Lindsay Creek Subbasin

TMDL Review

Hydrologic Unit Code 17060306

State of Idaho
Department of Environmental Quality
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Acknowledgments

DEQ thanks the Hatwai Creek/Lindsay Creek Watershed Advisory group for their input. DEQ also thanks local property owners for granting property access, and the Nez Perce Soil and Water Conservation District for providing the METER sensor and data logger installed in Lindsay Creek.

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Abbreviations, Acronyms, and Symbols

§303(d)	refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section
§	section (usually a section of federal or state rules or statutes)
AU	assessment unit
BMP	best management practice
BURP	Beneficial Use Reconnaissance Program
CFR	Code of Federal Regulations (refers to citations in the federal administrative rules)
cfs	cubic feet per second
cfu	colony forming unit
CWA	Clean Water Act
DEQ	Idaho Department of Environmental Quality
DO	dissolved oxygen
E. coli	*Escherichia coli*
EPA	United States Environmental Protection Agency
GIS	geographic information system
GWMA	Ground Water Management Area
HUC	hydrologic unit code
lb	pound
IDAPA	Refers to citations of Idaho administrative rules
IPDES	Idaho Pollutant Discharge Elimination System
IDWR	Idaho Department of Water Resources
L	liter
LOID	Lewiston Orchards Irrigation District
mg	milligram
mL	milliliter
MOS	margin of safety
mpn	most probable number
MSL	mean sea level
NO_3+NO_2-N	nitrate plus nitrite nitrogen
NPA	Nitrate Priority Area
NPSWCD	Nez Perce Soil and Water Conservation District

NPDES	National Pollutant Discharge Elimination System
TMDL	total maximum daily load
TP	total phosphorus
TN	total nitrogen
TSS	Total Suspended Solids
USDA	US Department of Agriculture
WAG	watershed advisory group

Executive Summary

This document presents a 5-year review of the Lindsay Creek subbasin assessment and total maximum daily loads (TMDLs) (DEQ 2007). TMDLs specify maximum pollutant inputs to surface water that can occur while still meeting state surface water quality standards. Idaho Code §39-3611(7) requires the Idaho Department of Environmental Quality (DEQ) to review Idaho TMDLs every five years. This review describes current water quality status, pollutant sources, and recent pollution control efforts in the watershed.

Subbasin at a Glance

Lindsay Creek is a third order tributary to the Clearwater River in Nez Perce County, Idaho (Figure A). The headwaters of Lindsay Creek begin within residential developments and farmland at approximately 1,800 feet above mean sea level (MSL). Lindsay Creek flows through basalt canyons, farmland, ranchland, and residential areas as it descends 1,000 ft to its mouth (750 feet above MSL), where it flows through a tunnel drain that is part of the levee system for the Lower Granite Dam and converges with the Clearwater River.

The Lindsay Creek watershed spans 22.4 square miles, has 72% dryland agriculture land use by area, and includes a portion of Lewiston, Idaho (population 31,894 in 2010 Census). Approximately 18% of the watershed land area is developed, and 4% of the land surface is impervious material (USGS 2017). Based on the US Department of Agriculture (USDA) Cropland Data Layer (USDA 2018), winter wheat (29%), fallow cropland (14%), dry beans (12%) and pasture (11%) were the dominant agricultural land uses in 2018 (Figure B). The watershed includes multiple small ranches and livestock operations, rural residences, and several residential developments outside of City of Lewiston boundaries.

Water in Lindsay Creek comes from precipitation, ground water, and irrigation inputs. Average annual precipitation from 1981-2010 in Lewiston, ID was 12.3 inches (NOAA 2018). Precipitation occurs primarily during fall, winter, and spring, with very limited summer precipitation. Lindsay Creek receives ground water inputs from springs and seeps associated with basalt canyon walls and basalt rock fall. Ground water inputs are thought to be substantial, but the percent ground water contribution to stream flow has not been quantified. A portion of the watershed also receives irrigation inputs. The Lewiston Orchards Irrigation District (LOID) conveys water from Sweetwater and Webb creeks into Mann Lake (also called Reservoir A). The water is delivered to the LOID service area through a pipe system; residents use it to water lawns, for livestock watering, and for fire protection. LOID water may enter ground water or surface water after being used within the LOID service area. Mann Lake does not discharge directly into Lindsay Creek, but a wetland near the outlet and Lindsay Creek headwaters suggests some limited under flow seepage may occur.

In 1978, the Idaho Department of Health and Welfare Division of Environmental Quality classified Lindsay Creek as ‘water quality limiting’ due to high bacteria and nutrient concentrations (IDHW 1978). In 1994, the United States Environmental Protection Agency (EPA) placed Lindsay Creek on Idaho’s §303(d) list, a biannual list of impaired state waters required by Clean Water Act (CWA) section 303(d). Idaho's 1994 §303(d) list was created by EPA under a court order (EPA 1994). For waters identified on Idaho's §303(d) list, states must develop a total maximum daily load (TMDL) for each pollutant, and submit TMDLs to EPA for approval. In 2007, the Idaho Department of Environmental Quality (DEQ) developed TMDLs for three pollutants in Lindsay Creek: nitrate plus nitrite nitrogen (NO_3+NO_2-N), bacteria (*Escherichia coli [E. coli]*), and sediment (total suspended solids [TSS]) (Table A). EPA approved the Lindsay Creek TMDLs in 2007. The NO_3+NO_2-N and sediment TMDLs were developed to restore and protect cold water aquatic life, and the bacteria TMDL was developed to protect secondary contact recreation use in Lindsay Creek.

The TMDLs attributed all pollutant loading to nonpoint sources. DEQ identified ground water as an important source of NO_3+NO_2-N to surface water (DEQ 2007). The watershed falls within administrative boundaries of the Lindsay Creek Nitrate Priority Area (NPA). NPAs are areas with elevated nitrate in ground water where DEQ conducts regular ground water nitrate monitoring and ground water quality improvement is needed to protect human health and the environment (DEQ 2014). Potential NO_3+NO_2-N sources in the watershed include soil, fertilizers, livestock, septic systems, and stormwater discharges. For *E. coli*, livestock and wildlife, and septic systems are potential sources. *E. coli* concentrations are very low or below detection in shallow ground water that feeds Lindsay Creek, so surface runoff from livestock and wildlife sources may be more important than septic and ground water sources. For sediment (TSS), stormwater discharges, and erosion from infrastructure (road banks, culverts) and agriculture are likely primary sources. Sediment concentrations spike during high stream flow periods (winter, spring) but meet TMDL targets most of the year.

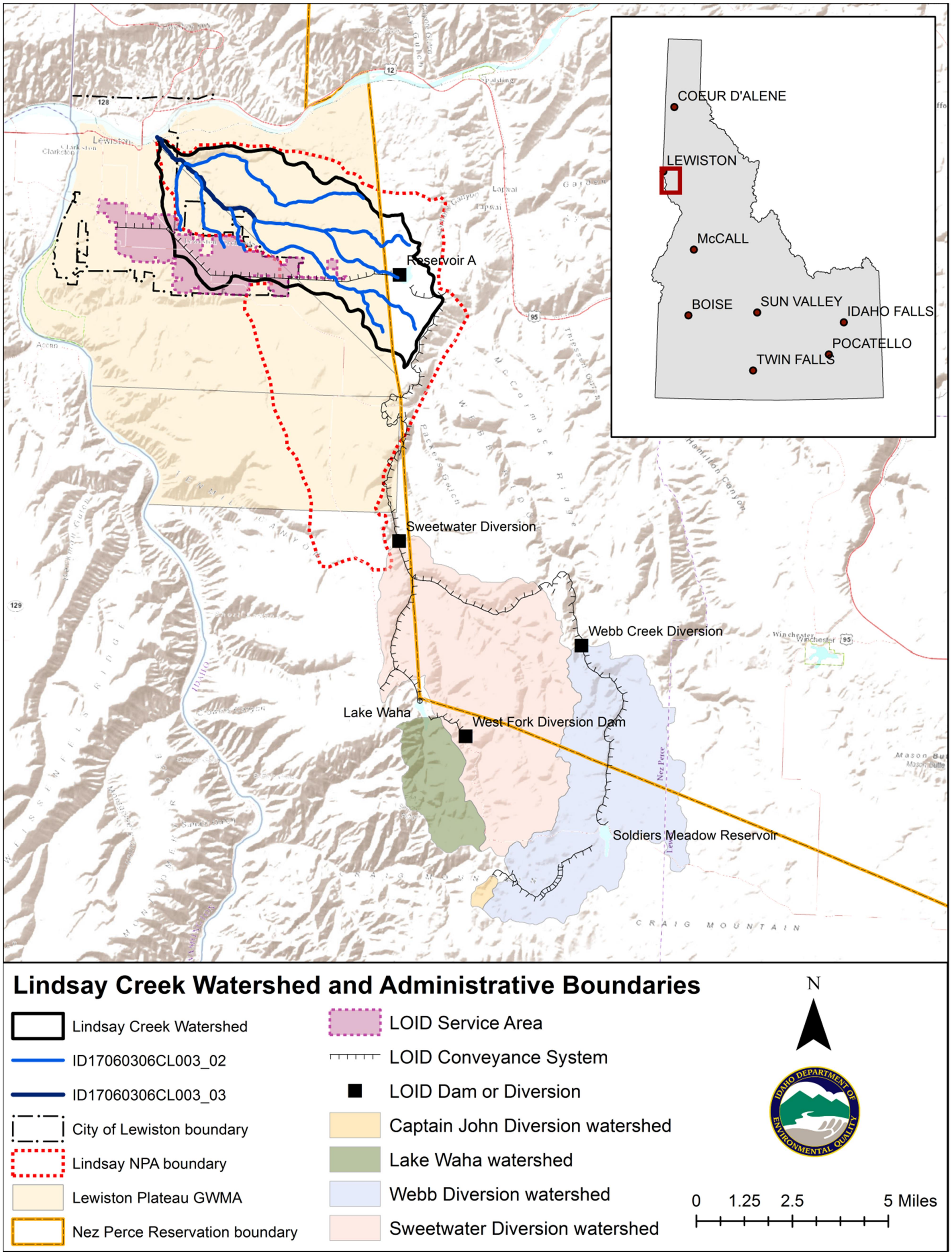

Figure A. Lindsay Creek subbasin and administrative boundaries.

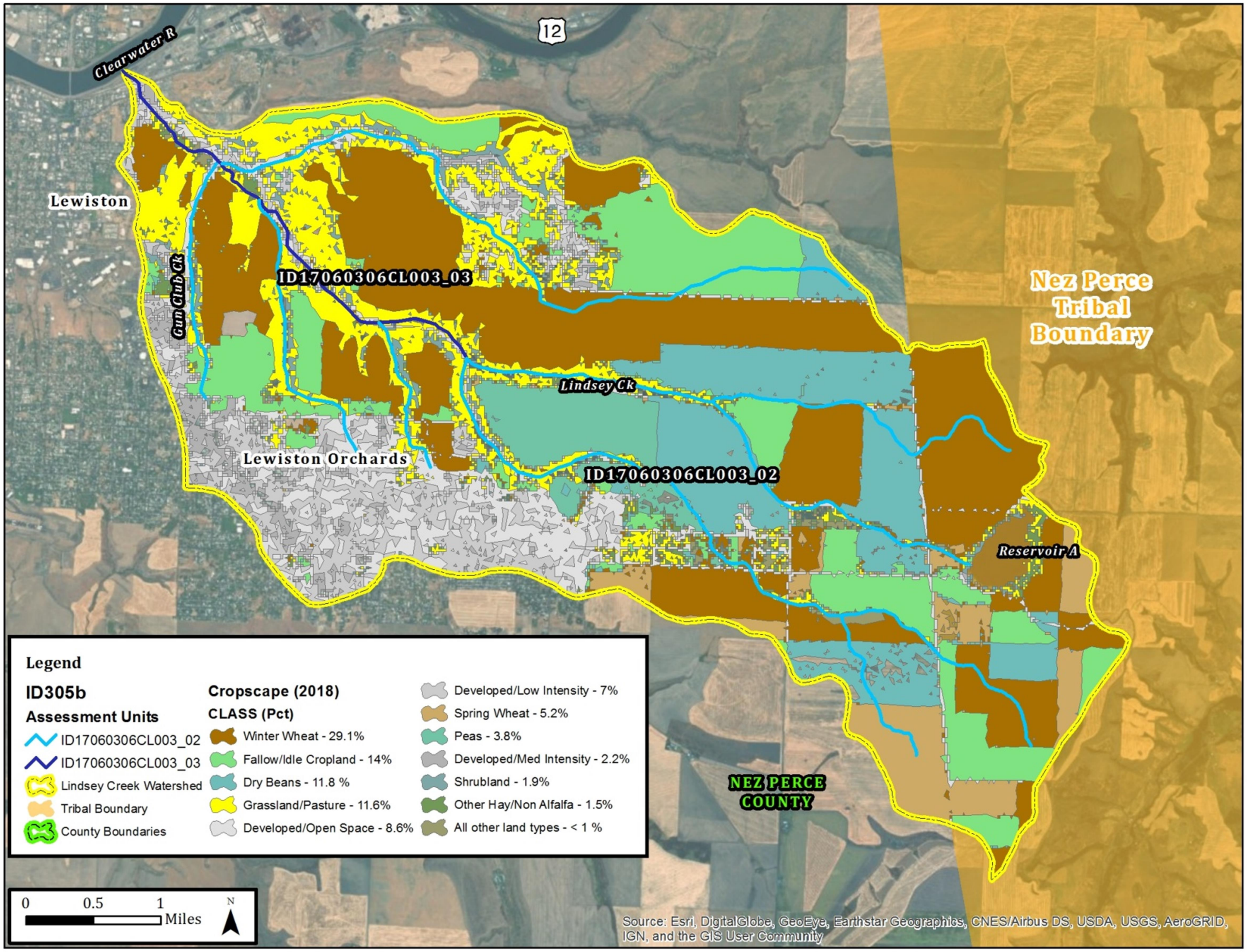

Figure B. Lindsay Creek watershed land use based on USDA 2018 CropScape data.

Key Findings

Table A. Existing TMDLs and general status.

Assessment Unit Name	Assessment Unit Number	Pollutants	TMDL Target	Water Quality Trend
Lindsay Creek—1st and 2nd order tributaries	ID17060306CL003_02	Nutrient/Eutrophication Biological Indicators	2 mg N/L NO_3+NO_2-N	Static
		Sediment (Total Suspended Solids [TSS])	80 mg/L max, 50 mg/L monthly average	Static
		E. coli	126 cfu/100 mL 30-day geometric mean	Static
Lindsay Creek—3rd order	ID17060306CL003_03	Nutrient/Eutrophication Biological Indicators	2 mg N/L NO_3+NO_2-N	Static
		Sediment (Total Suspended Solids [TSS])	80 mg/L max, 50 mg/L monthly average	Static
		E. coli	126 cfu/100 mL 30-day geometric mean	Static

Note: all Lindsay Creek TMDLs were approved by EPA in 2007.

Water quality targets established in the Lindsay Creek TMDLs (Table A) were not met in 2018. NO_3+NO_2-N concentrations greatly exceeded the 2 mg N/L target; concentrations were 7.9-9.9 mg N/L at the mouth and up to 14 mg N/L at some tributary stream sites. *E. coli* geometric mean concentrations (> 450 cfu/100 mL) also exceeded the target (126 cfu/100 mL). Sediment (TSS) concentrations exceeded targets in May and June 2018, but were relatively low the rest of the year.

Pollutant concentrations do not show a decreasing trend. Stream NO_3+NO_2-N concentrations consistently exceed TMDL targets across years where data are available after the TMDL (2008, 2009, 2018). NO_3+NO_2-N concentrations may have been greater in 2018 than in past years because 2018 was a wet year; Lindsay Creek NO_3+NO_2-N concentrations appear to be greater in wetter years. Lindsay Creek NO_3+NO_2-N concentrations and trends are affected by NO_3+NO_2-N contamination in the Saddle Mountains aquifer (< 250 feet below ground surface). Lindsay Creek *E. coli* also consistently exceeded targets across multiple years since the TMDL was completed. TSS concentrations exceeded targets during a short period in 2018, consistent with patterns in previous years.

TMDL Analysis

Table B. TMDL analysis summary.

Analysis	NO_3+NO_2-N	TSS	*E. coli*
Are the TMDL targets appropriate?	No	Yes	Yes
Are the pollutant allocations appropriate?	No	No	Yes
Are the assumptions and analysis appropriate?	No	Yes	Yes
Are the water quality criteria used in the TMDL consistent with current Idaho's water quality standards	Yes	Yes	Yes
Are the beneficial uses the TMDL was developed to protect appropriate and attainable?	Yes	Yes	Yes
Is the subbasin implementation plan appropriate?	No	No	No
Does DEQ recommend revising the TMDL at this time?	No	No	No

DEQ developed a nitrate plus nitrite nitrogen (NO_3+NO_2-N) TMDL to protect cold water aquatic life use, to reduce algal growths in Lindsay Creek, and to help address nitrate contamination in ground water (DEQ 2007). Several aspects of the NO_3+NO_2-N TMDL merit revision, but DEQ does not recommend revising the TMDLs at this time. It is not clear if the NO_3+NO_2-N target (2 mg N/L) will reduce algal growths or protect cold water aquatic life because it is not ecologically-based. The target is substantially higher than the lowest concentrations observed in ground water that feeds Lindsay Creek and concentrations observed at the Lindsay Creek headwaters, so it also does not represent achievable or background concentrations. The load allocations could also be revised; the TMDL did not develop separate load allocations for each assessment unit, but data necessary to do so are available. However, considering stream NO_3+NO_2-N concentrations were four to seven times greater than targets in 2018, and are consistently very high across years, DEQ should focus its limited resources on additional monitoring and coordinating efforts by designated management agencies and watershed stakeholders to reduce nitrogen inputs to ground water and surface water, rather than revising the TMDL.

DEQ developed a sediment TMDL to protect cold water aquatic life use in Lindsay Creek. Several aspects of the sediment (TSS) TMDL merit revision, but DEQ does not recommend revising the TMDL at this time. The sediment waste load allocation assigned to the City of Lewiston stormwater discharges and reserve for growth need to be revised because the city stormwater system has expanded since the TMDL was developed. The load allocation for nonpoint sources could also be revised; the TMDL did not develop separate load allocations for each assessment unit, but data necessary to do so are available. However, TSS concentrations exceeded targets only in May and June 2018, and the magnitude of exceedance was relatively small. An existing watershed erosion assessment (NPSWCD 2016) and other resources have identified priority areas for reducing sediment inputs, so DEQ believes sediment loads can be reduced and targets can be achieved in the relatively near future. DEQ should focus its limited resources on coordinating implementation efforts and monitoring TSS concentrations. The TMDL could be revised in the future if targets are not achieved through subsequent implementation efforts.

DEQ developed a *E. coli* TMDL to proctect secondary contact recreation use in Lindsay Creek. The *E. coli* TMDL is still appropriate and does not need revision. However, considering *E. coli* still exceeds targets the current implementation approach needs to be revisited.

Review of Beneficial Uses

A review of beneficial uses and their support status was conducted. Idaho water quality standards designate cold water aquatic life and secondary contact recreation as beneficial uses of water that must be protected in Lindsay Creek. These uses are still appropriate. Salmonid spawning is not a designated use in Idaho water quality standards for Lindsay Creek. It is also not an existing use that must be protected under the Clean Water Act because a tunnel drain in the Clearwater Levee at the mouth of Lindsay Creek prevents salmonids from entering Lindsay Creek from the Clearwater River (the Clearwater Levee was completed in February 1975) (Preston 1976).

In the TMDL, DEQ identified *E. coli* as exceeding the Idaho *E. coli* criterion and therefore determined *E. coli* impaired secondary contact recreation use. Recent data demonstrate *E. coli* concentrations still exceed the *E. coli* criterion, so DEQ still considers secondary contact recreation use to be impaired by *E. coli* in Lindsay Creek. For both assessment units, *E. coli* should remain in Category 4a of Idaho's next Integrated Report submitted to EPA.

In the TMDL, DEQ identified sediment (TSS) and NO_3+NO_2-N as impairing cold water aquatic life use in Lindsay Creek. Recent data demonstrate both NO_3+NO_2-N and TSS concentrations exceed targets established in the TMDL. For both assessment units, NO_3+NO_2-N and TSS should remain in Category 4a of Idaho's next Integrated Report unless subsequent pollutant and ecological monitoring demonstrate targets are achieved and cold water aquatic life use is supported (Table C).

Table C. Summary of Changes recommended for Idaho's next Integrated Report.

Assessment Unit Name	Assessment Unit Number	Pollutant	Recommended Changes to Next Integrated Report	Justification
Lindsay Creek—1st and 2nd order tributaries	ID17060306CL003_02	NO_3+NO_2-N	Retain in Category 4a	Target exceeded
		TSS	Retain in Category 4a	Target exceeded
		E. coli	Retain in Category 4a	Target exceeded
Lindsay Creek—3rd order	ID17060306CL003_02	NO_3+NO_2-N	Retain in Category 4a	Target exceeded
		TSS	Retain in Category 4a	Target exceeded
		E. coli	Retain in Category 4a	Target exceeded

Changes in Subbasin

Monitoring data used develop the TMDL were collected in 2001-2002, and the TMDL was finalized in 2007. Since then, several changes have occurred in the watershed, including:

- New residential development has occurred in the Lewiston Orchards area within the City of Lewiston, and in county subdivisions along NF Lindsay Creek. This development has increased the number of septic systems and expanded stormwater drainage systems in the watershed. Based on county records, DEQ estimates approximately 230 parcels in the watershed (~4% of parcels) had new construction and a septic system installed since data used to develop the TMDL were collected (2001-2002). As of 2018, ~800 parcels (~15%) in the watershed had a septic system.

- In 2018, the City of Lewiston installed a sewer trunk line into the eastern Lewiston Orchards, with 64 new sewer service stubs installed. As of April 2018, 8 users were hooked to the new sewer line, and 19 additional users have told the City they intend to convert from septic to public sewer in 2019 (Joe Kaufman, City of Lewiston, personal communication 4-11-2019). The City of Lewiston also anticipates building additional sewer main line segments in 2019 (Joe Kaufman, City of Lewiston, personal communication 4-11-2019).

- The Lewiston Orchards Irrigation District (LOID) is transitioning from using surface water to using ground water as its irrigation water source. LOID is constructing multiple ground water wells that will replace surface water diversions currently used to supply the LOID service area. One well has been constructed and additional wells are scheduled for construction over the next several years. The wells will be completed in the deep Grande Ronde aquifer. This means water that enters Lindsay Creek or the shallow Saddle Mountains aquifer through irrigation activities in the LOID service area will come from the deep Grande Ronde aquifer rather than from surface water in the future.

- Two Federal Clean Water Act §319 Nonpoint Source Management Program grants were awarded for water quality improvement projects in the watershed. Funds were used to implement agricultural best management practices, help stabilize streambanks, promote agricultural nutrient management, and other actions. A detailed description is provided in Section 4.2.

- In 2018, Nez Perce Drive was extended to connect with Gun Club Road near the top of Gun Club Creek (a tributary of Lindsay Creek) to open up additional land to commercial development. During construction for this project, construction crews identified a failed culvert that runs under Gun Club Road and feeds Gun Club Creek (Lewiston Tribune, 2018). The culvert was replaced in July 2018, and may help reduce sediment loads in Gun Club Creek.

Water Quality Criteria

Since the TMDL was developed, no changes to Idaho water quality criteria have occurred for pollutants addressed in the TMDL.

Implementation Activities

After the TMDL was finalized, two implementation plan documents were developed. The Nez Perce Soil and Water Conservation District (NPSWCD) developed the *Lindsay Creek Watershed Total Maximum Daily Load Implementation Plan for Agriculture* (NPSWCD 2008). This plan identified agricultural best management practices (BMPs) for cropland and riparian zones and recommended priorities for BMP implementation. The plan also identified several specific projects NPSWCD planned to complete. Specific actions planned in the *Lindsay Creek*

Watershed Total Maximum Daily Load Implementation Plan for Agriculture and the status of each planned action are described in Section 4.0.

In addition, DEQ and the Lindsay Creek WAG developed a draft *Lindsay Creek Nitrate Priority Area Ground Water Management Plan* (DEQ 2009) that was never finalized. The plan recommended public education about nitrate health risks and sources, and voluntary implementation of agricultural and residential best management practices to reduce nitrate inputs to ground water (DEQ 2009). Specific actions planned in the draft *Lindsay Creek Nitrate Priority Area Ground Water Management Plan* and the status of each planned action are described in section 4.0.

Considering TMDL targets are still not met and pollutant concentrations are not trending downward, existing implementation plans may need to be revisited, and additional actions are needed to achieve water quality goals established in the TMDL.

Recommendations for Further Action

DEQ believes implementation efforts, and monitoring to help inform and prioritize implementation should be a priority in the Lindsay Creek watershed. DEQ will work with designated management agencies, the Hatwai Creek/Lindsay Creek WAG, and watershed stakeholders to identify strategies for addressing pollution in Lindsay Creek. The following recommendations have been developed based on input received during public WAG meetings:

- The WAG, designated management agencies, and stakeholders should revisit the draft TMDL implementation plan for agriculture and *Lindsay Creek Nitrate Priority Ground Water Quality Management Plan*. These plans should be revised as needed and incorporated into a single TMDL implementation plan document. The document should include WAG, designated management agency, and stakeholder recommendations for all aspects of water quality management necessary to achieve support of beneficial uses (monitoring, and recommendations for managing surface water and ground water quality in agricultural, residential, and urban settings, outreach and education, etc.). This document should be developed cooperatively by DEQ, designated management agencies, and watershed stakeholders. Ideally, it would articulate shared goals, voluntary actions necessary to achieve those goals, resource and information needs, available funding sources, and serve as a resource to help designated management agencies, local government, and private land owners to consider surface water and ground water quality issues in their planning processes. The document should indicate priorities for recommended actions, and a schedule of implementation activities.

- The WAG, designated management agencies, and stakeholders should provide input to DEQ on what monitoring data or other information is needed to help guide and prioritize water quality improvement actions.

- DEQ should continue to monitor surface water and ground water in the Lindsay Creek Watershed. Monitoring should be designed to assess progress towards meeting TMDL targets, help guide and prioritize water quality improvement actions, assess the effectiveness of best management practices or other implementation activities, and to develop information needed to revise TMDL targets for nutrients and sediment.

- DEQ should organize an annual public meeting of designated management agencies and stakeholders to review progress towards meeting water quality goals in the Lindsay Creek watershed, identify resources needed, and to facilitate coordination of water quality improvement efforts among the many entities and individuals involved.

1 Introduction

Lindsay Creek is a tributary to the Clearwater River in Nez Perce County, Idaho (Figure 1, Figure 2).The Lindsay Creek watershed spans 22.4 square miles and includes a portion of Lewiston, Idaho. The headwaters of Lindsay Creek begin in residential development and farmland at approximately 1,800 feet above mean sea level (MSL). Lindsay Creek flows through basalt canyons, farmland, ranchland, and residential areas as it descends 1,000 feet to its mouth (750 feet above MSL), where Lindsay Creek flows into a tunnel drain that is part of the levee system for the Lower Granite Dam and converges with the Clearwater River. The main stem of Lindsay Creek is a 3rd-order stream with typical flows of 1–4 cubic feet per second (cfs) in summer and 5–9 cfs in spring at the mouth. Several 1st- and 2nd-order tributary segments have lower flows and go dry during summer.

In 1978, the Idaho Department of Health and Welfare Division of Environmental Quality classified Lindsay Creek as ‘water quality limiting’ due to high bacteria and nutrient concentrations (IDHW 1978). In 1994, the United States Environmental Protection Agency (EPA) placed Lindsay Creek on Idaho’s §303(d) list, a biannual list of impaired state waters required by Clean Water Act (CWA) section 303(d). Idaho’s 1994 §303(d) list was created by EPA under a court order (EPA 1994). For waters identified Idaho’s §303(d) list, states must develop TMDLs for each pollutant, and submit TMDLs to EPA for approval. In 2007, the Idaho Department of Environmental Quality (DEQ) developed TMDLs for three pollutants in Lindsay Creek: nitrate plus nitrite nitrogen (NO_3+NO_2-N), bacteria (*Escherichia coli [E. coli]*), and sediment (total suspended solids [TSS]) (DEQ 2007) (Table A). EPA approved the Lindsay Creek TMDLs in 2007 (EPA 2007). The TMDLs were developed to restore and protect cold water aquatic life and secondary contact recreation beneficial uses. The TMDLs attributed all pollutant loading to nonpoint sources.

Table 1. Lindsay Creek beneficial uses and associated pollutants with TMDLs.

Assessment Unit Name	Assessment Unit	Beneficial Use	Pollutant	TMDL Target
Lindsay Creek—1st and 2nd order tributaries	ID17060306CL003_02	Cold water aquatic life	Nutrient/Eutrophication Biological Indicators	0.072 mg N/L (NO_2+NO_3-N)
			Sedimentation/Siltation (total suspended solids [TSS])	80 mg/L max, 50 mg/L monthly mean
		Secondary contact recreation	*E. coli*	126 cfu/100 mL30-day geometric mean
Lindsay Creek—3rd order	ID17060306CL003_03	Cold water aquatic life	Nutrient/Eutrophication Biological Indicators	0.072 mg N/L (NO_2+NO_3-N)
			Sedimentation/Siltation (total suspended solids [TSS])	80 mg/L max, 50 mg/L monthly mean
		Secondary contact recreation	*E. coli*	126 cfu/100 mL 30-day geometric mean

Notes: milligrams (mg); colony forming unit (cfu); milliliter (mL)

Water in Lindsay Creek comes from precipitation, ground water, and irrigation inputs. Average annual precipitation from 1981-2010 in Lewiston, ID was 12.3 inches (NOAA 2018). Precipitation occurs primarily during fall, winter, and spring, with very limited summer precipitation. Lindsay Creek receives ground water inputs from springs and seeps associated basalt canyon walls and basalt rock fall. Ground water inputs are thought to be substantial, but the percent ground water contribution to stream flow has not been quantified. A portion of the watershed also receives irrigation inputs. The Lewiston Orchards Irrigation District (LOID) conveys water from Sweetwater and Webb creeks into Mann Lake (also called 'Reservoir A', Figure 1). The water is delivered to the LOID service area through a pipe system; residents use it to water lawns, for winter livestock watering, and for fire protection. LOID water may enter ground water or surface water after being used within the LOID service area. Mann Lake does not discharge directly into Lindsay Creek, but a wetland near the outlet and Lindsay Creek headwaters suggests some limited under flow seepage may occur.

The Saddle Mountains aquifer, and perhaps also the Wanapum aquifer (Figure 3) are the source of springs and seeps that provide ground water inputs to Lindsay Creek. The Saddle Mountains aquifer spans 0-250 ft below the ground surface, and is composed of multiple layers of fractured basalt. A sedimentary interbed called the Sweetwater formation sits below the Saddle Mountains Aquifer and separates it from a second lower fractured basalt aquifer, the Wanapum aquifer. A sedimentary interbed called the Vantage formation sits below the Wanapum aquifer and separates it from the Grande Ronde aquifer. Both the Saddle Mountains and Wanapum aquifers are 'perched' aquifers, meaning they are recharded primarily by precipitation and irrigation. Water from the Saddle Mountains likely percolates downward through basalt fractures and may be a source of water to the Wanapum aquifer, but the extent of hydrologic communication is not clear (Daniel Sturgis, IDWR, personal communication 11-14-2018). Nitrate concentrations are elevated in the Saddle Mountains aquifer (Figure 3), and therefore ground water is likely a significant source of nitrate inputs to Lindsay Creek. Nitrate patterns in ground water and surface water are described in detail in a separate document, *Ground Water and Surface Water Nitrate Patterns in the Lewiston Basin* (DEQ 2019b).

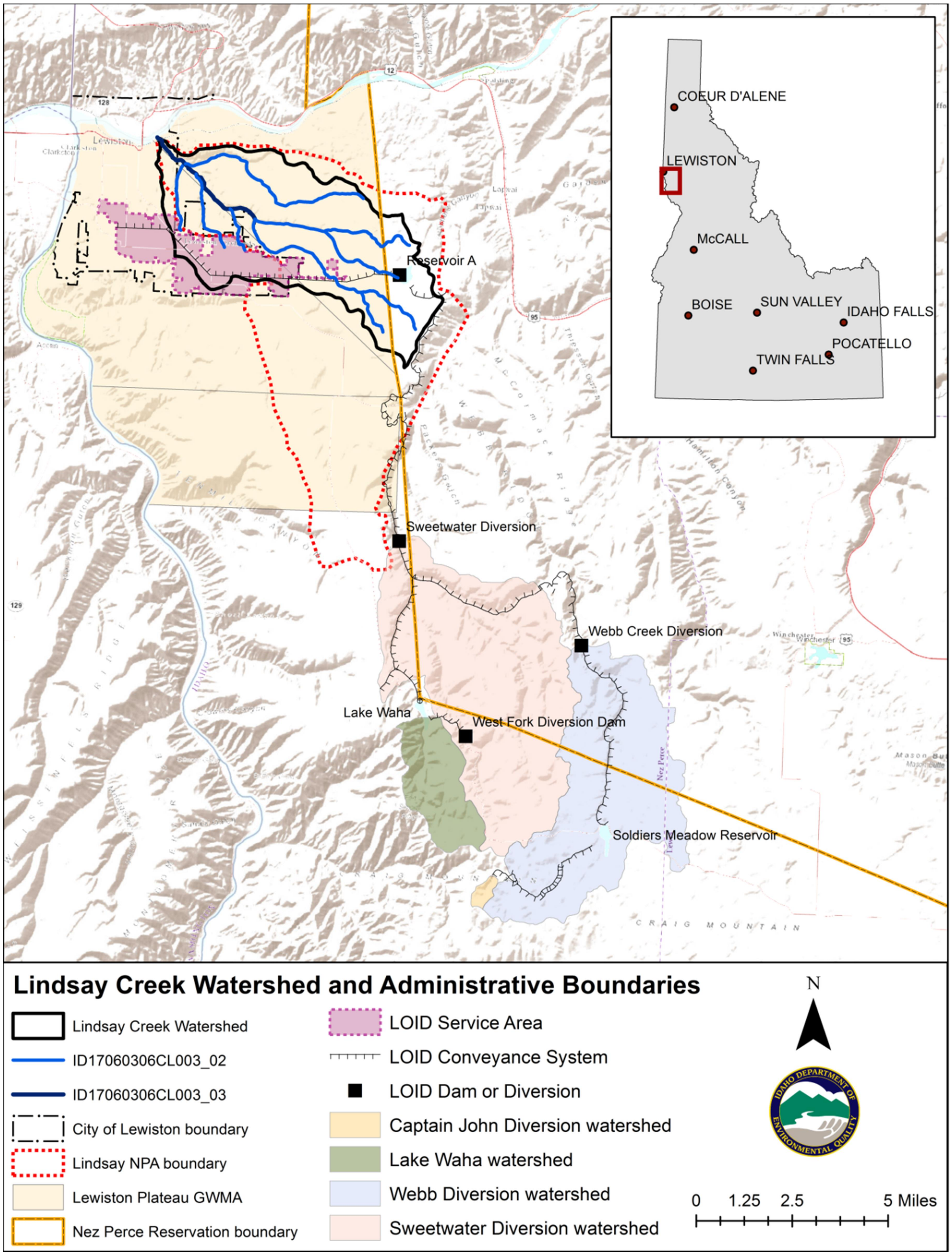

Figure 1. Lindsay Creek watershed and administrative boundaries.

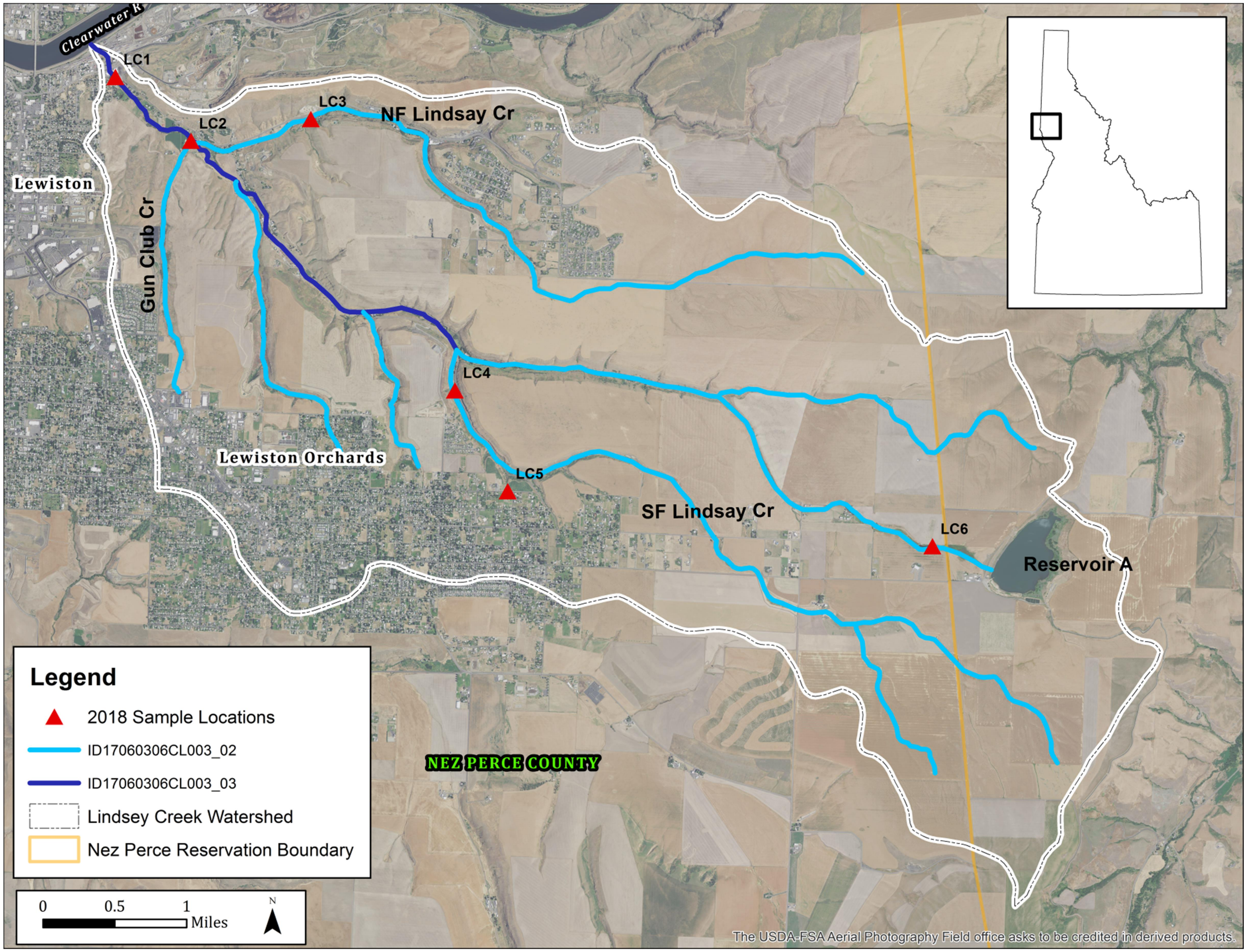

Figure 2. Lindsay Creek watershed and 2018 surface water monitoring locations.

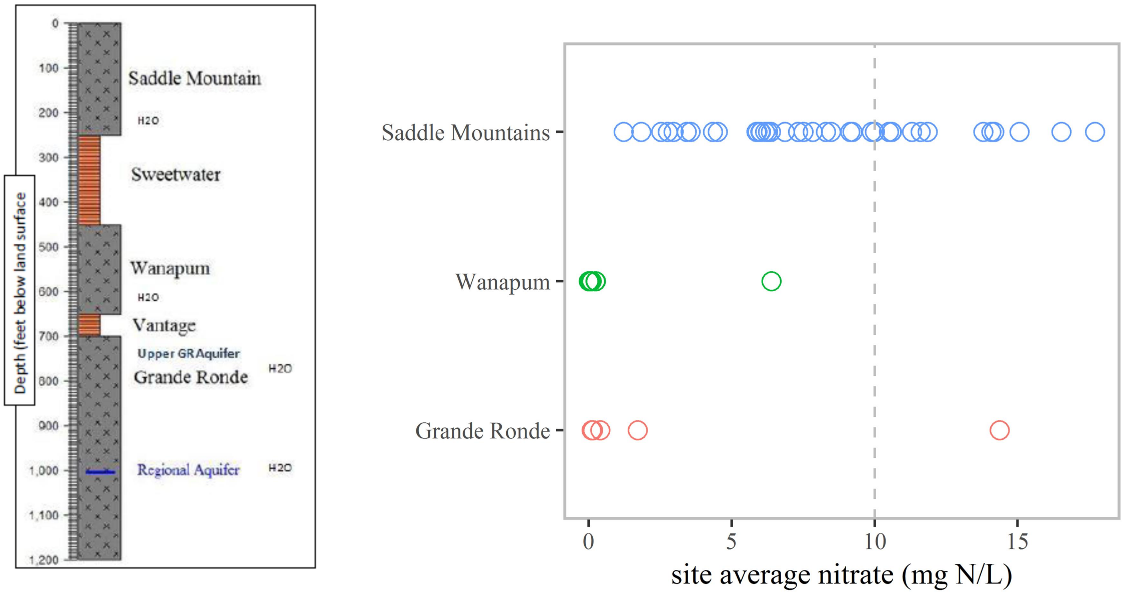

Figure 3. Geologic strata and average nitrate concentrations at wells and springs sampled by DEQ within the Lindsay Creek NPA and Lewiston plateau ground water management area (Figure 1). Geologic strata are from Neely 2018.

Land uses within the watershed include nonirrigated agriculture, small ranches and livestock operations, residential developments, and industrial businesses. Seventy-two percent of watershed area is nonirrigated agricultural land (USGS 2017). Based on the US Department of Agriculture (USDA) Cropland Data Layer (USDA 2018), winter wheat (29%), fallow cropland (14%), dry beans (12%) and pasture (11%) were the dominant agricultural land uses in 2018 (Figure 4). The watershed includes multiple small ranches and livestock operations, rural residences, and several residential developments outside of City of Lewiston boundaries. Approximately 18% of the watershed land area is developed, and 4% of the land surface is impervious material (USGS 2017).

There are no point source discharges to surface water within the watershed permitted under the EPA National Pollution Discharge Elimination System (NPDES) program. However, the City of Lewiston stormwater system discharges into some Lindsay Creek tributaries. Natural drainage ways in the Lewiston Orchards and within portions of the City of Lewiston convey ephemeral stormwater into tributaries of Lindsay Creek. In December 2018, EPA released a draft National Pollutant Discharge Elimination System (NPDES) MS4 stormwater permit for the City of Lewiston and Lewis-Clark State College for public comment (EPA 2018). City of Lewiston stormwater discharges will likely occur under a NPDES permit beginning in 2019 after EPA finalizes the permit. City of Lewiston stormwater discharges were treated as a point source and assigned a wasteload allocation in the TMDL (Section 2.3).

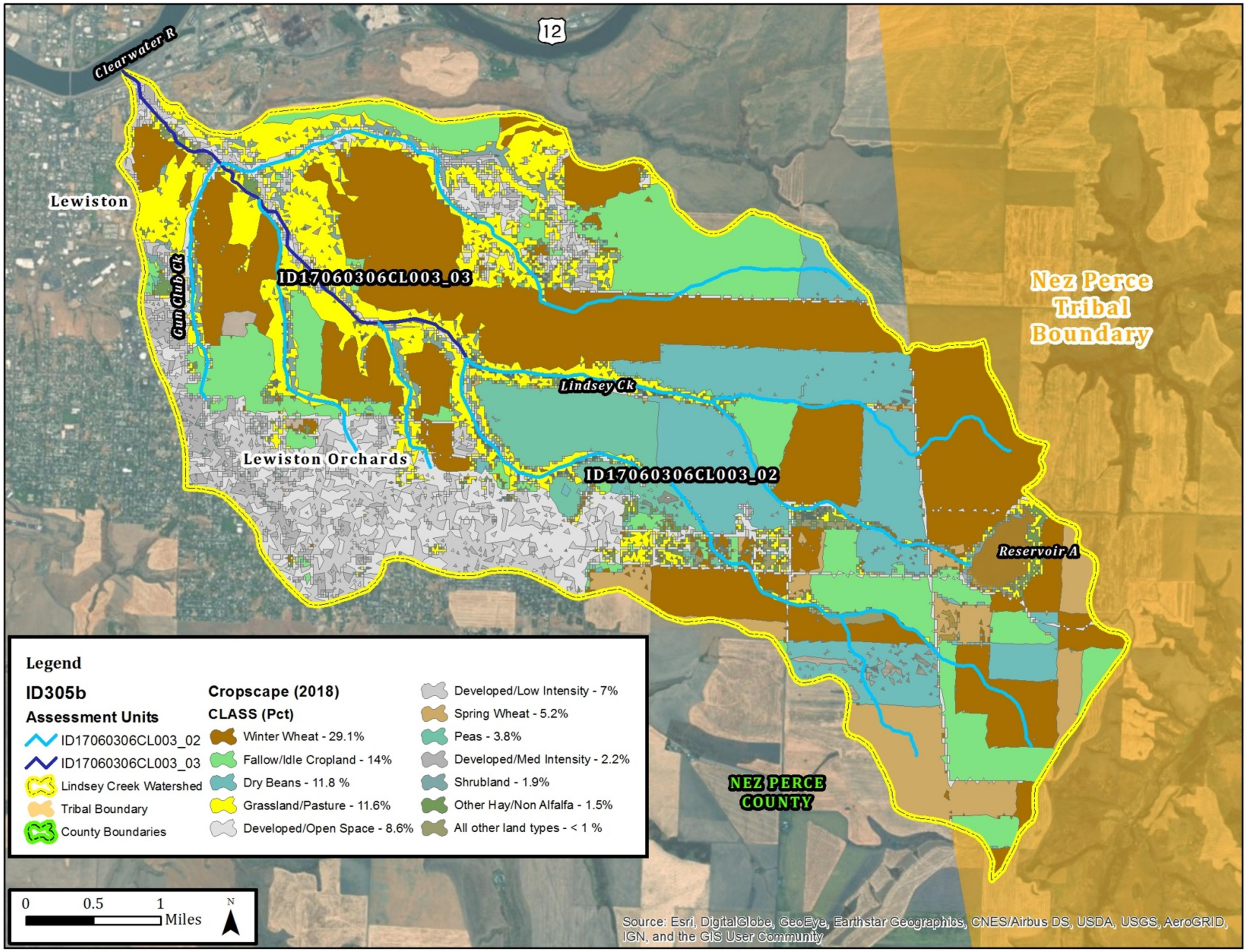

Figure 4. Lindsay Creek watershed land use based on USDA 2018 CropScape data.

Most parcels within city boundaries are connected to the City of Lewiston sewer line system. Many city parcels in the Lewiston Orchards area and all parcels outside city boundaries use septic systems; approximately 800 parcels in the watershed (~15%) have septic systems. In 2018, the City of Lewiston extended a sewer line into the eastern Lewiston Orchards area with 64 new sewer stubs installed. As of April 2018, 8 users were hooked to the new sewer line, and 19 users told the City they intend to convert from septic to public sewer in 2019. The City of Lewiston also anticipates building additional sewer main line segments in 2019 (Joe Kaufman, City of Lewiston, personal communication 4-11-2019).

The Lindsay Creek watershed falls within administrative boundaries of the Lindsay Creek Nitrate Priority Area (NPA) and Lewiston Plateau Ground Water Management Area (GWMA) (Figure 1). DEQ designated the Lindsay Creek Ground Water Nitrate Priority Area (NPA) in 2008 (DEQ 2008) and revised its boundaries in 2014 based on available ground water nitrate monitoring data (DEQ 2014) (Figure 1). NPAs are areas where DEQ conducts regular ground water nitrate monitoring, water quality improvement is needed to protect human health and the environment, and DEQ in some cases develops ground water quality improvement plans (DEQ 2014). In 2019, DEQ plans to revise boundaries of the Lindsay Creek NPA to include more of the City of Lewiston and eastern Lewiston Orchards. The Idaho Department of Water Resources (IDWR) established the Lewiston Plateau GWMA in response to declining water levels drawing from the Saddle Mountains Aquifer (IDWR 2015). The GWMA requires new wells be completed in the deep regional Grande Ronde aquifer, and requires well casing to seal off water from the Saddle Mountains and Wanapum aquifer (IDWR 2015, Daniel Sturgis IDWR, personal communication 1-14-2019).

1.1 Public Involvement

DEQ developed this 5-year review in consultation with the Hatwai Creek/Lindsay Creek Watershed Advisory Group (WAG) and held multiple public meetings with the WAG to discuss the TMDL review. The general public had the opportunity to comment on this document during public WAG meetings.

1.2 Regulatory Requirements

The federal CWA requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to the CWA§303 must adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. The water quality standards must specify beneficial uses to be achieved and protected for waters and water quality criteria that protect beneficial uses (40 CFR 131.6).

Idaho's "Water Quality Standards" (IDAPA 58.01.02) specify beneficial uses to be achieved and protected in Idaho waters as well as water quality criteria. Beneficial uses in IDAPA 58.01.02 include aquatic life uses (i.e., cold water, seasonal cold water, warm water, salmonid spawning, and modified) contact recreation (i.e., swimming and boating), water supply, wildlife habitats, and aesthetics. IDAPA 58.01.02.050.02 requires that surface waters of the state be protected for relevant beneficial uses, wherever attainable. Idaho's water quality criteria are numeric chemical-specific concentrations, or narrative statements representing water quality that protects a particular beneficial use.

The CWA§303(d) 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 publish a biannual priority list (a "§303(d) list") of impaired waters. 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. A TMDL specifies maximum inputs of a pollutant from all sources that can occur while still meeting water quality criteria and thus supporting beneficial uses.

Idaho Code §39-3611(7) requires a 5-year cyclic review process for Idaho TMDLs:

> The director shall review and reevaluate each TMDL, supporting subbasin assessment, implementation plan(s) and all available data periodically at intervals of no greater than five (5) years. Such reviews shall include the assessments required by section 39-3607, Idaho Code, and an evaluation of the water quality criteria, instream targets, pollutant allocations, assumptions and analyses upon which the TMDL and subbasin assessment were based. If the members of the watershed advisory group, with the concurrence of the basin advisory group, advise the director that the water quality standards, the subbasin assessment, or the implementation plan(s) are not attainable or are inappropriate based upon supporting data, the director shall initiate the process or processes to determine whether to make recommended modifications. The director shall report to the legislature annually the results of such reviews.

This 5-year review, developed with the Hatwai Creek/Lindsay Creek WAG, addresses the Lindsay Creek TMDLs (DEQ 2007). It considers the most current and applicable information in conformance with Idaho Code §39-3607, evaluates the appropriateness of the TMDL to current watershed conditions, and evaluates the implementation plans (NPSWCD 2009; DEQ 2009). An evaluation of the recommendations presented is provided. Final decisions for TMDL modifications are decided by the DEQ director. Approval of TMDL modifications is decided by the US Environmental Protection Agency (EPA), with consultation by DEQ.

1.3 Assessment Units

To assess if water quality criteria are met, beneficial uses are supported, and to fulfill CWA §303(d) and §305(b) reporting requirements, DEQ subdivides surface water bodies into assessment units (AUs). AUs are groups of similar streams with similar land use practices, ownership, or land management. AUs are based on Strahler stream order, although additional factors such as land use, landscape physical characteristics, and local knowledge may be considered. 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 used to specify beneficial uses, which relates them directly to Idaho's water quality standards. A detailed description of how DEQ subdivides state waters into AUs is provided in the Integrated Report (DEQ 2017). The Lindsay Creek watershed includes two AUs (Figure 2). AU ID17060306CL003_02 includes the Lindsay Creek tributaries (1st- and 2nd-order streams), and AU ID17060306CL003_03 includes the main stem of Lindsay Creek (3rd-order stream).

2 TMDL Review and Status

The Lindsay Creek TMDLs were developed to restore and protect beneficial uses in two AUs within the Lindsay Creek watershed (Figure 2; Table 1). DEQ developed nutrient and sediment TMDLs to restore and protect cold water aquatic life use, and developed an *E. coli* TMDL to restore and protect secondary contact recreation use (Table 1). Waters protected for cold water aquatic life use are expected to maintain a viable aquatic community for cold water species. Waters protected for secondary contact recreation are expected to allow for recreation activities, such as wading and fishing, where immersion and ingestion are unlikely. The Lindsay Creek TMDLs are found at *www.deq.idaho.gov/water-quality/surface-water/tmdls/table-of-sbas-tmdls.*

In 2018, DEQ collected water quality data in the Lindsay Creek watershed (DEQ 2018). DEQ used 2018 monitoring results and other relevant information to review the Lindsay Creek nutrient, sediment, and *E. coli* TMDLs as required by Idaho Code §39-3611(7).

2.1 Escherichia coli

DEQ developed an *E. coli* TMDL to protect secondary contact recreation use in Lindsay Creek. Idaho water quality standards (IDAPA 58.01.02.110–160) designate secondary contact recreation as a beneficial use that must be protected in Lindsay Creek. Secondary contact recreation activities are those where water immersion and ingestion are unlikely (wading, fishing, etc.).

2.1.1 Pollutant Targets

The Idaho *E. coli* water quality criterion is a 126 colony forming units (cfu)/100 milliliters (mL) 30-day geometric mean concentration (IDAPA 58.01.02.251.02). This criterion was selected as the *E. coli* TMDL target to protect secondary contact recreation use in Lindsay Creek (DEQ 2007). The *E. coli* criterion has not changed since TMDL development, so DEQ considers this target appropriate. The Lindsay Creek TMDL applied the *E. coli* target year-round (DEQ 2007; Table 18).

2.1.2 Control and Monitoring Points

In April 2005, DEQ collected *E. coli* samples near the Lindsay Creek mouth within the main stem AU (003_03). The resulting 5-sample geometric mean *E. coli* concentration (366 cfu/100 mL) exceeded the *E. coli* criterion (126 cfu/100 mL). In the TMDL, DEQ used this geometric mean to calculate the existing *E. coli* load, load capacity, and load allocations that were applied to both AUs (DEQ 2007). The TMDL used the site near the mouth within 003_03 as a TMDL control point; loads were calculated there and applied to both AUs, and the TMDL recommended using this site for long-term monitoring and to assess compliance with water quality standards and support of beneficial uses within the watershed (DEQ 2007, p 59).

After the TMDL was developed, DEQ collected *E. coli* data and calculated geometric mean concentrations at multiple locations, including within both AUs (Figure 5) (DEQ 2016, DEQ 2017, DEQ 2018). In 2012-2013, geometric mean *E. coli* concentrations exceeded the *E. coli* criterion at multiple locations within the main stem AU and DEQ identified potential human and ruminant *E. coli* sources (DEQ 2016). In 2018, *E. coli* concentrations at the TMDL control point

(LC1, Figure 2) and North Fork Lindsay Creek (LC3, Figure 2) exceeded the Idaho *E. coli* criterion in both AUs (Table 2). 2018 data were used to calculate current *E. coli* loads (Table 2).

Considering DEQ must assess and report support of beneficial uses at the assessment unit scale for Idaho's Integrated Report, DEQ should monitor *E. coli* in both assessment units in the future. DEQ should continue to monitor *E. coli* at the control point, within 003_02, and at additional locations as needed to help identify and track *E. coli* sources.

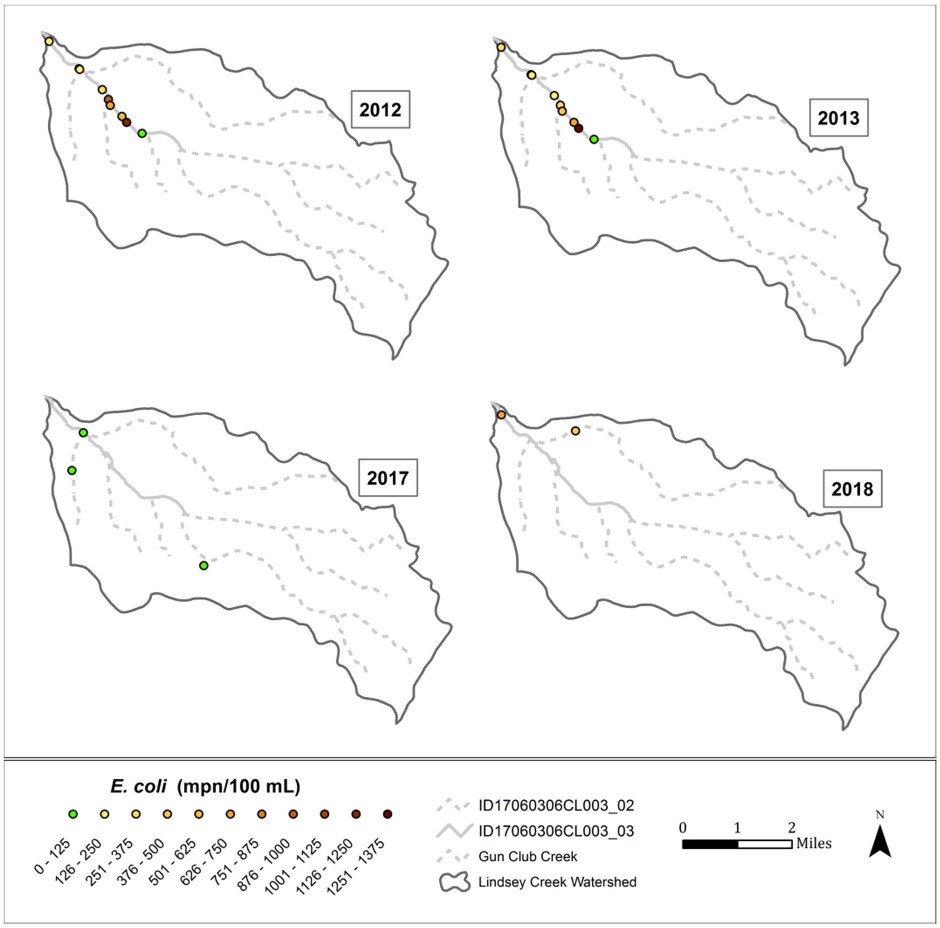

Figure 5. E. coli data collected 2012-2018. All values are geometric means except for the southern-most point in 2017 (Burrell Ave culvert).

2.1.3 Load Capacity

In the TMDL, the *E. coli* load capacity was expressed as a 126 cfu/100 mL 30-day geometric mean concentration consistent with the *E. coli* criterion (DEQ 2007). The *E. coli* criterion has not changed since TDML development, so the *E. coli* load capacity is still reasonable and applies to both AUs.

2.1.4 Load Allocations

A load allocation is the pollutant load allocated to nonpoint sources. In the TMDL, DEQ expressed the *E. coli* load allocation as a 126 cfu/100 mL geometric mean (DEQ 2007, Table 17). DEQ attributed the entire *E. coli* load to nonpoint sources and did not develop load allocations for specific tributaries or source types (e.g., livestock, wildlife, human sources). The load allocation represents the combined the total combined load allowable from all nonpoint sources. Load allocations are often calculated by subtracting a margin of safety from the load capacity. The Lindsay Creek TMDL did not use a margin of safety for *E. coli* because of several conservative assumptions incorporated into the TMDL (Section 2.1.5).

In 2018, geometric mean *E. coli* concentrations exceeded the *E. coli* criterion in both AUs (Table 2). Because the *E. coli* water quality criterion has not changed since TMDL development, DEQ believes the load allocation is still reasonable, and it is reasonable to apply this load allocation to both AUs.

Table 2. Lindsay Creek subbasin *E. coli* load allocations based on geometric mean concentrations calculated from *E. coli* samples collected 6/5/18 to 7/2/18.

Assessment Unit Name	Assessment Unit Number	Sample Site (Figure 2)	Current Load	Load Capacity	Load Allocation[a]	Load Reduction Required[b]
			(mpn/100 mL)			
Linday Creek—1st and 2nd order tributaries	ID17060306CL003_02	LC3	456.6	126	126	330.6 (72%)
Lindsay Creek—3rd order	ID17060306CL003_03	LC1	657.9	126	126	531.9 (81%)

a. Load allocation (mpn/100 mL) = load capacity
b. Load reduction required (mpn/100 mL) = current load – load allocation; load reduction required (%) = 1-(load allocation/current load) * 100
Note: Units of most probable number (mpn)/100 mL are considered equivalent to cfu/100 mL.

2.1.5 Margin of Safety

A MOS accounts for uncertainties that may affect the protectiveness of the TMDL. It reduces the pollutant load available for allocation to nonpoint and point sources. DEQ did not include a MOS in the TMDL because "Two implicit conservative assumptions have been incorporated…and should be used as a margin of safety" (DEQ 2007, p 47). The critical period for the target concentration was one conservative assumption because the target concentration was assumed to apply year-round rather than only during warmer months when *E. coli* concentrations are typically greatest (Section 2.1.6) (Figure 6).

However, using the Idaho *E. coli* criterion as the target and load capacity is inherently conservative (protective) for Lindsay Creek because the criterion was developed to protect against illness among people participating in primary contact recreation activities, where immersion and ingestion are likely, whereas only secondary contact recreation activities are likely in Lindsay Creek. Considering this conservative assumption and year-round application of targets, DEQ believes the *E. coli* TMDL is sufficiently protective and revising the TMDL to include a MOS for *E. coli* is necessary.

2.1.6 Seasonal Variation

Lindsay Creek *E. coli* concentrations are typically greatest in summer and fall months (Figure 6). DEQ expressed the load capacity and allocation as a constant geometric mean concentration. DEQ also used a year-round critical period, meaning the target concentration always applies and is not season-specific.

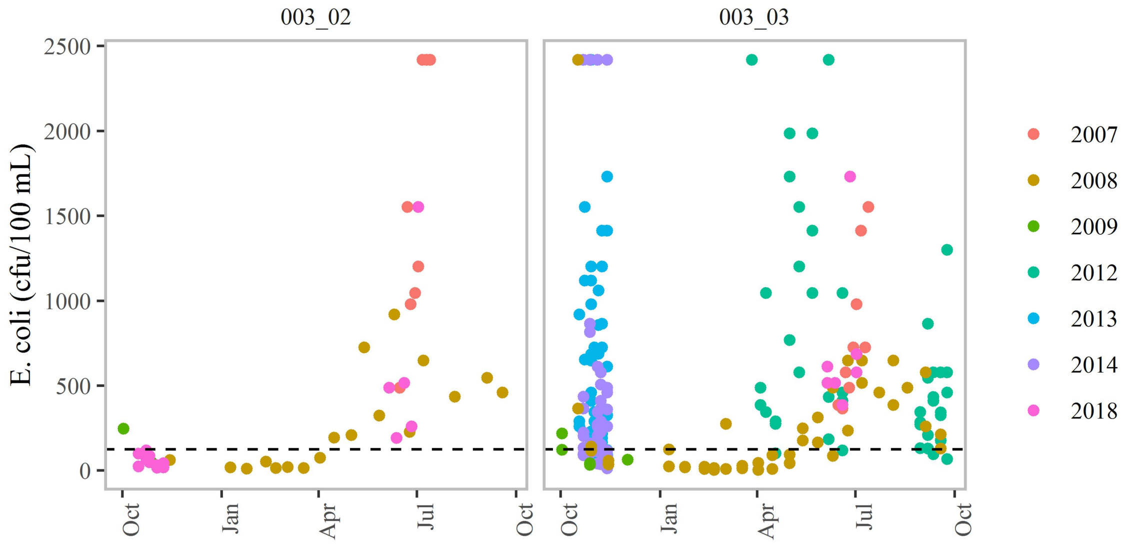

Figure 6. *E. coli* seasonal pattern for individual samples collected by water year (2007-2018) within the main stem AU (003_03) and tributary AU (003_02). The dashed horizontal line is the *E. coli* criterion (126 cfu/100 mL geometric mean).

2.1.7 Reserve

The TMDL did not include a reserve for growth and stated "any new source would need to be assigned a portion of the existing load allocation" (DEQ 2007). In the future, DEQ anticipates some agricultural land will become residential developments, the number of Lewiston Orchards residents connected to the City of Lewiston sewer line will increase, and the City of Lewiston will update and expand its stormwater system. However, considering conservative assumptions associated with the TMDL, DEQ believes it is still reasonable to not include a reserve for growth.

2.2 Nutrients (NO_3+NO_2-N)

DEQ developed a nitrate plus nitrite nitrogen (NO_3+NO_2-N) TMDL to protect cold water aquatic life use, to prevent or reduce algal growths in Lindsay Creek, and to help address nitrate contamination in ground water (DEQ 2007). Idaho's water quality standards designate cold water aquatic life as a use that must be protected in Lindsay Creek (IDAPA 58.01.02.110–160). Elevated nutrient concentrations can cause reduced dissolved oxygen concentrations and other conditions that negatively affect aquatic life. Idaho also has a narrative nutrient water quality criteria stating surface waters "shall be free of excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses" (IDAPA 58.01.02.200.06). Nitrate plus nitrite nitrogen can contribute to nuisance aquatic growths.

DEQ also developed the NO_3+NO_2-N TMDL to "initiate protective ground water quality management actions" (DEQ 2007, p xiv). Nitrate concentrations in the Saddle Mountains aquifer exceed Idaho's ground water quality standard (10 mg N/L) (IDAPA 58.01.11) (Figure 3), and ground water inputs from the Saddle Mountains aquifer likely represent a significant percentage of Lindsay Creek stream flow. NO_3+NO_2-N concentrations in the Saddle Mountains aquifer must be reduced in order to reduce NO_3+NO_2-N concentrations in Lindsay Creek. After the TMDL was completed, DEQ designated the Lindsay Creek Nitrate Priority Area to initiate regular ground water nitrate monitoring and ground water management planning efforts (DEQ 2008; DEQ 2009).

In the Lindsay Creek subbasin assessment, DEQ recognized that both nitrogen and phosphorus concentrations were elevated in Lindsay Creek (DEQ 2007). DEQ did not develop a phosphorus TMDL, but did develop a sediment TMDL (Section 2.3) that may help reduce stream phosphorus concentrations; phosphorus inputs to streams often occur as phosphorus bound to sediment particles.

2.2.1 Pollutant Targets

In the TMDL, DEQ selected a 2 mg N/L NO_3+NO_2-N target concentration (DEQ 2007). The TMDL stated:

> "Considering Lindsay Creek nutrient concentrations can only be as low as the concentrations in ground water that feed it, the target used to develop the total maximum daily load is based on a concentration considered to be normal for Idaho groundwater. Idaho reports that naturally occurring concentrations of nitrate plus nitrate (NO2 + NO3) typically do not exceed 2 mg/L and concentrations exceeding this level are considered to be outside the range of natural conditions (IDWR 1995)" (DEQ 2007, p 49).

The 2 mg/L target has several limitations. First, although the target was intended to represent background, available data suggest it does not represent either background or currently-achievable concentrations. DEQ measured NO_3+NO_2-N concentrations < 2 mg N/L in a headwaters segment of Lindsay Creek near Mann Lake, so concentrations lower than the target can clearly be achieved in Lindsay Creek. At the headwaters (LC6, Figure 2), NO_3+NO_2-N concentrations ranged from below detection to 0.49 mg N/L in 2001-2002 (DEQ 2007) and 0.75-1.7 mg N/L in 2018 (DEQ 2018). Concentrations < 2 mg/L have also been recorded in some wells and springs drawing from the Saddle Mountains aquifer that contribute to Lindsay Creek (Figure 3).

Second, because the target was not developed based on the relationship between nutrient concentrations and algal growth, it is unclear if targets will reduce algal growth. In 2018, NO_3+NO_2-N concentrations were 0.9-9.9 mg N/L at the mouth and up to 14.3 mg N/L at some tributary sites (DEQ 2018). These concentrations are far higher than the target and concentration thresholds typically considered protective against algal growths and aquatic life effects (0.15-1.5 mg N/L) (Evans-White et al. 2013; Tetra Tech 2017). NO_3+NO_2-N concentrations at the mouth vary across years, but concentrations consistently exceed the target (Figure 7).

It is not clear if NO_3+NO_2-N concentrations contribute to aquatic growths or impair cold water aquatic life use in Lindsay Creek. DEQ observed brief localized instances of extensive algal growths in Lindsay Creek in 2018 that may be related to elevated nutrient concentrations.

However, elevated nutrients and algal growths did not lead to reduced water column dissolved oxygen, likely because dissolved oxygen concentrations are relatively high and temperatures are relatively low in ground from the Saddle Mountains aquifer that feeds Lindsay Creek. In 2015, DEQ sampled macroinvertebrates in Lindsay Creek through DEQ's Beneficial Use Reconnaissance Program (BURP). Overall, the Lindsay Creek macroinvertebrate community was similar to that in comparable reference streams. However, taxa that cannot tolerate pollution were not abundant (< 1% intolerant taxa), and taxa that can tolerate pollution were abundant (> 60% pollutant-tolerant taxa), suggesting some effects. Stream algal abundance and community composition are more robust ecological indicators of nutrient effects than invertebrates (EPA 2014), but algal data are not available for Lindsay Creek.

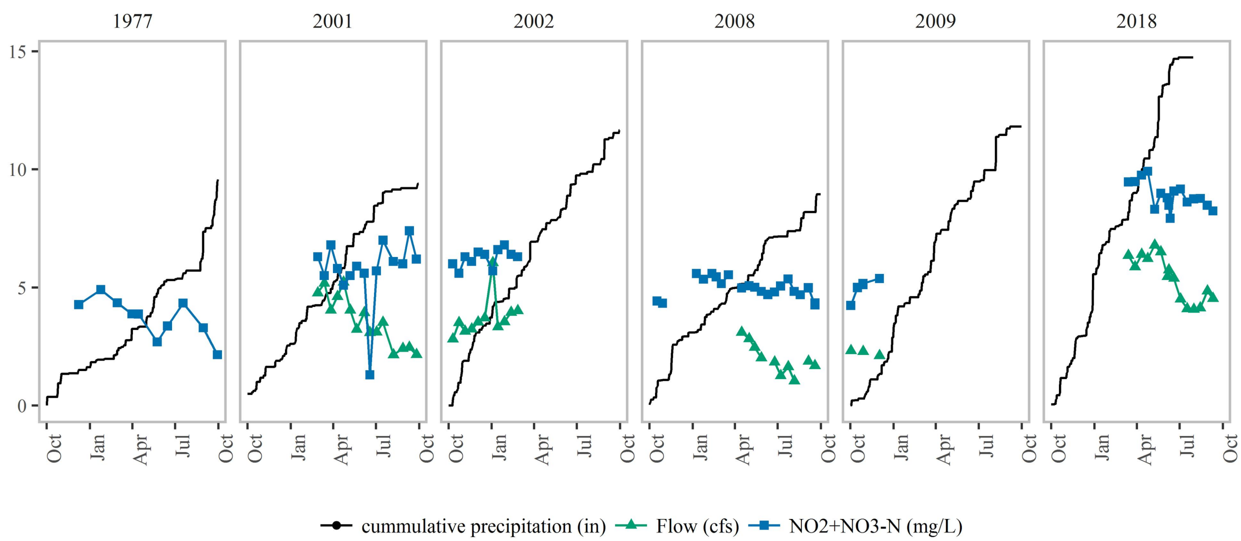

Figure 7. Stream flow and NO_2+NO_3-N concentrations at the Lindsay Creek mouth, and cumulative precipitation recorded at the Lewiston airport by water year.

Nitrogen also may not be the only nutrient that controls algal growth in Lindsay Creek. In freshwater, algal growth is typically limited by availability of nitrogen, phosphorus, or both elements (Elser et al. 2007, Harpole et al. 2011, Dodds and Smith 2016). The ratio of nitrogen to phosphorus in water is often used to predict which element limits algal growth (Dodds and Smith 2016). N:P in Lindsay Creek suggest P limits algal growth because NO_3+NO_2-N concentrations are so high. However, experimental additions of nutrients to streams demonstrate that N:P does not always accurately predict algal responses to nutrient additions or which nutrient limits growth (Keck and Lepori 2012). Many other factors, including light, algal grazing by herbivores, stream flow, and elements other than nitrogen and phosphorus can also affect algal growth. A watershed-specific study would likely be needed to determine if controlling nitrogen alone will protect against nuisance algal growths in Lindsay Creek.

Ideally, the TMDL target should be changed to an ecologically-based nutrient threshold that prevents nuisance algal growths and negative effects on aquatic life. Minimum concentrations observed at the headwaters could be used as the target, but would not be ecologically-based, and therefore may not be protective. An alternative target could be defined as the nutrient concentrations that cause algal biomass to exceed concentrations typically perceived a nuisance by the public (>150 µg chla/L) (Jakus et al. 2017), or threshold nutrient concentrations where the diatom assemblage in Lindsay Creek become substantially different from reference conditions in Idaho (Tetra Tech 2017). DEQ needs to collect additional chemical and ecological data to better characterize ecological effects of nutrients and define a representative threshold for Lindsay Creek.

Until such data are available, DEQ supports efforts to reduce nitrogen inputs to ground water. Reducing nutrient inputs to ground water will reduce nitrate concentrations in the Saddle Mountains aquifer used by some residents as a drinking water source, and will also reduce nitrate concentrations in Lindsay Creek.

2.2.2 Control and Monitoring Points

To develop the nutrient TMDL, DEQ used flow and nutrient data collected by the Idaho Association of Soil Conservation Districts (IASCD) between February 2001 and February 2002 (IASCD 2002). IASCD collected data at six different monitoring locations, including within both AUs. To calculate existing loads, load capacities, and load allocations, DEQ only used data collected near the mouth within AU 03_03. DEQ used this location as a TMDL control point, and recommended using it for long-term monitoring and to assess compliance with water quality standards and support of beneficial uses within the watershed (DEQ 2007, p 59).

Since the TMDL was developed, DEQ measured stream flow and NO_3+NO_2-N concentrations at multiple locations, including at the TMDL control point and at tributaries sites within 03_02. Data collected after the TMDL was developed are summarized below and in several DEQ reports (DEQ 2018, DEQ 2019). For purposes of this TMDL review, DEQ used 2018 flow and NO_3+NO_2-N data from the control point to calculate 2018 existing loads, load capacities, and load allocations to be consistent with the TMDL (Table 3). Existing loads in 2018 for each monitoring site are also plotted in Figure 8.

Considering DEQ must assess and report support of beneficial uses at the assessment unit scale for Idaho’s Integrated Report, DEQ should continue to monitor nutrients both assessment units in the future. DEQ should continue to monitor nutrients at the control point, within tributaries, and at additional locations as needed to help identify and track nutrient sources.

Table 3. Lindsay Creek subbasin NO_3+NO_2-N loads and allocations based on 2018 data collected at the TMDL control point within AU 03_03.

Sample Date	Flow (cfs)	NO_3+NO_2-N (mg/L)	Current Load	Load Capacity	Load Allocation[a]	Load Reduction Required[b]
			(lbs/day)			(%)
3-14-18	6.36	9.47	325	68.6	65.2	79.9
3-28-18	5.87	9.48	300	63.3	60.1	80
4-11-18	6.40	9.76	337	69.0	65.6	80.5
4-24-18	6.23	9.92	333	67.2	63.8	80.8
5-9-18	6.79	8.31	304	73.2	69.5	77.1
5-22-18	6.51	8.99	315	70.2	66.7	78.8
6-5-18	5.46	8.80	259	58.9	56.0	78.4
6-8-18	5.75	8.48	263	62.0	58.9	77.6
6-19-18	5.39	9.08	264	58.1	55.2	79.1
7-3-18	4.51	9.17	223	48.6	46.2	79.3
7-17-18	4.10	8.62	190	44.2	42.0	77.9
7-31-18	4.08	8.75	192	44.0	41.8	78.2
8-14-18	4.13	8.77	195	44.5	42.3	78.3
8-29-18	4.85	8.48	222	52.3	49.7	77.6
9-10-18	4.53	8.24	201	48.8	46.4	76.9

[a]. Load allocation (lbs/day) = load capacity – (load capacity * 5% margin of safety)
[b]. Load reduction required (lbs/day) = current load – load allocation; load reduction required (%) = 1-(load allocation/current load) * 100
Note: pounds (lbs)

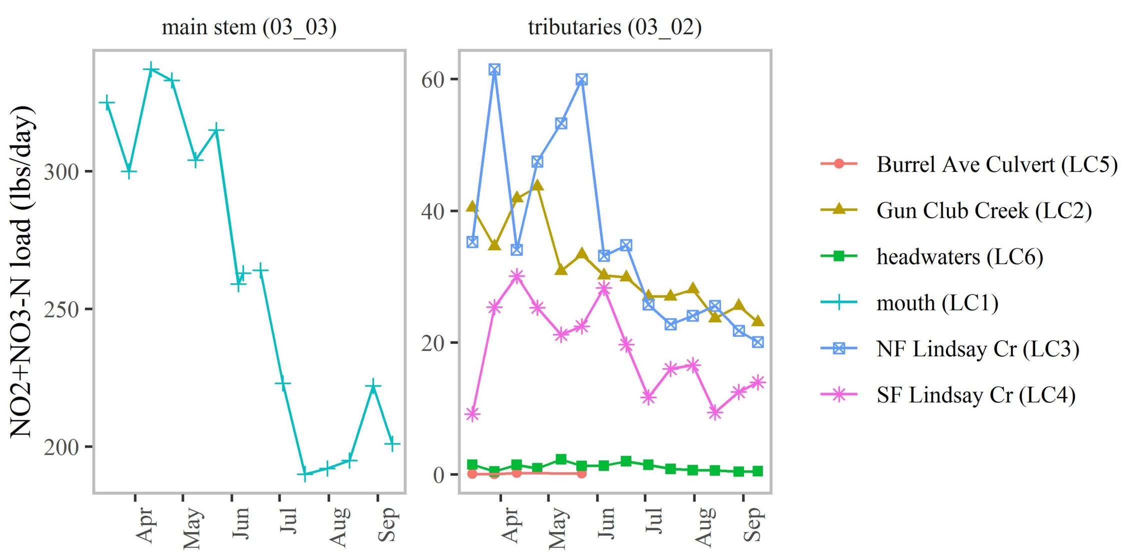

Figure 8. Instantaneous NO_2+NO_3-N loads at stream sites monitored in 2018 (Figure 2).

2.2.3 Load Capacity

In the TMDL, monthly NO_3+NO_2-N load capacities (lbs/month) were calculated by multiplying monthly average flows by the TMDL target concentration and a units conversion factor, using flow data from the TMDL control point. For this review, DEQ applied the same approach to data collected at the TMDL control point in 2018, except used daily flow data and calculated daily rather than monthly load capacities. Daily loads and load capacities (lbs/day) were greater in 2018 than in 2001-2002 because stream flow and NO_3+NO_2-N were greater in 2018 (Figure 7). The load reduction required averaged 78% in 2018, compared to 67% in 2001-2002 (DEQ 2007). Both flow and NO_3+NO_2-N appear to be greater in wetter years, and 2018 was a wetter than average year (Figure 7). The Lewiston airport recorded 15.2 inches of precipitation in water year 2018, compared to an 1981-2010 annual average of 12.3inches (NOAA 2018).

Load capacity calculations use flow data specific to the TMDL control point within the main stem AU (03_03), where flows typically range from 2-7 cfs (Figure 3). In contrast, flows measured in tributary stream segments within AU 03_02 are typically < 1 cfs (DEQ 2018). Load capacities presented here and in the TMDL therefore are specific to the TMDL control point. Based on data collected within the tributaries AU (03_02) (DEQ 2018), separate load capacities could be calculated for each AU. For this review, DEQ chose to only calculate 2018 load capacities at the TMDL control point to be consistent with the TMDL. It is clear that NO_3+NO_2-N concentrations greatly exceed the 2 mg/L target in both AUs and DEQ does not recommend revising the Lindsay Creek TMDL to include AU-specific load capacities unless other aspects of the TMDL (control points, targets, etc.) are also revised.

2.2.4 Load Allocations

A load allocation is the pollutant load allocated to nonpoint sources. In the TMDL, DEQ calculated monthly and daily NO_3+NO_2-N allocations by subtracting a 5% MOS (section 2.2.5) from load capacities. DEQ attributed all nutrient loads to nonpoint sources and did not develop load allocations for specific tributaries or nonpoint source types (e.g., fertilizer, livestock, wildlife, septic systems, etc.). The load allocation represents the combined load from all nonpoint sources. For this review, DEQ calculated 2018 load allocations using the same approach, except only daily load allocations were calculated. 2018 daily load allocations (Table 3) were larger than those in the TMDL (DEQ 2007, Table 19) because stream flows were greater in 2018 than 2001-2002 (Figure 7).

2.2.5 Margin of Safety

A MOS accounts for uncertainties that may affect the protectiveness of the TMDL, and reduces the pollutant load available for allocation to nonpoint and point sources. In the TMDL, DEQ defined an explicit 5% MOS. The MOS was intended to account for uncertainties in the relationship between nutrient concentrations and relevant ecological responses (i.e., aquatic plant growth cycles, biochemical oxygen demand, and dissolved oxygen) (DEQ 2007). Considering it is not clear if the NO_3+NO_2-N target is protective of nuisance aquatic growths or cold water aquatic life, it also is not clear if the 5% MOS is adequate. If nutrient targets are re-evaluated in the future, the MOS should be re-evaluated at the same time.

2.2.6 Seasonal Variation

At the TMDL control point, stream flow and NO_3+NO_2-N concentrations do not show large magnitude seasonal variation (Figure 7). Stream flow and NO_3+NO_2-N are greatest in March-April, but do not show large spring peaks typical of streams where flow is dominated by surface run-off. Year-round ground water inputs and summer and fall irrigation inputs likely reduce seasonal stream flow variation. NO_3+NO_2-N seasonal variation is also relatively small. Nearby watersheds such as Hatwai, Webb, and Tom Beall Creek, typically have larger simultaneous spring flow and NO_3+NO_2-N peaks. In contrast, seasonal variation in Lindsay Creek is relatively small, likely due to elevated NO_3+NO_2-N concentrations in ground water and significant year-round ground water contributions to stream flow.

Inter-annual variation in stream flow and NO_3+NO_2-N is substantial, and appears related to winter precipitation amount. Stream flow and NO_3+NO_2-N at the Lindsay Creek mouth were greater in wetter years among years where data were available (Figure 7). Precipitation effects may need to be considered when comparing NO_3+NO_2-N concentrations across years or evaluating concentration or loading trends. Nitrate patterns in Lindsay Creek surface water and ground water are described in detail in a separate report, *Ground Water and Surface Water Nitrate Patterns in the Lewiston Basin* (DEQ 2019b).

2.2.7 Reserve

The TMDL did not include a reserve for growth and stated "any new sources will need to obtain an allocation from the existing load allocation" (DEQ 2007, p51). Within the Lindsay Creek watershed, future development is likely to occur both within the City of Lewiston boundaries and in Nez Perce County. New development in the eastern Lewiston Orchards and Nez Perce County may include installation of new septic systems. DEQ has identified septic systems as one source of nonpoint source nitrate contamination in Lindsay Creek (DEQ 2019a). Estimates of current loading from non-point sources, including septic systems, may need to be updated to better reflect the load reductions needed to meet the TMDL.

2.3 Sediment

DEQ developed a sediment TMDL to protect cold water aquatic life use in Lindsay Creek. Idaho's water quality standards designate cold water aquatic life as a beneficial use that must be protected in Lindsay Creek (IDAPA 58.01.02.110–160). Salmonid spawning is not an existing use that must be protected because a tunnel drain in the Clearwater Levee at the mouth of Lindsay Creek prevents salmonids from entering Lindsay Creek from the Clearwater River. Idaho has a narrative sediment criterion that states sediment shall not exceed "quantities which impair designated beneficial uses" (IDAPA 58.01.02.200.08). DEQ selected water column total suspended solids (TSS) as the sediment measure in the TMDL because TSS data were available from IASCD 2001-2002 sampling (IASCD 2002). DEQ identified attributed sediment loads to nonpoint sources and to the City of Lewiston's stormwater system.

2.3.1 Pollutant Targets

DEQ selected TSS targets based on *Guide to Selection of Idaho Sediment Targets for Use in Idaho TMDLs* (DEQ 2003). DEQ selected two targets: 50 mg/L monthly average and an 80 mg/L daily maximum (DEQ 2007). The TMDL stated targets were "designed to maintain moderate protection of existing fish populations and restore habitat conditions in the Lindsay Creek watershed" (DEQ 2007, p 51-52).

Two targets were developed because the ecological effects of sediment to aquatic life depend on both concentration and duration of exposure. Based on a literature review, the *Guide to Selection* *of Idaho Sediment Targets for Use in Idaho TMDLs* concluded there is some evidence for negative effects on biota at concentrations as low as 25 mg/L, and strong evidence that long-term exposures > 80 mg/L have negative impacts on fish communities (DEQ 2003). The 80 mg/L daily maximum was selected as a target to protect aquatic life during short-term exposures, and the 50 mg/L monthly average was selected to protect against long-term exposures. DEQ believes these thresholds are still appropriate and will provide reasonable protection for aquatic biota in Lindsay Creek.

2.3.2 Control and Monitoring Points

In the TMDL, DEQ used flow and TSS data collected by the Idaho Association of Soil Conservation Districts (IASCD) between February 2001 and February 2002 (IASCD 2002). IASCD collected data at six different monitoring locations, including within both assessment units. To calculate existing loads, load capacities, and load allocations, DEQ only used data collected near the mouth within AU 03_03. DEQ used this location as a TMDL control point, and recommended using it for long-term monitoring and to assess compliance with water quality standards and support of beneficial uses within the watershed (DEQ 2007, p 59).

In 2018, DEQ measured stream flow and TSS concentrations at multiple locations, including at the TMDL control point and at tributary sites within AU 03_02. Data collected in 2018 are described in detail in a separate report (DEQ 2018) and below in Figure 9 and Figure 10. For purposes of this TMDL review, DEQ used 2018 flow and TSS data from the TMDL control point to calculate 2018 existing loads, load capacities, and load allocations (Table 4). In May 2018, TSS concentrations exceeded both the monthly and daily targets at the TMDL control point (Table 4). Existing loads in 2018 for each monitoring site are also plotted in Figure 9.

Considering DEQ must assess and report support of beneficial uses at the assessment unit scale for Idaho's Integrated Report, DEQ should continue to monitor TSS in both AUs. DEQ should continue to monitor TSS at the control point, within AU 03_02, and at additional locations as needed to help identify and track sediment sources.

2.3.3 Load Capacity

In the TMDL, daily TSS load capacities (lbs/day) were calculated by multiplying flow values by the 80 mg/L TSS target and a units conversion factor, using data from the TMDL control point (mouth). For this review, DEQ applied the same approach to data collected at the TMDL control point in 2018 (Table 4). Load capacities were greater in 2018 than in 2001-2002 because stream flow was greater in 2018 (Figure 7).

Load capacity calculations use flow data specific to the TMDL control point within AU 03_03, where flows typically range from 2-7 cfs (Figure 7). In contrast, flows measured in tributary stream segments within AU 03_02 are typically < 1 cfs (DEQ 2018). Load capacities presented here and in the TMDL therefore are specific to the TMDL control point. Based on data collected in 2018 (DEQ 2018), separate load capacities could be calculated for each AU. For this review, DEQ chose to only calculate 2018 load capacities at the TMDL control point to be consistent with the TMDL. DEQ does not recommend revising the Lindsay Creek TMDL to include AU-specific load capacities unless other aspects of the TMDL (control points, targets, etc.) are also revised.

Table 4. Lindsay Creek TSS loads and allocations based on 2018 data collected at the TMDL control point within AU 03_03.

Sample Date	Flow (cfs)	TSS (mg/L)	Current Load	Load Capacity	MOS	Load Capacity Available to Allocate	WLA	LA	Load Reduction Required[b]
			(lbs/day)						(%)
3-28-18	5.87	36.2	1150	2530	253	2095	62.8	2032	0
4-11-18	6.40	58.9	2030	2760	276	2285	68.5	2216	0
4-24-18	6.23	35.6	1200	2690	269	2227	68.8	2160	0
5-9-18	6.79	79.0	2890	2930	293	2426	72.8	2353	16
5-22-18	6.51	82.3	2890	2810	281	2327	69.8	2257	19
6-5-18	5.46	71.3	2100	2350	235	1946	58.4	1187	7
6-19-18	5.39	43.4	1260	2320	232	1921	57.6	1863	0
7-3-18	4.51	38.1	926	1940	194	1606	48.2	1558	0
7-17-18	4.10	44.9	992	1770	177	1466	44.0	1422	0
7-31-18	4.08	38.8	853	1760	176	1457	43.7	1413	0
8-14-18	4.13	28.5	634	1780	178	1474	44.2	1430	0
8-29-18	4.85	29.5	771	2090	209	1731	52.0	1679	0
9-10-18	4.53	27.5	671	1950	195	1614	48	1566	0

Current load = flow x TSS * 5.39; Load capacity = flow x 80 mg/L; MOS (lbs/day) = load capacity x 0.1; Available load = (Load capacity – MOS) – ((Load capacity – MOS) * reserve for growth), where reserve = 0.08; Waste Load Allocation (WLA) = available load * 0.03, Load Allocation (LA) = Available load – WLA.

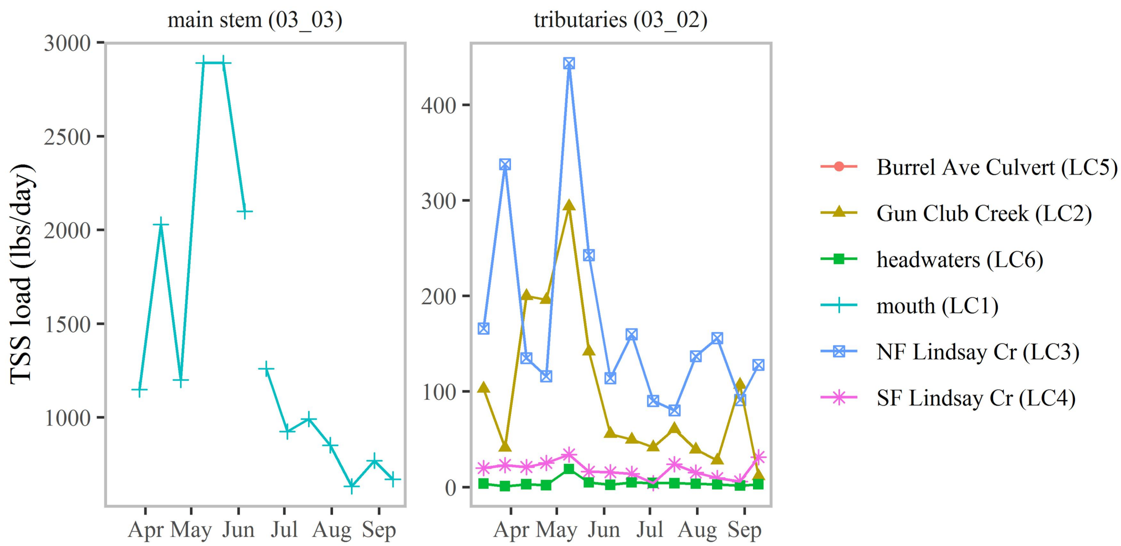

Figure 9. Instantaneous TSS loads at stream sites monitored in 2018 (Figure 2).

2.3.4 Margin of Safety

A MOS accounts for uncertainties that may affect the protectiveness of the TMDL, and reduces the pollutant load available for allocation to nonpoint and point sources. In the TMDL, DEQ defined an explicit 10% MOS. The MOS was intended to account for uncertainties in the relationship between TSS concentrations and effects on aquatic biota. DEQ believes the 10% MOS is still reasonable.

2.3.5 Reserve

A reserve for growth is intended to account for additional pollutant inputs associated with future development. Including a reserve for growth in a TMDL decreases the load allocation (nonpoint sources) or wasteload allocation (point sources). The sediment TMDL included an 8% reserve for growth to account for development anticipated to occur between Lindsay Creek and the Lewiston Orchards. The 8% reserve was estimated based on the City of Lewiston's 2001 Stormwater Master Plan (City of Lewiston 2001). Based on the plan, DEQ estimated the percent of land area where a stormwater drainage system was anticipated to be added in the future as 8% (DEQ 2007). DEQ used the 8% reserve for growth to calculated the load available for allocation (section 2.3.6).

In 2019, the City of Lewiston estimated 20.86% of watershed land area is served by the City of Lewiston stormwater system, and 37.49% of watershed land area may potentially be served by the stormwater system in the future (Joe Kaufman, City of Lewiston, personal communication 3-12-2019). These estimates are based on the percent of watershed area within City of Lewiston boundaries (20.86%) and percent of watershed area within City of Lewiston boundaries and the Area of City Impact (areas that may be annexed into the city in the future) (37.49%). The difference between these two values (16.63%) represents the percent of watershed area where stormwater systems may evolve in the future, and is greater than the 8% reserve used in the TMDL.

DEQ does not recommend revising the sediment TMDL at this time because TMDL targets are nearly met and continuing monitoring and implementation efforts would be a more productive use of limited DEQ resources. In 2018, sediment concentrations exceeded targets in spring, but otherwise targets were achieved (Table 4). DEQ believes the City of Lewiston, Nez Perce County, land owners and other stakeholders can take actions that would reduce sediment loads and cause sediment targets to be achieved in the near future. Multiple resources are available to guide sediment reduction efforts, such as a road inventory and assessment that identified potential sediment sources such as unstable road banks and plugged culverts (NPSWCD 2016) and guidance for agricultural best management practices (NPSWCD 2008). DEQ will help coordinate and promote sediment reduction efforts, and continue monitoring stream TSS at the TMDL control point to assess progress towards achieving targets. DEQ will consider revising the reserve for growth if subsequent implementation and monitoring do not yield TSS reductions.

2.3.6 Load Available for Allocation

DEQ calculated the load available for allocation to point and nonpoint sources by subtracting a 10% margin of safety and 8% reserve for growth (section 2.3.8) from the load capacity (Table 4).

2.3.7 Waste Load Allocation

A waste load allocation is a pollutant load allocated to a point source. In the TMDL, DEQ developed a sediment waste load allocation for stormwater inputs to Lindsay Creek from the City of Lewiston's municipal separate storm sewer system (MS4). Stormwater is the surface runoff that results from rain and snowmelt (EPA 2018). A MS4 includes any publically-owned conveyance or system of conveyances used for conveying stormwater that is not a combined sewer or part of publically owned water treatment works (EPA 2018). MS4s may include roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains (EPA 2018).

In the TMDL, DEQ calculated the stormwater waste load allocation based on information from the City of Lewiston's 2001 Stormwater Master Plan (City of Lewiston 2001). Based on the plan, DEQ estimated 11.4% of watershed area drained into the City of Lewiston stormwater system, but only 3% the percent of watershed land area had a significant City stormwater drainage system (DEQ 2007, p 56-57). Therefore, DEQ calculated the waste load allocation as 3% of the sediment load available for allocation (section 2.3.6). In Table 4, the 2018 stormwater waste loads were calculated using 2018 flow and TSS data collected at the TMDL control point and a 3% waste load allocation to be consistent with the TMDL.

In 2019, the City of Lewiston estimated 20.86% of watershed land area is served by the City of Lewiston stormwater system (Joe Kaufman, City of Lewiston, personal communication 3-12-2019). This estimate is based on the percentage of Lindsay Creek watershed area within City of Lewiston boundaries. In contrast to the 3% estimate in the TMDL, the 20.86% estimate assumes all City of Lewiston land area within the watershed contributes to stormwater discharges rather than just areas with a 'significant' City stormwater drainage system.

DEQ does not recommend revising the stormwater waste load allocation at this time for several reasons. First, DEQ has not monitored TSS discharges from City of Lewiston stormwater conveyances and therefore does not have data necessary to calculate estimate existing or future sediment loads from stormawater. DEQ anticipates City of Lewiston stormwater discharges will occur under an EPA National Pollution Discharge Elimination System (NPDES) permit beginning sometime in 2019 (see section 2.3.8). Conditions of this permit will require stormwater discharge monitoring that may help DEQ quantify sediment loads from stormwater more accurately in the future.

Second, in 2018 sediment concentrations exceeded targets in spring, but otherwise targets were achieved (Table 4). DEQ believes the City of Lewiston, Nez Perce County, land owners and other stakeholders can take actions that would reduce sediment loads and cause sediment targets to be achieved in the near future. Multiple resources are available to guide sediment reduction efforts, such as a road inventory and assessment that identified potential sediment sources such as unstable road banks and plugged culverts (NPSWCD 2016) and guidance for agricultural best management practices (NPSWCD 2008). DEQ will help coordinate and promote sediment reduction efforts, and continue monitoring stream TSS at the TMDL control point to assess progress towards achieving targets.

2.3.8 MS4 Stormwater Permit

Pollutant discharges from MS4 systems typically require a discharge permit. Currently, MS4 permits in Idaho are issued by EPA under the National Pollution Discharge Elimination System (NPDES). When the TMDL was developed, EPA had not yet issued a MS4 permit for City of Lewiston MS4 discharges, but anticipated doing so in the future. In 2018, EPA issued a draft

NPDES MS4 permit for the City of Lewiston and Lewis Clark State College, and opened the permit for public comment through March 22, 2019 (EPA 2018). The permit likely will go into effect in 2019. Permits are typically effective for 5 years, and are reviewed, revised as needed, and re-issued every 5 years. The draft permit requires the City of Lewiston to develop a stormwater monitoring/assessment plan, and undertake activities to reduce pollutant discharges from stormwater into Lindsay Creek, among other requirements (EPA 2018).

On June 5, 2018, EPA approved Idaho's application to administer and enforce pollutant discharge permitting under the Idaho Pollutant Discharge Elimination System (IPDES) (DEQ 2018). Therefore, on July 1, 2021, DEQ will take over permitting authority for MS4 systems from EPA. After that point, DEQ rather than EPA will oversee City of Lewiston permit requirements, and the City of Lewiston will submit documentation required by the permit to DEQ.

2.3.9 Load Allocation

A load allocation is the pollutant load allocated to nonpoint sources. In the TMDL, DEQ calculated the load allocation by subtracting the waste load allocation from the load available for allocation (Section 2.3.6). The TMDL did not develop load allocations for specific tributaries or nonpoint source types. The load allocation represents the combined load from all nonpoint sources. Approximately 79% of the load available for allocation was allocated to nonpoint sources (DEQ 2007). Table 4 shows load allocations calculated based on 2018 flow data from the TMDL control point. Load allocations calculated in 2018 are greater than those in the TMDL because flows were greater in 2018 (Figure 7).

2.3.10 Seasonal Variation

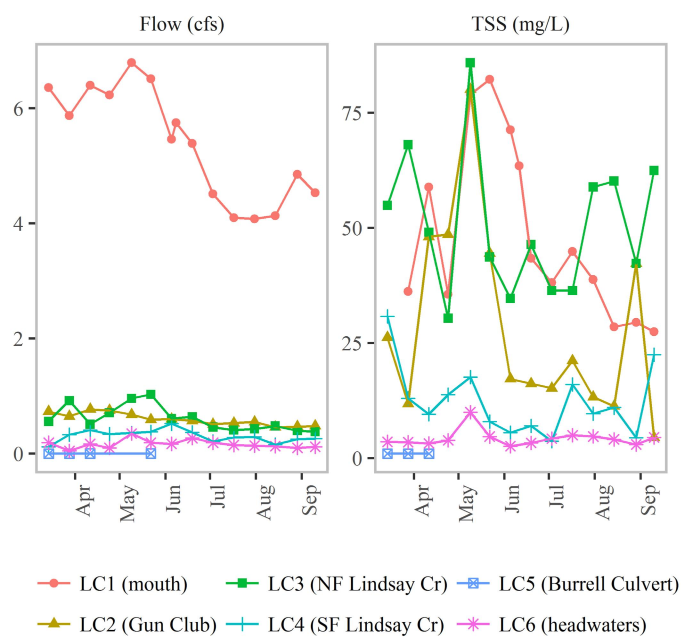

Figure 10. Lindsay Creek 2018 stream flow and TSS patterns.

In 2018, TSS concentrations were greatest during high flows in late spring (May-June) (Figure 10). In 2001-2002, TSS peaked in late spring and in January and February during precipitation events (DEQ 2007). The TMDL applied TSS targets year-round, which is protective.

2.4 Changes to Subbasin Characteristics

Since the TMDL was finalized 2007, additional residential development has occurred in the Lewiston Orchards area within the City of Lewiston, and in county subdivisions along NF Lindsay Creek (Figure 11). This development has increased the number of septic systems in the watershed. DEQ mapped the number of watershed parcels with a septic system, and number of parcels on septic where a septic was likely installed after data used to develop the TMDL were collected (2001-2002) based on Nez Perce County GIS records (Figure 11). As of 2018, ~800 parcels (~15%) in the watershed had a septic system. 232 parcels in the watershed had new construction after 2002 and also had a septic system according to county records; DEQ therefore estimates approximately 232 new septic systems (~4% of parcels) have been installed since 2002. However, in 2018, the City of Lewiston installed a sewer trunk line into the eastern Lewiston Orchards, and approximately 60 residences have hooked up to the sewer line, reducing the number of parcels with septic discharges. DEQ identified septic systems as one source of nitrate contamination in ground water and surface water, but the relative (percent) contribution of septic systems is not clear (DEQ 2019).

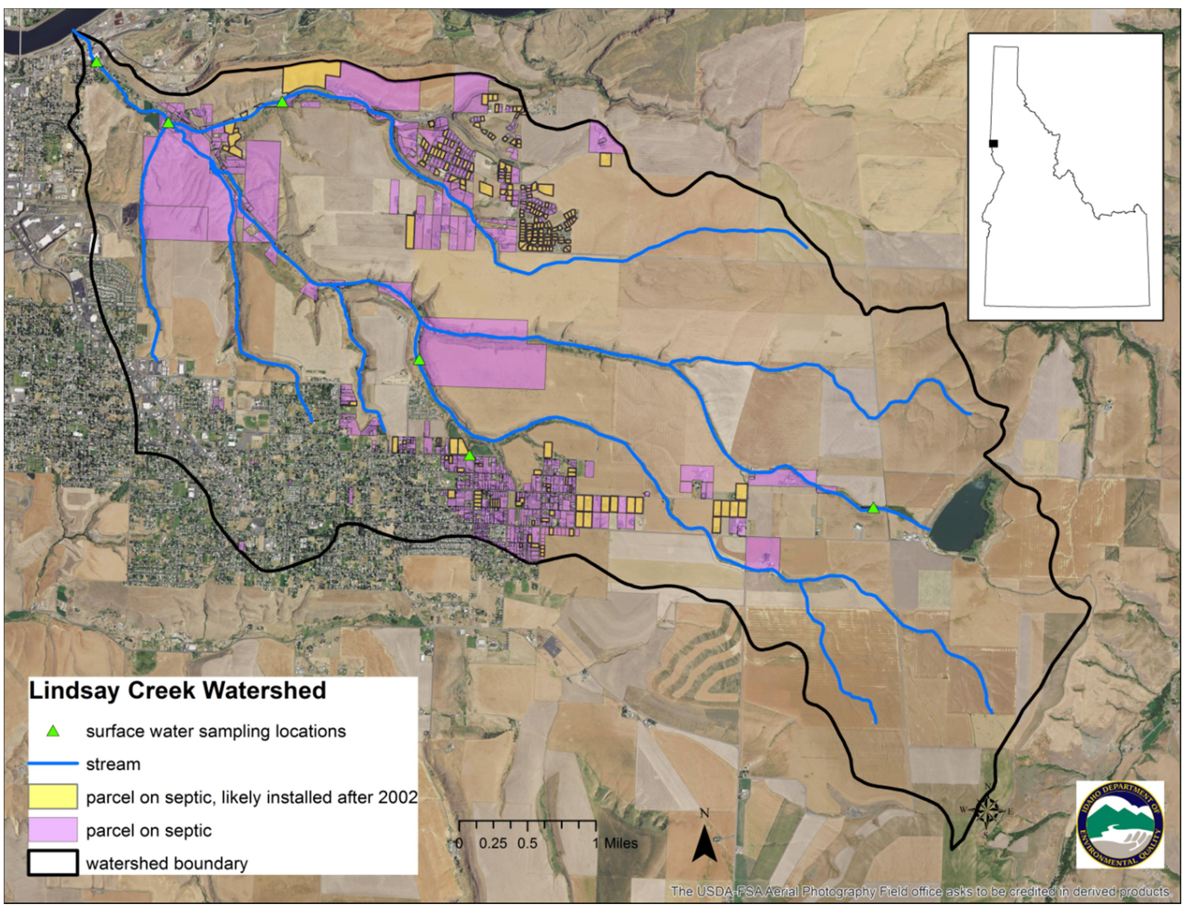

Figure 11. Parcels with a septic system, and parcels where a septic was likely installed after data used to develop the TMDL were collected (2001-2002).

In the TMDL, DEQ estimated approximately 72% of watershed area was used for non-irrigated agriculture. Based on 2018 USDA CropScape data that percentage has not changed significantly (Figure 4).

In 2018, Nez Perce Drive was extended to connect with Gun Club Road near the top of Gun Club Creek (Figure 2) to open up additional land to commercial development. During construction for this project, construction crews identified a failed culvert that runs under Gun Club Road and feeds Gun Club Creek (Lewiston Tribune, 2018). The culvert was replaced in July 2018, and may help reduce sediment loads in Gun Club Creek.

The Lewiston Orchards Irrigation District (LOID) is transitioning from using surface water to using ground water from as its irrigation water source. LOID is constructing multiple ground water wells that will replace surface water diversions currently used to supply the LOID service area. One well has been constructed and additional wells are scheduled for construction over the next several years. The wells will be completed in the deep Grande Ronde aquifer. This means water that enters Lindsay Creek or the shallow Saddle Mountains aquifer through irrigation activities in the LOID service area will derive from the deep Grande Ronde aquifer rather than from surface water in the future.

3 Beneficial Use Status

IDAPA 58.01.02 lists beneficial uses and sets water quality goals for waters of the state. IDAPA 58.01.02.050.02 requires that surface waters of the state be protected for beneficial uses, wherever attainable. These beneficial uses are interpreted as existing uses, designated uses, and presumed uses and are described in more detail at *www.deq.idaho.gov/water-quality/surface-water/beneficial-uses*. The *Water Body Assessment Guidance* (DEQ 2016) 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

3.1 Beneficial Uses

Beneficial uses addressed by the Lindsay Creek TMDLs are provided in Table 5. Idaho water quality standards designate cold water aquatic life and secondary contact recreation as beneficial uses that must be protected in Lindsay Creek (IDAPA 58.01.02.110–160). Waters protected for cold water aquatic life use are expected to maintain a viable aquatic community for cold water species. Waters protected for secondary contact recreation are expected to allow for recreation activities, such as wading and fishing where immersion and ingestion are unlikely.

Idaho water quality standards define a set of water quality criteria to protect beneficial uses, and include *numeric* criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity (Appendix A), and *narrative* criteria for pollutants such as sediment and nutrients (IDAPA 58.01.02.250–251).

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

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

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)"

Table 5. Beneficial uses of water bodies addressed by this 5-year review.

Assessment Unit Name	Assessment Unit Number	Beneficial Uses	Type of Use
Lindsay Creek—1st and 2nd order tributaries	ID17060306CL003_02	Cold water aquatic life	Designated
		Secondary contact recreation	Designated
Lindsay Creek—3rd order	ID17060306CL003_03	Cold water aquatic life	Designated
		Secondary contact recreation	Designated

3.2 Summary and Analysis of Current Water Quality Data

DEQ and the Nez Perce Soil & Water Conservation District (NPSWCD) have collected water quality data in Lindsay Creek since the TMDL was approved in 2007. Table 6 lists data collected since the TMDL was approved in 2007. Methods and results for collected data are described in detail in several reports:

- Lindsay Creek Stream Temperature Summary Report 2000-2010 (NPSWCD 2013). *http://www.nezperceswcd.org/Portals/2/DynamicDocs/Publications/Lindsay%20Creek%20Stream%20Temperature%20Data%20Summary%20-%202000-2010.pdf*

- Monitoring Surface Water for *Escherichia Coli* in the Lindsay Creek Watershed (DEQ 2016). *http://www.deq.idaho.gov/media/60178350/monitoring-surface-water-for-ecoli-lindsay-creek-watershed.pdf*

- Lindsay Creek Monitoring Data Summary: for years 2013-2015 (NPSWCD 2016). *http://www.nezperceswcd.org/Portals/2/DynamicDocs/Publications//Lindsay%20Creek%20Monitoring%20Data%20Summary%202013-2015.pdf*

- Lewiston Orchards Surface Water Monitoring Report (DEQ 2017). *http://www.deq.idaho.gov/media/60180509/lewiston-orchards-sw-report-0817.pdf*

- Lindsay Creek Surface Water Quality Monitoring Report: 2018 (DEQ 2018). *http://www.deq.idaho.gov/media/60182476/lindsay-creek-surface-water-quality-monitoring-report-2018.pdf*

- Evaluation of Septic Effluent Presence and Spatial Distribution in the Lindsay Creek Watershed (DEQ 2019). *http://www.deq.idaho.gov/media/60182525/evaluation-septic-effluent-presence-spatial-distribution-lindsay-creek-watershed.pdf*

- Ground Water and Surface Water Nitrate Patterns in the Lewiston Basin 1976-2018 (DEQ 2019). *http://www.deq.idaho.gov/media/60182780/ground-water-surface-water-nitrate-patterns-lewiston-basin-1976-2018.pdf*

Table 7 summarizes data DEQ collected in 2018 for this TMDL review. TMDL targets for NO_3+NO_2-N, *E. coli,* and TSS were exceeded. Idaho water quality criteria for water column dissolved oxygen and stream temperature were not exceeded.

Table 6. Data collected since the Lindsay Creek TMDL was approved in 2007.

Data Type	Agency	1st and 2nd order (ID17060306CL003_02)	3rd order (ID17060306CL003_03)
Beneficial Use Reconnaissance Program (BURP)	DEQ	—	2015, 2018
Instantaneous stream flow	DEQ	2007-2008, 2018	2007-2008, 2018
Continuous water level, temperature, conductivity	NPSWCD		2013-present
NO_3+NO_2-N	DEQ	2007-2008, 2018	2007-2008, 2018
TP	DEQ	2018	2018
Total suspended solids (TSS)	DEQ	2018	2018
E. coli	DEQ	2007-2008, 2017, 2018	2007-2008, 2012, 2013, 2018
E. coli DNA (source tracking)	DEQ	—	2013
Temperature logger data	DEQ	2018	2018
	NPSWCD	—	2013-present
Water column dissolved oxygen	DEQ	2018	2018
June 8–11, 2018, storm event monitoring with field sensors (water level, NO_3-N, dissolved oxygen, temperature, conductivity)	DEQ	—	2018
Turbidity	NPSWCD	—	2011–13
	DEQ	2018	2018
TSS-turbidity regression	DEQ		2018
Septic effluent indicators (artificial sweeteners, caffeine)	DEQ	2018	2018

Table 7. Summary of 2018 DEQ monitoring (DEQ 2018).

Parameter	Threshold	Threshold Source	Result	
			3rd order ID17060306CL003_03	1st and 2nd order ID17060306CL003_02
NO_3+NO_2-N	2 mg/L	Lindsay Creek TMDL target (DEQ 2010)	7.9–9.9 mg/L threshold exceeded	0.75–14.3 mg/L threshold exceeded
TP	0.013 mg/L	Tetra Tech (2017)	0.09–0.2 mg/L threshold exceeded	0.017–0.38 mg/L threshold exceeded
E. coli	126 mpn/100 mL geometric mean	Lindsay Creek TMDL target (DEQ 2010), IDAPA 58.01.02.251.01	658 mpn/100 mL threshold exceeded	456 mpn/100 mL threshold exceeded
TSS	80 mg/L maximum	Lindsay Creek TMDL target (DEQ 2010)	27.5–82.3 mg/L threshold exceeded	1.0–85.9 mg/L threshold exceeded
TSS	50 mg/L monthly average	Lindsay Creek TMDL target (DEQ 2010)	27.5–80.7 mg/L threshold exceeded	1–64.8 mg/L threshold exceeded
DO	6 mg/L (minimum)	IDAPA 58.01.02.250.02a	9.3–10.4 mg/L not exceeded	8.5–9.4 mg/L not exceeded
Temperature	19°C daily average	IDAPA 58.01.02.250.02b	8.0–17.4°C not exceeded	8.7–18°C not exceeded
	22°C daily maximum	IDAPA 58.01.02.250.02b	9.6–19°C not exceeded	9.5–20.8°C not exceeded

3.3 Assessment Unit Summary

This section includes AU support status recommendations for the next Integrated Report. All AUs evaluated are summarized in Table 8. Section 3.3.1 provides more detailed information.

Table 8. Summary of recommended changes for AUs and pollutants evaluated.

Assessment Unit Name	Assessment Unit Number	Pollutant	Recommended Changes to Next Integrated Report	Justification
Lindsay Creek—1st and 2nd order tributaries	ID17060306CL003_02	NO_3+NO_2-N	Retain in Category 4a	Target exceeded
		TSS	Retain in Category 4a	Target exceeded
		E. coli	Retain in Category 4a	Target exceeded
Lindsay Creek—3rd order	ID17060306CL003_03	NO_3+NO_2-N	Retain in Category 4a	Target exceeded
		TSS	Retain in Category 4a	Target exceeded
		E. coli	Retain in Category 4a	Target exceeded

3.4 Beneficial Use Recommendations

In ID17060306CL003_02, secondary contact recreation use remains impaired because *E. coli* concentrations exceed TMDL targets. Cold water aquatic life use remains impaired because NO_3+NO_2-N and TSS concentrations exceed TMDL targets at the TMDL control point. Recent BURP data are not available within this AU.

In ID17060306CL003_03, secondary contact recreation use remains impaired because *E. coli* concentrations exceed TMDL targets. Cold water aquatic life use also remains impaired because NO_3+NO_2-N and TSS concentrations exceed TMDL targets at the TMDL control point. BURP data from 2015 had a passing score, suggesting cold water aquatic life use is supported. However, macroinvertebrate taxa that cannot tolerate pollution were not abundant (< 1% intolerant taxa), and taxa that can tolerate pollution were abundant (> 60% pollutant-tolerant taxa), suggesting some water quality effects. Stream algal abundance and community composition are more robust ecological indicators of nutrient effects than invertebrates (EPA 2014), but algal data are not available for Lindsay Creek. Support of cold water aquatic life use should be re-assessed again after 2018 BURP data are available.

4 Review of Implementation Plan and Activities

After the Lindsay Creek TMDL was finalized, DEQ and the Lindsay Creek WAG worked with designated management agencies identified in Idaho Code and other stakeholders to identify strategies for achieving water quality goals established in the TMDL. Section 4.1 identifies responsible parties, including designated management agencies as defined by Idaho Code and other stakeholders. Section 4.2 summarizes planned implementation activities and their status.

4.1 Responsible Parties

Idaho Code §39-3612 states "Total maximum daily load processes shall be used by all designated agencies for achieving water quality standards." Idaho Code §39-3602(9) identifies designated management agencies, and their responsibilities (Table 9). DEQ relies on designated management agencies to implement pollution control measures or BMPs for pollutant sources identified as a priority.

Table 9. Designated management agencies and their responsibilities, per Idaho Code §39-3602(9).

Designated Management Agency	Responsibility
Idaho Soil and Water Conservation Commission	Grazing and agriculture activities
Idaho State Department of Agriculture	Aquaculture
Idaho Transportation Department	Public roads
Idaho Department of Lands	Timber harvest, oil and gas exploration, mining
Idaho Department of Environmental Quality	All other activities

Additional stakeholders in the Lindsay Creek watershed include the City of Lewiston, Nez Perce County, the Nez Perce Soil & Water Conservation District (NPSWCD), Public Health – Idaho North Central District (PH-INCD), and private land owners. NPSWCD provides technical assistance and funding to help growers identify and implement agricultural best management practices. The City of Lewiston, Nez Perce County, PH-INCD, and DEQ all play a role in management of septic systems. The City of Lewiston manages land use planning, roads, and the stormwater system within City of Lewiston boundaries. Nez Perce County manages land use planning and roads within Nez Perce County areas of the watershed.

4.2 Activities Planned and Implemented

After the TMDL was finalized, two implementation plan documents were developed. The Nez Perce Soil and Water Conservation District (NPSWCD) developed the *Lindsay Creek Watershed Total Maximum Daily Load Implementation Plan for Agriculture* (NPSWCD 2008). This plan identified agricultural best management practices (BMPs) for cropland and riparian zones and recommended priorities for BMP implementation. The plan also identified several specific projects NPSWCD planned to complete. Table 10 lists specific actions planned in the *Lindsay Creek Watershed Total Maximum Daily Load Implementation Plan for Agriculture* and the status of each planned action.

In addition, DEQ and the Lindsay Creek WAG developed a draft *Lindsay Creek Nitrate Priority Area Ground Water Management Plan* (DEQ 2009) that was never finalized. The plan recommended public education about nitrate health risks and sources, and voluntary implementation of agricultural and residential best management practices to reduce nitrate inputs to ground water (DEQ 2009). Table 11 lists specific actions planned in the draft *Lindsay Creek Nitrate Priority Area Ground Water Management Plan* and the status of each planned action.

Table 10. Status of activities recommended in the Lindsay Creek TMDL Implementation Plan for Agriculture.

Task	Status	Entity Responsible	Funding Source	Description
Stream Assessment	Completed	NPSWCD	319 grant	Streams were inventoried, evaluated for 14 health parameters, and categorized as 'excellent', 'good', 'fair' or 'poor' based on a standardized visual assessment protocol. A KMZ map of results was generated.
Road Inventory	Completed	NPSWCD	319 grant	Roads were inventoried and evaluated for potential sediment sources using the Nez Perce County Road Erosion Protocol. The project included a culvert sediment risk assessment, inventory of fish passage barriers, evaluation of road sediment runoff potential, inventory of road drainage obstructions, and development of treatment priorities and an implementation strategy.
Urban Fertilizer and Irrigation Survey	Partially completed	NPSWCD		The implementation plan stated "An urban fertilizer and irrigation survey will be completed in key areas that may be contributing nutrients to groundwater sources…The survey's goal is to identify current practices and select four sites to complete an intensive irrigation and fertilizer management plan". NPSWCD, Idaho North Central Public Health, and University of Idaho Extension began a collaborative effort that was not completed due to lack of funding.
Cropland Treatments to Reduce Sediment	Completed	NPSWCD	319 grant	Direct seeding treatments applied to 1,721 acres to reduce sheet/rill erosion, with an estimated average per acre soil loss reduction of 2 tons/acre.
Streambank Treatments to Reduce Sediment	Completed	NPSWCD	319 grant	1,200 ft of streambanks were protected through installation of bioengineering measures including post plantings and brush mattress. Over 18 acres of trees and shrubs were planted along 1.25 miles of stream.
Nutrient treatments	Completed	NPSWCD	319 grant	198 acres of cropland were converted to organic crop production and are no longer fertilized; the average per-acre fertilizer reduction is 120 lbs/acre.
Bacteria treatments	Incomplete	NPSWCD	319 grant	NPSWCD proposed to replace 13 septic systems, and use a livestock inventory to "prioritize livestock operations for BMP installations." Homeowners volunteered to participate, but septic systems were not replaced because a grant proposal was not funded. Some livestock BMP installations were completed.
Riparian Animal Management Project	Completed	PCEI	319 grant	A landowner agreed to exclude livestock from 300 ft of stream and planted the area with trees.
Walton Property Riparian restoration	Completed	PCEI	319 grant	Re-sloping and stabilization of approximately 8,258 sq ft, and re-vegetation of 21,292 sq ft of variable width buffer near the intersection of Lindsay Creek Rd and Gun Club Rd

Table 11. Status of activities recommended in the Draft Lindsay Nitrate Priority Area Ground Water Quality Management Plan. The plan did not specify entities responsible for specific tasks. Responsible entities have been added here where appropriate.

Task	Status	Entity Responsible	Funding Source	Description
Facilitate stakeholder meetings	Ongoing	DEQ	DEQ	DEQ formed the Hatwai/Lindsay Watershed Advisory Group in 2019 to facilitate stakeholder discussions.
Apply for §319 Grant	Completed	NPSWCD, PCEI	§319 Grant	NPSWCD and PCEI applied for §319 grants and received funding.
Educate private well owners about setbacks and other approaches to protecting wellheads	Unknown	not indicated in plan	Not identified	
Provide waste management education/training to private landowners who accept manure from animal feed lots for use as fertilizer	Unknown	not indicated in plan	Not identified	
Educate/train growers about how nutrient management, fertilizer application, and soil testing practices can be used to reduce nonpoint pollution	Ongoing	not indicated in plan	Not identified	University of Idaho Extension provides nutrient management education and training to growers.
Encourage private well owners to regularly test their well water.	Ongoing	DEQ	DEQ	DEQ samples private wells within the Lindsay Creek NPA annually, and provides nitrate test strips and education to well owners at public outreach events each year.
Reduce nitrate contributions from septic systems by promoting septic system maintenance.	Ongoing	PH-INCD	Not identified	Public Health – Idaho North Central Health District is responsible for conducting septic site evaluations, issuing septic permits, issuing septic tank pumper licenses, and conducting septic inspections according to Idaho Individual/Subsurface sewage disposal rules. DEQ provides technical guidance and assistance. Property owners are responsible for septic operation and maintenance.
Conduct ground water monitoring and present results to stakeholders and the public	Ongoing	DEQ	DEQ	DEQ has published multiple reports documenting surface water and ground water monitoring results. DEQ presented information at the Lewiston Plateau Ground Water Management Area Citizens advisory committee public meetings and Hatwai/Lindsay WAG public meetings.

4.3 Future Strategy

DEQ will work with designated management agencies, the Hatwai Creek/Lindsay Creek WAG, and watershed stakeholders to identify strategies for addressing pollution in Lindsay Creek. The following recommendations have been developed based on input received during public WAG meetings:

- The WAG, designated management agencies, and stakeholders should revisit the draft TMDL implementation plan for agriculture and *Lindsay Creek Nitrate Priority Ground Water Quality Management Plan*. These plans should be revised as needed and incorporated into a single TMDL implementation plan document. The document should include WAG, designated management agency, and stakeholder recommendations for all aspects of water quality management necessary to achieve support of beneficial uses (monitoring, and recommendations for managing surface water and ground water quality in agricultural, residential, and urban settings, outreach and education, etc.). This document should be developed cooperatively by DEQ, designated management agencies, and watershed stakeholders. Ideally, it would articulate shared goals, voluntary actions necessary to achieve those goals, resource and information needs, available funding sources, and serve as a resource to help designated management agencies, local government, and private land owners to consider surface water and ground water quality issues in their planning processes. The document should indicate priorities for recommended actions, and a schedule of implementation activities.

- The WAG, designated management agencies, and stakeholders should provide input to DEQ on what monitoring data or other information is needed to help guide and prioritize water quality improvement actions.

- DEQ should continue to monitor surface water and ground water in the Lindsay Creek watershed. Monitoring should be designed to assess progress towards meeting TMDL targets, help guide and prioritize water quality improvement actions, assess the effectiveness of best management practices or other implementation activities, and to develop information needed to revise TMDL targets for nutrients and sediment.

- DEQ should organize an annual public meeting of designated management agencies and stakeholders to review progress towards meeting water quality goals in the Lindsay Creek watershed, identify resources needed, and to facilitate coordination of water quality improvement efforts among the many entities and individuals involved.

4.4 Planned Time Frame

Idaho Code §39-3611(7) requires DEQ to review TMDLs every five years. If necessary implementation actions are completed, it is possible for *E. coli* and TSS targets to be achieved within five years. In contrast, it likely will take longer to achieve NO_3+NO_2-N targets because ground water is likely a significant source of NO_3+NO_2-N to surface water. The time required to achieve NO_3+NO_2-N stream targets will depend on how quickly nitrogen inputs to ground water are reduced and ground water residence time. DEQ should continue to monitor water quality and help coordinate water quality improvement actions until water quality goals are achieved.

5 Conclusion

This 5-year review addresses NO_3+NO_2-N, TSS, and *E. coli* TMDLs previously developed for Lindsay Creek (Table 1). In 2018, DEQ collected water quality data in the Lindsay Creek subbasin to evaluate progress towards meeting water quality goals previously defined in the Lindsay Creek TMDLs (DEQ 2007). The 2018 monitoring methods and results are summarized in this review and described in the Lindsay Creek monitoring report (DEQ 2018). In 2018, NO_3+NO_2-N, TSS, and *E. coli* concentrations exceeded TMDL targets in both AUs. Water quality goals established in the Lindsay Creek TMDLs have not been met.

Recommended changes to the next Integrated Report are summarized in Table 12.

Table 12. Existing TMDLs and recommendations for the next Integrated Report.

Assessment Unit Name	Assessment Unit Number	Pollutant	Recommended Changes to Next Integrated Report	Justification
Lindsay Creek—1st and 2nd order tributaries	ID17060306CL003_02	NO_3+NO_2-N	Retain in Category 4a	Target exceeded
		TSS	Retain in Category 4a	Target exceeded
		E. coli	Retain in Category 4a	Target exceeded
Lindsay Creek—3rd order	ID17060306CL003_03	NO_3+NO_2-N	Retain in Category 4a	Target exceeded
		TSS	Retain in Category 4a	Target exceeded
		E. coli	Retain in Category 4a	Target exceeded

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GIS Coverages

Appendix A. Water Quality Criteria

Table A1. Selected numeric criteria supportive of designated beneficial uses in Idaho's 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	—	—
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
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.

Appendix B. Water Quality Data

DEQ water quality data collected in 2018 are described in the *Lindsay Creek Surface Water Quality Monitoring Report 2018* (DEQ 2018). 2018 water chemistry and flow data are publically available through the *Water Quality Portal*, a national public data repository. To access Lindsay Creek 2018 data, query data using Project ID 'Lindsay Cr' or query data spatially. DEQ will also provide project data to interested parties in response to data requests.