Lake Walcott Total Maximum Daily Load 2013 Addendum

Marsh Creek Temperature and E. coli TMDLs

State of Idaho
Department of Environmental Quality

December 2013

Cover photo: Marsh Creek. Photo by Jerry West, Idaho Department of Environmental Quality, September 2009.

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Acknowledgments

Mark Shumar, Idaho Department of Environmental Quality (DEQ) Technical Services, prepared the potential natural vegetation temperature total maximum daily loads (TMDLs). Marti Bridges, TMDL program manager, helped with data analysis and evaluation of load calculations and methodology. The DEQ Twin Falls Regional Office provided presentations to the Lake Walcott Watershed Advisory Group and others and a final review of the TMDL. The Lake Walcott Watershed Advisory Group provided valuable input and review.

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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

AU assessment unit

AWS agricultural water supply

BID Burley Irrigation District

BMP best management practice

BURP Beneficial Use Reconnaissance Program

C Celsius

CFR Code of Federal Regulations

cfs cubic feet per second

CGP Construction General Permit

CW cold water aquatic life

DEQ Idaho Department of Environmental Quality

DMA designated management agency

DO dissolved oxygen

DWS domestic water supply

EPA United States Environmental Protection Agency

F Fahrenheit

HUC hydrologic unit code

IDAPA refers to citations of Idaho administrative rules

ISCC Idaho Soil Conservation Commission (now the Idaho Soil and Water Conservation Commission)

kWh kilowatt hours

LA load allocation

LC load capacity

m meter

mg/L milligrams per liter

mL milliliter

MOS margin of safety

MS4 municipal separate storm sewer systems

MSGP Multi-Sector General Permit

NB natural background

NPDES National Pollutant Discharge Elimination System

NREL National Renewable Energy Laboratory

NTU nephelometric turbidity unit

PCR primary contact recreation

PNV potential natural vegetation

SS salmonid spawning

SWMP stormwater management program

SWPPP stormwater pollution prevention plan

TMDL total maximum daily load

TP total phosphorus

TSS total suspended solids

USC United States Code

USGS United States Geological Survey

WAG watershed advisory group

WLA wasteload allocation

Purpose

The purpose of this document is to establish temperature and E. coli Total Maximum Daily Loads (TMDLs) for Marsh Creek.

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 one water body (two assessment units [AUs]) in the Lake Walcott subbasin that have been placed in Category 5 of Idaho's most recent federally approved Integrated Report (DEQ 2011).

This addendum describes the key physical and biological characteristics of the subbasin; water quality concerns and status; pollutant sources; and recent pollution control actions in the Lake Walcott subbasin, located in southern Idaho. For more detailed information about the subbasin and previous TMDLs, see the Lake Walcott subbasin assessment and TMDL (DEQ 2000).

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.

Subbasin at a Glance

This TMDL addendum has been developed to address the temperature- and bacteria-impaired water bodies in the Lake Walcott subbasin that have been placed on Idaho's current §303(d) list. The Lake Walcott subbasin is in southern Idaho (Figure A).

Two reaches of Marsh Creek in the Lake Walcott subbasin were listed on the 1998 §303(d) list for unknown pollutants. It has been determined that the only impairments for these reaches are temperature and *E. coli*. Additional water bodies in the subbasin are listed but not addressed in this addendum for various reasons (Table A). Lake Walcott is listed for mercury impairment but will be scheduled for a TMDL at a later date. A sediment listing for the Snake River from

Minidoka Dam to the Heyburn/Burley Bridge is an error, and that reach is proposed for delisting in the 2012 Integrated Report. No data support a listing for sediment as impairing beneficial uses in that reach. Listings also exist for Copper Creek and Cottonwood Creek in the Craters of the Moon National Monument and Preserve. These streams are hydrologically disconnected from surface waters in the Lake Walcott subbasin, as they infiltrate entirely into the aquifer. Corrections to the U S Geological Survey National Hydrography Dataset addressing the spatial distinction with these streams have not been addressed in the most recent version.

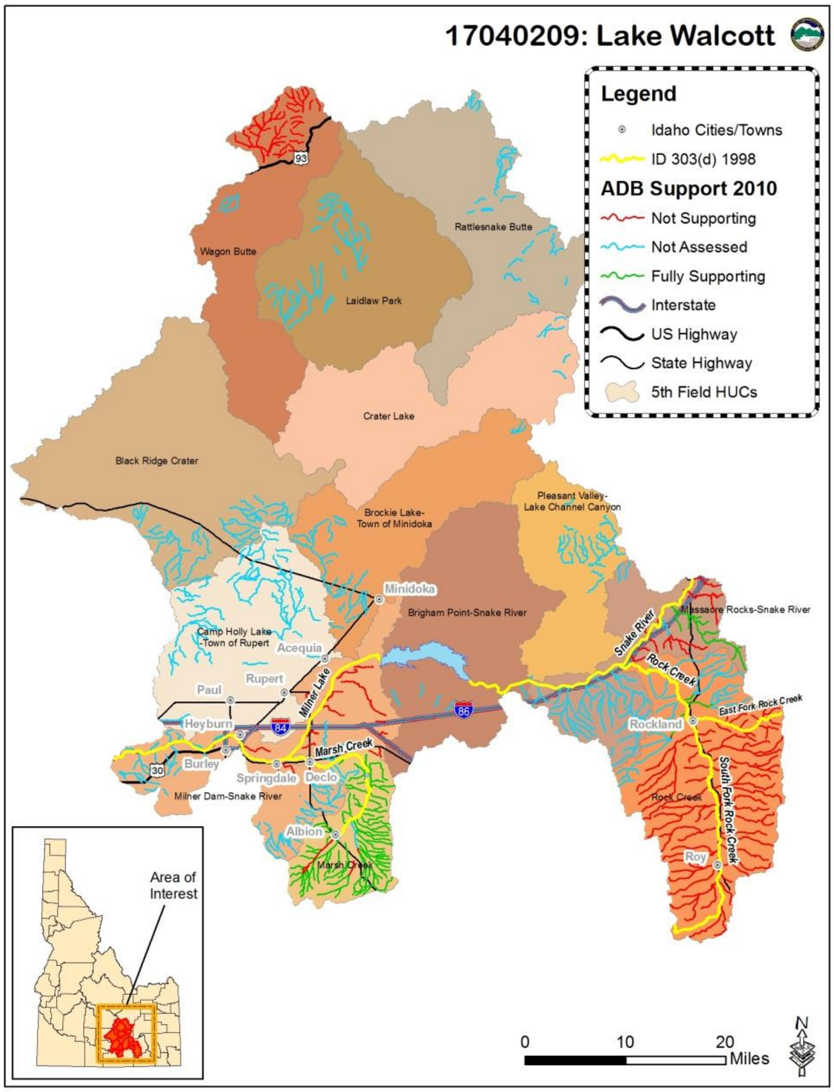

Figure A. Lake Walcott subbasin and support status of streams.

Table A. Subbasin at a glance.

Parameter	Description	
§303(d)-listed assessment units (Category 5 of the 2010 Integrated Report)	ID17040209SK002_07	Snake River—Minidoka Dam to Heyburn/Burley Bridge
	ID17040209SK003_03	Marsh Creek—source to mouth
	ID17040209SK003_04	Marsh Creek—source to mouth
	ID17040209SK004L_0L	Lake Walcott (Snake River)
	ID17040209SK011_02	Snake River—American Falls Reservoir Dam to Rock Creek
	ID17040209SK013_02	Craters of the Moon complex
	ID17040209SK013_03	Craters of the Moon complex
Pollutants of concern	Sediment, mercury, combined biota/habitat bioassessment, temperature, bacteria	
Marsh Creek NPDES facilities	None exist in the Marsh Creek drainage	
Approved TMDL	Lake Walcott TMDL (approved 2000)	
Other related approved TMDLs	Rueger Springs Creek TMDL Addendum (2007)—one fish farm NPDES facility Fall Creek TMDL Addendum (2007)—two fish farm NPDES facilities	

Note: NPDES = National Pollutant Discharge Elimination System

Key Findings

Marsh Creek is a perennial water body listed in Category 5 of the 2010 Integrated Report from its headwaters to its confluence with the Snake River. Marsh Creek discharges to the Snake River, which is also §303(d) listed, and specific reaches of the Snake River have EPA -approved TMDLs for TP. The new TMDLs are necessary to protect and restore the beneficial uses of impaired stream reaches in the Lake Walcott subbasin.

This Lake Walcott TMDL addendum does not modify the existing EPA-approved Lake Walcott TMDL (DEQ 2000) in any other way except establishing temperature and E.coli TMDLs for Marsh Creek, and updating any pertinent subbasin information.

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

Stream	Pollutant(s)
Marsh Creek	Temperature; *E. coli*

Effective shade targets were established for two listed reaches of Marsh Creek. Shade targets were derived from effective shade curves developed specifically for southern Idaho vegetation types. Existing shade was determined from aerial photo interpretation field verified with Solar Pathfinder data. Marsh Creek had excess solar loads based on target shade levels.

Water chemistry samples taken for *Escherichia coli* (*E. coli*) in September 2011 showed elevated levels that exceeded water quality standards of an instantaneous value of 576 *E. coli* organisms/100 mL based on the secondary contact recreation standard (IDAPA

58.01.02.251.01.b.i). This value triggered a need for additional samples to be collected to calculate a geometric mean based on a minimum of five samples. Based on this geometric mean calculation, *E. coli* was determined to be impairing water quality in two AUs, and a bacteria TMDL is provided for restoring beneficial uses to this stream. Table C provides a summary of assessment outcomes for the AUs of concern.

Table C. Summary of assessment outcomes.

Water Body Name/Assessment Unit	Drainage: Boundaries	Listed Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Marsh Creek ID17040209SK003_03 ID17040209SK003_04	Marsh Creek: source to mouth (3rd- and 4th-order streams)	Combined Biota/Habitat Bioassessments	*E. coli*, Temp.	Delist for Combined Biota/Habitat Bioassessments, Move to Category 4a	*E. coli* (unlisted but violates WQS) and Temperature identified as causal pollutants

DEQ's proposed actions for the Marsh Creek AUs are as follows:

- ID17040209SK003_02: Full Support (Category 2). No further action by DEQ is required for this AU. However, DEQ intends to visit this AU in the future to determine if the full support status is still viable.
- ID17040209SK003_02A: Unassessed Waters (Category 3). DEQ will visit this AU in the future and assess the water quality status.
- ID17040209SK003_03: TMDL required (Category 5). A TMDL was developed for this AU as part of this addendum.
- ID17040209SK003_04: TMDL required (Category 5). A TMDL was developed for this AU as part of this addendum.

Introduction

This document addresses one water body in the Lake Walcott subbasin (Marsh Creek) that has been placed in Category 5 of Idaho's most recent federally approved Integrated Report (DEQ 2011). The purpose of this total maximum daily load (TMDL) addendum is to characterize and document pollutant loads within the Lake Walcott subbasin; specifically Marsh Creek and tributaries. 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 Lake Walcott 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 Part 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 United States 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

A detailed discussion of the physical, biological, climatic, cultural, and subbasin characteristics is provided in the Lake Walcott TMDL approved by EPA in 2000 (DEQ 2000, available at *http://www.deq.idaho.gov/water-quality/surface-water/tmdls/table-of-sbas-tmdls/walcott-lake-subbasin.aspx*). Characteristics specific to Marsh Creek, the water body addressed in this addendum, are provided in the following sections.

1.1 Marsh Creek Description and Hydrologic Characteristics

The Lake Walcott TMDL describes Marsh Creek as originating in the Albion Mountains at 5,800 feet and draining the north side of the Albion Mountains (DEQ 2000, p. 32, 50). The headwaters flow from US Forest Service lands then into a broad alluvial valley that is primarily privately owned. The subbasin drains approximately 75,800 acres (Monek 2009, p. 1) (Figure 1).

Once Marsh Creek enters the privately owned land, much of its flow is diverted for agricultural uses (primarily for irrigation). However, agricultural return flow enters the channel from numerous drains and canals along Marsh Creek, providing continuous flow in portions of the stream during certain times of the year. A large diversion dam located on the Skaggs Ranch (i.e., Dewy Pond, sometimes spelled Dewey Pond) is capable of legally drying Marsh Creek entirely during the summer months. Below Dewy Pond, agricultural wastewater returns to Marsh Creek before it enters the Snake River in the Milner Pool area at river mile 659.3 near Parees Island (or Frenchman's Island) on the Snake River. For photos of Marsh Creek, see Appendix A.

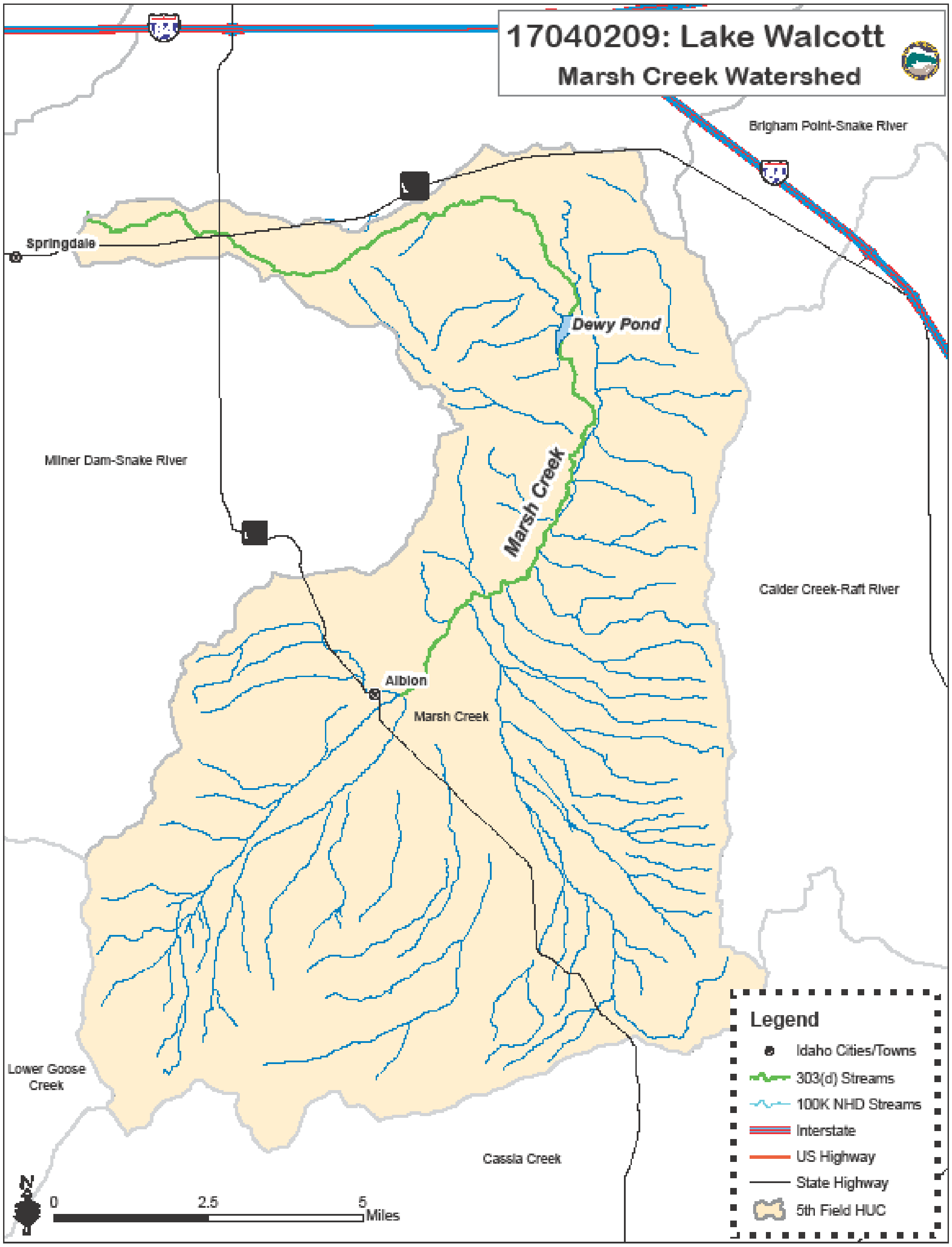

Figure 1. Marsh Creek watershed in the Lake Walcott subbasin (hydrologic unit code [HUC] 17040209).

US Geological Survey records from 1967–1974 for gage station 13082300 (above Dewy Pond) indicate the Marsh Creek drainage produces about 15,000 acre-feet of runoff per year (approximately 21 cubic feet per second [cfs]), of which a third is consumed for agriculture in the Albion Valley upstream of the US Geologic Survey (USGS) gage. Flow from the Skaggs Ranch to within 1–2 miles of the Snake River is infrequent. The final miles of Marsh Creek receive ground water or tail water from fields during the irrigation season and consequently, this segment of Marsh Creek flows year-round.

A discussion with the Burley Irrigation District (BID) (M. Etcheverry, personal communication with R. Bingham, 2009) indicates that the irrigation season generally runs from April 1 through October 15. During this season, the BID conveys approximately 250 inches of water per day (or 5 cfs) through Marsh Creek if it is dry. If Marsh Creek is not dry, then BID conveys less than 5 cfs, adjusting for what is in the stream channel. Most water that reaches South 750 East Road prior to discharge into the Snake River is spring water and agricultural irrigation returns.

Additionally, Marsh Creek has an associated Marsh Valley ground water system, sometimes referred to as ground water system 42. It likely exists within the sedimentary valley fill materials (i.e., Qs Aquifer), to which major sources of recharge are downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from Marsh Creek and its tributaries (Graham and Campbell 1981).

Therefore, the overall hydrology of Marsh Creek is highly dependent on certain sources:

- Snowmelt, and to a much lesser degree, stormwater
- Spring sources
- Irrigation diversions and conveyance

In general, the Marsh Creek drainage is considered a semiarid, snowmelt-driven catchment with two hydrologic cycle primary periods of watering. These primary periods are greatly influenced by the tributaries to Marsh Creek (e.g., Howell Creek and Land Creek):

- The first primary period is a “period of wetting,” when ground water contributes directly to surface streamflows.
- The second primary period is a “period of drying,” when ground water contributes little-to-nothing to surface water flows.

In general, between each primary period is a transition period:

- In the fall, the transition from drying to wetting starts with the infiltration of precipitation and some snowmelt elevating the rate of soil moisture accumulation to exceed evaporation and evapotranspiration. During this transition, and throughout the winter, the soil moisture is maintained.
- In the spring, the wetting period reaches its zenith when the infiltration of snowmelt and precipitation saturate the soil as evidenced by the overland flow of water or runoff. As the soil becomes saturated, hydraulic connectivity occurs, resulting in downslope subsurface flows. Both the runoff and the downslope subsurface flows contribute to increased streamflows at the bottom of the drainage.

As spring turns to summer, runoff subsides despite there being sufficient soil moisture to maintain hydraulic connectivity and continued downslope subsurface flow. At this time, streamflows decline, marking a transition from wetting to drying. As summer progresses, the transition into the drying period becomes complete when evaporation and evapotranspiration deplete the soil moisture until hydraulic connectivity is lost and downslope subsurface flows cease, causing further declines in streamflows. The drying period continues until fall when a transition into the wetting period occurs and the cycle starts over again (IDWR 2004).

1.2 Stream Characteristics

Figure 2 summarizes average flow conditions at two locations on Marsh Creek: the first near Albion above Skaggs Ranch (i.e., Dewy Pond) (USGS gage 13082300) and the second just above the confluence with the Snake River (approximately South 750 East Road). Comparing flows indicates the following:

- Average annual flow for the near Albion site (based on 246 data points) is 22.7 cfs, whereas the near confluence site (based on 136 data points) is 8.1 cfs.
- The highest monthly average flow for the near Albion site is in January at 96.9 cfs, whereas the near confluence site ranges from 11.3 cfs to 14.5 cfs during April, May, and June.
- The minimum recorded flow for the near Albion site has been zero for all months except May (i.e., 0.1 cfs), whereas the near confluence site has been zero only in April, June, and July.
- The maximum recorded flow for the near Albion site was 828.0 cfs on January 17, 1971. The maximum recorded flow for the near confluence site was 63.3 cfs on April 29, 1997.
- When considering the amount of flow that moves from the near Albion site to the near confluence site, approximately 82% of the average flow is at the near Albion site during November through March, whereas approximately 30% of the average flow is at the near Albion site from April through October.

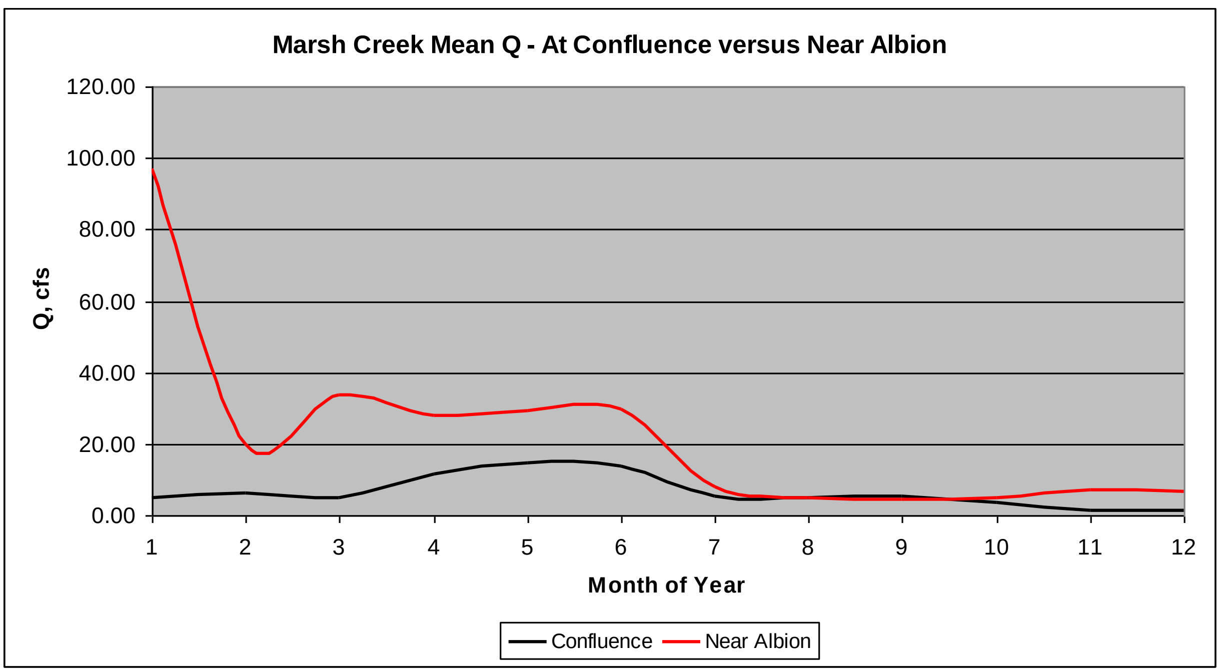

Figure 2. Marsh Creek mean flow (Q)—near confluence versus near Albion gages.

1.3 Assessment Units

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.

The Marsh Creek watershed (Figure 1) has four AUs, as described below. The status of these AUs in the 2010 Integrated Report is summarized below:

- ID17040209SK003_02: 1st- and 2nd-order tributaries to Marsh Creek. This AU includes the headwater portion of Marsh Creek and the 1st- and 2nd-order portions of Land Creek, Brim Canyon, Howell Creek, Summit Creek, Cow Creek, Archer Spring Creek, Bridger Spring Creek, and eight unnamed streams.

  The 2010 Integrated Report contains the following information for this AU: Marsh Creek, source to mouth, 170.84 miles, Category 2–Full Support.

  No additional action is currently required by DEQ under the TMDL process.

- ID17040209SK003_02A: Intermittent waters that are no longer tributaries to Marsh Creek.

  The 2010 Integrated Report contains the following information for this AU: Marsh Creek intermittent streams, Category 3–Unassessed Waters.

  DEQ needs to assess the water quality status of these intermittent streams at some time in the future based on available funding and resource constraints.

- ID17040209SK003_03: 3rd-order stream segment of Marsh Creek and its 3rd-order tributaries. This AU includes Marsh Creek from its headwaters to the confluence of Howell Creek, the 3rd-order portion of Howell Creek, and the 3rd-order portion of Summit Creek.

  The 2010 Integrated Report contains the following information for this AU: Marsh Creek, source to mouth, Category 5–Impaired water requiring a TMDL, Combined Biota/Habitat Bioassessments.

  A TMDL was developed for this AU as part of this addendum.

- ID17040209SK003_04: 4th-order stream segment of Marsh Creek and its 3rd-order tributaries. This AU includes Marsh Creek from the confluence of Land Creek to the Snake River and the 4th-order portion of Howell Creek (from the confluence of Summit Creek to the confluence of Howell Creek into Marsh Creek).

  The 2010 Integrated Report contains the following information for this AU: Marsh Creek, source to mouth, Category 5–Impaired water requiring a TMDL, Combined Biota/Habitat Bioassessment.

  A TMDL was developed for this AU as part of this addendum.

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.

2.1.1 Listed Waters

Table 1 shows the listed pollutants and the basis for listing for each 2010 §303(d)-listed AU in the Lake Walcott subbasin that has been added or carried forward since the TMDL was approved by EPA in 2000.

Table 1. 2010 §303(d)-listed assessment units in the Lake Walcott subbasin.

Assessment Unit Name	Assessment Unit Number	Listed Pollutants	Listing Basis
Marsh Creek—source to mouth	ID17040209SK003_03 ID17040209SK003_04	Combined Biota/Habitat Bioassessment	Carried from 1998 list as unknown
Snake River—Minidoka Dam to Burley Bridge	ID17040209SK002_07	Sedimentation	Appears listed in error. Informational TMDL exists for sediment as an antidegradation measure.
Lake Walcott—Lake Walcott of Snake River	ID17040209SK004L_0L	Mercury (in fish tissue)	2008, fish tissue exceedance of water quality standards
Snake River (tributaries)—American Falls Reservoir Dam to Rock Creek	ID17040209SK011_02	Combined Biota/Habitat Bioassessment	Carried from 2002 list as unknown; AU is recommended to be split as Beneficial Use Reconnaissance Program site is on private property and can't be accessed to determine causal pollutant
Craters of the Moon Complex—none identified	ID17040209SK013_02 ID17040209SK013_03	Combined Biota/Habitat Bioassessment	Carried from 2002 list; no surface water connectivity within Lake Walcott subbasin. Sites appear listed in error, ephemeral streams only.

Not all of the water bodies in Table 1 require a TMDL. Some waters newly listed in 2002 and 2008 were deferred due to insufficient data to develop a TMDL. However, a thorough investigation using the available data was performed before this conclusion was made. Lake Walcott is listed for mercury impairment but will be scheduled for a TMDL at a later date. A sediment listing for the Snake River from Minidoka Dam to the Heyburn/Burley Bridge is an error, and that reach is proposed for delisting in the 2012 Integrated Report. No data support a listing for sediment as impairing beneficial uses in that reach. Listings also exist for Copper Creek and Cottonwood Creek in the Craters of the Moon National Monument and Preserve. However, these streams are hydrologically disconnected from surface waters in the Lake Walcott subbasin, as they infiltrate entirely into the aquifer.

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 (e.g., swimming) or secondary (e.g., 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 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 Presumed Uses

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. These undesignated waters ultimately need to be designated for appropriate uses. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called *presumed uses,* DEQ applies the numeric cold water criteria and primary or secondary contact recreation criteria to undesignated waters. If in addition to these presumed uses, an additional existing use (e.g., salmonid spawning) exists, then the additional numeric criteria for salmonid spawning would also apply (e.g., intergravel dissolved oxygen, temperature) because of the requirement to protect water quality for existing uses. However, if for example, cold water aquatic life is not found to be an existing use, a use designation (rulemaking) to that effect is needed before some other aquatic life criteria (such as seasonal cold) can be applied in lieu of cold water criteria (IDAPA 58.01.02.101.01).

2.2.4 Beneficial Uses in the Subbasin

DEQ investigated existing beneficial uses for the Marsh Creek AUs. DEQ electrofished Marsh Creek in 1994 about one-quarter mile north of Albion, Idaho, (site 1994STWFA025) and found brook trout and Paiute sculpin. In 1996–1997, the Idaho Department of Fish and Game extensively surveyed Marsh Creek and several tributaries near Albion and determined the presence of “brook trout, hatchery rainbow trout, mottled sculpin *Cottus bairdi*, redside shiners *Richardsonius balteatus*, and longnose dace *Rhinichthys cataractae*. The highest trout densities were found in reaches of higher gradients where there was a mix of habitat types” (IDFG 1997, p. 44). In 2000–2001, the Idaho Department of Fish and Game investigated the entrainment of fishery in Howell Creek (a tributary to Marsh Creek) due to a man-made pond and determined the presence of brook trout and no other fish species (IDFG 2004, pp. 40, 44).

DEQ examined the water rights for Marsh Creek from the Idaho Department of Water Resources website and concluded the primary water uses in Marsh Creek are irrigation, irrigation storage, domestic water, and stockwater. Other minor uses include aesthetics, wildlife, mitigation, and water quality improvement.

Therefore, DEQ concluded the existing beneficial uses of Marsh Creek from the headwaters to the mouth (ID17040209SK003_03 and ID17040209SK003_04) are as follows:

- Cold Water Aquatic Life—The presence of brook trout in the stream is evidence that cold water habitat is present for their survival during certain times of the year.
- Salmonid Spawning—The presence of multiple age classes of brook trout in the stream is evidence of salmonid spawning during certain times of the year. Brook trout generally spawn in September and October depending upon elevation.
- Secondary Contact Recreation—Although some recreational fishing has been noted, more fishing occurs below Dewy Pond than above it. Kayaking has been noted toward the confluence of Marsh Creek into the Snake River.
- Agricultural Water Supply—From the headwaters to mouth, this is the dominant beneficial use along all private lands.

The beneficial uses of §303(d)-listed waters in the Lake Walcott subbasin are presented in Table 2.

Table 2. Lake Walcott subbasin beneficial uses of §303(d)-listed streams.

Assessment Unit Name	Assessment Unit Number	Beneficial Uses[a]	Type of Use
Marsh Creek	ID17040209SK003_03 ID17040209SK003_04	CW, SS, SCR, AWS	Existing
Lake Walcott	ID17040209SK004L_0L	CW, PCR, DWS	Designated
Snake River	ID17040209SK011_02	CW, PCR DWS	Designated
Craters of the Moon Complex	ID17040209SK013_02 ID17040209SK013_03	CW, SCR	Presumed

[a] Cold water (CW), salmonid spawning (SS), primary contact recreation (PCR), secondary contact recreation (SCR), agricultural water supply (AWS), domestic water supply (DWS)

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, dissolved oxygen, pH, ammonia, temperature, and turbidity, and *narrative* criteria for pollutants such as sediment and nutrients(IDAPA 58.01.02.250–251) (Table 3).

Table 3. Selected numeric criteria supportive of beneficial uses in Idaho water quality standards.

Parameter	Primary Contact Recreation	Secondary Contact Recreation	Cold Water Aquatic Life	Salmonid Spawning[a]
Water Quality Standards: IDAPA 58.01.02.250–251				
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	—	—
pH	—	—	Between 6.5 and 9.0	Between 6.5 and 9.5
Dissolved oxygen (DO)	—	—	DO exceeds 6.0 milligrams/liter (mg/L)	**Water Column DO**: DO exceeds 6.0 mg/L in water column or 90% saturation, whichever is greater **Intergravel DO**: DO exceeds 5.0 mg/L for a 1-day minimum and exceeds 6.0 mg/L for a 7-day average
Temperature[c]	—	—	22 °C or less daily maximum; 19 °C or less daily average **Seasonal Cold Water**: Between summer solstice and autumn equinox: 26 °C or less daily maximum; 23 °C or less daily average	13 °C or less daily maximum; 9 °C or less daily average **Bull Trout**: Not to exceed 13 °C maximum weekly maximum temperature over warmest 7-day period, June–August; not to exceed 9 °C daily average in September and October
Turbidity	—	—	Turbidity shall not exceed background by more than 50 nephelometric turbidity units (NTU) instantaneously or more than 25 NTU for more than 10 consecutive days.	—
Ammonia	—	—	Ammonia not to exceed calculated concentration based on pH and temperature.	—
EPA Bull Trout Temperature Criteria: Water Quality Standards for Idaho, 40 CFR Part 131				
Temperature	—	—	—	7-day moving average of 10 °C or less maximum daily temperature for June–September

[a] During spawning and incubation periods for inhabiting species
[b] *Escherichia coli* per 100 milliliters
[c] Temperature exemption: Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the ninetieth percentile of the 7-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.

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

> Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. (IDAPA 58.01.02.200.06)

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).

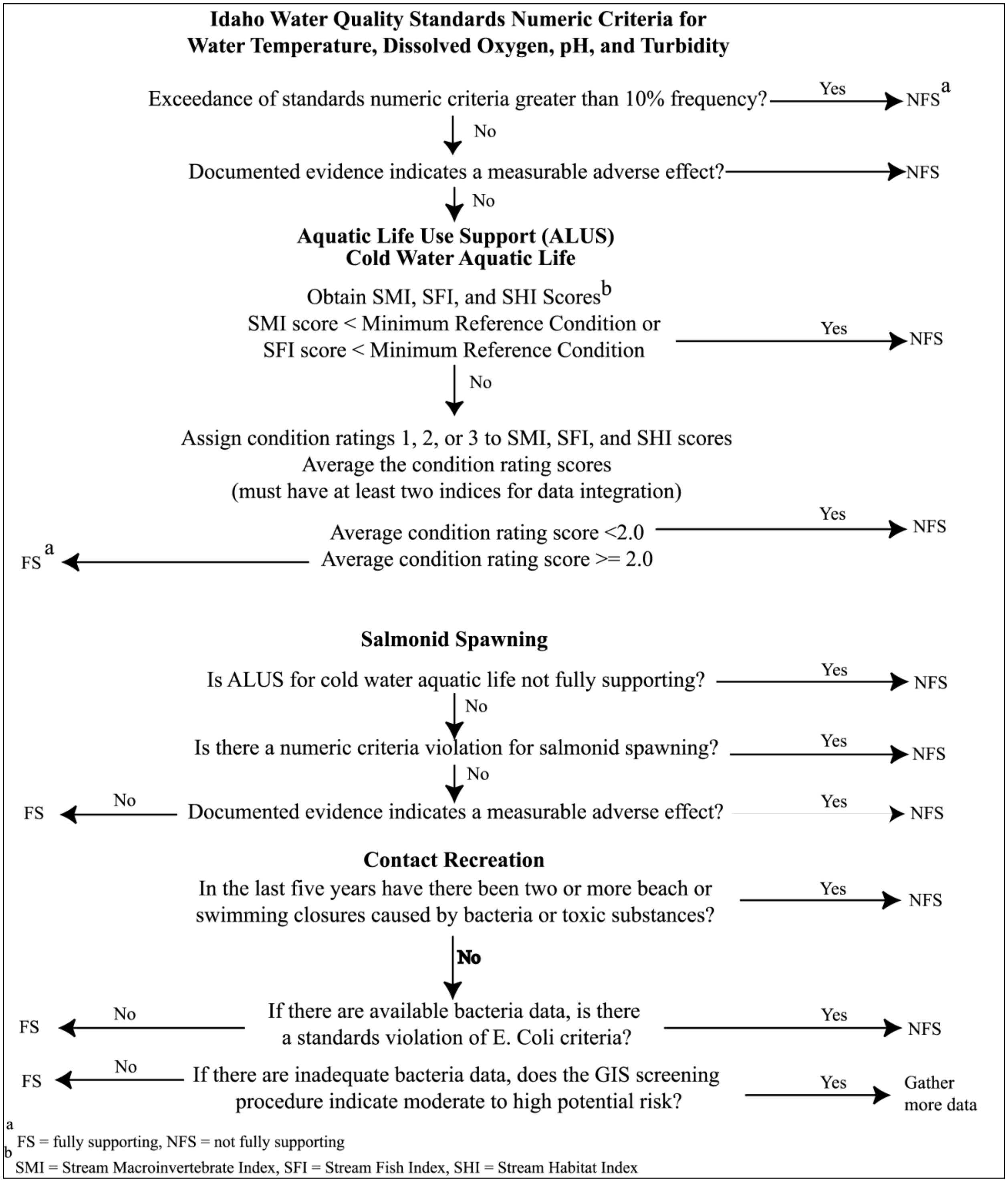

Figure 3. Steps and criteria for determining support status of beneficial uses in wadeable streams (Grafe et al. 2002).

2.3 Summary and Analysis of Existing Water Quality Data

A detailed summary and analysis of previous water quality data for the Lake Walcott subbasin is provided in the Lake Walcott TMDL (DEQ 2000). A summary of the available water quality data for total suspended solids (TSS), total phosphorus (TP), temperature, and *E. coli* is described in the following paragraphs. See Appendix B for data sources.

2.3.1 Sediment (as Total Suspended Solids)

Sediment is normally considered a naturally occurring material from the landscape that is broken down by processes of weathering and erosion. Subsequently, it is transported by the action of wind or water and/or by the force of gravity acting on the particle itself. In surface waters, this action can be seen on suspended sediments or TSS discharging into the water as a result of erosion on associated land surfaces. As these suspended sediments travel through the water, they eventually end up in the stream channel where they may impair the beneficial use of salmonid spawning.

In Marsh Creek, DEQ—in conjunction with the Idaho Soil Conservation Commission (ISCC, now the Idaho Soil and Water Conservation Commission), USGS, and BID—conducted TSS water quality monitoring from 1997 through 2008 (N = 235 samples) at various sites. Combining all site data resulted in the following TSS concentrations:

- Minimum = 0.0 milligrams per liter (mg/L)
- Mean = 21.5 mg/L
- Median = 6.0 mg/L
- Max = 472.0 mg/L

The water quality data also indicate that approximately 9.4% of the TSS samples exceed or are equal to the recommended 50.0 mg/L TSS instream target identified in the Lake Walcott TMDL. That target was advisory in nature and intended to prevent water quality degradation. The exceedances (N = 22 samples) had a minimum value of 51.6 mg/L, an average value of 138.0 mg/L, and a maximum value of 472.0 mg/L. In general, these exceedances occurred during April (n = 11, 50% of exceedances), May (n = 8, 36.4% of exceedances), June (n = 2, 9.1% of exceedances), and July (n = 1, 4.5% of exceedances). Figure 4 summarizes the TSS exceedances on a monthly basis based on the water quality monitoring data available to DEQ.

Because the TSS exceedances are less than the recommended 10% threshold level, a TSS TMDL will not be written for Marsh Creek at this time. However, DEQ intends to continue monitoring Marsh Creek for TSS to determine if sediment is impairing beneficial uses. Based on field observations, some reaches along Marsh Creek indicate that some bank erosion is occurring and some stream channel embeddedness exists. Streambank instability may be investigated in the future.

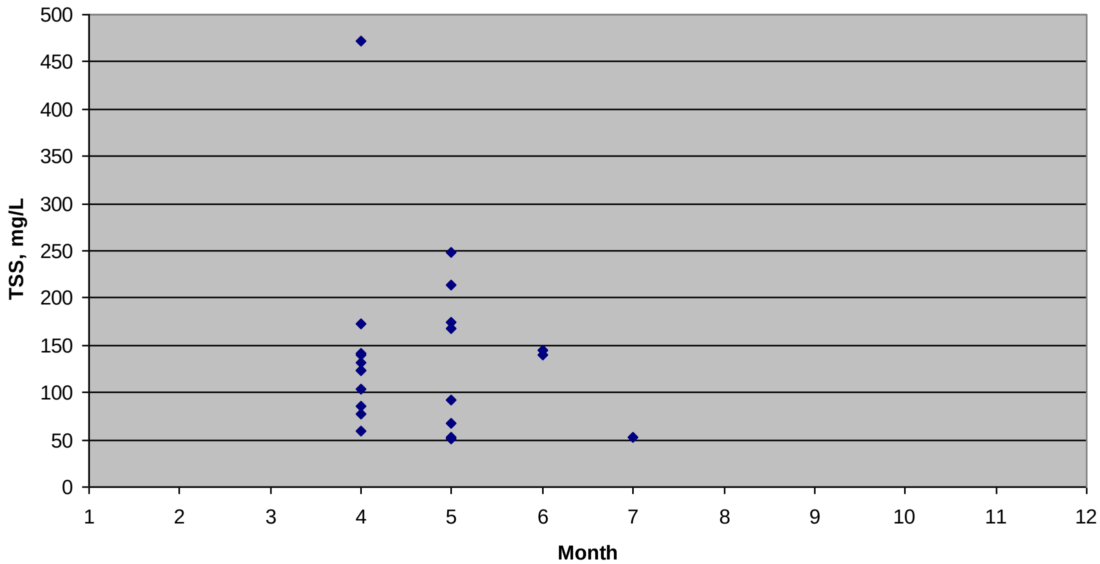

Figure 4. Total suspended solids (TSS) exceedances (≥50 mg/L) in Marsh Creek.

2.3.2 Total Phosphorus

Phosphorus is an important element for all forms of life, but it can also function as a pollutant in surface water. Human-caused eutrophication in the presence of high phosphorus levels can impair beneficial uses. High phosphorus concentrations are expressed as excess growth of aquatic plants and algae, and these tend to consume large amounts of dissolved oxygen, potentially suffocating fish and other aquatic animals while also blocking available sunlight to bottom-dwelling species.

A review of available water quality data (N = 230) from DEQ, ISCC, USGS, and BID for Marsh Creek indicates the following TP concentrations:

- Minimum = 0.009 mg/L
- Mean = 0.106 mg/L
- Median = 0.096 mg/L
- Maximum = 0.990 mg/L

Exceedances—as defined in the Lake Walcott TMDL—are concentrations greater than or equal to 0.100 mg/L TP. Approximately 47.0% of the values (or n = 108 samples) exceed or are equal to the 0.100 mg/L TP instream target defined by the Lake Walcott TMDL. The exceedances have a minimum value of 0.100 mg/L, an average of 0.163 mg/L, and a maximum of 0.990 mg/L. In general, the exceedances appear to occur year-round, but most occur from April through September (at 15.1% per month on average) with the least occurring from October through March (at 1.6% per month on average). Figure 5 summarizes TP exceedances on a monthly basis based on the water quality monitoring data available to DEQ.

Although TP monitoring of Marsh Creek shows exceedances of targets, nuisance aquatic growth, visible slimes, and algae blooms—indicators of impairment to beneficial uses—were not observed. Therefore, a TP TMDL will <u>not</u> be completed at this time. However, DEQ will continue to assess this stream for biological indicators that may indicate nuisance aquatic plant growths.

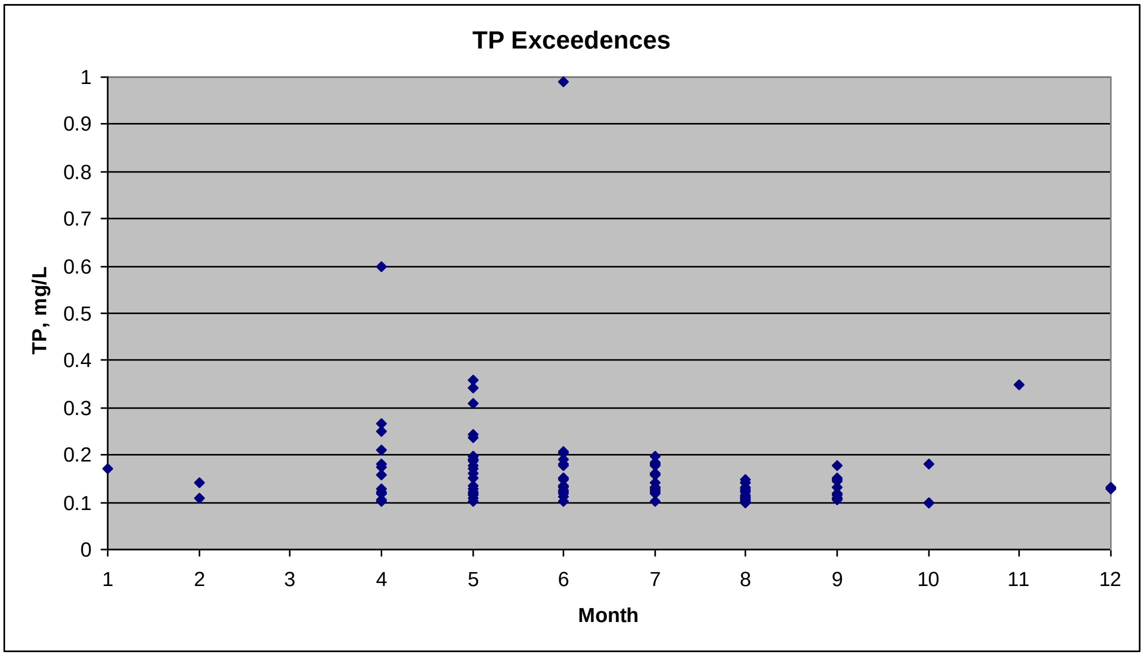

Figure 5. Total phosphorus (TP) exceedances (≥0.100 mg/L) in Marsh Creek.

2.3.3 Temperature

Continuous temperature data loggers were placed into Marsh Creek in 2011. Loggers were deployed at Six S Ranch on Marsh Creek where a large diversion dam and series of water quality improvement ponds have been constructed. Data suggest that in 2011, Marsh Creek (coming onto the ranch) reached daily maximum and daily average temperatures of 22 °C and 19 °C, respectively, during July and August (Figure 6). After leaving the bottom pond, Marsh Creek temperatures increased to above 30 °C in mid-July (Figure 7). These higher temperatures are specific to the pond system itself as a result of water diversion and are not representative of free-flowing Marsh Creek.

The ponds were installed specifically to reduce TSS, E. coli, and phosphorus. As a result, turbidity is also reduced which allows increased solar penetration and contributes to increased water temperatures. The free-flowing portions of Marsh Creek do not reflect the higher temperatures exhibited in the pond system. Salmonid spawning appears to be fully supported temperature-wise during September and October, but CWAL is not supported temperature-wise during the summer months, particularly in July.

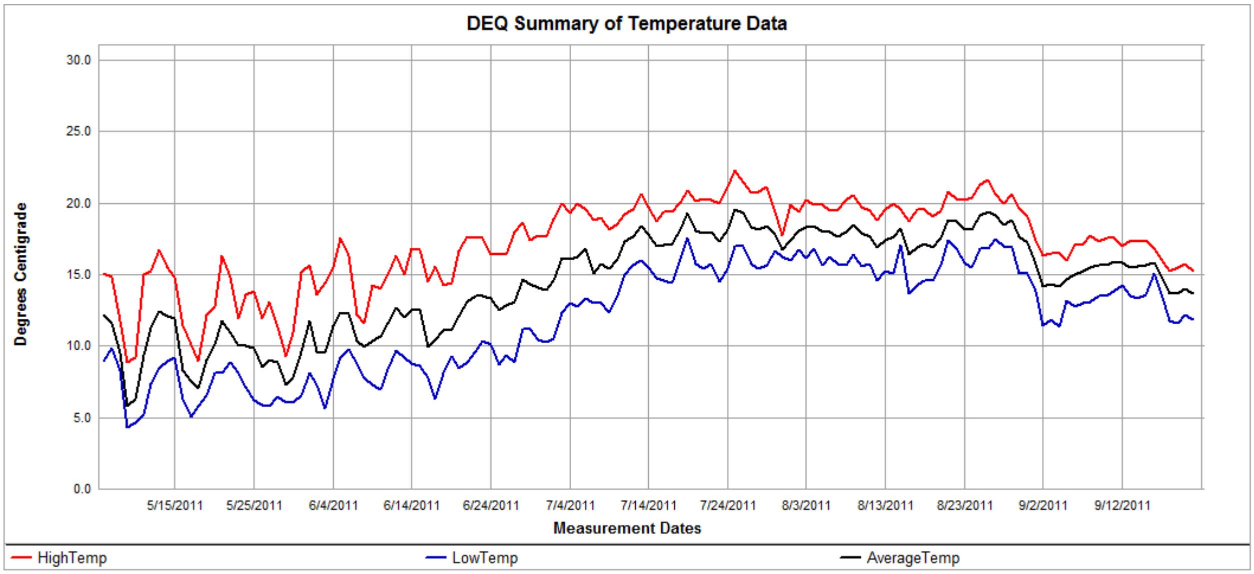

Figure 6. Marsh Creek temperatures at the top of Six S Ranch at flow gage, May through September 2011.

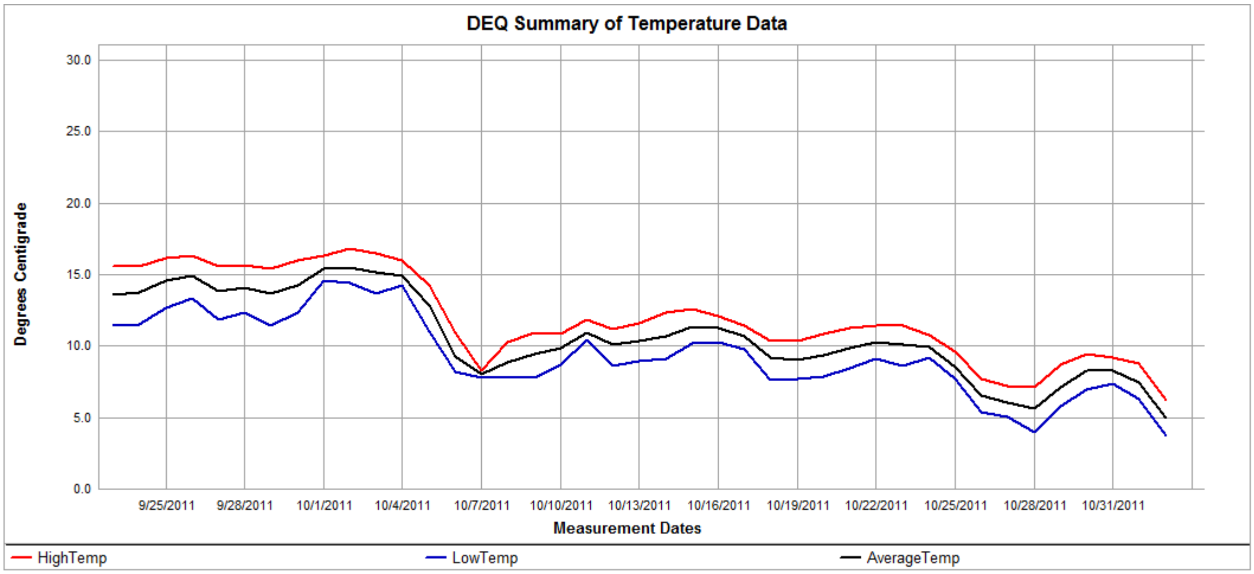

Figure 7b. Marsh Creek temperatures at top of Six S Ranch at flow gage, September through October 2011.

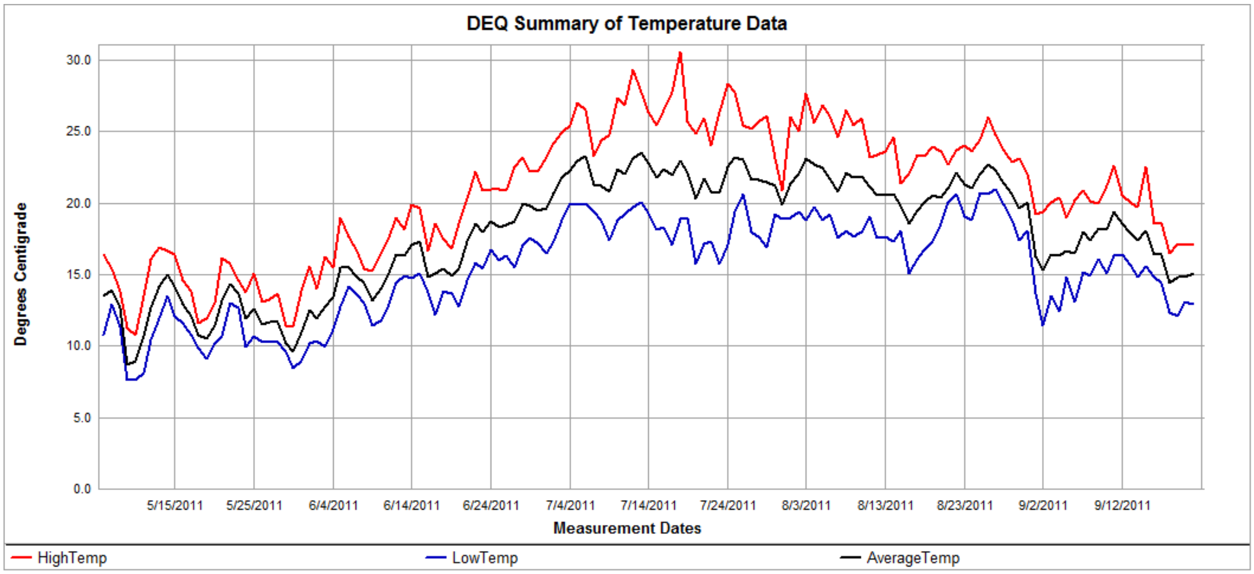

Figure 7. Marsh Creek temperatures at the bottom pond of Six S Ranch, May through September 2011.

2.3.4 *Escherichia coli*

For *E. coli*, levels that exceed the water quality standards tend to degrade recreational beneficial uses. *Primary contact recreation* includes recreational uses of water involving body contact with water, where ingestion of water is reasonably possible, such as swimming, wading, or use of natural hot springs. *Secondary contact recreation* includes recreational uses of water involving proximity to water but not normally involving body contact with water or ingestion of water. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, aquatic life study, fishing, hunting, sight-seeing, or aesthetic enjoyment. In many cases, the persistence of excess *E. coli* may indicate a change in the chemical, physical, or biological integrity of the water body in question. Excess *E. coli* are an indicator (but not necessarily the cause) of eutrophication. Under such conditions, public exposure may be inadvisable until *E. coli* are at safe levels.

A review of available water quality data (N = 115 samples) from DEQ, ISCC, USGS, and BID for Marsh Creek indicates the following *E. coli* levels:

- Minimum = 0.0 colony forming units per 100 milliliters (cfu/100 mL)
- Mean = 382.9 cfu/100 mL
- Median = 180 cfu/100 mL
- Maximum = 2,400 cfu/100 mL

Approximately 28.7% of the *E. coli* data exceed or are equal to the 406 cfu/100 mL instantaneous instream trigger value for conducting additional sampling to calculate a five-sample geometric mean under Idaho's water quality standards and as discussed in the Lake Walcott TMDL (DEQ 2000). The exceedances (n = 33) have a minimum value of 410.0 cfu/100 mL, an average of 1,040.6 cfu/100 mL, and a maximum of 2,400.0 cfu/100 mL. In general, these exceedances occur from April through September, at 16.7% per month on average. Figure 8 summarizes the *E. coli* exceedances on a monthly basis based on the water quality monitoring data available to DEQ.

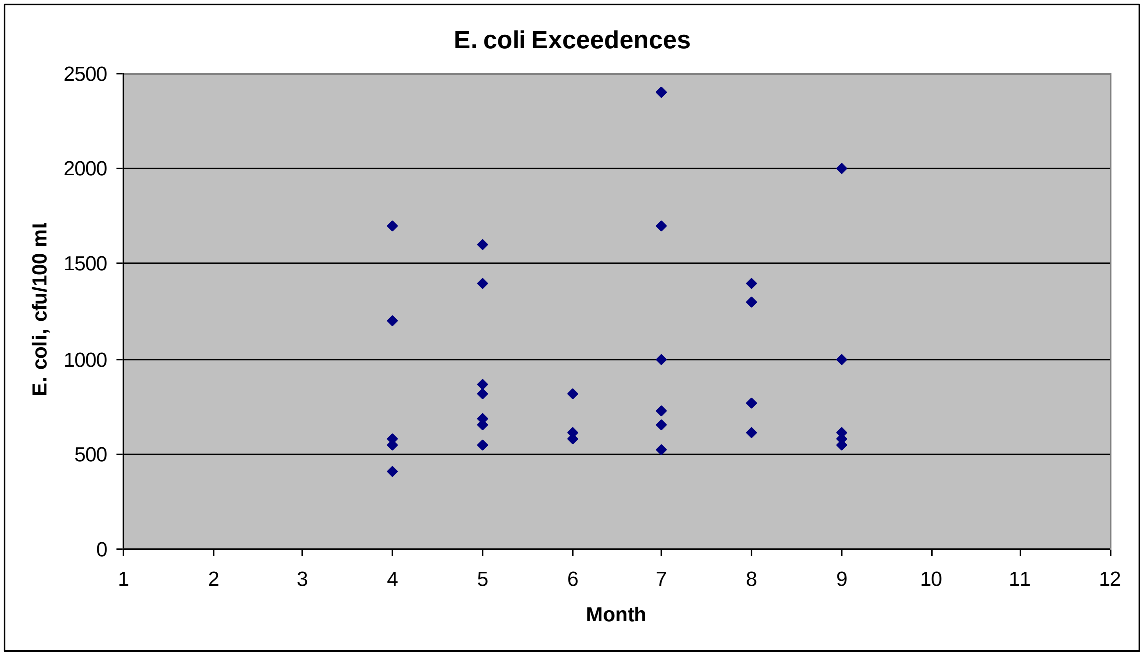

Figure 8. *E. coli* exceedances (≥406 cfu/100 mL) in Marsh Creek.

Because of the exceedance of trigger values, DEQ also collected *E. coli* samples in the 3rd- and 4th-order of Marsh Creek to determine if water quality standards were being violated. State of Idaho criteria for *E. coli* states that bacteria are not to exceed 126 cfu/100 mL of solution as a 30-day geometric mean. Initial *E. coli* samples taken on Marsh Creek violated the secondary contact recreation single sample criterion (576 cfu/100 mL) and triggered the subsequent sampling necessary to calculate a geometric mean concentration. Five *E. coli* bacteria samples were taken every 3 to 7 days over a 30-day period starting on July 19, 2012, through August 2, 2012. Data revealed a geometric mean of 492 cfu/100 mL in AU ID17040209SK003_03 and 210 cfu/100 mL in AU ID17040209SK003_04, thereby necessitating a TMDL. Table 4 summarizes the *E. coli* data collected in July and August 2012.

Table 4. *E. coli* bacteria geometric mean concentrations.

Assessment Unit	Water Body Name	Geometric mean *E. coli* concentration (cfu/100 mL)
ID17040209SK003_03	Marsh Creek	492
ID17040209SK003_04	Marsh Creek	210

2.3.5 Data Gaps

A detailed discussion of data gaps for the Lake Walcott subbasin is provided in the Lake Walcott subbasin TMDL (DEQ 2000).

3 Subbasin Assessment—Pollutant Source Inventory

3.1 Sources of Pollutants of Concern

A review of water quality data for Marsh Creek indicates TSS, TP, temperature, and *E. coli* as primary pollutants of concern. This TMDL addendum provides nonpoint source load allocations for temperature and *E. coli*. Because no known point sources exist that discharge to Marsh Creek, the main pollutant sources are associated with nonpoint sources. These sources appear to be associated with land use and landownership and include the following:

- Forested lands—Forestland exists primarily in the headwaters portion of Marsh Creek. These lands contribute TSS due to natural erosion.
- Wildlife—Access to the stream and instream use by wildlife introduces TSS and *E. coli* into Marsh Creek.
- Recreation—Pollutants from recreational uses include sediment and shade reduction from stream access areas and deposition of untreated waste.
- Rangeland grazing—Livestock grazing occurs on Marsh Creek lands managed by the US Forest Service, Bureau of Land Management, Idaho Department of Lands, and private owners. Instream livestock watering occurs in Marsh Creek when off-site watering is unavailable. Grazing can contribute to a reduction of stream shading where riparian grazing is concentrated and increased levels of TSS, TP, and *E. coli*.
- Irrigated agriculture—Marsh Creek water is diverted and returned through irrigation infrastructure and agriculture lands throughout the watershed, resulting in TSS, TP, *E. coli*, and temperature increases.
- Animal feeding operations—The Marsh Creek watershed has small private "backyard" type feedlots and dairies, rather than large permitted operations. These are primarily located near Declo, Idaho. An elk ranch is located near Albion, Idaho. These operations can contribute TSS, TP, and *E. coli* to Marsh Creek.
- Mineral extraction—Sand, gravel, and other mineral extraction and sorting operations exist in the Marsh Creek watershed. These land uses can contribute sediment to streams via stormwater runoff.
- Roads—Paved, graveled, and native surface roads exist in the Marsh Creek watershed. Sediment from these features can be introduced as a pollutant through stormwater runoff.
- Stream crossings/fords—Numerous stream crossings exist on Marsh Creek from the headwaters to its confluence with the Snake River. Stream crossings can introduce sediment and reduce stream shading.
- Urban stormwater—The towns of Albion and Declo contribute stormwater runoff and associated pollutants, mainly TSS, TP, and *E. coli*, to Marsh Creek and its tributaries.
- Rural stormwater—Periodic to severe flooding problems are known to exist in Marsh Creek and Land Creek near Albion, Idaho, due mainly to heavy rain, rapid snowmelt, or ice jams (Cassia County 2006, p. 37). Pollutants—especially TSS, TP, and *E. coli*—can be introduced into Marsh Creek during these events.
- Construction stormwater—Construction activities within the Marsh Creek watershed include home and small business development and contribute TSS to the creek. Pollutants resulting from new road construction and road maintenance activities (i.e., culvert replacement) are also included in this pollutant category.

- Dams/diversions—An investigation of Idaho Department of Water Resources water rights indicates that Marsh Creek is the primary source of water to much of the irrigated land that is associated with the local agricultural community, followed by use as stockwater and domestic water. Diversions account for much of the water in Marsh Creek being 100% diverted at times. Reduced flows can result in increased water temperatures.
- Water quality improvement ponds/impoundments – Several ponds were installed on Marsh Creek specifically to reduce TSS, *E. coli*, and phosphorus. As a result, turbidity is also reduced which allows increased solar penetration and contributes to increased water temperatures.
- Septic systems—Overloaded, malfunctioning, or decrepit private septic systems can contribute pollutants, particularly TP and *E. coli*, to the watershed.

3.2 Pollutant Sources Data Gaps

This section deals primarily with certain data gaps that are related to pollutant sources. Although DEQ did its best to identify all sources of potential pollutants in its initial assessment, other unknown sources may exist that were not identified. Therefore, DEQ will update this section as additional pollutant sources are identified. The existing known pollutant sources are identified in section 3.1.

DEQ conducted a survey of potential point sources associated with Marsh Creek—for multisector general permitted facilities, National Pollutant Discharge Elimination System (NPDES) municipalities, and industrial stormwater facilities—and determined that no point sources exist in the Marsh Creek drainage. Additionally, any confined animal feeding operations are well below the size restrictions for an NPDES permit. However, the TMDL does identify certain future point sources that may potentially discharge into Marsh Creek. These include the City of Albion and the City of Declo, both of which are currently land applying and not discharging to Marsh Creek.

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

A complete summary of water quality data collected by DEQ or other agencies and analyzed or summarized by DEQ is included in the Lake Walcott 5-year review (DEQ 2012). This document is available at *http://www.deq.idaho.gov/media/840549-lake-walcott-sba-assessment-tmdls-five-year-review-0512.pdf*. The 5-year review also includes a summary of water quality improvement projects that have been implemented since the original TMDL was written in 2000.

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 Part 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.

5.1 Potential Natural Vegetation Temperature TMDL

5.1.1 Instream Water Quality Targets

For the Marsh Creek temperature TMDL, we utilized a potential natural vegetation (PNV) approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered to be a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and for temperature TMDLs, the natural level of shade and channel width become the TMDL target. The instream temperature that results from attaining these conditions is consistent with the water quality standards, even if it exceeds numeric temperature criteria. See Appendix C for further discussion of water quality standards and background provisions.

The PNV approach is described briefly below. The procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in detail in *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual* (Shumar and De Varona 2009). The manual also provides a more complete discussion of shade and its effects on stream water temperature.

5.1.1.1 Factors Controlling Water Temperature in Streams

There are several important contributors of heat to a stream, including ground water temperature, air temperature, and direct solar radiation (Poole and Berman 2001). Of these, direct solar radiation is the source of heat that is most controllable. The parameters that affect the amount of solar radiation hitting a stream throughout its length are shade and stream morphology. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Stream morphology (i.e., structure) affects riparian vegetation density and water storage in the alluvial aquifer. Riparian vegetation and channel morphology are the factors influencing shade that are most likely to have been influenced by anthropogenic activities and can be most readily corrected and addressed by a TMDL.

Riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. However, depending on how much vertical elevation surrounds the stream, vegetation further away from the riparian corridor can also provide shade. We can measure the amount of shade that a stream enjoys in a number of ways. Effective shade (i.e., that shade provided by all objects that intercept the sun as it makes its way across the sky) can be measured in a given location with a Solar Pathfinder or with other optical equipment similar to a fish-eye lens on a camera. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and stream aspect.

In addition to shade, canopy cover is a similar parameter that affects solar radiation. Canopy cover is the vegetation that hangs directly over the stream and can be measured using a densiometer or estimated visually either on site or using aerial photography. All of these methods provide information about how much of the stream is covered and how much is exposed to direct solar radiation.

5.1.1.2 Potential Natural Vegetation for Temperature TMDLs

PNV along a stream is that riparian plant community that could grow to an overall mature state, although some level of natural disturbance is usually included in the development and use of shade targets. Vegetation can be removed by disturbance either naturally (e.g., wildfire, disease/old age, wind damage, wildlife grazing) or anthropogenically (e.g., domestic livestock grazing, vegetation removal, erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides a natural level of solar loading to the stream without any anthropogenic removal of shade-producing vegetation. Vegetation levels less than PNV (with the exception of natural levels of disturbance and age distribution) result in the stream heating up from anthropogenically created additional solar inputs.

We can estimate PNV (and therefore target shade) from models of plant community structure (shade curves for specific riparian plant communities), and we can measure or estimate existing canopy cover or shade. Comparing the two (target and existing shade) tells us how much excess solar load the stream is receiving and what potential exists to decrease solar gain. Streams disturbed by wildfire, flood, or some other natural disturbance will be at less than PNV and require time to recover. Streams that have been disturbed by human activity may require additional restoration above and beyond natural recovery.

Existing and PNV shade was converted to solar loads from data collected on flat-plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather stations collecting these data. In this case, we used the Pocatello, Idaho, station. The difference between existing and target solar loads, assuming existing load is higher, is the load reduction necessary to bring the stream back into compliance with water quality standards (Appendix C).

PNV shade and the associated solar loads are assumed to be the natural condition; thus, stream temperatures under PNV conditions are assumed to be natural (so long as no point sources or other anthropogenic sources of heat exist in the watershed) and are considered to be consistent with the Idaho water quality standards, even if they exceed numeric criteria.

5.1.1.2.1 Existing Shade Estimates

Existing shade was estimated for Marsh Creek from visual interpretation of aerial photos. Estimates of existing shade based on plant type and density were marked out as stream segments on a 1:100,000 or 1:250,000 hydrography taking into account natural breaks in vegetation density. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. Each segment was assigned a single value representing the bottom of a 10% shade class (adapted from the cumulative watershed effects process, IDL 2000). For example, if shade for a particular stream segment was estimated somewhere between 50% and 59%, we assigned a 50% shade class to that segment. The estimate is based on a general intuitive observation about the kind of vegetation present, its density, and stream width. Streams where the banks and water are clearly visible are usually in low shade classes (10%, 20%, or 30%). Streams with dense forest or heavy brush where no portion of the stream is visible are usually in high shade classes (70%, 80%, or 90%). More open canopies where portions of the stream may be visible usually fall into moderate shade classes (40%, 50%, or 60%).

Visual estimates made from aerial photos are strongly influenced by canopy cover and do not always take into account topography or any shading that may occur from physical features other than vegetation. It is not always possible to visualize or anticipate shade characteristics resulting from topography and landform. However, research has shown that shade and canopy cover measurements are remarkably similar (OWEB 2001), reinforcing the idea that riparian vegetation and objects proximal to the stream provide the most shade. The visual estimates of shade in this TMDL were partially field verified with a Solar Pathfinder, which measures effective shade and takes into consideration other physical features that block the sun from hitting the stream surface (e.g., hillsides, canyon walls, terraces, and man-made structures).

Solar Pathfinder Field Verification

The accuracy of the aerial photo interpretations was field verified with a Solar Pathfinder. The Solar Pathfinder is a device that allows one to trace the outline of shade-producing objects on monthly solar path charts. The percentage of the sun's path covered by these objects is the effective shade on the stream at the location where the tracing is made. To adequately characterize the effective shade on a stream segment, ten traces are taken at systematic or random intervals along the length of the stream in question.

At each sampling location, the Solar Pathfinder was placed in the middle of the stream at about the bank-full water level. Ten traces were taken following the manufacturer's instructions (i.e., orient to south and level). Systematic sampling was used because it is easiest to accomplish without biasing the sampling location. For each sampled segment, the sampler started at a unique location, such as 100 meters from a bridge or fence line, and proceeded upstream or downstream taking additional traces at fixed intervals (e.g., every 50 meters, every 50 paces, etc.). Alternatively, one can rando mLy locate points of measurement by generating random numbers to be used as interval distances.

When possible, the sampler also measured bank-full widths, took notes, and photographed the landscape of the stream at several unique locations while taking traces. Special attention was given to changes in riparian plant communities and what kinds of plant species (the large, dominant, shade-producing ones) were present. One can also take densiometer readings at the same location as Solar Pathfinder traces. These readings provide the potential to develop relationships between canopy cover and effective shade for a given stream.

The accuracy of the aerial photo interpretations were field verified with a Solar Pathfinder during the summer of 2008 at Howell Canyon Creek. The original aerial photo interpretation of 80% shade class was an overestimate, as the site was measured as 60.9%, or the 60% shade class. Although only one stream was field verified in this TMDL (Howell Creek), other work in streams of the Twin Falls region was used to help improve the aerial interpretation. These results were used to calibrate our eye, and aerial photo interpretations were corrected accordingly. Existing shade levels presented in this document reflect those corrections.

5.1.1.2.2 Target Shade Determination

PNV targets were determined from an analysis of probable vegetation at the streams and comparing that to shade curves developed for similar vegetation communities in Idaho (see Shumar and De Varona 2009). A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, shade decreases as vegetation has less ability to shade the center of wide streams. As the vegetation gets taller, the more shade the plant community is able to provide at any given channel width.

Natural Bank-Full Width

Stream width must be known to calculate target shade since the width of a stream affects the amount of shade the stream receives. Bank-full width is used because it best approximates the width between the points on either side of the stream where riparian vegetation starts. Measures of current bank-full width may not reflect widths present under PNV (i.e., natural widths). As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase such that streams become wider and shallow. Shade produced by vegetation covers a lower percentage of the water surface in wider streams, and widened streams can also have less vegetative cover if shoreline vegetation has eroded away.

Since existing bank-full width may not be discernible from aerial photo interpretation and may not reflect natural bank-full widths, this parameter must be estimated from available information. We used regional curves for the major basins in Idaho—developed from data compiled by Diane Hopster of the Idaho Department of Lands—to estimate natural bank-full width (Figure 9).

For each stream evaluated in the load analysis, natural bank-full width was estimated based on the drainage area of the Upper Snake curve from Figure 9. Existing width data should also be evaluated and compared to these curve estimates if such data are available. However, for the Marsh Creek watershed, only a few Beneficial Use Reconnaissance Program (BURP) sites exist, and bank-full width data from those sites represent only spot data (e.g., only three measured widths in a reach just several hundred meters long) that are not always representative of the stream as a whole.

If the stream’s existing width is wider than that predicted by the Upper Snake curve displayed in Table 5, then the Figure 9 estimate of bank-full width is used in the load analysis for natural width. If existing width is smaller, then existing width is used in the load analysis for natural width. In most cases, the Upper Snake curve estimates were used for natural bank-full width in most segments of each stream’s loading analysis. Notable exceptions include Marsh Creek where existing widths tended to be smaller than the prediction.

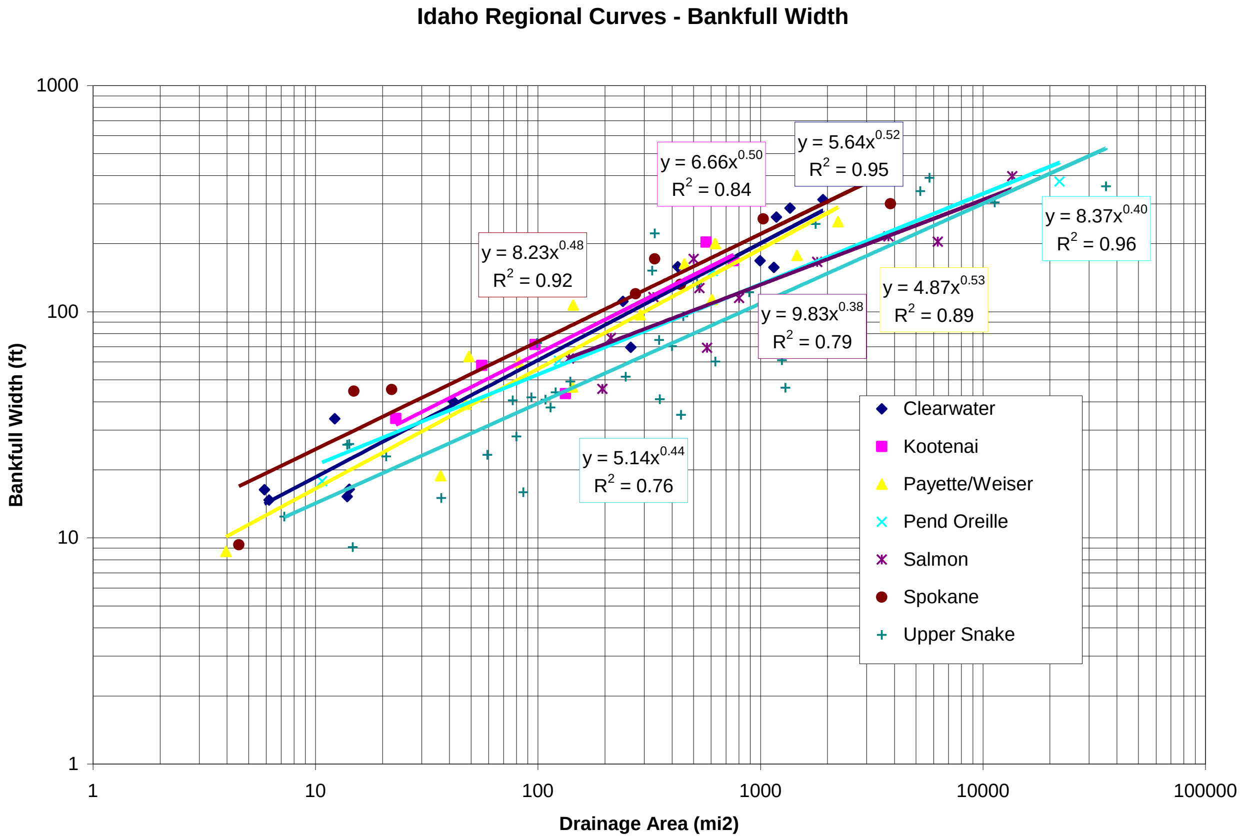

Figure 9. Bank-full width as a function of drainage area.

Table 5. Regional curve estimates and existing measurements of bank-full width.

Location	area (sq mi)	US (m)	existing (m)
Marsh @ Forest Service boundary	1.88	2	3.55
Marsh Creek above Land Creek	22.95	6	
Marsh Creek above Howell Can.	47.73	9	
Marsh below Howell Canyon	72.96	10	6.03
Marsh 1.6 miles below Howell Canyon	79.03	11	6.23
Marsh 3 miles below Howell Canyon	82.28	11	5.27
Marsh Creek @ mouth	118.38	13	
Land @ Forest Service boundary	1.42	2	3.5
Land above Pine Canyon	no data	no data	6.77
Howell Canyon @ Bennet Springs	2.37	2	5.73
Howell above road X-ing and Pine Creek	3.56	3	5.32
Howell Canyon .5 miles below Pine	5.53	3	3.23
Howell Canyon @ mouth	24.99	6	
green = low existing			
yellow = high existing			

Note: US = Upper Snake curve

Design Conditions

Streams examined in this document are found in four subecoregions in the Northern Basin and Range, Idaho Batholith, and Snake River Plain Level III Ecoregions of McGrath et al. (2001).

Streams on the southern side of the Snake River are found in the Northern Basin and Range Level III Ecoregion. Of those streams, a portion of the top of Marsh Creek is found in the Sagebrush Steppe Valleys Level IV Ecoregion. This ecoregion is dominated by sagebrush grassland and has less available water than other parts of the Snake River Plain. Grazing is the main land use in the area.

Streams to the southwest of Lake Walcott (Marsh, Land, and Howell Canyon Creeks) are found in the Dissected High Lava Plateau Level IV Ecoregion. This region is characterized by alluvial fans, rolling plains, and steep canyons. Sagebrush grassland is common with scattered woodlands on the rocky upland areas.

The lower portion of Marsh Creek is found in the Magic Valley Level IV Ecoregion of the Snake River Plain Level III Ecoregion. The soils are aridic and the native vegetation is sagebrush and bunchgrass. Overwatering of sprinkler-irrigated croplands in the Eastern Snake River Basalt Plains Level IV Ecoregion has created raised ground water levels and artificial wetlands in the Magic Valley Ecoregion.

Lake Walcott is in the Eastern Snake River Basalt Plains Level IV Ecoregion of the Snake River Plain Level III Ecoregion. This area is characterized by shallow, stony soils and widespread rangeland with natural vegetation of sagebrush and bunchgrass.

Riparian vegetation along streams varies greatly from high elevation Douglas-fir (*Pseudotsuga menziesii*) or lodgepole pine (*Pinus contorta*) forests and quaking aspen (*Populus tremuloides*) stands to willow or grass/sagebrush dominated areas at lower elevations. Some lower elevation areas in wide, flat valleys also have black cottonwood (*Populus trichocarpa*) dominated riparian areas. Generally, the mid-elevation willow communities are lumped into a Geyer willow (*Salix geyeriana*) type, and lower elevation willow communities are dominated by a coyote willow (*S. exigua*) type.

Shade Curve Selection

To determine PNV shade targets for the Lake Walcott subbasin streams, effective shade curves developed specifically for southern Idaho were examined. In particular we used shade curves from the southern Idaho non-forest group developed from data by Hansen and Hall (2002) and the subalpine fir, lodgepole pine, and Douglas-fir potential vegetation group shade curves developed for the Sawtooth National Forest. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. Targets (percent shade) are based on averaging the individual curves for the three aspects (N/S, E/W, and NE/SW/NW/SE) for any given community type. Table 6 through Table 12 present the shade targets for various vegetation communities of southern Idaho in the Lake Walcott subbasin.

Table 6. Shade targets for the subalpine fir vegetation type at various stream widths.

High Elev Subalpine Fir (PVG 11)	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m
0/180 aspect	94	91	88	85	80	74	68	63	59	56	53	50	48
45/135/225/315 aspect	94	92	89	85	80	75	69	65	60	57	54	51	48
90/270 aspect	95	93	88	85	81	76	70	65	59	54	50	46	43
Target (%)	**94**	**92**	**88**	**85**	**80**	**75**	**69**	**64**	**59**	**56**	**52**	**49**	**46**

Table 7. Shade targets for the lodgepole pine vegetation type at various stream widths.

Persistent Lodgepole (PVG 10)	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m
0/180 aspect	96	94	91	87	81	75	70	65	61	58	55	52	49
45/135/225/315 aspect	96	94	91	86	81	76	70	65	62	58	55	52	49
90/270 aspect	97	95	90	87	83	76	70	64	59	54	49	45	42
Target (%)	**96**	**94**	**91**	**87**	**82**	**76**	**70**	**65**	**61**	**57**	**53**	**50**	**47**

Table 8. Shade targets for the Douglas-fir vegetation type at various stream widths.

Cool, Dry Douglas Fir (PVG 4)	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m
0/180 aspect	94	92	90	86	82	75	69	65	61	57	54	51	49
45/135/225/315 aspect	95	93	90	86	82	76	71	66	62	59	55	52	50
90/270 aspect	95	94	90	87	84	79	73	67	62	56	52	48	44
Target (%)	**95**	**93**	**90**	**86**	**83**	**77**	**71**	**66**	**62**	**57**	**54**	**50**	**48**

Table 9. Shade targets for the aspen vegetation type at various stream widths.

Aspen	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m
0/180 aspect	99	99	99	96	93	90	86	82	78	75	71	68	65
45/135/225/315 aspect	100	99	99	96	93	89	85	81	77	73	69	65	62
90/270 aspect	100	99	99	97	95	91	84	76	67	61	56	52	48
Target (%)	**100**	**99**	**99**	**96**	**94**	**90**	**85**	**80**	**74**	**70**	**65**	**62**	**58**

Table 10. Shade targets for the black cottonwood vegetation type at various stream widths.

Black cottonwood	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m
0/180 aspect	97	97	96	96	94	91	88	85	82	78	74	70	67
45/135/225/315 aspect	98	97	96	96	94	91	88	85	81	76	72	68	64
90/270 aspect	97	97	97	96	95	93	91	87	78	71	65	61	56
Target (%)	**97**	**97**	**96**	**96**	**94**	**92**	**89**	**86**	**80**	**75**	**70**	**66**	**62**

Table 11. Shade targets for the Geyer willow vegetation type at various stream widths.

Geyer willow	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m
0/180 aspect	92	83	68	59	51	45	41	37	33	31	28	26	24
45/135/225/315 aspect	92	82	66	56	48	42	38	34	31	28	26	24	22
90/270 aspect	94	82	58	45	37	31	27	24	21	19	18	16	15
Target (%)	**93**	**82**	**64**	**53**	**45**	**39**	**35**	**32**	**28**	**26**	**24**	**22**	**20**

Table 12. Shade targets for the coyote willow vegetation type at various stream widths.

Coyote willow	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m	14m	15m	16m
0/180 aspect	94	87	74	64	56	50	45	41	37	34	31	29	27	25	24	23
45/135/225/315 aspect	94	86	72	61	53	47	42	37	34	31	29	26	25	23	22	20
90/270 aspect	95	89	64	50	41	34	30	27	24	22	20	18	17	16	15	14
Target (%)	**94**	**87**	**70**	**58**	**50**	**44**	**39**	**35**	**32**	**29**	**27**	**24**	**23**	**21**	**20**	**19**

5.1.2 Load Capacity

The load capacity for a stream under PNV is essentially the solar loading allowed under the shade targets specified for the segments within that stream. These loads are determined by multiplying the solar load measured by a flat-plate collector (under full sun) for a given period of time by the fraction of the solar radiation that is not blocked by shade (i.e., the percent open or 100% minus percent shade). In other words, if a shade target is 60% (or 0.6), the solar load hitting the stream under that target is 40% of the load hitting the flat-plate collector under full sun.

We obtained solar load data from flat-plate collectors at the NREL weather station in Pocatello, Idaho. The solar load data used in this TMDL analysis are spring/summer averages (i.e., an average load for the 6-month period from April through September). As such, load capacity calculations are also based on this 6-month period, which coincides with the time of year when stream temperatures are increasing, deciduous vegetation is in leaf, and fall spawning is occurring. During this period, temperatures may affect beneficial uses such as spring and fall salmonid spawning, and cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent the period of highest stream temperatures. However, solar gains can begin early in the spring and affect not only the highest temperatures reached later in the summer but also salmonid spawning temperatures in spring and fall.

Table 13 through Table 15 and Figure 10 show the PNV shade targets. The tables also show corresponding target summer loads (in kilowatt-hours per square meter per day [kWh/m^2/day] and kWh/day) that serve as the load capacities for the streams. Existing and target loads in kWh/day can be summed for the entire stream or portion of stream examined in a single load analysis table. These total loads are shown at the bottom of their respective columns in each table. Because load calculations involve stream segment area calculations, the segment channel width, which typically only has one or two significant figures, dictates the level of significance of the corresponding loads. One significant figure in the resulting load can create rounding errors when existing and target loads are subtracted. The totals row of each load table represents total loads with two significant figures in an attempt to reduce apparent rounding errors.

The AUs with the largest target load (i.e., load capacity) were Marsh Creek (AUs ID17040209SK003_03 and 003_04) with 850,000 kWh/day (Table 13). The smallest target load was in Land Creek (AU ID17040209SK003_02) with 46,000 kWh/day (Table 14).

5.1.3 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(I)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed) but may be aggregated by type of source or area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Existing loads in this temperature TMDL come from estimates of existing shade as determined from aerial photo interpretations. There are currently no permitted point sources in the affected AUs. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat-plate collector at the NREL weather station. Existing shade data are presented in Table 13 through Table 15 and Figure 11. Like load capacities (target loads), existing loads in Table 13 through Table 15 are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day). Existing loads in kWh/day are also summed for the entire stream or portion of stream examined in a single load analysis table. The difference between target and existing load is also summed for the entire table. Should existing load exceed target load, this difference becomes the excess load (i.e., lack of shade) to be discussed next in the load allocation section and as depicted in the lack-of-shade figure (Figure 12).

The AUs with the largest existing load (i.e., load capacity) were Marsh Creek (AUs ID17040209SK003_03 and 003_04) with 4,800,000 kWh/day (Table 13). The smallest existing load was in Land Creek (AU ID17040209SK003_02) with 120,000 kWh/day (Table 14).

Table 13. Existing and target solar loads for Marsh Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation ($kWh/m^2/day$)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation ($kWh/m^2/day$)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
003_02	Marsh Creek	1	1010	lodgepole pine - PVG10	96%	0.25	1	1,000	200	90%	0.62	1	1,000	600	400	-6%
003_02	Marsh Creek	2	1410	lodgepole pine - PVG10	94%	0.37	2	3,000	1,000	80%	1.23	3	4,000	5,000	4,000	-14%
003_02	Marsh Creek	3	420	lodgepole pine - PVG10	94%	0.37	2	800	300	90%	0.62	3	1,000	600	300	-4%
003_03	Marsh Creek	1	180	lodgepole pine - PVG10	94%	0.37	2	400	100	90%	0.62	3	500	300	200	-4%
003_03	Marsh Creek	2	160	lodgepole pine - PVG10	94%	0.37	2	300	100	80%	1.23	3	500	600	500	-14%
003_03	Marsh Creek	3	250	aspen	99%	0.06	3	800	50	70%	1.85	3	800	1,000	1,000	-29%
003_03	Marsh Creek	4	130	aspen	99%	0.06	3	400	20	80%	1.23	3	400	500	500	-19%
003_03	Marsh Creek	5	320	aspen	99%	0.06	3	1,000	60	70%	1.85	3	1,000	2,000	2,000	-29%
003_03	Marsh Creek	6	1220	aspen	99%	0.06	3	4,000	200	80%	1.23	4	5,000	6,000	6,000	-19%
003_03	Marsh Creek	7	890	aspen	99%	0.06	3	3,000	200	80%	1.23	4	4,000	5,000	5,000	-19%
003_03	Marsh Creek	8	620	aspen	96%	0.25	4	2,000	500	70%	1.85	4	2,000	4,000	4,000	-26%
003_03	Marsh Creek	9	690	geyer willow	53%	2.89	4	3,000	9,000	10%	5.54	4	3,000	20,000	10,000	-43%
003_03	Marsh Creek	10	540	geyer willow	53%	2.89	4	2,000	6,000	30%	4.31	4	2,000	9,000	3,000	-23%
003_03	Marsh Creek	11	210	geyer willow	53%	2.89	4	800	2,000	80%	1.23	4	800	1,000	(1,000)	0%
003_03	Marsh Creek	12	520	geyer willow	53%	2.89	4	2,000	6,000	50%	3.08	4	2,000	6,000	0	-3%
003_03	Marsh Creek	13	2430	coyote willow	50%	3.08	5	10,000	30,000	0%	6.15	5	10,000	60,000	30,000	-50%
003_03	Marsh Creek	14	220	coyote willow	50%	3.08	5	1,000	3,000	50%	3.08	5	1,000	3,000	0	0%
003_03	Marsh Creek	15	320	coyote willow	50%	3.08	5	2,000	6,000	80%	1.23	5	2,000	2,000	(4,000)	0%
003_03	Marsh Creek	16	430	coyote willow	50%	3.08	5	2,000	6,000	0%	6.15	5	2,000	10,000	4,000	-50%
003_03	Marsh Creek	17	120	coyote willow	50%	3.08	5	600	2,000	50%	3.08	5	600	2,000	0	0%
003_03	Marsh Creek	18	80	coyote willow	50%	3.08	5	400	1,000	20%	4.92	5	400	2,000	1,000	-30%
003_03	Marsh Creek	19	680	coyote willow	44%	3.44	6	4,000	10,000	20%	4.92	6	4,000	20,000	10,000	-24%
003_03	Marsh Creek	20	2600	coyote willow	44%	3.44	6	20,000	70,000	0%	6.15	6	20,000	100,000	30,000	-44%
003_04	Marsh Creek	1	680	coyote willow	44%	3.44	6	4,000	10,000	20%	4.92	6	4,000	20,000	10,000	-24%
003_04	Marsh Creek	2	610	coyote willow	44%	3.44	6	4,000	10,000	20%	4.92	6	4,000	20,000	10,000	-24%
003_04	Marsh Creek	3	680	coyote willow	44%	3.44	6	4,000	10,000	10%	5.54	6	4,000	20,000	10,000	-34%
003_04	Marsh Creek	4	330	coyote willow	44%	3.44	6	2,000	7,000	20%	4.92	6	2,000	10,000	3,000	-24%
003_04	Marsh Creek	5	350	coyote willow	44%	3.44	6	2,000	7,000	10%	5.54	6	2,000	10,000	3,000	-34%
003_04	Marsh Creek	6	730	coyote willow	44%	3.44	6	4,000	10,000	30%	4.31	6	4,000	20,000	10,000	-14%
003_04	Marsh Creek	7	790	coyote willow	44%	3.44	6	5,000	20,000	10%	5.54	6	5,000	30,000	10,000	-34%
003_04	Marsh Creek	8	1290	reservoir (coyote willow)	44%	3.44	6	8,000	30,000	0%	6.15	250	300,000	2,000,000	2,000,000	-44%
003_04	Marsh Creek	9	600	coyote willow	44%	3.44	6	4,000	10,000	30%	4.31	6	4,000	20,000	10,000	-14%
003_04	Marsh Creek	10	500	coyote willow	44%	3.44	6	3,000	10,000	40%	3.69	6	3,000	10,000	0	-4%
003_04	Marsh Creek	11	1040	coyote willow	44%	3.44	6	6,000	20,000	20%	4.92	6	6,000	30,000	10,000	-24%
003_04	Marsh Creek	12	1120	coyote willow	44%	3.44	6	7,000	20,000	10%	5.54	6	7,000	40,000	20,000	-34%
003_04	Marsh Creek	13	560	coyote willow	44%	3.44	6	3,000	10,000	0%	6.15	6	3,000	20,000	10,000	-44%
003_04	Marsh Creek	14	540	coyote willow	44%	3.44	6	3,000	10,000	20%	4.92	6	3,000	10,000	0	-24%
003_04	Marsh Creek	15	690	coyote willow	44%	3.44	6	4,000	10,000	10%	5.54	6	4,000	20,000	10,000	-34%
003_04	Marsh Creek	16	560	reservoir (coyote willow)	35%	4.00	8	4,000	20,000	0%	6.15	340	200,000	1,000,000	1,000,000	-35%
003_04	Marsh Creek	17	750	black cottonwood	66%	2.09	12	9,000	19,000	0%	6.15	12	9,000	55,000	36,000	-66%
003_04	Marsh Creek	18	360	black cottonwood	66%	2.09	12	4,300	9,000	10%	5.54	12	4,300	24,000	15,000	-56%
003_04	Marsh Creek	19	1180	black cottonwood	66%	2.09	12	14,000	29,000	0%	6.15	12	14,000	86,000	57,000	-66%
003_04	Marsh Creek	20	370	black cottonwood	66%	2.09	12	4,400	9,200	10%	5.54	12	4,400	24,000	15,000	-56%
003_04	Marsh Creek	21	7250	black cottonwood	66%	2.09	12	87,000	180,000	0%	6.15	12	87,000	540,000	360,000	-66%
003_04	Marsh Creek	22	1160	black cottonwood	62%	2.34	13	15,000	35,000	10%	5.54	13	15,000	83,000	48,000	-52%
003_04	Marsh Creek	23	1600	black cottonwood	62%	2.34	13	21,000	49,000	0%	6.15	13	21,000	130,000	81,000	-62%
003_04	Marsh Creek	24	690	black cottonwood	62%	2.34	13	9,000	21,000	60%	2.46	13	9,000	22,000	1,000	-2%
003_04	Marsh Creek	25	1240	black cottonwood	62%	2.34	13	16,000	37,000	0%	6.15	13	16,000	98,000	61,000	-62%
003_04	Marsh Creek	26	260	black cottonwood	62%	2.34	13	3,400	7,900	10%	5.54	13	3,400	19,000	11,000	-52%
003_04	Marsh Creek	27	2780	black cottonwood	62%	2.34	13	36,000	84,000	0%	6.15	13	36,000	220,000	140,000	-62%
							Totals		850,000					4,800,000	4,000,000	

Table 14. Existing and target solar loads for Land Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
003_02	Land Creek	1	1540	lodgepole - PVG10	96%	0.25	1	2,000	500	80%	1.23	1	2,000	2,000	2,000	-16%
003_02	Land Creek	2	620	supalpine fir - PVG11	94%	0.37	1	600	200	90%	0.62	2	1,000	600	400	-4%
003_02	Land Creek	3	300		92%	0.49	2	600	300	80%	1.23	3	900	1,000	700	-12%
003_02	Land Creek	4	920	aspen	99%	0.06	2	2,000	100	80%	1.23	4	4,000	5,000	5,000	-19%
003_02	Land Creek	5	320		99%	0.06	2	600	40	60%	2.46	4	1,000	2,000	2,000	-39%
003_02	Land Creek	6	460		99%	0.06	2	900	60	80%	1.23	4	2,000	2,000	2,000	-19%
003_02	Land Creek	7	100		99%	0.06	2	200	10	70%	1.85	3	300	600	600	-29%
003_02	Land Creek	8	370		99%	0.06	2	700	40	80%	1.23	3	1,000	1,000	1,000	-19%
003_02	Land Creek	9	880	geyer willow	82%	1.11	2	2,000	2,000	70%	1.85	3	3,000	6,000	4,000	-12%
003_02	Land Creek	10	370		64%	2.21	3	1,000	2,000	50%	3.08	3	1,000	3,000	1,000	-14%
003_02	Land Creek	11	460		64%	2.21	3	1,000	2,000	0%	6.15	3	1,000	6,000	4,000	-64%
003_02	Land Creek	12	310		64%	2.21	3	900	2,000	40%	3.69	3	900	3,000	1,000	-24%
003_02	Land Creek	13	610		64%	2.21	3	2,000	4,000	20%	4.92	4	2,000	10,000	6,000	-44%
003_02	Land Creek	14	330		64%	2.21	3	1,000	2,000	80%	1.23	4	1,000	1,000	(1,000)	16%
003_02	Land Creek	15	600		64%	2.21	3	2,000	4,000	30%	4.31	4	2,000	9,000	5,000	-34%
003_02	Land Creek	16	190		53%	2.89	4	800	2,000	0%	6.15	4	800	5,000	3,000	-53%
003_02	Land Creek	17	340		53%	2.89	4	1,000	3,000	50%	3.08	4	1,000	3,000	0	-3%
003_02	Land Creek	18	1280	coyote willow	58%	2.58	4	5,000	10,000	0%	6.15	4	5,000	30,000	20,000	-58%
003_02	Land Creek	19	200		58%	2.58	4	800	2,000	20%	4.92	4	800	4,000	2,000	-38%
003_02	Land Creek	20	1230		58%	2.58	4	5,000	10,000	0%	6.15	4	5,000	30,000	20,000	-58%
							Totals		46,000					120,000	79,000	

Table 15. Existing and target solar loads for Howell Creek.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
003_02	Howell Creek	1	1270	douglas fir - PVG4	93%	0.43	2	3,000	1,000	80%	1.23	4	5,000	6,000	5,000	-13%
003_02	Howell Creek	2	1170		93%	0.43	2	2,000	900	60%	2.46	5	6,000	10,000	9,000	-33%
003_02	Howell Creek	3	850		93%	0.43	2	2,000	900	70%	1.85	5	4,000	7,000	6,000	-23%
003_02	Howell Creek	4	1290	aspen	99%	0.06	3	4,000	200	80%	1.23	3	4,000	5,000	5,000	-19%
003_02	Howell Creek	5	1270		99%	0.06	3	4,000	200	60%	2.46	3	4,000	10,000	10,000	-39%
003_03	Howell Creek	1	1430	geyer willow	53%	2.89	4	6,000	20,000	20%	4.92	4	6,000	30,000	10,000	-33%
003_03	Howell Creek	2	1420		53%	2.89	4	6,000	20,000	40%	3.69	4	6,000	20,000	0	-13%
003_03	Howell Creek	3	270		53%	2.89	4	1,000	3,000	20%	4.92	4	1,000	5,000	2,000	-33%
003_03	Howell Creek	4	1750	coyote willow	50%	3.08	5	9,000	30,000	0%	6.15	5	9,000	60,000	30,000	-50%
003_04A	Howell Creek	1	410		50%	3.08	5	2,000	6,000	30%	4.31	5	2,000	9,000	3,000	-20%
003_04A	Howell Creek	2	120		50%	3.08	5	600	2,000	70%	1.85	5	600	1,000	(1,000)	0%
003_04A	Howell Creek	3	520		50%	3.08	5	3,000	9,000	20%	4.92	5	3,000	10,000	1,000	-30%
003_04A	Howell Creek	4	510		50%	3.08	5	3,000	9,000	0%	6.15	5	3,000	20,000	10,000	-50%
003_04A	Howell Creek	5	130		50%	3.08	5	700	2,000	50%	3.08	5	700	2,000	0	0%
003_04A	Howell Creek	6	290		50%	3.08	5	1,000	3,000	0%	6.15	5	1,000	6,000	3,000	-50%
003_04A	Howell Creek	7	240		44%	3.44	6	1,000	3,000	30%	4.31	6	1,000	4,000	1,000	-14%
003_04A	Howell Creek	8	1900		44%	3.44	6	10,000	30,000	10%	5.54	6	10,000	60,000	30,000	-34%
003_04A	Howell Creek	9	230		44%	3.44	6	1,000	3,000	40%	3.69	6	1,000	4,000	1,000	-4%
003_04A	Howell Creek	10	290		44%	3.44	6	2,000	7,000	60%	2.46	6	2,000	5,000	(2,000)	0%
003_04A	Howell Creek	11	520		44%	3.44	6	3,000	10,000	0%	6.15	6	3,000	20,000	10,000	-44%
							Totals		160,000					290,000	130,000	

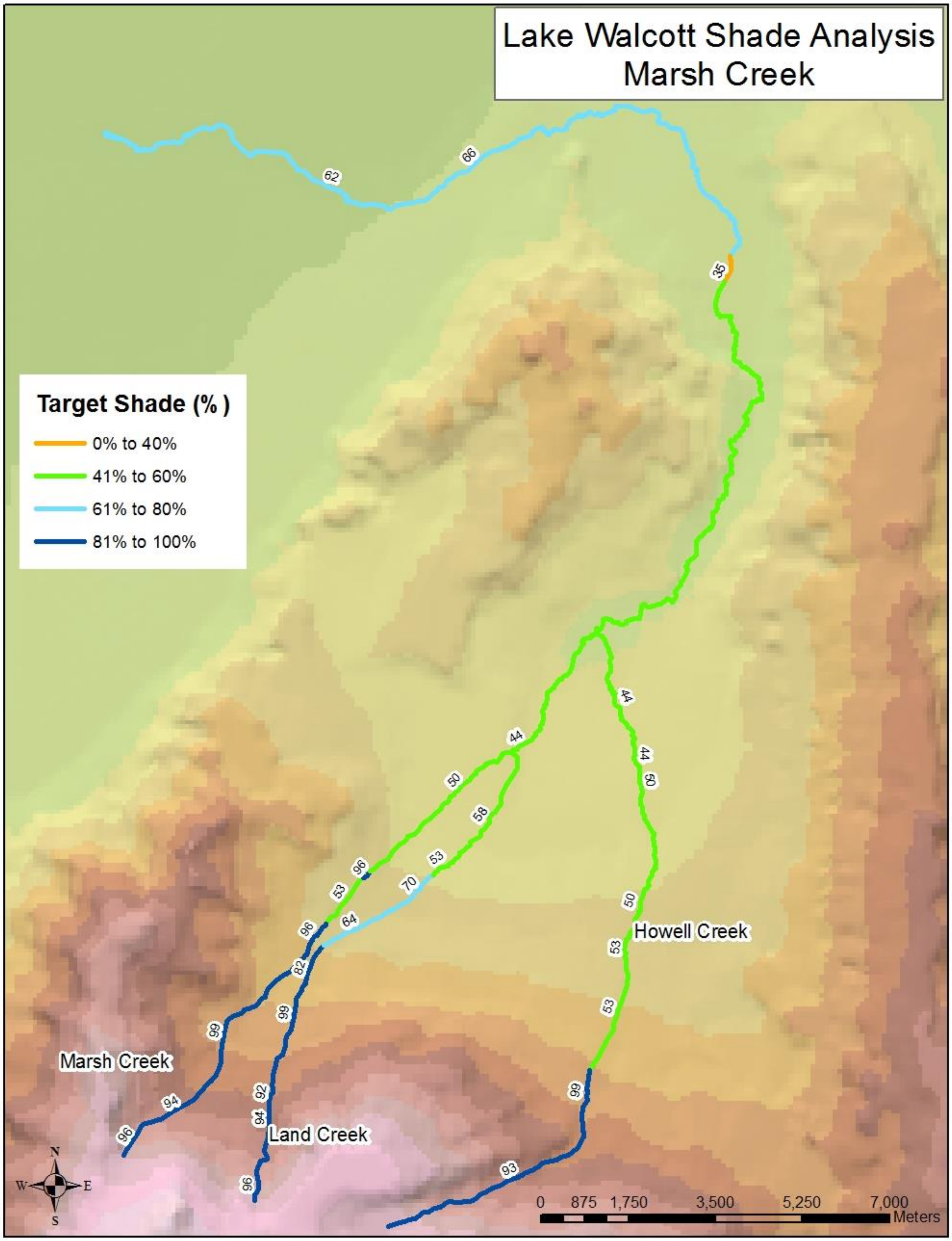

Figure 10. Target shade for the Marsh Creek watershed.

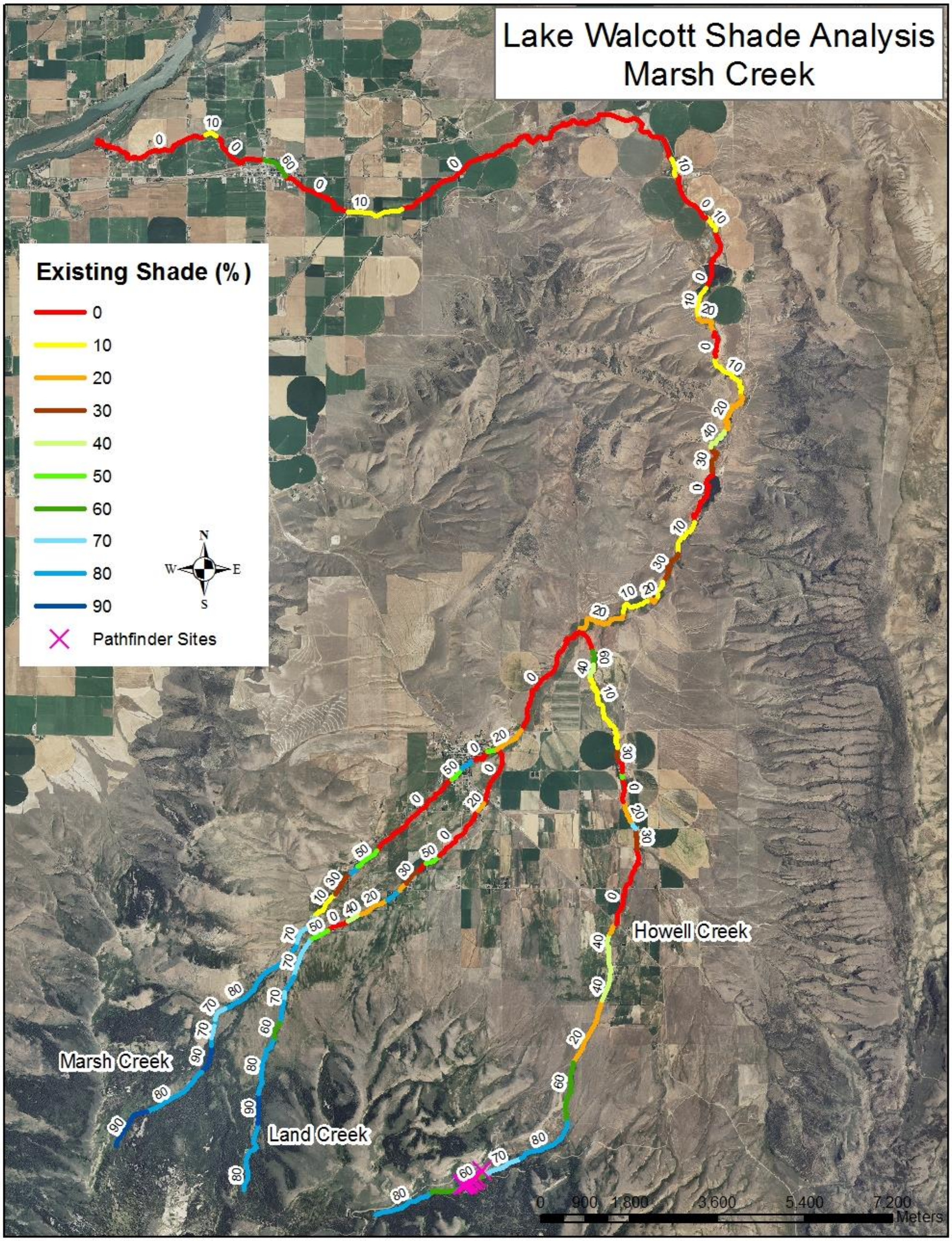

Figure 11. Existing shade estimated for the Marsh Creek watershed by aerial photo interpretation.

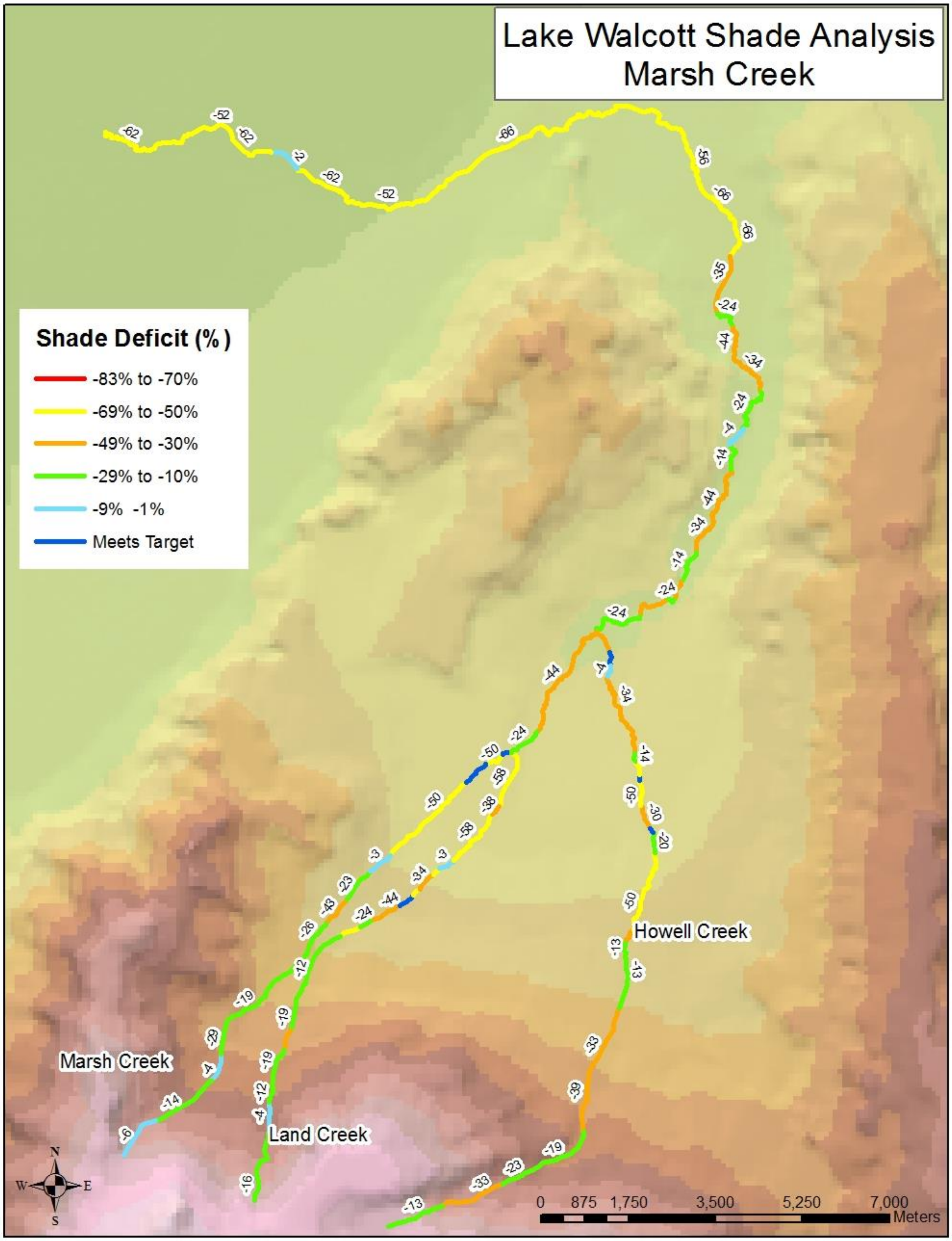

Figure 12. Lack of shade (difference between existing and target) for the Marsh Creek watershed.

5.1.4 Load and Wasteload Allocation

Because this TMDL is based on PNV, which is equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, to reach that objective, load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade as a whole. Therefore, load allocations are stream segment specific and dependent upon the target load for a given segment. There is no opportunity to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL is dependent upon background conditions for achieving water quality standards, all tributaries to the waters examined here need to be in natural conditions to prevent excess heat loads to the system.

Table 16 shows the total existing, target, and excess loads and the average lack of shade for each water body examined. The size of a stream influences the size of the excess load. Large streams have higher existing and target loads by virtue of their larger channel widths. The table lists the AUs in order of their excess loads, from highest to lowest. Therefore, large AUs tend to be listed first and small AUs last. Lake Walcott is an exception due to its target shade being zero.

Although this TMDL focuses on total solar loads, it is important to note that differences between existing shade and target shade, as depicted in Figure 12, are the key to successfully restoring these waters to achieving water quality standards. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts. Each load analysis table contains a column that lists the lack of shade on the stream segment. This value is derived from subtracting target shade from existing shade for each segment. Thus, stream segments with the largest lack of shade are in the worst shape. The average lack of shade derived from the last column in each load analysis table is listed in Table 16 and provides a general level of comparison among streams. Average lack of shade does not necessarily correspond to excess load. Most streams examined in this TMDL had excess solar loads greater than expected based on target shade levels (as previously explained).

Table 16. Total solar loads and average lack of shade for all waters.

Water Body	Total Existing Load	Total Target Load	Excess Load (Necessary % reduction)	Average Lack of Shade (%)[a]
	(kWh/day)			
Marsh Creek	4,800,000	850,000 (17%)	4,000,000 (83%)	-30
Howell Creek	290,000	160,000 (55%)	130,000 (45%)	-25
Land Creek	120,000	46,000 (34%)	79,000 (66%)	-27

Note: Due to rounding, loads may not sum across columns as expected.
[a] Excess load does not equal average lack of shade. The average lack of shade indicates the estimated percent of shade lacking on the stream

Marsh Creek has the largest excess load. Figure 12 shows that Marsh Creek's riparian shade has been affected throughout a large portion of its watershed. Howell Creek and Land Creek are considerably shorter than Marsh Creek, and thus have much smaller excess loads. However, all three streams are similarly impacted by shade deficits as seen in the consistent average lack of shade. The majority of the excess load seen in Marsh Creek comes from two reservoirs (3 million kWh/day) that were built instream for irrigation, erosion control and wildlife. Outside of those two reservoirs excess load in Marsh Creek would require a 56% reduction.

A certain amount of excess load is potentially created by the existing shade/target shade difference inherent in the loading analysis. Because existing shade is reported as a 10% shade class and target shade a unique integer between 0 and 100%, there is usually a difference between the two. For example, say a particular stream segment has a target shade of 86% based on its vegetation type and natural bank-full width. If existing shade on that segment were at target level, it would be recorded as 80% in the loading analysis because it falls into the 80% existing shade class. There is an automatic difference of 6%, which could be attributed to the margin of safety.

5.1.4.1 Water Diversion

Stream temperature may be affected by diversions of water for water rights purposes. Diversion of flow reduces the amount of water exposed to a given level of solar radiation in the stream channel, which can result in increased water temperature in that channel. Loss of flow in the channel also affects the ability of the near-stream environment to support shade-producing vegetation, resulting in an increase in solar load to the channel.

Although these water temperature effects may occur, nothing in this TMDL supersedes any water appropriation in the affected watershed. Section 101(g), the Wallop Amendment, was added to the Clean Water Act as part of the 1977 amendments to address water rights. It reads as follows:

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this chapter. It is the further policy of Congress that nothing in this chapter shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.

Additionally, Idaho water quality standards indicate the following:

> The adoption of water quality standards and the enforcement of such standards is not intended to…interfere with the rights of Idaho appropriators, either now or in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure… (IDAPA 58.01.02.050.01)

In this TMDL, we have not quantified what impact, if any, diversions are having on stream temperature. Water diversions are allowed for in state statute, and it is possible for a water body to be 100% allocated. Diversions notwithstanding, reaching shade targets as discussed in the TMDL will protect what water remains in the channel and allow the stream to meet water quality standards for temperature. This TMDL will lead to cooler water by achieving shade that would be expected under natural conditions and water temperatures resulting from that shade. DEQ encourages local landowners and holders of water rights to voluntarily do whatever they can to help instream flow for the purpose of keeping channel water cooler for aquatic life.

5.1.4.2 Margin of Safety

The margin of safety in this TMDL is considered implicit in the design. Because the target is essentially background conditions, loads (shade levels) are allocated to lands adjacent to these streams at natural background levels. Because shade levels are established at natural background or system potential levels, it is unrealistic to set shade targets at higher, or more conservative, levels. Additionally, existing shade levels are reduced to the next lower 10% shade class, which likely underestimates actual shade in the loading analysis. Although the loading analysis used in this TMDL involves gross estimations that are likely to have large variances, load allocations are applied to the stream and its riparian vegetation rather than specific nonpoint source activities and can be adjusted as more information is gathered from the stream environment.

5.1.4.3 Seasonal Variation

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

5.2 Bacteria TMDL

5.2.1 Instream Water Quality Targets

The numeric and narrative water quality targets set to achieve water quality standards are based in part on assumptions contained in the EPA-approved Lake Walcott TMDL (DEQ 2000). The instream target is as follows:

Bacteria (*E. coli*). *E. coli* has been incorporated as a water quality standard (IDAPA 58.01.02.251.01) for secondary contact recreation with a trigger single sample value of 576 cfu/100 mL and a geometric mean of 126 cfu/100 mL. Therefore, the application of the recreation geometric mean value (126 cfu/100 mL) will be applied on Marsh Creek to meet beneficial uses.

A single sample exceedance of the criterion does not in itself constitute a violation of water quality standards. The target developed for bacteria impairment is a geometric mean concentration of 126 cfu/100 mL. This mean is calculated from five samples taken 5–7 days apart over a 30-day period (IDAPA 58.01.02.251.01). A geometric mean is used to minimize random variability in the data.

5.2.1.1 Design Conditions

The critical period for the recreational beneficial use is from May through October. To protect for this beneficial use, the design conditions fall within the critical period when bacterial contamination is most likely to occur.

5.2.2 Flow (Q)

Q estimates were derived from DEQ, ISCC, BID and USGS. Two locations were used on Marsh Creek to estimate Q primarily because two hydrologies exist in Marsh Creek. One was at the USGS gage station near Albion, Idaho (the Albion reach). The other was near the confluence with the Snake River at the South 750 East Road near Declo, Idaho (the Declo reach). These flows were also previously graphed in Section 1.3.4, Figure 2 for both site locations. The Albion reach of Marsh Creek ends up fully diverted into the Dewy Pond (or Skaggs Ranch/Six S Ranch). Summary statistics developed by DEQ are as follows as annual averages from 1996 to 2008:

	Near Declo	Near Albion
N	36	246
Minimum	0.0 cfs	0.0 cfs
Mean	8.1 cfs	22.7 cfs
Median	4.0 cfs	8.0 cfs
Maximum	68.3 cfs	828.0 cfs

DEQ summary statistics for the same data set (1996 to 2008) but on a monthly average are as follows in the following tables:

Table 177. Marsh Creek near Albion, Idaho (Albion reach)

Statistics	January	February	March	April	May	June	July	August	September	October	November	December
N	17	12	14	31	28	30	22	22	22	25	12	11
Minimum	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mean	96.9	19.9	33.7	27.8	29.3	29.7	7.9	4.7	4.5	4.7	7.3	6.5
Median	17.1	14.0	16.0	15.2	25.4	19.9	6.2	4.9	4.1	4.7	6.0	6.8
Maximum	828.0	74.5	153.0	147.0	90.0	99.2	26.7	10.2	11.5	12.6	16.0	15.7

1. *Border contains median flows for critical exposure period*
2. *Highlight indicates critical period low-flow used for load calculation*

Table 18. Near Confluence of Marsh Creek to Snake River (Declo reach)

Statistics	January	February	March	April	May	June	July	August	September	October	November	December
N	3	3	3	13	18	22	20	19	17	12	3	3
Minimum	0.5	0.3	0.2	0.0	1.5	0.0	0.0	2.2	2.0	1.6	0.9	0.1
Mean	4.7	6.1	4.8	11.3	14.5	13.9	5.2	4.9	5.1	3.4	1.3	1.5
Median	0.8	0.9	0.3	2.3	4.8	7.6	5.5	4.2	4.5	3.0	1.4	0.9
Maximum	12.8	17.2	14.0	68.3	64.2	64.8	13.0	12.0	10.0	6.0	1.5	3.6

1. *Border contains median flows for critical exposure period*
2. *Highlight indicates critical period low-flow used for load calculation*

Although a flow duration curve was considered for the Declo reach data set, the lack of sufficient values for the months of December through March excluded the option for developing a duration curve. Future iterations of the TMDL may consider this approach if sufficient data is available.

To ensure the TMDL addressed critical periods of flow and loading, DEQ used the lowest median monthly flow for the critical time period (May – October) to calculate daily loads.

5.2.3 TMDL Components and Calculations

The *E. coli* Total Maximum Daily Load is calculated as follows:

E.coli TMDL = Load Capacity x Flow x time conversion x volume conversion

$$\text{TMDL} = \text{LC} \times \text{Q} \times (\text{sec/day}) \times (\text{mL/ft}^3)$$

Albion reach

$$\text{E.coli TMDL} = \frac{113\text{cfu}}{100\text{ mL}} \times \frac{4.1\text{ ft}^3}{1\text{ sec}} \times \frac{86400\text{ sec}}{1\text{ day}} \times \frac{1\text{ mL}}{.000353\text{ ft}^3}$$

E.coli TMDL = 1,133,969,405 cfu/day or **1.13 cfu^9/day**

Declo reach

$$\text{E.coli TMDL} = \frac{113\text{cfu}}{100\text{ mL}} \times \frac{3.0\text{ ft}^3}{1\text{ sec}} \times \frac{86400\text{ sec}}{1\text{ day}} \times \frac{1\text{ mL}}{.000353\text{ ft}^3}$$

E.coli TMDL = 829,733,711 cfu/day or **0.8 cfu^9/day**

5.2.3.1 Load Capacity

When calculating bacteria loads, the water quality standard is the load capacity of a system. The *E. coli* bacteria load capacity for Marsh Creek is initially expressed as the geometric mean concentration of 126 cfu/100 mL. This load capacity is expressed as a concentration because it is difficult to calculate a mass load due to changing variables (such as moisture conditions, temperature, and flow) that influence the die-off rate and loading of bacteria.

Albion reach

LC = 126 cfu/100 mL

Declo reach

LC = 126 cfu/100 mL

5.2.3.2 Margin of Safety

A 10% margin of safety was used to account for any lack of knowledge or uncertainty concerning the relationship between effluent limitations and water quality.

Margin of Safety = Load Capacity x 10%

Albion reach

MOS = 126 cfu/100 mL x 10%

MOS = 13 cfu/100 mL

Declo reach

Margin of Safety = 126 cfu/100 mL x 10%

MOS = 13 cfu/100 mL

5.2.3.3 Target Load

The margin of safety is deducted from the load capacity to provide an instream load target. This target is used to calculate load reductions necessary to assure compliance with the water quality standard.

Target Load = Load Capacity – Margin of Safety

Albion reach

Target Load = 126 cfu/100 mL - 13 cfu/100 mL

Target Load = 113 cfu/100 mL

Declo reach

Target Load = 126 cfu/100 mL - 13 cfu/100 mL

Target = 113 cfu/100 mL

5.2.3.4 Natural Background

Natural processes contribute pollutant loads. These natural processes have been identified as natural background. Natural background conditions are identified and described in the water quality standards:

> The physical, chemical, biological, or radiological conditions existing in a water body without human sources of pollution within the watershed. Natural disturbances including, but not limited to, wildfire, geologic disturbance, diseased vegetation, or flow extremes that affect the physical, chemical, and biological integrity of the water are part of natural background conditions. Natural background conditions should be described and evaluated taking into account this inherent variability with time and place. (IDAPA 58.01.02.010.63)

For Marsh Creek, DEQ chose to allocate 5% of the load capacity to natural background sources. This value is conservative considering the human development that has occurred in the Marsh Creek watershed for nonpoint sources.

Natural Background = Load Capacity * 5%

Albion reach

NB = 126 cfu/100 mL x 5%

NB = 6 cfu/100 mL

Declo reach

NB = 126 cfu/100 mL x 5%

NB = 6 cfu/100 mL

5.2.3.5 Load and Wasteload Allocation

The load allocation is the portion of the receiving water's load capacity attributed either to existing or future nonpoint sources of pollution.

The Marsh Creek *E. coli* bacteria TMDL load allocation is calculated as follows: from the Load Capacity of 126 cfu/100 mL, a 10% margin of safety and 5% natural background are subtracted to ensure the secondary contact beneficial use is supported. The result is the load allocation to anthropogenic nonpoint sources.

Load Allocation = Load Capacity – Margin of Safety – Natural Background

Albion reach

LA = 126 cfu/100 mL - 13 cfu/100 mL – 6 cfu/100 mL

LA = 107 cfu/100 mL

Declo reach

LA = 126 cfu/100 mL - 13 cfu/100 mL – 6 cfu/100 mL

LA = 107 cfu/100 mL

The wasteload allocation is the portion of the receiving water's load capacity attributed either to existing or future point sources of pollution. No point-source dischargers are permitted in the Marsh Creek watershed.

Albion reach

Wasteload Allocation = 0 cfu/100 mL

Declo reach

Wasteload Allocation = 0 cfu/100 mL

5.2.3.6 Reserve for Growth

The TMDL may incorporate a reserve allocation (or reserve capacity) for future discharges from point and nonpoint sources of pollution. However, because the Lake Walcott Watershed Advisory Group (WAG) did not specify a reserve capacity for future growth, DEQ did not assign any reserve for growth at this time. In the future, the potential for future dischargers may require a modification of the Marsh Creek TMDL.

The Lake Walcott TMDL (DEQ 2000, p. 105) states that "there are no NPDES permitted dischargers in this watershed. The Cities of Albion and Declo have total containment lagoons with land application of wastes." DEQ reviewed this information and confirmed its accuracy in 2013.

5.2.3.7 Existing Load

Five *E. coli* bacteria samples were taken every 3 to 7 days over a 30-day period starting on July 19, 2012, through August 2, 2012. Data revealed a geometric mean of 492 cfu/100 mL in the Albion reach (AU ID17040209SK003_03) and 210 cfu/100 mL in the Declo reach (AU ID17040209SK003_04) thereby necessitating a TMDL. [section 2.3.4]

Albion reach

Existing Load = 492 cfu/100 mL

Declo reach

Existing Load = 210 cfu/100 mL

5.2.3.7.1 Estimates of Existing Pollutant Contribution

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)). Bacteria affect the creek throughout the summer months and into the fall during baseflow conditions.

There are several existing land uses that may be contributing to bacteria loading. Marsh Creek is diverted for irrigation purposes at several locations, and the tailwater re-enters the creek from numerous drains along the channel. Wildlife and domestic livestock use exists along both reaches of Marsh Creek. Irrigation tailwater, livestock, wildlife, and septic system drain field influence are the most likely sources of *E. coli* found in Marsh Creek. Proportions of individual load contribution from each nonpoint source cannot be determined at this time.

5.2.3.7.2 Seasonal Variation

Seasonal variation was not considered for the Marsh Creek bacteria TMDL because little information existed to allow for it. This is especially true with the streamflow in the Declo reach of Marsh Creek.

5.2.3.8 Load Reduction

The load reduction required to achieve the instream target is calculated by subtracting the target (113 cfu/100 mL) from the existing load.

Load Reduction = Existing Load – Target Load

Albion reach

Load Reduction = 492 cfu/100 mL - 113 cfu/100 mL

Load Reduction = 379 cfu/100 mL

Declo reach

Load Reduction = 210 cfu/100 mL - 113 cfu/100 mL

Load Reduction = 97 cfu/100 mL

To express this reduction concentration as a percentage the load reduction is divided by the existing load, and then multiplied by 100.

Load Reduction % = (Load Reduction/Existing Load) x 100

Albion reach

Load Reduction % = (379 cfu/100 mL / 492 cfu/100 mL) x 100

Load Reduction = 77%

Declo reach

Load Reduction = (97 cfu/100 mL / 210 cfu/100 mL) x 100

Load Reduction = 46%

5.2.4 Load Summary Table

Table 19. Summary table for *E. coli* loads in Marsh Creek.

Stream Reach	LC	MOS	Target Load	NB	LA	Existing Load	Load Reduction		TMDL
	cfu/100 mL							%	cfu^9/day
Albion	126	13	113	6	107	492	379	77	1.13
Declo	126	13	113	6	107	210	97	46	0.8

- *LC=Load Capacity, NB=Natural Background, MOS=Margin of Safety, LA=Load Allocation*
- *TMDL expressed in cfu9/day [billion colony forming units per day].*
- *Refer to calculations in the TMDL section.*

5.3 Reasonable Assurance

Providing reasonable assurance that point sources and nonpoint sources will meet the load capacity of Marsh Creek is a necessary requirement for TMDLs to ensure that beneficial uses are met. There are no known point sources that discharge into Marsh Creek. Nonpoint sources have received load allocations that are below and within the load capacity of the Marsh Creek water body. The load capacity is specifically set to meet the beneficial uses of Marsh Creek and the Snake River.

To ensure the secondary contact recreation beneficial use is supported throughout the year, sources extending upstream from both of these locations must be managed to reduce the E. coli concentrations by 77% in the Albion reach, and 46% in the Declo reach.

5.4 Construction 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 the Multi-Sector General Permit (MSGP), and construction stormwater covered under the Construction General Permit (CGP).

5.4.1 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 U.S.
- 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 (SWMP), and use best management practices (BMPs) to control pollutants in stormwater discharges to the maximum extent practicable. There are no MS4s in these AU's.

5.4.2 Industrial Stormwater Requirements

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

Multi-Sector General Permit and Stormwater Pollution Prevention Plans

In Idaho, if an industrial facility discharges industrial stormwater into waters of the U.S., 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. There are no MSGPs in these AUs.

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 (see 40 CFR Part 136).

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

TMDL Industrial Stormwater Requirements

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

5.4.3 Construction Stormwater

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

Construction General Permit and Stormwater Pollution Prevention Plans

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

TMDL Construction Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a gross wasteload allocation for anticipated construction stormwater activities. Most loads developed in the past did not have a numeric wasteload allocation for construction stormwater activities. Construction stormwater activities are considered in compliance with provisions of the TMDL if operators obtain a CGP under the NPDES program and implement the appropriate

BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The CGP has monitoring requirements that must be followed.

Postconstruction Stormwater Management

Many communities throughout Idaho are currently developing rules for postconstruction stormwater management. Sediment is usually the main pollutant of concern in construction site stormwater. DEQ's *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* (DEQ 2005) should be used to select the proper suite of BMPs for the specific site, soils, climate, and project phasing in order to sufficiently meet the standards and requirements of the CGP to protect water quality. Where local ordinances have more stringent and site-specific standards, those are applicable.

5.5 Implementation Strategies

DEQ and designated management agencies (DMAs) responsible for TMDL implementation will make every effort to address past, present, and future pollution problems in an attempt to link them to watershed characteristics and management practices designed to improve water quality and restore beneficial uses. Any and all solutions to help restore beneficial uses of a stream will be considered as part of a TMDL implementation plan in an effort to make the process as effective and cost efficient as possible. Using additional information collected during the implementation phase of the TMDL, DEQ and DMAs will continue to evaluate sources of impairment and develop management actions appropriate to deal with these issues.

Implementation strategies for TMDLs produced using PNV-based shade and solar loading should incorporate the load analysis tables presented in this TMDL. These tables need to be updated, first to field verify the existing shade levels that have not yet been field verified and secondly to monitor progress toward achieving reductions and TMDL goals. Using the Solar Pathfinder to measure existing shade levels in the field is important to achieving both objectives. It is likely that further field verification will find discrepancies with reported existing shade levels in the load analysis tables. Due to the inexact nature of the aerial photo interpretation technique, these tables should not be viewed as complete until verified. Implementation strategies should include Solar Pathfinder monitoring to simultaneously field verify the TMDL and mark progress toward achieving desired reductions in solar loads.

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

5.5.1 Time Frame

The implementation strategy was designed to reduce pollutant loads to meet the TMDLs and water quality standards. DEQ realizes that implementation that involves significant restoration can create time and economic constraints. A definitive timeline for implementation practices is listed in Table 18.

Table 18. Implementation strategy goals and time frame for nonpoint sources.

Responsible Party	Year 1.5	Year 3	Year 10	Year 15	Year 25
Agriculture Industry	Develop implementation plan for private lands.	Begin BMP implementation.	Document BMP implementation progress for DEQ database.	Reevaluate targets and reductions.	Meet reviewed TMDL targets; beneficial uses fully supported.
Grazing Industry	Federal agencies review allotment management plans.	Begin allotment management adjustments as necessary.	Document BMP implementation progress for DEQ database.	Reevaluate targets and reductions.	Meet reviewed TMDL targets; beneficial uses fully supported.
DEQ	Maintain database, review nonpoint source efficacy data, and seek funding.	Collect data to determine water quality trends.	Collect data to determine water quality trend, BMP effectiveness, and beneficial use support.	Reevaluate targets and reductions and assess beneficial uses.	Collect data to determine water quality trend, BMP effectiveness, and beneficial use support.

Note: BMP = best management practice

5.5.2 Approach

The Marsh Creek TMDLs will be implemented through ongoing pollution control activities in the watershed. The WAG, DMAs, and other appropriate public process participants are expected to do the following:

- Identify BMPs to achieve load reductions for temperature and bacteria.
- Provide reasonable assurance that management measures will meet load allocations through both quantitative and qualitative analysis of management measures.
- Adhere to measurable milestones for progress.
- Develop a timeline to implementation, including 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 if water quality standards are being met.

The DEQ Twin Falls Regional Office, in conjunction with the land management agencies, will coordinate with public and private landownerships to incorporate water quality cleanup projects specifically targeted toward cooling stream temperatures and reducing bacteria.

5.5.3 Responsible Parties

Federal, state, and local governments; individuals; and other entities are all involved in or responsible for implementing the TMDL in the Marsh Creek watershed. DMAs are responsible for assisting with preparation of specific implementation plans, especially for the resources for which they have regulatory authority or responsibility. Idaho’s DMAs include the following:

- Idaho State Department of Agriculture for aquaculture, animal feeding operations, and confined animal feeding operations
- Idaho Department of Lands for timber harvest, oil and gas exploration and development, and mining
- Idaho Transportation Department for public roads

- Idaho Soil and Water Conservation Commission for grazing and agriculture
- DEQ for all other activities

Federal agency partners and land management agencies are also involved with preparing implementation plans. These partners include the Natural Resources Conservation Service, United States Forest Service, Bureau of Land Management, and United States Bureau of Reclamation.

All stakeholders within the watershed have the responsibility of working toward TMDL implementation, including DEQ, DMAs, landowners, local governing authorities, taxpayers, industries, and land managers. Past experience has shown that the best and most effective implementation strategies are those that have been developed with substantial stakeholder involvement and cooperation.

5.5.4 Monitoring Strategy

The overall purpose and intent of water quality monitoring is to assess beneficial use support and water quality standards attainment on Marsh Creek. The Marsh Creek monitoring plan will involve four approaches.

- First, DEQ intends to monitor (depending on available resources) Marsh Creek water quality, especially as it pertains to any water quality improvement projects. Monitoring locations may include the following: (1) headwaters reach, if applicable, and (2) just above the point of discharge into the Snake River. Flow monitoring of the Marsh Creek water body will be an important component in this monitoring scheme.
- Second, BURP will be used to ascertain the status of beneficial uses on Marsh Creek as defined by BURP protocols. The BURP process will be applied in the headwaters segment above Albion, Idaho; in the segment between Albion, Idaho, and Dewy Pond; and from Dewy Pond to the confluence with the Snake River.
- Third, other types of monitoring will be used that involve private landowners, public land management agencies, and the Idaho Soil and Water Conservation Commission. Erosion assessments may be undertaken along with implementation over the next 5 years.
- Fourth, effective shade monitoring will track progress toward meeting PNV shade targets. Monitoring can take place on any reach throughout the streams in this TMDL and be compared to estimates of existing shade seen on Figure 11 and described in Table 13 through Table 15. Those areas with the largest disparity between existing shade estimates and shade targets should be monitored with Solar Pathfinders to verify the existing shade levels and to determine progress toward meeting shade targets. Many existing shade estimates have not been field verified and may require adjustment during the implementation process. Stream segments for each change in existing shade vary in length depending on land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade toward target levels. Ten equally spaced Solar Pathfinder measurements within that segment averaged together should suffice to determine new shade levels in the future.

Monitoring will be conducted using DEQ-approved monitoring procedures at the time of sampling.

6 Conclusions

This TMDL examined the relationship between existing shade levels on streams and shade targets developed from vegetation typing in the region. Existing and target shade levels were converted to solar loads for an analysis of excess loading to streams. The streams examined in this TMDL lacked shade and had excess solar loads.

Lack of shade and excess solar loads can result from a variety of circumstances, some natural, such as wildfires, and some anthropogenic with varying degrees of permanency (e.g., paved roads or reservoirs versus partial vegetation removal). Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts, though each reach on each stream needs to be examined for possible corrective implementation. Some problems can be fixed and others cannot, and implementation strategies should take into account these realities.

Prior to finalizing the draft Marsh Creek TMDL, DEQ visited the Marsh Creek watershed and many of the nonpoint source land use areas associated with the watershed to gather the necessary information for establishing the TMDL. DEQ also met with the Lake Walcott WAG to discuss the details of the TMDL. For more information about public comments and the public participation process, see Appendix D. A distribution list is provided in Appendix E.

DEQ will be coordinating with the Idaho Soil and Water Conservation Commission, local soil conservation districts, federal land management agencies, and the Lake Walcott WAG on specific implementation projects that target *E. coli* and temperature reductions on both private and public lands.

Bacteria TMDLs were calculated for Marsh Creek requiring a 77% reduction in the Albion reach (ID17040209S003_03) and a 46% reduction in the Declo reach (ID17040209SK003_04).

Table 19. Summary of assessment outcomes.

Water Body Name/Assessment Unit	Drainage: Boundaries	Listed Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Marsh Creek ID17040209SK003_03 ID17040209SK003_04	Marsh Creek: source to mouth (3rd- and 4th-order streams)	Combined Biota/Habitat Bioassessments	*E. coli*, Temp.	Delist for Combined Biota/Habitat Bioassessments, move to Category 4a	*E. coli*(unlisted and violates WQS) and temperature identified as causal pollutants

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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. Photographs of Marsh Creek (November 19, 2009)

Figure A-1. Marsh Creek—near the headwaters.

Figure A-2. Marsh Creek—near Albion, Idaho.

Figure A-3. Marsh Creek—new constructed pond into the Six S Ranch above Dewy Pond.

Figure A-4. Marsh Creek—at Dewy Pond.

Figure A-5. Marsh Creek—at the discharge off of the Six S Ranch.

Figure A-6. Marsh Creek—near the Declo High School in Declo, Idaho.

Figure A-7. Marsh Creek—near the South 750 East Road near Declo, Idaho.

Figure A-8. Marsh Creek—near the discharge into the Snake River.

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Appendix B. Data Sources

Table B-1. Data sources for Marsh Creek TMDLs.

Water Body	Data Source	Type of Data	Collection Date
Howell Canyon	DEQ State Technical Services Office	Solar Pathfinder effective shade and stream width	Summer 2008
All streams in analysis	DEQ State Technical Services Office	Aerial photo interpretation of existing shade and stream width estimation	Spring 2008
All streams in analysis	DEQ IDASA database	Temperature	Fall 2011

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Appendix C. State and Site-Specific Standards and Criteria

Water Quality Standards Applicable to Salmonid Spawning Temperature

Water quality standards for temperature are specific numeric values not to be exceeded during the salmonid spawning and egg incubation period, which varies with species. For spring spawning salmonids, the default spawning and incubation period recognized by the Idaho Department of Environmental Quality is generally March 15–July 1 each year (Grafe et al. 2002). Fall spawning can occur as early as August 15 and continue with incubation into the following spring up to June 1. Per IDAPA 58.01.02.250.02.f.ii, the water quality criteria that need to be met during that time are as follows:

- 13 °C as a daily maximum water temperature
- 9 °C as a daily average water temperature

For the purposes of a temperature total maximum daily load, the highest recorded water temperature in a recorded data set (excluding any high water temperatures that may occur on days when air temperatures exceed the 90th percentile of the highest annual maximum weekly maximum air temperatures) is compared to the daily maximum criterion of 13 °C. The difference between the two water temperatures represents the temperature reduction necessary to achieve compliance with temperature standards.

Natural Background Provisions

For potential natural vegetation temperature total maximum daily loads, it is assumed that natural temperatures may exceed these criteria during some warmer periods. If potential natural vegetation targets are achieved yet stream temperatures are warmer than these criteria, it is assumed that the stream's temperature is natural (provided there are no point sources or human-induced ground water sources of heat) and natural background provisions of Idaho water quality standards apply.

> When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, there shall be no lowering of water quality from background conditions. Provided, however, that temperature may be increased above natural background conditions when allowed under Section 401. (IDAPA 58.01.02.200.09)

Section 401 relates to point source wastewater treatment requirements. In this case, if temperature criteria for any aquatic life use are exceeded due to natural conditions, then a point source discharge cannot raise the water temperature by more than 0.3 °C (IDAPA 58.01.02.401.01).

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Appendix D. Public Comments/Public Participation

Development of the Marsh Creek bacteria and potential natural vegetation (PNV) temperature total maximum daily load (TMDL) included the following public participation:

- The draft document was reviewed at the Lake Walcott Watershed Advisory Group (WAG) meeting on January 28, 2010. Comments and questions were directed to DEQ Twin Falls Regional Office staff.
- After the meeting, the draft document was available via the DEQ website. This information was sent to the Lake Walcott WAG in an e-mail
- The draft was circulated again at the Lake Walcott WAG meeting on July 22, 2010. Comments and questions were directed to DEQ Twin Falls Regional Office staff.
- No verbal or written comments were received as a result of the listed meetings or internet postings.
- After completing the bacteria TMDL sampling, the draft document was again handed out to the Lake Walcott WAG on February 28, 2013.
- The second draft document was presented to the Lake Walcott WAG on July 25, 2013.
- Public comment period for the draft TMDL was November 5, 2013 to December 4, 2013.
- No comments were received during the public comment period.

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Appendix E. Public Comment Distribution List

United States Bureau of Land Management

United States Forest Service

United States Bureau of Reclamation

Blaine County Commissioners

United States Department of Agriculture

Cassia County Commissioners

Idaho Department of Lands

Power County Commissioners

Minidoka County Commissioners

United States Fish and Wildlife Service

Blaine County Commissioners

Idaho Department of Fish and Game

Raft River Flood Control

Idaho Soil and Water Conservation Commission

University of Idaho

East Cassia Soil Conservation District

Minidoka Irrigation District

Natural Resources Conservation Service

Power County Soil Conservation District

Idaho Department of Environmental Quality

Lake Walcott Watershed Advisory Group members

Upper Snake Basin Advisory Group members

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