Montana Department of
ENVIRONMENTAL QUALITY

Final - East Fork Yaak River Nutrient Total Maximum Daily Loads

July 2014

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Document Number K03-TMDL-02aF

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Suggested citation: Montana DEQ. 2014. Final East Fork Yaak River Nutrient Total Maximum Daily Loads. Helena, MT: Montana Dept. of Environmental Quality.

ACKNOWLEDGEMENTS

The Montana Department of Environmental Quality (DEQ) would like to acknowledge multiple entities for their contributions in the development of the East Fork Yaak River nutrient Total Maximum Daily Load contained in this document. Various versions of sections of this document were sent to stakeholders for review and input. The involvement of all reviewers led to improvements in this document and is greatly appreciated. DEQ would like to thank Pat Price, Kenny Kindel, Kris Newgard, and Betty Holder of the Kootenai National Forest; Jim Dunnigan and Jay DeShazer of Montana Fish, Wildlife & Parks; and Marc Vessar from the Montana Department of Natural Resources & Conservation for their comments and contributions. Additionally, we would like the Yaak Valley Forest Council and the Montana Department of Transportation.

We would like to thank Janelle Egli, an administrative assistant for the Watershed Management Section of DEQ, for her time and efforts formatting this document.

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ACRONYM LIST

Acronym	Definition
AFDM	Ash Free Dry Mass
AFDW	Ash Free Dry Weight
AML	Abandoned Mine Lands
ARM	Administrative Rules of Montana
BMP	Best Management Practices
CFR	Code of Federal Regulations
chl-*a*	chlorophyll-*a*
CWA	Clean Water Act
DEQ	Department of Environmental Quality (Montana)
DNRC	Department of Natural Resources & Conservation (Montana)
DQA	Data Quality Analysis
EPA	Environmental Protection Agency (U.S.)
EQIP	Environmental Quality Incentives Program
FWP	Fish, Wildlife & Parks (Montana)
GIS	Geographic Information System
HBI	Hilsenhoff Biotic Index
IR	Integrated Report
LA	Load Allocation
MBMG	Montana Bureau of Mines and Geology
MCA	Montana Code Annotated
MOS	Margin of Safety
MPDES	Montana Pollutant Discharge Elimination System
MSU	Montana State University
NLCD	National Land Cover Dataset
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
PIBO	PACFISH/INFISH Biological Opinion
RDG	Reclamation and Development Grant
RIT	Resource Indemnity Trust
SMZ	Streamside Management Zone
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TPA	TMDL Planning Area
TPN	Total Persulfate Nitrogen
USDA	Department of Agriculture (U.S.)
USFS	Forest Service (U.S.)
USGS	United States Geological Survey
WLA	Wasteload Allocation
WRP	Watershed Restoration Plan

DOCUMENT SUMMARY

This document presents a Total Maximum Daily Load (TMDL) for one impaired tributary to the Yaak River, the East Fork Yaak River (**Table DS-1**).

The Montana Department of Environmental Quality (DEQ) develops TMDLs and submits them to the U.S. Environmental Protection Agency (EPA) for approval. The Montana Water Quality Act requires DEQ to develop TMDLs for streams and lakes that do not meet, or are not expected to meet, Montana water quality standards. A TMDL is the maximum amount of a pollutant a waterbody can receive and still meet water quality standards. TMDLs provide an approach to improve water quality so that streams and lakes can support and maintain their state-designated beneficial uses.

The East Fork Yaak River watershed is located in Lincoln County in northwestern Montana and includes the East Fork Yaak River and its tributaries. Located in the Purcell Mountain Range, the watershed area encompasses about 58,665 acres (91.7 mi^2), with mostly federal, and limited private land ownership.

Nutrient TMDLs are provided for one pollutant in the East Fork Yaak River. Nutrients are increasing net primary production in the water column and impacting habitat. If necessary nutrient reductions are achieved then beneficial uses should be restored. Nutrients are impairing the beneficial uses of aquatic life (including coldwater fishery) and primary contact recreation.

Nutrient loads from all identified sources such as timber harvest operations, grazing impacts from stock, residential and developed lands impacts, and natural background, were composited into a load allocation which is further described in **Sections 5.5.3.2** and **5.5.3.3**. The East Fork Yaak River is currently not exceeding nitrate+nitrite TMDL targets, but chlorophyll-*a* data suggest that the system is impaired during the growing season, which is also evidenced by visual observations of excess algal growth.

Implementation of water quality improvement measures described in this plan is based on voluntary actions of watershed stakeholders. Ideally, local watershed groups and/or other watershed stakeholders will use this TMDL document, and associated information, as a tool to guide local water quality improvement activities. Such activities can be documented within a Watershed Restoration Plan consistent with DEQ and EPA recommendations.

A flexible approach to most nonpoint source TMDL implementation activities may be necessary as more knowledge is gained through implementation and future monitoring. The plan includes a monitoring strategy designed to track progress in meeting TMDL objectives and goals and to help refine the plan during its implementation.

Although most water quality improvement measures are based on voluntary measures, federal law specifies permit requirements developed to protect narrative water quality criterion, a numeric water quality criterion, or both, to be consistent with the assumptions and requirements of wasteload allocations on streams where TMDLs have been developed and approved by EPA. The East Fork Yaak River Watershed currently has no permitted point source dischargers.

Table DS-1. List of Impaired Waterbodies and Their Impaired Uses in the Yaak TMDL Planning Area with a Completed Nutrient TMDL Contained in This Document

Waterbody and Location Description	TMDL Prepared	TMDL Pollutant Category	Impaired Use(s)
East Fork Yaak River, headwaters to mouth (Yaak River)	Nitrite + Nitrate	Nutrients	Aquatic Life, Primary Contact Recreation

1.0 PROJECT OVERVIEW

This document presents an analysis of water quality information and establishes a Total Maximum Daily Load (TMDL) for nutrient problems in the East Fork Yaak River watershed. This document also presents a general framework for resolving these problems. **Figure A-2**, found in **Appendix A**, shows a map of waterbodies in the East Fork Yaak River watershed with nutrient pollutant listings.

1.1 WHY WE WRITE TMDLS

In 1972, the U.S. Congress passed the Water Pollution Control Act, more commonly known as the Clean Water Act (CWA). The CWA's goal is to "restore and maintain the chemical, physical, and biometrical integrity of the Nation's waters." The CWA requires each state to designate uses of their waters and to develop water quality standards to protect those uses.

Montana's water quality designated use classification system includes the following:

- fish and aquatic life
- wildlife
- recreation
- agriculture
- industry
- drinking water

Each waterbody in Montana has a set of designated uses from the list above. Montana has established water quality standards to protect these uses, and a waterbody that does not meet one or more standards is called an impaired water. Each state must monitor their waters to track if they are supporting their designated uses, and every 2 years the Montana Department of Environmental Quality (DEQ) prepares a Water Quality Integrated Report (IR) which lists all impaired waterbodies and their identified impairment causes. Impairment causes fall within two main categories: pollutant and non-pollutant.

Montana's biennial IR identifies all the state's impaired waterbody segments. The 303(d) list portion of the IR includes all of those waterbody segments impaired by a pollutant, which require a TMDL, whereas TMDLs are not required for non-pollutant causes of impairments. **Table 1-1** lists all the impaired waterbodies in the East Fork Yaak River watershed and their impairment status.

Both Montana state law (Section 75-5-701 of the Montana Water Quality Act) and section 303(d) of the federal CWA require the development of TMDLs for all impaired waterbodies when water quality is impaired by a pollutant. A TMDL is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards.

Developing TMDLs and water quality improvement strategies includes the following components, which are further defined in **Section 4.0**:

- Determining measurable target values to help evaluate the waterbody's condition in relation to the applicable water quality standards
- Quantifying the magnitude of pollutant contribution from their sources
- Determining the TMDL for each pollutant based on the allowable loading limits for each waterbody-pollutant combination
- Allocating the total allowable load (TMDL) into individual loads for each source

In Montana, restoration strategies and monitoring recommendations are also incorporated in TMDL documents to help facilitate TMDL implementation (see **Sections 6.0** and **7.0** of this document).

Basically, developing a TMDL for an impaired waterbody is a problem-solving exercise: The problem is excess pollutant loading that impairs a designated use. The solution is developed by identifying the total acceptable pollutant load (the TMDL), identifying all the significant pollutant-contributing sources, and identifying where pollutant loading reductions should be applied to achieve the acceptable load.

1.2 Water Quality Impairments and TMDLs Addressed by This Document

Table 1-1 below lists all of the impairment causes from the *Draft 2014 Water Quality Integrated Report* that are addressed in this document (also see **Figure A-1** in **Appendix A**) (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau, 2014). Each pollutant impairment falls within a TMDL pollutant category (e.g., nutrients), and this document is organized by those categories. TMDLs are completed for each waterbody – pollutant combination. This document contains 1 TMDL (**Table 1-1**). Sediment TMDLs were previously completed for the Yaak TMDL Planning Area (TPA) in 2008 (Montana Department of Environmental Quality, 2008). No TMDLs have been developed previously for streams in the East Fork Yaak River watershed. **Table 1-1** lists all the impaired waterbodies in the East Fork Yaak River watershed addressed in this document.

Table 1-1. Water Quality Impairment Causes for the East Fork Yaak River Watershed Addressed within this Document

Waterbody and Location Description[a]	Waterbody ID	Impairment Cause	Pollutant Category	Impairment Cause Status[b]	Included in Draft 2014 Integrated Report
East Fork Yaak River, headwaters to mouth (Yaak River)	MT76B002_100	Nitrite + Nitrate	Nutrients	NO_2 + NO_3 TMDL completed	Yes

[a] All waterbody segments within Montana's Water Quality Integrated Report are indexed to the National Hydrography Dataset
[b] NO_2+NO_3 = Nitrite + Nitrate

1.3 What This Document Contains

This document addresses all of the required components of a TMDL and includes an implementation and monitoring strategy. The TMDL components are summarized within the main body of the document. Additional technical details are contained in the appendices. In addition to this introductory section, this document includes:

Section 2.0 East Fork Yaak River Watershed Description:
Describes the physical characteristics and social profile of the watershed.

Section 3.0 Montana Water Quality Standards:
Discusses the water quality standards that apply to the Yaak River watershed.

Section 4.0 Defining TMDLs and Their Components:
Defines the components of TMDLs and how each is developed.

Sections 5.0 Nutrient TMDL Components:
This section includes (a) a discussion of the affected waterbodies and the pollutant's effect on designated beneficial uses, (b) the information sources and assessment methods used to evaluate stream health and pollutant source contributions, (c) water quality targets and existing water quality conditions, (d) the quantified pollutant loading from the identified sources, (e) the determined TMDL for each waterbody, (f) the allocations of the allowable pollutant load to the identified sources.

Section 6.0 Water Quality Improvement Plan:
Discusses water quality restoration objectives and a strategy to meet the identified objectives and TMDLs.

Section 7.0 Monitoring for Effectiveness:
Describes a water quality monitoring plan for evaluating the long-term effectiveness of the "East Fork Yaak River Watershed Nutrient Total Maximum Daily Loads."

Section 8.0 Public Participation and Public Comments:
Describes other agencies and stakeholder groups who were involved with the development of this plan and the public participation process used to review the draft document. Addresses comments received during the public review period.

2.0 East Fork Yaak River Watershed Description

This watershed description provides a general overview of the physical and social characteristics of the East Fork Yaak River watershed.

Located within the larger Yaak River watershed and TPA, the East Fork Yaak River watershed is comprised of the East Fork Yaak River (of which this TMDL document addresses) and its tributaries (**Figure A-1**). A watershed description for the entire Yaak TPA can be found in the previously completed "Yaak River Watershed Sediment Total Maximum Daily Loads" document written by DEQ and approved by the U.S. Environmental Protection Agency (EPA) in 2008 (Montana Department of Environmental Quality, 2008).

Although certain information is current only through the 2014 timeframe, the addition of more recently collected watershed description data would not affect overall TMDL development given the purpose of this section of the document.

2.1 Physical Characteristics

The following information describes the physical characteristics of the East Fork Yaak River watershed.

2.1.1 Location

The East Fork Yaak River watershed encompasses approximately 91.7 square miles (58,665 acres), with approximately 2.8 square miles (1,781 acres) extending into Canada, and the remaining 88.9 square miles (56,884 acres) in the United States. The headwaters of Blacktail Creek and associated tributaries are the only stream portions located in Canada. This section of the document will only describe the portion of the East Fork Yaak River watershed that lies within the boundaries of the United States.

The East Fork Yaak River watershed is located in Lincoln County, Montana. Its headwaters are located in the Purcell Mountains west of Lake Koocanusa, and from the headwaters the stream flows westward 14.6 miles to its confluence with the Yaak River. The East Fork Yaak River watershed is composed of two 6^{th} order sub-watersheds: Basin Creek (170101030102), and East Fork Yaak River (170101030103). These fall within the larger Upper Yaak River 5^{th} order watershed (1701010301), and the Yaak 4^{th} order subbasin (17010103). The Yaak subbasin is located within the Kootenai 3^{rd} order basin (170101) and the Kootenai-Pend Oreille-Spokane 2^{nd} order subregion (1701), which is ultimately part of the Pacific Northwest 1^{st} order Region (17). The East Fork Yaak River is the only impaired waterbody within the two 6^{th} order sub-watersheds that encompass its watershed on the 303(d) list (**Figure A-2**).

2.1.2 Ecoregions

The East Fork Yaak River watershed is located in the Northern Rockies Level III Ecoregion (15). The Northern Rockies Ecoregion (15) is mountainous and rugged. Climate, trees, and understory species are characteristically maritime-influenced. Douglas Fir, subalpine fir, Engelmann spruce, western larch, lodgepole pine, and ponderosa pine as well as Pacific indicators such as western redcedar, western hemlock, mountain hemlock, and grand fir occur. Alpine areas occur but, as a whole, the region has lower elevations, less perennial snow and ice, and fewer glacial lakes than the adjacent Canadian Rockies (41). Metasedimentary rocks and thick volcanic ash deposits are common. Logging and mining are common land uses and have been documented to cause stream water quality problems in the region. Recreational uses are also important (Woods et al., 2002).

The entire watershed is also located in the Salish Mountains Level IV Ecoregion (15l), a subgroup of the Northern Rockies Level III Ecoregion (**Figure A-3**). The Salish Mountains Ecoregion can be characterized as partially glaciated by the Cordilleran Ice Sheet. Rather low forested mountains are underlain by Precambrian Belt formations; no alpine areas occur. Volcanic ash is found on peaks and ridges and glacial till occurs in the north where it influences slope hydrology; perennial streams are more numerous on till than elsewhere. Elevations range from 2,500 to 7,500 feet, but elevations over 7,000 feet are rare. Plant communities are composed of subalpine fir, Douglas fir, and grand fir forests, also Engelmann spruce. With loss of the climax forest overstory, ponderosa pine, western larch, and, sometimes, lodgepole pine can replace Douglas fir or grand fir (Woods et al., 2002).

2.1.3 Climate

Average annual precipitation in the watershed ranges from 30 to 34 inches/year near the mouth of the East Fork Yaak River to 55–60 inches/year in higher elevations in the Basin Creek drainage (**Figure A-4**). The nearest National Oceanographic and Atmospheric Administration weather station is the Troy 18 N station which is approximately 17 miles southwest of the East Fork Yaak River watershed, and data from that weather station can be found in **Table 2-1**. November, December, and January are typically the months that receive the most precipitation. The average total annual precipitation at the Troy 18 N climate station is 35.6 inches and the average total snowfall is 89.7 inches. Climate data reveal that July and August tend to be the hottest months and December and January are the coldest months.

Table 2-1. Western Regional Climate Center Climate Data for the Troy 18N Climate Station (MT Climate Station 248395)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temp. (F)	30.2	38.0	46.1	56.5	66.9	74.1	81.7	82.4	71.2	55.4	38.4	30.2	55.9
Average Min. Temp. (F)	16.1	20.0	24.4	29.7	36.6	43.1	46.2	45.7	38.9	31.8	25.8	18.6	31.4
Average Total Precip. (in.)	4.3	2.9	2.7	2.3	2.5	2.6	1.5	1.6	2.2	3.0	5.2	4.9	35.6
Average Total Snowfall (in.)	29.9	14.2	6.3	1.2	0.0	0.0	0.0	0.0	0.0	1.2	11.7	25.1	89.7
Average Snow Depth (in.)	20.0	22.0	14.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	10.0	6.0

Period of record: 06/01/1961 to 05/31/1994

2.1.4 Hydrology

Streamflow in the East Fork Yaak River watershed typically peak between May and June, which correlates to the melting of high-elevation snowpack. Streamflow begins to decline in late June, reaching minimum flow levels in September. Late fall and winter precipitation events provide increased streamflow throughout the winter months.

There are no currently operating USGS stream gages in the East Fork Yaak River watershed, but two historical gages: Basin Creek (12304040) and Blacktail Creek (12304060) can provide historical flow data for these two streams in the watershed. The nearest active USGS gage is located on the Yaak River near Troy, Montana (12304500). Basin Creek, which is the largest tributary to the East Fork Yaak River, can be used for a general comparison to the East Fork Yaak River in terms of typical flow regimes. A hydrograph of the mean daily discharge values over a 10-year average is shown in **Figure 2-1** for the Basin Creek gage.

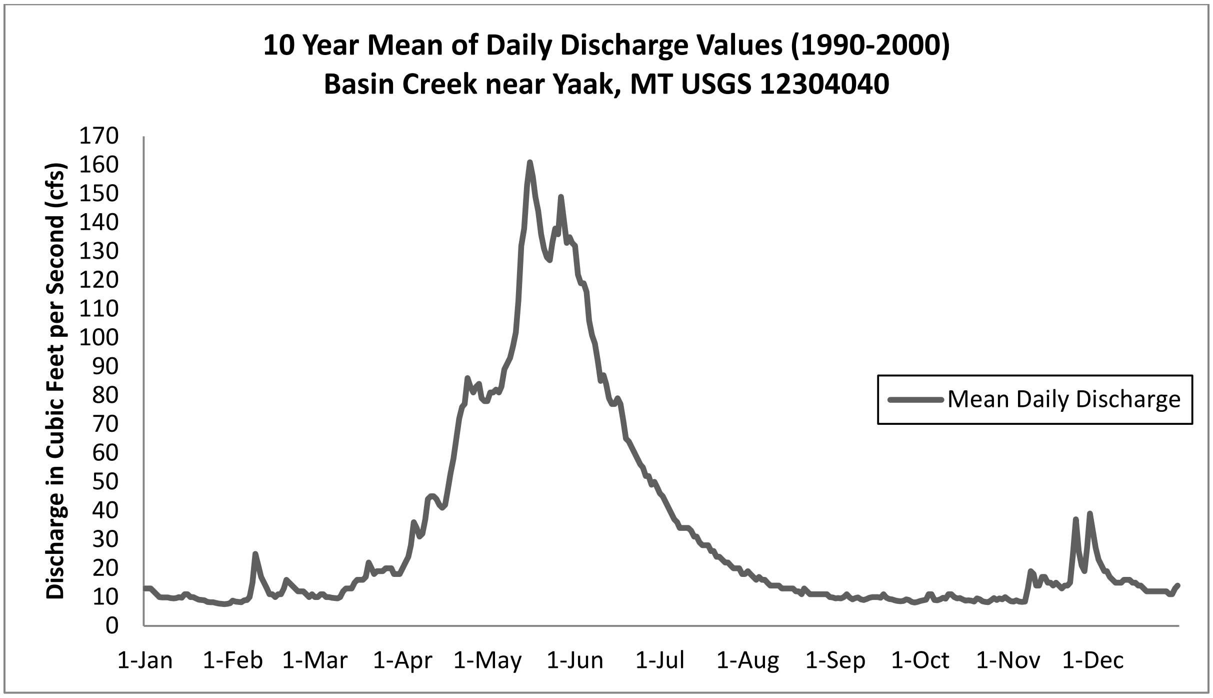

Figure 2-1. Hydrograph of the 10-Year Average Daily Discharge for Basin Creek

2.1.5 Topography

The highest elevation in the East Fork Yaak River watershed is Robinson Mountain (7,539 ft.), which is located in the Bridge Creek drainage. The lowest elevation in the watershed is the confluence of the East Fork Yaak River and the Yaak River (3,082 feet) (**Figure A-5**). Slopes in the watershed range from 0% to greater than 100%; the flattest areas are located near the mouth of the East Fork Yaak River and the steepest areas are located in the Bridge Creek drainage (**Figure A-6**).

2.1.6 Geology

A map of the geology of the East Fork Yaak River watershed is shown in **Figure A-7**. The valleys are typically Quaternary Glacial and Fluvioglacial deposits (till and outwash) from the Pleistocene era, with the higher elevations being a mixture of several formations of Middle Proterozoic era Belt Supergroup rocks. These formations are generally composed of green to purple argillite, siltite, and quartzite. On the northeast corner of the watershed, there are some intrusions of Purcell Lava which is a black to blackish-green basalt. Detailed descriptions for these map units can be found in the USGS maps of the Kalispell quadrangle (Harrison et al., 1992).

2.1.7 Soils

Soils are mapped by the U.S. Department of Agriculture–Natural Resources Conservation Service (USDA-NRCS) and a general soils map can be found in **Figure A-8**, which displays generalized soil map units and soil associations (Soil Survey Staff, 2013). More detailed soil maps and soil series descriptions are available from the USDA-NRCS.

Generally, soils in the East Fork Yaak River watershed are gravelly loams to gravelly ashy silt loams derived from volcanic ash and glacial till with a moderate to high potential for erodibility (**Figure A-9**). Soil permeability is shown in the map in **Figure A-10**. The most prominent soil in the valleys is the Wildgen-Waldbillig-Courville complex, and the most prominent soils in the higher elevations are the Courville-Bata complex and the Waldbillig-Rubble land-Rock outcrop-Phillcher-Holloway-Coerock complex. Minor intrusions of other soil complexes also occur in the lower portion of the watershed and in the upper portions of the Windy Creek drainage.

The Wildgen series is composed of very deep, well drained, moderately permeable gravelly loams that were formed in glacial till and colluvium. The Waldbillig series consists of very deep, well drained, moderately permeable gravelly ashy silt loams that were formed in volcanic ash over material derived from till. The Courville series is comprised of very deep, well drained, moderately permeable gravelly ashy silt loams that were formed in glacial till.

The Courville and Bata series are comprised of very deep, well drained, moderately permeable gravelly ashy silt loams that were formed in glacial till.

The Phillcher series consists of very deep, somewhat excessively drained, moderately-rapid permeable ashy silt loams that formed in volcanic ash over colluvium and glacial drift derived from argillite and quartzite. The Holloway series consists of very deep, somewhat excessively drained, moderately-rapid permeable gravelly ashy silt loams that formed in colluvium derived from argillite and quartzite rock. These soils have a large amount of volcanic ash in the surface layer. The Coerock series consists of shallow, well drained, moderately permeable very gravelly medial silt loams formed in volcanic ash over argillite or quartzite bedrock. These soils have a medium to very rapid potential for runoff.

2.2 Social Profile

The following information describes the social profile of the East Fork Yaak River watershed.

2.2.1 Land Ownership

The East Fork Yaak River watershed is almost entirely under the administration of the U.S. Forest Service (USFS). Approximately 97% of the land within the watershed (55,402.4 acres) is managed by USFS, with the remaining 3% of the land being under private ownership in two separate parcels. These parcels of private land are located on Windy Creek and on Basin/Porcupine Creeks (**Figure A-11**).

2.2.2 Land Cover/Land Use

The National Land Cover Dataset (NLCD) developed by the U.S. Geological Survey (USGS) shows that the watershed is composed of primarily evergreen forest, interspersed with pockets of shrub/scrub (**Figure A-12**) (Homer et al., 2004). Due to the methods that land cover is calculated for the NLCD, specific land cover types may potentially be misidentified. For example, most of the land identified as shrub/scrub in the East Fork Yaak River watershed actually appears to be re-vegetating evergreen forest clear cuts rather than shrub/scrub. **Table 2-2** shows the breakout of land cover and their associated acreages found in the watershed.

Table 2-2. Land Cover Distribution in the East Fork Yaak River Watershed

Land Cover	Acres	Square Miles	Percent of Total
Evergreen Forest	51,625.26	80.66	90.77%
Shrub/Scrub	4,652.42	7.27	8.18%
Herbaceous	283.55	0.44	0.50%
Emergent Herbaceous Wetlands	139.43	0.22	0.25%
Open Water	121.20	0.19	0.21%
Woody Wetlands	43.59	0.07	0.08%
Deciduous Forest	6.78	0.01	0.01%
Barren Land	2.89	0.01	0.01%
Hay/Pasture	0.20	< 0.01	0.00%
Total	**56,875.32**	**88.87**	**100.00%**

Minor measurement errors may occur during GIS analysis

Timber harvest historically is the main land use in the watershed, although no significant timber harvest has occurred since the mid-1990s. Livestock grazing does occur in the watershed, but is primarily restricted to private land, encompassing only a minor land use on USFS administered lands in the watershed. The three surrounding grazing allotments shown in **Figure A-13** are almost entirely located outside of the watershed, with the exception of the Upper Ford allotment, which slightly overlaps the boundaries of the watershed near the mouth of the East Fork Yaak River.

2.2.3 Population

According to the 2010 census, the total year-round resident population within the East Fork Yaak River watershed is two persons (United States Census Bureau, 2011). Population density throughout the watershed, with the exception of the area surrounding Okaga Lake, is less than one person per square mile (**Figure A-14**). Septic tank densities throughout the watershed are classified as low (**Figure A-15**).

2.2.4 Transportation

Transportation networks in a watershed have the potential to influence stream morphology, hydrology, sediment transport, aquatic life, and riparian areas. The road network in the East Fork Yaak River watershed is extensive and is a combination of county roads and USFS roads (**Figure A-16**). The Yaak River Road (NF-92) is a county road that is located along the East Fork Yaak River and parallels the river for much of its length. It is maintained by the USFS and is not plowed in winter. Most of the major tributaries also have roads that parallel the stream. Due to the history of logging in the watershed, there was an extensive network of USFS roads created to support that industry, many of which may not currently be in use, but still have the potential for watershed impacts.

2.2.5 Species of Concern

Several animal and plant species of concern are found within the East Fork Yaak River watershed. Species of concern are classified as sensitive, threatened, or endangered under the federal Endangered Species Act. Any changes to the environment can have significant impacts on the behavior and survival of these species. A list showing all species of concern is included in **Table 2-3** (Montana Natural Heritage Program, 2012a; Montana Natural Heritage Program, 2012b).

Table 2-3. Animal and Plant Species of Concern in the East Fork Yaak River Watershed

Animal/Plant Group	Common Name	Scientific Name	Status
Amphibians	Western Toad	*Anaxyrus boreas*	Sensitive
Birds	Bald Eagle	*Haliaeetus leucocephalus*	Sensitive
Birds	Black-backed Woodpecker	*Picoides arcticus*	Sensitive
Birds	Brown Creeper	*Certhia americana*	
Birds	Clark's Nutcracker	*Nucifraga columbiana*	
Birds	Common Loon	*Gavia immer*	Sensitive
Birds	Great Blue Heron	*Ardea herodias*	
Birds	Northern Goshawk	*Accipiter gentilis*	Sensitive
Birds	Pileated Woodpecker	*Dryocopus pileatus*	
Fish	Columbia River Redband Trout	*Oncorhynchus mykiss gairdneri*	Sensitive
Fish	Westslope Cutthroat Trout	*Oncorhynchus clarkii lewisi*	Sensitive
Invertebrates	Pale Jumping-slug	*Hemphillia camelus*	
Invertebrates	Pygmy Slug	*Kootenaia burkei*	
Invertebrates	Smoky Taildropper	*Prophysaon humile*	
Mammals	Canada Lynx	*Lynx canadensis*	Threatened
Mammals	Fisher	*Martes pennanti*	Sensitive
Mammals	Grizzly Bear	*Ursus arctos*	Threatened
Mammals	Wolverine	*Gulo gulo*	Sensitive
Vascular Plants	Moonworts	*Botrychium* sp. (SOC)	
Vascular Plants	Poor Sedge	*Carex magellanica*	

Fish species of concern in the watershed are the Westslope Cutthroat Trout and Columbia River Redband Trout. Both of these species are classified as sensitive and their distribution is shown in **Figure A-17**. The Montana Fisheries Information System (MFISH) is a database maintained by Montana Fish, Wildlife & Parks (FWP). This database includes fisheries related information (if available) for all surveyed waterbodies in Montana. A general list of fish species and their distribution in the East Fork Yaak River can be found in **Table 2-4**.

Table 2-4. Fish Species Distribution in the East Fork Yaak River Watershed

Begin Mile	End Mile	Species	Abundance	Origin
0	3	Brook Trout	Common	Introduced
0	4	Columbia Basin Redband Trout	Common	Native
4	13.9	Columbia Basin Redband Trout	Abundant	Native
0	4.2	Mountain Whitefish	Rare	Native
5.4	6.5	Redband X Westslope Cutthroat	Unknown	Not applicable
6.5	7.2	Redband X Westslope Cutthroat	Common	Not applicable
0	13.9	Sculpin	Abundant	Native

2.2.6 Point Source Discharges

There are no identified point source discharges within the East Fork Yaak River watershed.

2.2.7 Surface Water Monitoring

Nine surface water monitoring sites for nutrients have been identified in the East Fork Yaak River watershed (**Figure A-18**). Seven of these monitoring sites are located on the East Fork Yaak River and two sites are located on Basin Creek. **Table 2-5** shows these sites and their locations along with a brief site description.

Table 2-5. Nutrient Surface Water Monitoring Sites in the East Fork Yaak River Watershed

Site ID	Monitoring Site Description	Latitude	Longitude
K03BASNC01	Basin Creek East Fork upstream of confluence with West Fork	48.875300	-115.484000
K03BASNC02	Basin Creek East Fork	48.912200	-115.474817
K03YAKER01	Yaak River Upper East Fork	48.933840	-115.454340
K03YAKER02	Yaak River East Fork above Basin Creek	48.941670	-115.489360
K03YAKER03	Yaak River East Fork below Blacktail Creek	48.949680	-115.543310
K03YAKER04	Yaak River East Fork 50 yards above Road 8025 crossing	48.950600	-115.613800
K03YAKER05	Yaak River East Fork upstream of bridge	48.948500	-115.533100
K03YAKER06	Yaak River East Fork just upstream Hwy 92 crossing, d/s Bridge Creek	48.931630	-115.445500
K03YAKER07	Yaak River East Fork 0.5 mile downstream Basin Creek	48.948000	-115.500930

2.2.8 Fire History

Wildland fires can be an important and significant source of disturbance in a watershed. These fires are part of the natural processes within an ecosystem, but human activities have vastly altered the occurrence and management of such fires. Historically, wildland fires have played a significant role in the East Fork Yaak River watershed with much of the watershed being burned in the early 1900s (**Figure A-19**). Since the year 2000, very little large fire activity has occurred in the watershed with some smaller burns occurring in the Windy Creek and Blacktail Creek drainages. A table showing the extent of historical fires within the East Fork Yaak River watershed can be found in **Table A-1** (U.S. Geological Survey, 2013; U.S. Forest Service, Region 1, 2013).

2.2.9 Mining

Although some small mining operations did occur in the East Fork Yaak River watershed, historical mining impacts do not appear to be significant throughout the watershed. The Montana Bureau of Mines and Geology (MBMG) inventoried four sites from their abandoned mines inventory in the watershed: one placer mine, one surface mine, and two occurrences of locatable minerals (**Figure A-20**).

The Solo Joe placer was a small placer gold mine with a disturbance area of approximately ½ acre. Solo Joe is located on the East Fork Yaak River approximately ½ mile above the confluence with Solo Joe creek. The placer mine operation was initiated in the early 1900's and re-worked between 1938–1940 (Johns, 1961).

The Phillips mine was a surface gold and silver mine, described as an eight foot prospect into the hillside, and is located on the East Fork Yaak River approximately ½ mile upstream of the confluence with Windy Creek. The mineralization is associated with a northwest fault that crosses the Yaak River at the site, with a quartz vein containing pyrite, malachite, and iron oxides (Johns, 1961).

Two minerals occurrences are mapped in the headwaters of the Solo Joe Creek watershed. These are unnamed and described as silver, copper, and lead prospects.

3.0 Montana Water Quality Standards

The federal CWA provides for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's surface waters so that they support all designated uses. Water quality standards are used to determine impairment, establish water quality targets, and to formulate the TMDLs and allocations.

Montana's water quality standards and water quality standards in general include three main parts:

1. Stream classifications and designated uses
2. Numeric and narrative water quality criteria designed to protect designated uses
3. Nondegradation provisions for existing high-quality waters

Montana's water quality standards also incorporate prohibitions against water quality degradation as well as point source permitting and other water quality protection requirements.

Nondegradation provisions are not applicable to the TMDL developed within this document because of the impaired nature of the streams addressed. Those water quality standards that apply to this document are reviewed briefly below. More detailed descriptions of Montana's water quality standards may be found in the Montana Water Quality Act (75-5-301,302 Montana Code Annotated (MCA)), and Montana's Surface Water Quality Standards and Procedures (Administrative Rules of Montana (ARM) 17.30.601-670) and Circular DEQ-7 (Montana Department of Environmental Quality, 2012a).

3.1 Stream Classifications and Designated Beneficial Uses

Waterbodies are classified based on their designated uses. All Montana waters are classified for multiple uses. All streams and lakes within the East Fork Yaak River watershed are classified as B-1, which specifies that the water must be maintained suitable to support all of the following uses (ARM 17.30.623(1):

- Drinking, culinary, and food processing purposes, after conventional treatment (Drinking Water)
- Bathing, swimming, and recreation (Primary Contact Recreation)
- Growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers (Aquatic Life)
- Agricultural and industrial water supply

While some of the waterbodies might not actually be used for a designated use (e.g., drinking water supply), their water quality still must be maintained suitable for that designated use. More detailed descriptions of Montana's surface water classifications and designated uses are provided in **Appendix B**. DEQ's water quality assessment methods are designed to evaluate the most sensitive uses for each pollutant group addressed within this document, thus ensuring protection of all designated uses (Suplee and Sada de Suplee, 2011). For streams in Western Montana, the most sensitive use assessed for nutrients is aquatic life and primary contact recreation. DEQ determined that one waterbody segment in the East Fork Yaak River watershed does not meet nutrients water quality targets (**Table 3-1**).

Table 3-1. Impaired Waterbodies and Their Impaired Designated Uses in the Yaak TMDL Planning Area

Waterbody and Location Description	Waterbody ID	Impairment Cause[a]	Impaired Use(s)
East Fork Yaak River, headwaters to mouth (Yaak River)	MT76B002_100	Nitrite + Nitrate	Aquatic Life Primary Contact Recreation

[a] Only includes those pollutant impairments addressed by TMDLs in this document

3.2 Numeric and Narrative Water Quality Standards

In addition to the use classifications described above, Montana's water quality standards include numeric and narrative criteria that protect the designated uses. Numeric criteria define the allowable concentrations, frequency, and duration of specific pollutants so as not to impair designated uses.

Numeric standards apply to pollutants that are known to have adverse effects on human health or aquatic life (e.g., metals, organic chemicals, and other toxic constituents). Human health standards are set at levels that protect against long-term (lifelong) exposure via drinking water and other pathways such as fish consumption, as well as short-term exposure through direct contact such as swimming. Numeric standards for aquatic life include chronic and acute values. Chronic aquatic life standards prevent long-term, low level exposure to pollutants. Acute aquatic life standards protect from short-term exposure to pollutants. Numeric standards also apply to other designated uses such as protecting irrigation and stock water quality for agriculture.

Narrative standards are developed when there is insufficient information to develop numeric standards and/or the natural variability makes it impractical to develop numeric standards. Narrative standards describe the allowable or desired condition. This condition is often defined as an allowable increase above "naturally occurring." DEQ often uses the naturally occurring condition, called a "reference condition," to help determine whether or not narrative standards are being met (see **Appendix B**).

For the East Fork Yaak River watershed, numeric targets based on narrative standards are applied as the primary targets for impairment determinations and subsequent TMDL development. These targets address allowable water column chemistry concentrations. The specific numeric and narrative standards are summarized in **Appendix B**.

4.0 Defining TMDLs and Their Components

A TMDL is a tool for implementing water quality standards and is based on the relationship between pollutant sources and water quality conditions. More specifically, a TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive from all sources and still meet water quality standards.

Pollutant sources are generally defined as two categories: point sources and nonpoint sources (NPSs). Point sources are discernible, confined and discrete conveyances, such as pipes, ditches, wells, containers, or concentrated animal feeding operations, from which pollutants are being, or may be, discharged. Some sources such as return flows from irrigated agriculture are not included in this definition. All other pollutant loading sources are considered NPSs. NPSs are diffuse and are typically associated with runoff, streambank erosion, most agricultural activities, atmospheric deposition, and groundwater seepage. Natural background loading is a type of NPS.

As part of TMDL development, the allowable load is divided among all significant contributing point and NPSs. For point sources, the allocated loads are called “wasteload allocations” (WLAs). For NPSs, the allocated loads are called “load allocations” (LAs).

A TMDL is expressed by the equation: $TMDL = \Sigma WLA + \Sigma LA$, where:

ΣWLA is the sum of the wasteload allocation(s) (point sources)
ΣLA is the sum of the load allocation(s) (nonpoint sources)

TMDL development must include a margin of safety (MOS), which can be explicitly incorporated into the above equation. Alternatively, the MOS can be implicit in the TMDL. A TMDL must also ensure that the waterbody will be able to meet and maintain water quality standards for all applicable seasonal variations (e.g., pollutant loading or use protection).

Development of each TMDL has four major components:

- Determining water quality targets
- Quantifying pollutant sources
- Establishing the total allowable pollutant load
- Allocating the total allowable pollutant load to their sources

Although the way a TMDL is expressed can vary by pollutant, these four components are common to all TMDLs, regardless of pollutant. Each component is described in further detail in the following subsections.

Figure 4-1 illustrates how numerous sources contribute to the existing load and how the TMDL is defined. The existing load can be compared to the allowable load to determine the amount of pollutant reduction needed.

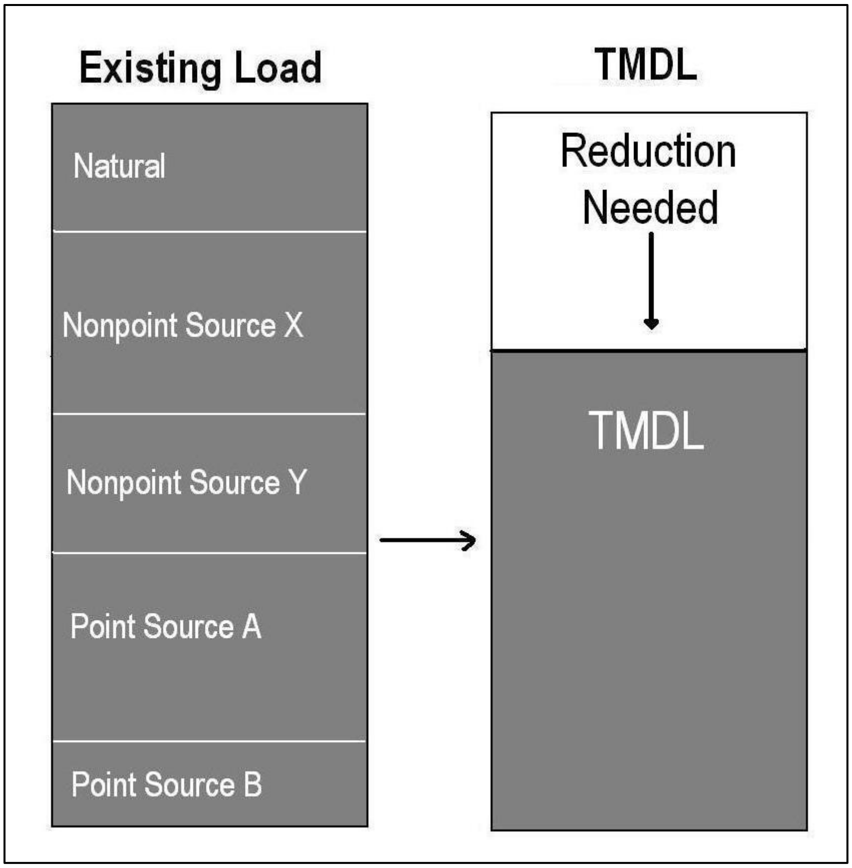

Figure 4-1. Schematic Example of TMDL Development

4.1 Developing Water Quality Targets

TMDL water quality targets are a translation of the applicable numeric or narrative water quality standard(s) for each pollutant. For pollutants with established numeric water quality standards, the numeric value(s) are used as the TMDL targets. For pollutants with narrative water quality standard(s), the targets provide a waterbody-specific interpretation of the narrative standard(s).

Water quality targets are typically developed for multiple parameters that link directly to the impaired beneficial use(s) and applicable water quality standard(s). Therefore, the targets provide a benchmark by which to evaluate attainment of water quality standards. Furthermore, comparing existing stream conditions to target values allows for a better understanding of the extent and severity of the problem.

4.2 Quantifying Pollutant Sources

All significant pollutant sources, including natural background loading, are quantified so that the relative pollutant contributions can be determined. Because the effects of pollutants on water quality can vary throughout the year, assessing pollutant sources must include an evaluation of the seasonal variability of the pollutant loading. The source assessment helps to define the extent of the problem by linking the pollutant load to specific sources in the watershed.

A pollutant load is usually quantified for each point source permitted under the Montana Pollutant Discharge Elimination System (MPDES) program. NPSs are quantified by source categories (e.g., unpaved roads) and/or by land uses (e.g., agriculture or forestry). These source categories and land uses can be divided further by ownership, such as federal, state, or private. Alternatively, most, or all, pollutant sources in a sub-watershed or source area can be combined for quantification purposes.

Because all potentially significant sources of the water quality problems must be evaluated, source assessments are conducted on a watershed scale. The source quantification approach may produce reasonably accurate estimates or gross allotments, depending on the data available and the techniques used for predicting the loading (40 Code of Federal Regulations (CFR) Section 130.2(I)). Montana TMDL development often includes a combination of approaches, depending on the level of desired certainty for setting allocations and guiding implementation activities.

4.3 Establishing the Total Allowable Load

Identifying the TMDL requires a determination of the total allowable load over the appropriate time period necessary to comply with the applicable water quality standard(s). Although "TMDL" implies "daily load," determining a daily loading may not be consistent with the applicable water quality standard(s), or may not be practical from a water quality management perspective. Therefore, the TMDL will ultimately be defined as the total allowable loading during a time period that is appropriate for applying the water quality standard(s) and which is consistent with established approaches to properly characterize, quantify, and manage pollutant sources in a given watershed. For example, sediment TMDLs may be expressed as an allowable annual load.

If a stream is impaired by a pollutant for which numeric water quality criteria exist, the TMDL, or allowable load, is typically calculated as a function of streamflow and the numeric criteria. This same approach can be applied when a numeric target is developed to interpret a narrative standard.

Some narrative standards, such as those for sediment, often have a suite of targets. In many of these situations it is difficult to link the desired target values to highly variable, and often episodic, instream loading conditions. In such cases the TMDL is often expressed as a percent reduction in total loading based on source quantification results and an evaluation of load reduction potential (**Figure 4-1**). The degree by which existing conditions exceed desired target values can also be used to justify a percent reduction value for a TMDL.

Even if the TMDL is preferably expressed using a time period other than daily, an allowable daily loading rate will also be calculated to meet specific requirements of the federal CWA. Where this occurs, TMDL implementation and the development of allocations will still be based on the preferred time period, as noted above.

4.4 Determining Pollutant Allocations

Once the allowable load (the TMDL) is determined, that total must be divided among the contributing sources. The allocations are often determined by quantifying feasible and achievable load reductions through application of a variety of Best Management Practices (BMPs) and other reasonable conservation practices.

Under the current regulatory framework (40 CFR 130.2) for developing TMDLs, flexibility is allowed in allocations in that "TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure." Allocations are typically expressed as a number, a percent reduction (from the current load), or as a surrogate measure (e.g., a percent increase in canopy density for temperature TMDLs).

Figure 4-2 illustrates how TMDLs are allocated to different sources using WLAs for point sources and LAs for natural and NPSs. Although some flexibility in allocations is possible, the sum of all allocations must meet the water quality standards in all segments of the waterbody.

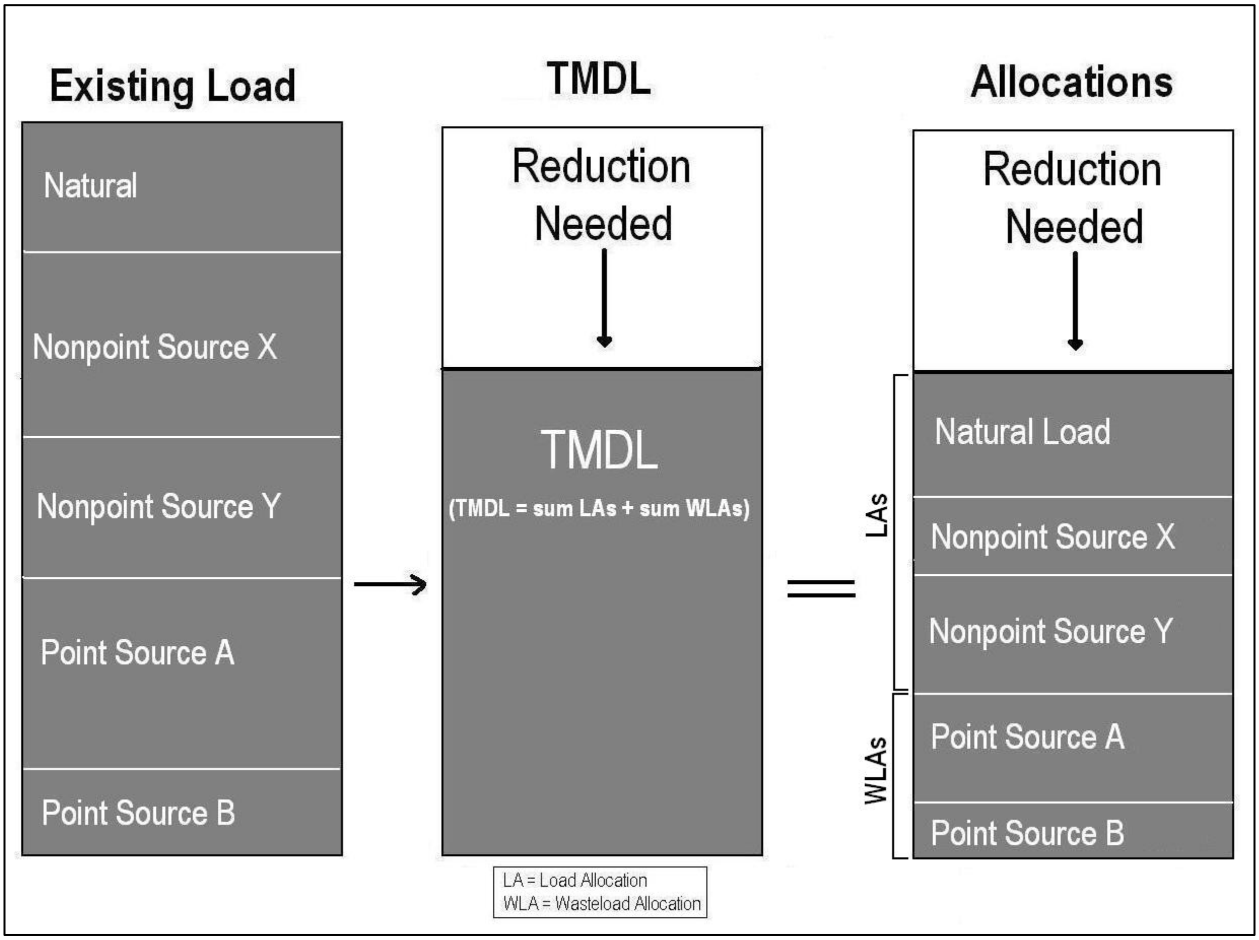

Figure 4-2. Schematic Diagram of a TMDL and Its Allocations

TMDLs must also incorporate an MOS. The MOS accounts for the uncertainty, or any lack of knowledge, about the relationship between the pollutant loads and the quality of the receiving waterbody. The MOS may be applied implicitly by using conservative assumptions in the TMDL development process, or explicitly by setting aside a portion of the allowable loading (i.e., a TMDL = WLA + LA + MOS) (U.S. Environmental Protection Agency, 1999). The MOS is a required component to help ensure that water quality standards will be met when all allocations are achieved. In Montana, TMDLs typically incorporate implicit margins of safety.

4.5 Implementing TMDL Allocations

The CWA and Montana state law (Section 75-5-703 of the Montana Water Quality Act) require WLAs to be incorporated into appropriate discharge permits, thereby providing a regulatory mechanism to achieve load reductions from point sources. NPS reductions linked to LAs are not required by the CWA or Montana statute, and are primarily implemented through voluntary measures. This document contains several key components to assist stakeholders in implementing NPS controls. **Section 6.0** discusses a restoration and implementation strategy by pollutant group and source category, and provides recommended BMPs per source category (e.g., grazing, cropland, urban, etc.). **Section 6.5** discusses potential funding sources that stakeholders can use to implement BMPs for NPSs. Other site-specific pollutant sources are discussed throughout the document, and can be used to target implementation activities. DEQ's Watershed Protection Section helps to coordinate nonpoint implementation throughout the state and provides resources to stakeholders to assist in NPS BMPs. Montana's Nonpoint Source Management Plan (available at http://www.deq.mt.gov/wqinfo/nonpoint/nonpointsourceprogram.mcpx) further discusses NPS implementation strategies at the state level.

DEQ uses an adaptive management approach to implementing TMDLs to ensure that water quality standards are met over time (outlined in **Section 7.0**). This includes a monitoring strategy and an implementation review that is required by Montana statute (see **Section 7.2**). TMDLs may be refined as new data become available, land uses change, or as new sources are identified.

5.0 Nutrient TMDL Components

This section focuses on nutrient causes of water quality impairment in the East Fork Yaak River watershed. The section (1) describes how excess nutrients impair beneficial uses, (2) discusses the affected stream segments, (3) discusses the currently available data pertaining to nutrient impairments in the East Fork Yaak River watershed, (4) describes the sources of nutrients based on recent studies and loading estimates, and (5) proposes nutrient TMDLs and their rationales.

5.1 Nutrient Effects on Beneficial Uses

Nitrogen and phosphorus are naturally occurring elements required for healthy functioning of aquatic ecosystems. Healthy streams strike a balance between nutrients from sources such as natural erosion, groundwater discharge, and instream biological decomposition. This balance relies on autotrophic organisms (e.g., algae) to consume excess nutrients and on the cycling of biologically fixed nitrogen and phosphorus into higher levels on the food chain, as well as on nutrient decomposition (e.g., changing organic forms of nutrients into inorganic forms). Human influences may alter nutrient cycling, damaging biological stream function and degrading water quality. The effects on streams of total nitrogen (TN), nitrate+nitrite (NO_3+NO_2; a component of TN), and total phosphorus (TP) are all considered in assessing the effects on beneficial uses.

Excess nitrogen in the form of dissolved ammonia (which is typically associated with municipal wastewater) can be toxic to fish and other aquatic life. Excess nitrogen in the form of nitrate in drinking water can inhibit normal hemoglobin function in infants. Excess nitrogen and phosphorus from human sources can cause excess algal growth, which in turn depletes the supply of dissolved oxygen, killing fish and other aquatic life. Excess nutrient concentrations in surface water create blue-green algae blooms (Priscu, 1987), which can produce toxins lethal to aquatic life, wildlife, livestock, and humans. Aside from the toxicity effects, nuisance algae can shift the structure of macroinvertebrate communities, which may also negatively affect fish (U.S. Environmental Protection Agency, 2010). Additionally, changes in water clarity, fish communities, and aesthetics can harm recreational uses, such as fishing, swimming, and boating (Suplee et al., 2009). Nuisance algae can also increase the cost of treating drinking water or pose health risks if ingested (World Health Organization, 2003).

5.2 Stream Segment of Concern

The stream of concern for this document is the East Fork Yaak River (**Figure 5-1**). This stream is on the Draft 2014 303(d) List as impaired for NO_3+NO_2 (**Table 5-1**). The assessment results are presented in **Section 5.4.3**, along with an updated nutrient impairment summary (see **Table 5-5**) for the planning area. There are no non-pollutant listings on the East Fork Yaak River.

Table 5-1. Stream Segment of Concern for Nutrients and Nutrient Pollutant Impairments Based on the Draft 2014 303(d) List

Stream Segment	Waterbody ID	Nutrient Impairment Identified on Draft 2014 303(d) List
East Fork Yaak River	MT76B002_100	Yes

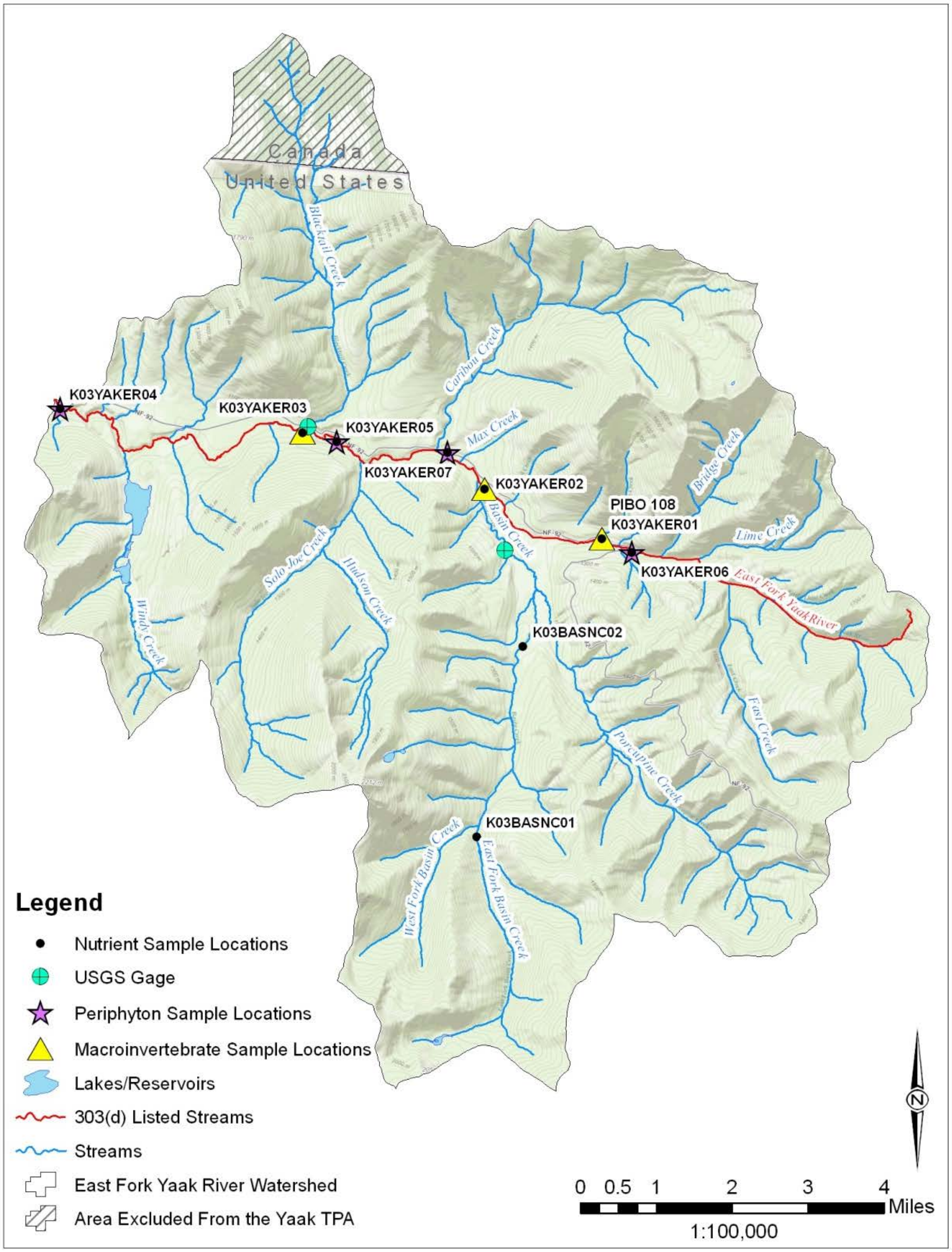

Figure 5-1. Sampling Locations in the East Fork Yaak River Watershed

5.3 Information Sources and Assessment Methods

DEQ's nutrient water quality assessment method has specific objectives and decision-making criteria for assessing the validity and reliability of data. DEQ uses a Data Quality Analysis (DQA) process to evaluate data for use in assessments and decision making. The DQA considers the technical, representativeness, currency, quality, spatial, and temporal components of the readily available data. The specific data requirements are detailed in the nutrient assessment method (Suplee and Sada de Suplee, 2011).

Primary data sources used to evaluate existing instream nutrient concentrations in the East Fork Yaak River watershed include the following:

1) **DEQ Monitoring and Assessment sampling.** The Monitoring and Assessment Section of the Water Quality Planning Bureau at DEQ collected water chemistry, chlorophyll-*a* (chl-*a*) and macroinvertebrate samples from the East Fork Yaak River over several field seasons (2003, 2006, 2008, 2012–2013).
2) **DEQ Assessment Files.** The files contain information used to make the existing nutrient impairment determinations. This includes water quality and algal data results and historical information collected or obtained by DEQ.
3) **USFS PACFISH/INFISH Biological Opinion (PIBO) Data.** USFS's PIBO group collects macroinvertebrate data throughout the Mountain West. Data collected in 2003 and 2008 were used in the analysis.

Because these sampling events represent the most recent, and the most exhaustive, water quality characterization of nutrients, DEQ used data from these events as the primary source for evaluating water quality targets and assessing nutrient sources. Raw data from these sources are extensive and are not included in this document but are publicly available via EPA's EPA STOrage and RETrieval database (STORET), a water quality database, and DEQ's EQuIS water quality database. Data are also available from DEQ upon request.

The following section provides an evaluation of water quality conditions with respect to nutrients for the stream segment of concern (East Fork Yaak River). **Figure 5-1** identifies the nutrient stream of concern and the available water quality data for the East Fork Yaak River.

5.4 Water Quality Targets

TMDL water quality targets are numeric indicator values used to evaluate whether water quality standards have been met. These are discussed further in **Section 4.0**. This section presents nutrient water quality targets and compares them with recently collected nutrient data in the East Fork Yaak River watershed following DEQ's draft assessment methodology (Suplee and Sada de Suplee, 2011). To be consistent with DEQ's draft assessment methodology, and because of improvements in analytical methods, only data collected since 2003 were included in the review of existing data.

5.4.1 Nutrient Water Quality Standards

Montana's water quality standards for nutrients (nitrogen and phosphorous) are narrative and are addressed via narrative criteria. Narrative criteria require state surface waters to be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will: 1) produce conditions that create concentrations or combinations of material toxic or harmful to aquatic life, and 2) create conditions that produce undesirable aquatic life (ARM 17.30.637 (1) (d-e)). DEQ is currently developing numeric nutrient criteria for TN and TP that will be established at levels consistent with narrative criteria requirements. These draft numeric criteria are the basis for the nutrient TMDL targets and are consistent with EPA's guidance on TMDL development and federal regulations.

5.4.2 Targets

Nutrient water quality targets include nutrient concentrations in surface waters and measures of benthic algae (a form of aquatic life that at elevated concentrations is undesirable) chl-*a* concentration and Ash Free Dry Mass (AFDM). The target concentrations for nitrogen and phosphorus are established at levels believed to prevent the harmful growth and proliferation of excess algae. Since 2002, DEQ has conducted a number of studies in order to develop numeric criteria for nutrients (N and P forms). DEQ is developing draft numeric nutrient standards for TN, TP, chl-*a* and AFDM based on 1) public surveys defining what level of algae was perceived as "undesirable" (Suplee et al., 2009), and 2) the outcome of nutrient stressor-response studies that determine nutrient concentrations that will maintain algal growth below undesirable and harmful levels (Suplee and Watson, 2013).

Nutrient targets for TN and TP (which are also draft numeric criteria), chl-*a*, and AFDM are based on Suplee and Watson (2013) and can be found in **Table 5-2**. The NO_3+NO_2 target is based on research by DEQ (Suplee et al., 2008) and can also be found in **Table 5-2**. DEQ has determined that the values for NO_3+NO_2, TN, and TP provide an appropriate numeric translation of the applicable narrative nutrient water quality standards based on existing water quality data in the East Fork Yaak River watershed and its location in the Northern Rockies Level III Ecoregion. The target values are based on the most sensitive uses; therefore, the nutrient TMDLs are protective of all designated uses. When the draft criteria for TN and TP become numeric standards they will be in DEQ's DEQ-12 circular.

The nutrient target suite for streams in the Northern Rockies Level III Ecoregion also includes two biometric indicators: macroinvertebrates and diatoms. For macroinvertebrates, the Hilsenhoff Biotic Index (HBI) score is used. The HBI value increases as the amount of pollution tolerant macroinvertebrates in a sample increases; the macroinvertebrate target is an HBI score equal to or less than 4.0 (Suplee and Sada de Suplee, 2011) (**Table 5-2**). Benthic diatoms, or periphyton, are a type of algae that grow on the stream bottom, and there are certain taxa that tend to increase as nutrient concentrations increase. The diatom target is a periphyton sample with a <51% probability of impairment by nutrients (Suplee and Sada de Suplee, 2011) (**Table 5-2**).

Because numeric nutrient chemistry is established to maintain algal levels below target chl-*a* concentrations and AFDM, target attainment applies and is evaluated during the summer growing season (July 1–September 30 for the Northern Rockies Level III Ecoregion) when algal growth will most likely affect beneficial uses.

Table 5-2. Nutrient Targets for the East Fork Yaak River Watershed

Parameter	Northern Rockies Level III Ecoregion Target Value
Nitrate+Nitrite (NO_3+NO_2)[a]	≤ 0.10 mg/L
Total Nitrogen (TN)[b]	≤ 0.275 mg/L
Total Phosphorus (TP)[b]	≤ 0.025 mg/L
Chlorophyll-*a*[b]	≤ 125 mg/m2
Ash Free Dry Mass (AFDM)	≤ 35 g/m2
Hilsenhoff Biotic Index (HBI)[c]	< 4.0
Periphyton[c]	< 51%

[a] Value is from Suplee et al. (2008)
[b] Value is from Suplee and Watson (2013)
[c] Value is from Suplee and Sada de Suplee (2011)

5.4.3 Existing Conditions and Comparison to Targets

To evaluate whether attainment of nutrient targets has been met, the existing water quality conditions in each waterbody segment are compared to the water quality targets in **Table 5-2** using the methodology in the DEQ draft guidance document "2011 Assessment Methodology for Determining

Wadeable Stream Impairment due to Excess Nitrogen and Phosphorus Levels" (Suplee and Sada de Suplee, 2011).

The assessment methodology uses two statistical tests (Exact Binomial Test and the One-Sample Student's T-test for the Mean) to evaluate water quality data for compliance with established target values. In general, compliance with water quality targets is not attained when nutrient chemistry data shows a target exceedance rate of >20% (Exact Binomial Test), when mean water quality nutrient chemistry exceeds target values (Student T-test), or when a single chl-*a* value exceeds benthic algal target concentrations (125 mg/m^2 or 35 g AFDW/m^2). Where water chemistry and algae data do not provide a clear determination of impairment, or where other limitations exist, macroinvertebrate and periphyton biometrics are considered in further evaluating compliance with nutrient targets. Lastly, inherent to any impairment determination is the existence of human sources of pollutant loading. Human-caused sources of nutrients must be present for a stream to be considered impaired. To ensure a higher degree of certainty for removing an impairment determination and making any new impairment determination, the statistical tests are configured differently for an unlisted nutrient form than for a listed nutrient form. This can result in a different number of allowable exceedances for nutrients within a single stream segment. Such tests help assure that assessment reaches do not vacillate between listed and delisted status by the change in results from a single additional sample. When applying the T-test for assessment and sample values were below detection limits, one-half the detection limit was used.

5.4.3.1 East Fork Yaak River (MT76B002_100)

East Fork Yaak River is on the Draft 2014 303(d) List as impaired for nitrate/nitrite ($N0_3$+NO_2). The impaired segment of East Fork Yaak River begins at the headwaters and flows 14.6 miles to the confluence with the Yaak River. It was originally listed for nitrate/nitrite in 2006. There are no other listings for the East Fork Yaak River.

Summary nutrient data statistics and assessment method evaluation results for East Fork Yaak River are provided in **Tables 5-3** and **5-4**, respectively. Fifteen NO_3+NO_2 samples were collected between 2003 and 2013; values ranged from below the detection limit (0.01 mg/L) to 0.08 mg/L with zero samples exceeding the NO_3+NO_2 target of 0.10 mg/L. Twelve TN samples were collected between 2012 and 2013; values ranged from < 0.04 to 0.16 mg/L with zero samples exceeding the TN target of 0.275 mg/L. Fifteen TP samples were collected between 2003 and 2013; values ranged from <0.003 to 0.004 mg/L with zero samples exceeding the TP target of 0.025 mg/L. Water chemistry concentrations were all very low compared with target concentrations.

Chl-*a* was visually estimated to be below 50 mg/m^2 at two sites in East Fork Yaak River in 2012. Two other chl-*a* samples were measured at less than the target threshold (125 mg/m^2). One of four AFDM samples exceeded the target threshold of 35 mg/m^2 and two of six periphyton samples were greater than the threshold (51%). However, all macroinvertebrate samples (*n*=10) had HBI scores less than the threshold of 4.0, indicating no impairment.

The exceedance of the targets for AFDM and periphyton indicate a nutrient impairment in the stream. According to DEQ's assessment methodology, failure of biological targets while meeting the nutrient targets indicates algae may be consuming excess nutrients in the water column and/or that water quality sampling missed the pulse of nutrients that is causing the biological response.

Based on the existing nutrient impairment listings and failure of multiple biological targets (**Table 5-4**), the NO_3+NO_2 nutrient listing will be retained. Therefore, a NO_3+NO_2 TMDL will be written for East Fork Yaak River. However, because none of the water samples exceeded target values, additional water column and biological sampling is recommended to help refine the impairment cause(s) and sources.

Table 5-3. Nutrient Data Summary for East Fork Yaak River

Nutrient Parameter	Sample Timeframe	Sample Size	Min[a]	Max	Median
NO_3+NO_2, mg/L	2003–2013	15	<0.01	0.08	<0.01
TN, mg/L	2012–2013	12	<0.04	0.16	<0.05
TP, mg/L	2003–2013	15	<0.003	0.004	<0.005
Chlorophyll-*a*, mg/m^2	2012	4 (2 visual[b])	8.6	27.5	18.1
AFDM, g/m^2	2012	2	18.7	74.7	46.7
Macroinvertebrate HBI	2003–2012	10	1.94	3.52	2.61
Periphyton	2006–2012	6	17.69%	71.32%	18.18%

[a] Values preceded by a "<" symbol are detection limits for that parameter. The actual sample value was below the detection limit
[b] Visually estimated to be less than 50 mg/m2

Table 5-4. Assessment Method Evaluation Results for East Fork Yaak River

Nutrient	Sample Size	Target Value (mg/L)	Target Exceed -ances	Binomial Test Result	T-test Result	Chl-*a* Test Result	AFDM Test Result	Macro Test Result	Peri-phyton	TMDL Required
NO_3+NO_2	15	0.10	0	PASS	PASS	PASS	FAIL	PASS	FAIL	**YES**
TN	12	0.275	0	PASS	PASS					NO
TP	15	0.025	0	PASS	PASS					NO

5.4.4 Nutrient TMDL Development Summary

Based on the assessment results, one nutrient TMDLs will be developed as summarized in **Table 5-5**.

Table 5-5. Nutrient TMDL Summary for the Yaak TMDL Planning Area

Stream Segment	Waterbody ID	TMDL
EAST FORK YAAK RIVER, headwaters to mouth (Yaak River)	MT76B002_070	NO_3+NO_2

5.5 Source Assessment and Quantification

This section summarizes the approach used for the source assessment, TMDL, and allocations, and then presents the source assessment results, TMDL, allocations, and estimated reductions necessary to meet water quality targets for each nutrient impaired stream.

5.5.1 Source Assessment Approach

Source characterization was conducted by using aerial photos, Geographic Information System (GIS) analysis, field work, phone interviews, and literature reviews to determine the potential major sources of nutrients in the East Fork Yaak River watershed. There are no permitted point sources in the watershed. Therefore, nutrient loading is coming from two source types: 1) natural sources derived from airborne deposition, vegetation, soils, and geologic weathering; and 2) human-caused NPSs dispersed across the landscape (e.g., mining, septic, grazing, residential development, and timber harvest).

Because of human sources in the watershed, no monitoring data could be used to estimate natural background nutrient loading. Natural background loading was estimated by using the median concentration from the reference nutrient dataset for NO_3+NO_2 in the Level III Northern Rockies Ecoregion (as described in Suplee and Watson (2013) and Suplee et al. (2008)): NO_3+NO_2 = 0.009. Monitoring data collected in the project area from 2003 through 2013 were analyzed to determine existing loads at various locations throughout the impaired streams.

5.5.2 TMDL and Allocations Summary

An NO_3+NO_2 TMDL will be developed for the East Fork Yaak River. Because streamflow varies seasonally, TMDLs are not expressed as a static value, but as an equation of the appropriate target multiplied by flow as shown in **Equation 5-1**. As flow increases, the allowable load (TMDL) increases as shown by the NO_3+NO_2 TMDL example in **Figure 5-2.** Like the water quality targets, the TMDLs are applied only to the summer growing season (July 1^{st} through Sept 30^{th}). For each stream, A TMDL example is presented for the East Fork Yaak River based on measured flows and the highest growing season concentration, but the range of reductions necessary based on all growing season sampling data is also discussed.

Equation 5-1*: TMDL (lbs/day) = (X) (Y) (k)*

X = water quality target in mg/L (NO_3+NO_2 = 0.1 mg/L)
Y = streamflow in cubic feet per second (cfs)
k = conversion factor of 5.4

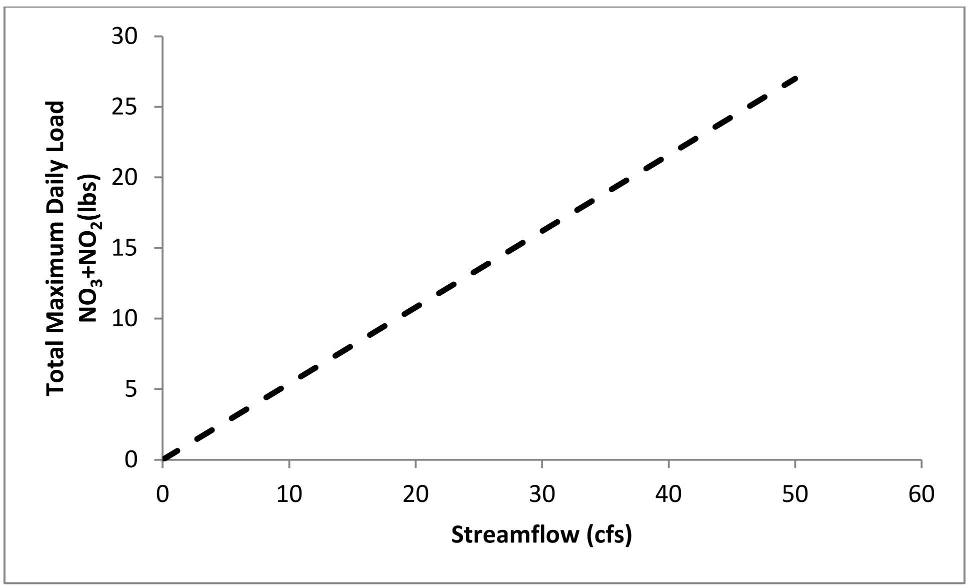

Figure 5-2. Example TMDL for NO_3+NO_2 for Streamflow Ranging from 0 to 50 cfs

Because a simple approach was used for the source assessment and all sources are NPSs, the TMDL allocations for the East Fork Yaak River are broken into an LA to natural background and a composite LA to all human-caused NPSs. Therefore, the equation for all nutrient TMDLs is as follows:

$$\text{TMDL} = \text{LA}_{\text{Natural Background}} + \text{LA}_{\text{Human Sources}}$$

The $\text{LA}_{\text{Human Sources}}$ is calculated by subtracting the $\text{LA}_{\text{Natural Background}}$ from the TMDL. Because there are no point sources, the WLA is 0. All nutrient TMDLs include an implicit MOS, which is based on the conservative assumptions described in **Section 5.6.2**.

5.5.2.1 Meeting Allocations

Allocations are intended to be met by implementation of BMPs. The first step toward meeting the nutrient allocations involves applying and/or maintaining land management practices or BMPs that will reduce nutrient loading. Once these actions have been completed at a given location, the landowner or land manager will have taken action consistent with the intent of the nutrient allocations for that location. For many NPSs, it can take several years to achieve the full load reduction at the location of concern, even though full BMP implementation is in effect. For example, it may take several years for riparian areas to fully recover and decrease nutrient loading after implementing grazing BMPs. It is also important to apply proper BMPs and other water quality protection practices for all new or changing land management activities to limit any potential increased nutrient loading.

Progress towards TMDL and individual allocation achievement can be gaged by BMP implementation and improvement in or attainment of water quality targets defined in **Section 5.4.2**. Any effort to calculate loads and percent reductions for purposes of comparison to TMDLs and allocations in this document should be accomplished via the same methodology used to develop the loads and percent reductions presented within this document.

5.5.3 East Fork Yaak River

5.5.3.1 Assessment of Water Quality Results

As stated in **Section 5.4.3.1**, all water quality concentrations for NO_3+NO_2, TN and TP were less than target concentrations. The water quality assessment failed due to exceedances of biometric targets, specifically AFDM and periphyton at several sampling sites on the East Fork Yaak River. The existing NO_3+NO_2 listing was retained from previous assessments. However, the source assessment will examine potential nutrient loading from all parameters.

Available instream water quality data for the East Fork Yaak River were mostly below detection limits for NO_3+NO_2 (11 of 15), TN (7 of 12), and TP (11 of 15). Where data are above detection limits, there are no clear sources of nutrient inputs given existing land uses. The exceedances of biometric measures including AFDM and periphyton occurred at sampling locations in the lower half of the assessment unit (**Table 5-6**).

Table 5-6. Biometric Criteria Exceedances in the East Fork Yaak River, 2006–2012

Parameter	Site ID	Site Description	Collection Date	Value	Target
Periphyton	K03YAKER04	50 yards upstream of Road 8025 crossing (nr mouth)	9/7/2006	65.00%	<51%
	K03YAKER05	0.5 mi downstream of Solo Joe Creek	9/12/2008	71.32%	
Ash Free Dry Mass (AFDM)	K03YAKER07	0.5 mi downstream of Basin Creek	8/29/2012	74.7 g/m^2	≤35 g/m^2

Of the three biometric exceedances, only one sampling event included water quality sample collection. TN, TP and NO_3+NO_2 were all non-detects for samples collected at K03YAKER07 on 8/29/2012.

A variety of potential source pathways were reviewed given existing land uses in the watershed. Forestry practices, roads, and agriculture in addition to lake dynamics were investigated. The water chemistry data collected from 2003 to 2013 were unable to provide clues as to the sources for the biometric exceedances. All exceedances were downstream of the Basin Creek confluence with the East Fork Yaak River. Land uses in this portion of the watershed are mostly recreation with very limited recent timber harvesting operations on USFS administered lands.

5.5.3.2 Source Assessment

The East Fork Yaak River watershed is located northeast of the community of Yaak, Montana, and contains lands primarily administered by the Kootenai National Forest with two private inholdings on Porcupine Creek/Basin Creek and on Windy Creek. The predominant human sources that could contribute nutrients to the East Fork Yaak River are timber harvest and grazing on private lands. Each of the potential human sources is discussed below, followed by an analysis of the sources.

Grazing

Currently, there is less cattle and stock grazing in the watershed on both private and public lands than in the past. The private inholding at the confluence of Basin and Porcupine Creeks no longer runs cattle on the property and likely has not for at least 5–10 years based on aerial imagery. There are a few USFS grazing leases in adjoining basins to the east (Scalp Mountain, West Kootenai) from which some stock may wander into the East Fork Yaak River watershed although potential impacts would likely be minimal (**Figure A-13**). The Upper Ford grazing lease does slightly overlap the watershed near the mouth, but given the terrain and cover in this small piece (450 acres), it is likely having negligible impact on water quality in the mainstem.

Timber Harvest

Timber harvest has the potential to affect nutrient loading because it can affect water yield and peak flows and also because it affects biometrical uptake and nutrient cycling in the soil. Timber harvest has long been a land use in the watershed, but since nutrient concentrations tend to return to normal within 2–3 years post-harvest (Feller and Kimmins, 1984; Likens et al., 1978; Martin and Harr, 1989), the assessment of the potential for harvest-related NO_3+NO_2 loading focused on recent harvest activity. According to the Kootenai National Forest, significant timber harvesting has not occurred in the watershed since the mid-1980s when large scale lodgepole pine salvage operations were completed. Some harvesting also occurred in the early 1990s in the Basin Creek watershed and the mid-1990s in the Windy Creek watershed. However, harvest operations in the past 5 years have been minimal, with approximately 1,350 acres harvested between 2009 and 2012.

Mining

Mining could be a source of NO_3+NO_2 to the East Fork Yaak River because it is a byproduct of explosives used during mining. However, mining activities in the watershed and are limited to two mineral deposits on the western flank of Mount Henry, the Solo Joe Creek placer operation on the mainstem of the East Fork Yaak River and the Phillips Mine (**Figure A-20**). The workings of the Phillips mine were described as an 8-foot prospect into the hillside (Johns, 1961). The Solo Joe placer was operated in the early 1900s and again in 1938–1940 with total production relatively small and disturbance limited to about ½ acre (Johns, 1961). Mining is not believed to be an appreciable source of nutrients.

Recreation

Possible nutrient sources from recreation include Okaga Lake and a USFS camping site at Caribou Creek. Okaga Lake is a private, earthen, top-release dam built in 1950 on Windy Creek. It is possible that the lake could be a source of nutrients to Windy Creek during fall turnover; however, it is not believed to be an appreciable source. The lake is a 103-acre dammed impoundment on Windy Creek with a total storage of 843 ac. ft. and an average depth of 8.2 ft.

The USFS maintains the Caribou Creek campground close to the mouth of Caribou Creek at the East Fork Yaak River. The facility includes three campsites and one vault toilet with no potable water available. It is considered a negligible source of nutrients to the East Fork Yaak River.

Loading Analysis

Based on the potential sources of NO_3+NO_2 or other nutrients from land-use practices in the watershed, no one land use may be singled out as the likely source of nutrients to the East Fork Yaak River. Although listed for NO_3+NO_2, the target exceedances of biometric criteria may also be caused by organic N or phosphorus as the analysis is not clear. Related to this observation, overland runoff from areas of high erosion risk near the mouth (**Figure A-9**) may be contributing sediment-bound phosphorus to the mainstem channel. These areas of high risk are overlain by andic dystrochrepts; typically presented as gravelly, ashy silt loams. Andic refers to the volcanic origin of soil parent materials and associated properties including high phosphorus retention (Schaetzl and Anderson, 2005). High in clays and, potentially phosphorus, erosion of these andic dystrochrepts could introduce phosphorus into the stream channel resulting in exceedances of biometric criteria. Although the stream was listed for sedimentation/siltation on the 1996 303(d) List, it was delisted in the late 1990s. However, localized fine sediment deposition from overland runoff to the mainstem via tributaries may be occurring.

Given the uncertainty of the nutrient source assessment, additional monitoring of the East Fork Yaak River near the mouth, springs, and groundwater in the watershed is recommended to help refine this assessment.

5.5.3.3 NO_3+NO_2 TMDL, Allocations, Current Loading, and Reductions

Based on the monitoring data, there is no identified NO_3+NO_2 load reductions for the East Fork Yaak River. Of the 15 available growing season samples in the East Fork Yaak River, none of them exceed the NO_3+NO_2 target.

Because of the uncertainty regarding human caused sources, the TMDL will be composed of two LAs: one to natural background sources and the other to all human sources (e.g., mining, timber harvest, recreation, etc.) (**Table 5-7**). Additional monitoring and refinement of the source assessment is recommended in the future to better identify source loadings from the river and the source of non-mining related loading.

Table 5-7. Example NO_3+NO_2 TMDL for East Fork Yaak River

Allocation	Source Category	Current Load (lbs/day)[a]	% Reduction	Allocation (lbs/day)	Rationale/Assumptions[a]
Load Allocation	Natural Background	1.38	0%	1.38	Assumes a natural background concentration of 0.009 mg/L NO_3+NO_2, which is the median NO_3+NO_2 concentration from the reference dataset for the Northern Rockies ecoregion
	Mining, Timber Harvest, and Other Human Sources	6.28	0%	13.93	Assumes a concentration of 0.05 minus natural background (0.009) for an estimated instream concentration of 0.041
TMDL	All Sources	7.66	0%	15.31	

[a] Based on a detection limit for samples and the median flow of 28.35 cfs (*n*=10) for samples collected downstream of the Basin Creek confluence; all samples in this reach were non-detect for NO_3+NO_2 but this reach includes the sites where biometric criteria were exceeded ; the TMDL is based on the NO_3+NO_2 target of 0.100 mg/L.

As stated previously in **Section 5.4.3.1**, no nutrient parameter was above instream target concentrations in the East Fork Yaak River dataset. However, exceedances of target thresholds for biometric criteria were found at three sampling sites downstream of the Basin Creek confluence. A source assessment was not able to conclusively determine what source and what parameter may be leading to exceedances of periphyton and AFDM thresholds, however, a possible source of sediment bound phosphorus was identified in the lower river near the mouth in areas upgradient of where periphyton and AFDM targets were exceeded. Further investigation is warranted.

5.6 Seasonality and Margin of Safety

Seasonality and MOS are both required elements of TMDL development. This section describes how seasonality and MOS were applied during development of the East Fork Yaak River nutrient TMDL.

5.6.1 Seasonality

Addressing seasonal variations is an important and required component of TMDL development and throughout this plan seasonality is an integral consideration. Specific examples of how seasonality has been addressed within this document include:

- Water quality targets and subsequent allocations are applicable for the summer-time growing season (July 1st – Sept 30th), to coincide with seasonal algal growth targets.
- Nutrient data used to determine compliance with targets and to establish an allowable load was collected during the summer-time period to coincide with applicable nutrient targets.

5.6.2 Margin of Safety

An MOS is a required component of TMDL development. The MOS accounts for the uncertainty about the pollutant loads and the quality of the receiving water and is intended to protect beneficial uses in the face of this uncertainty. The MOS may be applied implicitly by using conservative assumptions in the TMDL development process or explicitly by setting aside a portion of the allowable loading (U.S. Environmental Protection Agency, 1999). This plan addresses MOS implicitly in a variety of ways:

- A static nutrient target value (i.e., 0.100 mg/L NO_3+NO_2) was used to calculate the allowable load (TMDL). Allowable exceedances of nutrient targets were not incorporated into the calculation of an allowable load, thereby adding a MOS to established allocations.
- Target values were developed to err on the conservative side of protecting beneficial uses.
- By considering seasonality (discussed above) and variability in nutrient loading.
- By using an adaptive management approach to evaluate target attainment and allow for refinement of LA, assumptions, and restoration strategies to further reduce uncertainties associated with TMDL development (**Section 5.7**).

5.7 Uncertainty and Adaptive Management

Uncertainties in the accuracy of field data, nutrient targets, source assessments, loading calculations, and other considerations are inherent when assessing and evaluating environmental variables for TMDL development. However, mitigation and reduction of uncertainties through adaptive management approaches is a key component of ongoing TMDL implementation and evaluation. The process of adaptive management is predicated on the premise that TMDL targets, allocations, and the analyses supporting them may evolve, but are processes subject to modification and adjustment as new information and relationships are understood. Uncertainty is inherent in both the water quality data-based and model-based modes of assessing nutrient sources and needed reductions.

There is uncertainty associated with the East Fork Yaak River source assessment and additional monitoring is recommended to refine it. It is not clear what sources are contributing to the impairment or if the impairment is caused strictly by NO_3+NO_2 or if organic nitrogen or phosphorus are responsible for the biometric target threshold exceedances. Additional monitoring to assist with source assessment should help refine the impairment status.

6.0 Water Quality Improvement Plan

6.1 Summary of Restoration Strategy

This section describes an overall strategy and specific on-the-ground measures designed to restore beneficial water uses and attain water quality standards in the East Fork Yaak River. The strategy includes general measures for reducing loading from each significant identified pollutant source.

This section should assist stakeholders in developing a more detailed adaptive Watershed Restoration Plan (WRP) in the future. The locally developed WRP will likely provide more detailed information about restoration goals and spatial considerations within the watershed. The WRP may also encompass broader goals than the focused water quality restoration strategy outlined in this document. The intent of the WRP is to serve as a locally organized "road map" for watershed activities, sequences of projects, prioritizing types of projects, and funding sources towards achieving local watershed goals, including water quality improvements. Within this plan, the local stakeholders would identify and prioritize streams, tasks, resources, and schedules for applying BMPs. As restoration experiences and results are assessed through watershed monitoring, this strategy could be adapted and revised by stakeholders based on new information and ongoing improvements.

6.2 Role of DEQ, Other Agencies, and Stakeholders

The DEQ does not implement TMDL pollutant reduction projects for NPS activities, but can provide technical and financial assistance for stakeholders interested in improving their water quality. Successful implementation of TMDL pollutant reduction projects requires collaboration among private landowners, land management agencies, and other stakeholders. The DEQ will work with participants to use the TMDLs as a basis for developing locally-driven WRPs, administer funding specifically to help support water quality improvement and pollution prevention projects, and help identify other sources of funding.

Because most NPS reductions rely on voluntary measures, it is important that local landowners, watershed organizations, and resource managers work collaboratively with local and state agencies to achieve water quality restoration to meet TMDL targets and load reductions. Specific stakeholders and agencies that will likely be vital to restoration efforts for streams discussed in this document include the USFS, U.S. Fish and Wildlife Service, NRCS, Montana Department of Natural Resources & Conservation (DNRC), FWP, EPA, and DEQ. Other organizations and non-profits that may provide assistance through technical expertise, funding, educational outreach, or other means include the Yaak Valley Forest Council, Montana Trout Unlimited, Montana Water Trust, Montana Water Center, University of Montana Watershed Health Clinic, MBMG, Montana Aquatic Resources Services, and Montana State University (MSU) Extension Water Quality Program.

6.3 Water Quality Restoration Objectives

The water quality restoration objective for the East Fork Yaak River watershed is to reduce pollutant loads as identified in this document in order to meet the water quality standards/targets for full recovery of beneficial uses to all impaired streams. In short, the restoration objective is to meet the nitrate/nitrite TMDL for the East Fork Yaak River. Based on the assessment provided in this document, the TMDL can be achieved through proper implementation of appropriate BMPs.

A WRP can provide a framework strategy for water quality restoration and monitoring in the Yaak River watershed, focusing on how to meet conditions that will likely achieve the TMDLs presented in this document or in a previous TMDL document (Montana Department of Environmental Quality, 2008), as well as other water quality issues of interest to local communities and stakeholders. WRPs identify considerations that should be addressed during TMDL implementation and should assist stakeholders in developing a more detailed adaptive plan in the future. A locally developed WRP will likely provide more detailed information about restoration goals and spatial considerations but may also encompass more broad goals than this framework includes. A WRP would serve as a locally organized "road map" for watershed activities, sequences of projects, prioritizing of projects, and funding sources for achieving local watershed goals, including water quality improvements. The WRP is intended to be a living document that can be revised based on new information related to restoration effectiveness, monitoring results, and stakeholder priorities.

The EPA lists nine minimum elements for a WRP:

- Identification of the causes and sources
- Load reductions expected for the management measures
- Description of the NPS management measures
- Estimate of the amounts of technical and financial assistance
- An information/education component
- Schedule for implementing the NPS management measures
- Description of interim, measurable milestones
- Set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress
- Monitoring component

Water quality goals for the nutrients are detailed in **Section 5.0.** These goals include water quality and habitat targets as measures for long-term effectiveness monitoring. These targets specify satisfactory conditions to ensure protection and/or recovery of beneficial uses in the East Fork Yaak River. It is presumed that the meeting of all water quality and habitat targets will signal the achievement of water quality goals for a given stream. **Section 7.0** identifies a general monitoring strategy and recommendations to track post-implementation water quality conditions and measure restoration successes.

6.4 Overview of Management Recommendations

One nutrient TMDL was completed for the East Fork Yaak River. Other streams in the watershed may be in need of restoration or pollutant reduction, but insufficient information about them precludes TMDL formation at this time. The following sub-sections describe some generalized recommendations for implementing projects to achieve the TMDL. Details specific to the East Fork Yaak River are found within **Section 5.0**.

In general, restoration activities can be separated into two categories: active and passive. Passive restoration allows natural succession to occur within an ecosystem by removing a source of disturbance. Fencing off riparian areas from cattle grazing is a good example of passive restoration. Active restoration, on the other hand involves accelerating natural processes or changing the trajectory of succession. For example, historic placer mining often resulted in the straightening of stream channels and piling of processed rock on the streambank. These impacts would take so long to recover passively that active restoration methods involving removal of waste rock and rerouting of the stream channel would likely be necessary to improve stream and water quality conditions. In general, passive restoration is preferable for sediment, temperature, and nutrient problems because it is generally more cost effective, less labor intensive, and will not result in short term increase of pollutant loads as active restoration activities may. However, in some cases active restoration is the only feasible mechanism for achieving desired goals; these activities must be assessed on a case by case basis. (http://www.nature.com/scitable/knowledge/library/restoration-ecology-13339059)

6.4.1 Nutrients Restoration Approach

The goal of the nutrient restoration strategy is to reduce nutrient input to stream channels by increasing the filtering and uptake capacity of riparian vegetation areas, decreasing the amount of bare ground, and limiting the transport of nutrients from rangeland, cropland and mined areas (including impoundments and other storage facilities).

Although agricultural land use is a minor component of the watershed, there are some BMPs such as vegetative restoration and long-term filter area maintenance that may improve some areas. Grazing systems with the explicit goal of increased vegetative post-grazing ground cover are needed to address the same nutrient loading from rangelands where grazing occurred historically or where it occurs presently in the East Fork Yaak River watershed. Grazing prescriptions that enhance the filtering capacity of riparian filter areas offer a second tier of controls on the sediment content of upland runoff. Grazing and pasture management adjustments should consider:

- The timing and duration of near-stream grazing
- The spacing and exposure duration of on-stream watering locations
- Provision of off-stream site watering areas to minimize near-stream damage and allow impoundment operations that minimize salt accumulations
- Active reseeding and rest rotation of locally damaged vegetation stands
- Improved management of irrigation systems
- Incorporation of streamside vegetation buffer to irrigated croplands and animal feeding areas

In general, these are sustainable grazing and cropping practices that can reduce nutrient inputs while meeting production goals. Sound planning combined with effective conservation BMPs should be sought whenever possible. Assistance from resource professionals from various local, state, and federal agencies or non-profit groups is widely available in Montana. The local USDA Service Center and county conservation district offices are geared to offer both planning and implementation assistance.

In addition to the agricultural related BMPs, a reduction of sediment delivery from roads and eroding streambanks is another component of the nutrient reduction restoration plan, particularly where excess phosphorus is a problem. This may address a possible source pathway of phosphorus to the East Fork Yaak River to the mainstem downstream of the Basin Creek confluence.

6.5 Restoration Approaches by Source

General management recommendations are outlined below for the major sources of human caused pollutant loads in the East Fork Yaak River watershed: grazing, upland sources, riparian and wetland vegetation removal, and roads. Applying BMPs is the core of the NPS pollutant reduction strategy, but BMPs are only part of a watershed restoration strategy. For each major source, BMPs will be most effective as part of a comprehensive management strategy. The WRP, developed by local watershed groups, should contain more detailed information on restoration goals and specific management recommendations that may be required to address key pollutant sources. BMPs are usually identified as a first effort and further monitoring and evaluation of activities and outcomes, as part of an adaptive management approach will be used to determine if further restoration approaches are necessary to achieve water quality standards. Monitoring is an important part of the restoration process. Monitoring recommendations are outlined in **Section 7.0**.

6.5.1 Agriculture Sources

Reduction of pollutants from upland agricultural sources can be done by limiting the amount of erodible soil, reducing the rate of runoff, and intercepting eroding soil and runoff before it enters a waterbody. The main BMP recommendations for the East Fork Yaak River are riparian buffers, wetland restoration, and vegetated filter strips, where appropriate. These methods reduce the rate of runoff, promote infiltration of the soil (instead of delivering runoff directly to the stream), and intercept pollutants. Filter strips and buffers are even more effective for reducing upland agricultural related sediment when used in conjunction with BMPs that reduce the availability of erodible soil. Additional BMP information, design standards and effectiveness, and details on the suggested BMPs can be obtained from your local USDA Agricultural Service Center and in Montana's Nonpoint Source Management Plan (Montana Department of Environmental Quality, 2012b).

An additional benefit of reducing sediment input to the stream is a decrease in sediment-bound nutrients. Reductions in sediment loads may help address some nutrient related problems. Nutrient management considers the amount, source, placement, form, and timing of plant nutrients and soil amendments. Conservation plans should include the following information (NRCS MT 590-1):

- Field maps and soil maps
- Planned crop rotation or sequence
- Results of soil, water, plant, and organic materials sample analysis
- Realistic expected yields
- Sources of all nutrients to be applied
- A detailed nutrient budget
- Nutrient rates, form, timing, and application method to meet crop demands and soil quality concerns
- Location of designated sensitive areas
- Guidelines for operation and maintenance

6.5.1.1 Grazing

Grazing has the potential to increase sediment and nutrient loads, as well as stream temperatures (by altering channel width and riparian vegetation), but these effects can be mitigated with appropriate management. Development of riparian grazing management plans should be a goal for any landowner in the watershed who operates livestock and does not currently have such plans. Private land owners may be assisted by state, county, federal, and local conservation groups to establish and implement appropriate grazing management plans. Note that riparian grazing management does not necessary eliminate all grazing in riparian corridors. Nevertheless, in some areas, a more limited management strategy may be necessary for a period of time in order to accelerate re-establishment of a riparian community with the most desirable species composition and structure.

Every livestock grazing operation should have a grazing management plan. The plan should at least include the following elements:

- A map of the operation showing fields, riparian and wetland areas, winter feeding areas, water sources, animal shelters, etc.
- The number and type of livestock
- Realistic estimates of forage needs and forage availability
- The size and productivity of each grazing unit (pasture/field/allotment)
- The duration and time of grazing
- Practices that will prevent overgrazing and allow for appropriate regrowth
- Practices that will protect riparian and wetland areas and associated water quality
- Procedures for monitoring forage use on an ongoing basis
- Development plan for off-site watering areas

Reducing grazing pressure in riparian and wetland areas and improving forage stand health are the two keys to preventing NPS pollution from grazing. Grazing operations should use some or all of the following practices:

- Minimizing or preventing livestock grazing in riparian and wetland areas
- Providing off-stream watering facilities or using low-impact water gaps to prevent 'loafing' in wet areas
- Managing riparian pastures separately from upland pastures
- Installing salt licks, feeding stations, and shelter fences to prevent 'loafing' in riparian areas
- Replanting trodden down banks and riparian and wetland areas with native vegetation (this should always be coupled with a reduction in grazing pressure)
- Rotational grazing or intensive pasture management

The following resources provide guidance to help prevent pollution and maximize productivity from grazing operations:

- Plum Creek Timber Company's Native Fish Habitat Conservation Plan (http://www.plumcreek.com/Environment/nbspSustainableForestrySFI/nbspSFIImplementation/HabitatConservationPlans/tabid/153/Default.aspx)
- USDA-NRCS. You can find your local USDA Agricultural Service Center listed in your phone directory or on the Internet at www.nrcs.usda.gov
- MSU Extension Service (www.extn.msu.montana.edu)
- DEQ Watershed Protection Section, Nonpoint Source Program – Nonpoint Source Management Plan (http://deq.mt.gov/wqinfo/nonpoint/NonpointSourceProgram.mcpx)

The key strategy of the recommended grazing BMPs is to develop and maintain healthy riparian and wetland vegetation and minimize disturbance of the streambank and channel. The primary recommended BMPs for the East Fork Yaak River are limiting livestock access to streams and stabilizing the stream at access points, providing off-site watering sources when and where appropriate, planting native stabilizing vegetation along streambanks, and establishing and maintaining riparian buffers. Although bank revegetation is a preferred BMP, in some instances bank stabilization may be necessary prior to planting vegetation. DEQ does recognize that, currently, grazing pressure from cattle and horses in the East Fork Yaak River watershed is quite low.

6.5.2 Forestry and Timber Harvest

The East Fork Yaak River is part of one of the best timber growing regions in Montana. As a result it has been impacted by historical timber harvest activities. Future harvest activities should be conducted by all landowners according to Forestry BMPs for Montana (Montana State University, Extension Service, 2001) and the Montana Streamside Management Zone (SMZ) Law (77-5-301 through 307 MCA). The Montana Forestry BMPs cover timber harvesting and site preparation, harvest design, other harvesting activities, slash treatment and site preparation, winter logging, and hazardous substances. While the SMZ Law is intended to guide commercial timber harvesting activities in streamside areas (i.e., within 50 feet of a waterbody), the riparian protection principles behind the law can be applied to numerous land management activities (i.e. timber harvest for personal use, agriculture, development). Prior to harvesting on private land, landowners or operators are required to notify DNRC. DNRC is responsible for assisting landowners with BMPs and monitoring their effectiveness. The Montana Logging Association and DNRC offer regular Forestry BMP training sessions for private landowners.

The SMZ Law protects against excessive erosion and therefore is appropriate for helping meet sediment LAs. USFS Inland Native Fish Strategy (INFISH) Riparian Habitat Conservation Area guidelines provide significant sediment protection as well as protection from elevated thermal loading (i.e., elevated temperature) by providing adequate shade. This guidance improves upon Montana's SMZ law and includes an undisturbed 300 foot buffer on each side of fish bearing streams and 150 foot buffer on each side of non-fish bearing streams with limited exclusions and BMP guidance for timber harvest, roads, grazing, recreation and other human sources (U.S. Department of Agriculture, Forest Service, 1995). The Kootenai National Forest adheres to these guidelines.

In addition to the BMPs identified above, effects that timber harvest may have on yearly streamflow levels, such as peak flow, should be considered. Water yield and peak flow increases should be modeled in areas of continued timber harvest and potential effects should be evaluated. Furthermore, increased use, construction, and maintenance of unpaved roads associated with forestry and timber harvest activities should be addressed with appropriate BMPs discussed in **Section 6.5.5**. Finally, noxious weed control should be actively pursued in all harvest areas and along all forest roads.

6.5.3 Riparian Areas, Wetlands, and Floodplains

Healthy and functioning riparian areas, wetlands, and floodplains are critical for wildlife habitat, groundwater recharge, reducing the severity of floods and upland and streambank erosion, and filtering pollutants from runoff. The performance of the above named functions is dependent on the connectivity of riparian areas, wetlands and floodplains to both the stream channel and upland areas. Anthropogenic activities affecting the quality of these transitional habitats or their connectivity can alter their performance and greatly affect the transport of water, sediments, and contaminants (e.g. channelization, increased stream power, bank erosion, and habitat loss or degradation). Therefore, restoring maintaining, and protecting riparian areas, wetlands, and floodplains within the watershed should be a priority of TMDL implementation.

Reduction of riparian and wetland vegetative cover by various land management activities is a principal cause of water quality and habitat degradation in watersheds throughout Montana. Although implementation of passive BMPs that allow riparian and wetland vegetation to recover at natural rates is typically the most cost-effective approach, active restoration (i.e. plantings) may be necessary in some instances. The primary advantage of riparian and wetland plantings is that installation can be accomplished with minimum impact to the stream channel, existing vegetation, and private property.

Factors influencing the appropriate riparian and wetland restoration would include severity of degradation, site-potential for various species, and availability of local sources for native transplant materials. In general, riparian and wetland plantings would promote establishment of functioning stands of native species. The following recommended restoration measures would allow for stabilization of the soil, decrease sediment delivery to the stream, and increase absorption of nutrients from overland runoff:

- Harvest and transplant locally available sod mats with an existing dense root mass which provide immediate promotion of bank stability and filtering nutrients and sediments.
- Transplanting mature native shrubs, particularly willows (*Salix* sp.), provides rapid restoration of instream habitat and water quality through overhead cover and stream shading as well as uptake of nutrients.
- Seeding with native graminoids (grasses and sedges) and forbs is a low cost activity at locations where lower bank shear stresses would be unlikely to cause erosion.
- Willow sprigging expedites vegetative recovery, but involves harvest of dormant willow stakes from local sources.
- ***Note***: Before transplanting *Salix* from one location to another it is important to determine the exact species so that we do not propagate the spread of non-native species. There are several non-native willow species that are similar to our native species and commonly present in Montana watersheds.

In addition to the benefits noted above, it should be noted that in some cases wetlands act as areas of shallow subsurface groundwater recharge and/or storage areas. The captured water via wetlands is then generally discharged to the stream later in the season and contributes to the maintenance of base flows and stream temperatures. Restoring ditched or drained wetlands can have a substantial effect on the quantity, temperature, and timing of water returning to a stream, as well as the pollutant filtering capacity that improved riparian and wetlands provide.

6.5.4 Unpaved Roads

Unpaved roads contribute sediment (and potentially nutrients and other pollutants) to streams in the East Fork Yaak River watershed this may occur in locations where roads cross the stream channel or closely parallel the stream such as at the hairpin turn in NF-92 in the upper East Fork Yaak River watershed. The main focus of the BMPs used to estimate reduction in loading was to reduce the contributing length to the maximum extent practicable at each crossing. Achieving this reduction in sediment loading from roads may occur through a variety of methods at the discretion of local land managers and restoration specialists. Road BMPs can be found on the Montana DEQ or DNRC websites and within Montana's NPS Management Plan (Montana Department of Environmental Quality, 2012b). Examples include:

- Providing adequate ditch relief up-grade of stream crossings
- Constructing waterbars, where appropriate, and up-grade of stream crossings
- Using rolling dips on downhill grades with an embankment on one side to direct flow to the ditch
- Insloping roads along steep banks with the use of cross slopes and cross culverts
- Outsloping low traffic roads on gently sloping terrain with the use of a cross slope
- Using ditch turnouts and vegetative filter strips to decrease water velocity and sediment carrying capacity in ditches
- For maintenance, grading materials to the center of the road and avoid removing the toe of the cutslope

- Preventing disturbance to vulnerable slopes
- Using topography to filter sediments; flat, vegetated areas are more effective sediment filters
- Where possible, limiting road access during wet periods when drainage features could be damaged

6.5.4.1 Culverts
Undersized and improperly installed and maintained culverts can be a substantial source of sediment to streams and a barrier to fish and other aquatic organisms. There are a lot of factors associated with culvert failure and it is difficult to estimate the true at-risk load. As culverts fail, they should be replaced by culverts that pass a 100 year flood on fish bearing streams and at least 25 year events on non-fish bearing streams. Some road crossings may not pose a feasible situation for upgrades to these sizes because of road bed configuration; in those circumstances, the largest size culvert feasible should be used. If funding is available, culverts should be prioritized and replaced prior to failure.

Another consideration for culvert upgrades should be fish and aquatic organism passage. Each fish barrier should be assessed individually to determine if it functions as an invasive species and/or native species barrier. These two functions should be weighed against each other to determine if each culvert acting as a fish passage barrier should be mitigated. FWP can aid in determining if a fish passage barrier should be mitigated, and, if so, can aid in culvert design.

6.5.5 Bank Hardening/Riprap/Revetment/Floodplain Development
The use of riprap or other “hard” approaches is not recommended and is not consistent with water quality protection or implementation of this plan. Although it is necessary in some instances, it generally redirects channel energy and exacerbates erosion in other places. Bank armoring should be limited to areas with a demonstrated threat to infrastructure. Where deemed necessary, apply bioengineered bank treatments to induce vegetative reinforcement of the upper bank, reduce stream scouring energy, and provide shading and cover habitat. Limit threats to infrastructure by reducing floodplain development through land-use planning initiatives.

Bank stabilization using natural channel design techniques can provide both bank stability and habitat potential. The primary recommended structures include natural or “natural-like” structures, such as large woody debris jams. These natural arrays can be constructed to emulate historical debris assemblages that were introduced to the channel by the adjacent cottonwood dominated riparian community types. When used together, woody debris jams and straight log vanes can benefit the stream and fishery by improving bank stability, reducing bank erosion rates, adding protection to fillslopes and/or embankments, reducing near-bank shear stress, and enhancing aquatic habitat and lateral channel margin complexity.

6.6 Potential Funding Sources

Funding and prioritization of restoration or water quality improvement projects is integral to maintaining restoration activities and monitoring project successes and failures. Several government agencies fund watershed or water quality improvement projects. Below is a brief summary of potential funding sources to assist with TMDL implementation.

6.6.1 Section 319 Nonpoint Source Grant Program

Section 319 grant funds are typically used to help identify, prioritize, and implement water quality protection projects with focus on TMDL development and implementation of NPS projects. Individual contracts under the yearly grant typically range from $20,000 to $150,000, with a 40% match requirement. 319 projects typically need to be administered through a non-profit or local government such as a conservation district, a watershed planning group, or a county. For information about past grant awards and how to apply, please visit http://deq.mt.gov/wqinfo/nonpoint/319GrantInfo.mcpx.

6.6.2 Future Fisheries Improvement Program

The Future Fisheries grant program is administered by FWP and offers funding for on-the-ground projects that focus on habitat restoration to benefit wild and native fish. Anyone ranging from a landowner or community-based group to a state or local agency is eligible to apply. Applications are reviewed annually in December and June. Projects that may be applicable to the East Fork Yaak River watershed include restoring streambanks, improving fish passage, and restoring/protecting spawning habitats. For additional information about the program and how to apply, please visit http://fwp.mt.gov/fishAndWildlife/habitat/fish/futureFisheries/.

6.6.3 Watershed Planning and Assistance Grants

DNRC administers Watershed Planning and Assistance Grants to watershed groups that are sponsored by a conservation district. Funding is capped at $10,000 per project and the application cycle is quarterly. The grant focuses on locally developed watershed planning activities; eligible activities include developing a watershed plan, group coordination costs, data collection, and educational activities. For additional information about the program and how to apply, please visit http://dnrc.mt.gov/cardd/LoansGrants/WatershedPlanningAssistance.asp.

Numerous other funding opportunities exist for addressing NPS pollution. Additional information regarding funding opportunities from state agencies is contained in Montana's Nonpoint Source Management Plan (Montana Department of Environmental Quality, 2012b) and information regarding additional funding opportunities can be found at http://www.epa.gov/nps/funding.html.

6.6.4 Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is administered by NRCS and offers financial (i.e., incentive payments and cost-share grants) and technical assistance to farmers and ranchers to help plan and implement conservation practices that improve soil, water, air and other natural resources on their land. The program is based on the concept of balancing agricultural production and forest management with environmental quality, and is also used to help producers meet environmental regulations. EQIP offers contracts with a minimum length of 1 year after project implementation to a maximum of 10 years. Each county receives an annual EQIP allocation and applications are accepted continually during the year; payments may not exceed $300,000 within a 6-year period. For additional information about the program and how to apply, please visit http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/.

6.6.5 Resource Indemnity Trust/Reclamation and Development Grant Program

The Resource Indemnity Trust/Reclamation and Development Grant (RIT/RDG) program is an annual program administered by DNRC that can provide up to $300,000 to address environmental related issues. This money can be applied to sites included on the Abandoned Mine Lands (AML) priority list, but of low enough priority where cleanup under AML is uncertain. RIT/RDG program funds can also be used for conducting site assessment/characterization activities such as identifying specific sources of water quality impairment. RIT/RDG projects typically need to be administered through a non-profit or local government such as a conservation district, a watershed planning group, or a county. For additional information about the program and how to apply, please visit http://dnrc.mt.gov/cardd/ResourceDevelopment/rdgp/ReclamationDevelopmentGrantsProgram.asp.

7.0 Monitoring Strategy and Adaptive Management

7.1 Introduction

The monitoring strategies discussed in this section are an important component of watershed restoration, a requirement of TMDL development under Montana's TMDL law, and the foundation of the adaptive management approach. Water quality targets and allocations presented in this document are based on available data at the time of analysis, and the data are only an estimate of a complex ecological system. The scale of the watershed analysis coupled with constraints on time and resources often result in necessary compromises that include estimations, extrapolation, and a level of uncertainty. The MOS is put in place to reflect some of this uncertainty, but other issues only become apparent when restoration strategies are underway. Having a monitoring strategy in place allows for feedback on the effectiveness of restoration activities, the level of reduction of instream pollutants (whether TMDL targets are being met), if all significant sources have been identified, and whether attainment of TMDL targets is feasible. Data from long-term monitoring programs also provide technical justifications to modify restoration strategies, targets, or allocations where appropriate.

The DEQ will continue to serve as the lead agency for developing and conducting impairment status monitoring but will work with other agencies and organizations willing to provide compatible data. The monitoring strategy presented in this section provides a starting point for the development of more detailed and locally-developed planning efforts regarding monitoring needs important to any WRP; it does not assign monitoring responsibility. Monitoring recommendations provided are intended to assist local land managers, stakeholder groups, and federal and state agencies in developing appropriate monitoring plans to meet aforementioned goals. Funding for future monitoring is uncertain and can vary with economic and political changes. Prioritizing monitoring activities depends on stakeholder priorities for restoration and funding opportunities.

7.2 Adaptive Management and Uncertainty

In accordance with the Montana Water Quality Act (MCA 75-5-703 (7) and (9)), DEQ is required to assess the waters for which TMDLs have been completed and BMPs have been applied to determine whether compliance with water quality standards has been attained. These assessments align with the adaptive management approach taken throughout the assessment and listing process.

Adaptive management, as discussed throughout this document, is a systematic approach for improving resource management by learning from management outcomes (http://www.doi.gov/initiatives/AdaptiveManagement/TechGuide/Chapter1.pdf). There is an inherent amount of uncertainty involved in the TMDL process, including: establishing appropriate water quality standards; calculating existing loads and necessary LAs; determining source assessment; and understanding effects of BMP implementation. Use of an adaptive management approach based on continued monitoring of project implementation and water quality parameters helps manage resource commitments as well as achieve success in meeting the water quality standards and supporting all beneficial uses allows for adjustments to restoration goals or pollutant targets, TMDLs, and/or allocations, as necessary.

7.3 Future Monitoring Guidance

The objectives for future monitoring in the East Fork Yaak River include: 1) strengthen the spatial understanding of sources for future restoration work, which will also strengthen source assessment analysis for future TMDL review, 2) gather additional data to supplement target analysis, better characterize existing conditions, and improve or refine assumptions made in TMDL development, 3) gather consistent information among agencies and watershed groups that is comparable to targets and allows for common threads in discussion and analysis, 4) expand the understanding of streams throughout the East Fork Yaak River watershed beyond where TMDLs have been developed and address issues if necessary, and 5) track restoration projects as they are implemented and assess their effectiveness.

7.3.1 Strengthening Source Assessment

In the East Fork Yaak River watershed, the identification of sources was conducted largely through watershed field tours, aerial assessment, the incorporation of GIS information, available data and literature review, with limited field verification and on-the-ground analysis. In many cases, assumptions were made based on overall TPA conditions and extrapolated throughout the watershed. As a result, the level of detail often does not provide specific areas by which to focus restoration efforts, only broad source categories to reduce nutrient loads from each of the discussed sub-watersheds. Strategies for strengthening source assessments for nutrients may include:

- A better understanding of nutrient concentrations in groundwater (as well as the sources) and the spatial variability of groundwater with high nutrient concentrations
- A better understanding of the cattle grazing practices and the number of animals grazed in the East Fork Yaak River
- A more detailed understanding of nutrient contributions from historical mining within the watershed
- A better understanding of septic system contributions to nutrient loading such as at the USFS Caribou Creek campground
- A review of land management practices specific to sub-watersheds of concern to determine where the greatest potential for improvement can occur for the major land-use categories
- Additional sampling in the East Fork Yaak River and tributary streams with limited data

The level of detail of the source assessment allows allocations to broad source categories and geographic areas. Additional monitoring may be helpful to better partition pollutant loading at mine sites with multiple sources. The needed refinements may require more seasonally stratified sampling or a more detailed field reconnaissance and follow-up sampling to better locate stream segments representing background loading.

7.3.2 Increase Available Data

Infrequent sampling events at a small number of sampling sites may provide some indication of overall water quality and habitat condition. However, regularly scheduled sampling at consistent locations, under a variety of seasonal conditions is the best way to assess overall stream health and monitor change in the East Fork Yaak River. As existing water quality suggests that the stream is meeting instream nutrient targets, continued monitoring of AFDM and/or periphyton may aid in determining trending conditions in the stream.

7.3.2.1 Nutrients

Water quality sampling locations for nutrients were distributed spatially along the East Fork Yaak River in order to best delineate nutrient sources. Over multiple sample seasons, sampling locations were refined to better quantify loading sources to the impaired waterbodies. Available data indicate borderline impairment, and additional data collection is recommended to strengthen the impairment determination. Source refinement will continue to be necessary to better assess nutrient loading.

It will be important to continually assess nutrient sources in a watershed with changing land uses and/or new MPDES permitted discharges to surface waters.

7.3.3 Consistent Data Collection and Methodologies

Wherever possible, it is recommended that the type of data and methodologies used to collect and analyze the information be consistent so as to allow for comparison to TMDL targets and track progress toward meeting TMDL goals.

DEQ is the lead agency for developing and conducting impairment status monitoring. However, other agencies or entities may work closely with DEQ to provide compatible data if interest arises. Impairment determinations are conducted by the state but can use data collected from other sources. The information in this section provides general guidance for future impairment status monitoring and effectiveness tracking. Future monitoring efforts should consult DEQ on updated monitoring protocols. Improved communication between agencies and stakeholders will further improve accurate and efficient data collection.

It is important to note that monitoring recommendations are based on TMDL related efforts to protect beneficial uses in a manner consistent with Montana's water quality standards. Other regulatory programs with water quality protection responsibilities may impose additional requirements to ensure full compliance with all appropriate local, State and Federal laws.

7.3.3.1 Nutrients

For those watershed groups and/or government agencies that monitor water quality, it is recommended that the same analytical procedures and reporting limits are used so that water quality data may be compared to TMDL targets (**Table 7-1**). In addition, stream discharge should be measured at time of sampling.

Table 7-1. DEQ Nutrient Monitoring Parameter Requirements

Analyte	Preferred Method	Alternate Method	Required Reporting Limit (ppb)	Holding Time (days)	Bottle	Preservative
Total Persulfate Nitrogen (TPN)	A4500-NC	A4500-N B	40	28	250mL HDPE[a]	≤6°C (7d HT); Freeze (28d HT)
Total Phosphorus as P	EPA-365.1	A4500-P F	3			H2S04, ≤6°C of Freeze
Nitrate-Nitrite as N	EPA-353.2	A4500-N03 F	10			

[a] High-density polyethylene

7.3.4 Effectiveness Monitoring for Restoration Activities

As restoration activities are implemented, monitoring is valuable to determine whether restoration activities are improving water quality, instream flow, and aquatic habitat and communities. Monitoring can help attribute water quality improvements to restoration activities and ensure that restoration activities have been implemented and are functioning effectively. Restoration projects will often require additional maintenance after initial implementation to ensure functionality. It is important to remember that degradation of aquatic resources happens over many decades and that restoration is often also a long-term process. An efficiently executed long-term monitoring effort is an essential component to any restoration effort.

Due to the natural high variability in water quality conditions, trends in water quality are difficult to define and even more difficult to relate directly to restoration or other changes in management. Improvements in water quality or aquatic habitat from restoration activities will most likely be evident in fine sediment deposition and channel substrate embeddedness, changes in channel cumulative width/depths, improvements in bank stability and riparian habitat, increases in instream flow, and changes in communities and distribution of fish and other bio-indicators. Specific monitoring methods, priorities, and locations will depend heavily on the type of restoration projects implemented, landscape or other natural setting, the land-use influences specific to potential monitoring sites, and budget and time constraints.

As restoration activities begin throughout the watershed, pre and post monitoring to understand the change that follows implementation will be necessary to track the effectiveness of specific projects. Monitoring activities should be selected such that they directly investigate those subjects that the project is intended to effect, and when possible, linked to targets and allocations in the TMDL.

7.3.5 Watershed Wide Analyses

Recommendations for monitoring in the watershed should not be confined to only the East Fork Yaak River. The water quality targets presented herein are applicable to all streams in the watershed, and the absence of a stream from the State’s 303(d) list does not necessarily imply a stream that fully supports all beneficial uses. Furthermore, as conditions change over time and land management evolves, consistent data collection methods throughout the watershed will allow resource professionals to identify problems as they occur, and to track improvements over time.

8.0 Stakeholder and Public Participation

Stakeholder and public involvement is a component of TMDL planning supported by EPA's guidelines and required by Montana state law (MCA 75-5-703, 75-5-704) which directs DEQ to consult with watershed advisory groups and local conservation districts during the TMDL development process. Technical advisors, stakeholders and interested parties, state and federal agencies, interest groups, and the public were solicited to participate in differing capacities throughout the TMDL development process in the Yaak TPA.

8.1 Participants and Roles

Throughout completion of the East Fork Yaak River nutrient TMDLs, DEQ worked with stakeholders to keep them apprised of project status and solicited input from a TMDL advisory group. A description of the participants in the development of the TMDLs in the Yaak TPA and their roles is contained below.

8.1.1 Montana Department of Environmental Quality

Montana state law (MCA 75-5-703) directs DEQ to develop all necessary TMDLs. DEQ has provided resources toward completion of these TMDLs in terms of staff, funding, internal planning, data collection, technical assessments, document development, and stakeholder communication and coordination. DEQ has worked with other state and federal agencies to gather data and conduct technical assessments. DEQ has also partnered with watershed organizations to collect data and coordinate local outreach activities for this project.

8.1.2 U.S. Environmental Protection Agency

EPA is the federal agency responsible for administering and coordinating requirements of the CWA. Section 303(d) of the CWA directs states to develop TMDLs (see **Section 1.1**), and EPA has developed guidance and programs to assist states in that regard. EPA has provided funding and technical assistance to Montana's overall TMDL program and is responsible for final TMDL approval. Project management was primarily provided by the EPA Regional Office in Helena, Montana.

8.1.3 TMDL Advisory Group

The Yaak TPA TMDL Advisory Group consisted of selected resource professionals who possess a familiarity with water quality issues and processes in the Yaak TPA, and also representatives of applicable interest groups. All members were solicited to participate in an advisory capacity per Montana state law (75-5-703 and 704). DEQ requested participation from the interest groups defined in MCA 75-5-704 and included local county representatives, livestock-oriented and farming-oriented agriculture representatives, conservation groups, watershed groups, state and federal land management agencies, and representatives of recreation and tourism interests. The advisory group also included additional stakeholders and landowners with an interest in maintaining and improving water quality and riparian resources.

Advisory group involvement was voluntary and the level of involvement was at the discretion of the individual members. Members had the opportunity to provide comment and review of technical TMDL assessments and reports and to attend meetings organized by DEQ for the purpose of soliciting feedback on project planning. Typically, draft documents were released to the advisory group for review under a limited timeframe, and their comments were then compiled and evaluated. Final technical decisions regarding document modifications resided with DEQ.

Communications with the group members was typically conducted through email and draft documents were made available through DEQ's wiki for TMDL projects (http://montanatmdlflathead.pbworks.com). Opportunities for review and comment were provided for participants at varying stages of TMDL development, including opportunity for review of the draft TMDL document prior to the public comment period.

8.2 Response to Public Comments

Upon completion of the draft TMDL document, and prior to submittal to EPA, DEQ issues a press release and enters into a public comment period. During this timeframe, the draft TMDL document is made available for general public comment, and DEQ addresses and responds to all formal public comments.

The public review period began on May 6, 2014, and ended on June 4, 2014. DEQ made the draft document available to the public, solicited public input and comments, and announced a public meeting at which the TMDLs were presented to the public. These outreach efforts were conducted via emails to watershed advisory group members and other interested parties, posts on the DEQ website, notices posted at the Yaak Mercantile and the Yaak Community Center, and an announcement in the Western News (Troy). DEQ provided an overview of the nutrient TMDLs at a public presentation in Yaak on May 12, 2014.

No public comments were received by DEQ for the *East Fork Yaak River Nutrient Total Maximum Daily Loads* during the public comment period.

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APPENDIX A – MAPS

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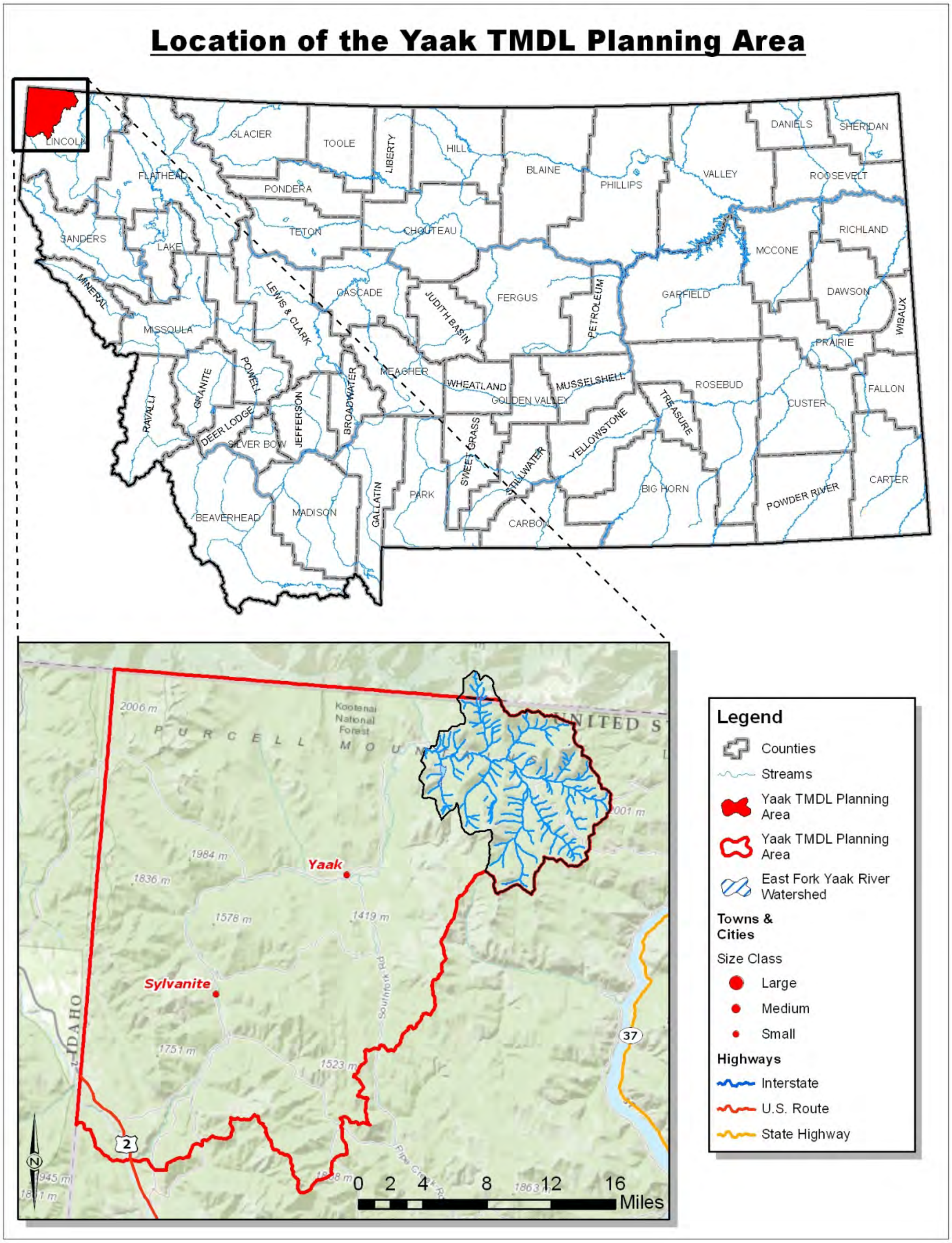

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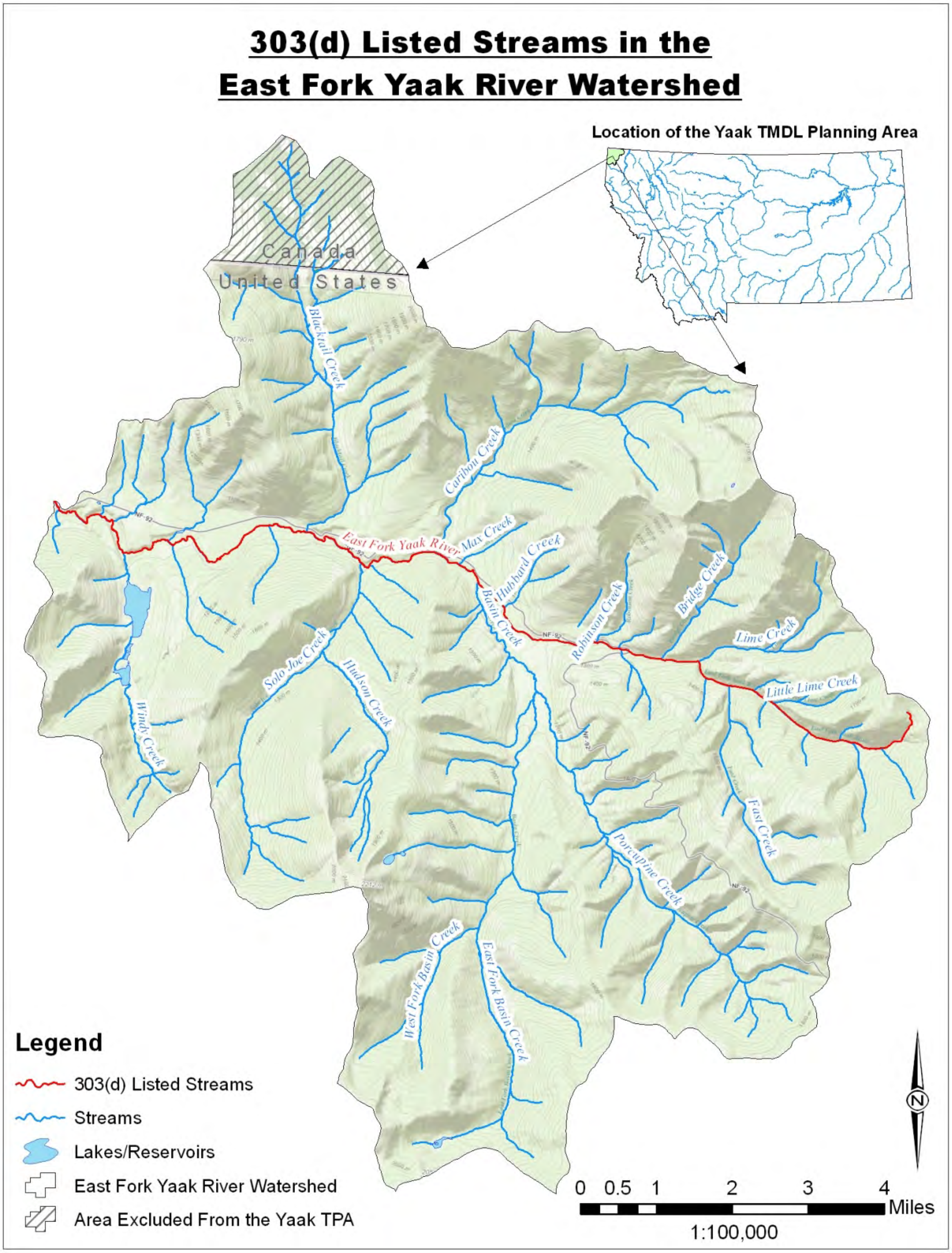

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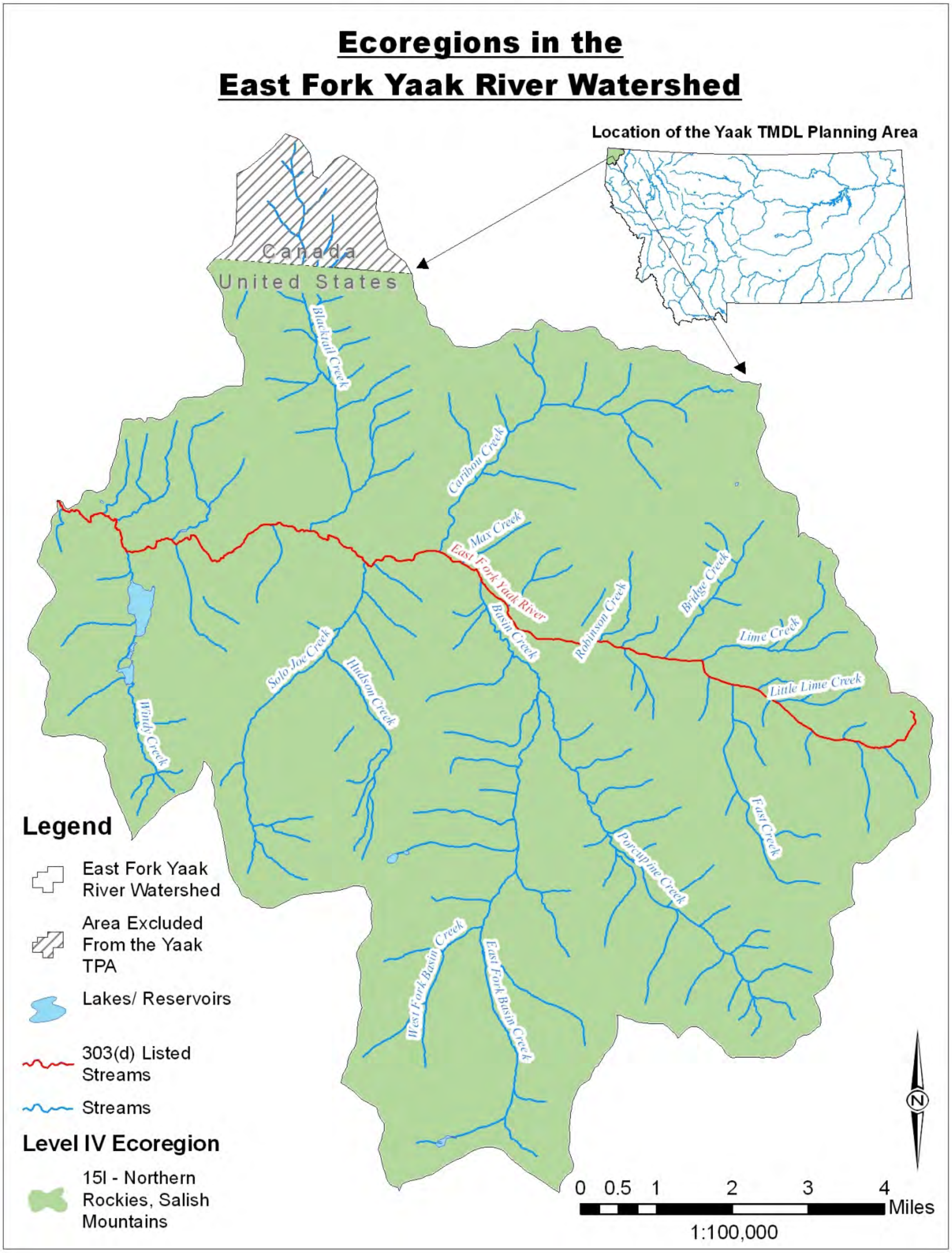

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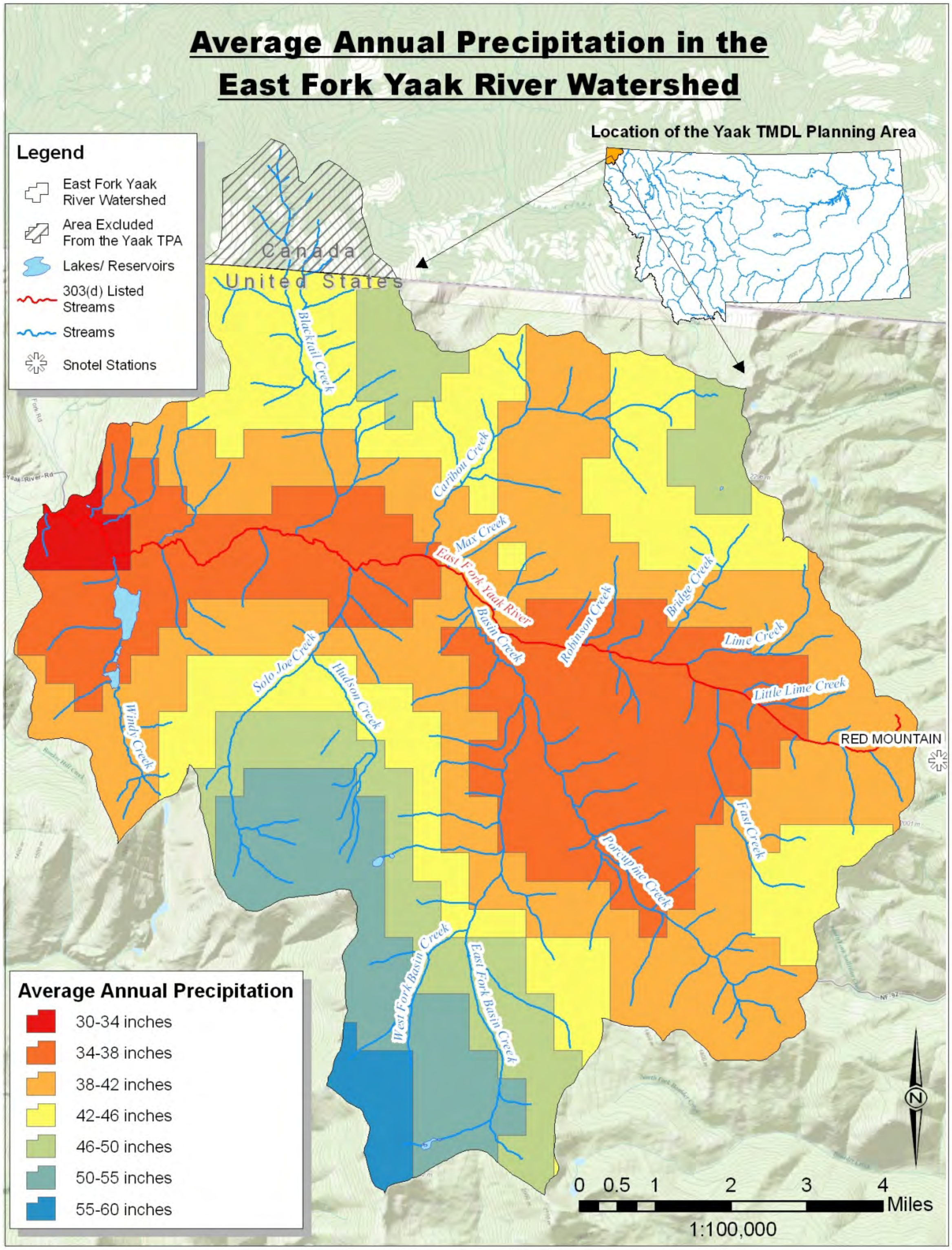

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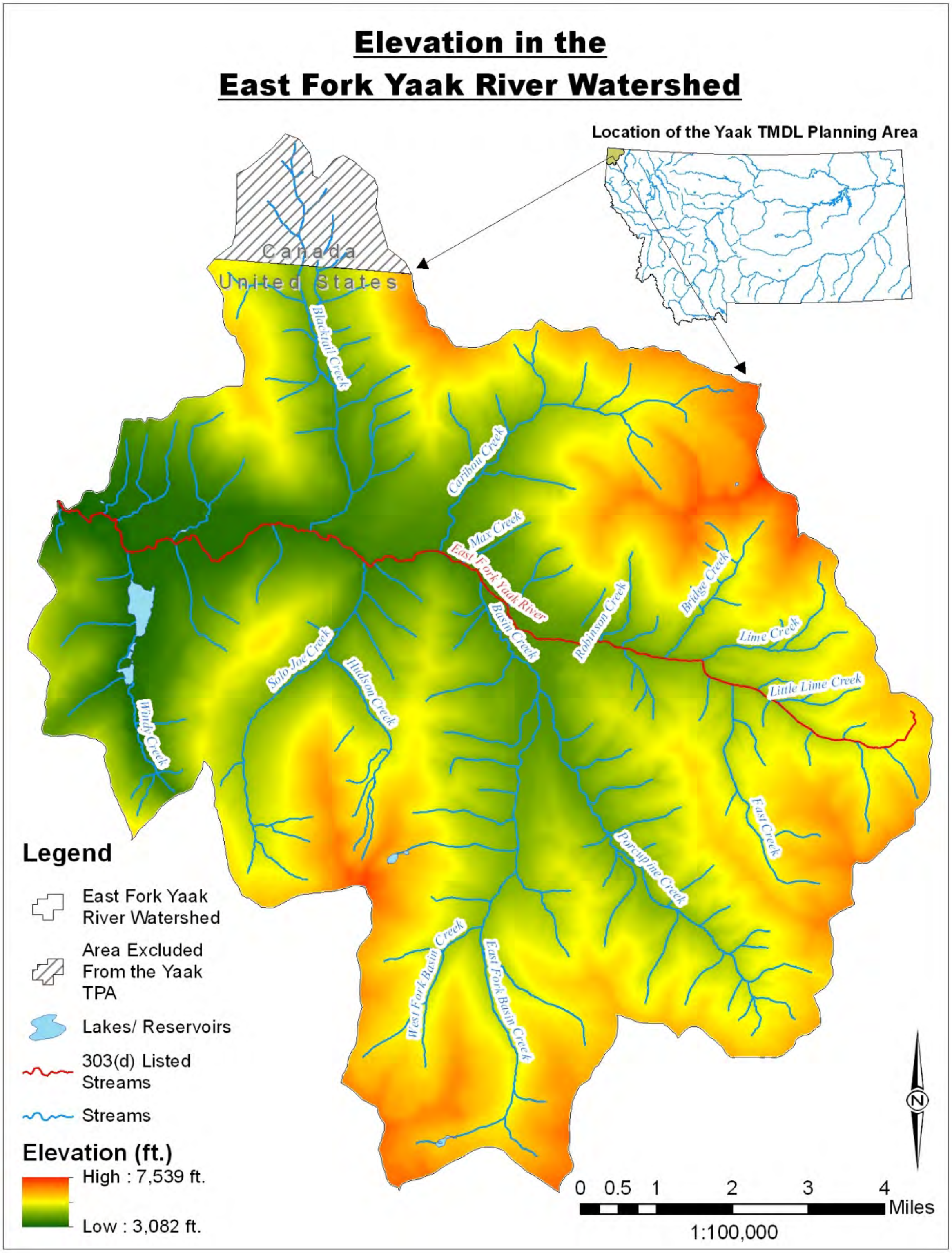

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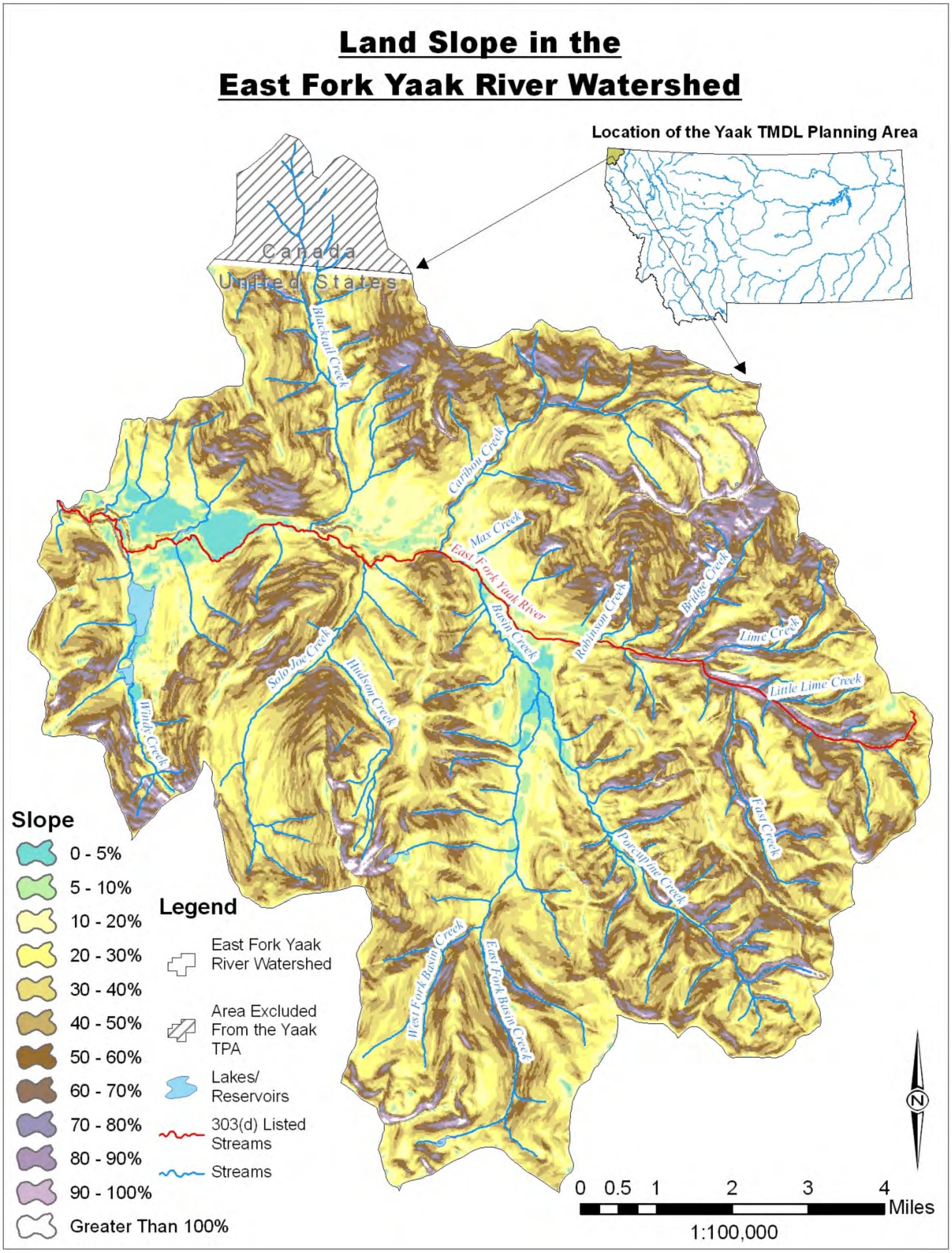

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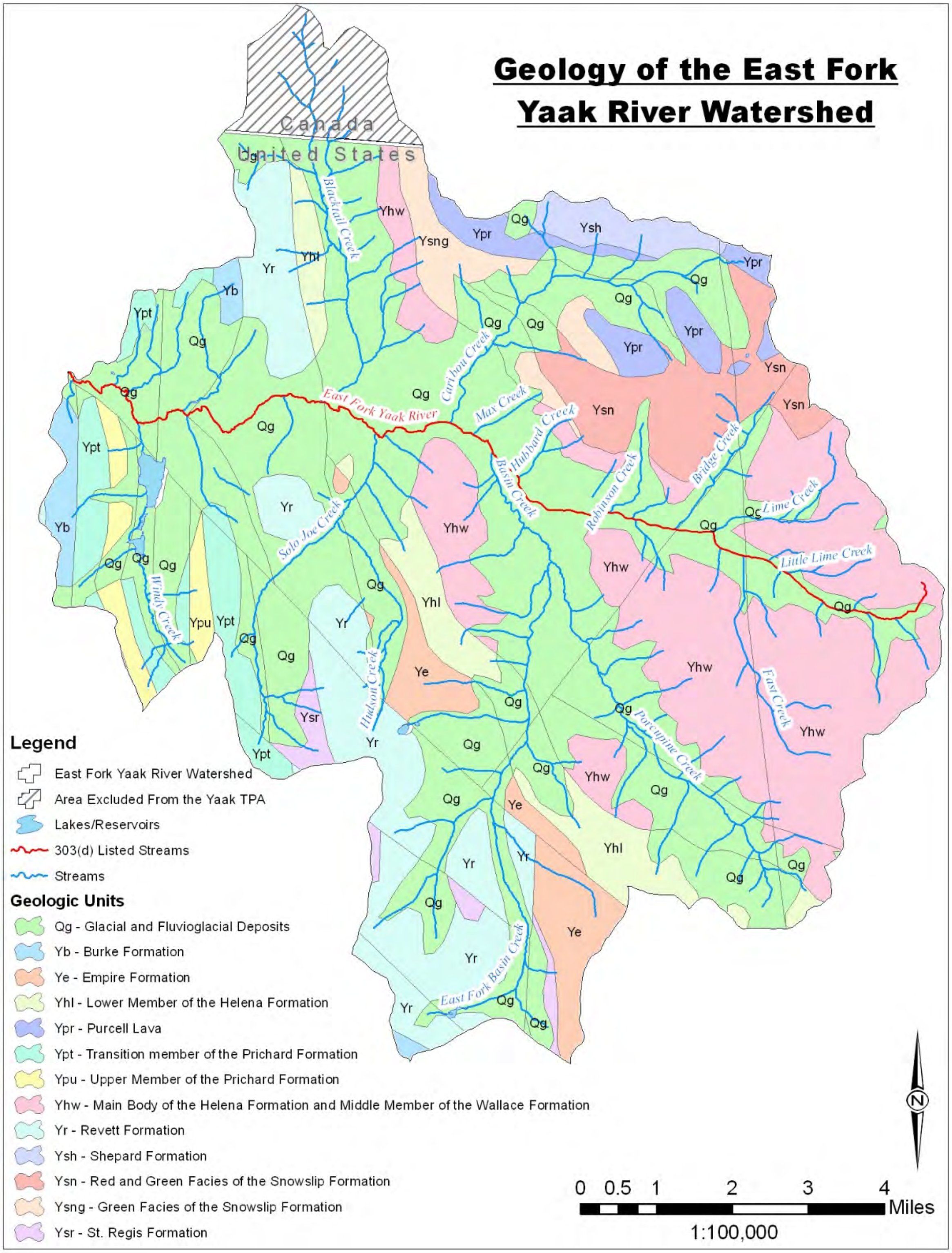

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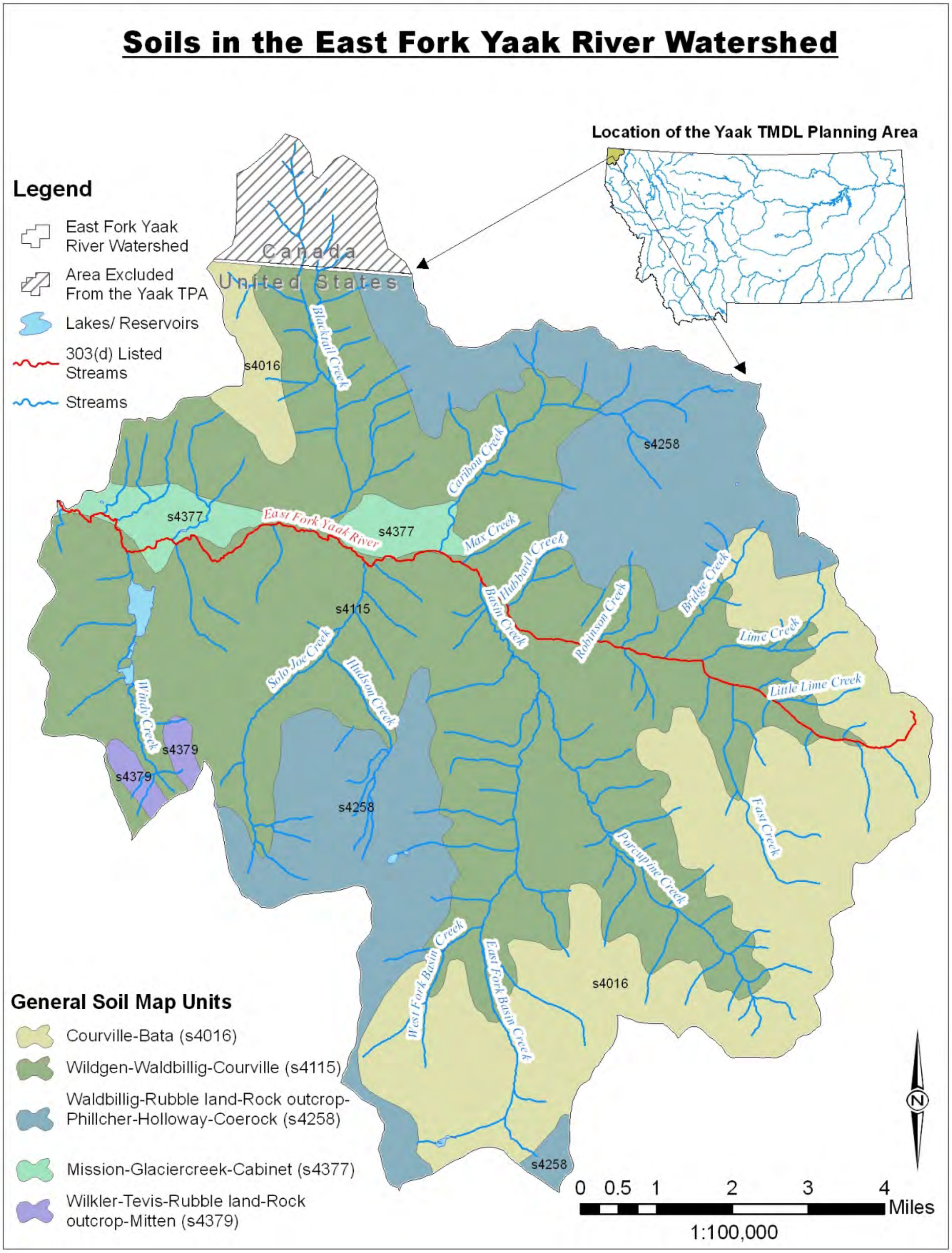
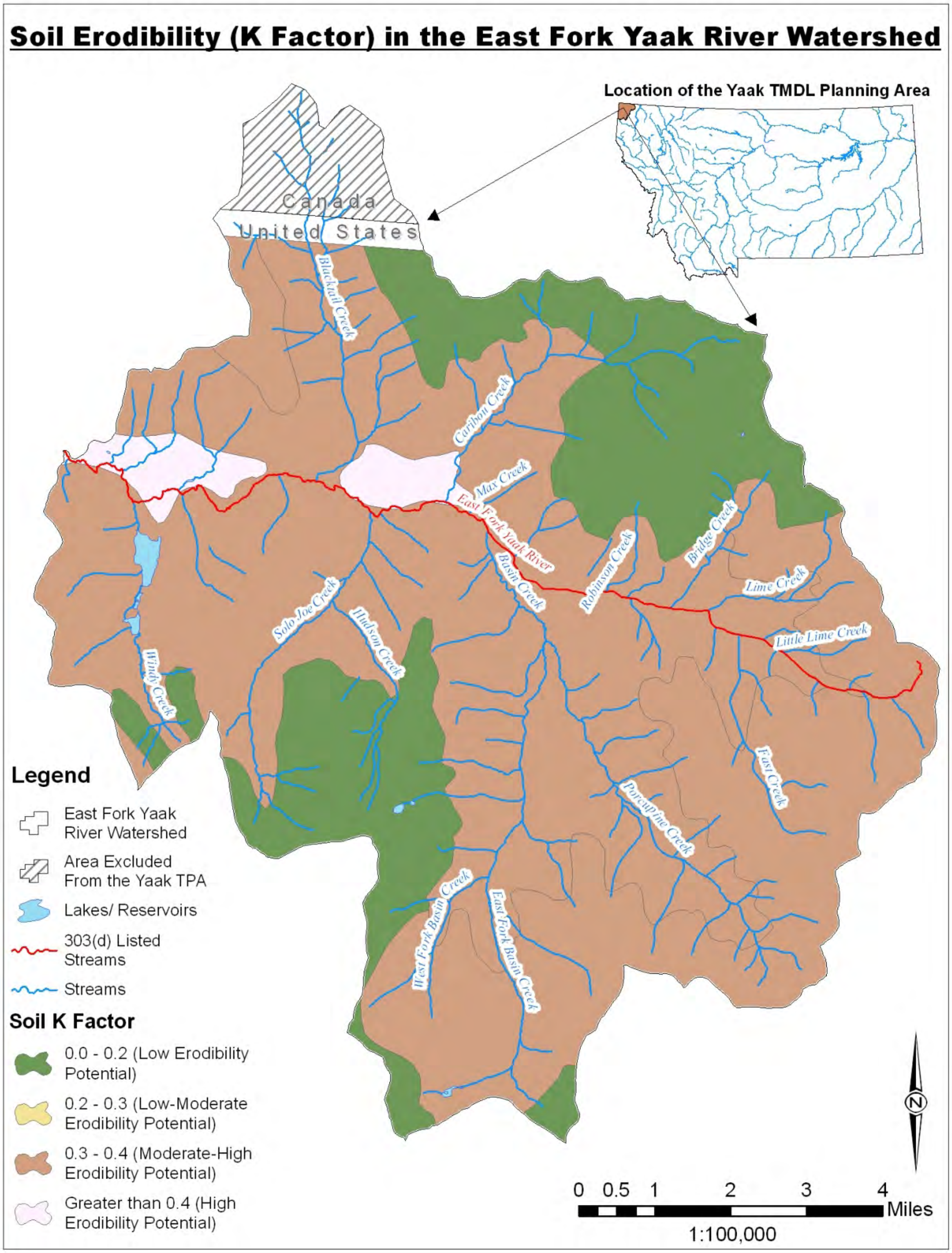


Figure A-8. Map of the Soils in the East Fork Yaak River Watershed



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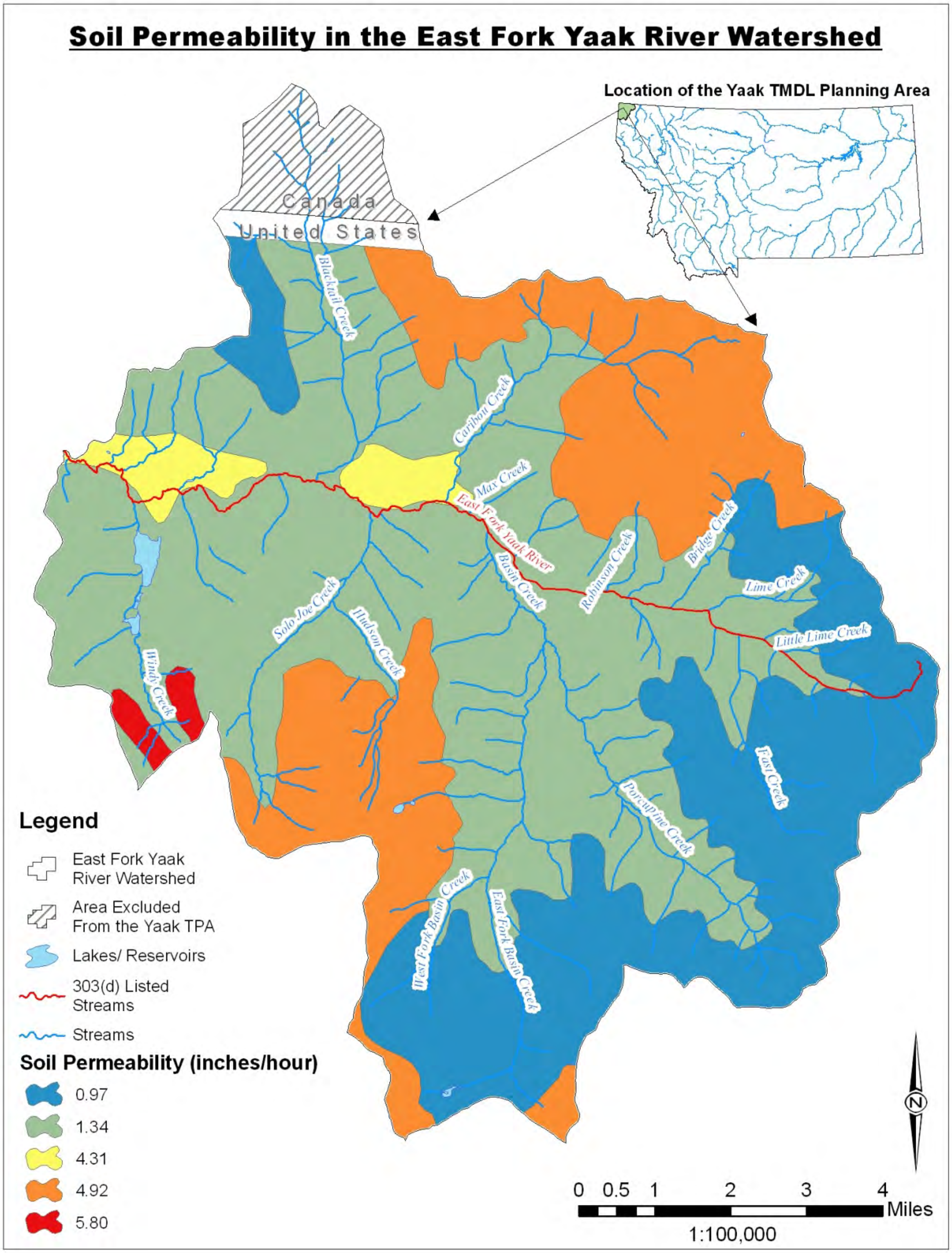

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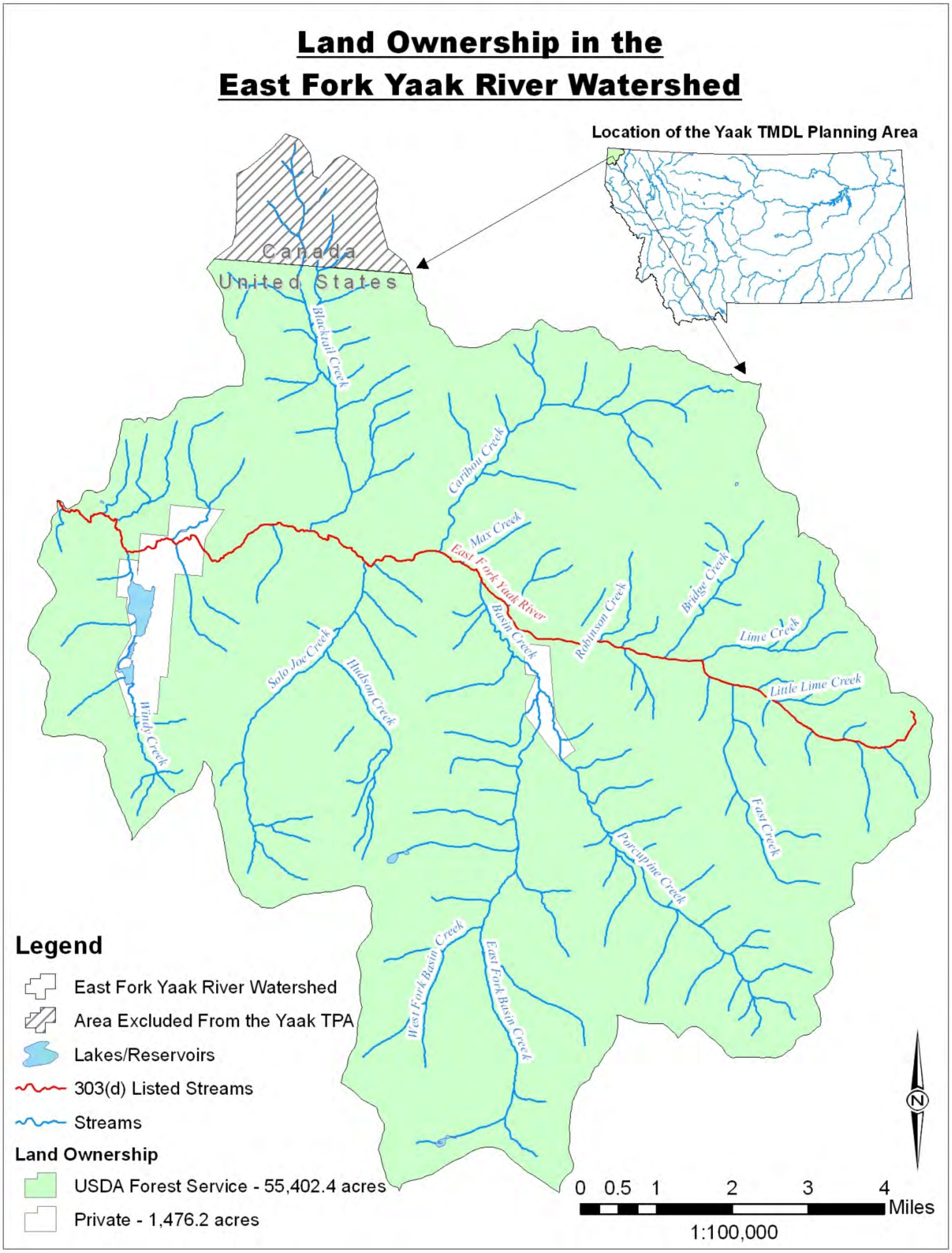


Figure A-11. Map of Land Ownership in the East Fork Yaak River Watershed

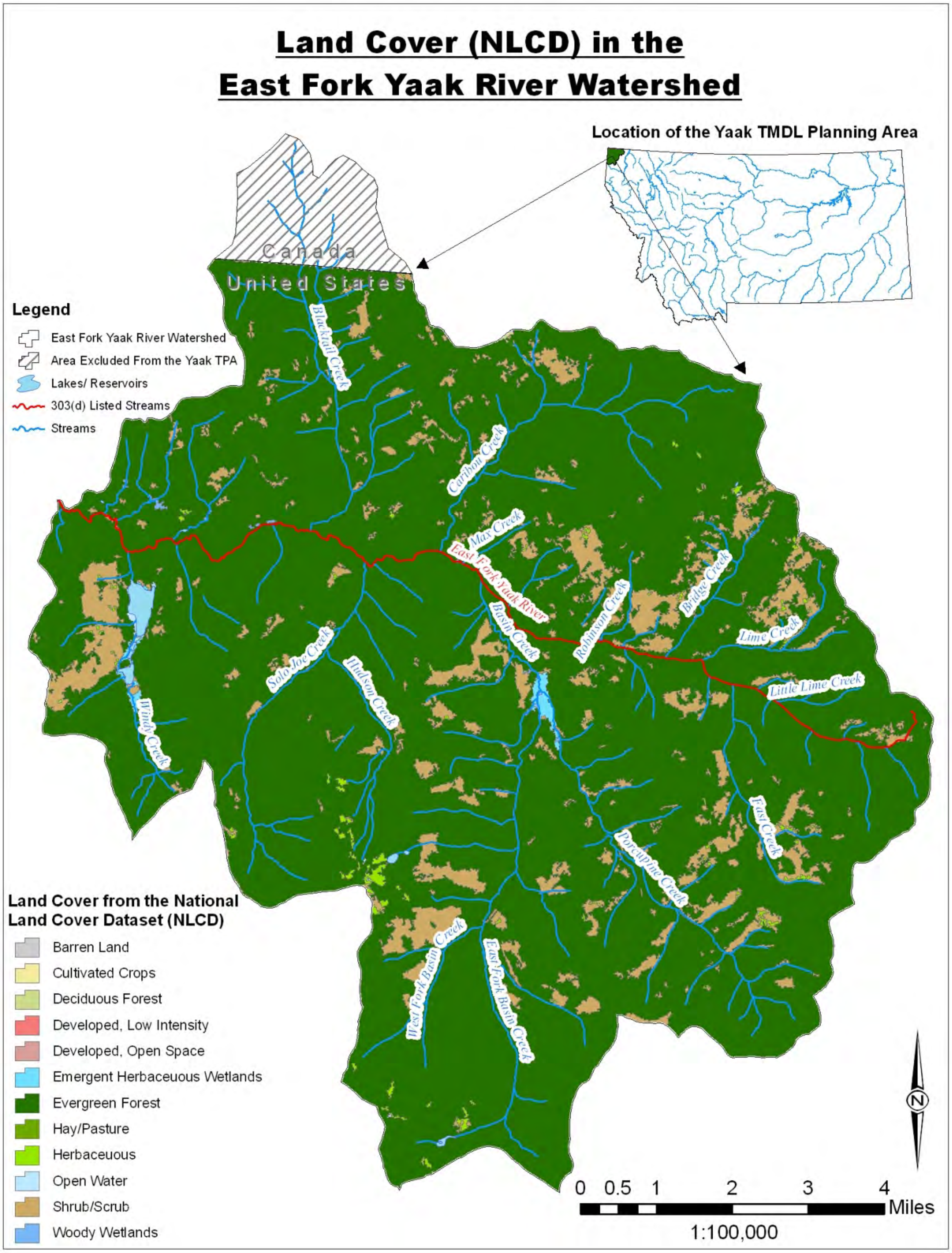
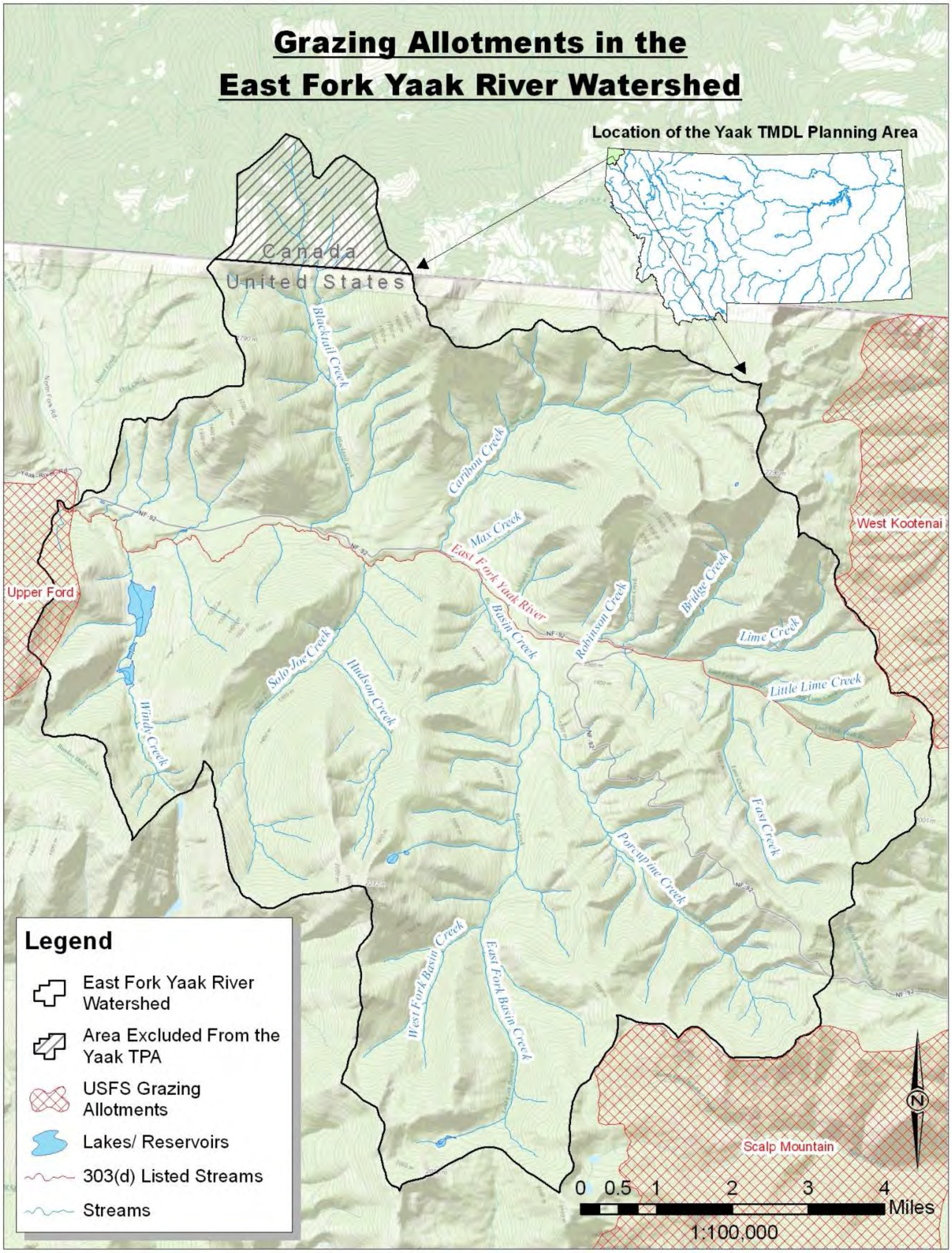


Figure A-12. Map of Land Cover in the East Fork Yaak River Watershed



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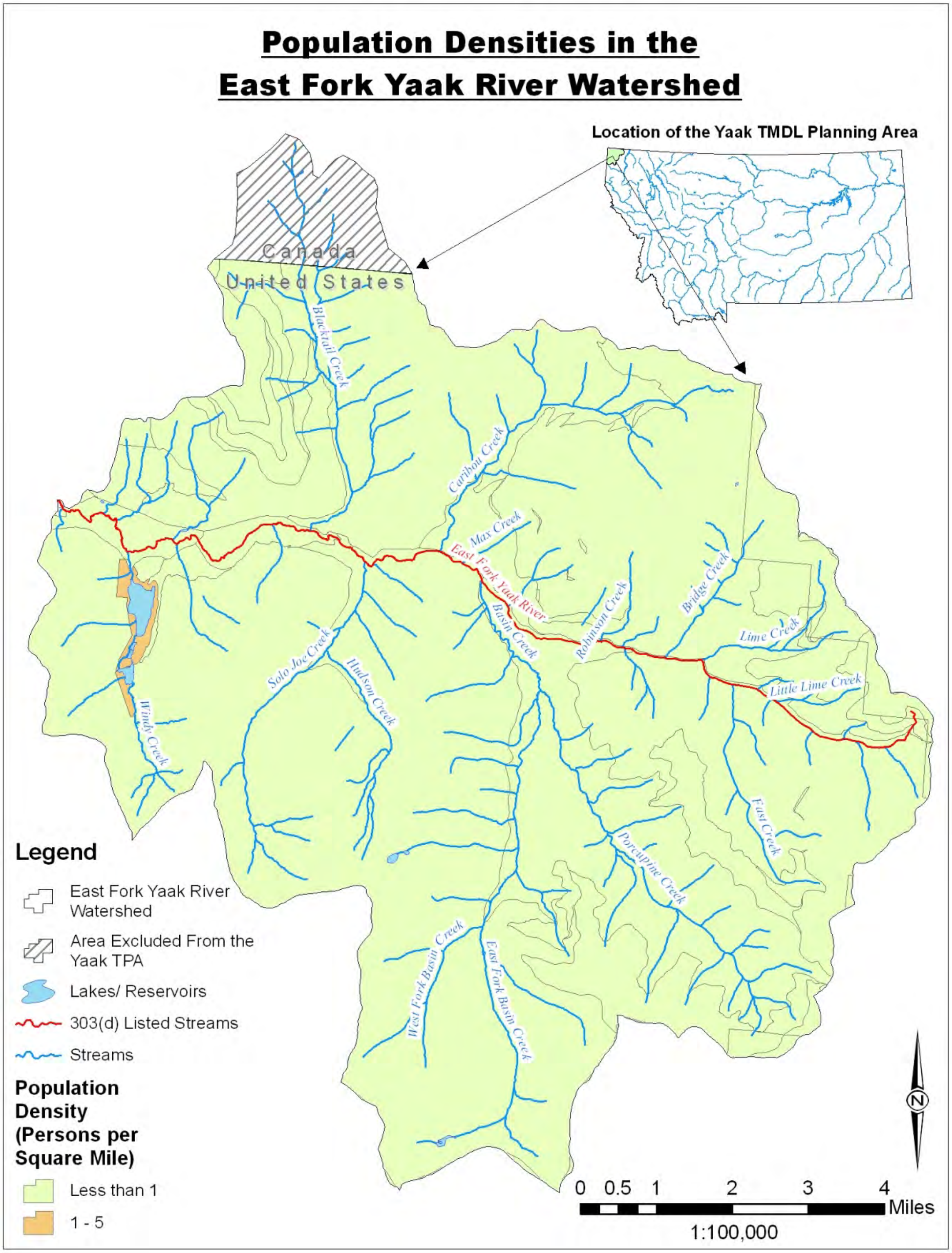
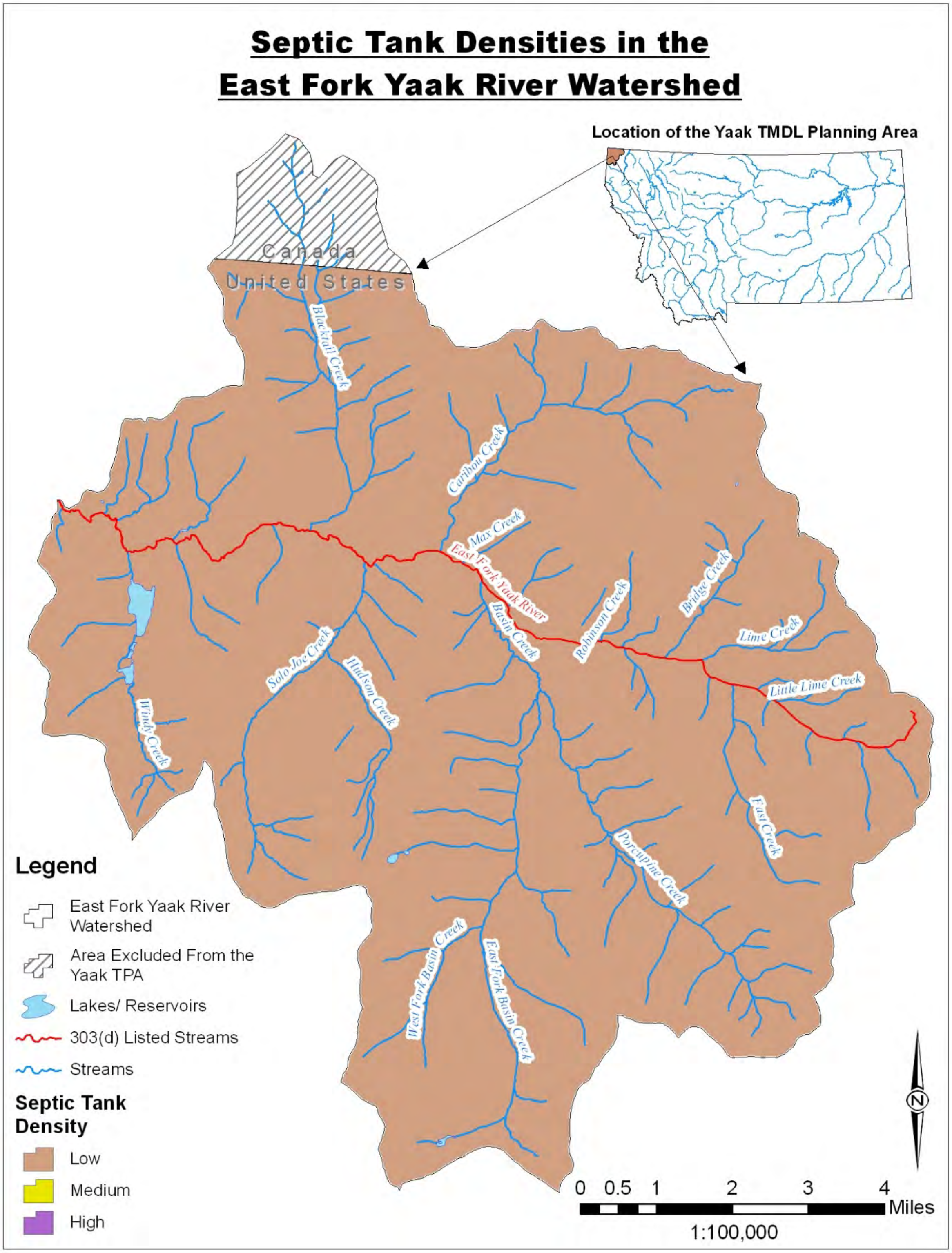


Figure A-14. Map of Population Densities in the East Fork Yaak River Watershed



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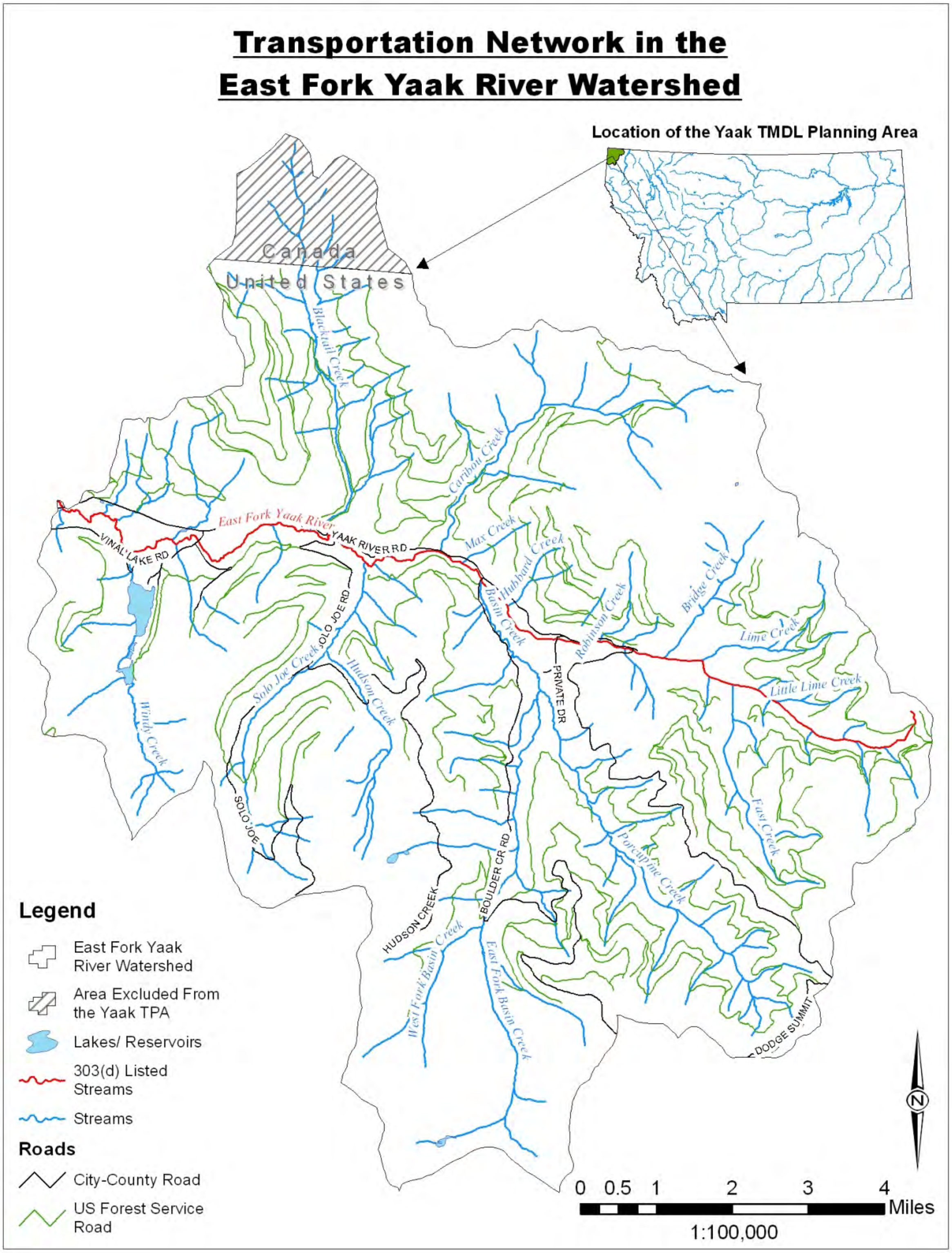


Figure A-16. Map of the Transportation Network in the East Fork Yaak River Watershed

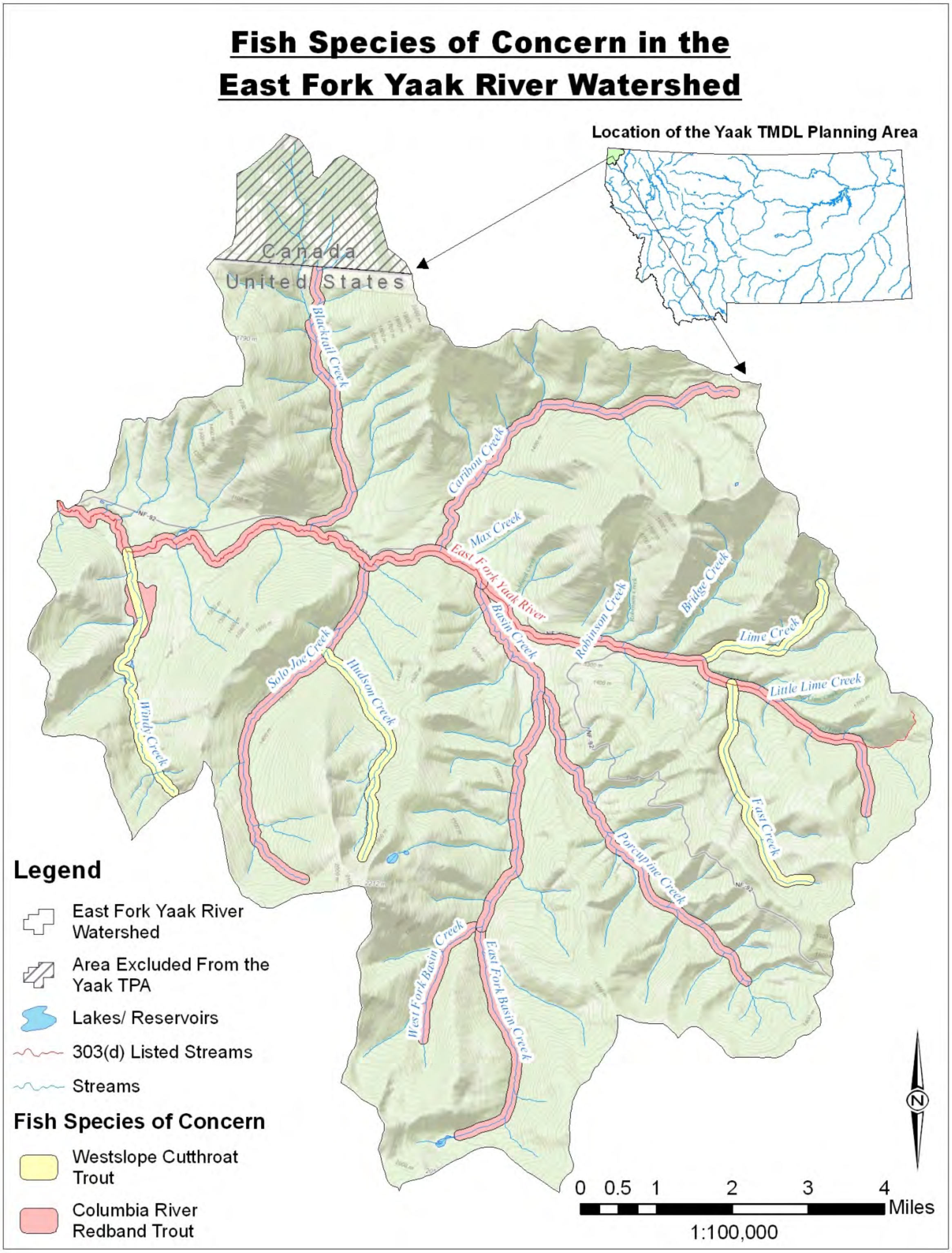
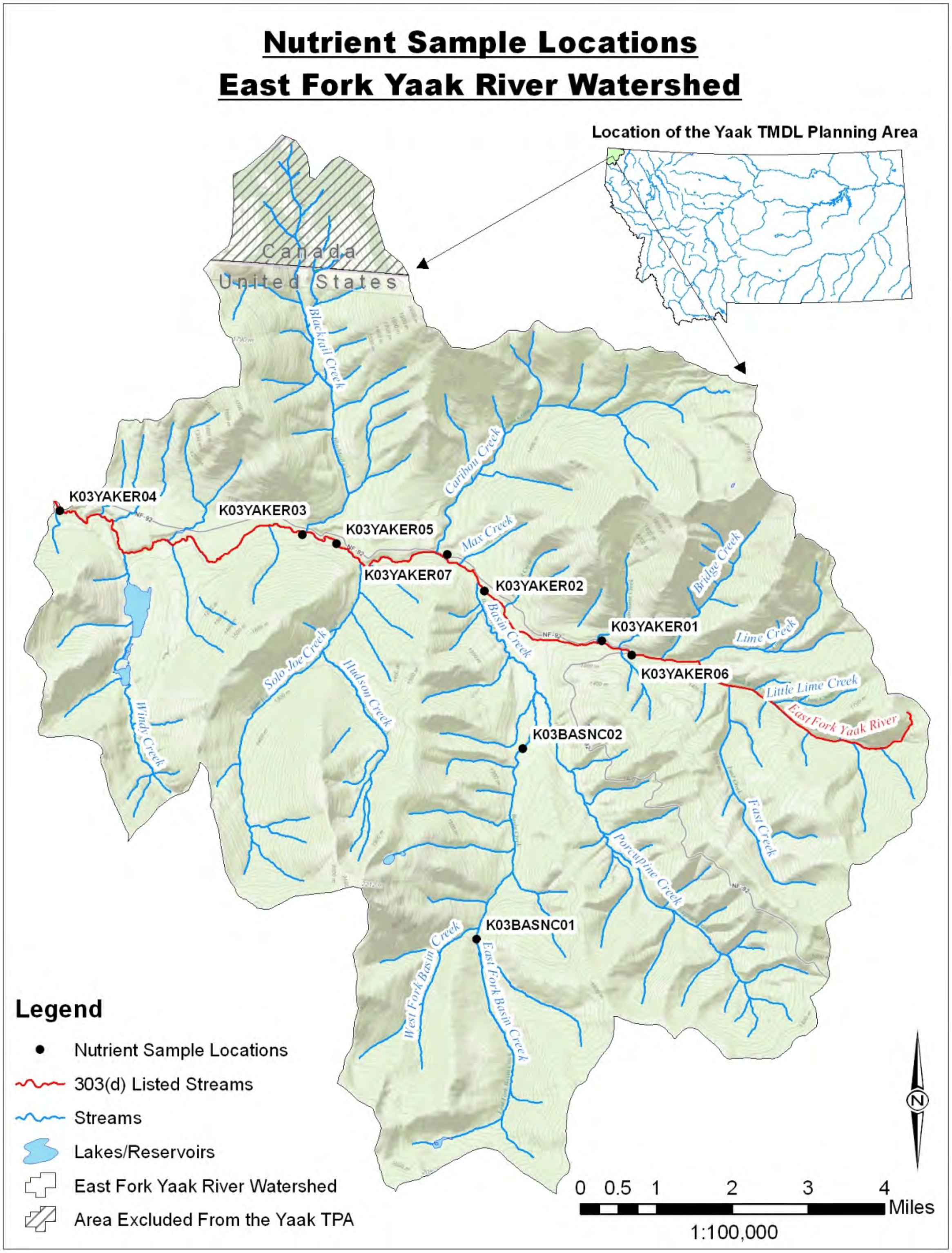


Figure A-17. Map of the Fish Species of Concern in the East Fork Yaak River Watershed



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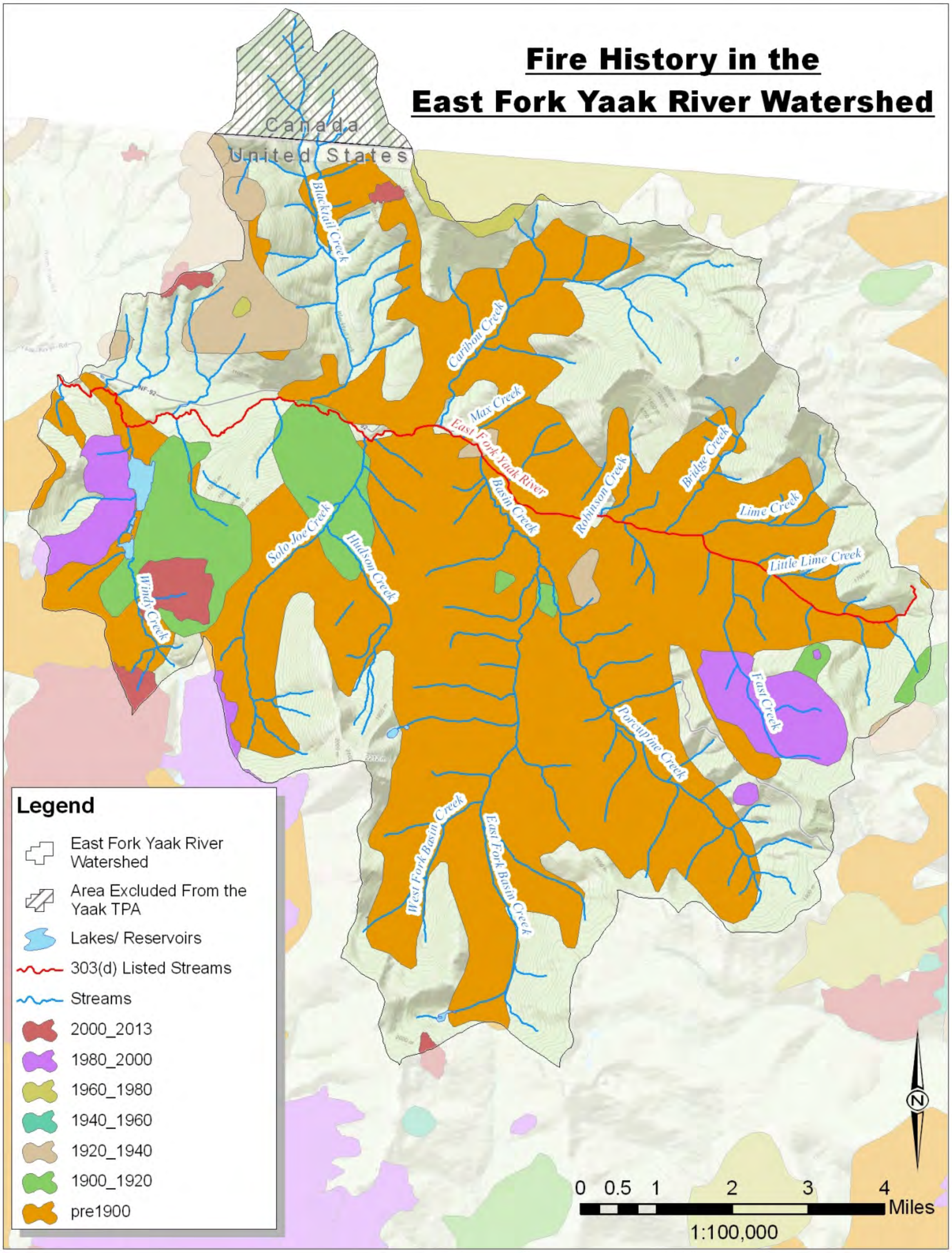

Figure A-19. Map of the Fire History in the East Fork Yaak River Watershed

Table A-1. Fire History in the East Fork Yaak River Watershed

Fire Name	Fire Year	Acres	Agency
Caribou Mountain	2009	85	USFS
Purcell Summit	2008	90	USFS
Grubstake	2000	95	USFS
Okaga	2000	454	USFS
Upper Beaver	2000	9,423	USFS
Zimmerman Hill	1994	785	USFS
Fish Fry	1994	1,420	USFS
Porcupine	1993	40	USFS
Unnamed	1991	Data Unavailable	
Unnamed	1991	498	USFS
Unnamed	1976	Data Unavailable	
Unnamed	1973	Data Unavailable	
Unnamed	1931	Data Unavailable	
Unnamed	1928	Data Unavailable	
Unnamed	1926	Data Unavailable	
Unnamed	1924	Data Unavailable	
Unnamed	1921	Data Unavailable	
Unnamed	1921	Data Unavailable	
Unnamed	1920	Data Unavailable	
Unnamed	1919	Data Unavailable	
Unnamed	1919	Data Unavailable	
Unnamed	1919	Data Unavailable	
Unnamed	1915	Data Unavailable	
Unnamed	1915	Data Unavailable	
Unnamed	1910	Data Unavailable	
Unnamed	1889	Data Unavailable	
Unnamed	1889	Data Unavailable	
Unnamed	1860	Data Unavailable	

Fire acreage may include burned areas outside of the watershed

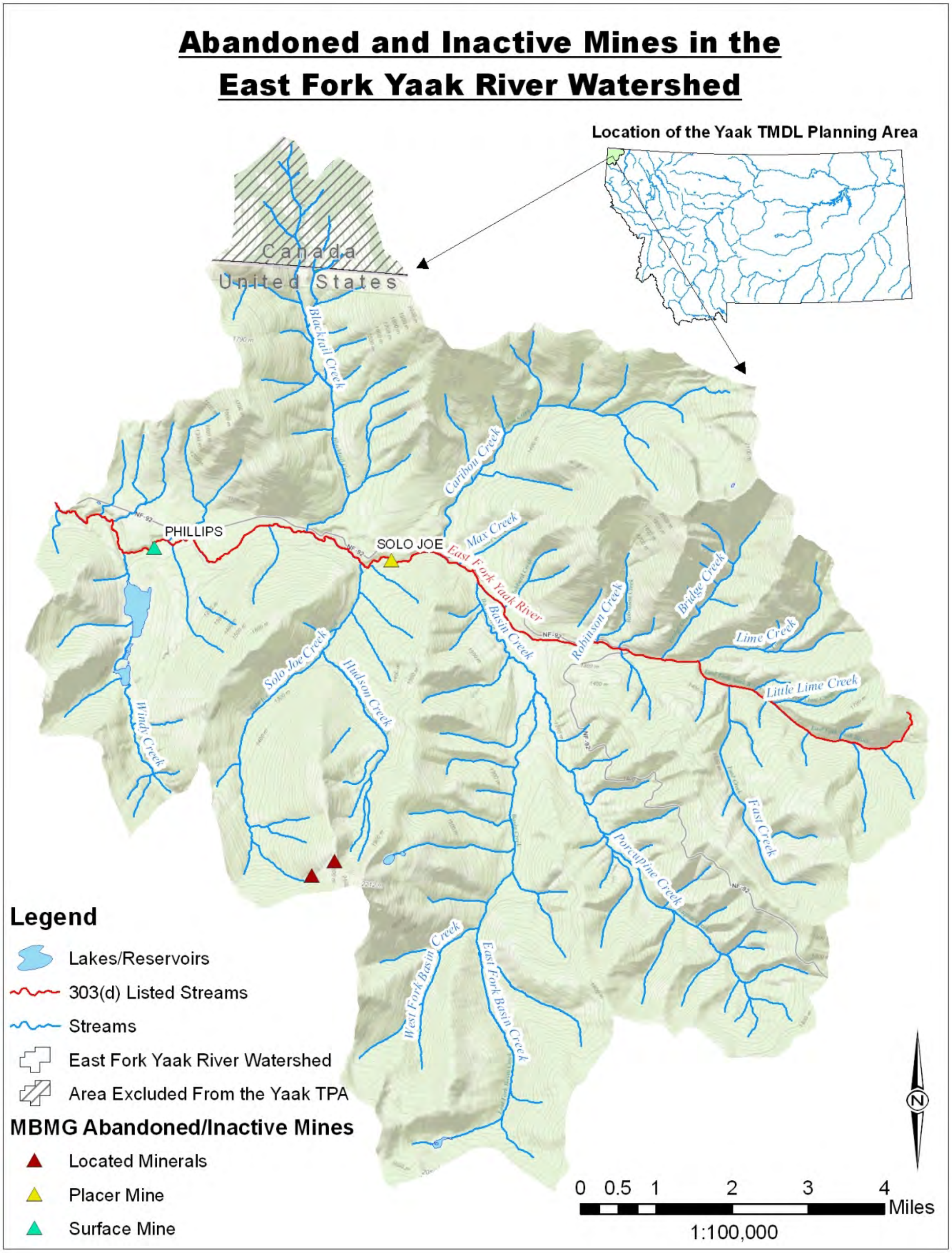

Figure A-20. Map of the Abandoned and Inactive Mines in the East Fork Yaak River Watershed

Appendix B – Regulatory Framework and Reference Condition Approach

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ACRONYMS

Acronym	Definition
ARM	Administrative Rules of Montana
BER	Board of Environmental Review (Montana)
CWA	Clean Water Act
DEQ	Department of Environmental Quality (Montana)
EPA	Environmental Protection Agency (U.S.)
MCA	Montana Code Annotated
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TPA	TMDL Planning Area
TSS	Total Suspended Solids
UAA	Use Attainability Analysis
WQA	Water Quality Act
WQS	Water Quality Standards

This appendix presents details about applicable Montana Water Quality Standards (WQS) and the general and statistical methods used for development of reference conditions.

B1.0 TMDL Development Requirements

Waterbodies, or individual waterbody segments where streams have been split into multiple segments, can become impaired from a variety of causes defined as either pollutants or non-pollutants. Pollutants include sediment, temperature, nutrients, and metals. Non-pollutants include flow alterations and different forms of habitat degradation. Section 303 of the Federal Clean Water Act (CWA) and the Montana Water Quality Act (WQA) (Section 75-5-703) require development of Total Maximum Daily Loads (TMDLs) for impaired waterbodies where one or more pollutants are the cause of impairment within the waterbody segment of interest.

Section 303(d) requires states to submit a list of impaired waterbodies in need of TMDL development to the U.S. Environmental Protection Agency (EPA) every 2 years. This list is referred to as the 303(d) list, and only includes waterbodies with impairment causes linked to a pollutant as defined under the CWA. The 303(d) list also includes the suspected source(s) of the pollutants of concern such as various land-use activities. Prior to 2004, EPA and the Montana Department of Environmental Quality (DEQ) defined the 303(d) list as the list of all impaired waterbodies and associated impairment causes (pollutants and non-pollutants), versus just those waters with impairment causes linked to pollutants. Montana integrates the 303(d) list within the 305(b) report, which contains an assessment of Montana's water quality, information on streams impaired by non-pollutants, TMDL development status, and a description of Montana's water quality programs. This 305(b) report is also referred to as the Integrated Water Quality Report.

Under Montana state law, an "impaired waterbody" is defined as a waterbody or stream segment for which sufficient credible data show that the waterbody or stream segment is failing to achieve compliance with applicable WQS (Montana WQA; Section 75-5-103(11)). State law (Montana Code Annotated (MCA) 75-5-702) identifies that a sufficient credible data methodology for determining the impairment status of each waterbody is used for consistency; the actual methodology is identified in DEQ's Water Quality Assessment Process and Methods (Montana Department of Environmental Quality, 2006). This methodology was developed via a public process and was incorporated into the EPA-approved 2000 version of the 305(b) report.

A TMDL is a pollutant budget for a waterbody identifying the maximum amount of the pollutant that a waterbody can assimilate without causing applicable WQS to be exceeded. TMDLs are often expressed in terms of an amount, or mass, of a particular pollutant over a particular time period (e.g., pounds of total nitrogen (TN) per day). TMDLs can also be expressed in other appropriate measures such as a percent reduction in pollutant loading. TMDLs must account for loads/impacts from point and nonpoint sources in addition to natural background sources and must incorporate a margin of safety and consider influences of seasonality on analysis and compliance with WQS.

To satisfy the Federal CWA and Montana state law, TMDL development will eventually be needed for each waterbody-pollutant combination identified on Montana's 2012 303(d) List of impaired waters in the Yaak TMDL Planning Area (TPA), unless new data and associated analyses is sufficient to remove a pollutant cause of impairment from one or more waterbodies. State law (Administrative Rules of Montana (ARM) 75-5-703(8)) also directs DEQ to "...support a voluntary program of reasonable land, soil, and water conservation practices to achieve compliance with WQS standards for nonpoint source activities for waterbodies that are subject to a TMDL…" This is an important directive that is reflected in the overall TMDL development and implementation strategy within this plan. It is important to note that water quality protection measures are not considered voluntary where such measures are already a requirement under existing federal, state, or local regulations.

B2.0 Applicable Water Quality Standards

WQS include the uses designated for a waterbody, the legally enforceable standards that ensure that the uses are supported, and a nondegradation policy that protects the high quality of a waterbody. The ultimate goal of this TMDL document, once implemented, is to ensure that all designated beneficial uses are fully supported and all standards are met. WQS form the basis for the targets described in **Section 5.0** of the main document. These sections provide a summary of the applicable WQS for sediment and nutrients. The sediment and nutrient TMDLs presented in this document also inherently address the additional non-pollutant causes of impairment identified in **Section 1.0** of the main document, **Table 1-1**.

B2.1 Classification and Beneficial Uses

Classification is the assignment (designation) of a single or group of uses to a waterbody based on the potential of the waterbody to support those uses. Designated Uses or Beneficial Uses are simple narrative descriptions of water quality expectations or water quality goals. There are a variety of "uses" of state waters including growth and propagation of fish and associated aquatic life; drinking water; agriculture; industrial supply; and recreation and wildlife. The Montana WQA directs the Board of Environmental Review (BER) to establish a classification system for all waters of the state that includes their present (when the Act was originally written) and future most beneficial uses (§ 75-5-301(1), MCA) and to adopt standards to protect those uses ((§ 75-5-301(1), MCA).

Montana, unlike many other states, uses a watershed based classification system with some specific exceptions. As a result, *all* waters of the state are classified and have designated uses and supporting standards. Some waters may not actually be used for a specific designated use, for example as a public drinking water supply; however, the quality of that waterbody must be maintained suitable for that designated use. When natural conditions limit or preclude a designated use, permitted point source discharges or nonpoint source activities or pollutant discharges may not make the natural conditions worse.

Modification of classifications or standards that would lower a water's classification or a standard (i.e., B-1 to a B-3), or removal of a designated use because of natural conditions can only occur if the water was originally misclassified. All such modifications must be approved by the BER, and are undertaken via a Use Attainability Analysis (UAA) that must meet EPA requirements (40 Code of Federal Regulations 131.10(g), (h) and (j)). The UAA and findings presented to the BER during rulemaking must prove that the modification is correct and all existing uses are supported. An existing use cannot be removed or made less stringent.

Descriptions of Montana's surface water classifications and designated beneficial uses are presented in **Table B-1**.

Table B-1. Montana Surface Water Classifications and Designated Beneficial Uses

Classification	Designated Uses
A-CLOSED CLASSIFICATION:	Waters classified A-Closed are to be maintained suitable for drinking, culinary and food processing purposes after simple disinfection.
A-1 CLASSIFICATION:	Waters classified A-1 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities.
B-1 CLASSIFICATION:	Waters classified B-1 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
B-2 CLASSIFICATION:	Waters classified B-2 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
B-3 CLASSIFICATION:	Waters classified B-3 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
C-1 CLASSIFICATION:	Waters classified C-1 are to be maintained suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
C-2 CLASSIFICATION:	Waters classified C-2 are to be maintained suitable for bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
C-3 CLASSIFICATION:	Waters classified C-3 are to be maintained suitable for bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers. The quality of these waters is naturally marginal for drinking, culinary and food processing purposes, agriculture and industrial water supply. Degradation which will impact established beneficial uses will not be allowed.
I CLASSIFICATION:	The goal of the State of Montana is to have these waters fully support the following uses: drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

B2.2 Numeric and Narrative Water Quality Standards

In addition to the Use Classifications described above, Montana's WQS include numeric and narrative criteria as well as a nondegradation policy.

Numeric surface WQS have been developed for many parameters to protect human health and aquatic life. Most of these standards are contained within the Department Circular Water Quality Bureau-7 (Montana Department of Environmental Quality, 2010). The numeric human health standards have been developed for parameters determined to be toxic, carcinogenic, or harmful and have been established at levels to be protective of long-term (i.e., lifelong) exposures as well as through direct contact such as swimming.

The numeric aquatic life standards include chronic and acute values that are based on extensive laboratory studies including a wide variety of potentially affected species, a variety of life stages and durations of exposure. Chronic aquatic life standards are protective of long-term exposure to a parameter. The protection afforded by the chronic standards includes detrimental effects to reproduction, early life stage survival and growth rates. In most cases the chronic standard is more stringent than the corresponding acute standard. Acute aquatic life standards are protective of short-term exposures to a parameter and are not to be exceeded.

Narrative standards have been developed for substances or conditions for which sufficient information does not exist to develop specific numeric standards. The term "Narrative Standards" commonly refers to the General Prohibitions in ARM 17.30.637 and other descriptive portions of the surface WQS. The General Prohibitions are also called the "free from" standards; that is, the surface waters of the state must be free from substances attributable to discharges, including thermal pollution, that impair the beneficial uses of a waterbody. Uses may be impaired by toxic or harmful conditions (from one or a combination of parameters) or conditions that produce undesirable aquatic life. Undesirable aquatic life includes bacteria, fungi, and algae.

B2.3 Pollutant Specific Standards

The standards applicable to the TMDLs addressed in Yaak TPA document are summarized below.

B2.3.1 Nutrient Standards

The narrative standards applicable to nutrients in Montana are contained in the General Prohibitions of the surface WQS (ARM 17.30.637 et seq.). The prohibition against the creation of "*conditions which produce undesirable aquatic life*" is generally the most relevant to nutrients. Undesirable aquatic life includes bacteria, fungi, and algae. Montana has recently developed draft nutrient criteria for TN and total phosphorus (TP) based on the level III ecoregion in which a stream is located (Suplee and Watson, 2013a). In addition, Suplee and Watson (2013a) developed a target for nitrate (also known as nitrate+nitrite nitrogen or NO_2+NO_3) for the Northern Rockies Level III Ecoregion that provides an appropriate numeric translation of the applicable narrative nutrient water quality standard. For the Northern Rockies Level III Ecoregion, draft water quality criteria for TN and TP and the target for nitrate are presented in **Table B-2**. This target and the proposed criteria are growing season, or summer, values applied from July 1st through September 30th. Additionally, numeric human health standards exist for nitrogen (**Table B-3**), but the narrative standard is most applicable to nutrients as the concentration in most waterbodies in Montana is well below the human health standard and the nutrients contribute to undesirable aquatic life at much lower concentrations than the human health standard.

Table B-2. Nitrate Target and Proposed Numeric Nutrient and Criteria for the Northern Rockies Ecoregion

Parameter	Criteria/Target
Nitrate (Nitrate+Nitrite)	≤ 0.100 mg/L[a]
Total Nitrogen	≤ 0.275 mg/L[b]
Total Phosphorus	≤ 0.025 mg/L[b]

[a] From Suplee et al. (2008)
[b] From Suplee and Watson (2013b)

Table B-3. Human Health Standards for Nitrogen for the State of Montana

Parameter	Human Health Standard (µL)[a]
Nitrate as Nitrogen (NO_3-N)	10,000
Nitrite as Nitrogen (NO_2-N)	1,000
Nitrate plus Nitrite as N	10,000

[a] Maximum allowable concentration

B2.4 Nondegradation

High quality waters are afforded an additional level of protection by the nondegradation rules (ARM 17.30.701 et seq.) and in statute (75-5-303 MCA). Changes in water quality must be "non-significant," or an authorization to degrade must be granted by the Department. However, under no circumstance may standards be exceeded. It is important to note that waters that meet or are of better quality than a standard are high quality for that parameter, and nondegradation policies apply to new or increased discharges to the waterbody. Although these nondegradation rules are not integrated into TMDL development, they help limit pollutant loading in waters where designated uses are currently satisfied. Some of these waters may be healthy tributaries to waters where a TMDL is developed; thus nondegradation can help implement TMDL related pollutant controls at a watershed scale.

B3.0 Reference Conditions

B3.1 DEQ Approach for Defining a Reference Condition

DEQ uses the reference condition to evaluate compliance with many of the narrative WQS. The term "reference condition" is defined as the condition of a waterbody capable of supporting its present and future beneficial uses when all reasonable land, soil, and water conservation practices have been applied. In other words, reference condition reflects a waterbody's greatest potential for water quality given historic land-use activities. Although sediment water quality targets typically relate most directly to the aquatic life use, the targets are protective of all designated beneficial uses because they are based on the reference approach, which strives for the highest possible condition.

DEQ applies the reference condition approach for making beneficial-use support determinations for certain pollutants (such as sediment) that have specific narrative standards. All classes of waters are subject to the provision that there can be no increase above naturally occurring concentrations of sediment and settleable solids, oils, or floating solids sufficient to create a nuisance or render the water harmful, detrimental, or injurious. These levels depend on site-specific factors, so the reference conditions approach is used.

Montana WQS do not contain specific provisions addressing detrimental modifications of habitat. However, detrimental modifications of habitat may often lead to or result from increases above naturally occurring concentrations of sediment, etc., and therefore the reference condition approach is used to help determine whether beneficial uses are supported when habitat modifications are present. The reference approach can also be used to develop riparian and shade target parameters when evaluating temperature.

Waterbodies used to determine reference condition are not necessarily pristine or perfectly suited to giving the best possible support to all possible beneficial uses. Reference condition also does not reflect an effort to turn the clock back to conditions that may have existed before human settlement, but is intended to accommodate natural variations in biological communities, water chemistry, etc. due to climate, bedrock, soils, hydrology, and other natural physiochemical differences. The intention is to differentiate between natural conditions and widespread or significant alterations of biology, chemistry, or hydrogeomorphology due to human activity. Therefore, reference conditions should reflect minimum impacts from human activities. It attempts to identify the potential condition that could be attained (given historical land use) by the application of reasonable land, soil, and water conservation practices. DEQ realizes that pre-settlement water quality conditions usually are not attainable.

Comparison of conditions in a waterbody to reference waterbody conditions must be made during similar season and/or hydrologic conditions for both waters. For example, the Total Suspended Solids (TSS) of a stream at base flow during the summer should not be compared to the TSS of reference condition that would occur during a runoff event in the spring. In addition, a comparison should not be made to the lowest or highest TSS values of a reference site, which represent the outer boundaries of reference conditions. The following methods may be used to determine reference conditions:

Primary Approach

- Comparing conditions in a waterbody to baseline data from minimally impaired waterbodies that are in a nearby watershed or in the same region having similar geology, hydrology, morphology, and/or riparian habitat.
- Evaluating historical data relating to condition of the waterbody in the past.
- Comparing conditions in a waterbody to conditions in another portion of the same waterbody, such as an unimpaired segment of the same stream.

Secondary Approach

- Reviewing literature (e.g., a review of studies of fish populations, etc., that were conducted on similar waterbodies that are least impaired).
- Seeking expert opinion (e.g., expert opinion from a regional fisheries biologist who has a good understanding of the waterbody's fisheries health or potential).
- Applying quantitative modeling (e.g., applying sediment transport models to determine how much sediment is entering a stream based on land-use information, etc.).

DEQ uses the primary approach for determining reference condition if adequate regional or other primary reference data is available, and uses the secondary approach to estimate reference condition when primary approach data is limited or unavailable. DEQ often uses more than one approach to determine reference condition, especially when regional reference condition data are sparse or nonexistent.

B3.2 Use of Statistics for Developing Reference Values or Ranges

Reference value development must consider natural variability as well as variability that can occur as part of field measurement techniques. Statistical approaches are commonly used to help incorporate variability. One statistical approach is to compare stream conditions to the mean (average) value of a reference data set to see if the stream condition compares favorably to this value or falls within the range of one standard deviation around the reference mean. The use of these statistical values assumes a normal distribution; whereas, water resources data tend to have a non-normal distribution (Helsel and Hirsch, 1995). For this reason, another approach is to compare stream conditions to the median value of a reference data set to see if the stream condition compares favorably to this value or falls within the range defined by the 25th and 75th percentiles of the reference data. This is a more realistic approach than using one standard deviation since water quality data often include observations considerably higher or lower than most of the data. Very high and low observations can have a misleading impact on the statistical summaries if a normal distribution is incorrectly assumed, whereas statistics based on non-normal distributions are far less influenced by such observations.

Figure B-1 is an example boxplot type presentation of the median, 25th and 75th percentiles, and minimum and maximum values of a reference data set. In this example, the reference stream results are stratified by two different stream types. Typical stratifications for reference stream data may include Rosgen stream types, stream size ranges, or geology. If the parameter being measured is one where low values are undesirable and can cause harm to aquatic life, then measured values in the potentially impaired stream that fall below the 25th percentile of reference data are not desirable and can be used to indicate impairment. If the parameter being measured is one where high values are undesirable, then measured values above the 75th percentile can be used to indicate impairment.

The use of a non-parametric statistical distribution for interpreting narrative WQS or developing numeric criteria is consistent with EPA guidance for determining nutrient criteria (U.S. Environmental Protection Agency, 1999). Furthermore, the selection of the applicable 25th or 75th percentile values from a reference data set is consistent with ongoing DEQ guidance development for interpreting narrative WQS where it is determined that there is “good” confidence in the quality of the reference sites and resulting information (Suplee, 2004). If it is determined that there is only a “fair” confidence in the quality of the reference sites, then the 50th percentile or median value should be used, and if it is determined that there is “very high” confidence, then the 90th percentile of the reference data set should be used. Most reference data sets available for water quality restoration planning and related TMDL development, particularly those dealing with sediment and habitat alterations, would tend to be “fair” to “good” quality. This is primarily due to a the limited number of available reference sites/data points available after applying all potentially applicable stratifications on the data, inherent variations in monitoring results among field crews, the potential for variations in field methodologies, and natural yearly variations in stream systems often not accounted for in the data set.

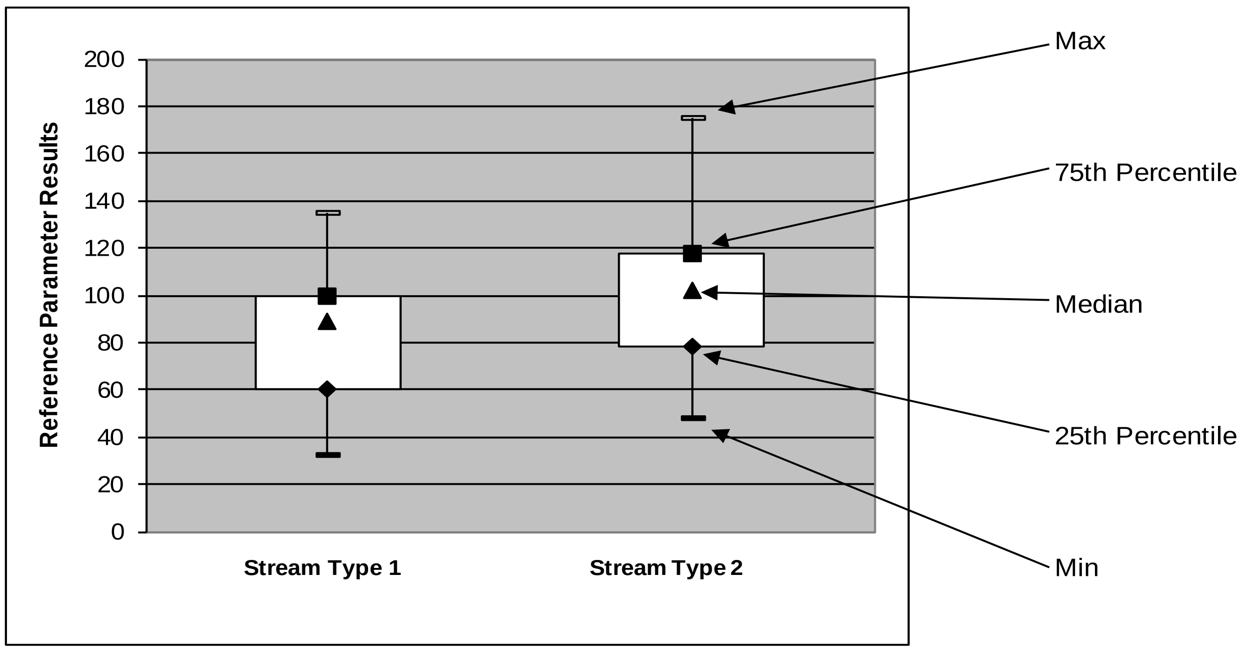

Figure B-1. Boxplot Example for Reference Data

The above 25th to 75th percentile statistical approach has several considerations:

- It is a simple approach that is easy to apply and understand.
- About 25% of all streams would naturally fall into the impairment range. Thus, it should not be applied unless there is some linkage to human activities that could lead to the observed conditions. Where applied, it must be noted that the stream's potential may prevent it from achieving the reference range as part of an adaptive management plan.
- About 25% of all streams would naturally have a greater water quality potential than the minimum water quality bar represented by the 25th to 75th percentile range. This may represent a condition where the stream's potential has been significantly underestimated. Adaptive management can also account for these considerations.
- Obtaining reference data that represents a naturally occurring condition can be difficult, particularly for larger waterbodies with multiple land uses within the drainage. This is because all reasonable land, soil, and water conservation practices may not be in place in many larger waterbodies across the region. Even if these practices are in place, the proposed reference stream may not have fully recovered from past activities, such as riparian harvest, where reasonable land, soil, and water conservation practices were not applied.
- A stream should not be considered impaired unless there is a relationship between the parameter of concern and the beneficial use such that not meeting the reference range is likely to cause harm or other negative impacts to the beneficial use as described by the WQS. In other words, if not meeting the reference range is not expected to negatively impact aquatic life, coldwater fish, or other beneficial uses, then an impairment determination should not be made based on the particular parameter being evaluated. Relationships that show an impact to the beneficial use can be used to justify impairment based on the above statistical approach.

As identified in (2) and (3) above, there are two types of errors that can occur due to this or similar statistical approaches where a reference range or reference value is developed: (1) A stream could be considered impaired even though the naturally occurring condition for that stream parameter does not meet the desired reference range or (2) a stream could be considered not impaired for the parameter(s) of concern because the results for a given parameter fall just within the reference range, whereas the naturally occurring condition for that stream parameter represents much higher water quality and beneficial uses could still be negatively impacted. The implications of making either of these errors can be used to modify the above approach, although the approach used will need to be protective of water quality to be consistent with DEQ guidance and WQS (Suplee, 2004). Either way, adaptive management is applied to this water quality plan and associated TMDL development to help address the above considerations.

Where the data does suggest a normal distribution, or reference data is presented in a way that precludes use of non-normal statistics, the above approach can be modified to include the mean plus or minus one standard deviation to provide a similar reference range with all of the same considerations defined above.

Options When Regional Reference Data is Limited or Does Not Exist
In some cases, there is very limited reference data and applying a statistical approach like above is not possible. Under these conditions, the limited information can be used to develop a reference value or range, with the need to note the greater level of uncertainty and perhaps a greater level of future monitoring as part of the adaptive management approach. These conditions can also lead to more reliance on secondary type approaches for reference development.

Another approach would be to develop statistics for a given parameter from all streams within a watershed or region of interest (Buck et al., 2000). The boxplot distribution of all the data for a given parameter can still be used to help determine potential target values knowing that most or all of the streams being evaluated are either impaired or otherwise have a reasonable probability of having significant water quality impacts. Under these conditions you would still use the median and the 25th or 75th percentiles as potential target values, but you would use the 25th and 75th percentiles in a way that is opposite from how you use the results from a regional reference distribution. This is because you are assuming that, for the parameter being evaluated, as many as 50% to 75% of the results from the whole data distribution represent questionable water quality. **Figure B-2** is an example statistical distribution of an entire dataset where lower values represent better water quality (and reference data are limited). In **Figure B-2**, the median and 25th percentiles of all data represent potential target values versus the median and 75th percentiles discussed above for regional reference distribution. Whether you use the median, the 25th percentile, or both should be based on an assessment of how impacted all the measured streams are in the watershed. Additional consideration of target achievability is important when using this approach. Also, there may be a need to also rely on secondary reference development methods to modify how you apply the target and/or to modify the final target value(s). Your certainty regarding indications of impairment may be lower using this approach, and you may need to rely more on adaptive management as part of TMDL implementation.

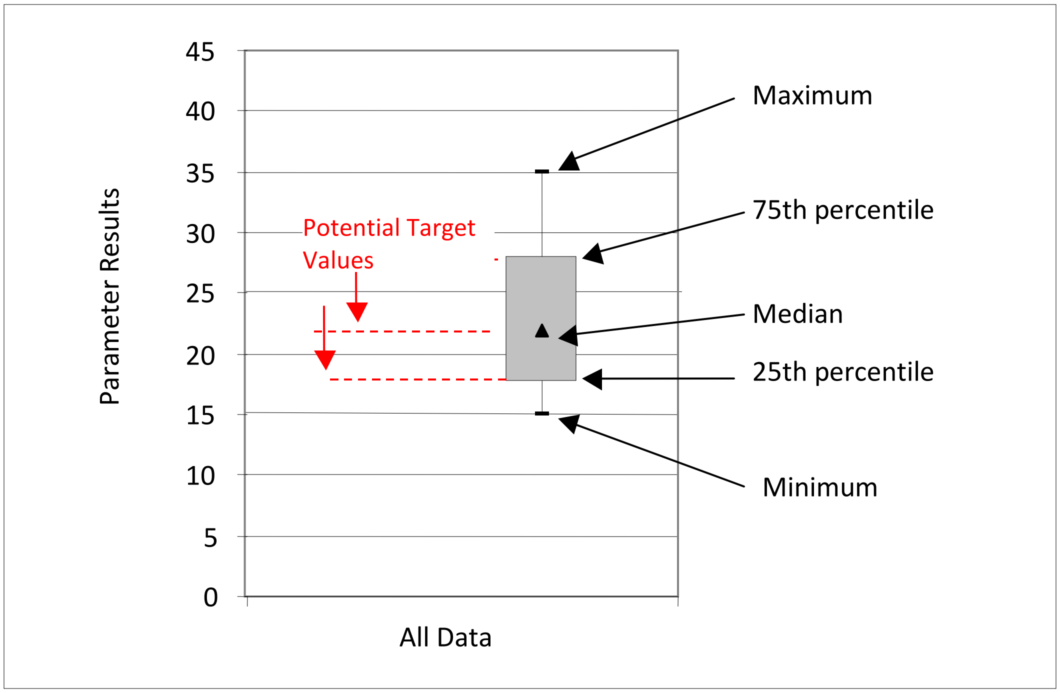

Figure B-2. Boxplot Example for the Use of All Data to Set Targets

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