Canyon Mine does not have a wasteload allocation for *E. coli* as a point source. Potential sources of *E. coli* in Smoky and Crow Creeks are livestock, wildlife, and humans. Smoky Canyon Mine does not discharge sewage into either of these waterbodies. Mining activities occur in upstream areas of Smoky Creek (and are not proximate to Crow Creek). Grazing occurs on USFS and private land below active or reclaimed areas of the mine. Grazing animals that have uncontrolled access to streams are the likely source of *E. coli* levels above Idaho’s water quality standards. Disturbance in the Smoky Creek drainage occurs in an intermittent reach of the stream and springs well below the mining activity return perennial streamflow to the reach. No mining activity occurs directly on the 4^{th} order segment of Crow Creek. Grazing on both private and public land likely contributes to *E. coli* levels in excess of state water quality standards.

3.2 Nonpoint Sources

Various nonpoint sources contribute additional (above natural) inputs of sediment to streams of the Salt River subbasin. Much of the subbasin is grazed by cattle and sheep on public and private lands, which can lead to increased bank erosion. Agriculture, mostly hay production, on private land in valleys of the subbasin may contribute excess sediment to streams through field erosion. Further, roads and trails in the subbasin, especially streamside, may contribute additional sediment to streams. Stormwater runoff may pick up pollutants from agricultural and other nonpoint source activities in the watershed and transport it untreated into waterbodies.

E. coli is an intestinal bacterium common to warm-blooded animals. Both livestock and wildlife contribute *E. coli* to streams by defecating in and near water. Elevated *E. coli* levels are often associated with riparian grazing and related streambank erosion.

CERCLA Sites

The Salt River subbasin contains J.R. Simplot Company's Smoky Canyon Mine Site, which has both historic and active mining operations (Figure 11). Mining operations at Smoky Canyon began in 1983 and has progressed through a series of panels. Four panels are no longer actively mined, and are in various phases of reclamation. The Pole Canyon Overburden Disposal Area (ODA) is a 120-acre cross-valley fill that contains roughly 26 million cubic yards of materials (Formation Environmental 2012). In 2008, a remedial action was completed that diverted water from Pole Canyon Creek around the ODA (DEQ 2012). Four AUs in the Salt River subbasin are listed for selenium: North Fork Sage (ID17040105SK009_02), Pole Canyon (ID17040105SK009_02d), South Fork Sage (ID17040105SK009_02e), and Sage (ID17040105SK009_03) Creeks. All of these AUs are in proximity to each other and drain the Smoky Canyon Mine Site including the disposal areas. Elevated levels of selenium are associated with waste rock dumps and can have adverse effects for both humans and the environment (DEQ 2012). The Smoky Canyon Mine Site also contributed sediment to lower Pole Canyon Creek and portions of Sage Creek during two washouts of the ODA in the 1990s (Formation Environmental 2012). Selenium from the Smoky Canyon Mine is being dealt with under CERCLA framework with oversight from EPA, USFS, and DEQ (DEQ 2012).

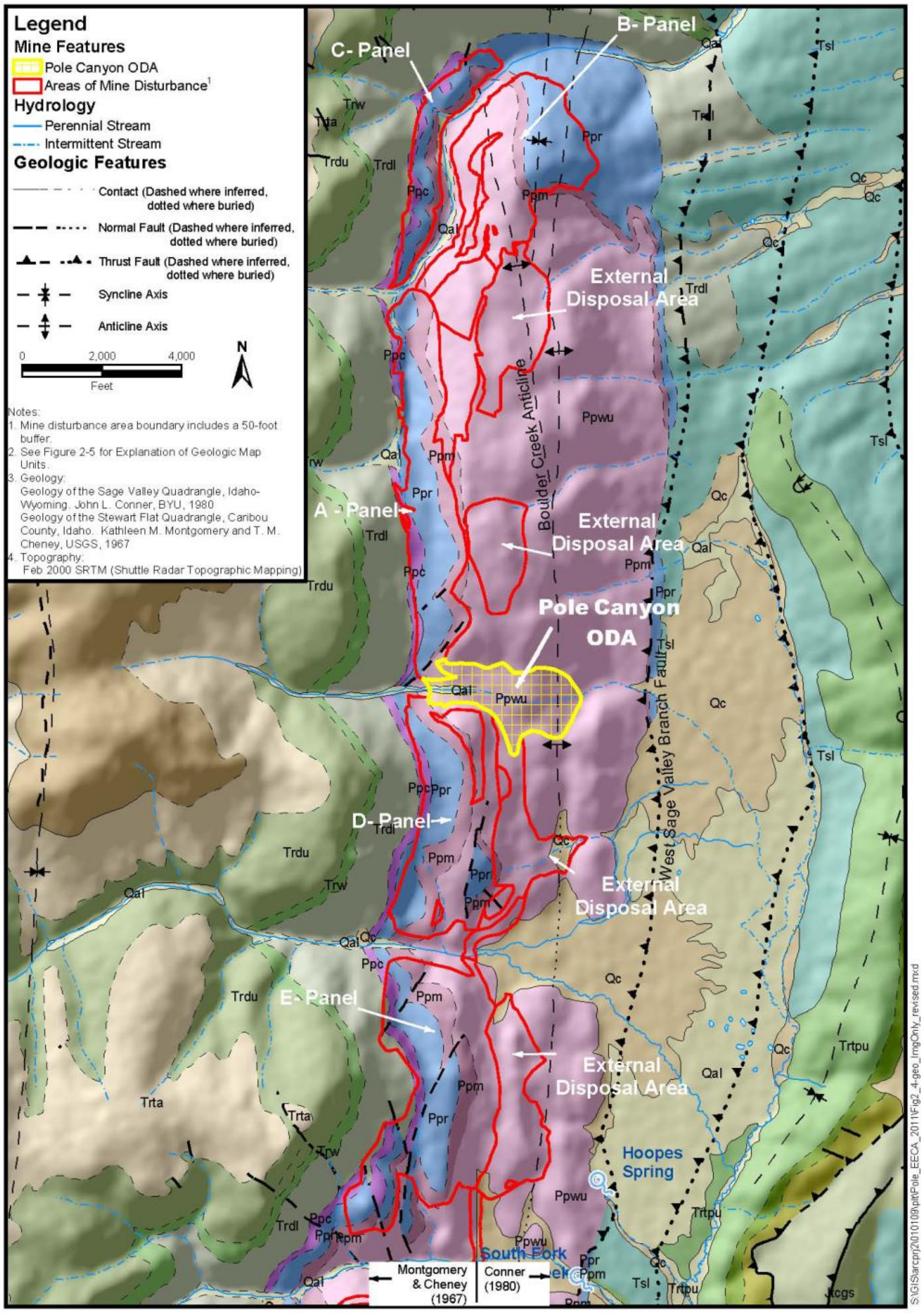

Figure 11. Smoky Canyon Mine site (Formation Environmental 2012).

3.3 Pollutant Transport

Pollutant transport refers to the pathway by which pollutants move from the pollutant source to cause a problem or water quality violation in the receiving water body. Sediment makes its way to streams most readily during high flow events, typically during spring snowmelt. During bankfull conditions, streambank erosion from livestock trampling can contribute excess sediment to streams. Overland flow during storms and during snowmelt can pick up sediment from roads, trails, and municipal, industrial and construction sources and deposit that sediment into streams. Overland flow through lands disturbed by agriculture can contribute excess sediment to streams. The retention of sediment in streams is also governed by flow levels. In the absence of high-flushing flows, fine sediment can accumulate in the streambed, negatively impacting biota.

E. coli is a living organisms and its transport and concentration in water is influenced by many factors. *E. coli* makes its way to streams when warm-blooded animals defecate in them or when overland flow moves fecal particles to streams. Once *E. coli* is discharged into water, its density generally decreases as a result of dilution, dispersion, settling, predation, and decay (Hellweger et al. 2009). Therefore, higher flows can be expected to increase the dilution of *E. coli*. In one study, lower temperatures decreased the die-off rate of *E. coli* (Easton et al. 2005). In some conditions, such as when ambient nutrients are high, growth of surface water-adapted cells is possible (Bucci et al. 2011). In general, the decay of *E. coli* is thought to be biphasic with a quick initial die-off, followed by slower prolonger decay (Hellweger et al. 2009).

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

The Caribou-Targhee National Forest has taken efforts to control pollution in the Salt River subbasin. Along Jackknife Creek (ID17040105SK002_04), the USFS in collaboration with Trout Unlimited, National Resources Conservation Service, and Bonneville County, removed a motorized vehicle road (1.6 miles) and replaced it with a nonmotorized trail (1.9 miles) to accommodate foot, horse, and bicycle traffic. A bridge was also replaced to provide adequate channel function. Streambanks were reshaped to promote aggradation of the down-cut channel and meanders that have been lost were reconnected (Issacs 2011).

The Caribou-Targhee National Forest also converted Forest Service Road #389 from a full-sized vehicle road to an all-terrain vehicle trail along Squaw Creek (ID17040105SK002_03a), a tributary to Jackknife Creek. During this process, two bridges were created instead of road fords to limit sedimentation. Bank stabilization and willow plantings were also implemented (Duehren 2013).

In 2009, the Caribou-Targhee National Forest restored meander bends in middle Crow Creek (ID17040105SK008_04). This action increased stream length. Willows were planted to provide bank stabilization. This site has been recolonized by beaver since implementation.

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. It further allocates this load capacity among the various sources of the pollutant. 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 attaining water quality standards, the rules regarding TMDLs (40 CFR 130) require a margin of safety be included in the TMDL. Practically, the margin of safety 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 margin of safety 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 for the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary for pollutant trading to occur. 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 (40 CFR 130.2). These other measures must still be quantifiable and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads and allow "gross allotment" as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

This document contains TMDLs for sediment and *E. coli*. Where SEIs were conducted, an estimation of the current annual sediment load (tons/years) and the sediment load at the 80% targeted streambank stability was calculated. Annual loads are most appropriate for sediment because most bank erosion occurs during bankfull flows at spring runoff, but excess sediment can have consequences for instream biota year round. Additionally, for AUs where salmonid spawning will likely be designated as a beneficial use, targets for subsurface fine sediments are presented. Targets for subsurface fines in spawning areas (pool tailout and riffles) are set that fine sediments (< 6.35 mm) not exceed 27% of the total volume of sediment and that ultrafine sediment (< 0.85 mm) not exceed 10%. *E. coli* TMDLs were set by state water quality standards as a concentration of bacteria in water. Loads based on flows are reported in Appendix G.

5.1 Instream Water Quality Targets

Water quality targets were selected to restore "full support of designated beneficial uses" (Idaho Code §39-3611 and §39-3615). For sediment, the pollutant affecting the majority of AUs listed in the Salt River subbasin, a target of 80% streambank stability was set. This target was selected because research indicates that for Rosgen (1996) A, B, and C channel types, natural streambank stability is generally 80% or greater (Overton et al. 1995). Full support of beneficial uses is assumed to be achieved when this condition is met, bank erosion decreases, instream fines and embeddedness of substrate decrease, and BURP scores indicate no impairment of aquatic life.

For AUs where salmonid spawning is likely to be designated as a beneficial use, additional targets for subsurface fine sediments in spawning areas were developed. In nearby Pine Creek, Idaho, Thurow and King (1994) observed that redds were constructed by Yellowstone cutthroat trout in areas were fine sediments (< 6.35 mm) comprised a mean of 20% of the total volume of sediment and ultrafine sediments (< 0.85 mm) comprised a mean of 5%. Many studies have documented negative effects of excess fine sediments on embryo survival of salmonids and number of redds constructed (Kemp et al. 2011; Magee et al. 1996). Rowe et al. (2003) recommend that in Idaho, subsurface fine sediments should not exceed 27% of the total volume of sediments, and ultrafine sediments should not exceed 10% in salmonid spawning habitats. DEQ uses these recommendations as the targets in this document.

For *E. coli*, the water quality target is set by Idaho. Full support of the beneficial use of SCR is assumed to be met when the concentration of *E. coli* bacteria is below 576 cfu/100 mL for a single sample or 126 cfu/100 mL for a geometric mean of five samples taken over a 30-day period (IDAPA 58.01.02.251).

5.1.1 Design Conditions

The water quality standard for *E. coli* does not account for seasonality. Rather, the standard must be met at all times. Exceedances, however, are more likely to occur provided certain conditions. Exceedances are most likely when flows are low, decreasing the dilution of bacteria, and when water is warm, decreasing the die-off rate of bacteria. Exceedances are also most likely to occur when livestock or wildlife are concentrated near streams, which varies seasonally.

Effects of sediment in streams are not limited to a particular time of the year. The process of erosion, transport, and deposition of sediment varies seasonally and annually. The majority of bank erosion occurs during bankfull conditions, typically during spring snowmelt. Annual variability in precipitation and timing of precipitation and snowmelt can greatly influence the amount of sediment delivered to streams. Furthermore, stochastic events such as debris flows can contribute the majority of sediment to streams over long time frames in certain landscapes. Given this variability in sediment loading, sediment TMDLs are expressed as annual average loads. For areas where salmonid spawning is likely to be designated as a beneficial use, targets for subsurface fine sediments were developed. In the *Guide to Selection of Sediment Targets for*

Use in Idaho TMDLs, Rowe et al. (2003) recommend a 5-year mean target for subsurface fines. However, since McNeil cores are not normally collected on an annual basis, DEQ recommends an instantaneous target instead. While fine sediment values may change year-to-year, normally there is not enough data to generate 5-year means of subsurface fines.

5.1.2 Target Selection

SEI uses eroding streambank measurements to calculate estimated sediment load conveyed by the stream, generally during bankfull conditions. Surveyors measure eroding area, lateral recession rate, and soil properties along at least 10% of a stream's length. These measurements are then used to calculate bank erosion rate:

$$E = [A_E * R_{LR} * \Delta_B]/2{,}000 \text{ lb/ton}$$

where:

E = bank erosion rate (tons/year)
A_E = eroding area (square feet)
R_{LR} = lateral recession rate (feet/year)
Δ_B = bulk density of bank material (pounds/cubic feet)

The current sediment load is compared to assumed natural background conditions. Natural background erosion rates are assumed to be achieved at 80% streambank stability, which equates with the load capacity. The difference between the current sediment load and the load capacity equals the necessary load reduction. If the current sediment load is less than the load capacity, there is no load reduction needed because the 80% target of streambank stability is already achieved. In such cases, fine sediment is likely being deposited in the stream by other processes such as field erosion or erosion from streamside roads or mines. SEIs cost effectively calculate sediment loads from instream erosion and are also useful when targeting high-priority areas for implementation efforts.

McNeil core samples document the distribution of sediments of various sizes and are intended for salmonid spawning habitats (DEQ 2014c). A sediment core is driven into the streambed in salmonid spawning habitats to a depth of 4 inches for nonanadromous salmonids. The contents of the core are removed and sorted by size with sieves. Sediments of various sizes are then used to displace water, and the volume of water displayed is measured with graduated cylinders. After documenting the volume of certain-sized sediments, calculations of percent fine sediment <6.25 mm and < 0.85 mm are made. The mean of three core values is compared to targets for percent fine sediments <6.25 mm and <0.85 mm. These measurements document actual streambed conditions and are used with SEIs to set targets for sediment. Percent fine sediments <6.25 mm is used because sediments in the 1–10 mm size range are known to block emergence of fry through intragravel pores (Everest et al. 1987). Meanwhile, percent fines <0.85 mm is used because sediment <1 mm are known to reduce the permeability of gravel and prevent flow of oxygen in sufficient quantities for developing embryos (Kondolf 2000). Sediments >63 mm were excluded from analyses because they are too large for nonanadromous salmonids to mobilize during spawning.

Bacteria targets are set by Idaho's water quality standards (IDAPA 58.01.02.251). *E. coli* is not to exceed 126 cfu/100 mL of water based on the geometric mean of five samples taken over a

30-day period. This criterion applies to both PCR and SCR. Bacteria TMDLs are based on meeting this criterion at all times.

5.1.3 Water Quality Monitoring Points

Streams with suspected sediment problems were monitored with SEIs that included at least 10% of the AU's length. In the future, SEIs of the same AUs can be used to evaluate if streambank stability targets are being achieved and observe change in bank conditions over time. This information can be used in conjunction with BURP assessments to evaluate if an AU is supporting its beneficial uses. Assessors should pay close attention to measures such as percent fines and substrate embeddedness to determine if the sediment problem is improving and to relate SEI information to BURP measures.

Further, streams with suspected sediment problems and where salmonid spawning is likely to be designated as a beneficial use were monitored with McNeil core sampling. In the future, percent fines <6.25 mm and <0.85 mm can be compared to initial values to document changes in streambed conditions in salmonid spawning areas through time. Because three cores are taken and a standard deviation is calculated, a *t*-test can be used to assess if changes in streambed conditions of salmonid spawning are significantly different.

E. coli monitoring was conducted on some AUs by DEQ and the Wyoming Star Valley Conservation District. Future *E. coli* monitoring by DEQ should be used to evaluate if streams are meeting their TMDLs at critical time periods of low flow and warm water.

5.2 Load Capacity

The load capacity for sediment from streambank erosion is based on ≥80% streambank stability, which is assumed to be the natural stability (Overton et al. 1995). It is presumed that beneficial uses were supported at natural background rates of sediment loading. Therefore the load capacity is between the current loading level and sediment loading from natural streambank erosion.

McNeil core samples in salmonid spawning habitats do not attempt to estimate sediment-loading rates from streambanks or other contributors in the watershed. Rather, they document instream conditions. Targets for subsurface fine sediments exist outside of targets for streambank stability and represent the load capacity for salmonid spawning habitats. If streambanks are restored and percent subsurface fines in spawning habitats remain high, other pathways of sediment transport should be considered for reduction. Salmonid spawning habitats may take years to recover after streambanks are stabilized. For example, a 20-year study of Chinook Salmon spawning habitat in the South Fork Salmon River indicated that once a moratorium on logging was instituted in 1965, percent subsurface fines at spawning sites continued to increase, for up to 10 years in some cases, before they began to decline (Platts et al. 1989). Initial increases were likely observed because the watershed took time to recover and fines were still being delivered to the channel by logging roads. The study indicated that subsurface sediments took longer to react to changing watershed management than surface sediments. Hydrology in the years following watershed restoration can also affect the transport of the bedload and the reduction in the percent of subsurface fines. A flow event of great enough magnitude to scour the streambed and disrupt armor layers may be needed to substantially reduce subsurface fine sediments given that erosion is reduced (Platts et al. 1989).

For *E. coli*, the load capacity is 126 cfu/100 mL for a geometric mean of five samples taken over a 30-day period. For water designated for SCR, a single sample must be over 576 cfu/100 mL to warrant additional sampling to evaluate a potential violation of the water quality standards. For waters designated for SCR, a single sample must exceed 406 cfu/100 mL to warrant further sampling (IDAPA 58.01.02.251). The beneficial use of SCR is assumed to be met when levels are below this load capacity.

5.3 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" (40 CFR 130.2(g)).

E. coli concentrations were sampled by DEQ and the Wyoming Star Valley Conservation District. DEQ collected samples based on protocols outlined in IDAPA 58.01.02. The Wyoming Star Valley Conservation District followed protocols outlined by the Wyoming DEQ.

Table 15Table 15 displays existing concentrations of *E. coli* calculated from these sampling efforts. Since no point sources of *E. coli* exist (e.g., confined animal feeding operations or failing human septic tanks known in the subbasin), all *E. coli* concentrations were attributed to nonpoint sources. Nonpoint sources of *E. coli* are livestock and wildlife. Annual rates of sediment loading from bank erosion were estimated by SEIs conducted in 2010, 2012, and 2014 on AUs in the Salt River subbasin where sediment was the suspected pollutant. Since no known point sources of sediment pollution exist in the Salt River subbasin, all estimated sediment loads above natural levels (assumed ≥80% streambank stability) was attributed to nonpoint source pollution.

Table 16 displays estimated annual sediment loads from nonpoint source pollution. The sediment load from nonpoint sources equals the current load (tons/year) minus the target load (tons/year).

Table 15. Current *E. coli* concentrations from nonpoint sources in the Salt River subbasin.

Assessment Unit Name	Assessment Unit Number	Current Concentration (cfu/100 mL)	Estimation Method	TMDL Required?
Bear Canyon	ID17040105SK003_02e	170	DEQ sampling geometric mean	Yes
Lower Stump Creek	ID17040105SK006_04	454	Average of 2 exceeding geometric means sampled by Wyoming Star Valley Conservation District	Yes
Smokey Creek	ID17040105SK007_02c	1,060	DEQ sampling geometric mean	Yes
Crow Creek	ID17040105SK008_04	579	DEQ sampling geometric mean	Yes

Notes: cfu = colony forming unit; mL = milliliter

Table 16. Estimated annual sediment loads from nonpoint sources in the Salt River subbasin.

Assessment Unit Name	Assessment Unit Number	Current Load (tons/year)	Estimation Method	TMDL Required?
Newswander Canyon	ID17040105SK001_02b	38.5	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Tincup Creek	ID17040105SK003_02	112	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Luthi Canyon	ID17040105SK003_02i	11.1	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Haderlie Creek	ID17040105SK003_02j	1.3	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Upper Boulder Creek	ID17040105SK006_02c	61.9	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Graehl Canyon	ID17040105SK006_02g	10.47	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Lower Stump Creek	ID17040105SK006_04	252	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Smokey Creek	ID17040105SK007_02c	199.1	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Draney Creek	ID17040105SK007_02f	28.8	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Tygee Creek	ID17040105SK007_03	560	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
White Dugway Creek	ID17040105SK008_02a	12.3	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Beaver Dam Creek	ID17040105SK008_02c	53.5	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Crow Creek	ID17040105SK008_04	107.2	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Rock Creek	ID17040105SK011_03	57.35	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Little Elk Creek	ID17040105SK012_02a	12.4	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes
Spring Creek	ID17040105SK012_02	14.23	Observed erosion rate from SEI—erosion rate at 80% bank stability	Yes

Note: SEI = streambank erosion inventory

5.4 Load Allocations

5.4.1 E. coli

Load allocations are estimated targets of pollutants designed to improve water quality and return impaired stream segments to full support of beneficial uses. Load allocations for nonpoint sources of *E. coli* are presented in Table 17. No waste load allocation is presented because no known point sources of *E. coli* exist in the subbasin. Therefore, all required reductions must come from nonpoint sources. Load allocation becomes a wasteload reduction in the event when a nonpoint source gets designated as a point source. The load reduction was calculated based on meeting Idaho’s water quality standards for SCR.

Table 17. *E. coli* nonpoint source load allocations for the Salt River subbasin.

Assessment Unit Name	Assessment Unit Number	Existing Concentration (cfu/100 mL)	Concentration Capacity (cfu/100 mL)	Concentration Reduction (%)
Bear Canyon	ID17040105SK003_02e	170	126	26
Lower Stump Creek	ID17040105SK006_04	454	126	72
Smokey Creek	ID17040105SK007_02c	1,060	126	88
Draney Creek	ID17040105SK007_02f	4,527	126	97
Crow Creek	ID17040105SK008_04	579	126	78

Notes: cfu = colony forming unit; mL = milliliter

E. coli daily loads are presented as colony forming units per day in Appendix G.

5.4.2 Sediment

Sediment load allocations are anticipated to be met when streambank stability is restored to the streambank stability of ≥80%. Load allocations for nonpoint sources of sediment are presented in Table 18. Phosphate mines such as Simplot's Smoky Canyon Mine manage potential stormwater discharges from mining facilities through EPA's MSGP No/ IDR05000. Under the MSGP, Smoky Canyon Mine is required to select, design, install, and implement control measures (including best management practices) to address the selection and design considerations and meet the non-numeric effluent limitations according to Part 2.1.2 of the MSGP as well as meet limits contained in applicable effluent limitation guideleines in Part 2.1.3 of the MSGP. Allocations for MSGPs are discussed in Section 5.4.7, Construction Stormwater and TMDL Wasteload Allocations. Total suspended solids (TSS) monitoring should be required of MSGP permit holders to monitor compliance with Idaho's water quality standards.

Table 18. Sediment nonpoint source load allocations for the Salt River subbasin.

Assessment Unit Name	Assessment Unit Number	Current Bank Stability (%)	Current Load (tons/year)	Target Load (tons/year)	Target Load (lb/day)	Load Reduction (%)
Newswander Canyon	ID17040105SK001_02b	52	66.3	27.8	152.3	58
Tincup Creek	ID17040105SK003_02	61	230	118	646.6	49
Luthi Canyon	ID17040105SK003_02i	75	55.8	44.7	244.9	20
Haderlie Creek	ID17040105SK003_02j	79	41.5	40.2	220.3	3
Upper Boulder Creek	ID17040105SK006_02c	29	86.2	24.3	133.2	72
Graehl Canyon	ID17040105SK006_02g	50	17.4	6.93	38.0	60
Lower Stump Creek	ID17040105SK006_04	62	535	283	1,550.7	47
Smokey Creek	ID17040105SK007_02c	10	256	56.9	311.8	78
Draney Creek	ID17040105SK007_02f	61	59.6	30.8	168.8	48
Tygee Creek	ID17040105SK007_03	55	1,010	450	2,465.8	55
White Dugway Creek	ID17040105SK008_02a	74	51.2	38.9	213.2	24
Beaver Dam Creek	ID17040105SK008_02c	17	70.6	17.1	93.7	76
Crow Creek	ID17040105SK008_04	80	107.2	98.8	541.4	16
Rock Creek	ID17040105SK011_03	81 (51% in USFS reach)	57.35 overall (224 in USFS reach)	88.9	487.1	64
Little Elk Creek	ID17040105SK012_02a	64	27.9	15.5	84.9	45
Spring Creek	ID17040105SK012_03	48	23.1	8.87	48.6	62

Notes: lb = pound; USFS = US Forest Service

Additional targets for fine subsurface sediments are set for AUs where salmonid spawning is likely to be designated as a beneficial use. These targets are recommended for salmonid spawning habitats only (i.e., pool tailouts and riffles), and calculations of percent fines by volume should not include sediments >63 mm. Table 19 presents current conditions and targets for subsurface fines in salmonid spawning habitat. Many AUs did not contain accessible salmonid spawning habitats when visited by DEQ during summers 2012 and 2014. Such cases are marked as *no spawning habitat* in the table. Areas were DEQ could not collect McNeil core samples because landowner permission was not secured are marked as *not sampled*. Targets for subsurface fines are intended to help restore salmonid spawning as a beneficial use if met.

Table 19. Targets and current conditions of fine subsurface sediment in salmonid spawning habitats of the Salt River subbasin.

Assessment Unit Name	Assessment Unit Number	Current % Fines <6.25 mm	Target % Fines <6.25 mm	Current % Fines <0.85 mm	Target % Fines <0.85 mm
Tincup Creek	ID17040105SK003_02	No spawning habitat	27	No spawning habitat	10
Haderlie Creek	ID17040105SK003_02j	No spawning habitat	27	No spawning habitat	10
Upper Boulder Creek	ID17040105SK006_02c	No spawning habitat	27	No spawning habitat	10
Lower Stump Creek	ID17040105K006_04	41.8	27	12.3	10
Smokey Creek	ID17040105SK007_02c	No spawning habitat	27	No spawning habitat	10
Draney Creek	ID17040105SK007_02f	62.5	27	22.2	10
Tygee Creek	ID17040105SK007_03	Not sampled	27	Not sampled	10
White Dugway Creek	ID17040105SK008_02a	45.0	27	20.4	10
Beaver Dam Creek	ID17040105SK008_02c	No spawning habitat	27	No spawning habitat	10
Crow Creek	ID17040105SK008_04	38.5	27	12.7	10
Rock Creek	ID17040105SK011_03	45.0	27	23.4	10
Spring Creek	ID17040105SK012_03	No spawning habitat	27	Not sampled	10

Note: mm = millimeter

5.4.3 Margin of Safety

An implicit or explicit portion of a water body’s load capacity is 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 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. Conservative assumptions made as part of the loading analysis are discussed below.

In the case of *E. coli*, the pollutant load capacity has been calculated for the most critical time period identified and is applied year-round. Existing loads are based on sampling done during periods when bacteria concentrations are likely to be higher (e.g., heavy grazing or warm temperatures). Application of these conservative methods is considered an implicit MOS.

Margin of safety factored into the streambank sediment load allocation is implicit. Margin of safety includes the conservative assumptions used to develop existing sediment loads. Because it is assumed that the beneficial uses can be supported at natural background sediment loading rates, the load capacity lies somewhere between the current loading level and the sediment loading from natural background. The target load was established at the more restrictive natural streambank erosion level, which is conservative and results in an implicit MOS.

For targets of subsurface fine sediment, margin of safety is implicit. Measurements of fine subsurface sediments are made in areas where fish have not yet displaced fine sediments through spawning, which overestimates the fine sediment content in the redd. Targets were developed based on 50% emergence success from laboratory studies. Redds with at least 50% emergence success are considered productive by most biologists, and measures of emergence is some natural streams with successful reproduction are considerably below 50% (Kondolf 2000).

5.4.4 Seasonal Variation

E. coli concentrations are expected to be highest when flows are low, water is warm, and warm-blooded animals are concentrated near the stream. *E. coli* concentrations are measured by DEQ when these conditions exist, and exceedances are most likely to occur. This is also the time when the beneficial use of contact recreation is most likely to be impaired by *E. coli*. Summer is the critical time period for *E. coli*, but the exceedance criteria exists year-round.

Erosion and sediment delivery to the stream are functions of climatic variability and the geomorphic properties of the stream and its drainage area. Years with high precipitation often produce higher than average erosion and higher sediment loads in streams with unstable banks. Streams with stable banks and floodplain connectivity are more able to withstand large hydrologic events without becoming unstable. Sediment load is not evenly distributed throughout the year. Most erosion occurs during spring runoff at bankfull conditions.

Streambank erosion mostly occurs during spring, but beneficial use support is the product of longer term processes. SEI calculates estimated annual erosion rates by directly measuring bank stability.

5.4.5 Reasonable Assurance

Following acceptance of this TMDL by DEQ, EPA, and stakeholders, implementation will begin. Idaho’s water quality standards designate agencies that are responsible for evaluating and modifying best management practices (BMPs) to restore impaired water bodies to full support of beneficial uses. Implementation strategies should incorporate field verification of the load analyses included in this TMDL.

The 5-year review of this TMDL will report ongoing assessments of beneficial use support status of water bodies included here. If full support status has not been obtained, further implementation actions will be needed and reassessment performed until full support status is attained by all impaired water bodies. If full support status is achieved, the requirements of the TMDL will be considered complete.

5.4.6 Natural Background

For annual sediment loads, natural background conditions are estimated at ≥80% streambank stability (Overton et al. 1995). Current annual loads and annual target were calculated for AUs impaired by sediment with SEIs.

5.4.7 Stormwater and TMDL 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 Multi-Sector General Permit (MSGP), and construction stormwater covered under the Construction General Permit (CGP). Under most circumstances, EPA regulations require that all point sources including municipal, construction, and industrial sources get a wasteload allocation if they discharge into an impaired water body. Through the terms and conditions of their permits, there are additional monitoring requirements that the permittees must follow. Through a sources analysis it was found that the only point source in this watershed is the Smoky Canyon Mine. Point sources must implement all reasonable and relevant BMPs as deemed necessary for their specific permit, sector and project needs. The TSS wasteload allocation for Smoky Canyon Mine, as determined by EPA (Appendix H), is 36.24 tons/yr (0.10 tons/day).

The MSGP currently utilizes a BMP based approach to control pollutant discharge. It is recommended that the stormwater WLA be incorporated as a benchmark. Under the MSGP, exceedance of the benchmark triggers mandatory corrective action which involves review and improvement of BMPs as needed to achieve the benchmark. EPA has no reason to believe that the continued use of such an interative BMP management approach will not be sufficient to achieve the stormwater WLA.

5.4.7.1 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, ditches, etc.)
- 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 an 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. There are no MS4s in the Salt River subbasin in Idaho.

5.4.7.2 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. In Idaho, EPA has issued a general permit No. IDR05000I for stormwater discharges from industrial sites.

Smoky Canyon Mine currently operates under the NPDES MSGP NPDES No. IDR050000 for stormwater discharges associated with industrial activity. According to the 2009 Notice of Intent, the facility includes approximately 2,000 acres of industrial activity that is exposed to stormwater. This facility discharges into Smoky (ID17040105SK007_02c), Tygee (ID17040105SK007_03), Roberts (ID17040105SK007_02g), Pole Canyon (ID17040105SK009_02d), Sage (ID17040105SK009_02c), South Sage (ID17040105SK009_02e), Manning (ID17040105SK008_02), Deer (ID17040105SK010_02a), North Fork Deer (ID17040105SK010_02b), South Fork Deer (ID17040105SK010_02a), Crow (ID17040105SK008_04), and Wells Canyon (ID17040105SK008_02) Creeks (J.R. Simplot 2009). Smoky, Tygee, South Fork Deer, and Crow Creeks are listed in Category 5 for sedimentation/siltation. As part of this subbasin assessment and TMDL, DEQ recommends that South Fork Deer Creek be delisted for sedimentation/siltation and moved to Category 2 as fully supporting beneficial uses. TMDLs for sediment were developed for Smoky, Tygee, and Crow Creeks based on a streambank stability target of 80%. Roberts, Sage, and South Fork Sage Creeks are listed for combined biota/habitat bioassessments. As part of this subbasin assessment and TMDL, DEQ determined that Roberts Creek should be delisted for combined biota/habitat bioassessments and listed in Category 3 as unassessed in the next Integrated Report. Sage and South Fork Sage Creeks should remain in Category 5 until new BURP data are available to evaluate their current biological status.

The Smoky Canyon Mine is not a major source of streambank erosion as determined in the TMDLs based on BURP sites and on-site evaluations. Excess streambank erosion is caused mostly from streambank trampling due to livestock grazing and natural hydrologic and geomorphic processes that contribute sediment to streams. TMDLs for *E. coli* were developed for Smoky and Crow Creeks and are included in this document. However, mining operations are not a source of *E. coli* to the lands within its boundaries and does not have a wasteload allocation for *E. coli* as a point source. *E. coli* loads are likely the result of livestock grazing and wildlife, not mining activities.

Multisector General Permit (MSGP) 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. Smoky Canyon Mine falls under Sector J which has no additional sector specific requirements. EPA anticipates issuing a new MSGP in 2015. DEQ anticipates including specific requirements for impaired waters as a condition of the 401 certification.

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 because it is considered a point source. Regardless of if a permittee receives a wasteload allocation, the permittee must select, design, install, and implement control measures (BMPs) in accordance with the Control Measures requirement (Part 2.1) of the MSGP. In this case, DEQ will not include a wasteload allocation for the Smoky Canyon Mine because stormwater discharges are highly variable in frequency and duration and are not easily characterized. Numeric wasteload allocations for stormwater discharge would be unprecedented in Idaho as stormwater discharges are currently addressed in Idaho through the application and adaptive management of BMPs and without numeric effluent limitations.

The Smoky Canyon Mine controls stormwater by using BMPs outlined in its SWPPP. The mine uses stormwater water control features such as sediment ponds and silt traps to collect runoff from disturbed areas for containment. These features are designed and maintained to provide retention for runoff associated with a 100-year, 24-hour storm event. These features are located near the outside edges of the mining disturbance (Caribou-Targhee National Forest and BLM 2007, Chapter 2). BMPs for erosion and sediment controls are outlined in the 2007 Final Environmental Impact Statement for the Smoky Canyon Mine Panels F and G and include overburden fill grading, haul road runoff controls, soil stabilization, pit backfilling, run-on collection, and seeding and revegetation (Caribou-Targhee National Forest and BLM 2007, Appendix 2D).

J.R. Simplot's Smoky Canyon Mine does not intentionally discharge to streams. Breaches of sediment ponds may occur during storm and runoff events. Such an incident occurred in spring 1997 when a tailing pond blew out and dumped large amounts of sediment into Smoky Creek (ID17040105SK007_02c) (1997 BURP field site notes). A site inspection by EPA on May 17, 2010, resulted in a Notice of Violation of their MSGP. The notice stated, "during the inspection, the inspectors observed sediment had sloughed off a hillside near the old access road and entered the Smoky Creek channel—an indication that erosion controls were inadequate" (EPA 2011).

For streams where sediment TMDLs were developed, the major source of excess sediment was bank instability as evidenced by SEI results. Bank stability was identified to be the result of poor riparian quality, bank shear, and trampling from grazing livestock. Smoky Canyon Mine has the potential to discharge into three streams with sediment TMDLs: Smoky (ID17040105SK007_02c), Tygee (ID17040105SK007_03), and Crow (ID17040105SK008_04)

Creeks. Simplot must follow their SWPPP at the Smoky Canyon Mine and use BMPs to comply with Idaho's water quality standards.

Smoky Canyon Mine also has the potential to discharge into two AUs with TMDLs for *E. coli*: Smoky (ID17040105SK007_02c) and Crow (ID17040105SK008_04) Creeks. Because there are no data we are aware of suggesting that operations at phosphate mines are a source of *E. coli* to these streams, and exceedances of water quality standards are likely associated with other activities (livestock grazing, recreation, etc.), a wasteload allocation for the Smoky Canyon Mine is not appropriate.

5.4.7.3 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 No. IDR120000 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. Construction permittees must take measures to control erosion and sediment from further impairing water bodies by designing, installing, and maintaining erosion and sediment controls that minimize the discharge of pollutants from earth-disturbing activities. Construction permittees are also required to minimize the amount of soil exposed during construction activities. The CGP has monitoring requirements (including turbidity) that must be followed.

Construction Facilities Discharging to Impaired Water Bodies

Construction permittees discharging to a surface water that is impaired for sediment or a sediment-related parameter (e.g., TSS or turbidity), including impaired waters for which a TMDL had been approved or established for the impairment, are required to comply with their CGP parts: 3.2.2.1 Frequency of Site Inspection, 3.2.2.2 Deadline to Complete Stabilization, and 3.2.2.3 State and Tribal Requirements. The permittee must also conduct turbidity monitoring each day during construction activities when the project is not stabilized per GCP part 2.2 or shut down per GCP part 4.1.4.3.

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.

5.5 Implementation Strategies

TMDLs in this document are primarily streambank stability targets. For streambank stability to increase, implementation strategies should focus on reducing riparian grazing along stream segments with sediment TMDLs. Establishment of stabilizing riparian vegetation can also be sped up with riparian plantings. Efforts to limit or exclude livestock from riparian corridors will also help alleviate bacteria problems in streams.

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that TMDL goals are not being met or significant progress is not being made toward achieving the goals. Reasonable assurance (section 5.4.5) for the TMDL to meet water quality standards is based on the implementation strategy.

5.5.1 Time Frame

The expected time frame for attaining water quality standards and restoring beneficial uses is a function of management intensity, climate, ecological potential, and natural variability of environmental conditions. If BMP implementation is embraced enthusiastically, some improvements may be seen is as little as several years. Even with aggressive implementation, however, some natural processes required to satisfy this TMDL's requirements may not be seen for several decades. The deleterious effects of historic land management practices have accrued over many years, and recovery of natural systems may take longer than administrative needs allow.

Similarly, the expected time frame for restoring the Salt River subbasin and its component streams to conditions that support all beneficial uses highly depends on several variables, principally the efforts taken by those responsible for implementing such measures. In an ideal situation, where implementation occurs within 5 years of TMDL approval, vegetation recovery to natural conditions could occur within 20 years of planting and near exclusion of livestock. Additionally, some AUs are included in Category 4c for pollution because of habitat alterations such as damming, channelization, or diversion. Some of these AUs should not be expected to achieve full support of beneficial uses as *pollution* is not dealt with under the TMDL framework.

Four AUs in the Salt River subbasin are listed in Category 3 for selenium, and selenium TMDLs are not presented in this document. According to a July 2014 update on the southeastern Idaho selenium project, work is continuing under the 2009 Administrative Settlement Agreement to conduct a remedial investigation/feasibility study for the Smoky Canyon Mine (DEQ 2014d). Most site characterization is complete and a revised draft remedial investigation was issued in May 2014. Work on covering the Pole Canyon ODA should begin later this year. Pilot studies for the design and construction of facilities to treat spring and seep water are ongoing (DEQ 2014d).

5.5.2 Approach

It is anticipated that by improving riparian management practices, overall riparian zone recovery will precipitate streambank stabilization, reduce inputs of fine sediments, and restore salmonid spawning grounds, all of which will improve stream habitat. Implementing riparian zone recovery practices will contribute to overall improvement in stream morphology and habitat, shifting stream health towards beneficial use attainment. In cases where excess sediment is contributed through roads and watershed effects, other changes to land management practices may be needed. To reduce inputs of *E. coli* to AUs impaired for SCR, grazing changes such as reduced range time or fencing may be needed.

The designated management agencies, watershed advisory group (WAG), and other appropriate public process participants are expected to implement the following:

- Develop BMPs to achieve load allocations.
- Give reasonable assurance that management measures will meet load allocations through both quantitative and qualitative analyses of management measures.
- Adhere to measureable milestones for progress.
- Develop a timeline for implementation, with reference to costs and funding.
- Develop a monitoring plan to determine if BMPs are being implemented, if individual BMPs are effective, if load allocations and wasteload allocations are being met, and whether or not water quality standards are being met.

5.5.3 Responsible Parties

Several designated land management agencies are involved where watershed implementation is concerned. The Idaho Soil and Water Conservation Commission, Idaho Department of Lands, Idaho Transportation Department, BLM, and USFS are identified as the state and federal entities that will be involved in or responsible for implementing the TMDL. The designated management agencies will recommend specific control actions and will then submit the implementation plan to DEQ. DEQ will act as a repository for approved implementation plans and conduct 5-year reviews of progress towards TMDL goals.

In addition to the designated management agencies, the public, through the WAG, will be provided with opportunities to be involved in developing the implementation plan to the maximum extent possible.

5.5.4 Implementation Monitoring Strategy

The objectives of a monitoring effort are to demonstrate long-term recovery, better understand natural variability, track implementation of projects and BMPs, and track effectiveness of TMDL implementation. This monitoring and evaluation mechanism is a major component of the *reasonable assurance of implementation* for the TMDL implementation plan.

The implementation plan will be tracked by accounting for the numbers, types, and locations of watershed improvement projects; educational activities; or other actions taken to improve or protect water quality. Reports submitted to DEQ will be the mechanism for tracking specific implementation efforts.

The monitoring and evaluation component has two basic components:

1. Track the implementation progress of specific watershed improvement plans.
2. Track the progress of improving water quality through monitoring physical, chemical, and biological parameters.

Monitoring plans will provide information on progress made towards achieving TMDL allocations and water quality standards and will provide evaluation, an important component of an adaptive management approach. DEQ monitors AUs through BURP. Data are compiled and support status is determined under the *Water Body Assessment Guidance* (Grafe et al. 2002). BURP data can also be used to track changes in watershed conditions through time. Additionally, DEQ may conduct additional SEIs and collect McNeil core samples to track if sedimentation problems are improving. DEQ will also take water samples for *E. coli* analyses from AUs with *E. coli* TMDLs to evaluate the effectiveness of BMPs that are implemented.

While DEQ has the primary responsibility for watershed monitoring, other agencies and entities have shown interest in such monitoring. In these instances, data sharing is encouraged. The designated agencies have primary responsibility for BMP monitoring.

6 Conclusions

Sediment, bacteria, habitat modifications, and selenium are stressors affecting beneficial uses in the subbasin. Assessments identified sediment as the appropriate pollutant in 16 AUs in the subbasin, and TMDLs were developed for each based on meeting a target streambank stability of 80%. Additional targets for subsurface fines were developed for 12 AUs where salmonid spawning is likely to be designated as a beneficial use and sediment is affecting this beneficial use. Assessments by DEQ and the Wyoming Star Valley Conservation District identified five AUs—Bear Canyon (ID17040105SK003_02e), Lower Stump (ID17040105SK006_04), Smoky (ID17040105SK007_02c), Draney (ID17040105SK007_02f), and Crow (ID17040105SK008_04) Creeks—that were not meeting their beneficial use of SCR because of high levels of *E. coli* bacteria. Bacteria TMDLs were calculated for each of these AUs based on meeting the geometric mean criteria of 126 cfu/100 mL of water. Three AUs—Crow Creek (ID17040105SK008_02, ID17040105SK008_02d, and ID17040105SK008_03b)—were mistakenly listed in Category 5 for *E. coli*. Four AUs in the subbasin—North Fork Sage (ID17040105SK009_02), Pole Canyon (ID17040105SK009_02d), South Fork Sage (ID17040105SK009_02e), and Sage (ID17040105SK009_03) Creeks—are listed in Category 5 for selenium. These AUs drain areas of the Smoky Canyon Mine site including waste rock dumps. Selenium listings will not be addressed as part of this subbasin assessment and TMDL. Rather, these listings are being addressed under CERCLA, a mine reclamation program. Assessment outcomes and a brief justification for recommended changes to the next Integrated Report are listed in Table 20.

Table 20. Summary of assessment outcomes for evaluated assessment units.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Newswander Canyon	ID17040105SK001_02b	Sedimentation/ siltation (physical substrate habitat alterations)	Yes	List in Category 4a for sedimentation/siltation. Keep listed in Category 4c for physical substrate habitat alterations.	Sediment TMDL completed based on streambank stability of 80%. Stream is dammed below BURP site for irrigation and should not be expected to be fully supporting beneficial uses in this portion of the AU.
Cabin Creek	ID17040105SK002_02c	Sedimentation/ siltation (physical substrate habitat alterations)	No	List in Category 3 as unassessed, delist for sedimentation/siltation, and remove from Category 4c for physical substrate habitat alterations.	BURP assessments conducted within or near beaver ponds, producing invalid data. SEI shows no impairment of streambank stability. Physical substrate has not been altered.
Tincup Creek	ID17040105SK003_02	Sedimentation/ siltation	Yes	List in Category 4a for sedimentation/siltation. Change SCR to assessed and full support.	Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitat. *E. coli* data indicate support of SCR.
Rich Creek	ID17040105SK003_02a	Habitat assessments and cause unknown	No	Delist for habitat assessments and cause unknown, and move to Category 2.	Assessed by BURP during 2004 drought at flow of 0.3 cfs. Not valid comparison to reference conditions. Other data (1999 BURP, 2010 SEI) indicate no impairment.
Whiskey Creek	ID17040105SK003_02b	Combined biota/habitat bioassessments	No	Delist for combined biota/ habitat bioassessments, and move to Category 2.	Assessed by BURP during 2004 drought at flow of 0.09 cfs. Not valid comparison to reference conditions. Other data (1999 BURP, 2010 SEI) indicate no impairment.
Lau Creek	ID17040105SK003_02c	Habitat assessments and cause unknown	No	Delist for habitat assessments and cause unknown, and move to Category 2.	Assessed by BURP during 2004 drought at flow of 0.2 cfs. Not valid comparison to reference conditions. Other data (2010 SEI, 1999 and 2004 SMI) indicate no impairment.
Houtz Creek	ID17040105SK003_02d	Cause unknown	No	Delist for cause unknown, and move to Category 4c for habitat alteration.	Bottom 100 meters of this AU is channelized and should be listed for habitat alteration. Bank erosion not contributing excess sediment as documented in 2010 SEI with bank stability of 99%. 1999 BURP assessment above channelization indicates no impairment.
Bear Canyon	ID17040105SK003_02e	*E. coli*	Yes	List in Category 4a for *E. coli.*	*E. coli* TMDL completed based on meeting geometric mean criteria of 126 cfu/100 mL.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Chicken Creek	ID17040105SK003_02g	Combined biota/habitat bioassessments	No	Delist for combined biota/habitat bioassessments, and move to Category 2.	Assessed by BURP during 2004 drought at flow of 0.08 cfs. Not valid comparison to reference conditions. Other data (1999 BURP assessment, 2010 SEI) indicate no impairment.
Luthi Canyon	ID17040105SK003_02i	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80%.
Haderlie Creek	ID17040105SK003_02j	Sedimentation/ siltation (physical substrate habitat alterations)	Yes	List in Category 4a for sedimentation/siltation, and keep listed in Category 4c for physical substrate habitat alterations.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitat. Much of AU is in a ditch through fields.
Upper Boulder Creek	ID17040105SK006_02c	Cause unknown	Yes	List in Category 4a for sedimentation/siltation, and delist for cause unknown.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats.
West Fork Boulder Creek	ID17040105SK006_02d	Cause unknown	No	List in Category 2, and delist for cause unknown.	2001 BURP assessment indicates full support of CWAL and 2012 SEI calculated 100% streambank stability. Listed in error.
White Canyon	ID17040105SK006_02f	Sedimentation/ siltation (physical substrate habitat alterations)	No	List in Category 3 as unassessed, and delist for sedimentation/siltation and physical substrate habitat alterations in Category 4c.	Stream is intermittent and BURP protocols are not appropriate for nonperennial streams. Stream is not physically altered.
Graehl Canyon	ID17040105SK006_02g	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80%.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Lower Stump Creek	ID17040105SK006_04	Sedimentation/ siltation	Yes	List in Category 4a for sedimentation/siltation and *E. coli.*	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts and high subsurface fines documented by McNeil core samples in salmonid spawning habitat. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. Exceedances of *E. coli* criteria documented by Wyoming Star Valley Conservation District. *E. coli* TMDL completed based on geometric mean criteria of 126 cfu/100 mL. Unlisted but impaired by *E. coli.*
Smoky Creek	ID17040105SK007_02c	*E. coli* and sedimentation/ siltation (physical substrate habitat alterations)	Yes	List in Category 4a for *E. coli* and sedimentation/siltation, and keep listed in Category 4c for physical substrate habitat alterations.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. *E. coli* TMDL completed based on geometric mean criteria of 126 cfu/100 mL. Drains Smoky Canyon Mine, and physical habitat is altered.
Draney Creek	ID17040105SK007_02f	Sedimentation/ siltation and fecal coliform (physical substrate habitat alterations)	Yes	List in Category 4a for sedimentation/siltation and *E. coli*. Remove from Category 4c for physical substrate habitat alterations.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. *E. coli* TMDL completed based on geometric mean criteria of 126 cfu/100 mL. AU habitat is not physically altered.
Roberts Creek	ID17040105SK007_02g	Combined biota/habitat bioassessments	No	List in Category 3 as unassessed, and delist for combined biota/habitat bioassessments.	BURP assessments took place in marshy reach and do not represent entire AU. Data from Formation Environmental indicate no impairments.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Tygee Creek	ID17040105SK007_03	Sedimentation/ siltation (low-flow alterations and physical substrate habitat alterations)	Yes	List in Category 4a for sedimentation/siltation, and keep listed in Category 4c for low-flow alterations and physical substrate habitat alterations.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. Stream is channelized and rerouted around a pond used for milling ore and is diverted for agriculture.
Crow Creek (source to Idaho/Wyoming border)	ID17040105SK008_02	*E. coli*	No	Delist *E. coli,* and move to Category 3.	Data on 4th-order segment misapplied to this AU. SCR and CWAL have not been assessed.
White Dugway Creek	ID17040105SK008_02a	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts and high subsurface fines measured in McNeil core samples. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats.
Beaver Dam Creek	ID17040105SK008_02c	Sedimentation/ siltation (physical substrate habitat alterations)	Yes	List in Category 4a for sedimentation/siltation, and remove from Category 4c for physical substrate habitat alterations.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. Stream is not impacted by channelization or other active channel manipulation.
Crow Creek	ID17040105SK008_02d	*E. coli*	No	Delist *E. coli,* and move to Category 2. Only SCR was assessed.	Listed in error. Data misapplied from 4th-order segment of Crow Creek. Data from 2014 indicate no impairment.
Crow Creek	ID17040105SK008_03b	*E. coli*	No	Delist *E. coli*, change SCR to fully supporting, and move AU to Category 2.	2001 *E. coli* sample meets criteria for SCR. Listed in error. Data misapplied from 4th-order segment of Crow Creek.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Crow Creek (Deer Creek to border)	ID17040105SK008_04	*E. coli* and sedimentation/ siltation	Yes	List in Category 4a for *E. coli* and sedimentation/siltation.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats. *E. coli* TMDL completed based on geometric mean criteria of 126 cfu/100 mL.
North Fork Sage Creek	ID17040105SK009_02	Selenium	No	Keep in Category 5 for selenium.	Selenium remediation under CERCLA.
Sage Creek	ID17040105SK009_02c	Combined biota/habitat bioassessments	No	Keep in Category 5 and combined biota/habitat bioassessments.	Impairment documented because of failing habitat score in 2006. Revisit indicated that banks are stable and fine sediments are not elevated. Recommend BURP resample AU and electroshock for fish.
Pole Canyon Creek	ID17040105SK009_02d	Selenium	No	Keep in Category 5 for selenium.	Selenium remediation under CERCLA.
South Fork Sage Creek	ID17040105SK009_02e	Combined biota/habitat bioassessments and selenium	No	Keep in Category 5 for selenium and combined biota/habitat bioassessments.	Impairment documented by a BURP assessment in an unrepresentative reach. Revisit indicated surface fines are not elevated and banks are stable. Recommend BURP resample AU in a more representative reach and electroshock for fish. Selenium remediation under CERCLA.
Sage Creek (confluence with North Fork Sage Creek to mouth)	ID17040105SK009_03	Selenium	No	Keep in Category 5 for selenium.	Selenium remediation under CERCLA.
South Fork Deer Creek	ID17040105SK010_02a	Sedimentation/ siltation (physical substrate habitat alterations)	No	Move to Category 2, delist for sedimentation/siltation, and remove from Category 4c for physical substrate habitat alterations.	BURP assessment was misapplied and conducted in beaver pond. SEI indicated very stable banks. Data from Formation Environmental indicates AU is meeting CWAL beneficial use. Stream habitat is not altered.

Assessment Unit Name	Assessment Unit Number	Pollutant (pollution)	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Rock Creek	ID17040105SK011_03	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.	BURP data indicates unstable and sloughing banks. The 2014 SEI indicates that banks are unstable (49%) on USFS land. In this reach, banks are trampled, and stream is widened by livestock. Sediment TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats.
Little Elk Creek	ID17040105SK012_02a	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments. Change SCR to assessed and full support.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80%. *E. coli* data indicate support of SCR.
Spring Creek	ID17040105SK012_03	Combined biota/habitat bioassessments	Yes	List in Category 4a for sedimentation/siltation, and delist for combined biota/habitat bioassessments.	Sediment problem confirmed by high levels of fine sediment in Wolman pebble counts. Streambank stability below 80%. TMDL completed based on streambank stability of 80% and percent subsurface fines in salmonid spawning habitats.

Notes: TMDL = total maximum daily load; BURP = Beneficial Use Reconnaissance Program; AU = assessment unit; SEI = streambank erosion inventory; cfs = cubic feet per second; cfu = colony forming unit; mL = milliliter; CWAL = cold water aquatic life; *E. coli* = *Escherichia coli*; SCR = secondary contact recreation; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

This document was prepared with input from the public, as described in Appendix BH. Following the public comment period, comments and DEQ responses will also be included in this appendix, and a distribution list will be included in Appendix JI.

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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 group of similar streams that have similar land use practices, ownership, or land management. However, stream order is the main basis for determining AUs. All the waters of the state are defined using AUs, and because AUs are a subset of water body identification numbers, they tie directly to the water quality standards so that beneficial uses defined in the water quality standards are clearly tied to streams on the landscape.

Beneficial Use

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

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.

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).

Load Allocation (LA)

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

Load(ing)

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

Load 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 uncertainly 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 discernable point or origin. They 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 Assessed (NA)

A concept and an assessment category describing water bodies that have been studied but are missing critical information needed to complete an assessment.

Not 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 the joining of 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 Criteria

Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, aquatic habitat, or industrial processes.

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 used in TMDL development.

Water Body	Assessment Unit Number	Data Source	Type of Data	Collection Date
Newswander Canyon	ID17040105SK001_02b	DEQ	BURP and SEI	1999 and 2012
Cabin Creek	ID17040105SK002_02c	DEQ	BURP and SEI	1999 and 2004 BURP and 2012 SEI
Tincup Creek	ID17040105SK003_02	DEQ	BURP and SEI	2005 and 2008 BURP and 2012 SEI
Rich Creek	ID17040105SK003_02a	DEQ	BURP and SEI	1999 and 2004 BURP and 2010 SEI
Whiskey Creek	ID17040105SK003_02b	DEQ	BURP and SEI	1999 and 2004 BURP and 2010 SEI
Lau Creek	ID17040105SK003_02c	DEQ	BURP and SEI	1999 and 2004 BURP and 2010 SEI
Houtz Creek	ID17040105SK002_02d	DEQ	BURP and SEI	1999 and 2004 BURP and 2010 SEI
Bear Canyon	ID17040105SK003_02e	DEQ	BURP and *E. coli*	1999 and 2004 BURP and 2004 *E. coli*
Chicken Creek	ID17040105SK003_02g	DEQ	BURP and SEI	1999 and 2004 BURP and 2010 SEI
Luthi Canyon	ID17040105SK003_02i	DEQ	BURP and SEI	1999 and 2004 BURP and 2010 SEI
Haderlie Creek	ID17040105SK003_02j	DEQ	BURP and SEI	1996, 2002, and 2011 BURP and 2010 SEI
Upper Boulder Creek	ID17040105SK006_02c	DEQ	BURP and SEI	1996, 2001, and 2006 BURP and 2012 SEI
West Fork Boulder Creek	ID17040105SK006_02d	DEQ	BURP and SEI	2001 and 2012
White Canyon	ID17040105SK006_02f	DEQ	BURP and SEI	1999 and 2004 BURP and 2012 SEI
Graehl Canyon	ID17040105SK006_02g	DEQ	BURP and SEI	1999 and 2004 BURP and 2012 SEI
Lower Stump Creek	ID17040105SK006_04	DEQ	BURP, SEI, and *E. coli*	1996 and 2002 BURP, 2012 SEI, and 1999 *E. coli*
Lower Stump Creek	ID17040105SK006_04	Wyoming Star Valley Conservation District	*E. coli*	2008-2013
Smoky Creek	ID17040105SK007_02c	DEQ	BURP, SEI, and *E. coli*	1997 and 2002 BURP, 2012 SEI, and 2002 *E. coli*
Draney Creek	ID17040105SK007_02f	DEQ	BURP, SEI, and *E. coli*	1998 and 2003 BURP, 2012 SEI, and 1999 and 2014 *E. coli*
Roberts Creek	ID17040105SK007_02g	DEQ	BURP	2002
Roberts Creek	ID17040105SK007_02g	Formation Environmental	TSS, turbidity, selenium, phosphorus, nitrogen, temperature	2000-2012

Water Body	Assessment Unit Number	Data Source	Type of Data	Collection Date
Tygee Creek	ID17040105SK007_03	DEQ	BURP, SEI, and *E. coli*	1996 and 2002 BURP, 2012 SEI, and 2014 *E. coli*
Tygee Creek	ID17040105SK007_03	Wyoming Star Valley Conservation District	*E. coli*	2007
White Dugway Creek	ID17040105SK008_02a	DEQ	BURP	1998, 2004, and 2012
Beaver Dam Creek	ID17040105SK008_02c	DEQ	BURP and SEI	1998 and 2003 BURP and 2012 SEI
Crow Creek	ID17040105SK008_02d	DEQ	BURP and *E. coli*	2012 and 2014
Crow Creek	ID17040105SK008_03b	DEQ	BURP and *E. coli*	1996 and 2002 BURP and 2001 *E. coli*
Crow Creek	ID17040105SK008_04	DEQ	BURP, SEI, and *E. coli*	1996, 2002, 2006, 2008, and 2012 BURP, 2012 SEI, and 2008 *E. coli*
Crow Creek	ID17040105SK008_04	Formation Environmental and HabiTech	% bank stability and McNeil sediment cores	2006, 2007, and 2008
Sage Creek	ID17040105SK009_02c	DEQ	BURP, SEI, McNeil sediment cores, and Wolman pebble counts	2006 and 2014
South Fork Sage Creek	ID17040105SK009_02e	DEQ	BURP, SEI, McNeil sediment cores, and Wolman pebble counts	2006 and 2014
South Fork Sage Creek	ID17040105SK009_02e	Formation Environmental	Turbidity and TSS	1991-2012
Deer Creek	ID17040105SK010_02a	DEQ	BURP and SEI	1998 and 2012
Deer Creek	ID17040105SK010_02a	Formation Environmental	Steam habitat and macroinvertebrates	2009–2011 habitat and 2011 macroinvertebrates
Rock Creek	ID17040105SK011_03	DEQ	BURP	1998 and 2003
Little Elk Creek	ID17040105SK012_02a	DEQ	BURP, SEI, and *E. coli*	1999, 2004, and 2006 BURP, 2012 SEI, and 2006 *E. coli*
Spring Creek	ID17040105SK012_03	DEQ	BURP, SEI, and *E. coli*	1999, 2004, and 2006 BURP, 2012 SEI, and 2006 *E. coli*
Salt River near Etna, Wyoming		USGS	Flow	1954–2012

Notes: DEQ = Idaho Department of Environmental Quality; BURP = Beneficial Use Reconnaissance Program; SEI = stream erosion inventory; *E. coli* = *Escherichia coli*; TSS = total suspended solids; USGS = US Geological Survey

Appendix B. **Streambank Erosion Inventory Data**

Newswander Canyon ID17040105SK001_02b

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
			Latitude	Longitude	
Stream:	Newswander Canyon ID17040105SK001_				
Reach:	1	*Beginning:*	43.06791	111.04410	
Date Collected:	9/26/2012	*Ending:*			
Field Crew:	dg	**Landuse and Notes:**	grazing		
Data Reduced By:	dg	**Soil Type:**	silt		

Streambank Erosion Calculations

Average Erosive Bank Height	0.98425197	ft
Total Inventoried Bank Length	1033.46457	ft
Inventoried Bank to Bank Length	2066.92914	ft
Erosive Bank Length	492.125985	ft
Bank to Bank Eroding Segment Length	984.25197	ft
Percent Eroding Bank	48%	%
Eroding Area	968.751939	ft^2
Recession Rate	0.06	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	2.61563024	tons/year/sample reach
Erosion Rate (Er)	13.3633296	tons/mile/year
Feet of similar stream type	25156	ft
Eroding Bank Extrapolation	24942.3472	ft
Total Streambank Erosion (existing load)	66.2837967	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
13.36332958	66.2837967	5.612598425	27.8391946	58

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	406.8758	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	1.098565	tons/yr/sample
Allowed Erosion Rate	5.612598	tons/mile/year
Eroding Bank Extrapolation (with reduction)	4988.469	ft
Total Streambank Erosion	27.83919	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	1
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	5
Recession Rate	**0.06**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	1.0	492.1	0.0	
2	0.0	0.0	541.3	
	1.0	**492.1**	**541.3**	**1033.5**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.3	150		
2			165	
	0.3	**150**	**165**	**315**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Newswander Canyon—bottom of reach looking upstream (left) and downstream (right).

Cabin Creek ID17040105SK002_02c

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Cabin Creek ID17040105SK002_02c		Latitude	Longitude	
Reach:	1	*Beginning:*	43.04472	111.09817	
Date Collected:	7/7/2010	*Ending:*	43.04206	111.10475	
Field Crew:	js, cw	**Landuse and Notes:**		grazing, road, forest	
Data Reduced By:	dg	**Soil Type:**	silt		

Streambank Erosion Calculations

Average Erosive Bank Height	0.49212598	ft
Total Inventoried Bank Length	1587.92651	ft
Inventoried Bank to Bank Length	3175.85302	ft
Erosive Bank Length	85.3018374	ft
Bank to Bank Eroding Segment Length	170.603675	ft
Percent Eroding Bank	5%	%
Eroding Area	83.9585014	ft^2
Recession Rate	0.045	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.17001597	tons/year/sample reach
Erosion Rate (Er)	0.56531854	tons/mile/year
Feet of similar stream type	14305	ft
Eroding Bank Extrapolation	1707.5045	ft
Total Streambank Erosion (existing load)	1.70162235	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	312.584	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.632983	tons/yr/sample
Allowed Erosion Rate	2.104724	tons/mile/year
Eroding Bank Extrapolation (with reduction)	341.5009	ft
Total Streambank Erosion	6.335271	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	3.5
Recession Rate	**0.045**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.56531854	1.70162235	0.56531854	1.70162235	0

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	452.8	
2	0.3	13.1	0.0	
3	0.7	72.2	0.0	
4	0.0	0.0	328.1	
5	0.0	0.0	367.5	
6	0.0	0.0	354.3	
	0.5	85.3	1502.6	1587.9
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			138	
2	0.1	4		
3	0.2	22		
4			100	
5			112	
6			108	
	0.15	26	458	484
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**


Cabin Creek—top of reach looking upstream (left) and downstream (right).

Tincup Creek ID17040105SK003_02

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)		**Elevation (ft)**
Stream:	Upper Tincup Cr ID17040105SK003_02		Latitude	Longitude
Reach:	1	*Beginning:*	43.00246	111.27949
Date Collected:	8/9/2012	*Ending:*	42.99692	111.28834
Field Crew:	dg, gm	**Landuse and Notes:**		forest, grazing
Data Reduced By:	dg	**Soil Type:**	silt to cobbles	

Streambank Erosion Calculations

Average Erosive Bank Height	4.39268008	ft
Total Inventoried Bank Length	5013.12337	ft
Inventoried Bank to Bank Length	10026.2467	ft
Erosive Bank Length	1948.8189	ft
Bank to Bank Eroding Segment Length	3897.6378	ft
Percent Eroding Bank	39%	%
Eroding Area	17121.0759	ft^2
Recession Rate	0.03	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	23.1134525	tons/year/sample reach
Erosion Rate (Er)	24.343911	tons/mile/year
Feet of similar stream type	44830	ft
Eroding Bank Extrapolation	38752.376	ft
Total Streambank Erosion (existing load)	229.806167	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	8808.419	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	11.89137	tons/yr/sample
Allowed Erosion Rate	12.52441	tons/mile/year
Eroding Bank Extrapolation (with reduction)	7750.475	ft
Total Streambank Erosion	118.2302	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
24.34391104	229.806167	12.52440945	118.230243	48.55218855

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0.5
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	2
Recession Rate	**0.03**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)
1	0.0	0.0	98.4
2	3.9	183.7	0.0
3	0.0	0.0	249.3
4	3.6	105.0	0.0
5	0.0	0.0	210.0
6	4.9	164.0	0.0
7	0.0	0.0	229.7
8	4.6	52.5	0.0
9	0.0	0.0	32.8
10	3.3	19.7	0.0
11	0.0	0.0	65.6
12	3.9	183.7	0.0
13	0.0	0.0	39.4
14	2.6	98.4	0.0
15	0.0	0.0	39.4
16	3.6	32.8	0.0
17	0.0	0.0	19.7
18	6.6	91.9	0.0
19	0.0	0.0	78.7
20	3.0	39.4	0.0
21	0.0	0.0	734.9
22	6.6	72.2	0.0
23	0.0	0.0	111.5
24	1.6	39.4	0.0
25	0.0	0.0	269.0
26	9.8	150.9	0.0
27	0.0	0.0	544.6
28	4.6	137.8	0.0
29	0.0	0.0	26.2
30	4.6	137.8	0.0
31	0.0	0.0	72.2
32	4.6	105.0	0.0
33	0.0	0.0	65.6
34	2.3	131.2	0.0
35	0.0	0.0	45.9
36	4.9	203.4	0.0
37	0.0	0.0	131.2

Ave Bank Ht	Total Erosive	Total Stable	Total Bank Length
4.4	1948.8	3064.3	5013.1

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)
1			30
2	1.2	56	
3			76
4	1.1	32	
5			64
6	1.5	50	
7			70
8	1.4	16	
9			10
10	1	6	
11			20
12	1.2	56	
13			12
14	0.8	30	
15			12
16	1.1	10	
17			6
18	2	28	
19			24
20	0.9	12	
21			224
22	2	22	
23			34
24	0.5	12	
25			82
26	3	46	
27			166
28	1.4	42	
29			8
30	1.4	42	
31			22
32	1.4	32	
33			20
34	0.7	40	
35			14
36	1.5	62	
37			40

Ave Bank Ht	Total Erosive	Total Stable	Total Bank Length
1.338888889	594	934	1528

Tincup Creek—top of reach looking downstream (left) and upstream (right).

Rich Creek ID17040105SK003_02a

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			**Elevation (ft)**
Stream:	Rich Creek ID17040105SK003_02a		Latitude	Longitude	
Reach:	1	*Beginning:*	42.97800	111.24067	
Date Collected:	7/7/2010	*Ending:*	42.98008	111.24244	
Field Crew:	js, cw	**Landuse and Notes:**		forest	
Data Reduced By:	dg	**Soil Type:**	silt, sand		

Streambank Erosion Calculations

Average Erosive Bank Height	1.96850394	ft
Total Inventoried Bank Length	1030.18373	ft
Inventoried Bank to Bank Length	2060.36746	ft
Erosive Bank Length	62.3359581	ft
Bank to Bank Eroding Segment Length	124.671916	ft
Percent Eroding Bank	6%	%
Eroding Area	245.417158	ft^2
Recession Rate	0.015	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.16565658	tons/year/sample reach
Erosion Rate (Er)	0.84903957	tons/mile/year
Feet of similar stream type	6890	ft
Eroding Bank Extrapolation	958.493572	ft
Total Streambank Erosion (existing load)	1.2735889	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	811.1683	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.547539	tons/yr/sample
Allowed Erosion Rate	2.806299	tons/mile/year
Eroding Bank Extrapolation (with reduction)	191.6987	ft
Total Streambank Erosion	4.209546	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.849039571	1.2735889	0.849039571	1.2735889	0

Recession Rate Calculation Worksheet

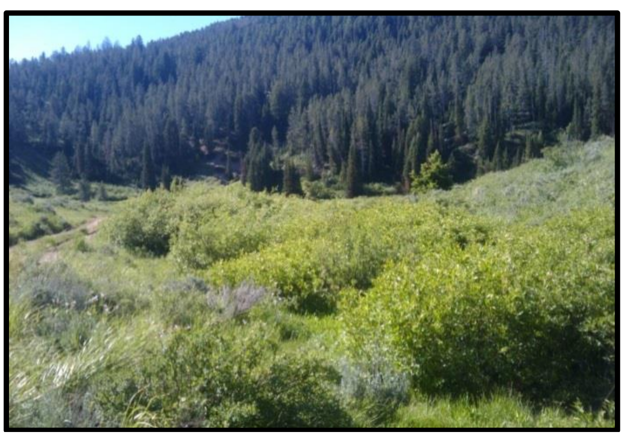
Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0.5
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	0.5
Recession Rate	**0.015**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	249.3	
2	0.7	6.6	0.0	
3	0.0	0.0	45.9	
4	2.6	3.3	0.0	
5	0.0	0.0	42.7	
6	2.6	16.4	0.0	
7	0.0	0.0	52.5	
8	2.3	6.6	0.0	
9	0.0	0.0	78.7	
10	2.0	9.8	0.0	
11	0.0	0.0	6.6	
12	1.3	13.1	0.0	
13	0.0	0.0	210.0	
14	0.0	0.0	78.7	
15	2.3	6.6	0.0	
16	0.0	0.0	98.4	
17	0.0	0.0	105.0	
	2.0	62.3	967.8	1030.2
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			76	
2	0.2	2		
3			14	
4	0.8	1		
5			13	
6	0.8	5		
7			16	
8	0.7	2		
9			24	
10	0.6	3		
11			2	
12	0.4	4		
13			64	
14			24	
15	0.7	2		
16			30	
17			32	
	0.6	19	295	314
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**



Rich Creek—bottom of reach looking downstream (left) and upstream (right).

Whiskey Creek ID17040105SK003_02b

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Whiskey Cr ID17040105SK003_02b		Latitude	Longitude	
Reach:	1	*Beginning:*	42.97739	111.23097	
Date Collected:	7/7/2010	*Ending:*	42.97939	111.23194	
Field Crew:	js, cw	**Landuse and Notes:**		grazing	
Data Reduced By:	dg	**Soil Type:**	silt, gravel, cobble		

Streambank Erosion Calculations

Average Erosive Bank Height	1.53105862	ft
Total Inventoried Bank Length	882.545933	ft
Inventoried Bank to Bank Length	1765.09187	ft
Erosive Bank Length	78.7401576	ft
Bank to Bank Eroding Segment Length	157.480315	ft
Percent Eroding Bank	9%	%
Eroding Area	241.111594	ft^2
Recession Rate	0.01	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.10850022	tons/year/sample reach
Erosion Rate (Er)	0.64912332	tons/mile/year
Feet of similar stream type	7301	ft
Eroding Bank Extrapolation	1460.26098	ft
Total Streambank Erosion (existing load)	1.00608532	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.649123321	1.00608532	0.649123321	1.00608532	0

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	540.4918	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.243221	tons/yr/sample
Allowed Erosion Rate	1.455118	tons/mile/year
Eroding Bank Extrapolation (with reduction)	292.0522	ft
Total Streambank Erosion	2.255308	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	0
Recession Rate	**0.01**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	164.0	
2	2.6	65.6	0.0	
3	0.0	0.0	328.1	
4	0.0	0.0	164.0	
5	1.3	6.6	0.0	
6	0.0	0.0	49.2	
7	0.7	6.6	0.0	
8	0.0	0.0	65.6	
9	0.0	0.0	32.8	
	1.5	**78.7**	**803.8**	**882.5**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			50	
2	0.8	20		
3			100	
4			50	
5	0.4	2		
6			15	
7	0.2	2		
8			20	
9			10	
	0.466666667	**24**	**245**	**269**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Whiskey Creek—top of reach looking downstream (left) and upstream (right).

Lau Creek ID17040105SK003_02c

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			**Elevation (ft)**
Stream:	Lau Creek ID 17040105SK003_02c		Latitude	Longitude	
Reach:	1	*Beginning:*	42.97220	111.20793	
Date Collected:	7/7/2010	*Ending:*	42.96900	111.20847	
Field Crew:	js, cw	**Landuse and Notes:**		Forest	
Data Reduced By:	dg	**Soil Type:**	Silt, Bedrock		

Streambank Erosion Calculations

Average Erosive Bank Height	0.9295713	ft
Total Inventoried Bank Length	1263.12336	ft
Inventoried Bank to Bank Length	2526.24672	ft
Erosive Bank Length	32.808399	ft
Bank to Bank Eroding Segment Length	65.616798	ft
Percent Eroding Bank	3%	%
Eroding Area	60.9954925	ft^2
Recession Rate	0.01	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.02744797	tons/year/sample reach
Erosion Rate (Er)	0.11473566	tons/mile/year
Feet of similar stream type	9455	ft
Eroding Bank Extrapolation	556.785629	ft
Total Streambank Erosion (existing load)	0.23290737	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	469.6653	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.211349	tons/yr/sample
Allowed Erosion Rate	0.883465	tons/mile/year
Eroding Bank Extrapolation (with reduction)	111.3571	ft
Total Streambank Erosion	1.793387	tons/year

Recession Rate Calculation Worksheet

Slope Factor	**Rating**
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	0
Recession Rate	**0.01**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.114735658	0.23290737	0.114735658	0.23290737	0

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	72.2	
2	0.8	6.6	0.0	
3	0.0	0.0	210.0	
4	1.0	9.8	0.0	
5	0.0	0.0	262.5	
6	0.0	0.0	324.8	
7	1.0	16.4	0.0	
8	0.0	0.0	196.9	
9	0.0	0.0	164.0	
	0.9	**32.8**	**1230.3**	**1263.1**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			22	
2	0.25	2		
3			64	
4	0.3	3		
5			80	
6			99	
7	0.3	5		
8			60	
9			50	
	0.283333333	**10**	**375**	**385**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**


Lau Creek—bottom of reach looking downstream (left) and upstream (right).

Houtz Creek ID17040105SK003_02d

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Houtz Creek ID17040105SK003_02d		Latitude	Longitude	
Reach:	1	*Beginning:*	42.97558	111.19986	
Date Collected:	7/7/2010	*Ending:*	42.97439	111.19875	
Field Crew:	js	**Landuse and Notes:**			
Data Reduced By:	dg	**Soil Type:**			

Streambank Erosion Calculations

Average Erosive Bank Height	0.98425197	ft
Total Inventoried Bank Length	656.16798	ft
Inventoried Bank to Bank Length	1312.33596	ft
Erosive Bank Length	6.5616798	ft
Bank to Bank Eroding Segment Length	13.1233596	ft
Percent Eroding Bank	1%	%
Eroding Area	12.9166925	ft^2
Recession Rate	0.02	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.01162502	tons/year/sample reach
Erosion Rate (Er)	0.09354331	tons/mile/year
Feet of similar stream type	5310	ft
Eroding Bank Extrapolation	119.32336	ft
Total Streambank Erosion (existing load)	0.10569983	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	258.3339	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.2325	tons/yr/sample
Allowed Erosion Rate	1.870866	tons/mile/year
Eroding Bank Extrapolation (with reduction)	23.86467	ft
Total Streambank Erosion	2.113997	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	1
Recession Rate	0.02

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.093543307	0.10569983	0.093543307	0.10569983	0

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	275.6	
2	1.0	6.6	0.0	
3	0.0	0.0	262.5	
4	0.0	0.0	98.4	
5	0.0	0.0	13.1	
	1.0	6.6	649.6	656.2
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			84	
2	0.3	2		
3			80	
4			30	
5			4	
	0.3	2	198	200
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Houtz Creek—bottom of reach looking downstream (right) and upstream (left).

Houtz Creek—channelized lower 100 meters.

Chicken Creek ID17040105SK003_02g

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)		**Elevation (ft)**
Stream:	Chicken Creek ID17040105SK003_02g		Latitude	Longitude
Reach:	1	*Beginning:*	42.99500	111.14853
Date Collected:	7/14/2010	*Ending:*		
Field Crew:	js, cw	**Landuse and Notes:**		
Data Reduced By:	dg	**Soil Type:**		

Streambank Erosion Calculations

Average Erosive Bank Height	3.1167979	ft
Total Inventoried Bank Length	918.635172	ft
Inventoried Bank to Bank Length	1837.27034	ft
Erosive Bank Length	39.3700788	ft
Bank to Bank Eroding Segment Length	78.7401576	ft
Percent Eroding Bank	4%	%
Eroding Area	245.417158	ft^2
Recession Rate	0.03	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.33131316	tons/year/sample reach
Erosion Rate (Er)	1.90427447	tons/mile/year
Feet of similar stream type	7477	ft
Eroding Bank Extrapolation	719.625872	ft
Total Streambank Erosion (existing load)	3.02795335	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
1.904274466	3.02795335	1.904274466	3.02795335	0

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	1145.28	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	1.546128	tons/yr/sample
Allowed Erosion Rate	8.886614	tons/mile/year
Eroding Bank Extrapolation (with reduction)	143.9252	ft
Total Streambank Erosion	14.13045	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0.5
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	0.5
Total = Slight (0-4); Moderate (5-8); Severe (9+)	2
Recession Rate	**0.03**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	505.2	
2	4.6	19.7	0.0	
3	0.0	0.0	32.8	
4	1.6	19.7	0.0	
5	0.0	0.0	341.2	
	3.1	39.4	879.3	918.6
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			154	
2	1.4	6		
3			10	
4	0.5	6		
5			104	
	0.95	12	268	280
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Chicken Creek—top of reach looking downstream (left) and upstream (right).

Luthi Canyon ID17040105SK003_02i

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)		Elevation (ft)
Stream:	Luthi Canyon ID17040105SK003_02i			Latitude	Longitude
Reach:	1	*Beginning:*			
Date Collected:	7/13/2010	*Ending:*			
Field Crew:	js	**Landuse and Notes:**			
Data Reduced By:	dg	**Soil Type:**	silt, pebble		

Streambank Erosion Calculations

Average Erosive Bank Height	1.46375934	ft
Total Inventoried Bank Length	1013.77953	ft
Inventoried Bank to Bank Length	2027.55906	ft
Erosive Bank Length	252.624672	ft
Bank to Bank Eroding Segment Length	505.249345	ft
Percent Eroding Bank	25%	%
Eroding Area	739.563446	ft^2
Recession Rate	0.075	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	2.49602663	tons/year/sample reach
Erosion Rate (Er)	12.9998883	tons/mile/year
Feet of similar stream type	21637	ft
Eroding Bank Extrapolation	11288.738	ft
Total Streambank Erosion (existing load)	55.7684854	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
12.99988827	55.7684854	10.43367656	44.7596416	19.74025974

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	593.5717	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	2.003304	tons/yr/sample
Allowed Erosion Rate	10.43368	tons/mile/year
Eroding Bank Extrapolation (with reduction)	2257.748	ft
Total Streambank Erosion	44.75964	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	2
Bank Stability Condition (0-3)	1.5
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	5.5
Recession Rate	**0.075**

Converted Data				
Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	223.1	
2	0.7	3.3	0.0	
3	2.3	19.7	0.0	
4	0.0	0.0	45.9	
5	0.7	6.6	0.0	
6	0.0	0.0	39.4	
7	0.7	13.1	0.0	
8	0.0	0.0	19.7	
9	0.7	9.8	0.0	
10	0.0	0.0	26.2	
11	0.3	6.6	0.0	
12	0.0	0.0	13.1	
13	3.6	16.4	0.0	
14	1.3	45.9	0.0	
15	0.0	0.0	111.5	
16	1.0	3.3	0.0	
17	0.0	0.0	98.4	
18	0.7	13.1	0.0	
19	1.6	29.5	0.0	
20	0.0	0.0	111.5	
21	4.9	45.9	0.0	
22	0.0	0.0	72.2	
23	0.7	39.4	0.0	
	1.5	252.6	761.2	1013.8
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data				
Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			68	
2	0.2	1		
3	0.7	6		
4			14	
5	0.2	2		
6			12	
7	0.2	4		
8			6	
9	0.2	3		
10			8	
11	0.1	2		
12			4	
13	1.1	5		
14	0.4	14		
15			34	
16	0.3	1		
17			30	
18	0.2	4		
19	0.5	9		
20			34	
21	1.5	14		
22			22	
23	0.2	12		
	0.446153846	77	232	309
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Luthi Creek—bottom of reach looking upstream (left) and downstream (right).

Haderlie Creek ID17040105SK003_02j

STREAMBANK EROSION INVENTORY WORKSHEET

Stream:	Haderlie Creek ID17040105SK003_02j	**Stream Segment Location (DD)**			**Elevation (ft)**
			Latitude	Longitude	
Reach:	1	*Beginning:*	43.00794	111.10392	
Date Collected:	7/13/2010	*Ending:*	43.01231	111.10758	
Field Crew:	js, cw	**Landuse and Notes:**		forest, grazing	
Data Reduced By:	dg	**Soil Type:**			

Streambank Erosion Calculations

Average Erosive Bank Height	1.62983659	ft
Total Inventoried Bank Length	3097.11287	ft
Inventoried Bank to Bank Length	6194.22573	ft
Erosive Bank Length	639.763781	ft
Bank to Bank Eroding Segment Length	1279.52756	ft
Percent Eroding Bank	21%	%
Eroding Area	2085.42084	ft^2
Recession Rate	0.045	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	4.2229772	tons/year/sample reach
Erosion Rate (Er)	7.19938878	tons/mile/year
Feet of similar stream type	27369	ft
Eroding Bank Extrapolation	12586.6356	ft
Total Streambank Erosion (existing load)	41.5411726	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	2019.115	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	4.088708	tons/yr/sample
Allowed Erosion Rate	6.970485	tons/mile/year
Eroding Bank Extrapolation (with reduction)	2517.327	ft
Total Streambank Erosion	40.22038	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	3.5
Recession Rate	**0.045**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
7.199388784	41.5411726	6.970485141	40.2203763	3.179487179

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)
1	1.6	6.6	0.0
2	0.0	0.0	13.1
3	1.0	6.6	0.0
4	0.0	0.0	269.0
5	0.0	0.0	52.5
6	1.0	13.1	0.0
7	0.7	3.3	0.0
8	0.0	0.0	13.1
9	1.3	13.1	0.0
10	0.0	0.0	45.9
11	1.3	9.8	0.0
12	0.0	0.0	88.6
13	0.7	6.6	0.0
14	0.0	0.0	13.1
15	5.2	16.4	0.0
16	3.0	19.7	0.0
17	0.7	19.7	0.0
18	5.9	32.8	0.0
19	0.0	0.0	39.4
20	1.3	13.1	0.0
21	2.0	78.7	0.0
22	0.0	0.0	65.6
23	0.7	3.3	0.0
24	0.0	0.0	91.9
25	0.7	19.7	0.0
26	0.0	0.0	59.1
27	0.7	13.1	0.0
28	1.0	13.1	0.0
29	0.0	0.0	124.7
30	1.3	6.6	0.0
31	0.0	0.0	32.8
32	4.3	13.1	0.0
33	0.0	0.0	91.9
34	0.7	3.3	0.0
35	0.0	0.0	347.8
36	0.7	3.3	0.0
37	0.0	0.0	32.8
38	1.3	6.6	0.0
39	0.7	91.9	0.0
40	0.0	0.0	65.6
41	2.3	16.4	0.0
42	0.0	0.0	26.2

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)
1	0.5	2	
2			4
3	0.3	2	
4			82
5			16
6	0.3	4	
7	0.2	1	
8			4
9	0.4	4	
10			14
11	0.4	3	
12			27
13	0.2	2	
14			4
15	1.6	5	
16	0.9	6	
17	0.2	6	
18	1.8	10	
19			12
20	0.4	4	
21	0.6	24	
22			20
23	0.2	1	
24			28
25	0.2	6	
26			18
27	0.2	4	
28	0.3	4	
29			38
30	0.4	2	
31			10
32	1.3	4	
33			28
34	0.2	1	
35			106
36	0.2	1	
37			10
38	0.4	2	
39	0.2	28	
40			20
41	0.7	5	
42			8

43	1.3	3.3	0.0	
44	0.0	0.0	19.7	
45	2.3	16.4	0.0	
46	3.0	16.4	0.0	
47	0.0	0.0	39.4	
48	1.3	29.5	0.0	
49	1.0	85.3	0.0	
50	0.0	0.0	45.9	
51	0.7	39.4	0.0	
52	0.0	0.0	328.1	
53	0.0	0.0	190.3	
54	0.0	0.0	164.0	
55	1.3	19.7	0.0	
56	0.0	0.0	196.9	
	1.6	639.8	2457.3	3097.1
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

43	0.4	1		
44			6	
45	0.7	5		
46	0.9	5		
47			12	
48	0.4	9		
49	0.3	26		
50			14	
51	0.2	12		
52			100	
53			58	
54			50	
55	0.4	6		
56			60	
	0.496774194	195	749	944
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**


Haderlie Creek—top of reach looking downstream (left) and upstream (right).


Haderlie Creek—examples of cut banks.

Upper Boulder Creek ID17040105SK006_02c

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)		Elevation (ft)
Stream:	Upper Boulder ID17040105_SK006_02c		Latitude	Longitude	
Reach:	1	*Beginning:*	42.84543	111.19639	
Date Collected:	8/16/2012	*Ending:*	42.84515	111.19447	
Field Crew:	dg, gm	**Landuse and Notes:**		USFS, no sign of grazing	
Data Reduced By:	dg	**Soil Type:**	silt	silt	

Streambank Erosion Calculations

Average Erosive Bank Height	3.32185039	ft
Total Inventoried Bank Length	705.380579	ft
Inventoried Bank to Bank Length	1410.76116	ft
Erosive Bank Length	498.687665	ft
Bank to Bank Eroding Segment Length	997.37533	ft
Percent Eroding Bank	71%	%
Eroding Area	3313.13163	ft^2
Recession Rate	0.075	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	11.1818193	tons/year/sample reach
Erosion Rate (Er)	83.6995056	tons/mile/year
Feet of similar stream type	4733	ft
Eroding Bank Extrapolation	7689.61719	ft
Total Streambank Erosion (existing load)	86.2101829	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	937.2675	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	3.163278	tons/yr/sample
Allowed Erosion Rate	23.67815	tons/mile/year
Eroding Bank Extrapolation (with reduction)	1537.923	ft
Total Streambank Erosion	24.38841	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1.5
Bank Stability Condition (0-3)	2
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	5.5
Recession Rate	**0.075**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
83.69950559	86.2101829	23.67814961	24.388407	71.71052632

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	3.3	39.4	0.0	
2	0.0	0.0	13.1	
3	4.3	210.0	0.0	
4	0.0	0.0	6.6	
5	4.3	65.6	0.0	
6	0.0	0.0	82.0	
7	3.9	39.4	0.0	
8	0.0	0.0	19.7	
9	3.6	52.5	0.0	
10	0.0	0.0	39.4	
11	2.3	32.8	0.0	
12	2.3	26.2	0.0	
13	0.0	0.0	26.2	
14	2.6	32.8	0.0	
15	0.0	0.0	19.7	
	3.3	498.7	206.7	705.4
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	1	12		
2			4	
3	1.3	64		
4			2	
5	1.3	20		
6			25	
7	1.2	12		
8			6	
9	1.1	16		
10			12	
11	0.7	10		
12	0.7	8		
13			8	
14	0.8	10		
15			6	
	1.0125	152	63	215
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**


Upper Boulder Creek—top of reach looking downstream (left) and site overview (right).

West Fork Boulder Creek ID17040105SK006_02d

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)		Elevation (ft)
		Latitude	Longitude	
Stream:	Boulder Cr West Fk ID17040105_SK02d			
Reach:	1	*Beginning:* 42.83565	111.18996	
Date Collected:	8/16/2012	*Ending:* 42.83511	111.19387	
Field Crew:	dg, gm	**Landuse and Notes:**	Forest, grazing (not curre	
Data Reduced By:	dg	**Soil Type:** Silt & larger	Silt & larger	

Streambank Erosion Calculations

Average Erosive Bank Height	1.31233596	ft
Total Inventoried Bank Length	1679.79003	ft
Inventoried Bank to Bank Length	3359.58006	ft
Erosive Bank Length	6.5616798	ft
Bank to Bank Eroding Segment Length	13.1233596	ft
Percent Eroding Bank	0%	%
Eroding Area	17.2222567	ft^2
Recession Rate	0.01	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.00775002	tons/year/sample reach
Erosion Rate (Er)	0.02436024	tons/mile/year
Feet of similar stream type	15110	ft
Eroding Bank Extrapolation	131.170235	ft
Total Streambank Erosion (existing load)	0.07746274	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.024360236	0.07746274	0.024360236	0.07746274	0

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	881.7795	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.396801	tons/yr/sample
Allowed Erosion Rate	1.247244	tons/mile/year
Eroding Bank Extrapolation (with reduction)	26.23405	ft
Total Streambank Erosion	3.966092	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	0
Recession Rate	**0.01**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	958.0	
2	1.3	6.6	0.0	
3	0.0	0.0	649.6	
4	0.0	0.0	65.6	
	1.3	6.6	1673.2	1679.8
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			292	
2	0.4	2		
3			198	
4			20	
	0.4	2	510	512
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

West Fork Boulder Creek—top of reach looking downstream (left) and upstream (right).

White Canyon ID17040105SK006_02f

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)		Elevation (ft)
Stream:	White Canyon ID17040105SK006_02f		Latitude	Longitude	
Reach:	1	*Beginning:*	42.83193	111.12034	
Date Collected:	8/14/2012	*Ending:*	42.83271	111.11515	
Field Crew:	sl, hy, lb	**Landuse and Notes:**		USFS	
Data Reduced By:	dg	**Soil Type:**	silt & pebble	silt & pebble	

Streambank Erosion Calculations

Average Erosive Bank Height	1.31233596	ft
Total Inventoried Bank Length	1758.53019	ft
Inventoried Bank to Bank Length	3517.06037	ft
Erosive Bank Length	226.377953	ft
Bank to Bank Eroding Segment Length	452.755906	ft
Percent Eroding Bank	13%	%
Eroding Area	594.167856	ft^2
Recession Rate	0.02	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.53475107	tons/year/sample reach
Erosion Rate (Er)	1.60559408	tons/mile/year
Feet of similar stream type	15137	ft
Eroding Bank Extrapolation	4349.96859	ft
Total Streambank Erosion (existing load)	5.13775818	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	923.113	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.830802	tons/yr/sample
Allowed Erosion Rate	2.494488	tons/mile/year
Eroding Bank Extrapolation (with reduction)	869.9937	ft
Total Streambank Erosion	7.98214	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
1.605594077	5.13775818	1.605594077	5.13775818	0

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0.5
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0.5
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	1
Recession Rate	**0.02**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	78.7	
2	1.6	16.4	0.0	
3	0.0	0.0	111.5	
4	1.3	13.1	0.0	
5	0.0	0.0	216.5	
6	0.8	26.2	0.0	
7	0.0	0.0	9.8	
8	1.0	26.2	0.0	
9	0.0	0.0	288.7	
10	1.6	13.1	0.0	
11	0.0	0.0	308.4	
12	2.0	6.6	0.0	
13	0.0	0.0	32.8	
14	1.6	19.7	0.0	
15	0.0	0.0	105.0	
16	1.3	39.4	0.0	
17	0.0	0.0	111.5	
18	0.8	13.1	0.0	
19	0.0	0.0	249.3	
20	1.0	52.5	0.0	
21	0.0	0.0	19.7	
	1.3	226.4	1532.2	1758.5
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			24	
2	0.5	5		
3			34	
4	0.4	4		
5			66	
6	0.25	8		
7			3	
8	0.3	8		
9			88	
10	0.5	4		
11			94	
12	0.6	2		
13			10	
14	0.5	6		
15			32	
16	0.4	12		
17			34	
18	0.25	4		
19			76	
20	0.3	16		
21			6	
	0.4	69	467	536
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

White Canyon—top of reach looking downstream (left) and upstream (right).

Graehl Canyon ID17040105SK006_02g

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Graehl Canyon ID17040105SK006_02g		Latitude	Longitude	
Reach:	1	*Beginning:*	42.82874	111.10385	
Date Collected:	10/3/2012	*Ending:*	42.82932	111.10187	
Field Crew:	dg, gm	**Landuse and Notes:**		Grazing	
Data Reduced By:	dg	**Soil Type:**	silt	silt	

Streambank Erosion Calculations

Average Erosive Bank Height	1.15692775	ft
Total Inventoried Bank Length	918.635172	ft
Inventoried Bank to Bank Length	1837.27034	ft
Erosive Bank Length	462.598426	ft
Bank to Bank Eroding Segment Length	925.196852	ft
Percent Eroding Bank	50%	%
Eroding Area	1070.38591	ft^2
Recession Rate	0.045	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	2.16753148	tons/year/sample reach
Erosion Rate (Er)	12.4582278	tons/mile/year
Feet of similar stream type	6473	ft
Eroding Bank Extrapolation	7444.43257	ft
Total Streambank Erosion (existing load)	17.440658	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
12.45822775	17.440658	4.947948612	6.92678617	60.28368794

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	425.1178	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.860864	tons/yr/sample
Allowed Erosion Rate	4.947949	tons/mile/year
Eroding Bank Extrapolation (with reduction)	1488.887	ft
Total Streambank Erosion	6.926786	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1
Bank Stability Condition (0-3)	1
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0.5
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	3.5
Recession Rate	**0.045**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.7	32.8	0.0	
2	0.0	0.0	32.8	
3	0.7	26.2	0.0	
4	0.0	0.0	13.1	
5	1.3	59.1	0.0	
6	0.0	0.0	32.8	
7	0.7	19.7	0.0	
8	0.0	0.0	6.6	
9	1.0	23.0	0.0	
10	0.0	0.0	23.0	
11	1.3	26.2	0.0	
12	0.0	0.0	13.1	
13	1.3	19.7	0.0	
14	0.0	0.0	9.8	
15	0.7	39.4	0.0	
16	0.0	0.0	19.7	
17	1.3	6.6	0.0	
18	0.0	0.0	13.1	
19	1.6	6.6	0.0	
20	0.0	0.0	16.4	
21	1.3	13.1	0.0	
22	0.0	0.0	85.3	
23	1.0	16.4	0.0	
24	0.0	0.0	52.5	
25	1.3	32.8	0.0	
26	0.0	0.0	19.7	
27	1.0	9.8	0.0	
28	0.0	0.0	26.2	
29	2.0	13.1	0.0	
30	0.0	0.0	45.9	
31	1.0	13.1	0.0	
32	1.3	88.6	0.0	
33	0.0	0.0	32.8	
34	1.3	13.1	0.0	
35	0.0	0.0	13.1	
36	1.3	3.3	0.0	
	1.2	462.6	456.0	918.6
	Ave Bank Ht	Total Erosive	Total Stable	Total Bank Length

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.2	10		
2			10	
3	0.2	8		
4			4	
5	0.4	18		
6			10	
7	0.2	6		
8			2	
9	0.3	7		
10			7	
11	0.4	8		
12			4	
13	0.4	6		
14			3	
15	0.2	12		
16			6	
17	0.4	2		
18			4	
19	0.5	2		
20			5	
21	0.4	4		
22			26	
23	0.3	5		
24			16	
25	0.4	10		
26			6	
27	0.3	3		
28			8	
29	0.6	4		
30			14	
31	0.3	4		
32	0.4	27		
33			10	
34	0.4	4		
35			4	
36	0.4	1		
	0.352631579	141	139	280
	Ave Bank Ht	Total Erosive	Total Stable	Total Bank Length

Graehl Creek—top of reach looking downstream (left) and upstream (right).

Stump Creek ID17040105SK006_04

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)		**Elevation (ft)**
Stream:	Lower Stump Cr ID17040105SK006_04		Latitude	Longitude
Reach:	1	*Beginning:*	42.79175	111.07399
Date Collected:	10/3/2012	*Ending:*	42.79950	111.08082
Field Crew:	dg, gm	**Landuse and Notes:**		grazing
Data Reduced By:	dg	**Soil Type:**	silt & gravel	silt & gravel

Streambank Erosion Calculations

Average Erosive Bank Height	2.89983913	ft
Total Inventoried Bank Length	5403.54332	ft
Inventoried Bank to Bank Length	10807.0866	ft
Erosive Bank Length	2043.96326	ft
Bank to Bank Eroding Segment Length	4087.92652	ft
Percent Eroding Bank	38%	%
Eroding Area	11854.3293	ft^2
Recession Rate	0.105	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	56.0117059	tons/year/sample reach
Erosion Rate (Er)	54.7310884	tons/mile/year
Feet of similar stream type	46234	ft
Eroding Bank Extrapolation	39065.1967	ft
Total Streambank Erosion (existing load)	535.261165	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
54.73108841	535.261165	28.93807468	283.009675	47.12680578

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	6267.763	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	29.61518	tons/yr/sample
Allowed Erosion Rate	28.93807	tons/mile/year
Eroding Bank Extrapolation (with reduction)	7813.039	ft
Total Streambank Erosion	283.0097	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	2
Bank Stability Condition (0-3)	1
Bank Cover/Vegetation (0-3)	0.5
Lateral Channel Stablity (0-3)	1
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	6.5
Recession Rate	**0.105**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	137.8	
2	0.3	6.6	0.0	
3	0.0	0.0	6.6	
4	1.3	19.7	0.0	
5	0.0	0.0	91.9	
6	1.6	13.1	0.0	
7	0.0	0.0	98.4	
8	0.3	13.1	0.0	
9	0.0	0.0	45.9	
10	2.3	19.7	0.0	
11	0.0	0.0	9.8	
12	3.3	13.1	0.0	
13	0.0	0.0	62.3	
14	2.3	39.4	0.0	
15	0.0	0.0	19.7	
16	1.3	6.6	0.0	
17	0.0	0.0	6.6	
18	1.0	6.6	0.0	
19	0.0	0.0	154.2	
20	1.6	6.6	0.0	
21	0.0	0.0	26.2	
22	2.3	13.1	0.0	
23	0.0	0.0	150.9	
24	6.6	68.9	0.0	
25	0.0	0.0	134.5	
26	4.6	137.8	0.0	
27	0.0	0.0	45.9	
28	2.6	26.2	0.0	
29	0.0	0.0	249.3	
30	6.6	19.7	0.0	
31	0.0	0.0	19.7	
32	3.3	170.6	0.0	
33	3.0	65.6	0.0	
34	0.0	0.0	196.9	
35	3.6	36.1	0.0	
36	0.0	0.0	269.0	
37	2.6	6.6	0.0	
38	0.0	0.0	206.7	
39	3.3	6.6	0.0	
40	0.0	0.0	19.7	
41	3.3	134.5	0.0	
42	0.0	0.0	298.6	
43	4.6	301.8	0.0	
44	0.0	0.0	91.9	
45	0.0	0.0	183.7	
46	3.3	45.9	0.0	
47	0.0	0.0	223.1	
48	3.6	105.0	0.0	
49	0.0	0.0	347.8	
50	2.6	19.7	0.0	
51	0.0	0.0	13.1	
52	2.6	29.5	0.0	
53	1.6	16.4	0.0	
54	0.0	0.0	45.9	
55	4.9	65.6	0.0	
56	0.0	0.0	164.0	
57	4.3	91.9	0.0	
58	0.3	32.8	0.0	
59	0.0	0.0	39.4	
60	4.9	505.2	0.0	
	2.9	2044.0	3359.6	5403.5
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			42	
2	0.1	2		
3			2	
4	0.4	6		
5			28	
6	0.5	4		
7			30	
8	0.1	4		
9			14	
10	0.7	6		
11			3	
12	1	4		
13			19	
14	0.7	12		
15			6	
16	0.4	2		
17			2	
18	0.3	2		
19			47	
20	0.5	2		
21			8	
22	0.7	4		
23			46	
24	2	21		
25			41	
26	1.4	42		
27			14	
28	0.8	8		
29			76	
30	2	6		
31			6	
32	1	52		
33	0.9	20		
34			60	
35	1.1	11		
36			82	
37	0.8	2		
38			63	
39	1	2		
40			6	
41	1	41		
42			91	
43	1.4	92		
44			28	
45			56	
46	1	14		
47			68	
48	1.1	32		
49			106	
50	0.8	6		
51			4	
52	0.8	9		
53	0.5	5		
54			14	
55	1.5	20		
56			50	
57	1.3	28		
58	0.1	10		
59			12	
60	1.5	154		
	0.883870968	623	1024	1647
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Stump Creek—top of reach looking upstream (left) and downstream (right).

Stump Creek—examples of unstable streambanks.

Smoky Creek ID17040105SK007_02c

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Smoky Cr ID17040105SK007_02c		Latitude	Longitude	
Reach:	1	*Beginning:*	42.73132	111.09402	
Date Collected:	8/21/2012	*Ending:*	42.72776	111.09855	
Field Crew:	sl, hy, lb	**Landuse and Notes:**		grazing	
Data Reduced By:	dg	**Soil Type:**	silt	silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.63273341	ft
Total Inventoried Bank Length	3300.52494	ft
Inventoried Bank to Bank Length	6601.04988	ft
Erosive Bank Length	2972.44095	ft
Bank to Bank Eroding Segment Length	5944.8819	ft
Percent Eroding Bank	90%	%
Eroding Area	3761.52539	ft^2
Recession Rate	0.16	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	27.0829828	tons/year/sample reach
Erosion Rate (Er)	43.3258805	tons/mile/year
Feet of similar stream type	27904	ft
Eroding Bank Extrapolation	56205.367	ft
Total Streambank Erosion (existing load)	256.053697	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	835.341	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	6.014455	tons/yr/sample
Allowed Erosion Rate	9.621597	tons/mile/year
Eroding Bank Extrapolation (with reduction)	11241.07	ft
Total Streambank Erosion	56.86314	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	1.5
Bank Cover/Vegetation (0-3)	2.5
Lateral Channel Stablity (0-3)	0.5
Channel Bottom Stability (0-3)	0.5
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	9
Recession Rate	**0.16**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
43.32588049	256.053697	9.6215973	56.8631388	77.79249448

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.7	19.7	0.0	
2	0.7	236.2	0.0	
3	0.7	203.4	0.0	
4	0.0	0.0	13.1	
5	0.7	78.7	0.0	
6	0.3	52.5	0.0	
7	0.7	59.1	0.0	
8	0.7	26.2	0.0	
9	0.0	0.0	19.7	
10	0.0	0.0	6.6	
11	0.7	190.3	0.0	
12	0.7	13.1	0.0	
13	0.0	0.0	26.2	
14	1.0	52.5	0.0	
15	0.0	0.0	26.2	
16	0.3	26.2	0.0	
17	0.7	98.4	0.0	
18	0.0	0.0	9.8	
19	0.7	19.7	0.0	
20	0.0	0.0	26.2	
21	1.0	85.3	0.0	
22	0.7	157.5	0.0	
23	0.7	65.6	0.0	
24	0.0	0.0	13.1	
25	0.7	52.5	0.0	
26	0.0	0.0	13.1	
27	0.5	13.1	0.0	
28	0.0	0.0	19.7	
29	0.7	249.3	0.0	
30	0.0	0.0	13.1	
31	0.0	0.0	19.7	
32	0.5	157.5	0.0	
33	0.0	0.0	13.1	
34	0.7	78.7	0.0	
35	0.0	0.0	13.1	
36	0.7	39.4	0.0	
37	0.3	52.5	0.0	
38	0.0	0.0	13.1	
39	0.5	495.4	0.0	
40	0.0	0.0	13.1	
41	0.7	196.9	0.0	
42	0.0	0.0	13.1	
43	0.7	62.3	0.0	
44	0.0	0.0	16.4	
45	0.7	118.1	0.0	
46	0.0	0.0	39.4	
47	0.8	72.2	0.0	
	0.6	2972.4	328.1	3300.5
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.2	6		
2	0.2	72		
3	0.2	62		
4			4	
5	0.2	24		
6	0.1	16		
7	0.2	18		
8	0.2	8		
9			6	
10			2	
11	0.2	58		
12	0.2	4		
13			8	
14	0.3	16		
15			8	
16	0.1	8		
17	0.2	30		
18			3	
19	0.2	6		
20			8	
21	0.3	26		
22	0.2	48		
23	0.2	20		
24			4	
25	0.2	16		
26			4	
27	0.15	4		
28			6	
29	0.2	76		
30			4	
31			6	
32	0.15	48		
33			4	
34	0.2	24		
35			4	
36	0.2	12		
37	0.1	16		
38			4	
39	0.15	151		
40			4	
41	0.2	60		
42			4	
43	0.2	19		
44			5	
45	0.2	36		
46			12	
47	0.25	22		
	0.192857143	906	100	1006
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**


Smoky Creek—bottom of reach looking downstream (left) and upstream (right).


Smoky Creek—examples of unstable and trampled streambanks.

Draney Creek ID17040105SK007_02f

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Draney Creek ID17040105SK007_02f		Latitude	Longitude	
Reach:	1	Beginning:	42.73786	111.10485	
Date Collected:	8/14/2012	Ending:	42.73690	111.11414	
Field Crew:	sl, hy, lb	Landuse and Notes:		grazing, dirt roads, animal	
Data Reduced By:	dg	Soil Type:	silt, gravel	silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.74134363	ft
Total Inventoried Bank Length	3494.09449	ft
Inventoried Bank to Bank Length	6988.18899	ft
Erosive Bank Length	1351.70604	ft
Bank to Bank Eroding Segment Length	2703.41208	ft
Percent Eroding Bank	39%	%
Eroding Area	2004.15732	ft^2
Recession Rate	0.09	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	8.11683716	tons/year/sample reach
Erosion Rate (Er)	12.2655241	tons/mile/year
Feet of similar stream type	22167	ft
Eroding Bank Extrapolation	19854.2177	ft
Total Streambank Erosion (existing load)	59.6111312	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	1036.13	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	4.196326	tons/yr/sample
Allowed Erosion Rate	6.341157	tons/mile/year
Eroding Bank Extrapolation (with reduction)	3970.844	ft
Total Streambank Erosion	30.81838	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1.5
Bank Stability Condition (0-3)	1.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0.5
Channel Bottom Stability (0-3)	0.5
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	6
Recession Rate	**0.09**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
12.2655241	59.6111312	6.341156875	30.8183761	48.30097087

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)
1	1.6	26.2	0.0
2	0.0	0.0	59.1
3	0.7	6.6	0.0
4	0.0	0.0	13.1
5	0.5	13.1	0.0
6	1.1	3.3	0.0
7	0.0	0.0	29.5
8	0.8	19.7	0.0
9	0.7	13.1	0.0
10	0.0	0.0	32.8
11	0.7	32.8	0.0
12	0.0	0.0	6.6
13	0.0	0.0	13.1
14	0.0	0.0	98.4
15	0.5	6.6	0.0
16	0.0	0.0	52.5
17	0.2	42.7	0.0
18	0.0	0.0	6.6
19	0.3	52.5	0.0
20	0.0	0.0	26.2
21	0.8	6.6	0.0
22	0.0	0.0	9.8
23	1.0	19.7	0.0
24	0.0	0.0	26.2
25	1.0	26.2	0.0
26	0.8	16.4	0.0
27	0.0	0.0	26.2
28	0.7	9.8	0.0
29	0.0	0.0	9.8
30	1.0	23.0	0.0
31	0.0	0.0	26.2
32	0.8	26.2	0.0
33	0.2	13.1	0.0
34	0.0	0.0	26.2
35	1.3	19.7	0.0
36	0.0	0.0	105.0
37	0.7	13.1	0.0
38	0.0	0.0	13.1
39	0.8	52.5	0.0
40	0.0	0.0	19.7
41	0.7	32.8	0.0
42	0.0	0.0	13.1

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)
1	0.5	8	
2			18
3	0.2	2	
4			4
5	0.15	4	
6	0.35	1	
7			9
8	0.25	6	
9	0.2	4	
10			10
11	0.2	10	
12			2
13			4
14			30
15	0.15	2	
16			16
17	0.05	13	
18			2
19	0.1	16	
20			8
21	0.25	2	
22			3
23	0.3	6	
24			8
25	0.3	8	
26	0.25	5	
27			8
28	0.2	3	
29			3
30	0.3	7	
31			8
32	0.25	8	
33	0.05	4	
34			8
35	0.4	6	
36			32
37	0.2	4	
38			4
39	0.25	16	
40			6
41	0.2	10	
42			4

43	0.5	26.2	0.0	
44	0.0	0.0	32.8	
45	0.8	52.5	0.0	
46	0.0	0.0	26.2	
47	0.7	6.6	0.0	
48	0.0	0.0	39.4	
49	1.0	26.2	0.0	
50	0.0	0.0	59.1	
51	0.2	13.1	0.0	
52	0.0	0.0	32.8	
53	0.8	26.2	0.0	
54	0.0	0.0	45.9	
55	0.5	9.8	0.0	
56	0.0	0.0	32.8	
57	0.0	0.0	59.1	
58	0.3	6.6	0.0	
59	0.0	0.0	52.5	
60	0.3	9.8	0.0	
61	0.0	0.0	32.8	
62	1.0	32.8	0.0	
63	0.0	0.0	13.1	
64	1.3	45.9	0.0	
65	0.0	0.0	39.4	
66	1.6	13.1	0.0	
67	0.0	0.0	59.1	
68	1.1	19.7	0.0	
69	0.0	0.0	45.9	
70	0.2	6.6	0.0	
71	0.0	0.0	91.9	
72	0.5	26.2	0.0	
73	0.0	0.0	32.8	
74	0.0	0.0	65.6	
75	0.5	6.6	0.0	
76	0.0	0.0	98.4	
77	1.1	3.3	0.0	
78	0.0	0.0	91.9	
79	0.0	0.0	98.4	
80	0.0	0.0	52.5	
81	0.2	19.7	0.0	
82	0.0	0.0	19.7	
83	0.7	59.1	0.0	
84	0.0	0.0	6.6	
85	0.0	0.0	39.4	
86	1.0	6.6	0.0	
87	0.0	0.0	65.6	
88	0.0	0.0	59.1	
89	0.2	6.6	0.0	
90	0.0	0.0	32.8	
91	1.3	91.9	0.0	
92	0.0	0.0	52.5	
93	0.2	26.2	0.0	
94	1.0	85.3	0.0	
95	0.2	65.6	0.0	
96	1.6	6.6	0.0	
97	0.2	85.3	0.0	
98	0.0	0.0	13.1	
99	0.3	6.6	0.0	
100	0.0	0.0	13.1	
101	1.6	32.8	0.0	
102	0.0	0.0	32.8	
103	1.0	52.5	0.0	
104	0.0	0.0	91.9	
	0.7	1351.7	2142.4	3494.1
	Ave Bank Ht	Total Erosive	Total Stable	Total Bank Length

43	0.15	8		
44			10	
45	0.25	16		
46			8	
47	0.2	2		
48			12	
49	0.3	8		
50			18	
51	0.05	4		
52			10	
53	0.25	8		
54			14	
55	0.15	3		
56			10	
57			18	
58	0.1	2		
59			16	
60	0.1	3		
61			10	
62	0.3	10		
63			4	
64	0.4	14		
65			12	
66	0.5	4		
67			18	
68	0.35	6		
69			14	
70	0.05	2		
71			28	
72	0.15	8		
73			10	
74			20	
75	0.15	2		
76			30	
77	0.35	1		
78			28	
79			30	
80			16	
81	0.05	6		
82			6	
83	0.2	18		
84			2	
85			12	
86	0.3	2		
87			20	
88			18	
89	0.05	2		
90			10	
91	0.4	28		
92			16	
93	0.05	8		
94	0.3	26		
95	0.05	20		
96	0.5	2		
97	0.05	26		
98			4	
99	0.1	2		
100			4	
101	0.5	10		
102			10	
103	0.3	16		
104			28	
	0.225961538	412	653	1065
	Ave Bank Ht	Total Erosive	Total Stable	Total Bank Length

Draney Creek—bottom of reach looking downstream (left) and upstream (right).

Draney Creek—example of unstable streambank.

Tygee Creek ID17040105SK007_03

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Tygee Creek ID17040105SK007_03		Latitude	Longitude	
Reach:	1	*Beginning:*	42.77414	111.06648	
Date Collected:	10/3/2012	*Ending:*	42.77414	111.06648	
Field Crew:	dg, gm	**Landuse and Notes:**		grazing	
Data Reduced By:	dg	**Soil Type:**	silt	silt	

Streambank Erosion Calculations

Average Erosive Bank Height	3.2808399	ft
Total Inventoried Bank Length	3854.98688	ft
Inventoried Bank to Bank Length	7709.97377	ft
Erosive Bank Length	1729.00263	ft
Bank to Bank Eroding Segment Length	3458.00525	ft
Percent Eroding Bank	45%	%
Eroding Area	11345.1616	ft^2
Recession Rate	0.27	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	137.843713	tons/year/sample reach
Erosion Rate (Er)	188.798258	tons/mile/year
Feet of similar stream type	24393	ft
Eroding Bank Extrapolation	25339.0453	ft
Total Streambank Erosion (existing load)	1010.07021	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	5059.038	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	61.46731	tons/yr/sample
Allowed Erosion Rate	84.18898	tons/mile/year
Eroding Bank Extrapolation (with reduction)	5067.809	ft
Total Streambank Erosion	450.4108	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	2
Bank Cover/Vegetation (0-3)	2
Lateral Channel Stablity (0-3)	1
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	10
Recession Rate	**0.27**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
188.7982577	1010.07021	84.18897638	450.410814	55.40796964

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)
1	3.3	75.5	0.0
2	0.0	0.0	62.3
3	3.3	36.1	0.0
4	0.0	0.0	29.5
5	3.3	144.4	0.0
6	0.0	0.0	42.7
7	3.3	144.4	0.0
8	0.0	0.0	137.8
9	3.3	32.8	0.0
10	0.0	0.0	75.5
11	3.3	128.0	0.0
12	0.0	0.0	29.5
13	3.3	78.7	0.0
14	0.0	0.0	16.4
15	3.3	39.4	0.0
16	0.0	0.0	39.4
17	3.3	154.2	0.0
18	0.0	0.0	98.4
19	3.3	95.1	0.0
20	0.0	0.0	49.2
21	3.3	196.9	0.0
22	0.0	0.0	78.7
23	3.3	68.9	0.0
24	0.0	0.0	72.2
25	3.3	26.2	0.0
26	0.0	0.0	42.7
27	3.3	39.4	0.0
28	0.0	0.0	95.1
29	3.3	105.0	0.0
30	0.0	0.0	72.2
31	3.3	55.8	0.0
32	0.0	0.0	52.5
33	3.3	62.3	0.0
34	0.0	0.0	68.9
35	3.3	16.4	0.0
36	0.0	0.0	82.0
37	3.3	141.1	0.0
38	0.0	0.0	42.7
39	3.3	19.7	0.0
40	0.0	0.0	232.9
41	3.3	68.9	0.0
42	0.0	0.0	52.5
43	0.0	0.0	544.6
44	0.0	0.0	108.3

3.3	1729.0	2126.0	3855.0
Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)
1	1	23	
2			19
3	1	11	
4			9
5	1	44	
6			13
7	1	44	
8			42
9	1	10	
10			23
11	1	39	
12			9
13	1	24	
14			5
15	1	12	
16			12
17	1	47	
18			30
19	1	29	
20			15
21	1	60	
22			24
23	1	21	
24			22
25	1	8	
26			13
27	1	12	
28			29
29	1	32	
30			22
31	1	17	
32			16
33	1	19	
34			21
35	1	5	
36			25
37	1	43	
38			13
39	1	6	
40			71
41	1	21	
42			16
43			166
44			33

	1	527	648	1175
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**


Tygee Creek—top of reach looking downstream (left) and upstream (right).

White Dugway Creek ID17040105SK008_02a

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	White Dugway Cr ID17040105SK008_02a		Latitude	Longitude	
Reach:	1	*Beginning:*	42.53370	111.16418	
Date Collected:	8/20/2012	*Ending:*	42.53238	111.16117	
Field Crew:	sl, hy	**Landuse and Notes:**		grazing, forest	
Data Reduced By:	dg	**Soil Type:**	silt	silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.91590114	ft
Total Inventoried Bank Length	2470.47244	ft
Inventoried Bank to Bank Length	4940.94489	ft
Erosive Bank Length	649.6063	ft
Bank to Bank Eroding Segment Length	1299.2126	ft
Percent Eroding Bank	26%	%
Eroding Area	1189.9503	ft^2
Recession Rate	0.105	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	5.62251516	tons/year/sample reach
Erosion Rate (Er)	12.0166813	tons/mile/year
Feet of similar stream type	20023	ft
Eroding Bank Extrapolation	11829.2365	ft
Total Streambank Erosion (existing load)	51.1925928	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
12.01668131	51.1925928	9.13996063	38.9373963	23.93939394

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	905.0834	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	4.276519	tons/yr/sample
Allowed Erosion Rate	9.139961	tons/mile/year
Eroding Bank Extrapolation (with reduction)	2365.847	ft
Total Streambank Erosion	38.9374	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1.5
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	2
Lateral Channel Stablity (0-3)	0.5
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	6.5
Recession Rate	**0.105**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	19.7	
2	0.0	0.0	91.9	
3	2.6	26.2	0.0	
4	0.0	0.0	144.4	
5	0.0	0.0	13.1	
6	0.7	13.1	0.0	
7	0.0	0.0	78.7	
8	0.0	0.0	52.5	
9	0.0	0.0	39.4	
10	0.7	32.8	0.0	
11	0.0	0.0	39.4	
12	0.7	6.6	0.0	
13	0.0	0.0	150.9	
14	1.3	65.6	0.0	
15	0.3	13.1	0.0	
16	1.1	59.1	0.0	
17	0.0	0.0	196.9	
18	1.0	19.7	0.0	
19	0.0	0.0	144.4	
20	1.0	19.7	0.0	
21	0.0	0.0	13.1	
22	0.3	39.4	0.0	
23	0.0	0.0	59.1	
24	0.7	13.1	0.0	
25	1.0	32.8	0.0	
26	0.3	13.1	0.0	
27	0.0	0.0	85.3	
28	0.0	0.0	39.4	
29	1.1	32.8	0.0	
30	0.0	0.0	26.2	
31	0.7	13.1	0.0	
32	0.0	0.0	111.5	
33	0.0	0.0	59.1	
34	1.0	6.6	0.0	
35	0.0	0.0	32.8	
36	1.0	78.7	0.0	
37	0.7	26.2	0.0	
38	0.0	0.0	157.5	
39	0.0	0.0	42.7	
40	1.3	19.7	0.0	
41	0.0	0.0	45.9	
42	0.7	16.4	0.0	
43	0.0	0.0	118.1	
44	1.3	6.6	0.0	
45	0.0	0.0	26.2	
46	1.0	36.1	0.0	
47	0.0	0.0	13.1	
48	0.0	0.0	19.7	
49	1.0	45.9	0.0	
50	0.7	13.1	0.0	
	0.9	**649.6**	**1820.9**	**2470.5**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			6	
2			28	
3	0.8	8		
4			44	
5			4	
6	0.2	4		
7			24	
8			16	
9			12	
10	0.2	10		
11			12	
12	0.2	2		
13			46	
14	0.4	20		
15	0.1	4		
16	0.35	18		
17			60	
18	0.3	6		
19			44	
20	0.3	6		
21			4	
22	0.1	12		
23			18	
24	0.2	4		
25	0.3	10		
26	0.1	4		
27			26	
28			12	
29	0.35	10		
30			8	
31	0.2	4		
32			34	
33			18	
34	0.3	2		
35			10	
36	0.3	24		
37	0.2	8		
38			48	
39			13	
40	0.4	6		
41			14	
42	0.2	5		
43			36	
44	0.4	2		
45			8	
46	0.3	11		
47			4	
48			6	
49	0.3	14		
50	0.2	4		
	0.279166667	**198**	**555**	**753**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

White Dugway Creek—bottom of reach looking downstream (left) and upstream (right).

White Dugway Creek—examples of unstable and trampled streambanks.

Beaver Dam Creek ID17040105SK008_02c

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)		Elevation (ft)
Stream:	Beaver Dam Cr ID17040105SK008_02c			Latitude	Longitude
Reach:		1	*Beginning:*	42.50011	111.17606
Date Collected:		8/13/2012	*Ending:*	42.49945	111.17211
Field Crew:	sl, hy, lb		Landuse and Notes:		grazing, forest
Data Reduced By:	dg		Soil Type:	silt	silt

Streambank Erosion Calculations

Average Erosive Bank Height	0.57209646	ft
Total Inventoried Bank Length	2001.31234	ft
Inventoried Bank to Bank Length	4002.62468	ft
Erosive Bank Length	1653.54331	ft
Bank to Bank Eroding Segment Length	3307.08662	ft
Percent Eroding Bank	83%	%
Eroding Area	1891.97254	ft^2
Recession Rate	0.075	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	6.38540731	tons/year/sample reach
Erosion Rate (Er)	16.8464212	tons/mile/year
Feet of similar stream type	20122	ft
Eroding Bank Extrapolation	36557.8669	ft
Total Streambank Erosion (existing load)	70.5868632	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
16.8464212	70.5868632	4.077903543	17.0865026	75.79365079

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	457.9775	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	1.545674	tons/yr/sample
Allowed Erosion Rate	4.077904	tons/mile/year
Eroding Bank Extrapolation (with reduction)	7311.573	ft
Total Streambank Erosion	17.0865	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	2.5
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1.5
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	5.5
Recession Rate	**0.075**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.7	6.6	0.0	
2	0.0	0.0	6.6	
3	0.7	32.8	0.0	
4	0.8	32.8	0.0	
5	1.0	26.2	0.0	
6	0.0	0.0	6.6	
7	0.0	0.0	6.6	
8	1.0	13.1	0.0	
9	0.5	65.6	0.0	
10	0.0	0.0	23.0	
11	0.5	39.4	0.0	
12	0.5	26.2	0.0	
13	0.0	0.0	39.4	
14	0.3	19.7	0.0	
15	0.7	39.4	0.0	
16	0.0	0.0	16.4	
17	0.8	39.4	0.0	
18	0.0	0.0	13.1	
19	0.7	26.2	0.0	
20	0.7	13.1	0.0	
21	0.0	0.0	19.7	
22	0.2	65.6	0.0	
23	0.2	19.7	0.0	
24	0.0	0.0	13.1	
25	0.0	0.0	32.8	
26	0.0	0.0	26.2	
27	0.0	0.0	59.1	
28	0.5	26.2	0.0	
29	0.0	0.0	6.6	
30	0.2	45.9	0.0	
31	0.0	0.0	19.7	
32	0.2	19.7	0.0	
33	0.0	0.0	13.1	
34	0.0	0.0	6.6	
35	0.2	45.9	0.0	
36	0.0	0.0	6.6	
37	0.5	52.5	0.0	
38	0.0	0.0	6.6	
39	0.7	196.9	0.0	
40	1.3	85.3	0.0	
41	1.0	98.4	0.0	
42	0.0	0.0	19.7	
43	1.0	59.1	0.0	
44	0.7	45.9	0.0	
45	0.8	111.5	0.0	
46	0.5	45.9	0.0	
47	0.0	0.0	6.6	
48	0.7	98.4	0.0	
49	0.2	59.1	0.0	
50	0.7	118.1	0.0	
51	0.3	26.2	0.0	
52	0.2	52.5	0.0	
	0.6	1653.5	347.8	2001.3
	Ave Bank Ht	Total Erosive	Total Stable	Total Bank Length

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.2	2		
2			2	
3	0.2	10		
4	0.23	10		
5	0.3	8		
6			2	
7			2	
8	0.3	4		
9	0.15	20		
10			7	
11	0.15	12		
12	0.15	8		
13			12	
14	0.1	6		
15	0.2	12		
16			5	
17	0.25	12		
18			4	
19	0.2	8		
20	0.2	4		
21			6	
22	0.05	20		
23	0.05	6		
24			4	
25			10	
26			8	
27			18	
28	0.15	8		
29			2	
30	0.05	14		
31			6	
32	0.05	6		
33			4	
34			2	
35	0.05	14		
36			2	
37	0.15	16		
38			2	
39	0.2	60		
40	0.4	26		
41	0.3	30		
42			6	
43	0.3	18		
44	0.2	14		
45	0.25	34		
46	0.15	14		
47			2	
48	0.2	30		
49	0.05	18		
50	0.2	36		
51	0.1	8		
52	0.05	16		
	0.174375	504	106	610
	Ave Bank Ht	Total Erosive	Total Stable	Total Bank Length

Beaver Dam Creek—bottom of reach looking downstream (left) and upstream (right).

Crow Creek ID17040105SK008_04

STREAMBANK EROSION INVENTORY CALCULATION WORKSHEET

Stream:	Crow Creek	Stream Segment Location (DD)	
Assessment Unit:	17040105SK008_04	*Upstream N*	42.585400
egment Inventoried:	1	*W*	-111.132510
Total Reach:	5330 ft	*Downstream N*	42.594520
Date Collected:	27-Aug-14	*W*	-111.126570
Field Crew:	Andrew Kirsch, Hannah Harris	Notes:	exclosure fence, intact riparian, stream restoration project in lower section of reach
Data Reduced By:	Hannah Harris		

Current Load Streambank Erosion Calculations		Unit	Area Applied
Right, left or both bank measurements	1	Single Bank	Inventoried Segment
ventory/Thalweg Length (LBB) (stream flowpath distance)	5330.00	ft	Inventoried Segment
TMDL Margin of Safety	10	%	Total Reach
Bulk Density (BD)	85	lb/ft^3	Total Reach
Length of Similar Stream	52325	ft	Total Reach
Estimated Distance inventoried	5330.00	ft	"
Total Erosive Bank Length	1088.96	ft	"
Percent Erosive Bank	20.4	%	"
Eroding Area (AE)	6046.58	ft^2	"
Lateral Recession Rate (RLR)	0.0425		"
Bank Erosion (E)	10.92	tons/year	"
Total Bank Erosion Rate (ER)	10.82	tons/mile/year	Reach and Segment
Total Bank Erosion	107.22	tons/year	"

Recession Rate Calculations

Factor	Field Stability Score	Erosion Severity Reduction
Bank Erosion Evidence (0 to 3)	1	0.5
Bank Stability Condition (0 to 3)	0.5	0.5
Bank Cover/Vegetation(0 to 3)	1	0.5
Lateral Channel Stability (0 to 3)	0.5	0.5
Channel Bottom Stability (0 to 2)	0.5	0.5
In-Channel Deposition (-1 to 1)	-0.25	0.5
Total = Slight (0-4); Moderate (4-8); Severe (>8)	3.25	3
Lateral Recession Rate (RLR) (ft/yr)	**0.0425**	**0.04**

oad Capacity Streambank Erosion Calculations for Total Reac		Unit	Area Applied
Eroding Area at Load Capacity (AE)	5919.09	ft^2	Inventoried Segment
Bank Erosion at Load Capacity (E)	10.06	tons/year	"
Total Bank Erosion Rate at Load Capacity (ER)	9.97	tons/mile/year	Reach and Segment
Total Bank Erosion at Load Capacity for Reach	98.78	tons/year	Total Reach

Summary of Loads

Current Load		Load Capacity			
Total Bank Erosion Rate (tons/mile/yr)	Total Bank Erosion (tons/yr)	Total Bank Erosion Rate (tons/mile/yr)	Total Bank Erosion (tons/yr)	Load Reduction Required?	Margin of Safety (tons/yr)
10.8	**107.2**	**10.0**	**98.8**	**YES**	**11**

Percent Erosion Reduction (%)	**16**
Total Erosion Reduction (tons/yr)	**19**

Crow Creek—examples of bank conditions within reach surveyed.

Sage Creek ID17040105SK009_02c

STREAMBANK EROSION INVENTORY CALCULATION WORKSHEET

Stream:	Sage Creek	Stream Segment Location (DD)	
Assessment Unit:	17040105SK009_02c	*Upstream N*	42.654960
ɛgment Inventoried:	1	*W*	-111.110710
Total Reach:	2086 ft	*Downstream N*	42.652610
Date Collected:	10-Oct-14	*W*	-111.107150
Field Crew:	Jenny Cornell, Hannah Harris	Notes:	in pasture, mining above, no willows, very little shade
Data Reduced By:	Hannah Harris		

Current Load Streambank Erosion Calculations		Unit	Area Applied
Right, left or both bank measurements	1	Single Bank	Inventoried Segment
ıventory/Thalweg Length (LBB) (stream flowpath distance)	2086.00	ft	Inventoried Segment
TMDL Margin of Safety	10	%	Total Reach
Bulk Density (BD)	85	lb/ft^3	Total Reach
Length of Similar Stream	9557	ft	Total Reach
Estimated Distance inventoried	2086.00	ft	"
Total Erosive Bank Length	85.28	ft	"
Percent Erosive Bank	4.1	%	"
Eroding Area (AE)	253.90	ft^2	"
Lateral Recession Rate (RLR)	0.0225		"
Bank Erosion (E)	0.24	tons/year	"
Total Bank Erosion Rate (ER)	0.61	tons/mile/year	Reach and Segment
Total Bank Erosion	1.11	tons/year	"

Recession Rate Calculations

Factor	Field Stability Score	Erosion Severity Reduction
Bank Erosion Evidence (0 to 3)	0.25	1.5
Bank Stability Condition (0 to 3)	0.25	1.5
Bank Cover/Vegetation(0 to 3)	0.5	1.5
Lateral Channel Stability (0 to 3)	0	1.5
Channel Bottom Stability (0 to 2)	0.25	1
In-Channel Deposition (-1 to 1)	0	1
Total = Slight (0-4); Moderate (4-8); Severe (>8)	1.25	8
Lateral Recession Rate (RLR) (ft/yr)	**0.0225**	**0.15**

ɔad Capacity Streambank Erosion Calculations for Total Reac		Unit	Area Applied
Eroding Area at Load Capacity (AE)	1242.10	ft^2	Inventoried Segment
Bank Erosion at Load Capacity (E)	7.92	tons/year	"
Total Bank Erosion Rate at Load Capacity (ER)	20.04	tons/mile/year	Reach and Segment
Total Bank Erosion at Load Capacity for Reach	36.28	tons/year	Total Reach

Summary of Loads

Current Load		Load Capacity			
Total Bank Erosion Rate (tons/mile/yr)	Total Bank Erosion (tons/yr)	Total Bank Erosion Rate (tons/mile/yr)	Total Bank Erosion (tons/yr)	Load Reduction Required?	Margin of Safety (tons/yr)
0.6	**1.1**	**20.0**	**36.3**	**No**	**0**

Percent Erosion Reduction (%)	**-3161**
Total Erosion Reduction (tons/yr)	**-35**


Sage Creek—examples of bank stability conditions within reach surveyed.

South Fork Sage Creek ID17040105SK009_02e

STREAMBANK EROSION INVENTORY CALCULATION WORKSHEET

Stream:	South Fork Sage Creek	Stream Segment Location (DD)	
Assessment Unit:	17040105SK009_02e	Upstream N	42.632610
gment Inventoried:	1	W	-111.109650
Total Reach:	2099 ft	Downstream N	42.629330
Date Collected:	1-Oct-14	W	-111.107420
Field Crew:	Jenny Cornell, Hannah Harris	Notes:	stream drains mine and is in a pasture that was not grazed this year. Long grass and sedges. Lots of fish observed. Top of reach riffle
Data Reduced By:	Hannah Harris		

Current Load Streambank Erosion Calculations		Unit	Area Applied
Right, left or both bank measurements	1	Single Bank	Inventoried Segment
ventory/Thalweg Length (LBB) (stream flowpath distance)	2099.00	ft	Inventoried Segment
TMDL Margin of Safety	10	%	Total Reach
Bulk Density (BD)	85	lb/ft^3	Total Reach
Length of Similar Stream	24182	ft	Total Reach
Estimated Distance inventoried	2099.00	ft	"
Total Erosive Bank Length	350.96	ft	"
Percent Erosive Bank	16.7	%	"
Eroding Area (AE)	1320.77	ft^2	"
Lateral Recession Rate (RLR)	0.035		"
Bank Erosion (E)	1.96	tons/year	"
Total Bank Erosion Rate (ER)	4.94	tons/mile/year	Reach and Segment
Total Bank Erosion	22.63	tons/year	"

Recession Rate Calculations

Factor	Field Stability Score	Erosion Severity Reduction
Bank Erosion Evidence (0 to 3)	0.5	1.5
Bank Stability Condition (0 to 3)	0.25	1.5
Bank Cover/Vegetation(0 to 3)	0.75	1.5
Lateral Channel Stability (0 to 3)	1	1.5
Channel Bottom Stability (0 to 2)	0.25	1
In-Channel Deposition (-1 to 1)	-0.25	1
Total = Slight (0-4); Moderate (4-8); Severe (>8)	2.5	8
Lateral Recession Rate (RLR) (ft/yr)	**0.035**	**0.15**

oad Capacity Streambank Erosion Calculations for Total Reac		Unit	Area Applied
Eroding Area at Load Capacity (AE)	1579.84	ft^2	Inventoried Segment
Bank Erosion at Load Capacity (E)	10.07	tons/year	"
Total Bank Erosion Rate at Load Capacity (ER)	25.33	tons/mile/year	Reach and Segment
Total Bank Erosion at Load Capacity for Reach	116.03	tons/year	Total Reach

Summary of Loads

Current Load		Load Capacity			
Total Bank Erosion Rate (tons/mile/yr)	Total Bank Erosion (tons/yr)	Total Bank Erosion Rate (tons/mile/yr)	Total Bank Erosion (tons/yr)	Load Reduction Required?	Margin of Safety (tons/yr)
4.9	**22.6**	**25.3**	**116.0**	**No**	**0**

Percent Erosion Reduction (%)	**-413**
Total Erosion Reduction (tons/yr)	**-93**

South Fork Sage Creek—examples of bank stability conditions within reach surveyed.

South Fork Deer Creek ID17040105SK010_02a

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	SF Deer Creek ID17040105SK010_02a		Latitude	Longitude	
Reach:	1	*Beginning:*	42.58806	111.22047	
Date Collected:	8/13/2012	*Ending:*	42.58736	111.21492	
Field Crew:	sl, hy, lb	**Landuse and Notes:**		Forest, road	
Data Reduced By:	dg	**Soil Type:**	silt	silt	

Streambank Erosion Calculations

Average Erosive Bank Height	1.12778871	ft
Total Inventoried Bank Length	1778.21523	ft
Inventoried Bank to Bank Length	3556.43045	ft
Erosive Bank Length	32.808399	ft
Bank to Bank Eroding Segment Length	65.616798	ft
Percent Eroding Bank	2%	%
Eroding Area	74.0018842	ft^2
Recession Rate	0.015	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.04995127	tons/year/sample reach
Erosion Rate (Er)	0.14831878	tons/mile/year
Feet of similar stream type	14009	ft
Eroding Bank Extrapolation	582.554067	ft
Total Streambank Erosion (existing load)	0.44347358	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.148318781	0.44347358	0.148318781	0.44347358	0

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	802.1804	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.541472	tons/yr/sample
Allowed Erosion Rate	1.607776	tons/mile/year
Eroding Bank Extrapolation (with reduction)	116.5108	ft
Total Streambank Erosion	4.807254	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0.5
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	0.5
Recession Rate	**0.015**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	13.1	
2	0.3	6.6	0.0	
3	0.0	0.0	32.8	
4	0.0	0.0	13.1	
5	0.0	0.0	59.1	
6	0.0	0.0	26.2	
7	0.0	0.0	23.0	
8	0.0	0.0	26.2	
9	0.0	0.0	9.8	
10	0.0	0.0	85.3	
11	0.0	0.0	13.1	
12	0.0	0.0	101.7	
13	1.5	6.6	0.0	
14	0.0	0.0	39.4	
15	0.0	0.0	9.8	
16	0.0	0.0	13.1	
17	0.7	3.3	0.0	
18	0.0	0.0	13.1	
19	0.0	0.0	13.1	
20	0.0	0.0	23.0	
21	0.0	0.0	32.8	
22	0.0	0.0	29.5	
23	0.0	0.0	13.1	
24	0.0	0.0	160.8	
25	0.3	3.3	0.0	
26	0.0	0.0	52.5	
27	1.3	3.3	0.0	
28	0.0	0.0	42.7	
29	1.3	3.3	0.0	
30	0.0	0.0	52.5	
31	1.1	3.3	0.0	
32	0.0	0.0	26.2	
33	2.5	3.3	0.0	
34	0.0	0.0	255.9	
35	0.0	0.0	380.6	
36	0.0	0.0	98.4	
37	0.0	0.0	85.3	
	1.1	**32.8**	**1745.4**	**1778.2**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			4	
2	0.1	2		
3			10	
4			4	
5			18	
6			8	
7			7	
8			8	
9			3	
10			26	
11			4	
12			31	
13	0.45	2		
14			12	
15			3	
16			4	
17	0.2	1		
18			4	
19			4	
20			7	
21			10	
22			9	
23			4	
24			49	
25	0.1	1		
26			16	
27	0.4	1		
28			13	
29	0.4	1		
30			16	
31	0.35	1		
32			8	
33	0.75	1		
34			78	
35			116	
36			30	
37			26	
	0.34375	**10**	**532**	**542**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

South Fork Deer Creek—bottom of reach looking downstream (left) and upstream (right).

Rock Creek ID17040105SK011_03

STREAMBANK EROSION INVENTORY CALCULATION WORKSHEET

Stream:	Rock Creek	Stream Segment Location (DD)	
Assessment Unit:	17040105SK011_03	*Upstream N*	
gment Inventoried:	1	*W*	
Total Reach:	3011 ft	*Downstream N*	42.615070
Date Collected:	17-Oct-14	*W*	111.084070
Field Crew:	Greg Mladenka, Hannah Harris	Notes:	segment downstream of fence. Riparian more intact than above although still grazing impacts
Data Reduced By:	Hannah Harris		

Current Load Streambank Erosion Calculations		Unit	Area Applied
Right, left or both bank measurements	1	Single Bank	Inventoried Segment
ventory/Thalweg Length (LBB) (stream flowpath distance)	3011.00	ft	Inventoried Segment
TMDL Margin of Safety	10	%	Total Reach
Bulk Density (BD)	85	lb/ft^3	Total Reach
Length of Similar Stream	18216	ft	Total Reach
Estimated Distance inventoried	3011.00	ft	"
Total Erosive Bank Length	488.72	ft	"
Percent Erosive Bank	16.2	%	"
Eroding Area (AE)	3389.33	ft^2	"
Lateral Recession Rate (RLR)	0.05		"
Bank Erosion (E)	7.20	tons/year	"
Total Bank Erosion Rate (ER)	12.63	tons/mile/year	Reach and Segment
Total Bank Erosion	43.57	tons/year	"

Recession Rate Calculations

Factor	Field Stability Score	Erosion Severity Reduction
Bank Erosion Evidence (0 to 3)	1	1.5
Bank Stability Condition (0 to 3)	0.5	1.5
Bank Cover/Vegetation(0 to 3)	0.5	1.5
Lateral Channel Stability (0 to 3)	0.5	1.5
Channel Bottom Stability (0 to 2)	1	1
In-Channel Deposition (-1 to 1)	0.5	1
Total = Slight (0-4); Moderate (4-8); Severe (>8)	4	8
Lateral Recession Rate (RLR) (ft/yr)	0.05	0.15

oad Capacity Streambank Erosion Calculations for Total Reac		Unit	Area Applied
Eroding Area at Load Capacity (AE)	4176.32	ft^2	Inventoried Segment
Bank Erosion at Load Capacity (E)	26.62	tons/year	"
Total Bank Erosion Rate at Load Capacity (ER)	46.69	tons/mile/year	Reach and Segment
Total Bank Erosion at Load Capacity for Reach	161.07	tons/year	Total Reach

Summary of Loads

Current Load		Load Capacity			
Total Bank Erosion Rate (tons/mile/yr)	Total Bank Erosion (tons/yr)	Total Bank Erosion Rate (tons/mile/yr)	Total Bank Erosion (tons/yr)	Load Reduction Required?	Margin of Safety (tons/yr)
12.6	43.6	46.7	161.1	No	0

Percent Erosion Reduction (%)	-270
Total Erosion Reduction (tons/yr)	-117

STREAMBANK EROSION INVENTORY CALCULATION WORKSHEET

		Stream Segment Location (DD)	
Stream:	Rock Creek		
Assessment Unit:	17040105SK011_03	*Upstream N*	42.611300
Segment Inventoried:	2	*W*	-111.080850
Total Reach:	249 ft	*Downstream N*	
Date Collected:	17-Oct-14	*W*	
Field Crew:	Greg Mladenka, Hannah Harris	Notes:	Upstream of fence on Forest Service land. Heavily impacted by grazing, overwidened and trampled.
Data Reduced By:	Hannah Harris		

Current Load Streambank Erosion Calculations		Unit	Area Applied
Right, left or both bank measurements	1	Single Bank	Inventoried Segment
Inventory/Thalweg Length (LBB) (stream flowpath distance)	249.00	ft	Inventoried Segment
TMDL Margin of Safety	10	%	Total Reach
Bulk Density (BD)	85	lb/ft^3	Total Reach
Length of Similar Stream	18216	ft	Total Reach
Estimated Distance inventoried	249.00	ft	"
Total Erosive Bank Length	121.36	ft	"
Percent Erosive Bank	48.7	%	"
Eroding Area (AE)	464.76	ft^2	"
Lateral Recession Rate (RLR)	0.155		"
Bank Erosion (E)	3.06	tons/year	"
Total Bank Erosion Rate (ER)	64.92	tons/mile/year	Reach and Segment
Total Bank Erosion	223.98	tons/year	"

Recession Rate Calculations		
Factor	**Field Stability Score**	**Erosion Severity Reduction**
Bank Erosion Evidence (0 to 3)	2.5	1.5
Bank Stability Condition (0 to 3)	2	1.5
Bank Cover/Vegetation(0 to 3)	2	1.5
Lateral Channel Stability (0 to 3)	0.5	1.5
Channel Bottom Stability (0 to 2)	0.5	1
In-Channel Deposition (-1 to 1)	1	1
Total = Slight (0-4); Moderate (4-8); Severe (>8)	8.5	8
Lateral Recession Rate (RLR) (ft/yr)	**0.155**	**0.15**

Load Capacity Streambank Erosion Calculations for Total Reach		Unit	Area Applied
Eroding Area at Load Capacity (AE)	190.72	ft^2	Inventoried Segment
Bank Erosion at Load Capacity (E)	1.22	tons/year	"
Total Bank Erosion Rate at Load Capacity (ER)	25.78	tons/mile/year	Reach and Segment
Total Bank Erosion at Load Capacity for Reach	88.94	tons/year	Total Reach

Summary of Loads					
Current Load		**Load Capacity**			
Total Bank Erosion Rate (tons/mile/yr)	Total Bank Erosion (tons/yr)	Total Bank Erosion Rate (tons/mile/yr)	Total Bank Erosion (tons/yr)	Load Reduction Required?	Margin of Safety (tons/yr)
64.9	**224.0**	**25.8**	**88.9**	**YES**	**22**

Percent Erosion Reduction (%)	**64**
Total Erosion Reduction (tons/yr)	**157**

Rock Creek—examples of bank stability conditions in reach 1.

Rock Creek—examples of bank stability in reach 2.

Little Elk Creek ID17040105SK012_02a

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)			Elevation (ft)
Stream:	Little Elk Cr ID17040105SK012_02a			Latitude	Longitude	
Reach:		1	*Beginning:*	42.51797	111.08869	
Date Collected:		8/20/2012	*Ending:*	42.51549	111.08904	
Field Crew:	sl, hy		Landuse and Notes:		grazing, forest	
Data Reduced By:	dg		Soil Type:	silt	silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.71315099	ft
Total Inventoried Bank Length	2142.38845	ft
Inventoried Bank to Bank Length	4284.77691	ft
Erosive Bank Length	774.278216	ft
Bank to Bank Eroding Segment Length	1548.55643	ft
Percent Eroding Bank	36%	%
Eroding Area	1104.35455	ft^2
Recession Rate	0.06	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	2.98175728	tons/year/sample reach
Erosion Rate (Er)	7.34865725	tons/mile/year
Feet of similar stream type	17922	ft
Eroding Bank Extrapolation	14502.8964	ft
Total Streambank Erosion (existing load)	27.9254382	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
7.348657254	27.9254382	4.066672192	15.4536535	44.66101695

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	611.1386	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	1.650074	tons/yr/sample
Allowed Erosion Rate	4.066672	tons/mile/year
Eroding Bank Extrapolation (with reduction)	2900.579	ft
Total Streambank Erosion	15.45365	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1.5
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0.5
Channel Bottom Stability (0-3)	0.5
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	5
Recession Rate	**0.06**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	19.7	
2	0.7	13.1	0.0	
3	0.0	0.0	101.7	
4	0.5	19.7	0.0	
5	0.0	0.0	26.2	
6	0.7	13.1	0.0	
7	0.0	0.0	170.6	
8	0.7	26.2	0.0	
9	0.0	0.0	210.0	
10	0.8	6.6	0.0	
11	0.0	0.0	72.2	
12	1.0	26.2	0.0	
13	0.0	0.0	144.4	
14	0.0	0.0	52.5	
15	0.7	39.4	0.0	
16	0.7	137.8	0.0	
17	0.0	0.0	19.7	
18	0.0	0.0	111.5	
19	0.0	0.0	59.1	
20	0.0	0.0	39.4	
21	2.0	111.5	0.0	
22	0.4	91.9	0.0	
23	0.0	0.0	26.2	
24	1.3	52.5	0.0	
25	0.0	0.0	32.8	
26	0.7	13.1	0.0	
27	0.0	0.0	65.6	
28	0.5	52.5	0.0	
29	0.0	0.0	32.8	
30	0.7	13.1	0.0	
31	0.0	0.0	45.9	
32	0.7	39.4	0.0	
33	0.3	26.2	0.0	
34	0.0	0.0	26.2	
35	0.0	0.0	39.4	
36	0.0	0.0	52.5	
37	0.7	45.9	0.0	
38	0.5	19.7	0.0	
39	0.0	0.0	19.7	
40	0.3	26.2	0.0	
	0.7	774.3	1368.1	2142.4
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			6	
2	0.2	4		
3			31	
4	0.15	6		
5			8	
6	0.2	4		
7			52	
8	0.2	8		
9			64	
10	0.25	2		
11			22	
12	0.3	8		
13			44	
14			16	
15	0.2	12		
16	0.2	42		
17			6	
18			34	
19			18	
20			12	
21	0.6	34		
22	0.13	28		
23			8	
24	0.4	16		
25			10	
26	0.2	4		
27			20	
28	0.15	16		
29			10	
30	0.2	4		
31			14	
32	0.2	12		
33	0.1	8		
34			8	
35			12	
36			16	
37	0.2	14		
38	0.15	6		
39			6	
40	0.1	8		
	0.217368421	236	417	653
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**


Little Elk Creek—bottom of reach looking downstream (left) and upstream (right).


Little Elk Creek—examples of trampled (left) and slumping (right) banks.

Appendix C. **McNeil Core Sampling Data**

8/28/2014

Tincup Creek ID17040105SK003_02

Andrew Kirsch and Hannah Harris visited Tincup Creek to complete sediment cores. Meadow floodplain in upper reach with beaver activity (dams, lodges). Trampled by cows. Many cutthroat observed. Pools filled with fine sediment, algae, and macrophytes. Meadow drains to steep step-pool mountain stream with predominately large cobbles and boulders that are highly embedded with fine sediments. No spawning habitat within SEI reach. Meadow influenced by beaver and in step-pool area sediments are too large for trout spawning. Bald eagle observed. Spruce, Douglas fir forest with riparian of dogwood and willow (especially willow in meadow). Area below SEI reach also contains no spawning habitat. Substrate is too large and blocky for salmonids to move.


Representative photos of Tincup Creek ID17040105SK003_02

8/3/2014

Haderlie Creek ID17040105SK003_02j

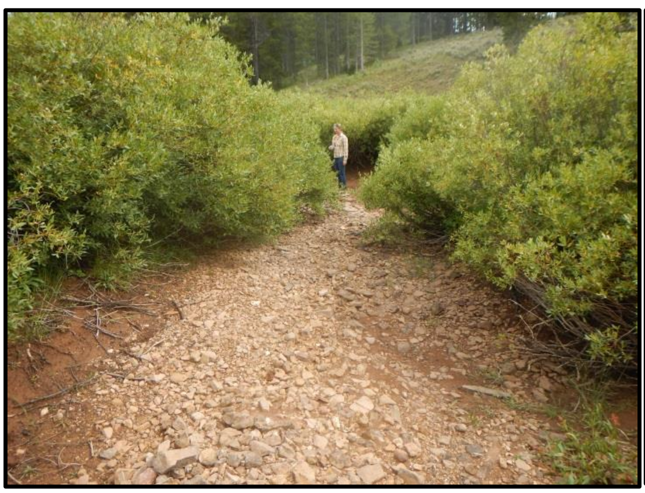
Aubree Thomas and Andrew Kirsch visited Haderlie Creek to complete sediment cores. No salmonid spawning habitat was observed on the Forest land where the SEI was completed. Water was low and fine sediments were abundant.


Representative photos of Haderlie Creek ID17040105SK003_02j

8/26/2014

Upper Boulder Creek ID17040105SK006_02c

Andrew Kirsch and Hannah Harris visited Upper Boulder Creek to complete McNeil sediment cores. No spawning habitat because creek is dry except for some small low spots. Lots of willows surrounding a large dry channel. Red soil.




Representative photos of Upper Boulder Creek ID17040105SK006_02c

8/4/2012

Lower Stump Creek ID17040105SK006_04

Stream:	Lower Stump Creek					
Date (mm/dd/yyyy):	8/4/2014					
Site Description:	SK006_04					
Lat/Lon Core 1:	42.79354 N -111.07595 W					
Lat/Lon Core 2:	42.79355 N -111.07595 W					
Lat/Lon Core 3:	42.79318 N -111.07573 W					
Samping Event ID						
Personnel:	Aubree Thomas, Andrew Kirsch					
Rosgen Channel:	C		beaver dam at bridge, lots of fish			
Habitat Unit	pool tailout					
Reach Gradient (%):	2-4%					
Geology (Q, G, V, or S):	S					
Target Species:	cutthroat					
Flow (cfs):						
Surrounding Land Use:	recreation, grazing					
Sample number		1	2	3		
Ocular est. % surface fines						
Sieve size		(mL)	(mL)	(mL)		
63 mm (2.5")		0	0	0		
25 mm (1.0")		270	1870	930		
12.5 mm (0.5")		1090	2400	1780		
6.34 mm (0.25")		1390	670	1350		
1.0 - 0.25" Subtotal		2750	4940	4060		
4.75 mm (0.187")		430	100	320		
2.36 mm (0.0937")		1110	285	790		
850 µm (0.0331")		1490	245	1630		
212 µm (0.0083")		1390	310	800		
106 µm (0.0041")		35	20	40		
75 µm (0.0029")		30	5	20		
53 µm (0.0021")						
Bottom pan (< 53 µm)						
< 6.25 mm Subtotal		4485	965	3600		
Sample total w/o 2.5" particles		7235	5905	7660	Mean	STDDEV
% fines <6.25 mm w/o 2.5" particles		0.619903248	0.16342083	0.46997389	**0.41777**	**0.18998**
Sample total w/ 2.5" particles		7235	5905	7660	Mean	STDDEV
% fines <6.25 mm w/ 2.5" particles		0.619903248	0.16342083	0.46997389	0.41777	0.18998
< 0.85 mm Subtotal		1455	335	860	Mean	STDEV
% fines <0.85 mm w/o 2.5" particles		0.201105736	0.056731583	0.11227154	**0.12337**	**0.07282**
% fines <0.85 mm w/ 2.5" particles		0.201105736	0.056731583	0.11227154	0.12337	0.07282

8/26/2014

Smoky Creek ID17040105SK007_02c

Andrew Kirsch and Hannah Harris visited Smoky Creek to complete sediment cores. In upper reach, beaver complex with lots of side channels. In lower reach, riffle dominated but not enough water for spawning. No pools. Lots of muddy banks and cow trails and trampling. Lost my sandal in the muck. No spawning habitat. Area is near Smoky Canyon Mine. Can see mountain top removed upstream.

Representative photos of Smoky Creek ID17040105SK007_02c

8/14/2012

Draney Creek ID17040105SK007_02f

Stream:	Draney Creek					
Date (mm/dd/yyyy):	8/14/2012					
Site Description:	SK007_02f					
Lat/Lon Core 1:						
Lat/Lon Core 2:						
Lat/Lon Core 3:						
Samping Event ID						
Personnel:	Greg Mladenka, Shannon Lance					
Rosgen Channel:						
Habitat Unit						
Reach Gradient (%):						
Geology (Q, G, V, or S):						
Target Species:						
Flow (cfs):						
Surrounding Land Use:						
Sample number	1	2	3			
Ocular est. % surface fines						
Sieve size	(mL)	(mL)	(mL)			
63 mm (2.5")						
25 mm (1.0")	115	100	600			
12.5 mm (0.5")	1020	700	910			
6.34 mm (0.25")	1020	930	780			
1.0 - 0.25" Subtotal	2155	1730	2290			
4.75 mm (0.187")	340	320	220			
2.36 mm (0.0937")	840	890	725			
850 µm (0.0331")	830	1040	1440			
212 µm (0.0083")	710	1260	920			
106 µm (0.0041")	110	80	115			
75 µm (0.0029")	40	20	160			
53 µm (0.0021")	2	40	250			
Bottom pan (< 53 µm)						
< 6.25 mm Subtotal	2872	3650	3830			
Sample total w/o 2.5" particles	5027	5380	6120	Mean	STDDEV	
% fines <6.25 mm w/o 2.5" particles	0.5713149	0.678438662	0.625816993	**0.62519**	**0.04374**	
Sample total w/ 2.5" particles	5027	5380	6120	Mean	STDDEV	
% fines <6.25 mm w/ 2.5" particles	0.5713149	0.678438662	0.625816993	0.62519	0.04374	
< 0.85 mm Subtotal	862	1400	1445	Mean	STDEV	
% fines <0.85 mm w/o 2.5" particles	0.17147404	0.260223048	0.236111111	0.2226	0.04589	
% fines <0.85 mm w/ 2.5" particles	0.17147404	0.260223048	0.236111111	**0.2226**	**0.04589**	

8/5/2014

White Dugway Creek ID17040105SK008_02a

Stream:	White Dugway Creek					
Date (mm/dd/yyyy):	8/5/2014					
Site Description:	SK008_02a, 0.38 miles east of Crow Canyon Road					
Lat/Lon Core 1:	42.5339 N -111.16431 W					
Lat/Lon Core 2:	42.53307 N -111.16361 W					
Lat/Lon Core 3:	42.53319 N -111.16360 W					
Samping Event ID						
Personnel:	Andrew Kirsch, Aubree Thomas					
Rosgen Channel:	G/E					
Habitat Unit	pool tail-out					
Reach Gradient (%):	2-4%					
Geology (Q, G, V, or S):	sedimentary					
Target Species:	cutthroat					
Flow (cfs):						
Surrounding Land Use:	grazing cattle					
Sample number		1	2	3		
Ocular est. % surface fines						
Sieve size		(mL)	(mL)	(mL)		
63 mm (2.5")		0	1265	880		
25 mm (1.0")		300	1625	2400		
12.5 mm (0.5")		720	695	560		
6.34 mm (0.25")		830	760	670		
1.0 - 0.25" Subtotal		1850	3080	3630		
4.75 mm (0.187")		230	345	260		
2.36 mm (0.0937")		450	560	545		
850 µm (0.0331")		490	375	540		
212 µm (0.0083")		1670	420	640		
106 µm (0.0041")		110	30	85		
75 µm (0.0029")		140	10	10		
53 µm (0.0021")						
Bottom pan (< 53 µm)						
< 6.25 mm Subtotal		3090	1740	2080		
Sample total w/o 2.5" particles		4940	4820	5710	Mean	STDDEV
% fines <6.25 mm w/o 2.5" particles		0.625506073	0.360995851	0.364273205	**0.45026**	**0.12393**
Sample total w/ 2.5" particles		4940	6085	6590	Mean	STDDEV
% fines <6.25 mm w/ 2.5" particles		0.625506073	0.285949055	0.315629742	0.40903	0.15355
< 0.85 mm Subtotal		1920	460	735	Mean	STDEV
% fines <0.85 mm w/o 2.5" particles		0.388663968	0.095435685	0.128721541	**0.20427**	**0.16055**
% fines <0.85 mm w/ 2.5" particles		0.388663968	0.075595727	0.111532625	0.19193	0.17132

8/5/2014

Beaver Dam Creek ID17040105SK008_02c

Aubree Thomas and Andrew Kirsch visited Beaver Dam Creek and observed no salmonid spawning habitat. Water was low and banks were highly trampled. Stream bottom was largely covered in fines.

Representative photos of Beaver Dam Creek ID17040105SK008_02c

8/27/2014

Crow Creek ID17040105SK008_04

Stream:	Crow Creek					
Date (mm/dd/yyyy):	8/27/2014					
Site Description:	SK008_04					
Lat/Lon Core 1:	42.59189 N -111.12914 W					
Lat/Lon Core 2:	42.5916 N -111.12914 W					
Lat/Lon Core 3:	42.59270 N -111.12880 W					
Samping Event ID						
Personnel:	Andrew Kirsch, Hannah Harris					
Rosgen Channel:	B/C					
Habitat Unit	riffle, pool tailout					
Reach Gradient (%):						
Geology (Q, G, V, or S):	S					
Target Species:	cutthroat					
Flow (cfs):						
Surrounding Land Use:	recreation, grazing but reach in exclosure fence					
Sample number		1	2	3		
Ocular est. % surface fines						
Sieve size		(mL)	(mL)	(mL)		
63 mm (2.5")		440	1015	800		
25 mm (1.0")		1980	1810	1780		
12.5 mm (0.5")		880	840	1200		
6.34 mm (0.25")		840	720	880		
1.0 - 0.25" Subtotal		3700	3370	3860		
4.75 mm (0.187")		260	270	350		
2.36 mm (0.0937")		820	495	500		
850 µm (0.0331")		850	380	740		
212 µm (0.0083")		790	380	900		
106 µm (0.0041")		130	60	50		
75 µm (0.0029")		15	5	5		
53 µm (0.0021")						
Bottom pan (< 53 µm)						
< 6.25 mm Subtotal		2865	1590	2545		
Sample total w/o 2.5" particles		6565	4960	6405	Mean	STDDEV
% fines <6.25 mm w/o 2.5" particles		0.436405179	0.320564516	0.397345824	**0.38477**	**0.04812**
Sample total w/ 2.5" particles		7005	5975	7205	Mean	STDDEV
% fines <6.25 mm w/ 2.5" particles		0.408993576	0.266108787	0.353226926	0.34278	0.0588
< 0.85 mm Subtotal		935	445	955	Mean	STDEV
% fines <0.85 mm w/o 2.5" particles		0.142421935	0.089717742	0.149102264	**0.12708**	**0.03253**
% fines <0.85 mm w/ 2.5" particles		0.133476089	0.074476987	0.132546842	0.1135	0.0338

10/10/2014

Sage Creek ID17040105SK009_2c

Stream:	Sage Creek					
Date (mm/dd/yyyy):	10/10/2014					
Site Description:	SK009_02c					
Lat/Lon Core 1:	42.65423 N -111.10903 W					
Lat/Lon Core 2:	42.65435 N -111.10934 W					
Lat/Lon Core 3:	42.65464 N -111.10982 W					
Samping Event ID						
Personnel:	Jenny Cornell, Hannah Harris					
Rosgen Channel:	C					
Habitat Unit	pool tailout, riffle					
Reach Gradient (%):	<2%					
Geology (Q, G, V, or S):	S					
Target Species:	cutthroat, brown trout					
Flow (cfs):						
Surrounding Land Use:	grazing, mining					
Sample number		1	2	3		
Ocular est. % surface fines						
Sieve size		(mL)	(mL)	(mL)		
63 mm (2.5")		155	440	0		
25 mm (1.0")		1370	2010	1275		
12.5 mm (0.5")		830	910	710		
6.34 mm (0.25")		730	820	530		
1.0 - 0.25" Subtotal		2930	3740	2515		
4.75 mm (0.187")		100	320	70		
2.36 mm (0.0937")		640	664	460		
850 µm (0.0331")		760	524	430		
212 µm (0.0083")		440	250	190		
106 µm (0.0041")		68	25	10		
75 µm (0.0029")		40	20	5		
53 µm (0.0021")						
Bottom pan (< 53 µm)						
< 6.25 mm Subtotal		2048	1803	1165		
Sample total w/o 2.5" particles		4978	5543	3680	Mean	STDDEV
% fines <6.25 mm w/o 2.5" particles		0.411410205	0.325275122	0.316576087	0.35109	0.0428
Sample total w/ 2.5" particles		5133	5983	3680	Mean	STDDEV
% fines <6.25 mm w/ 2.5" particles		0.398986947	0.301353836	0.316576087	0.33897	0.04289
< 0.85 mm Subtotal		548	295	205	Mean	STDEV
% fines <0.85 mm w/o 2.5" particles		0.110084371	0.053220278	0.055706522	0.073	0.03214
% fines <0.85 mm w/ 2.5" particles		0.106760179	0.049306368	0.055706522	0.07059	0.03149

10/3/2014

South Fork Sage Creek ID17040105SK009_02e

Stream:	South Fork Sage Creek					
Date (mm/dd/yyyy):	10/3/2014					
Site Description:	downstream 0.5 miles from springs					
Lat/Lon Core 1:	42.63255 N -111.10960 W					
Lat/Lon Core 2:	42.63104 N -111.10835 W					
Lat/Lon Core 3:	42.63071 N -111.10822 W					
Samping Event ID						
Personnel:	Greg Mladenka, Hannah Harris					
Rosgen Channel:	E- somewhat over widened					
Habitat Unit	pool tailout					
Reach Gradient (%):	1.5-2%					
Geology (Q, G, V, or S):	S					
Target Species:	cutthroat, brown trout					
Flow (cfs):						
Surrounding Land Use:	grazing, mining					
Sample number		1	2	3		
Ocular est. % surface fines						
Sieve size		(mL)	(mL)	(mL)		
63 mm (2.5")		330	0	175		
25 mm (1.0")		1225	1230	565		
12.5 mm (0.5")		670	835	370		
6.34 mm (0.25")		760	490	380		
1.0 - 0.25" Subtotal		2655	2555	1315		
4.75 mm (0.187")		155	337	184		
2.36 mm (0.0937")		430	371	703		
850 µm (0.0331")		395	300	1088		
212 µm (0.0083")		1016	765	1565		
106 µm (0.0041")		155	89	21		
75 µm (0.0029")		5	70	18		
53 µm (0.0021")						
Bottom pan (< 53 µm)						
< 6.25 mm Subtotal		2156	1932	3579		
Sample total w/o 2.5" particles		4811	4487	4894	Mean	STDDEV
% fines <6.25 mm w/o 2.5" particles		0.44813968	0.430577223	0.731303637	0.53667	0.13781
Sample total w/ 2.5" particles		5141	4487	5069	Mean	STDDEV
% fines <6.25 mm w/ 2.5" particles		0.419373663	0.430577223	0.706056421	0.51867	0.13258
< 0.85 mm Subtotal		1176	924	1604	Mean	STDEV
% fines <0.85 mm w/o 2.5" particles		0.244439825	0.205928237	0.327748263	0.25937	0.06227
% fines <0.85 mm w/ 2.5" particles		0.228749271	0.205928237	0.316433222	0.25037	0.05834

10/17/2014

Rock Creek ID17040105SK011_03

Stream:	Rock Creek				
Date (mm/dd/yyyy):	10/17/2014				
Site Description:	SK011_03				
Lat/Lon Core 1:	42.061496 N -111.08498 W				
Lat/Lon Core 2:	42.61487 N -111.08495 W				
Lat/Lon Core 3:	42.61455 N -111.08449 W				
Samping Event ID					
Personnel:	Greg Mladenka, Hannah Harris				
Rosgen Channel:	C/E				
Habitat Unit	pool tailout, riffle				
Reach Gradient (%):					
Geology (Q, G, V, or S):	sedimentary				
Target Species:	cutthroat				
Flow (cfs):					
Surrounding Land Use:	grazing				
Sample number	1	2	3		
Ocular est. % surface fines					
Sieve size	(mL)	(mL)	(mL)		
63 mm (2.5")	680	360	0		
25 mm (1.0")	905	960	920		
12.5 mm (0.5")	520	605	820		
6.34 mm (0.25")	350	310	885		
1.0 - 0.25" Subtotal	1775	1875	2625		
4.75 mm (0.187")	110	79	320		
2.36 mm (0.0937")	220	136	440		
850 µm (0.0331")	410	270	650		
212 µm (0.0083")	530	510	1370		
106 µm (0.0041")	128	164	46		
75 µm (0.0029")	29	8	15		
53 µm (0.0021")					
Bottom pan (< 53 µm)					
< 6.25 mm Subtotal	1427	1167	2841		
Sample total w/o 2.5" particles	3202	3042	5466	Mean	STDDEV
% fines <6.25 mm w/o 2.5" particles	0.445658963	0.383629191	0.519758507	0.44968	0.05565
Sample total w/ 2.5" particles	3882	3402	5466	Mean	STDDEV
% fines <6.25 mm w/ 2.5" particles	0.367594024	0.34303351	0.519758507	0.41013	0.07817
< 0.85 mm Subtotal	687	682	1431	Mean	STDEV
% fines <0.85 mm w/o 2.5" particles	0.214553404	0.224194609	0.26180022	0.23352	0.02496
% fines <0.85 mm w/ 2.5" particles	0.176970634	0.200470312	0.26180022	0.21308	0.0438

8/14/2014

Spring Creek ID17040105SK012_03

Hannah Harris and Aubree Thomas visited Spring Creek on the afternoon of 8/14/2014. Area is grazed and the landownership is Forest Service. Stream was full of filamentous algae and macrophytes. It drains a large spring/pond complex and has lots of beaver activity. Water seemed to be rich in tannins. There was no salmonid spawning habitat. In riffles, substrate was too large and other areas were inundated by beaver ponds. Emergence of mayflies, possibly of the family Baetidae.

Representative photos of Spring Creek ID17040105SK012_03

Appendix D. **Formation Environmental Data on Salt River Tributaries**

South Fork Deer Creek ID17040105SK010_02a

Stream Habitat Index

#	Habitat Measure	DC-100		
		2009	**2010**	**2011**
1	% Instream Cover [1]	8	8	7
2	# Large Organic Debris	2	1	1
3	% Fines	0	8	10
4	Embeddedness [1]	8	8	9
5	# Wolman Classes	7	7	6
6	Channel Shape	7	8	8
7	% Bank Vegetation	5	8	9
8	% Canopy Cover	5	4	6
9	Disruptive Pressure [1]	8	8	9
10	Zone of Influence [1]	8	8	8
	Total Score[2]	**58**	**68**	**73**
	Condition Category[3]	**2**	**3**	**3**

[1] % Cover, embeddedness, disruptive pressure and zone of influence were scored in the field using IDEQ criteria.

[2] Maximum possible score is 100, 10 for each habitat measure.

[3] Condition Categories are for the Northern and Middle Rockies Ecoregion scoring criteria.

1 <58 = <10th percentile of reference

2 58 - 65 = 10th-25th percentile of reference

3 >66 = >25th percentile of reference

Stream Macroinvertebrate Index

Metrics	Metric Scoring Formulas	DC-100		
		2009	**2010**	**2011**
Total Taxa	100*(Total Taxa)/95th	NM	NM	41
Ephemeroptera Taxa	100*(Ephemeroptera Taxa)/95th			30
Plecoptera Taxa	100*(Plecoptera Taxa)/95th			50
Trichoptera Taxa	100*(Trichoptera Taxa)/95th			22
Percent Plecoptera	100*(%Plecoptera)/95th			100
Hilsenhoff Biotic Index (HBI)	100*(10 - HBI)/(10 - 5th)			98
Percent 5 Dominant Taxa	100*(100 -%5dom)/(100 - 5th)			76
Scraper Taxa	100*(Scraper Taxa)/95th			38
Clinger Taxa	100*(Clinger Taxa)/95th			47
	SMI Score			**56**
	Condition Rating			**2**

NM - Not Measured

SMI Bioregion Scoring Thresholds: Central and Southern Mountains

	Score	Condition Rating
Above the 25th percentile of reference	≥59	3
10th to 25th percentile of reference	51-58	2
Minimum to 10th percentile of reference	33 -50	1
Below minimum of reference condition	<33	Minimum threshold (Min)

Total Suspended Solids

Station Name	X_Coord	Y_Coord	Sample Date	TSS (mg/L)
SW-SFDC-200	482061	4715031	5/18/2003	21
SW-SFDC-200	482061	4715031	8/13/2003	5
SW-SFDC-200	482061	4715031	10/28/2003	5
SW-SFDC-300	483017	4715054	5/22/2002	4
SW-SFDC-300	483017	4715054	5/18/2003	2
SW-SFDC-300	483017	4715054	5/25/2006	5
SW-SFDC-300	483017	4715054	5/20/2007	5
SW-SFDC-300	483017	4715054	6/17/2008	5
SW-SFDC-300	483017	4715054	6/17/2008	5
SW-SFDC-300	483017	4715054	6/3/2009	5
SW-SFDC-300	483017	4715054	6/7/2010	27
SW-SFDC-300	483017	4715054	6/14/2011	9
SW-SFDC-300	483017	4715054	5/10/2012	5
SW-SFDC-800	484089	4715227	5/23/2002	4
SW-SFDC-800	484089	4715227	5/19/2003	4
SW-SFDC-800	484089	4715227	5/17/2004	5
SW-UTSFDC-900	484054	4715185	5/19/2003	1

Turbidity

StationName	X_Coord	Y_Coord	Sample Date	Turbidity (NTUs)
SFDC-50	481701	4714861	8/24/2012	2.44
SW-SFDC-200	482061	4715031	5/18/2003	6.9
SW-SFDC-200	482061	4715031	5/18/2003	13
SW-SFDC-200	482061	4715031	8/13/2003	0.802
SW-SFDC-200	482061	4715031	10/28/2003	1.71
SW-SFDC-300	483017	4715054	5/22/2002	2.3
SW-SFDC-300	483017	4715054	5/18/2003	0.65
SW-SFDC-300	483017	4715054	5/18/2003	5
SW-SFDC-300	483017	4715054	5/25/2006	6.2

StationName	X_Coord	Y_Coord	Sample Date	Turbidity (NTUs)
SW-SFDC-300	483017	4715054	5/20/2007	2.52
SW-SFDC-300	483017	4715054	6/17/2008	4.1
SW-SFDC-300	483017	4715054	6/3/2009	8.04
SW-SFDC-300	483017	4715054	6/7/2010	20.6
SW-SFDC-300	483017	4715054	6/14/2011	21.8
SW-SFDC-300	483017	4715054	5/10/2012	2.93
SW-SFDC-800	484089	4715227	5/23/2002	0.4
SW-SFDC-800	484089	4715227	5/23/2002	0
SW-SFDC-800	484089	4715227	5/19/2003	1.8
SW-SFDC-800	484089	4715227	5/19/2003	2.2
SW-SFDC-800	484089	4715227	5/17/2004	0.82
SW-SFDC-800	484089	4715227	5/17/2004	155
SW-UTSFDC-900	484054	4715185	5/19/2003	2.4
SW-UTSFDC-900	484054	4715185	5/19/2003	2.8

Roberts Creek ID17040105SK007_02g

Total Suspended Solids

Station Name	X_Coord	Y_Coord	Sample Date	TSS (mg/L)
UR-1	490872	4728519	9/29/2004	5
UR-2	491652	4728591	5/24/2003	26
UR-2	491652	4728591	5/24/2003	5
UR-2	491652	4728591	8/13/2003	5
UR-2	491652	4728591	10/29/2003	5
UR-2	491652	4728591	5/17/2004	5
UR-2	491652	4728591	7/27/2004	5
UR-2	491652	4728591	5/18/2005	5
UR-2	491652	4728591	7/12/2005	5
UR-2	491652	4728591	9/20/2005	5
UR-2	491652	4728591	9/20/2005	38
UR-2	491652	4728591	5/18/2008	5
UR-2	491652	4728591	5/18/2008	10
UR-3	492041	4728742	6/21/2000	9
UR-3	492041	4728742	9/25/2000	5
UR-3	492041	4728742	12/20/2000	4
UR-3	492041	4728742	5/21/2006	5
UR-3	492041	4728742	8/6/2006	5
UR-3	492041	4728742	10/17/2006	5
UR-3	492041	4728742	5/20/2007	6
UR-3	492041	4728742	7/15/2007	5

Station Name	X_Coord	Y_Coord	Sample Date	TSS (mg/L)
UR-3	492041	4728742	9/24/2007	5
UR-3	492041	4728742	5/18/2008	5
UR-3	492041	4728742	7/20/2008	5
UR-3	492041	4728742	11/9/2008	5
UR-3	492041	4728742	3/19/2009	10
UR-3	492041	4728742	6/1/2009	5
UR-3	492041	4728742	9/27/2009	5
UR-3	492041	4728742	11/21/2009	5
UR-3	492041	4728742	6/2/2010	7
UR-3	492041	4728742	6/2/2010	9
UR-3	492041	4728742	9/29/2010	5
UR-3	492041	4728742	11/10/2010	5
UR-3	492041	4728742	3/29/2011	5
UR-3	492041	4728742	6/15/2011	5
UR-3	492041	4728742	9/29/2011	8
UR-3	492041	4728742	11/9/2011	1
UR-3	492041	4728742	5/12/2012	5
UR-3	492041	4728742	9/13/2012	6
UR-3	492041	4728742	11/13/2012	5

Turbidity

Station Name	X_Coord	Y_Coord	Sample Date	Turbidity (NTUs)
UR-1	490872	4728519	9/29/2004	0.78
UR-2	491652	4728591	5/24/2003	1.11
UR-2	491652	4728591	10/29/2003	0.62
UR-2	491652	4728591	7/27/2004	1.55
UR-2	491652	4728591	5/18/2008	5.7
UR-3	492041	4728742	6/21/2000	2.6
UR-3	492041	4728742	9/25/2000	0.29
UR-3	492041	4728742	9/25/2000	140
UR-3	492041	4728742	12/20/2000	4.5
UR-3	492041	4728742	5/18/2005	3.32
UR-3	492041	4728742	7/12/2005	0.31
UR-3	492041	4728742	9/20/2005	1.06
UR-3	492041	4728742	5/21/2006	1.48
UR-3	492041	4728742	8/6/2006	0.57
UR-3	492041	4728742	10/17/2006	2.7
UR-3	492041	4728742	5/20/2007	0.97
UR-3	492041	4728742	9/24/2007	2.5

Station Name	X_Coord	Y_Coord	Sample Date	Turbidity (NTUs)
UR-3	492041	4728742	5/18/2008	3.1
UR-3	492041	4728742	7/21/2008	1.7
UR-3	492041	4728742	11/9/2008	1.7
UR-3	492041	4728742	3/19/2009	3.33
UR-3	492041	4728742	6/1/2009	16.08
UR-3	492041	4728742	9/27/2009	3.64
UR-3	492041	4728742	11/21/2009	3.11
UR-3	492041	4728742	6/2/2010	1.52
UR-3	492041	4728742	8/26/2010	1.34
UR-3	492041	4728742	9/29/2010	1.87
UR-3	492041	4728742	11/10/2010	3.65
UR-3	492041	4728742	3/29/2011	1.71
UR-3	492041	4728742	6/15/2011	2.96
UR-3	492041	4728742	9/29/2011	3.32
UR-3	492041	4728742	11/9/2011	1.85
UR-3	492041	4728742	5/12/2012	3.34
UR-3	492041	4728742	9/13/2012	2.77
UR-3	492041	4728742	11/13/2012	2.2

Selenium

Station Name	X_Coord	Y_Coord	SampleDate	SampleTime	Selenium (mg/L)
UR-3	492041.1	4728742	6/21/2000	10:30	0.001
UR-3	492041.1	4728742	9/25/2000	11:15	0.001
UR-3	492041.1	4728742	12/20/2000	10:00	0.001
UR-3	492041.1	4728742	5/21/2006	11:15	0.00021
UR-3	492041.1	4728742	8/6/2006	08:10	0.0002
UR-3	492041.1	4728742	10/17/2006	17:30	0.0002
UR-3	492041.1	4728742	5/20/2007	09:15	0.0002
UR-3	492041.1	4728742	7/15/2007	10:45	0.0002
UR-3	492041.1	4728742	9/24/2007	08:35	0.0002
UR-3	492041.1	4728742	5/18/2008	09:34	0.0002
UR-3	492041.1	4728742	5/18/2008	09:34	0.00035
UR-3	492041.1	4728742	7/20/2008	10:30	0.00043
UR-3	492041.1	4728742	11/9/2008	11:10	0.00042
UR-3	492041.1	4728742	3/19/2009	14:35	0.00021
UR-3	492041.1	4728742	6/1/2009	14:40	0.00035
UR-3	492041.1	4728742	9/27/2009	13:00	0.0002
UR-3	492041.1	4728742	11/21/2009	12:40	0.00033
UR-3	492041.1	4728742	6/2/2010	16:05	0.0002

Station Name	X_Coord	Y_Coord	SampleDate	SampleTime	Selenium (mg/L)
UR-3	492041.1	4728742	6/2/2010	16:05	0.0002
UR-3	492041.1	4728742	9/29/2010	10:35	0.0002
UR-3	492041.1	4728742	11/10/2010	12:45	0.0002
UR-3	492041.1	4728742	3/29/2011	10:25	0.0002
UR-3	492041.1	4728742	6/15/2011	11:50	0.00035
UR-3	492041.1	4728742	9/29/2011	09:45	0.00024
UR-3	492041.1	4728742	11/9/2011	11:45	0.00023
UR-3	492041.1	4728742	5/12/2012	10:05	0.00021
UR-3	492041.1	4728742	9/13/2012	15:00	0.00033
UR-3	492041.1	4728742	11/13/2012	13:40	0.00024

Total Phosphorus

StationName	X_Coord	Y_Coord	SampleDate	Sample Time	Total Phosphorus (mg/L)
UR-2	491652	4728591	12/10/2002	12:40	0.11
UR-2	491652	4728591	12/10/2002	12:40	0.06
UR-2	491652	4728591	5/24/2003	17:50	0.02
UR-2	491652	4728591	5/24/2003	17:50	0.02
UR-2	491652	4728591	8/13/2003	00:00	0.01
UR-3	492041.1	4728742	6/21/2000	10:30	0.05
UR-3	492041.1	4728742	9/25/2000	11:15	0.06
UR-3	492041.1	4728742	12/20/2000	10:00	0.04

Nitrate + Nitrite

StationName	X_Coord	Y_Coord	SampleDate	Sample Time	Nitrate + Nitrite as N (mg/L)
UR-1	490872	4728519	9/29/2004	08:13	0.07
UR-2	491652	4728591	5/17/2004	12:25	0.04
UR-2	491652	4728591	7/27/2004	12:10	0.04
UR-2	491652	4728591	5/18/2005	11:30	0.04
UR-2	491652	4728591	7/12/2005	09:00	0.08
UR-2	491652	4728591	9/20/2005	08:20	0.09
UR-2	491652	4728591	9/20/2005	10:05	0.02
UR-2	491652	4728591	5/18/2008	08:48	0.131
UR-2	491652	4728591	5/18/2008	00:00	0.116
UR-3	492041.1	4728742	6/21/2000	10:30	0.05
UR-3	492041.1	4728742	9/25/2000	11:15	0.11
UR-3	492041.1	4728742	12/20/2000	10:00	0.09
UR-3	492041.1	4728742	5/21/2006	11:15	0.08
UR-3	492041.1	4728742	8/6/2006	08:10	0.12

StationName	X_Coord	Y_Coord	SampleDate	Sample Time	Nitrate + Nitrite as N (mg/L)
UR-3	492041.1	4728742	10/17/2006	17:30	0.04
UR-3	492041.1	4728742	5/20/2007	09:15	0.06177
UR-3	492041.1	4728742	7/15/2007	10:45	0.4
UR-3	492041.1	4728742	9/24/2007	08:35	0.116
UR-3	492041.1	4728742	5/18/2008	09:34	0.155
UR-3	492041.1	4728742	7/20/2008	10:30	0.117
UR-3	492041.1	4728742	11/9/2008	11:10	0.114
UR-3	492041.1	4728742	3/19/2009	14:35	0.0766
UR-3	492041.1	4728742	6/1/2009	14:40	0.0565
UR-3	492041.1	4728742	9/27/2009	13:00	0.098
UR-3	492041.1	4728742	11/21/2009	12:40	0.11
UR-3	492041.1	4728742	6/2/2010	16:05	0.0352
UR-3	492041.1	4728742	6/2/2010	16:05	0.0344
UR-3	492041.1	4728742	9/29/2010	10:35	0.0914
UR-3	492041.1	4728742	11/10/2010	12:45	0.0905
UR-3	492041.1	4728742	3/29/2011	10:25	0.078
UR-3	492041.1	4728742	6/15/2011	11:50	0.093
UR-3	492041.1	4728742	9/29/2011	09:45	0.141
UR-3	492041.1	4728742	11/9/2011	11:45	0.134
UR-3	492041.1	4728742	5/12/2012	10:05	0.074
UR-3	492041.1	4728742	9/13/2012	15:00	0.066
UR-3	492041.1	4728742	11/13/2012	13:40	0.107

Dissolved Oxygen

StationName	X_Coord	Y_Coord	SampleDate	Sample Time	Dissolved oxygen (mg/L)
UR-1	490872	4728519	9/29/2004	08:13	6.2
UR-2	491652	4728591	5/24/2003	17:50	3.76
UR-2	491652	4728591	10/29/2003	07:30	6.8
UR-2	491652	4728591	7/27/2004	11:47	7.8
UR-2	491652	4728591	5/18/2008	08:25	5.6
UR-3	492041.1	4728742	6/21/2000	10:30	5.9
UR-3	492041.1	4728742	9/25/2000	11:15	13.5
UR-3	492041.1	4728742	12/1/2000	00:00	13.8
UR-3	492041.1	4728742	5/18/2005	11:28	6
UR-3	492041.1	4728742	7/12/2005	08:30	6.4
UR-3	492041.1	4728742	9/20/2005	08:20	3.8
UR-3	492041.1	4728742	5/21/2006	11:15	7.8
UR-3	492041.1	4728742	8/6/2006	08:10	5.8
UR-3	492041.1	4728742	10/17/2006	17:07	8.8

StationName	X_Coord	Y_Coord	SampleDate	Sample Time	Dissolved oxygen (mg/L)
UR-3	492041.1	4728742	5/20/2007	09:22	8.4
UR-3	492041.1	4728742	9/24/2007	08:38	7
UR-3	492041.1	4728742	5/18/2008	09:37	8.3
UR-3	492041.1	4728742	7/21/2008	10:10	7.8
UR-3	492041.1	4728742	11/9/2008	11:10	6.06
UR-3	492041.1	4728742	3/19/2009	14:35	12.67
UR-3	492041.1	4728742	6/1/2009	14:40	8.15
UR-3	492041.1	4728742	9/27/2009	13:00	11.94
UR-3	492041.1	4728742	11/21/2009	12:40	10.47
UR-3	492041.1	4728742	6/2/2010	16:05	11.51
UR-3	492041.1	4728742	8/26/2010	11:00	9.36
UR-3	492041.1	4728742	9/29/2010	10:35	8.92
UR-3	492041.1	4728742	11/10/2010	12:45	10.41
UR-3	492041.1	4728742	3/29/2011	10:25	16.63
UR-3	492041.1	4728742	6/15/2011	11:50	7.9
UR-3	492041.1	4728742	9/29/2011	09:45	9.58
UR-3	492041.1	4728742	11/9/2011	11:45	10.1
UR-3	492041.1	4728742	5/12/2012	10:05	8.6
UR-3	492041.1	4728742	9/13/2012	15:00	9.14
UR-3	492041.1	4728742	11/13/2012	13:40	8.92

Temperature

StationName	X_Coord	Y_Coord	SampleDate	Sample Time	Temperature (˚C)
UR-1	490872	4728519	9/17/2002	11:00	9.5
UR-1	490872	4728519	9/29/2004	08:13	8.4
UR-2	491652	4728591	12/10/2002	12:40	4.3
UR-2	491652	4728591	5/24/2003	17:50	17.1
UR-2	491652	4728591	10/29/2003	07:30	8.3
UR-2	491652	4728591	7/27/2004	11:47	9.9
UR-2	491652	4728591	5/18/2008	08:25	8.3
UR-3	492041.1	4728742	6/21/2000	10:30	15.3
UR-3	492041.1	4728742	9/25/2000	11:15	8.8
UR-3	492041.1	4728742	12/1/2000	00:00	4
UR-3	492041.1	4728742	5/18/2005	11:28	9.2
UR-3	492041.1	4728742	7/12/2005	08:30	8.7
UR-3	492041.1	4728742	9/20/2005	08:20	8.2
UR-3	492041.1	4728742	5/21/2006	11:15	10.3
UR-3	492041.1	4728742	8/6/2006	08:10	8.6
UR-3	492041.1	4728742	10/17/2006	17:07	7.7

StationName	X_Coord	Y_Coord	SampleDate	Sample Time	Temperature (˚C)
UR-3	492041.1	4728742	5/20/2007	09:22	9.1
UR-3	492041.1	4728742	9/24/2007	08:38	8.4
UR-3	492041.1	4728742	5/18/2008	09:37	8.7
UR-3	492041.1	4728742	7/21/2008	10:10	10.4
UR-3	492041.1	4728742	11/9/2008	11:10	8
UR-3	492041.1	4728742	3/19/2009	14:35	8.62
UR-3	492041.1	4728742	6/1/2009	14:40	9.49
UR-3	492041.1	4728742	9/27/2009	13:00	9.48
UR-3	492041.1	4728742	11/21/2009	12:40	5.89
UR-3	492041.1	4728742	6/2/2010	16:05	9.85
UR-3	492041.1	4728742	8/26/2010	11:00	9.48
UR-3	492041.1	4728742	9/29/2010	10:35	8.08
UR-3	492041.1	4728742	11/10/2010	12:45	6
UR-3	492041.1	4728742	3/29/2011	10:25	4.47
UR-3	492041.1	4728742	6/15/2011	11:50	11.48
UR-3	492041.1	4728742	9/29/2011	09:45	7.8
UR-3	492041.1	4728742	11/9/2011	11:45	5.8
UR-3	492041.1	4728742	5/12/2012	10:05	8.7
UR-3	492041.1	4728742	9/13/2012	15:00	10
UR-3	492041.1	4728742	11/13/2012	13:40	6.4

Sage Creek ID17040105SK009_02c

Total Suspended Solids

Station Name	X_Coord	Y_Coord	SampleDate	TSS (mg/L)
AWI012-24	491679	4718597	5/6/2003	18
AWI012-24	491679	4718597	5/16/2006	104
AWI012-24	491679	4718597	5/18/2006	38
AWI012-24	491679	4718597	5/19/2006	50
AWI012-24	491679	4718597	5/21/2007	6
AWI012-24	491679	4718597	5/22/2007	5
AWI012-24	491679	4718597	5/24/2007	5
AWI012-25	489593	4723099	5/19/2006	54
LS	490366	4722894	9/15/1990	2
LS	490366	4722894	5/15/1991	2
LS	490366	4722894	9/15/1991	4
LS	490366	4722894	5/15/1992	2
LS	490366	4722894	9/15/1992	2
LS	490366	4722894	5/15/1993	86
LS	490366	4722894	9/15/1993	4

Station Name	X_Coord	Y_Coord	SampleDate	TSS (mg/L)
LS	490366	4722894	5/15/1994	2
LS	490366	4722894	9/15/1994	6
LS	490366	4722894	5/15/1995	5
LS	490366	4722894	9/15/1995	8
LS	490366	4722894	5/15/1996	30
LS	490366	4722894	9/15/1996	5
LS	490366	4722894	5/15/1997	220
LS	490366	4722894	9/15/1997	5
LS	490366	4722894	5/15/1998	14
LS	490366	4722894	9/15/1998	5
LS	490366	4722894	5/15/1999	178
LS	490366	4722894	9/15/1999	5
LS	490366	4722894	5/15/2000	18
LS	490366	4722894	6/21/2000	14
LS	490366	4722894	9/15/2000	6
LS	490366	4722894	9/26/2000	2
LS	490366	4722894	5/15/2001	12
LS	490366	4722894	9/15/2001	5
LS	490366	4722894	5/16/2002	20
LS	490366	4722894	10/17/2002	5
LS	490366	4722894	5/23/2003	16
LS	490366	4722894	5/23/2003	22
LS	490366	4722894	10/28/2003	5
LS	490366	4722894	5/7/2004	11
LS	490366	4722894	5/7/2004	18
LS	490366	4722894	7/20/2004	8
LS	490366	4722894	9/28/2004	5
LS	490366	4722894	5/19/2005	17
LS	490366	4722894	9/19/2005	5
LS	490366	4722894	5/22/2006	25
LS	490366	4722894	5/22/2006	25
LS	490366	4722894	10/16/2006	5
LS	490366	4722894	5/22/2007	5
LS	490366	4722894	9/25/2007	5
LS	490366	4722894	5/19/2008	5
LS	490366	4722894	5/31/2009	5
LS	490366	4722894	11/20/2009	5
LS	490366	4722894	11/20/2009	5
LS	490366	4722894	6/6/2010	10
LS	490366	4722894	11/13/2010	5

Station Name	X_Coord	Y_Coord	SampleDate	TSS (mg/L)
LS	490366	4722894	6/16/2011	37
LS	490366	4722894	11/10/2011	0
LS	490366	4722894	5/9/2012	5
LS	490366	4722894	11/13/2012	5
LSV-1	491496	4720997	5/16/2002	6
LSV-1	491496	4720997	10/17/2002	5
LSV-1	491496	4720997	5/22/2003	5
LSV-1	491496	4720997	10/27/2003	5
LSV-1	491496	4720997	5/8/2004	5
LSV-1	491496	4720997	7/21/2004	5
LSV-1	491496	4720997	6/6/2010	16
LSV-1	491496	4720997	11/13/2010	5
LSV-1a	491345	4720647	5/22/2003	5
LSV-1a	491345	4720647	6/6/2010	28
LSV-1a	491345	4720647	11/13/2010	7
LSV-1b	491301	4720511	5/22/2003	5
LSV-1b	491301	4720511	6/6/2010	13
LSV-1b	491301	4720511	11/13/2010	7
LSV-2	491370	4720039	5/16/2002	5
LSV-2	491370	4720039	10/17/2002	5
LSV-2	491370	4720039	5/22/2003	5
LSV-2	491370	4720039	10/27/2003	5
LSV-2	491370	4720039	5/8/2004	5
LSV-2	491370	4720039	7/21/2004	5
LSV-2	491370	4720039	5/19/2008	17
LSV-2	491370	4720039	11/20/2008	5
LSV-2	491370	4720039	5/31/2009	18
LSV-2	491370	4720039	11/20/2009	5
LSV-2	491370	4720039	6/14/2011	35
LSV-2	491370	4720039	5/10/2012	5
LSV-2	491370	4720039	11/15/2012	5
LSV-2a	491236	4719667	5/22/2003	5
LSV-2a	491236	4719667	6/6/2010	9
LSV-2a	491236	4719667	11/12/2010	6
LSV-2c	491340	4720392	6/6/2010	9
LSV-2c	491340	4720392	11/13/2010	6
LSV-2c	491340	4720392	11/13/2010	5
LSV-2c	491340	4720392	11/10/2011	18
LSV-3	491172	4719509	5/15/2002	5
LSV-3	491172	4719509	10/17/2002	5

Station Name	X_Coord	Y_Coord	SampleDate	TSS (mg/L)
LSV-3	491172	4719509	5/22/2003	5
LSV-3	491172	4719509	10/27/2003	5
LSV-3	491172	4719509	5/8/2004	6
LSV-3	491172	4719509	7/21/2004	5
LSV-3	491172	4719509	9/28/2004	5
LSV-3	491172	4719509	5/19/2005	13
LSV-3	491172	4719509	9/19/2005	5
LSV-3	491172	4719509	5/21/2006	14
LSV-3	491172	4719509	10/16/2006	5
LSV-3	491172	4719509	5/20/2007	5
LSV-3	491172	4719509	5/31/2009	54
LSV-3	491172	4719509	11/20/2009	6
LSV-3	491172	4719509	6/6/2010	10
LSV-3	491172	4719509	11/12/2010	5
LSV-3	491172	4719509	11/12/2010	7
LSV-3	491172	4719509	6/14/2011	65
LSV-3	491172	4719509	11/10/2011	4
LSV-3	491172	4719509	5/10/2012	5
LSV-3	491172	4719509	11/15/2012	5
LSV-3a	491109	4718857	5/22/2003	5
LSV-3a	491109	4718857	5/22/2003	10
LSV-3a	491109	4718857	10/27/2003	5
LSV-3a	491109	4718857	6/7/2010	20
LSV-3a	491109	4718857	11/9/2010	5
LSV-3a	491109	4718857	11/9/2010	6
LSV-4	491632	4718606	5/15/2002	8
LSV-4	491632	4718606	5/15/2002	8
LSV-4	491632	4718606	5/16/2002	5
LSV-4	491632	4718606	10/17/2002	5
LSV-4	491632	4718606	10/18/2002	5
LSV-4	491632	4718606	5/22/2003	14
LSV-4	491632	4718606	10/27/2003	5
LSV-4	491632	4718606	2/5/2004	11
LSV-4	491632	4718606	5/8/2004	5
LSV-4	491632	4718606	7/21/2004	5
LSV-4	491632	4718606	10/17/2005	5
LSV-4	491632	4718606	5/21/2006	21
LSV-4	491632	4718606	5/21/2007	7
LSV-4	491632	4718606	9/26/2007	5
LSV-4	491632	4718606	5/18/2008	5

Station Name	X_Coord	Y_Coord	SampleDate	TSS (mg/L)
LSV-4	491632	4718606	5/18/2008	9
LSV-4	491632	4718606	5/19/2008	5
LSV-4	491632	4718606	5/19/2008	12
LSV-4	491632	4718606	5/19/2008	14
LSV-4	491632	4718606	6/17/2008	5
LSV-4	491632	4718606	11/9/2008	5
LSV-4	491632	4718606	6/3/2009	25
LSV-4	491632	4718606	6/3/2009	22
LSV-4	491632	4718606	11/18/2009	12
LSV-4	491632	4718606	11/18/2009	18
LSV-4	491632	4718606	6/4/2010	7
LSV-4	491632	4718606	11/9/2010	9
LSV-4	491632	4718606	6/14/2011	18
LSV-4	491632	4718606	11/10/2011	0
LSV-4	491632	4718606	5/10/2012	5
LSV-4	491632	4718606	11/14/2012	8
LSV-4	491632	4718606	11/14/2012	6
SV-1	490362	4723246	5/16/2002	86
SV-1	490362	4723246	10/17/2002	5
SV-1	490362	4723246	6/6/2010	59
US	488450	4723211	9/15/1990	8
US	488450	4723211	5/15/1991	2
US	488450	4723211	9/15/1991	2
US	488450	4723211	5/15/1992	2
US	488450	4723211	9/15/1992	6
US	488450	4723211	5/15/1993	76
US	488450	4723211	9/15/1993	14
US	488450	4723211	5/15/1994	4
US	488450	4723211	9/15/1994	10
US	488450	4723211	5/15/1995	5
US	488450	4723211	9/15/1995	5
US	488450	4723211	5/15/1996	6
US	488450	4723211	9/15/1996	5
US	488450	4723211	5/15/1997	44
US	488450	4723211	9/15/1997	5
US	488450	4723211	5/15/1998	8
US	488450	4723211	9/15/1998	5
US	488450	4723211	5/15/1999	90
US	488450	4723211	9/15/1999	18
US	488450	4723211	5/15/2000	14

Station Name	X_Coord	Y_Coord	SampleDate	TSS (mg/L)
US	488450	4723211	9/15/2000	5
US	488450	4723211	5/15/2001	8
US	488450	4723211	9/15/2001	5
US	488450	4723211	5/16/2002	28
US	488450	4723211	10/18/2002	5
US	488450	4723211	10/18/2002	5
US	488450	4723211	5/23/2003	10
US	488450	4723211	10/28/2003	5
US	488450	4723211	5/7/2004	5
US	488450	4723211	7/20/2004	5
US	488450	4723211	9/19/2005	5
US	488450	4723211	5/22/2006	6
US	488450	4723211	10/17/2006	5
US	488450	4723211	5/22/2007	5
US	488450	4723211	9/26/2007	5
US	488450	4723211	11/22/2009	5
US	488450	4723211	6/8/2010	11
US	488450	4723211	11/10/2010	5
US	488450	4723211	11/10/2011	5
US	488450	4723211	11/16/2012	5
US-3	489147	4723184	6/22/2000	2
US-3	489147	4723184	9/26/2000	2
US-4	489449	4723138	6/8/2010	10
US-4	489449	4723138	11/10/2010	5

Turbidity

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
AWI012-24	491679	4718597	5/6/2003	4.89
AWI012-24	491679	4718597	5/7/2003	5.49
AWI012-24	491679	4718597	5/8/2003	4.83
AWI012-24	491679	4718597	5/19/2006	31.1
AWI012-24	491679	4718597	5/24/2007	3.4
AWI012-25	489593	4723099	5/19/2006	30.1
AWI012-25	489593	4723099	9/15/2010	0
LS	490366	4722894	5/15/1991	0.66
LS	490366	4722894	9/15/1991	1.09
LS	490366	4722894	5/15/1992	1.2
LS	490366	4722894	9/15/1992	1.4
LS	490366	4722894	5/15/1993	31

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
LS	490366	4722894	9/15/1993	1.7
LS	490366	4722894	5/15/1994	1.37
LS	490366	4722894	9/15/1994	2
LS	490366	4722894	5/15/1995	2.6
LS	490366	4722894	9/15/1995	1.7
LS	490366	4722894	5/15/1996	13.5
LS	490366	4722894	9/15/1996	1.4
LS	490366	4722894	5/15/1997	55.3
LS	490366	4722894	9/15/1997	1.2
LS	490366	4722894	5/15/1998	2.1
LS	490366	4722894	9/15/1998	0.5
LS	490366	4722894	5/15/1999	38
LS	490366	4722894	9/15/1999	2.5
LS	490366	4722894	5/15/2000	3.3
LS	490366	4722894	6/21/2000	3.9
LS	490366	4722894	9/1/2000	41
LS	490366	4722894	9/15/2000	2
LS	490366	4722894	9/26/2000	1.4
LS	490366	4722894	5/15/2001	3.4
LS	490366	4722894	9/15/2001	2.7
LS	490366	4722894	5/16/2002	6.93
LS	490366	4722894	10/17/2002	2.7
LS	490366	4722894	5/23/2003	24.4
LS	490366	4722894	10/28/2003	3.6
LS	490366	4722894	5/7/2004	13.8
LS	490366	4722894	7/20/2004	4.32
LS	490366	4722894	9/28/2004	1.62
LS	490366	4722894	5/19/2005	13.1
LS	490366	4722894	9/19/2005	2.52
LS	490366	4722894	5/22/2006	8.24
LS	490366	4722894	10/16/2006	1.5
LS	490366	4722894	5/22/2007	2.5
LS	490366	4722894	9/25/2007	1.1
LS	490366	4722894	5/19/2008	27
LS	490366	4722894	5/31/2009	5.24
LS	490366	4722894	9/12/2009	3.51
LS	490366	4722894	11/20/2009	1.45
LS	490366	4722894	6/6/2010	10.2
LS	490366	4722894	8/26/2010	6.63
LS	490366	4722894	9/15/2010	7.05

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
LS	490366	4722894	11/13/2010	2.03
LS	490366	4722894	6/16/2011	49.18
LS	490366	4722894	11/10/2011	2.14
LS	490366	4722894	5/9/2012	3.33
LS	490366	4722894	11/13/2012	1.01
LSV	491662	4721387	5/22/2003	3.9
LSV-1	491496	4720997	5/16/2002	3.65
LSV-1	491496	4720997	10/17/2002	1.7
LSV-1	491496	4720997	5/22/2003	5.41
LSV-1	491496	4720997	10/27/2003	0.7
LSV-1	491496	4720997	5/8/2004	1.65
LSV-1	491496	4720997	7/21/2004	0.67
LSV-1	491496	4720997	5/21/2006	20
LSV-1	491496	4720997	10/17/2006	4.6
LSV-1	491496	4720997	9/17/2008	7.42
LSV-1	491496	4720997	5/31/2009	144.4
LSV-1	491496	4720997	10/21/2009	12.8
LSV-1	491496	4720997	11/20/2009	19.87
LSV-1	491496	4720997	6/6/2010	8.36
LSV-1	491496	4720997	9/14/2010	0
LSV-1	491496	4720997	11/13/2010	5.06
LSV-1	491496	4720997	6/1/2011	6.56
LSV-1	491496	4720997	6/14/2011	52.41
LSV-1	491496	4720997	9/19/2011	6.24
LSV-1	491496	4720997	11/10/2011	12.58
LSV-1	491496	4720997	5/10/2012	11.5
LSV-1	491496	4720997	9/10/2012	1.32
LSV-1	491496	4720997	11/15/2012	2.7
LSV-1a	491345	4720647	5/22/2003	3.3
LSV-1a	491345	4720647	10/27/2003	1
LSV-1a	491345	4720647	6/6/2010	22.6
LSV-1a	491345	4720647	9/14/2010	0.01
LSV-1a	491345	4720647	11/13/2010	6.16
LSV-1b	491301	4720511	5/22/2003	5.09
LSV-1b	491301	4720511	10/27/2003	0.9
LSV-1b	491301	4720511	6/6/2010	13.1
LSV-1b	491301	4720511	11/13/2010	4.02
LSV-2	491370	4720039	5/16/2002	2.73
LSV-2	491370	4720039	10/17/2002	3.1
LSV-2	491370	4720039	5/22/2003	3.73

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
LSV-2	491370	4720039	10/27/2003	1.2
LSV-2	491370	4720039	5/8/2004	2.25
LSV-2	491370	4720039	7/21/2004	2.01
LSV-2	491370	4720039	5/21/2006	18.2
LSV-2	491370	4720039	10/17/2006	2.6
LSV-2	491370	4720039	5/20/2007	2.83
LSV-2	491370	4720039	9/25/2007	1.7
LSV-2	491370	4720039	5/19/2008	19.7
LSV-2	491370	4720039	9/17/2008	4.01
LSV-2	491370	4720039	11/20/2008	3.05
LSV-2	491370	4720039	5/31/2009	60.4
LSV-2	491370	4720039	9/28/2009	5.41
LSV-2	491370	4720039	11/20/2009	3.72
LSV-2	491370	4720039	6/14/2011	26.27
LSV-2	491370	4720039	5/10/2012	7.46
LSV-2	491370	4720039	9/10/2012	1.46
LSV-2	491370	4720039	11/15/2012	1.8
LSV-2a	491236	4719667	5/22/2003	7.2
LSV-2a	491236	4719667	10/27/2003	0.8
LSV-2a	491236	4719667	6/6/2010	3.8
LSV-2a	491236	4719667	11/12/2010	3.2
LSV-2c	491340	4720392	9/6/2006	2.66
LSV-2c	491340	4720392	5/12/2007	1.45
LSV-2c	491340	4720392	8/28/2007	1.68
LSV-2c	491340	4720392	5/17/2008	12.58
LSV-2c	491340	4720392	9/5/2008	10.51
LSV-2c	491340	4720392	9/12/2009	5.81
LSV-2c	491340	4720392	6/6/2010	4.3
LSV-2c	491340	4720392	8/28/2010	9.89
LSV-2c	491340	4720392	9/14/2010	6.4
LSV-2c	491340	4720392	11/13/2010	7.82
LSV-2c	491340	4720392	8/26/2011	13.07
LSV-2c	491340	4720392	11/10/2011	1.63
LSV-2c	491340	4720392	9/10/2012	1.58
LSV-3	491172	4719509	5/15/2002	3.8
LSV-3	491172	4719509	10/17/2002	1.3
LSV-3	491172	4719509	5/22/2003	6.98
LSV-3	491172	4719509	10/27/2003	1.1
LSV-3	491172	4719509	5/8/2004	4.6
LSV-3	491172	4719509	7/21/2004	0.72

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
LSV-3	491172	4719509	9/28/2004	2.49
LSV-3	491172	4719509	5/19/2005	19.7
LSV-3	491172	4719509	9/19/2005	1.52
LSV-3	491172	4719509	5/21/2006	16.6
LSV-3	491172	4719509	10/16/2006	7.8
LSV-3	491172	4719509	5/20/2007	2.23
LSV-3	491172	4719509	5/31/2009	55.4
LSV-3	491172	4719509	9/28/2009	4.79
LSV-3	491172	4719509	11/20/2009	3.55
LSV-3	491172	4719509	6/6/2010	6.06
LSV-3	491172	4719509	8/25/2010	1.53
LSV-3	491172	4719509	9/30/2010	4.33
LSV-3	491172	4719509	11/12/2010	3.19
LSV-3	491172	4719509	6/14/2011	47.67
LSV-3	491172	4719509	9/19/2011	2.12
LSV-3	491172	4719509	11/10/2011	4.34
LSV-3	491172	4719509	5/10/2012	5.14
LSV-3	491172	4719509	9/10/2012	0.77
LSV-3	491172	4719509	11/15/2012	2.03
LSV-3a	491109	4718857	5/22/2003	7.91
LSV-3a	491109	4718857	10/27/2003	1.2
LSV-3a	491109	4718857	6/7/2010	10.6
LSV-3a	491109	4718857	11/9/2010	8.84
LSV-4	491632	4718606	5/15/2002	3.84
LSV-4	491632	4718606	5/16/2002	5.81
LSV-4	491632	4718606	10/17/2002	1.6
LSV-4	491632	4718606	5/22/2003	11.7
LSV-4	491632	4718606	10/27/2003	1.5
LSV-4	491632	4718606	2/7/2004	5.71
LSV-4	491632	4718606	5/8/2004	7.1
LSV-4	491632	4718606	7/21/2004	0.88
LSV-4	491632	4718606	10/17/2005	0.724
LSV-4	491632	4718606	5/21/2006	20.8
LSV-4	491632	4718606	9/5/2006	2.44
LSV-4	491632	4718606	5/9/2007	6.48
LSV-4	491632	4718606	5/21/2007	3.74
LSV-4	491632	4718606	9/26/2007	1.1
LSV-4	491632	4718606	5/18/2008	8.2
LSV-4	491632	4718606	9/17/2008	2.04
LSV-4	491632	4718606	11/9/2008	4.4

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
LSV-4	491632	4718606	6/3/2009	18.89
LSV-4	491632	4718606	10/23/2009	6.72
LSV-4	491632	4718606	11/18/2009	2.14
LSV-4	491632	4718606	6/4/2010	11.2
LSV-4	491632	4718606	8/25/2010	0.71
LSV-4	491632	4718606	9/30/2010	2.02
LSV-4	491632	4718606	11/9/2010	4.63
LSV-4	491632	4718606	6/1/2011	8.7
LSV-4	491632	4718606	6/6/2011	34.2
LSV-4	491632	4718606	6/7/2011	42.7
LSV-4	491632	4718606	6/9/2011	55.3
LSV-4	491632	4718606	6/14/2011	38.65
LSV-4	491632	4718606	6/15/2011	146
LSV-4	491632	4718606	6/21/2011	22.7
LSV-4	491632	4718606	8/24/2011	10.79
LSV-4	491632	4718606	11/10/2011	1.86
LSV-4	491632	4718606	5/10/2012	8.07
LSV-4	491632	4718606	8/22/2012	2.01
LSV-4	491632	4718606	11/14/2012	1.17
LSV-T1	491048	4719355	5/22/2003	3.25
LSV-T3	491007	4718890	5/22/2003	16.4
SV-1	490362	4723246	5/16/2002	3.84
SV-1	490362	4723246	10/17/2002	2.6
SV-1	490362	4723246	6/6/2010	37.6
US	488450	4723211	5/15/1991	0.3
US	488450	4723211	9/15/1991	1.42
US	488450	4723211	5/15/1992	1.1
US	488450	4723211	9/15/1992	0.7
US	488450	4723211	5/15/1993	27
US	488450	4723211	9/15/1993	0.5
US	488450	4723211	5/15/1994	1.07
US	488450	4723211	9/15/1994	4.5
US	488450	4723211	5/15/1995	2.8
US	488450	4723211	9/15/1995	2.5
US	488450	4723211	5/15/1996	4.5
US	488450	4723211	9/15/1996	0.8
US	488450	4723211	5/15/1997	11.5
US	488450	4723211	9/15/1997	0.2
US	488450	4723211	5/15/1998	1
US	488450	4723211	9/15/1998	0.6

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
US	488450	4723211	5/15/1999	21
US	488450	4723211	9/15/1999	1.3
US	488450	4723211	5/15/2000	2.4
US	488450	4723211	9/15/2000	0.7
US	488450	4723211	5/15/2001	0.5
US	488450	4723211	9/15/2001	0.7
US	488450	4723211	5/16/2002	3.53
US	488450	4723211	10/18/2002	1.8
US	488450	4723211	5/23/2003	19
US	488450	4723211	10/28/2003	0.98
US	488450	4723211	5/7/2004	7.09
US	488450	4723211	7/20/2004	2.78
US	488450	4723211	9/28/2004	1.2
US	488450	4723211	9/19/2005	2.38
US	488450	4723211	5/22/2006	7
US	488450	4723211	10/17/2006	2.8
US	488450	4723211	5/22/2007	0.71
US	488450	4723211	9/26/2007	0.7
US	488450	4723211	11/22/2009	2.3
US	488450	4723211	6/8/2010	4.78
US	488450	4723211	8/27/2010	5.29
US	488450	4723211	9/15/2010	0.28
US	488450	4723211	11/10/2010	0.26
US	488450	4723211	11/10/2011	1.62
US	488450	4723211	11/16/2012	0.01
US-2	488825	4723175	9/15/2010	3.22
US-3	489147	4723184	6/22/2000	1.1
US-3	489147	4723184	9/26/2000	0.81
US-3	489147	4723184	9/26/2000	171
US-3	489147	4723184	9/15/2010	0
US-4	489449	4723138	6/8/2010	17.5
US-4	489449	4723138	8/27/2010	11.73
US-4	489449	4723138	9/15/2010	23.92
US-4	489449	4723138	11/10/2010	1.35

South Fork Sage Creek ID17040105SK009_02e

Total Suspended Solids

Station Name	X_Coord	Y_Coord	SampleDate	TSS (mg/L)
AWI012-26	490558	4720592	5/6/2003	5
AWI012-26	490558	4720592	5/16/2006	82
LSS	490595	4720578	5/15/1992	2
LSS	490595	4720578	9/15/1992	2
LSS	490595	4720578	5/15/1993	406
LSS	490595	4720578	9/15/1993	8
LSS	490595	4720578	5/15/1994	2
LSS	490595	4720578	9/15/1994	2
LSS	490595	4720578	5/15/1995	8
LSS	490595	4720578	9/15/1995	8
LSS	490595	4720578	5/15/1996	5
LSS	490595	4720578	9/15/1996	5
LSS	490595	4720578	5/15/1997	174
LSS	490595	4720578	9/15/1997	5
LSS	490595	4720578	5/15/1998	10
LSS	490595	4720578	9/15/1998	6
LSS	490595	4720578	5/15/1999	72
LSS	490595	4720578	9/15/1999	12
LSS	490595	4720578	5/15/2000	16
LSS	490595	4720578	6/21/2000	2
LSS	490595	4720578	6/22/2000	2
LSS	490595	4720578	9/15/2000	8
LSS	490595	4720578	9/26/2000	2
LSS	490595	4720578	5/15/2001	12
LSS	490595	4720578	9/15/2001	5
LSS	490595	4720578	5/15/2002	14
LSS	490595	4720578	10/17/2002	5
LSS	490595	4720578	5/21/2003	6
LSS	490595	4720578	5/21/2003	5
LSS	490595	4720578	8/12/2003	5
LSS	490595	4720578	10/26/2003	5
LSS	490595	4720578	10/26/2003	5
LSS	490595	4720578	2/5/2004	5
LSS	490595	4720578	5/7/2004	5
LSS	490595	4720578	5/18/2004	5
LSS	490595	4720578	7/20/2004	9
LSS	490595	4720578	9/28/2004	5

Station Name	X_Coord	Y_Coord	SampleDate	TSS (mg/L)
LSS	490595	4720578	9/28/2004	5
LSS	490595	4720578	9/28/2004	5
LSS	490595	4720578	5/19/2005	9
LSS	490595	4720578	5/19/2005	7
LSS	490595	4720578	9/19/2005	5
LSS	490595	4720578	9/19/2005	5
LSS	490595	4720578	10/19/2005	9
LSS	490595	4720578	5/22/2006	12
LSS	490595	4720578	5/22/2006	8
LSS	490595	4720578	10/16/2006	5
LSS	490595	4720578	10/16/2006	5
LSS	490595	4720578	5/22/2007	5
LSS	490595	4720578	5/22/2007	5
LSS	490595	4720578	9/25/2007	5
LSS	490595	4720578	5/19/2008	16
LSS	490595	4720578	11/20/2008	5
LSS	490595	4720578	11/20/2008	5
LSS	490595	4720578	11/24/2008	5
LSS	490595	4720578	3/31/2009	5
LSS	490595	4720578	5/31/2009	5
LSS	490595	4720578	9/28/2009	5
LSS	490595	4720578	11/20/2009	20
LSS	490595	4720578	6/3/2010	86
LSS	490595	4720578	9/8/2010	5
LSS	490595	4720578	11/10/2010	5
LSS	490595	4720578	11/10/2010	5
LSS	490595	4720578	6/15/2011	168
LSS	490595	4720578	8/28/2011	43
LSS	490595	4720578	11/7/2011	0
LSS	490595	4720578	3/23/2012	5
LSS	490595	4720578	5/9/2012	5
LSS	490595	4720578	8/28/2012	5
LSS	490595	4720578	11/13/2012	5
LSS-1a	490193	4720795	5/21/2003	5
LSS-2	491198	4719558	5/21/2003	8
LSS-2	491198	4719558	5/22/2003	6
LSS-2	491198	4719558	6/6/2010	12
LSS-2	491198	4719558	11/12/2010	5
LSS-M1	490425	4720661	6/3/2010	79
LSS-M2	490483	4720649	6/3/2010	62

Station Name	X_Coord	Y_Coord	SampleDate	TSS (mg/L)
SW-SFSC-200	485902	4719212	5/20/2003	6
SW-SFSC-200	485902	4719212	8/12/2003	5
SW-SFSC-500	487850	4720525	5/20/2002	8
SW-SFSC-500	487850	4720525	8/12/2003	5
SW-SFSC-500	487850	4720525	10/19/2005	5
SW-SFSC-500	487850	4720525	5/23/2006	5
SW-SFSC-500	487850	4720525	10/16/2006	5
SW-SFSC-500	487850	4720525	5/22/2007	5
SW-SFSC-500	487850	4720525	9/26/2007	5
SW-SFSC-500	487850	4720525	5/19/2008	30
SW-SFSC-500	487850	4720525	6/4/2009	5
SW-SFSC-500	487850	4720525	6/6/2010	31
SW-SFSC-500	487850	4720525	11/13/2010	5
SW-SFSC-500	487850	4720525	6/16/2011	7
SW-SFSC-500	487850	4720525	11/8/2011	0
SW-SFSC-500	487850	4720525	5/11/2012	5
USS	488842	4720746	6/4/1979	1
USS	488842	4720746	5/15/1992	2
USS	488842	4720746	5/15/1993	552
USS	488842	4720746	5/15/1994	2
USS	488842	4720746	9/15/1995	10
USS	488842	4720746	5/15/1996	5
USS	488842	4720746	9/15/1996	5
USS	488842	4720746	5/15/1997	377
USS	488842	4720746	9/15/1997	5
USS	488842	4720746	5/15/1998	8
USS	488842	4720746	5/15/1999	100
USS	488842	4720746	5/15/2000	18
USS	488842	4720746	5/16/2002	172
USS	488842	4720746	5/21/2003	8
USS	488842	4720746	5/22/2003	5
USS	488842	4720746	10/26/2003	5
USS	488842	4720746	5/7/2004	5
USS	488842	4720746	7/20/2004	66
USS	488842	4720746	9/28/2004	5
USS	488842	4720746	9/28/2004	5
USS	488842	4720746	9/19/2005	5
USS	488842	4720746	5/23/2006	9
USS	488842	4720746	10/16/2006	5
USS	488842	4720746	5/22/2007	5

Station Name	X_Coord	Y_Coord	SampleDate	TSS (mg/L)
USS	488842	4720746	9/26/2007	19
USS	488842	4720746	5/19/2008	36
USS	488842	4720746	11/20/2008	7
USS	488842	4720746	6/4/2009	5
USS	488842	4720746	6/6/2010	11
USS	488842	4720746	11/13/2010	5
USS	488842	4720746	6/16/2011	18
USS	488842	4720746	11/8/2011	0
USS	488842	4720746	5/11/2012	5
USS	488842	4720746	11/16/2012	5
USS-1b	489051	4720748	6/22/2000	5

Turbidity

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
AWI012-26	490558	4720592	5/6/2003	1.12
AWI012-26	490558	4720592	5/7/2003	1.86
AWI012-26	490558	4720592	5/8/2003	11.4
AWI012-26	490558	4720592	5/16/2006	56.1
LSS	490595	4720578	5/15/1992	0.9
LSS	490595	4720578	9/15/1992	1.1
LSS	490595	4720578	5/15/1993	105
LSS	490595	4720578	9/15/1993	1.25
LSS	490595	4720578	5/15/1994	0.7
LSS	490595	4720578	9/15/1994	0.44
LSS	490595	4720578	5/15/1995	0.4
LSS	490595	4720578	9/15/1995	0.5
LSS	490595	4720578	5/15/1996	6.3
LSS	490595	4720578	9/15/1996	0.5
LSS	490595	4720578	5/15/1997	42
LSS	490595	4720578	9/15/1997	0.1
LSS	490595	4720578	5/15/1998	0.8
LSS	490595	4720578	9/15/1998	0.2
LSS	490595	4720578	5/15/1999	21
LSS	490595	4720578	9/15/1999	2.2
LSS	490595	4720578	5/15/2000	0.9
LSS	490595	4720578	6/21/2000	0.1
LSS	490595	4720578	6/22/2000	0.25
LSS	490595	4720578	9/15/2000	0.4
LSS	490595	4720578	9/26/2000	0.1

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
LSS	490595	4720578	9/26/2000	47
LSS	490595	4720578	5/15/2001	1.2
LSS	490595	4720578	9/15/2001	0.6
LSS	490595	4720578	5/15/2002	9.97
LSS	490595	4720578	10/17/2002	0.6
LSS	490595	4720578	5/21/2003	3.62
LSS	490595	4720578	8/12/2003	0.386
LSS	490595	4720578	8/12/2003	0
LSS	490595	4720578	10/26/2003	0.87
LSS	490595	4720578	2/5/2004	1.8
LSS	490595	4720578	5/7/2004	3.19
LSS	490595	4720578	5/18/2004	0.512
LSS	490595	4720578	5/18/2004	677
LSS	490595	4720578	9/28/2004	0.134
LSS	490595	4720578	9/28/2004	0.85
LSS	490595	4720578	5/19/2005	5.69
LSS	490595	4720578	9/19/2005	0.72
LSS	490595	4720578	10/19/2005	0.537
LSS	490595	4720578	5/22/2006	7.69
LSS	490595	4720578	10/16/2006	0.6
LSS	490595	4720578	1/13/2007	0
LSS	490595	4720578	2/23/2007	0
LSS	490595	4720578	3/15/2007	0
LSS	490595	4720578	4/16/2007	0
LSS	490595	4720578	5/15/2007	0.69
LSS	490595	4720578	5/22/2007	0.65
LSS	490595	4720578	6/14/2007	0
LSS	490595	4720578	7/16/2007	1
LSS	490595	4720578	8/13/2007	1
LSS	490595	4720578	9/25/2007	0.3
LSS	490595	4720578	12/9/2007	0
LSS	490595	4720578	2/14/2008	0
LSS	490595	4720578	3/21/2008	0
LSS	490595	4720578	4/24/2008	1
LSS	490595	4720578	5/19/2008	15.4
LSS	490595	4720578	5/29/2008	4
LSS	490595	4720578	7/27/2008	8
LSS	490595	4720578	8/27/2008	0.74
LSS	490595	4720578	9/17/2008	3.61
LSS	490595	4720578	10/22/2008	0.78

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
LSS	490595	4720578	11/20/2008	1.65
LSS	490595	4720578	11/20/2008	1.65
LSS	490595	4720578	11/24/2008	0.43
LSS	490595	4720578	1/27/2009	0.68
LSS	490595	4720578	2/24/2009	0.34
LSS	490595	4720578	3/31/2009	0.68
LSS	490595	4720578	4/28/2009	0.64
LSS	490595	4720578	5/31/2009	13.56
LSS	490595	4720578	6/28/2009	15.3
LSS	490595	4720578	9/3/2009	1.73
LSS	490595	4720578	9/13/2009	0.92
LSS	490595	4720578	9/28/2009	1.06
LSS	490595	4720578	11/20/2009	1.59
LSS	490595	4720578	2/23/2010	0.97
LSS	490595	4720578	5/26/2010	0.82
LSS	490595	4720578	6/3/2010	44.1
LSS	490595	4720578	7/29/2010	0.56
LSS	490595	4720578	8/26/2010	3.61
LSS	490595	4720578	9/8/2010	1
LSS	490595	4720578	11/10/2010	8.23
LSS	490595	4720578	2/9/2011	0.43
LSS	490595	4720578	6/1/2011	21.7
LSS	490595	4720578	6/15/2011	231
LSS	490595	4720578	7/19/2011	0.67
LSS	490595	4720578	8/28/2011	115.9
LSS	490595	4720578	8/29/2011	1.99
LSS	490595	4720578	9/19/2011	0.08
LSS	490595	4720578	11/7/2011	0.27
LSS	490595	4720578	12/19/2011	0.5
LSS	490595	4720578	1/31/2012	0.48
LSS	490595	4720578	2/22/2012	0.74
LSS	490595	4720578	3/23/2012	0.61
LSS	490595	4720578	4/25/2012	4.62
LSS	490595	4720578	5/9/2012	2.17
LSS	490595	4720578	6/21/2012	0.41
LSS	490595	4720578	7/30/2012	0.3
LSS	490595	4720578	8/28/2012	0.51
LSS	490595	4720578	9/12/2012	1.11
LSS	490595	4720578	10/29/2012	0.9
LSS	490595	4720578	11/13/2012	0.93

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
LSS	490595	4720578	12/19/2012	0.81
LSS-1a	490193	4720795	5/21/2003	8.03
LSS-1b	489809	4720788	5/21/2003	11.8
LSS-1c	489456	4720773	5/21/2003	9.4
LSS-2	491198	4719558	5/21/2003	8.5
LSS-2	491198	4719558	5/22/2003	8.98
LSS-2	491198	4719558	10/26/2003	1.8
LSS-2	491198	4719558	10/27/2003	1
LSS-2	491198	4719558	6/6/2010	3.34
LSS-2	491198	4719558	11/12/2010	2.63
LSS-2a	490799	4720396	5/21/2003	4.98
LSS-2b	490938	4720114	5/21/2003	6.34
LSS-M1	490425	4720661	8/9/2007	0
LSS-M1	490425	4720661	10/9/2007	0
LSS-M1	490425	4720661	12/9/2007	0
LSS-M1	490425	4720661	5/29/2008	6
LSS-M1	490425	4720661	7/27/2008	0
LSS-M1	490425	4720661	5/31/2009	4.19
LSS-M1	490425	4720661	11/22/2009	1.24
LSS-M1	490425	4720661	6/3/2010	76.2
LSS-M2	490483	4720649	8/9/2007	0
LSS-M2	490483	4720649	10/9/2007	0.2
LSS-M2	490483	4720649	12/9/2007	1
LSS-M2	490483	4720649	5/29/2008	4
LSS-M2	490483	4720649	7/27/2008	2
LSS-M2	490483	4720649	5/31/2009	6.71
LSS-M2	490483	4720649	11/22/2009	1.46
LSS-M2	490483	4720649	6/3/2010	46.2
SW-SFSC-200	485902	4719212	5/20/2003	2.4
SW-SFSC-200	485902	4719212	5/20/2003	3.7
SW-SFSC-200	485902	4719212	8/12/2003	0.142
SW-SFSC-200	485902	4719212	8/12/2003	0
SW-SFSC-500	487850	4720525	5/20/2002	1.4
SW-SFSC-500	487850	4720525	5/20/2002	3
SW-SFSC-500	487850	4720525	8/12/2003	0.184
SW-SFSC-500	487850	4720525	8/12/2003	0
SW-SFSC-500	487850	4720525	10/19/2005	0.105
SW-SFSC-500	487850	4720525	5/23/2006	2.711
SW-SFSC-500	487850	4720525	10/16/2006	0.3
SW-SFSC-500	487850	4720525	5/22/2007	1.25

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
SW-SFSC-500	487850	4720525	9/26/2007	0.3
SW-SFSC-500	487850	4720525	5/19/2008	13.2
SW-SFSC-500	487850	4720525	6/4/2009	2.25
SW-SFSC-500	487850	4720525	6/6/2010	60.7
SW-SFSC-500	487850	4720525	11/13/2010	0.58
SW-SFSC-500	487850	4720525	6/16/2011	19.86
SW-SFSC-500	487850	4720525	11/8/2011	0.1
SW-SFSC-500	487850	4720525	5/11/2012	6.32
USS	488842	4720746	6/4/1979	1
USS	488842	4720746	5/15/1992	2.1
USS	488842	4720746	5/15/1993	130
USS	488842	4720746	5/15/1994	2.2
USS	488842	4720746	9/15/1995	2.1
USS	488842	4720746	5/15/1996	6.4
USS	488842	4720746	9/15/1996	0.7
USS	488842	4720746	5/15/1997	96
USS	488842	4720746	9/15/1997	0.5
USS	488842	4720746	5/15/1998	0.8
USS	488842	4720746	5/15/1999	21
USS	488842	4720746	5/15/2000	4.2
USS	488842	4720746	5/16/2002	75.7
USS	488842	4720746	5/20/2003	43.5
USS	488842	4720746	5/21/2003	7.69
USS	488842	4720746	5/22/2003	8.42
USS	488842	4720746	10/26/2003	1.24
USS	488842	4720746	5/7/2004	4.32
USS	488842	4720746	9/28/2004	2.29
USS	488842	4720746	9/19/2005	1.5
USS	488842	4720746	5/23/2006	8.42
USS	488842	4720746	10/16/2006	1.3
USS	488842	4720746	5/22/2007	2.42
USS	488842	4720746	9/25/2007	15.9
USS	488842	4720746	5/19/2008	24.4
USS	488842	4720746	11/20/2008	1.48
USS	488842	4720746	6/4/2009	6.44
USS	488842	4720746	6/6/2010	44.2
USS	488842	4720746	11/13/2010	1.45
USS	488842	4720746	6/16/2011	33.22
USS	488842	4720746	11/8/2011	2.65
USS	488842	4720746	5/11/2012	1.87

Station Name	X_Coord	Y_Coord	SampleDate	Turbidity (NTUs)
USS	488842	4720746	11/16/2012	1.94
USS-1a	488422	4720586	5/20/2003	9.87
USS-1b	489051	4720748	6/22/2000	3.6
USS-2	485855	4719175	5/20/2003	3.73

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Appendix E. Star Valley Conservation District *E. coli* Sampling and Analysis Plan

Sampling and Analysis Plan (SAP)

for the Salt River Watershed

Prepared: August 2004

Star Valley Conservation District

P.O. Box 216

Afton, Wyoming 83110

Prepared by:

Western Management Services, LLC

Cheyenne, Wyoming

(307) 634-0286

This Sampling and Analysis Plan (SAP) is written to meet the requirements of the Wyoming Department of Environmental Quality (DEQ) and the United States Environmental Protection Agency (EPA). It also provides guidelines to field and lab personnel who will be collecting and analyzing samples. *Information printed in italics is especially important to field and lab personnel.*

Table of Contents

INTRODUCTION:

Portions the Salt River Watershed, including Stump Creek, have been listed as impaired due to elevated concentrations of fecal coliform bacteria. There are a number of possible sources of these bacteria including municipalities, septic systems, dairies, beef operations, horse pastures, and wildlife.

The growing human population of Star Valley is dependent upon the Salt River and its tributaries for many uses including recreation, livestock watering, and irrigation. Some of these uses could be impacted by high fecal coliform concentrations.

In recognition of the importance of the Salt River to the residents of Star Valley, the Star Valley Conservation District has decided to take a pro-active role in monitoring fecal coliform bacteria. This Sampling and Analysis Plan (SAP) has been developed to guide monitoring efforts for the next several years. Results will be used to identify the primary sources of the bacteria and to promote solutions to the problem.

SPECIFIC WATER QUALITY CONCERNS AND SAMPLING GOALS:

Fecal coliform bacteria are the primary concern. The State standard for fecal coliform bacteria requires that the geometric mean of five samples collected during a 30 day period not exceed 200 colonies per 100 ml in waters utilized for recreation. Some historical data have approached or exceeded this standard.

Fecal coliform bacteria are known to originate from the intestines of warm blooded animals, including humans and livestock. While rare, livestock wastes have been known to transmit anthrax, brucellosis, colibacilos, coliform mastitismetritis, cryptosporidosis, erysipelas, giardiasis, leptospirosis, salmonella, tetanus, tuberculosis and tularemia. Some of these same diseases, as well as numerous others, can be transmitted by human wastes. (For a detailed description see: 'Control of Communicable Diseases in Man', 1995, American Public Health Association, 1015 15th St. N.W., Washington, D.C.)

It should be noted that water samples submitted for analysis are seldom tested for specific disease causing organisms such as those listed above. Instead, to reduce lab costs, samples are usually tested for fecal coliform bacteria. While most varieties of fecal coliform bacteria do not pose a serious health threat, their presence serves as an indication of pollution. If they are present, there is a possibility that serious pathogens exist.

Because of these concerns, the Star Valley Conservation District intends to monitor fecal coliform bacteria at numerous locations in the Salt River Watershed beginning August 2004. The District is currently involved with a five

Extensive or Intensive Monitoring?

When developing this SAP, the District faced a decision between extensive and intensive sampling. The State standard is written to emphasize intensive sampling. It requires 5 samples from a single location within a 30 day period. Because of the costs, a sampling plan developed around this requirement would be limited to relatively few locations and times of the year. Recognizing this limitation, it was decided that a more extensive view of the Valley throughout the calendar year is also needed. Therefore, this SAP utilizes both an extensive and intensive approach. Using an extensive approach, many sites throughout the Valley will be sampled once per month during ice-free periods. Using an intensive approach, a few sites (locations to be decided by findings) will be sampled 5 times within a 30 day period in order to conform with the requirements of the State standard. Together, extensive and intensive sampling will allow the District to get broad view data for planning purposes and provide intensive data complying with the requirements of the state standard.

year watershed planning effort, and this SAP is intended to be a complement to that effort during approximately the same timeframe. The two goals of the fecal coliform monitoring program include:

- Primary Goal: To collect creditable fecal coliform data at numerous locations and at various times of the year in order to develop an understanding of the primary sources of fecal coliform bacteria at various times of the year.
- Secondary Goal: To utilize the accumulated information to promote appropriate Best Management Practices (BMPs) in the Salt River Watershed and to continue to monitor for progress.

PARAMETERS, SAMPLES AND METHODS:

Parameters... Water quality monitoring will focus almost exclusively on surface water fecal coliform bacteria (field temperature readings and turbidity estimates will be recorded because they have relevance to bacteria concentrations and will not add to the cost of the project). Bacteria samples will be analyzed by the City of Afton's water treatment plant laboratory. *Lab results will provide a colony count and not just a positive/negative reading.*

Sample Stations... Surface water sample stations will be monitored at numerous locations in the Salt River Watershed (see map). Criteria for selecting the stations included: 1) desire to obtain a broad geographical representation of the Salt River watershed; 2) proximity to possible sources of bacteria; 3) access to the monitoring site; and 4) budgetary considerations dictating the total number of possible sites.

Sample stations fall into two categories: regular and optional. On every sample date, samples will be collected at 9 regular stations (if water is present and ice conditions allow):

1. McCoy Creek Road Bridge (on Salt River immediately above Palisades Reservoir)
2. Etna gaging station (on Salt River at USGS gaging site)
3. Freedom Bridge (on Salt River near Freedom, Wyoming)
4. East Side Canal (on Salt River above Thayne, Wyoming)
5. The Narrows (on Salt River near Auburn, Wyoming
6. Stump Creek (near Wyoming/Idaho boundary)
7. Burton Springs (on Salt River near Afton, Wyoming)
8. Smoot Bridge (on Salt River near Smoot, Wyoming)
9. Forest Dell (on Salt River south of Smoot, Wyoming)

Note: In recent years, a station on Crow Creek has been monitored for fecal coliform bacteria. Because the results for this station have been consistently low, the Crow Creek station has been designated an optional station in this SAP.

In addition to these regular stations, numerous optional stations will be sampled. There will be two types of optional stations: 1) optional exploratory stations; and 2) optional intensive stations. Optional exploratory stations are especially important. For example, if a high fecal reading is obtained at the regular station on the lower end of Stump Creek, the three tributaries that confluence immediately above the regular site would be obvious choices for optional exploratory stations. Similarly, other optional exploratory stations will be sampled in other locations in the valley when a regular station produces a high reading. The anticipated benefit of the optional exploratory sites will be to more precisely identify the major fecal coliform contributing areas. Optional intensive stations year watershed planning effort, and this SAP is intended to be a complement to that effort during approximately the same timeframe. The two goals of the fecal coliform monitoring program include:

- Primary Goal: To collect creditable fecal coliform data at numerous locations and at various times of the year in order to develop an understanding of the primary sources of fecal coliform bacteria at various times of the year.

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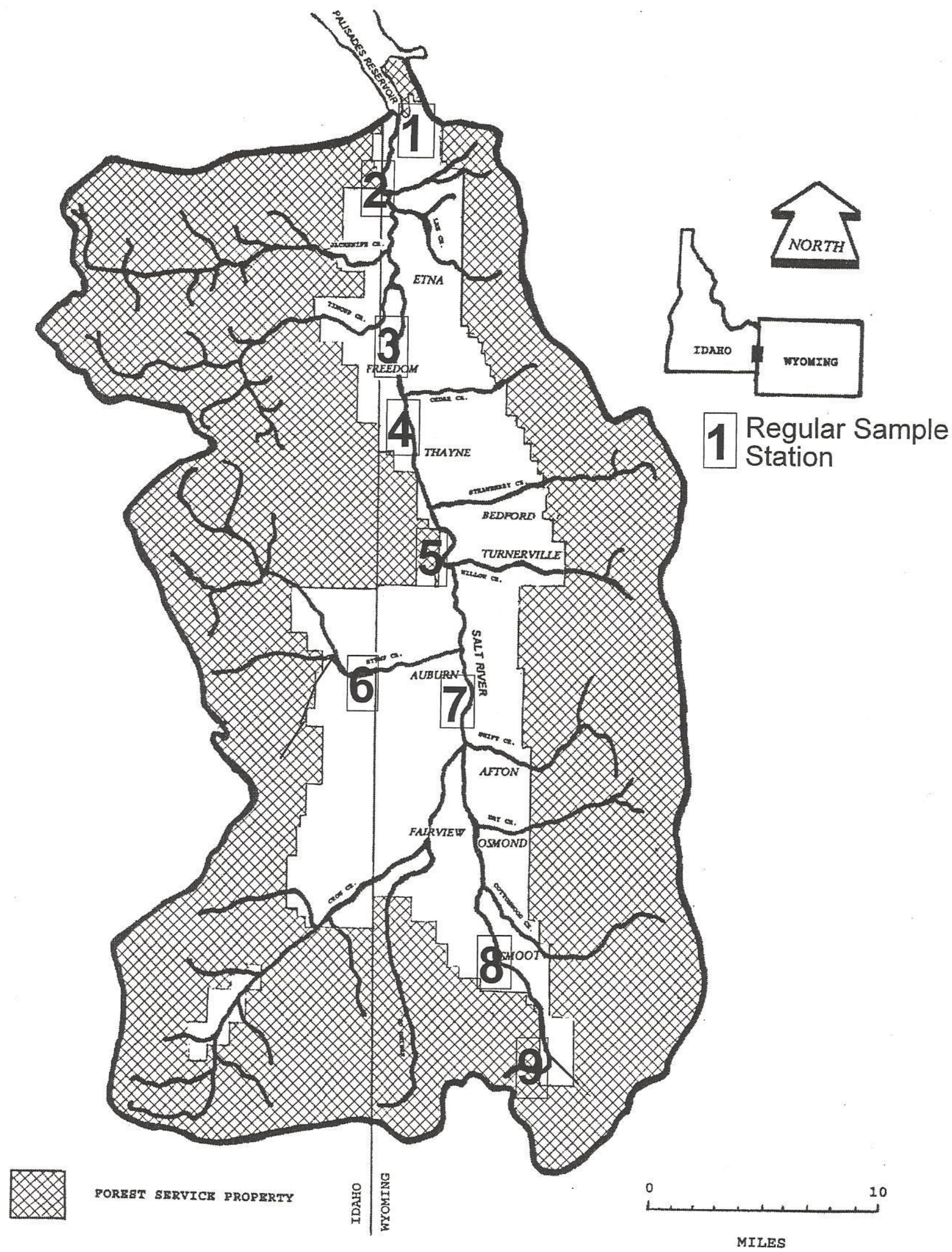
MAP OF THE SALT RIVER WATERSHED



will be established if it is determined that substantially high or low coliform counts merit following a protocol consistent with the State standard which requires 5 samples within a 30 day period. *Optional exploratory stations and/or optional intensive stations will be selected based on the observations of field personnel. Optional exploratory sites will be sampled within one week of a high reading at a regular site. Ideally, optional exploratory sites will be sampled the day after lab results reveal a "hot spot" at a regular site. All optional sites will be carefully identified and described. Due to extensive irrigation withdrawals, some of streams at the upper end of the valley may not contain flowing water during irrigation season. It is not unusual for some of these streams to be completely dry during June, July and August. Field personnel should use discretion when selecting these low water sites as optional stations. If water is present but not flowing, the site should not be sampled.*

Sample Frequency... For "regular stations"**, s**amples will be collected monthly (seven times per year) during the "ice free" period. In order to allow for possible event based sampling (during or immediately after runoff), specific sample dates have not been established. Generally, sample dates will be: mid-April; mid-May, mid-June, mid-July, mid-August, mid-September, and mid-October.

Sample Collection Methods... Samples will be collected by the laboratory technician who will analyze the samples. This arrangement offers several advantages: 1) chain of custody issues are minimized; 2) the lab technician can conduct sampling activities at times that are conducive to his lab schedule thereby avoiding holding time problems; 3) sampling and/or lab procedures can be readily modified if duplicates and blanks produce inconsistent results; and 4) optional stations can be quickly selected based on lab results and field observations.

Grab samples, rather than composite samples, will be collected from each sample station. Grab samples will be taken from a well mixed section of the channel or stream 6 to 12 inches below the water surface. *(Note to monitoring personnel: It is especially important that hands and runoff from hands do not contaminate the sample.)* Sample bottles (100 ml) containing sodium thiosulfate will be purchased from IDEXX. These bottles will be used directly for collecting samples. It should be noted that the DEQ protocol calls for using Whirl-Pac bags for collecting the samples and then transferring the sample to a bottle. The proposed collection procedure is a slight deviation from this protocol. Specifically, samples will be collected using the following procedure:

1. using 100ml bottles, containing sodium thiosultfate, remove the screw cap
2. lower the open bottle, upside down, into the water column (note: the sodium thiosultfate is adhered to the walls of the bottle and will not run out when the bottle is turned upside down.)
3. at approximately 6 to 12 inches of depth, turn the bottle right side up (facing it upstream) and allow the bottle to fill
4. remove the bottle from the stream
5. replace the screw cap and immediately pack the bottle carefully in a cooler with ice

Equipment...Coolers and sample bottles will be supplied by the lab in Afton. All samples will be refrigerated with ice during sampling and transporting. *(Note to monitoring personnel: Be sure to bring enough sample bottles for the anticipated number of sample locations plus additional bottles for duplicate and blank samples; see section entitled Quality Control Samples. Also, if conditions require sampling procedures different than those described in this section, please describe in detail.)*

QUALITY CONTROL (QC) SAMPLES:

In order to insure quality of field work and laboratory analysis, several procedures will be followed. First, 10 percent of all samples will be duplicates. In other words for 10 percent of the samples, two samples will be collected from one station and both samples will be submitted for analysis. The station to be sampled in duplicate will be varied from one sample date to the next *(location of duplicates and blanks listed in data report).*

Second, 10 percent field blanks will be submitted to the lab on each monitoring trip. *(Note: The Afton lab uses autoclaved de-ionized water as a blank.)*

Third, all sample containers will be carefully labeled as to date and exact location, and a field report will be completed for each sampling date (see field report in appendix). Detailed notes will be maintained regarding locations of duplicate samples and field blanks as well as weather conditions and approximate flow rates.

ANALYTICAL METHODS AND HOLDING TIMES:

The laboratory will be using the IDEXX/Colilert (http://www.idexx.com/Water/Products/colilert/index.cfm) method for analyzing samples. It should be noted that this method is designed to enumerate E. coli even though the State standard is expressed as total fecal coliform bacteria. Because the method provides quick results and because E. coli are typically the predominant form of fecal coliform bacteria, the Wyoming Department of Environmental Quality has approved the IDEXX/Colilert method for testing in Wyoming. The method also provides a total coliform reading which will be recorded.

Parameters and Analysis Methods				
Parameter	**Reporting Units**	**Test Method**	**Reducing Agent***	**Holding Time**
E. coli	Colonies/100 ml	IDEXX/Colilert	Sodium thiosulfate	6 hours
Total coliform bacteria	Colonies/100 ml	IDEXX/Colilert	Sodium thiosulfate	6 hours

* Dechlorinates samples. If chlorine is present in the water, it may interfere with bacterial reproduction and cause inaccurate lab results.

CALIBRATION AND MAINTENANCE OF EQUIPMENT:

Field and lab personnel will be responsible for calibration and maintenance of field and lab equipment. Sample duplicates and blanks will provide the primary means of assessing the quality of field and lab procedures.

CHAIN OF CUSTODY:

Samples will be collected by lab personnel and transported directly to the lab. This will greatly reduce chain of custody issues because the samples will be continuously in the possession of one individual. Nevertheless, field and lab forms will be signed for each sample date.

PROJECT OVERSIGHT AND CORRECTIVE ACTION:

The Star Valley Conservation District Board of Supervisors will be responsible for project oversight and corrective action. The Board will review project data on a regular basis and at the end of each field season. If deemed appropriate, the Board may seek the assistance of technical experts to review end of season data. A board member of the Star Valley Conservation District will accompany field personnel on at least one monitoring trip.

DATA EVALUATION:

Periodic evaluation of data will be important for a number of reasons, especially for selecting optional sites. This will be accomplished by field/lab personnel in communication with the Star Valley Conservation District.

PROJECT RECORDS AND REPORTS:

All lab reports and field data will be sent to the Star Valley Conservation District. The Board of Supervisors will be responsible for obtaining the technical assistance necessary to analyze the data and produce a report.

HEALTH AND SAFETY:

While most sample stations are not expected to contain extremely high concentrations of bacteria, there is the potential that some sites (especially those near livestock operations and municipalities) could have high concentrations of bacteria. Therefore, it is prudent to observe health and safety precautions when collecting all samples, particularly those near a suspected source of bacteria. Some of the more common diseases known to be transmitted by livestock include: anthrax, brucellosis, colibacilos, coliform mastitismetritis, cryptosporidosis, erysipelas, giardiasis, leptospirosis, salmonella, tetanus, tuberculosis and tularemia. *To reduce chances of getting these diseases, monitoring personnel should wear rubber gloves and avoid drinking/splashing contaminated water. Hands should be washed thoroughly after sampling.*

Also, the collection of samples in running streams involves inherent dangers, especially during high water and/or icy conditions. *Field monitoring personnel are admonished to use prudence.*

BUDGET:

There are numerous unknowns in the proposed SAP. For example, it is not known how many optional stations may be needed. Also, it is not known how many years of monitoring data will be needed to identify primary contributing areas. Therefore, the following budget is a "best guess" estimate.

Approximate Annual Budget for the Star Valley Sampling and Analysis Plan (SAP)

Item	Cost Per Sample Trip	Annual Cost
Regular Site Laboratory Analysis*	11 samples@ $23 per sample = $253**	$1,771
Regular Site Field Personnel Time/Travel	4 hours and 100 miles = $100	$700
Optional Site Laboratory Analysis	10 samples@$23 per sample = $230**	$1,610
Optional Site Field Personnel Time/Travel	3 hours and 60 miles = $65	$455
Technical Assist. to Review Data/Prepare Report	none	$2,000
Misc. District Expenses (printing, mileage, etc.)	none	$500
Totals		**$7,036**

* assumes seven sample trips per year. **includes duplicates and blanks

8

Appendix F. **Star Valley Conservation District Surface Water Quality Monitoring Field Audit**

Surface Water Quality Monitoring Field Audit

Sampling Entity:	Star Valley Conservation District
Date:	May 31, 2007
Participants:	Brenda Ashworth, Star Valley CD
	Codee Baxter , Star Valley CD
	Jack Smith, WDEQ/WQD
Location:	Salt River, Lincoln County
Audit By:	Jack Smith, NPS Coordinator

Introduction

The current monitoring program on the Salt River consists of the collection of bacteria (Total Coliform and *E. coli*) and field parameters at nine primary locations along the Salt River and one location on Stump Creek. Additional sample locations of interest have been established periodically to substantiate high readings at the primary locations.

Calibrations

The district recently obtained a new multiprobe field parameter instrument (Hanna Instruments 9828). The district was using calibration standards provided with the instrument. District staff was not clear what specific standards (pH and EC) are utilized in the factory calibration kit.

Comment: Field readings with this new probe for dissolved oxygen and pH were consistently lower than readings obtained by DEQ with their field meters. The auditor felt the multiprobe values were unrealistically low for the Salt River system. It was recommended that the district learn more about this new piece of equipment and its calibration. The factory pH calibration kit may be using a two-point calibration solution of pH 3 and pH 7 while the instrument is being mechanically set to do a two-point calibration of pH 7 and pH 10. The DO meter may need to have the barometric pressure or elevation entered into the instrument during the calibration process. DO readings were becoming more reasonable later in the day, which suggests the instrument "warm-up" period may not have been long enough or even interrupted by the instrument's automatic shut off mode.

DEQ field parameter data are provided in Table 1 if the district wishes to include these in their data set.

Field Notebooks and Data Sheets.

The district's field data sheets are complete. The district was very good at making certain all items on the data sheet were completed.

1

Equipment.

The district had all necessary equipment for the monitoring effort – both for field and laboratory work. As mentioned above, the district does need to learn more about the calibration, operation, and function with their new Hanna multiprobe.

Field Procedures.

Site Selection. The district has established monitoring locations along the entire length of the Salt River within Star Valley. These sites should enable the district to evaluate water quality bacteriological conditions throughout the valley and also partition out loading from various land use effects in the valley.

Bacteria Sample Collection. The district used very good field procedures in the collection, transport, and preservation of bacteria samples. The district used good aseptic techniques and the potential of sample contamination in the field appeared low. Sodium thiosulfate was used in all samples. All samples were immediately place in a cooler on ice following sample collection. Sample collection times were consistently and accurately recorded.

Field Parameter Data Collection. The district used very good field procedures to collect field water chemistry data. The field readings were collected in the thalwag and the readings should reflect a well mixed and representative water column. The samplers took care to locate the probe at the approximate $6/10^{th}$ depth in the water column. The samplers stood to the side and slightly downstream of the probe. If these in-situ readings appear to "drift" too much due to the moving water column, the samplers may wish to use clean, polyethylene bucket or large laboratory beaker to grab a sample for meter readings.

QA Samples. The district made one field blank sample for this sampling event. One duplicate bacteria sample was collected during the sampling event. This intensity of QA samples met QA/QC objectives.

Comment: As mentioned earlier in this report, meter readings were a concern because of unfamiliarity with the new instrument. The samplers should always be cognizant of "abnormal" readings with their meters while in the field. For example, unexpected acidic conditions (pH values less than 6 standard units, unexpected basic conditions (pH values greater than 9 standard units), or hypoxic conditions (DO values less than 5 mg/L) in flowing waters, should cause the samplers to immediately recalibrate the instrument in the field and collect another reading.

Laboratory Procedures.

E. coli Sample Processing.

The district uses the Idexx Colilert system to determine Total Coliform and *E. coli* most probable numbers (MPN). The district exhibited very good lab sample processing techniques. All samples were processed within 6 hours of collection. No dilutions were made. The staff checked and verified the incubator was at the proper temperature (35°C) prior to processing. Correct sample volumes were used. Tray sealing techniques were very good with a minimum of air bubbles in sample cells. Trays were completely and accurately labeled. Samples entered the incubator within the maximum 30 minutes after the reagent was mixed with the sample.

E. coli Sample Reading.

The district counted trays that had been collected and processed the previous day. The trays were taken out of the incubator within the mandatory 26 ± 2 hour incubation period. The district counted both Total Coliform and *E.coli* for each tray. Idexx comparator trays were used in the counts. Each positive cell was marked with a permanent marker and then tallied. The permanent marker checks allow the district to go back and recount the number tallied at a later date if questions arise. There was excellent communication between staff members on questionable positive cells. The district correctly used the MPN Table to record values on their data sheets.

Conclusions.

The May 31, 2007 field audit of the Star Valley Conservation District bacterial monitoring program indicates the district staff is well trained and knowledgeable about bacteria monitoring. The audit identified problems with field parameters collected with the district's new Hanna 9828 multiprobe. Familiarity with the new probe, primarily its calibration and warm-up time, needs to be attained. At this point, field pH values less than 7 standard units and dissolved oxygen levels less than 7 mg/L, appear questionable. This audit suggested that the *E. coli* data collected by the Star Valley Conservation District should have few QA problems and the data should be representative of the field conditions encountered.

Table 1. WDEQ Field Parameter Data. Salt River. May 31, 2007.

Station	Time	Temp. (°C)	pH (Std. Units)	EC (uS/cm)	DO (mg/L)	Turbidity (NTU)
Salt River at East Side Canal	09:10	9.4	8.21	497	9.54	8.08
Salt River at Burton Springs	10:25	8.7	7.99	444	10.7	1.68
Salt River at Smoot Bridge	11:12	8.0	8.67	344	9.75	No data
Salt River at Co. Rd 151	11:26	8.3	8.24	343	9.86	No data
Salt River at Forest Dell	11:50	8.7	8.43	349	9.65	No data

Jack Smith 10/8/2007

Jack Smith, NPS Program Coordinator Date

Cc: Jeff Clark - WDEQ Cheyenne

3

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Appendix G. ***E. coli* TMDLs**

The Salt River subbasin has one streamflow gage maintained by the USGS, located on the main-stem river near Etna, Wyoming (13027500). This gage has been in operation since 1953 and continues to collect streamflow data currently. Peak stream flows generally occur in May and June, with base flow conditions generally occurring during the winter months of January, February, and March (Table G-1 and Figure G-1). These flow data were used to generate total maximum daily loads for sediment and *E. coli* in the Salt River watershed. BURP streamflow data were used in combination with flow data from the gaging station to generate estimates of monthly flows for ungaged streams requiring *E. coli* TMDLs.

Table G-1. Monthly discharge data for Salt River at Etna (USGS gage 13027500) for period of record (1953–2014).

	Month											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Monthly mean discharge (cfs)	440	426	472	946	1,660	1,480	846	603	615	599	570	501
Standard deviation	74	71	117	340	811	901	451	200	163	136	108	89
Percent of total	4.8	4.7	5.2	10.3	18.1	16.2	9.2	6.6	6.7	6.5	6.2	5.5

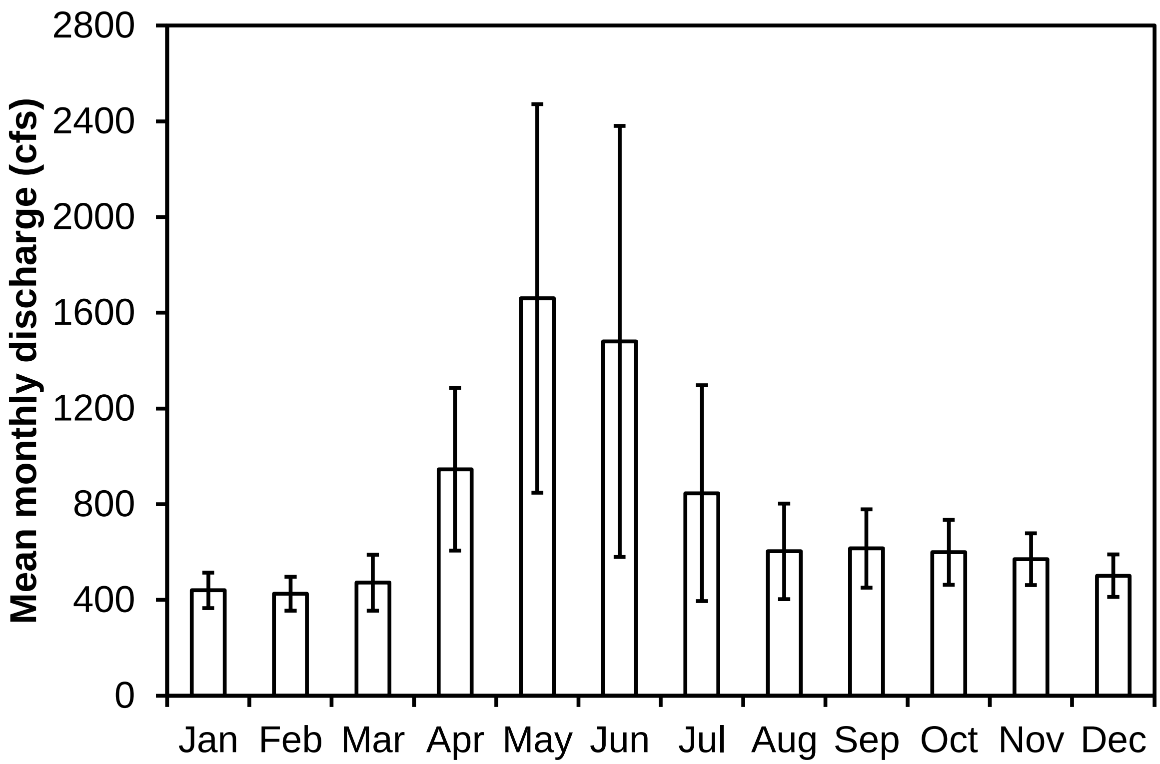

Figure G-1. Mean monthly discharge and standard deviation of Salt River at Etna (USGS gage 13027500).

Bear Canyon (ID17040105SK003_02e) was monitored by BURP in 1999 and 2004, and both surveys took place in July. Discharge was 3.1 and 3.14 cfs, respectively. Assuming that at the Etna gage, July flows typically represent 9.2% of the total discharge for a year, we estimated Bear Canyon flows to follow the same pattern.

Lower Stump Creek (ID17040105SK006_04) was monitored by BURP in 1996 and 2002. Since 1996 was a relatively wet year and 2002 was a relatively dry year, we used an average on the estimated monthly flows from each year to better approximate the mean monthly discharge.

Smoky Creek (ID17040105SK007_02c) was monitored by BURP in 1997 and 2002. In 1997, it was a wet year and 2002 was a relatively dry year. Therefore, the generated flows were averaged to better estimate the mean monthly flow.

Draney Creek (ID17040105SK007_02f) was monitored by BURP in 1998 and 2003. The two flows were averaged to better estimate the mean monthly flow.

Crow Creek (ID17040105SK008_04) was monitored by BURP in 1996, 2002, 2006, 2008, and 2012. Discharge results indicate that flow in this segment of Crow Creek is highly variable in summer, likely as a result of irrigation diversions. Flows ranged from less than 3 cfs in July of 2008 to over 35 cfs in July of 1996. To generate an estimate for mean monthly flow for Crow Creek, BURP flows were averaged and then extrapolated to other months using the same relationships as the Salt River at Etna gage. Table G-2 shows estimates on mean monthly flows for AUs requiring *E. coli* TMDLs, and Table G-3 shows the TMDLs based on the water quality standard for *E. coli*.

Table G-2. Estimated mean monthly flows for AUs in the Salt River subbasin requiring *E. coli* TMDLs.

Water Body/ Assessment Unit Number	Mean Monthly Flow Estimates (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bear Canyon ID17040105SK003_02e	1.62	1.57	1.74	3.49	6.12	5.46	3.12	2.22	2.27	2.21	2.10	1.85
Lower Stump Creek ID17040105SK006_04	9.20	8.91	9.87	19.78	34.72	30.95	17.69	12.61	12.86	12.53	11.92	10.48
Smoky Creek ID17040105SK007_02c	0.26	0.25	0.28	0.56	0.99	0.88	0.50	0.36	0.37	0.36	0.34	0.30
Draney ID17040105SK007_02f	0.76	0.73	0.81	1.63	2.86	2.55	1.46	1.04	1.06	1.03	0.98	0.86
Crow Creek ID17040105SK008_04	10.13	9.80	10.86	21.77	38.20	34.06	19.47	13.88	14.15	13.79	13.12	11.53

Note: cfs = cubic feet per second.

Table G-3. *E. coli* TMDLs for streams in the Salt River subbasin based on estimated monthly flows and the water quality standard of 126 cfu/100 mL for a five-sample geometric mean over a 30-day period.

Water Body/ Assessment Unit Number	Target Monthly *E. coli* Loads (cfu/day × 10^9)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bear Canyon ID17040105SK003_02e	4.99	4.84	5.36	10.76	18.87	16.83	16.83	6.84	7.00	6.81	6.47	5.70
Lower Stump Creek ID17040105SK006_04	28.36	27.47	30.43	60.98	107.03	95.41	54.33	38.87	39.64	38.63	36.75	32.31
Smoky Creek	0.80	0.77	0.86	1.73	3.05	2.71	1.54	1.11	1.14	1.11	1.05	0.92

ID17040105SK007_02c												
Draney Creek ID17040105SK007_02f	2.33	2.26	2.51	5.03	8.83	7.87	4.50	3.21	3.27	3.18	3.03	2.66
Crow Creek ID17040105SK008_04	31.23	30.21	33.48	67.11	117.76	105.00	60.02	42.79	43.62	42.51	40.45	35.53

Note cfu = colony forming unit

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Appendix H. JR Simplot Smoky Canyon Mine TSS Wasteload Allocation.

December 2015

JR SIMPLOT SMOKY CANYON MINE SEDIMENT LOADING ANALYSIS

Marty Jacobson, US EPA ORISE Participant

This document describes the methodology used to calculate sediment loading from the Smoky Canyon Mine into Smoky Creek. Specifically, it explains the rationale behind the choosing of values associated with factors used in the sediment loading equation. In the analysis it was assumed that all of the runoff from the mine was at the level of the Idaho turbidity criteria, and no adjustment was made for the use of BMPs to control sediment in runoff.

Sediment loads were calculated using the Simple Method (Schueler 1987):

Load (lbs) = Runoff x Area x Sediment concentration (TSS) x Conversion factor

Target Sediment Concentration

The Idaho turbidity criteria of 25 NTU was used as a water column target. It was converted to a TSS value based on a measured relationship between NTU and TSS in a nearby watershed which was provided by IDEQ. The following equation represents that relationship: $y = 1.7805x + 2.9388$ ($R^2 = 0.86$).

Runoff

Runoff in the Simple Method equation was calculated as:

Runoff (in) = Runoff coefficient x Precipitation x Fraction of precipitation events generating runoff

The fraction of precipitation events that generate runoff is usually assumed to be 0.9 and therefore 0.9 was used in this analysis. The runoff coefficient represents the proportion of precipitation that becomes overland runoff from the landscape. Larger runoff coefficient values indicate greater amounts of runoff while smaller values indicate less runoff. Runoff coefficients are primarily determined from soil characteristics, land cover, and topography.

Soils – Soils have not been mapped for the area of interest. Therefore, soil characteristics were examined in adjacent areas that had topography similar to that of Smoky Canyon mine (i.e. mountainous). A classification of hydrologic soil group B was chosen for this analysis. Hydrologic soil group B soils have moderately low runoff potential.

Land cover – Land cover was determined by analyzing recent satellite imagery, specifically, Landsat8 imagery from September 19, 2015. The satellite imagery was acquired from the U.S. Geological Survey's LandsatLook Viewer (http://landsatlook.usgs.gov/viewer.html). The Landsat8 imagery was used to classify vegetative cover as either bare, thin vegetation, or forested.

Topography - The average slope of the area of interest was determined to be greater than 25%. Slope was calculated from a digital elevation model (DEM).

Runoff coefficients of 0.6, 0.4, and 0.3 were chosen for bare, thinly vegetated, and forested land, respectively. Previous sediment load analyses in Idaho have shown a runoff coefficient of 0.6 to be a reasonably accurate runoff coefficient for bare ground associated with mining, given the slopes at the mine. Runoff coefficients for thinly vegetated and forest areas were chosen based on soil, land cover, and topography (Table 1, Gray 1972). An area-weighted runoff coefficient of 0.46 was calculated based on number of acres classified as bare, thinly vegetated, and forested.

December 2015

Table 1. Runoff coefficient factors associated with varying topography, soils, and land cover (Gray 1972).

Rural areas	Value of C*
Topography	
Flat land with slopes less than 1%	0.3
Rolling land with average slopes 1%–3%	0.2
Hilly land with average slopes of 3%–6%	0.1
Soil	
Tight, impervious clay	0.1
Medium, combination of clay and loam	0.2
Open, sandy loam	0.4
Cover	
Cultivated land	0.1
Woodland	0.2

Source: Data for urban areas from American Society of Civil Engineers (1982) and for rural areas from Gray (1972).

*The magnitude of the runoff coefficient, C, is obtained by adding values of C's for each of the three factors (topography, soil, and cover) and subtracting the sum from unity. For example, for flat cultivated watershed with medium soils $C = 1 - (0.3 + 0.2 + 0.1) = 0.4$.

Precipitation

Precipitation data were obtained from the National Climactic Data Center (NCDC) for the period of January 1, 1981 to December 31, 2014. Three stations were considered for use in this analysis. Afton Station (GHCND:USC00480027), Slug Creek Station (GHCND:USS0011G05S), and Willow Creek Station (GHCND:USS0010G23S). All three stations were of similar distance (Table 2) from Smoky Canyon mine but the Slug Creek station more closely matched the elevation of the area of interest which ranged from approximately 7,000 feet to 7,600 feet. In addition, Slug Creek had a much more complete dataset than Afton. Between 1981 and 2014, the Slug Creek data set had 35 years of complete data (not missing any daily precipitation values). In comparison, Afton only had 3 complete years between 1981 and 2014. For the analysis however, a particular year was included if it had a minimum of 345 days of data.

Table 2. National Climactic Data Center station elevation, distance from Smoky Canyon mine, and the number of years of data between 1981 and 2014 that were included in the calculation of the mean annual precipitation.

Station Name	Elevation (ft)	Distance (mi)	Mean Annual Precipitation (in)	Years of data between 1981 and 2014
Afton	6,243	10	18.5	19
Slug Creek	7,222	13	32.9	35
Willow Creek	8,378	15	52.9	34

Area

The area of Smoky Canyon mine included in this analysis was 492 acres. The watershed boundary is approximate and was delineated by hand using a shaded relief map, and shown as a dark black outline. The mine area within the Smoky Creek watershed boundary is the crosshatched area in Figure 3 below.

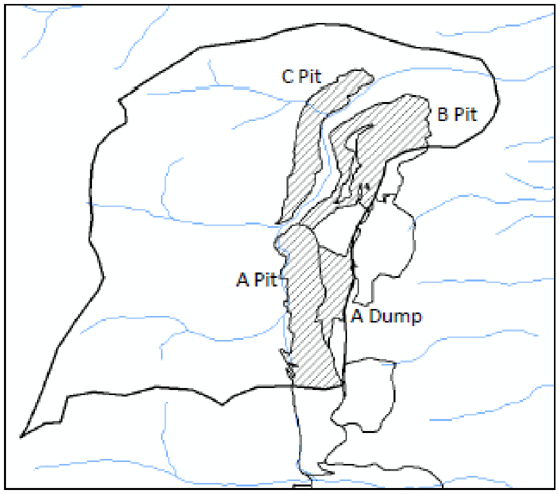

Figure 3. Smoky Creek watershed boundary (approximate) and Smoky Canyon mine panel boundaries.

Results

This analysis calculated a sediment load from Smoky Canyon mine to Smoky Creek of 72,482 pounds per year or 36.24 tons per year.

References

Gray, D.H. 1972. Soil and the city. In: T.R. Detwyler and M.G. Marcus (Editors). Urbanization and the Environment. Duxbury Press, Belmont, CA. pp. 135-168.

Schueler, T.R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments, Washington, DC.

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Appendix I. **Public Participation and Public Comments**

This TMDL addendum was developed with participation from the Salt River Watershed Advisory Group. Public comment was held April 28, 2015 to May 29, 2015.

Hannah Harris
DEQ Pocatello Regional Office
444 Hospital Way, #300
Pocatello, ID 83201

Re: Comments on Proposed Salt River Subbasin Assessment and TMDLs

Dear Ms. Harris,

On behalf of Snake River Waterkeeper, I submit these comments in my official capacity as Executive Director and on behalf of members of Snake River Waterkeeper, Inc., a registered 501(c)(3) organization based in Boise, Idaho. With a membership spanning the geographic reach of the Snake River Basin, my organization works to ensure the Clean Water Act's mandates of "swimmable, fishable, drinkable waters" are met for area residents as well as the fish, wildlife, and lands associated with and depending on the health and ecology of Snake River Basin waters.
We appreciate the opportunity to offer these comments on IDEQ's proposed Salt River subbasin assessment and related TMDLs. We are, however, concerned that the proposed assessments and TMDLs suffer from significant scientific errors and are flawed as a matter of law. As discussed below, these errors and flaws must be corrected in order for the Salt River to once again meet water quality standards as required under federal law – specifically, *inter alia*, provisions of the federal Clean Water Act, Administrative Procedures Act, and the CERCLA.

Where Surface Waters are Undesignated, the Most Sensitive Use Must Be Protected

IDEQ states that, within the Salt River subbasin, no streams possess designated uses. In turn, the state has assigned a presumed beneficial use of secondary contact recreation (SCR) on all streams in the subbasin because "their small size makes swimming, water skiing, or skin diving unlikely."[1] Thus, in the instant subbasin assessment, proposed TMDLs are written to protect, at most, SCR. Doing so ignores the CWA's mandate that the most sensitive use of a water be protected.

Specifically, and as noted in IDEQ's document (but not acted upon in salient TMDLs), a majority of streams within the subbasin would likely, as of 1975, support salmonid spawning.[2] A beneficial use of salmonid spawning requires stringent pollutant load limitations, as coldwater fisheries are one of the most sensitive beneficial uses of a waterway. The sensitive character of waters protected as potential salmonid spawning means that DEQ should, and indeed must, apply very stringent limitations on sediment and selenium, two primary pollutants of concern in the subbasin assessment.

On one hand, it appears that IDEQ accepts that the majority of streams within the Salt River subbasin will merit designation for salmonid spawning at some future date. On the other hand, none of IDEQ's sediment TMDLs for streams with a presumed SS beneficial use incorporate sufficient protections for that use or otherwise render it achievable. For instance, the subbasin assessment notes several times that a leading cause of sedimentation impairment is basin-wide grazing by cattle, much of which occurs on public lands under the control of the USFS. However, TMDLs for waterways impaired by sedimentation caused largely by grazing do not reflect more stringent limits necessary to counteract the disproportionate sedimentation rates grazing incites via degradation of streambanks. Instead, those TMDLs only state an overarching goal of meeting sediment load allocations when all streambanks achieve >80% stability. DEQ cites only one study supporting its 80% figure as necessary to achieve a SCR beneficial use; there is no discussion of whether more reductions are needed to meet a more sensitive use – such as salmonid habitat – and therefore at minimum sediment TMDLs appear to be inadequate to protect appropriate beneficial uses of many waterways in the subbasin.

E. Coli & Sediment TMDLs Possess Inadequate Margins of Safety

IDEQ's subbasin assessment and TMDLs possess inadequate margins of safety that violate Section 303(d) of the Clean Water Act. Section 303(d) requires every TMDL to contain a "margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." 33 U.S.C. § 1313(d)(1)(C). The purpose of a margin of safety is to compensate for uncertainties surrounding a TMDL's calculation of a waterbody's loading capacity. Loading capacity is the total amount of pollution that can enter a waterbody while still achieving applicable standards. 40 C.F.R. § 130.2(f). In the TMDL, portions of the loading capacity are then allocated to individual point and nonpoint sources of pollution. *See* 40 C.F.R. § 130.2(i).
To ensure that these allocations do not exceed the waterbody's actual loading capacity, and to compensate for fully expected uncertainties in the TMDL's application of standards to actual waterbodies, a portion of the loading capacity is often reserved as a "margin of safety." This is commonly expressed as a mathematical equation, where LC represents the waterbody's loading capacity and "MOS" represents the margin of safety: TMDL = LC + WLA + LA + MOS. Margins of safety can be implicit, in conservative assumptions for estimating the waterbody's loading capacity, or they can be explicit, by making them a specific allocation.

In all of IDEQ's E. Coli and sediment TMDLs for the Salt River Subbasin, the margins of safety are described, in whole or in pertinent part, as being implicit in the purportedly "conservative" approach that Idaho uses to develop its reference condition. In the case of *E. coli*, IDEQ set a pollutant load capacity using the most critical time period and then applied that standard year-round. By creating a loading capacity based on sampling performed when bacteria concentrations are likely to be highest (*e.g.*, heavy grazing or warmer temperatures), IDEQ claims its implicit margin of safety is adequate. In the case of streambank sediment impairment, IDEQ also claimed an implicit margin of safety. There, IDEQ again states it used conservative assumptions in developing the existing sediment load. Specifically, IDEQ established a load allocation equal to the level of natural streambank erosion. Next, IDEQ claims that it created an implicit margin of safety for subsurface fine sediment pollution, a subcategory of sediment TMDLs like streambank sedimentation. There, a loading capacity was created using a target of 50% spawning success from one set of *laboratory* studies, where IDEQ additionally alleges 50% reproduction equates to a healthy margin of safety because natural stream succession can be below 50%. IDEQ claims these approaches constitute a "margin of safety" because of the conservative assumptions relied upon. However, it appears that salmonid spawning was not the beneficial use actually utilized in setting TMDLs. Conservative estimates alone, when combined with the vast uncertainties in ascertaining a realistic baseline for beneficial uses in this degraded subbasin, mean the document's TMDLs possess scant surety that they accurately address the impairment realities for local waterways. DEQ has not quantified both the high level of uncertainty in its calculations nor the allegedly "conservative" assumptions to demonstrate that TMDLs actually produce the required margin of safety, as opposed to simply meeting the basic requirements for a TMDL to meet water quality standards. Sediment and E.coli conservative assumptions furthermore appear to conflate the margin of safety requirement with the separate, free-standing requirement of TMDLs to account for "critical conditions."

Finally, sediment and *E.coli* TMDLs suffer from an invalid margin of safety because they fail to account for the proven effects of climate change on mountainous regions that will experience increased variability in precipitation and drought. The brief attention given seasonal variation does not provide the analysis necessary to ascertain uncertainties posed by the threat of climate change and, in turn, the more stringent limitations needed to account for such uncertainty in order to satisfy water quality standards.

Salt River Sediment TMDLs Lack Reasonable Assurance

The largest point source contributor of pollutant impairment to waterways in the subbasin is the Smoky Canyon Mine, a known Superfund site that discharges toxic, harmful quantities of sediment and selenium. Instead of attempting to use available data on known pollutant-waterway impacts of that facility in terms of creating science-based wasteload allocations, the subbasin assessment and TMDLs simply state that "wasteload allocations for stormwater discharges in the phosphate mining district are unprecedented."[3]

[3] *Id*. at 44.

The fact that available data would not perfectly capture the pollutant loading from Smoky Canyon Mine does not mean that DEQ is relieved from its mandatory duty to create estimates of necessary pollutant reductions in the form of a wasteload allocation. Indeed, the very purpose of a TMDL is, to paraphrase EPA guidance, to be an iterative planning document that sets pollutant reduction goals necessary to meet water quality standards based on best available data. IDEQ's determination not to create appropriate WLAs for pollutant loads contributing to impairment – particularly selenium and sediment – is arbitrary and capricious as a matter of law.

Recommendations

In light of the concerns outlined above, Snake River Waterkeeper requests that IDEQ revisit the subbasin assessment with consideration of salmonid spawning as the most sensitive and important beneficial use for the majority of the subbasin's waterways. Pursuant to the management realities of supporting said use, IDEQ should revise all relevant TMDLs in the subbasin as needed to protect salmonid spawning. More substantial consideration should be given to adequate margins of safety and reasonable assurances, with greater scientific support and analysis provided to explain why the allocations chosen are legally sufficient under the requirements of the Clean Water Act.
IDEQ should also undertake the unenviable task of creating a WLA for Smoky Canyon Mine. Although a CERCLA action in progress may mean that there is progress in creating pollution reductions of harmful pollutants from the facility, ample data and years of experience show the mine as a substantial contributor of impairment to local watersheds. As a result, the integrity and legal defensibility of TMDLs addressing those impacts depends on, at a minimum, a best guess estimate of pollutant loading and assessment of the effectiveness of the general stormwater permit at the facility as well as current use data from the permit.

Respectfully submitted this 28th day of May, 2015.

Very truly yours,

F.S. "Buck" Ryan, III

Executive Director, Snake River Waterkeeper

DEQ's Response to F.S. "Buck" Ryan, III of Snake River Waterkeeper

DEQ appreciates the comments of F.S. "Buck" Ryan, III on behalf of Snake River Waterkeeper and thanks the organization for their involvement in the TMDL process.

Although the trigger point for further sampling differs, Idaho's water quality standard for both primary and secondary contact recreation is the same: a five sample geometric mean of samples collected between 3 and 7 days apart within 30 days cannot exceed 126 colony forming units per 100 mL of water. Therefore, regardless of whether the presumed use is primary or secondary contact recreation, the standard of protection is identical.

DEQ acknowledges that setting water quality targets for narrative criteria (sediment and nutrients) is difficult. A TMDL is an iterative process. If streambank erosion is reduced to less *than 20% and beneficial uses are still not being supported, the TMDL could be amended to include more stringent targets for bank stability. Referring to Table 18 in the document, it is apparent that most AUs where sediment TMDLs were developed have current bank stabilities well below 80%, with one having bank stability of just 10%. Regardless of if the standard is 80% or 100%, many of these streams will need time to recover and increase bank stability in order to adequately support cold water aquatic life. Streambank stability of 80% is a goal that reflects current scientific thinking. Streambank stability of 80% has been shown to be a reasonably achievable number in most stream types (some streams may not have this high of stability even in reference condition) and is a feature that can be measured throughout time to assess improvement and tie back to beneficial use support. As the TMDL acknowledges, excess sedimentation is a nonpoint source issue. Sedimentation in these waterbodies cannot be controlled through NPDES permits or other mandatory means. All improvements will be made voluntarily by landowners and through the implementation of standards and guides according to federal land management plans. DEQ will encourage management strategies that promote water quality and support 319 non-point source implementation projects in the watershed to increase streambank stability. DEQ disagrees that "none of IDEQ's sediment TMDLs for streams with a presumed SS beneficial use incorporate sufficient protections for that use or otherwise render it achievable." For AUs where SS is either existing (as documented by the presence of salmonids < 100 mm) or presumed (based on the 2014 IDEQ report), DEQ set additional standards for fine subsurface sediment in spawning habitats (Target limits have been set so that fine sediments (>6.25 millimeters [mm]) are not to exceed 25% of the total volume of sediment, and ultrafine sediments (>0.85 mm) are not to exceed 10%). These targets were developed after literature review of both field and laboratory studies and are further explained in the "2003 Guide to Selection of Sediment Targets for Use in Idaho TMDLs". DEQ disagrees that margins of safety are inadequate. Identical sediment targets have been used in EPA approved TMDLs generated by DEQ's Pocatello Regional Office including the 2002 Blackfoot River TMDL and the 2013 Blackfoot River Addendum. Additionally, E. coli TMDLs set at the water quality standard have been applied state-wide.*

DEQ realizes that climate change can increase variability in precipitation and drought. However, it is not clear as to how this would impact water quality in streams impaired by sediment and E. coli bacteria.

DEQ will not be including a numeric WLA for Smoky Canyon Mine. It is not feasible or appropriate to establish numeric limits for stormwater discharges, and therefore, WLAs in approved TMDLs are expressed in stormwater permits as Best Management Practices. For industrial stormwater dischargers, EPA continues to focus on the use of BMPs and an adaptive management process to evaluate and as necessary change BMPs. Discharges from Smoky Canyon Mine are currently permitted by the MSGP requiring the design, implementation, and evaluation of BMPs to meet water quality standards.

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OFFICE OF
WATER AND
WATERSHEDS

May 4, 2015

Hannah Harris, Water Quality Scientist
Idaho Department of Environmental Conservation
Pocatello Regional Office
444 Hospital Way #300
Pocatello, Idaho 83201

Dear Hannah,

Thank you for giving EPA the opportunity to provide comments on the Salt River TMDL. Described below is EPA's only comment on the TMDL.

In the TMDL, Idaho Department of Environmental Conservation (DEQ) acknowledges that Smoky Canyon Mine has discharged sediment periodically to the streams and is under a multi sector general permit (MSGP). Because Smoky Canyon Mine is a recognized point source of sediment loading, DEQ must assign a numeric waste load allocation (WLA) to deal with potential stormwater runoff from the Smoky Canyon Mine currently under the multi sector general permit (MSGP) now and in the future. In the TMDL, DEQ states "…development of realistic numeric wasteload allocations would require data not currently available and would not be practicably implemented." EPA recognizes that these WLAs might be fairly rudimentary because of data limitations and variability in the system and would be happy to discuss how to develop the WLAs. For example one method of calculating a WLA for the mine could be translating the turbidity criteria into a mass based number so that it is comparable to the mass based load allocations and EPA would be glad to provide technical support in making that translation.

The requirement for a numeric WLA for sources covered under Stormwater NPDES permit is mandatory, as it is based on EPA regulations. EPA's 2002 memo " Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs" states "The WLAs and LAs are to be expressed in numeric form in the TMDL" and cites 40 C.F.R. § 130.2(h) & (i) as the basis of this requirement (http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf). This same memorandum noted that NPDES-regulated storm water discharges must be addressed by the wasteload allocation component of a TMDL and cited 40 C.F.R. § 130.2(h) as the basis for this requirement. The memorandum further notes that EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability in the system.

The regulations defining "Total Maximum Daily Load" use the mathematical terms "sum" and "plus" as in the "TMDL is the *sum* of that point source WLA *plus* the LAs for any nonpoint sources of pollution and natural background sources, tributaries, or adjacent segments."[*emphasis added*] It is clear that a WLA must be in numeric form to meet this mathematical requirement, per federal regulations. A narrative WLA does not provide the quantifiable information necessary to determine whether allocations assigned to point and nonpoint sources would be adequate to attain applicable water quality standards. TMDLs may be expressed in alternative measures per federal regulations at 130.2(i), however, this flexibility does not obviate the requirement for those measures to be quantifiable to ensure that TMDL calculations will attain applicable water quality standards.

Below are the regulatory definitions for TMDL and related terms referenced in the paragraph above:
40 C.F.R. §130.2(i) ***Total maximum daily load (TMDL).*** The sum of the individual WLAs for point sources and LAs for nonpoint sources and natural background. If a receiving water has only one point source discharger, the TMDL is the sum of that point source WLA plus the LAs for any nonpoint sources of pollution and natural background sources, tributaries, or adjacent segments. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure. If Best Management Practices (BMPs) or other nonpoint source pollution controls make more stringent load allocations practicable, then wasteload allocations can be made less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs [*emphasis added*].
40 C.F.R. §130.2(f) ***Loading capacity.*** The greatest amount of loading that a water can receive without violating water quality standards [*emphasis added*].
40 C.F.R. §130.2(h) ***Wasteload allocation (WLA).*** The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation [*emphasis added*].

Please feel free to contact me with any questions on the contents of EPA's concerns at (206) 553-8512 or carlin.jayne@epa.gov.

Sincerely,

Jayne Carlin, EPA Region 10
Office of Water and Watersheds, Watershed Unit

2

DEQ's response to Jayne Carlin of EPA Region 10

DEQ appreciates the involvement of EPA in the TMDL process. DEQs general policy, however, is to not assign numeric wasteload allocations to MSGP's permitted facilities until such time as very specific information becomes available for a facility that lend itself to crafting and prescribing a numeric wasteload allocation. Multi-Sector General Permit holders such as Smoky Canyon Mine are obligated to install best management practices (BMPs) in lieu of numeric wasteload allocations due to the hybrid nature of permitting stormwater runoff, which acts more like a non-point source. Simplot's Smoky Canyon Stormwater Pollution Prevention Plan (SWPPP, a requirement of the MSGP under which Simplot has permit coverage) puts in place BMP design standards intended to handle certain magnitudes of storm water during precipitation events. These facilities are designed to be non-discharging up to their design capacity. As such, any discharges from these facilities are episodic and unexpected (ballpark- "shot-in-the-dark"- WLA's would be meaningless and unenforceable). The MSGP is structured for facilities to design, implement, and evaluate best management practices (under an EPA required SWPPP) and enable facilities to meet water quality standards. If the MSGP permit holders follow permit requirements, they are considered in compliance with the intent of the TMDL.

Appendix J. **Distribution List**

Chris Banks, Water Quality Resource Conservationist, Idaho Association of Soil Conservation Districts

Pauline Bassett, Administrative Assistant, Caribou Soil Conservation District

Jayne Carlin, Watersheds Unit, United States Environmental Protection Agency

Sandi Fisher, Contaminants Biologist, United States Fish and Wildlife Service

Monty Johnson, Environmental Engineering Manager, Simplot Company

Dan Kotansky, Environmental Protection Specialist, Bureau of Land Management

Jim Mende, Environmental Coordinator, Idaho Fish and Game

Larry Mickelson, District Conservationist, Natural Resource Conservation Service

Josh Miller, District Conservationist, Natural Resource Conservation Service

Brian Reed, Water Quality Resource Conservationist, Idaho Soil Conservation Commission

Kathy Rinaldi, Idaho Conservation Coordinator, Greater Yellowstone Coalition

Mary Spotten, District Conservationist, Star Valley Conservation District

Louis Wasniewski, Forest Hydrologist, United States Forest Service

Matt Woodard, Project Director, Trout Unlimited