# Tongue River Watershed Pathogen Total Maximum Daily Loads

# DRAFT

## Data Summary and Watershed Characterization Memorandum

Prepared for

**Wyoming Department of Environmental Quality**

Prepared by

**SWCA Environmental Consultants**

February 2016

# TONGUE RIVER WATERSHED PATHOGEN TOTAL MAXIMUM DAILY LOADS

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## DATA SUMMARY AND WATERSHED CHARACTERIZATION MEMORANDUM

Prepared for

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# 1. INTRODUCTION

## 1.1. Purpose

Seven river segments in the Tongue River Watershed contain concentrations of pathogenic bacteria that exceed Wyoming water quality criteria for their recreational designated use. Under current Wyoming water quality regulations, these exceedances resulted in these river segments being listed as impaired. The federal Clean Water Act (CWA) requires states to develop a pollutant load reduction plan or total maximum daily load (TMDL) to correct each impairment. This memorandum presents a data summary and watershed characterization for development of a TMDL for each of the seven impaired segments in the Tongue River Watershed. Once completed, the TMDLs will be submitted to the Wyoming Department of Environmental Quality (WDEQ) and the U.S. Environmental Protection Agency (EPA) for approval.

The following subsections provide background information and a summary of work completed in the Tongue River Watershed, the federal requirements of the CWA, a summary of Wyoming water quality standards, a description of the impaired river segments in the Tongue River Watershed, and a definition of the study area for this project.

## 1.2. Background

The Tongue River Watershed is in Sheridan County in north-central Wyoming. The Tongue River originates at the confluence of the North Tongue River and the South Tongue River in the Bighorn National Forest, flows downstream through the towns of Dayton and Ranchester, and eventually becomes a tributary of the Yellowstone River in Montana.

Extensive work toward understanding the Tongue River Watershed and improving its water quality has been a consistent and ongoing effort by the Sheridan County Conservation District (SCCD). SCCD has collected water quality datasets throughout the years that have been crucial in developing segment-specific bacteria loads and in deriving load capacities for each critical stream in the watershed. Other historical monitoring efforts within the Tongue River Watershed have been conducted by WDEQ, U.S. Geological Survey (USGS), Wyoming Game and Fish Department, Natural Resources Conservation Service (NRCS), Wyoming State Board of Control, and the U.S. Forest Service (USFS). SCCD used the results of these historical monitoring data (in cooperation with the NRCS and the Tongue River Watershed Steering Committee [TRWSC]) to develop the initial Tongue River Watershed assessment for 1996–1999 (SCCD 2000a).

The Tongue River Watershed assessment for 1996–1999 served as the foundation for local watershed planning and improvement efforts. TRWSC, which consists of stakeholders representing rural, urban, and other local interests, recognized bacteria levels as a major concern. Possible causes and sources of the bacteria were identified to be wildlife, livestock and other domestic animals, and humans. The 2000 Tongue River Watershed plan (TRWP) (SCCD 2000b) was developed to address these concerns and was approved by WDEQ in 2000. The TRWP outlines the goals, objectives, and action items for improving water quality in the Tongue River Watershed, along with prioritizing best management practices and providing future recommendations.

After 5 years, several improvement projects were completed, and all of the action items in the TRWP were either completed or otherwise addressed by TRWSC. However, interim monitoring continued to identify unacceptable bacteria levels. As a result, in the summer of 2005, TRWSC began an update of the

TRWP, which was submitted to WDEQ in 2007 (SCCD 2007). However, bacteria continued to be a primary concern. As a result, many of the action items in the TRWP addressed bacteria concerns and focused on reducing the potential contributions from domestic animals and livestock, and from faulty septic systems (SCCD 2007).

In February 2008, representatives from WDEQ met with TRWSC to discuss changes needed in future watershed plans. The 2007 TRWP contains most of the "nine essential elements" that WDEQ and EPA believed were necessary to meet the requirements of the CWA, but it needed to take a more focused, quantitative approach. TRWSC decided to move forward with an update of the 2007 plan to meet the CWA requirements.

The mission of TRWSC and of SCCD and NRCS has and will continue to be to maintain and improve existing water quality, natural resource health, economic stability, and the quality of life on the Tongue River Watershed through voluntary financial, technical, and educational resources (SCCD 2012). In the most recent TRWP (revision 2) (SCCD 2012), SCCD and NRCS have committed to implementing the following recommendations:

- Continue a watershed improvement effort by providing leadership and project oversight.
- Reduce bacteria contributions by an average of 18% over the entire Tongue River Watershed by 2017.
- Reduce water quality impacts, other than bacteria, such as nutrient concentrations, organic matter, temperature, and sediment loads.
- Increase awareness and encourage participation in the watershed improvement efforts.
- Increase awareness and understanding about water quality impacts and relationships among water quality parameters.

## 1.3. Federal Requirements of the Clean Water Act

The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the U.S. and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, but the act was significantly reorganized and expanded in 1972. The 1972 amendments to the CWA require that each state develop water quality standards for surface waters within their borders. A water quality standard consists of the following elements:

- Designated use or uses such as "supporting aquatic life" or "recreation"
- Water quality criteria necessary to protect the designated uses
- Antidegradation requirements

The 1972 amendments to the CWA also include Section 303(d), which requires states to develop lists of waterbodies that do not meet water quality standards for their designated uses and to submit updated lists to EPA every 2 years. Waterbodies on this list, called the 303(d) list, are considered to be not supporting their designated uses and referred to as "impaired."

For waterbodies on the 303(d) list, the CWA requires that a pollutant load reduction plan or TMDL be developed to correct each impairment. TMDLs must document the nature of the water quality impairment, determine the maximum amount of a pollutant that can be discharged and still meet water quality standards, and identify allowable loads from the contributing sources. The elements of a TMDL include a problem statement, description of the desired future condition (numeric target), pollutant source analysis, load allocations, description of how allocations relate to meeting targets, and margin of safety.

In addition to the TMDL, an implementation plan is developed for each waterbody and associated pollutant on the 303(d) list. The TMDL and the implementation plan serve as the means to attain and maintain water quality standards for the impaired waterbody.

Section 305(b) of the CWA requires that each state prepare and submit to the EPA a biennial report describing water quality conditions of lakes and streams. Streams are then classified as supporting, not supporting, or only partially supporting their designated uses. The most recent EPA-approved Wyoming biennial report, titled the *Wyoming Water Quality Assessment and Impaired Waters List (2012 Integrated 305(b) and 303(d) Report)* (hereafter the integrated report; WDEQ 2012), lists seven stream segments in the Tongue River Watershed in Wyoming as impaired due to exceedances of the state's water quality criteria for pathogenic bacteria.

## 1.4. Designated Uses and Associated Water Quality Standards

The State of Wyoming has designated surface water uses, water quality criteria to protect those uses, and antidegradation policies and procedures in *Water Quality Rules and Regulations Chapter 1, Wyoming Surface Water Quality Standards* (hereafter Wyoming's surface water quality standards; WDEQ 2013a). Section 2(b)(ix) of the surface water quality standards defines *designated uses* as "those uses specified in water quality standards for each water body or segment whether or not they are being attained" (WDEQ 2013a:1-3). The designated uses that are protected for Wyoming's surface waters are listed and described in Section 3 of the surface water quality standards and include agriculture, fisheries, industry, drinking water, recreation, scenic value, aquatic life other than fish, wildlife, and fish consumption. These uses are defined in Wyoming's surface water quality standards as follows (WDEQ 2013a:1-8–1-9):

> (a) Agriculture. For purposes of water pollution control, agricultural uses include irrigation and/or livestock watering.
>
> (b) Fisheries. The fisheries use includes water quality, habitat conditions, spawning and nursery areas, and food sources necessary to sustain populations of cold water game fish, warm water game fish and nongame fish. This use does not include the protection of aquatic invasive species or other fish which may be considered "undesirable" by the Wyoming Game and Fish Department or the U.S. Fish and Wildlife Service within their appropriate jurisdictions.
>
> (c) Industry. Industrial use protection involves maintaining a level of water quality useful for industrial purposes.
>
> (d) Drinking water. The drinking water use involves maintaining a level of water quality that is suitable for potable water or intended to be suitable after receiving conventional drinking water treatment.
>
> (e) Recreation. Recreational use protection involves maintaining a level of water quality which is safe for human contact. It does not guarantee the availability of water for any recreational purpose. The recreation designated use includes primary contact recreation and secondary contact recreation subcategories.
>
> (f) Scenic value. Scenic value use involves the aesthetics of the aquatic systems themselves (odor, color, taste, settleable solids, floating solids, suspended solids and solid waste) and is not necessarily related to general landscape appearance.
>
> (g) Aquatic life other than fish. This use includes water quality and habitat necessary to sustain populations of organisms other than fish in proportions which make up diverse aquatic communities common to the waters of the state. This use does not include the protection of human pathogens, insect pests, aquatic invasive species or other organisms which may be

considered "undesirable" by the Wyoming Game and Fish Department or the U.S. Fish and Wildlife Service within their appropriate jurisdictions.

(h) Wildlife. The wildlife use includes protection of water quality to a level which is safe for contact and consumption by avian and terrestrial wildlife species.

(i) Fish consumption. The fish consumption use involves maintaining a level of water quality that will prevent any unpalatable flavor and/or accumulation of harmful substances in fish tissue.

Wyoming's surface waters are classified according to their designated uses using a hierarchical system described in Wyoming's surface water quality standards (WDEQ 2013a). There are four major classes of surface water in Wyoming with various subcategories within each class. Waters are placed into Classes 1–4 (Table 1) based on their designated uses, with Class 1 waters being managed for the highest water quality and Class 4 waters being managed for the lowest water quality. Table 1 provides a summary of Wyoming's surface water classifications (far left column) and associated designated uses (top row). For each surface water class, a "Yes" indicates that a designated use is protected for that class, whereas a "No" indicates that the use is not protected for that class (WDEQ 2013b).

**Table 1.** Wyoming's Surface Water Classes and Designated Uses

| Class | Drinking Water | Game Fish | Non-Game Fish | Fish Consumption | Other Aquatic Life | Recreation | Wildlife | Agriculture | Industry | Scenic Value |
|---|---|---|---|---|---|---|---|---|---|---|
| 1* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 2AB | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 2A | Yes | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| 2B | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 2C | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 2D | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 3A | No | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| 3B | No | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| 3C | No | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| 3D | No | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| 4A | No | No | No | No | No | Yes | Yes | Yes | Yes | Yes |
| 4B | No | No | No | No | No | Yes | Yes | Yes | Yes | Yes |
| 4C | No | No | No | No | No | Yes | Yes | Yes | Yes | Yes |

*Note*: "Yes" indicates the use is protected for that water class, whereas "No" indicates that it is not protected for that water class.

*Source*: WDEQ (2013b).

* Class 1 waters are not protected for all uses in all circumstances. For example, all waters in the national parks and wilderness areas are Class 1; however, all do not support fisheries or other aquatic life uses (e.g., hot springs, ephemeral waters, wet meadows; WDEQ 2013b).

The State of Wyoming has classified the impaired segments in the Tongue River Watershed as either Class 1, 2AB, or 3B waterbodies. These water classifications are defined by the WDEQ in the Wyoming surface water quality standards as follows:

- Class 1 waters are those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be

controlled through implementation of appropriate best management practices. Pursuant to Section 7 of these regulations, the water quality and physical and biological integrity which existed on the water at the time of designation will be maintained and protected. In designating Class 1 waters, the Environmental Quality Council (council) shall consider water quality, aesthetic, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archaeological, fish and wildlife, the presence of significant quantities of developable water and other values of present and future benefit to the people.

- Class 2AB waters are those known to support game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is otherwise attainable. Class 2AB waters include all permanent and seasonal game fisheries and can be either "cold water" or "warm water" depending upon the predominance of cold water or warm water species present. All Class 2AB waters are designated as cold water game fisheries unless identified as a warm water game fishery by a "ww" notation in the *Wyoming Surface Water Classification List*. Unless it is shown otherwise, these waters are presumed to have sufficient water quality and quantity to support drinking water supplies and are protected for that use. Class 2AB waters are also protected for nongame fisheries, fish consumption, aquatic life other than fish, recreation, wildlife, industry, agriculture and scenic value uses.
- Class 3B waters are tributary waters including adjacent wetlands that are not known to support fish populations or drinking water supplies and where those uses are not attainable. Class 3B waters are intermittent and ephemeral streams with sufficient hydrology to normally support and sustain communities of aquatic life including invertebrates, amphibians, or other flora and fauna which inhabit waters of the state at some stage of their life cycles. In general, 3B waters are characterized by frequent linear wetland occurrences or impoundments within or adjacent to the stream channel over its entire length. Such characteristics will be a primary indicator used in identifying Class 3B waters.

Section 305(b) of the CWA requires states to describe the water quality condition of all their waters and determine whether these waters support their designated uses. As stated in the integrated report (WDEQ 2012), Wyoming's Watershed Monitoring Program is responsible for providing most of the information used in determining whether designated uses are supported for the surface waters of the state; however, other groups (e.g., the USGS and Wyoming's 34 conservation districts) also contribute substantially. These data are used to determine water quality condition following methods outlined in *Wyoming's Methods for Determining Surface Water Quality Condition and TMDL Prioritization* (WDEQ 2014). This methodology is revised periodically to maintain consistency with changes in the state's water quality standards and to comply with Wyoming's "Credible Data" Law.

Generally, a water is deemed to be non-supporting of one or more designated uses (i.e., impaired) if any narrative or numeric criteria are exceeded, or if designated uses are shown to be adversely affected by anthropological activities (WDEQ 2014). Wyoming's integrated report (WDEQ 2012) lists segments in the Tongue River Watershed as not supporting their recreation designated use due to exceedances of the fecal coliform or *Escherichia coli* (*E. coli*) water quality criteria, and these segments were added to the 303(d) list in 2002, 2004, and 2010.

Another component of the protection of waters under the CWA is the establishment of water quality criteria to protect designated uses. Wyoming's water quality criteria applicable to the Tongue River Watershed impairments consist of numeric criteria for *E. coli* concentrations for primary contact recreation.

In all waters designated for primary contact recreation, during the summer recreation season (May 1–September 30), concentrations of *E. coli* bacteria shall not exceed a geometric mean of 126 organisms per 100 milliliters (mL) during any 60-day period. During the winter recreation season (October 1–April 30), concentrations of *E. coli* bacteria shall not exceed a geometric mean of 630 organisms per 100 mL during any consecutive 60-day period (WDEQ 2013a: Section 27).

## 1.5. Impaired Waters

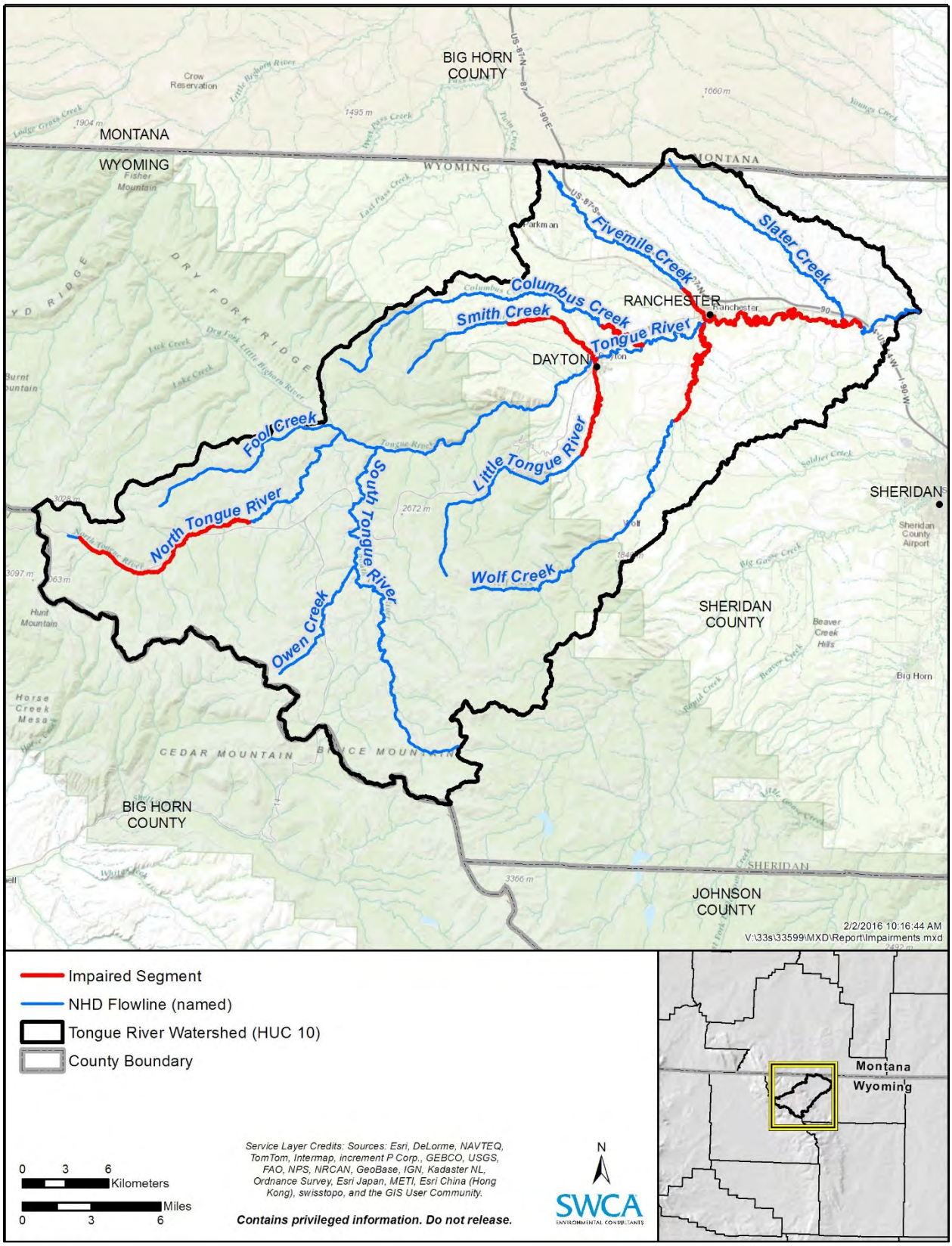
Water quality assessments conducted by WDEQ in 2002, 2004, and 2010 resulted in seven segments in the Tongue River Watershed being listed as impaired and added to the state's 303(d) list due to exceedances of the state's bacteria (fecal coliform or *E. coli*) water quality standards. Impaired segments in the Tongue River Watershed are summarized in Table 2 and are shown on Map 1. Original impairment listings for North Tongue River, Columbus Creek, Smith Creek, Fivemile Creek, and Wolf Creek were based on the fecal coliform standard that stated that the geometric mean (hereafter geomean) of five samples should not exceed 200 organisms per 100 mL obtained during separate 24-hour periods within a 30-day time span.

In 1986, EPA recommended that *E. coli* replace fecal coliform bacteria in state water quality standards (EPA 1986). Therefore, in 2001, WDEQ began the transition toward using *E. coli* bacteria, instead of fecal coliform, as an indicator of potential pathogen contamination. As such, TMDL development is structured around *E. coli* data only.

**Table 2.** Tongue River Watershed Impaired Segment Descriptions from Wyoming's 2012 Integrated Report

| Waterbody | 305(b) Identifier | Class | Location | Miles | Uses | Cause | List Date | TMDL Date |
|---|---|---|---|---|---|---|---|---|
| | | | | | Use Support | Source(s) | | |
| North Tongue River | WYTR100901010101_01 | 1 | From Road 171 upstream to the confluence with Pole Creek. | 11.1 | Recreation | Fecal coliform | 2004 | 2013 |
| | | | | | Not supporting | Grazing | | |
| Columbus Creek | WYTR100901010106_01 | 2AB | From the confluence with the Tongue River to a point 3.1 miles upstream. | 3.1 | Recreation | Fecal coliform | 2002 | 2013 |
| | | | | | Not supporting | Unknown | | |
| Smith Creek | WYTR100901010106_02 | 2AB | From the confluence with the Tongue River to a point 5.8 miles upstream. | 5.8 | Recreation | Fecal coliform | 2002 | 2013 |
| | | | | | Not supporting | Unknown | | |
| Little Tongue River | WYTR100901010107_02 | 2AB | From the confluence with the Tongue River upstream to the confluence with Frisbee Ditch. | 4.8 | Recreation | *E. coli* | 2002 | 2013 |
| | | | | | Not supporting | Unknown | | |
| Fivemile Creek | WYTR100901010108_01 | 3B | From the confluence with the Tongue River upstream to the confluence with Hanover Ditch. | 2.1 | Recreation | Fecal coliform | 2002 | 2013 |
| | | | | | Not supporting | Unknown | | |
| Wolf Creek | WYTR100901010110_01 | 2AB | From the confluence with the Tongue River upstream to the confluence with East Wolf Creek. | 10.6 | Recreation | Fecal coliform | 2002 | 2013 |
| | | | | | Not supporting | Unknown | | |
| Tongue River | WYTR100901010111_01 | 1 | From Monarch Road upstream to Wolf Creek Road. | 13.5 | Recreation | *E. coli* | 2010 | 2013 |
| | | | | | Not supporting | Unknown | | |

*Source*: WDEQ (2012).




**Map 1.** Impaired segments in the Tongue River Watershed.

## 1.6. Problem Statement

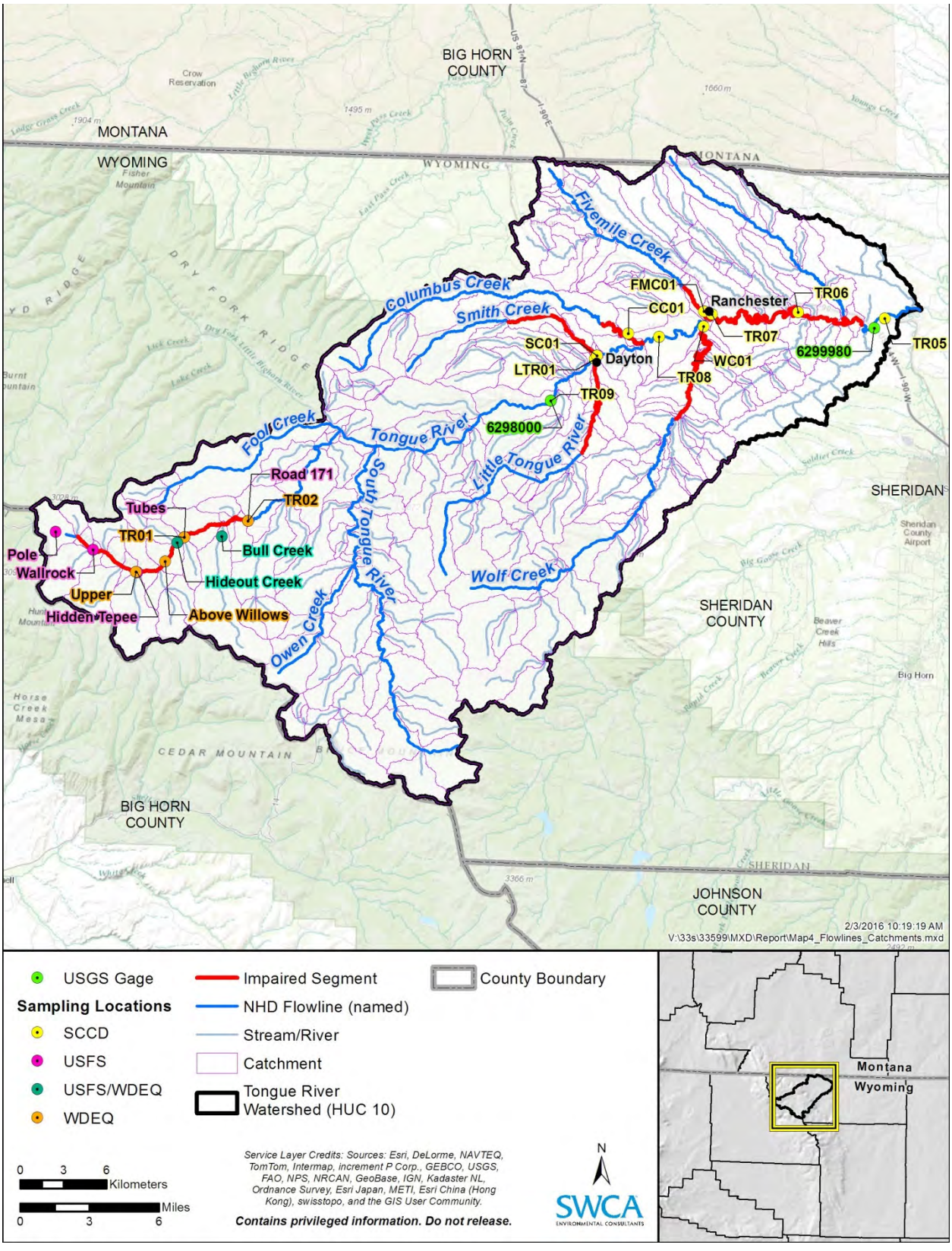
An assessment of water quality conducted by WDEQ resulted in seven segments in the Tongue River Watershed in Wyoming being listed as impaired due to exceedances of the state's water quality criteria for fecal coliform or *E. coli*. *E. coli* is one species of fecal coliform that can also be used as an indicator of fecal contamination. Most *E. coli* strains are not pathogenic to humans (Nataro and Kaper 1998); however, some strains of *E. coli*, such as *E. coli* 157:H7, are responsible for hemorrhagic colitis (severe diarrhea) and hemolytic uremic syndrome (kidney failure) (Nataro and Kaper 1998).

These pathogenic bacteria have the potential to affect watershed residents because the impaired segments are extensively used for irrigation, recreation, and fishing. Impairment of waterbodies in the Tongue River Watershed is cause for concern because of the potential human health risk, degradation of aquatic life, and implications for future management of agricultural practices and local communities. Common sources of *E. coli* include waste from livestock and wildlife as well as input from faulty septic systems. In more urban areas with high degrees of impervious surface, pet waste runoff can also become a significant source.

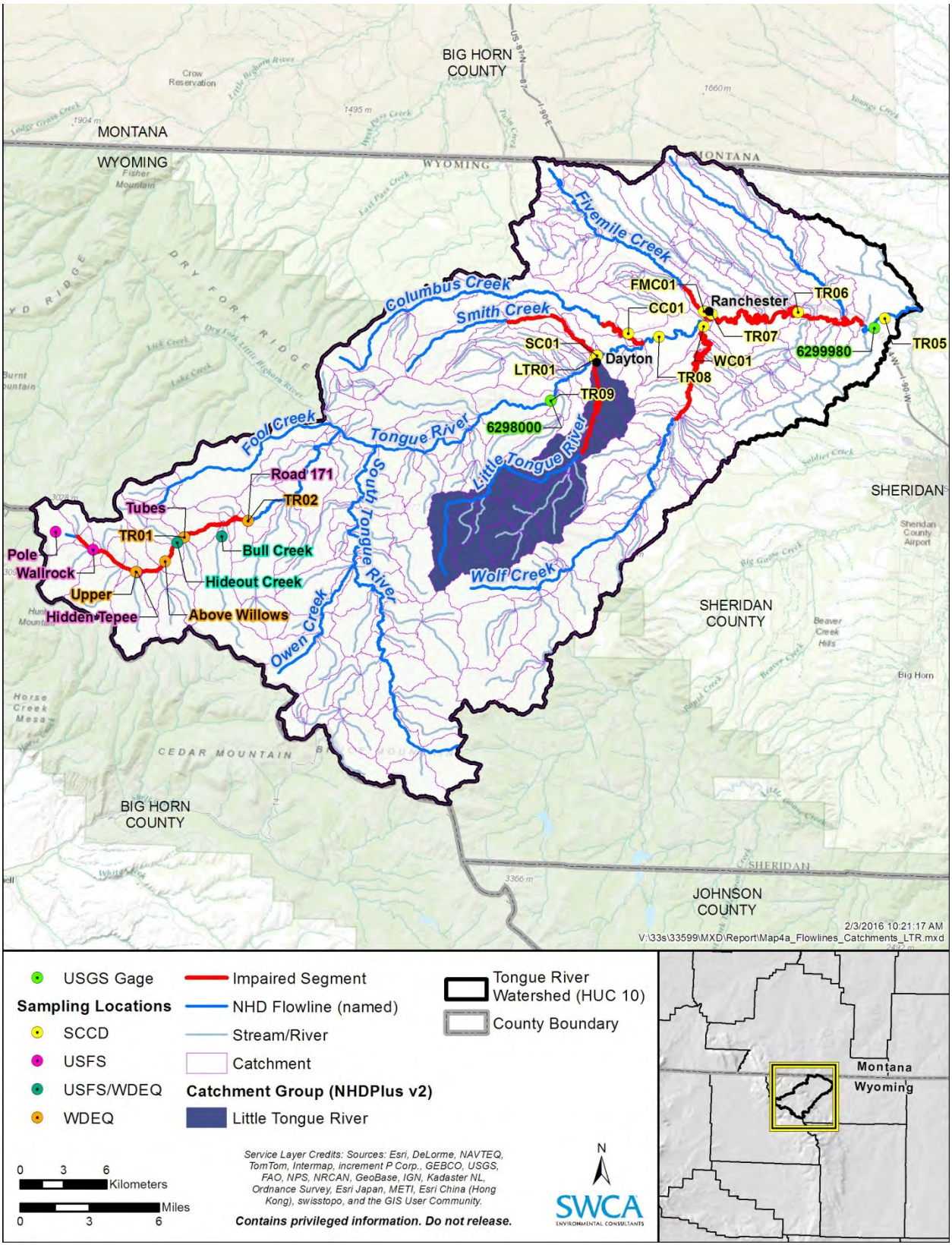
## 1.7. Study Area

For the purposes of defining the study area for TMDL development and implementation, subwatershed boundaries in the Tongue River Watershed were delineated for each of the seven impaired segments. Subwatershed boundaries were delineated based on NHDPlus Version 2 (NHDPlus) catchments (Map 2). NHDPlus is an integrated suite of geospatial datasets that incorporate features from the National Hydrography Dataset (NHD), the National Elevation Dataset, and the Watershed Boundary Dataset (Horizon Systems Corporation 2016). The application of this tool is illustrated in the map series below (see Map 2–5).

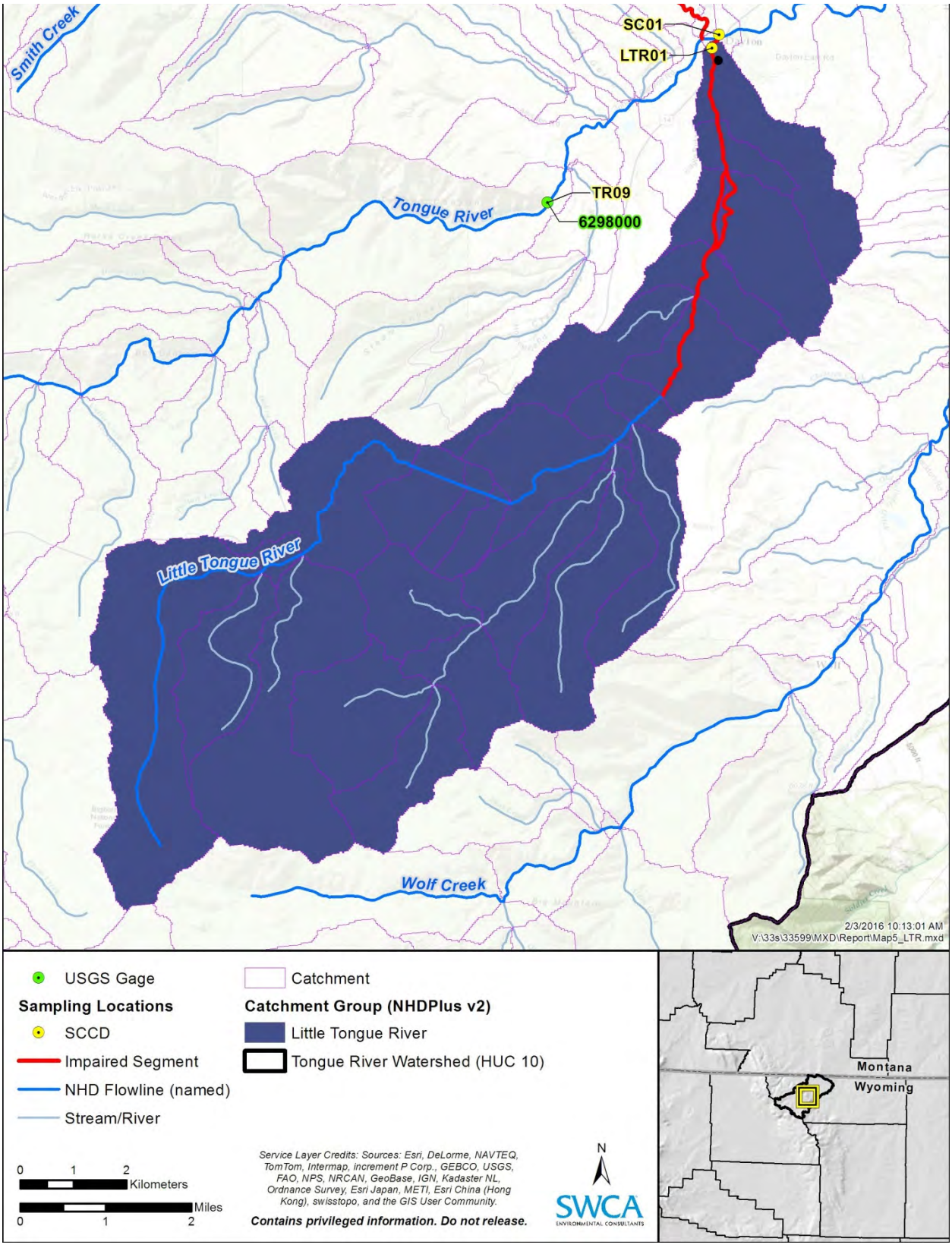
For each impaired segment, all NHDPlus catchments contributing to the segment were identified. An example of this process for the Little Tongue River is shown on Maps 3 and 4. The entirety of the contributing area for each impaired segment was delineated and presented as the subwatershed boundary (Map 5).



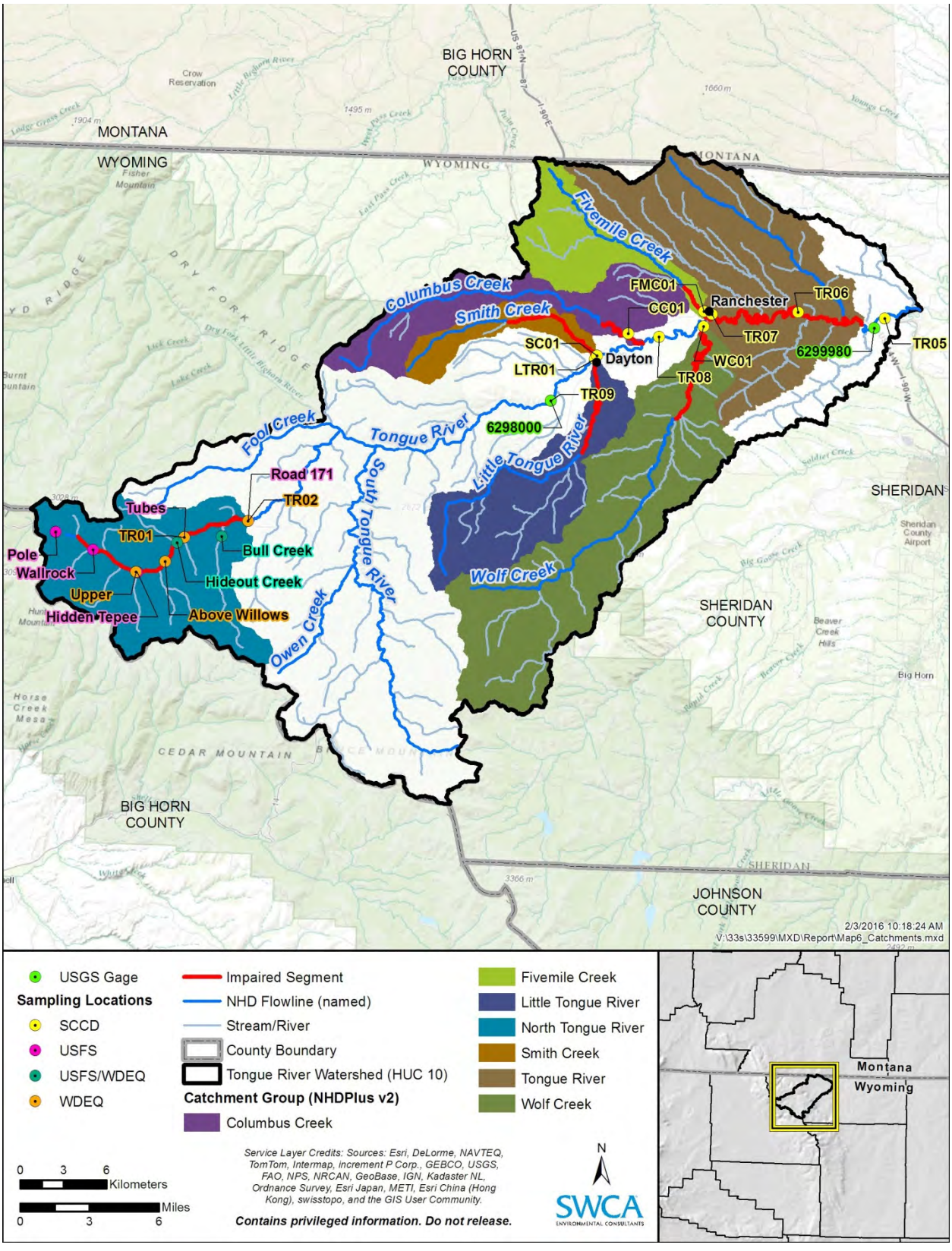

**Map 2.** NHDPlus catchments in the Tongue River Watershed.




**Map 3.** Little Tongue River subwatershed in the Tongue River Watershed.




**Map 4.** NHDPlus Version 2 catchments in the Little Tongue River subwatershed.




**Map 5.** Subwatershed boundaries for each impaired segment in the Tongue River Watershed.

# 2. REGIONAL SETTING

## 2.1. Population

The Tongue River Watershed is 313,340 acres, all of which are in Sheridan County, Wyoming. Two municipalities are located in the watershed: Dayton and Ranchester. As of 2010, the population of Sheridan County was 29,116 (U.S. Census Bureau 2010). The Wyoming Department of Administration and Information, Economic Analysis Division (EADIV) estimated the 2015 population of Sheridan County at 30,180 representing a 4% growth from 2010 to 2015 (EADIV 2015). Understanding future population growth at the watershed scale requires an examination of both countywide projected population estimates and future population estimates for the towns of Dayton and Ranchester. Future population growth for Ranchester and Dayton was estimated by EADIV and is displayed in Table 3 along with Sheridan County and the state of Wyoming population forecasts. Between 2010 and 2040, the population of Wyoming is estimated to increase by 20%, whereas Sheridan County is estimated to increase by 18%. Ranchester and Dayton are both projected to increase by 18%.

**Table 3.** Projected Population Growth for Wyoming and the Tongue River Watershed

| Location | Population 2010 | Population 2015 | Estimated Population 2020 | Estimated Population 2040 |
|---|---|---|---|---|
| Wyoming | 563,626* | 587,660* | 616,140† | 703,530† |
| Sheridan County | 29,116* | 30,180† | 31,460† | 35,530† |
| Ranchester | 855† | 886† | 924† | 1,043† |
| Dayton | 757† | 785† | 818† | 924† |

* Data from U.S. Census (2010).

† Data from Wyoming Economic Analysis Division (2015).

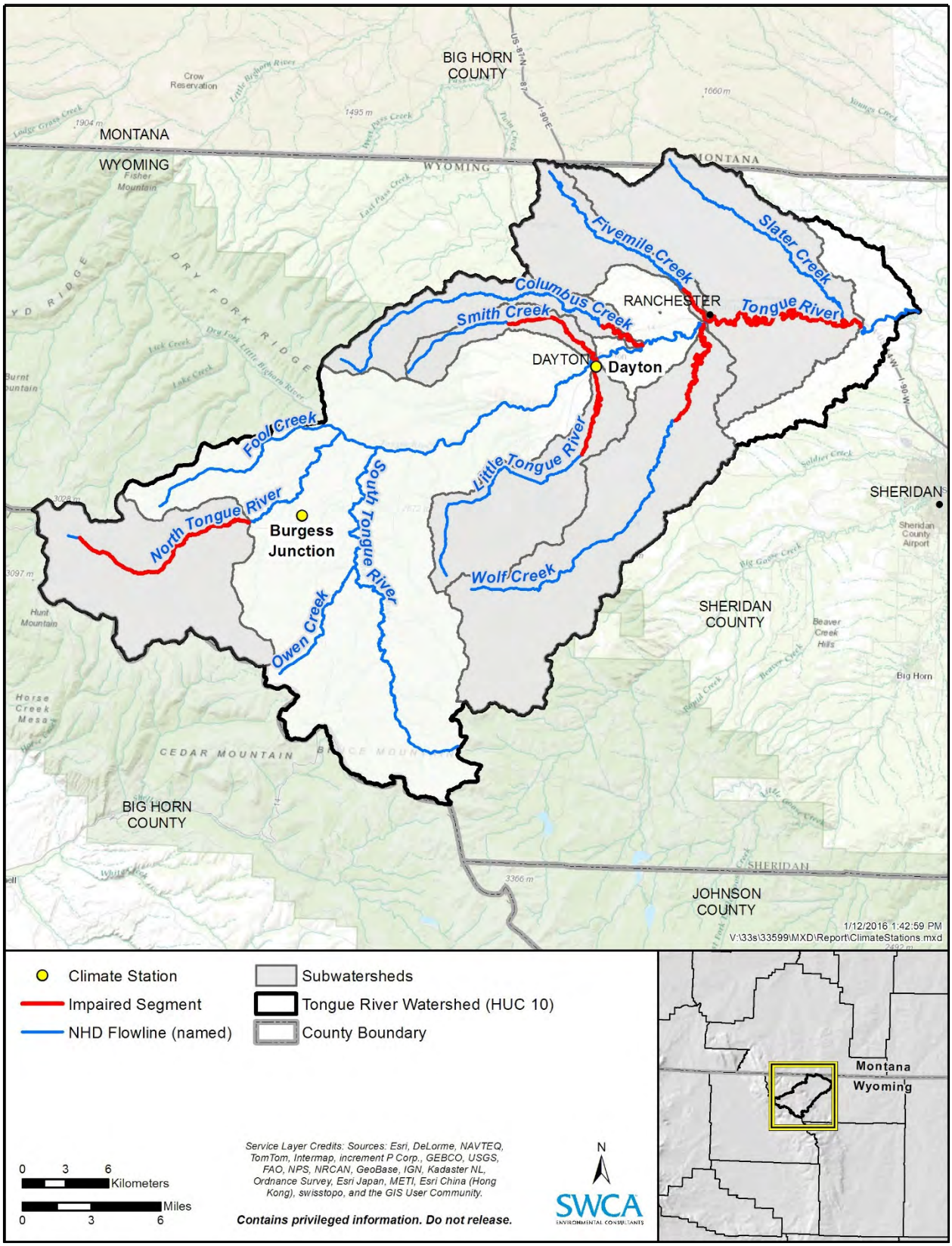
## 2.2. Climate

Two climate stations are located in the Tongue River Watershed: one in the town of Dayton and one in the Bighorn National Forest near Burgess Junction (Table 4, Map 6). Data from these stations show that temperatures vary widely by season, with the lowest average temperature occurring in December and the highest average temperature occurring in July (Tables 5 and 6). Snowfall is the dominant form of precipitation, but amounts vary with elevation and location within the watershed (see Tables 5 and 6).

**Table 4.** Climate Stations in the Tongue River Watershed

| Climate Station Name | Climate Station ID Number | Latitude | Longitude | Elevation (feet) | Period of Record Available |
|---|---|---|---|---|---|
| Dayton | USC00482399 | 44.873 | -107.265 | 3,930 | 03/01/1951 to 10/31/2015 |
| Burgess Junction | USC00481220 | 44.774 | -107.521 | 8,060 | 09/01/1960 to 11/30/2015 |

*Source*: Utah State University (2015).




**Map 6.** Climate stations located in the Tongue River Watershed.

**Table 5.** Climate Summary for the Dayton Weather Station

| Month | Average Temperature (°F) | Average Total Precipitation (inches) | Average Total Snowfall (inches) |
|---|---|---|---|
| January | 24.3 | 0.8 | 6.0 |
| February | 24.1 | 0.9 | 6.0 |
| March | 35.8 | 1.3 | 5.8 |
| April | 41.7 | 1.9 | 2.5 |
| May | 50.9 | 3.3 | 0.2 |
| June | 60.6 | 2.2 | 0.0 |
| July | 69.4 | 1.2 | 0.0 |
| August | 67.5 | 1.0 | 0.0 |
| September | 58.5 | 1.2 | 0.2 |
| October | 45.1 | 1.7 | 1.8 |
| November | 33.4 | 0.9 | 4.1 |
| December | 21.0 | 1.0 | 6.8 |
| **Annual** | **44.4** | **17.3** | **33.4** |

*Source*: Utah State University (2015).

**Table 6.** Climate Summary for the Burgess Junction Weather Station

| Month | Average Temperature (°F) | Average Total Precipitation (inches) | Average Total Snowfall (inches) |
|---|---|---|---|
| January | 17.1 | 1.4 | 11.7 |
| February | 17.8 | 1.4 | 10.8 |
| March | 22.6 | 1.9 | 11.7 |
| April | 29.1 | 2.6 | 10.0 |
| May | 38.7 | 2.5 | 6.0 |
| June | 48.4 | 1.9 | 1.5 |
| July | 55.8 | 1.3 | 0.1 |
| August | 54.1 | 1.2 | 0.0 |
| September | 45.1 | 1.6 | 2.3 |
| October | 35.1 | 1.9 | 6.7 |
| November | 24.1 | 1.4 | 9.6 |
| December | 17.6 | 1.4 | 11.4 |
| **Annual** | **33.8** | **20.3** | **81.9** |

*Source*: Utah State University (2015).

# 3. WATERSHED CHARACTERIZATION

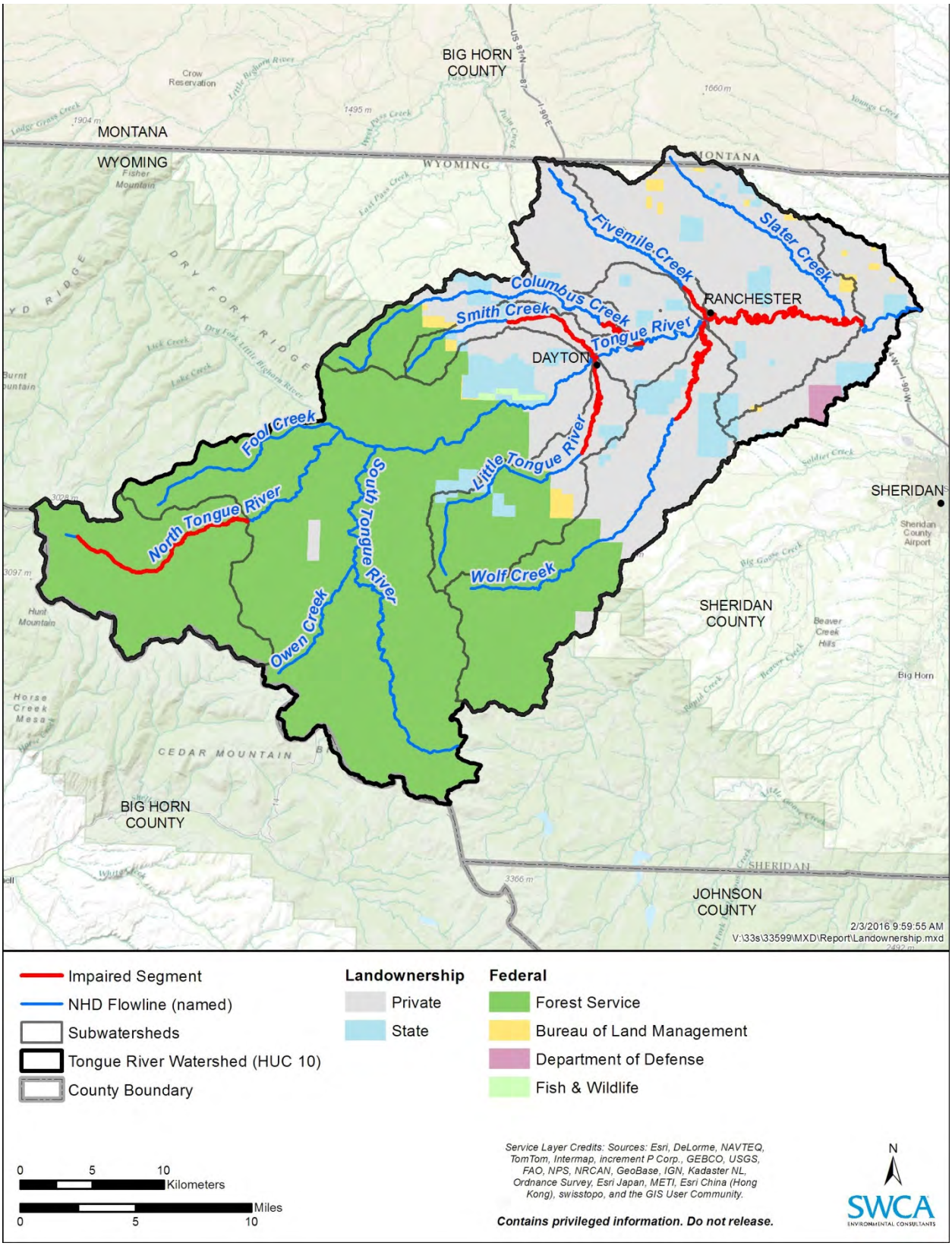
## 3.1. Land Ownership

In the Tongue River Watershed, land is primarily federally owned by the USFS with most of it occurring in the Bighorn National Forest (Table 7, Map 7). Several smaller Bureau of Land Management (BLM) allotments are scattered throughout the lower elevation areas as well as some state-owned parcels. Privately owned land mostly occurs in lower elevation areas around the towns of Ranchester and Dayton.

Understanding landownership patterns in each subwatershed is important for developing implementation strategies that are appropriate for the region in question. In the subwatersheds, the proportion of privately owned land versus federally owned land varies greatly between subwatersheds, with state-owned land consistently comprising the smallest acreage in each subwatershed (see Table 7). Federal ownership is primarily by the USFS in the headwaters regions in the Bighorn National Forest and comprises the entirety of the North Tongue subwatershed. The BLM has several holdings scattered throughout the lower elevation portions of the watershed, and much of the privately owned land is also located in the lower elevation portions of the subwatersheds (see Map 7).

**Table 7.** Landownership in the Tongue River Watershed

| Subwatershed | Private | Federal | State | Total | Private | Federal | State |
|---|---|---|---|---|---|---|---|
| North Tongue River | 0 | 30,855 | 0 | **30,855** | 0% | 100% | 0% |
| Columbus Creek | 6,545 | 5,681 | 1,262 | **13,488** | 49% | 42% | 9% |
| Smith Creek | 3,714 | 2,306 | 699 | **6,719** | 55% | 34% | 10% |
| Little Tongue River | 6,573 | 13,608 | 1,546 | **21,727** | 30% | 63% | 7% |
| Fivemile Creek | 12,983 | 21 | 163 | **13,167** | 98% | <1% | 1% |
| Wolf Creek | 19,255 | 22,800 | 3,856 | **45,912** | 42% | 50% | 8% |
| Tongue River | 37,515 | 1,104 | 3,154 | **41,773** | 90% | 3% | 8% |
| **Tongue River Watershed** | **115,812** | **178,974** | **18,488** | **313,274** | **37%** | **57%** | **6%** |




**Map 7.** Landownership in the Tongue River Watershed.

## 3.2. Land Cover and Land Use

Land cover and land use are important parameters to consider when determining *E. coli* loads to receiving waterbodies. For example, if most of a watershed was covered by agricultural operations, it would be expected that livestock-derived *E. coli* could make up an important component of the total load. Land cover data for the Tongue River Watershed were obtained from the National Land Cover Database. Results indicate that land cover in the Tongue River Watershed is dominated by forests, scrub/shrub, and grasslands, whereas wetlands, crops, pasture/hay, and development represent the least amount of land cover (Map 8). Land cover in the Tongue River Watershed is summarized in Tables 8 and 9. Approximately 39% of the land is evergreen forest, 28% is grassland, and 23% is shrub/scrub. Evergreen forests are most predominant in the headwaters region in the national forest, and shrub/scrub and grassland dominate the lowlands.

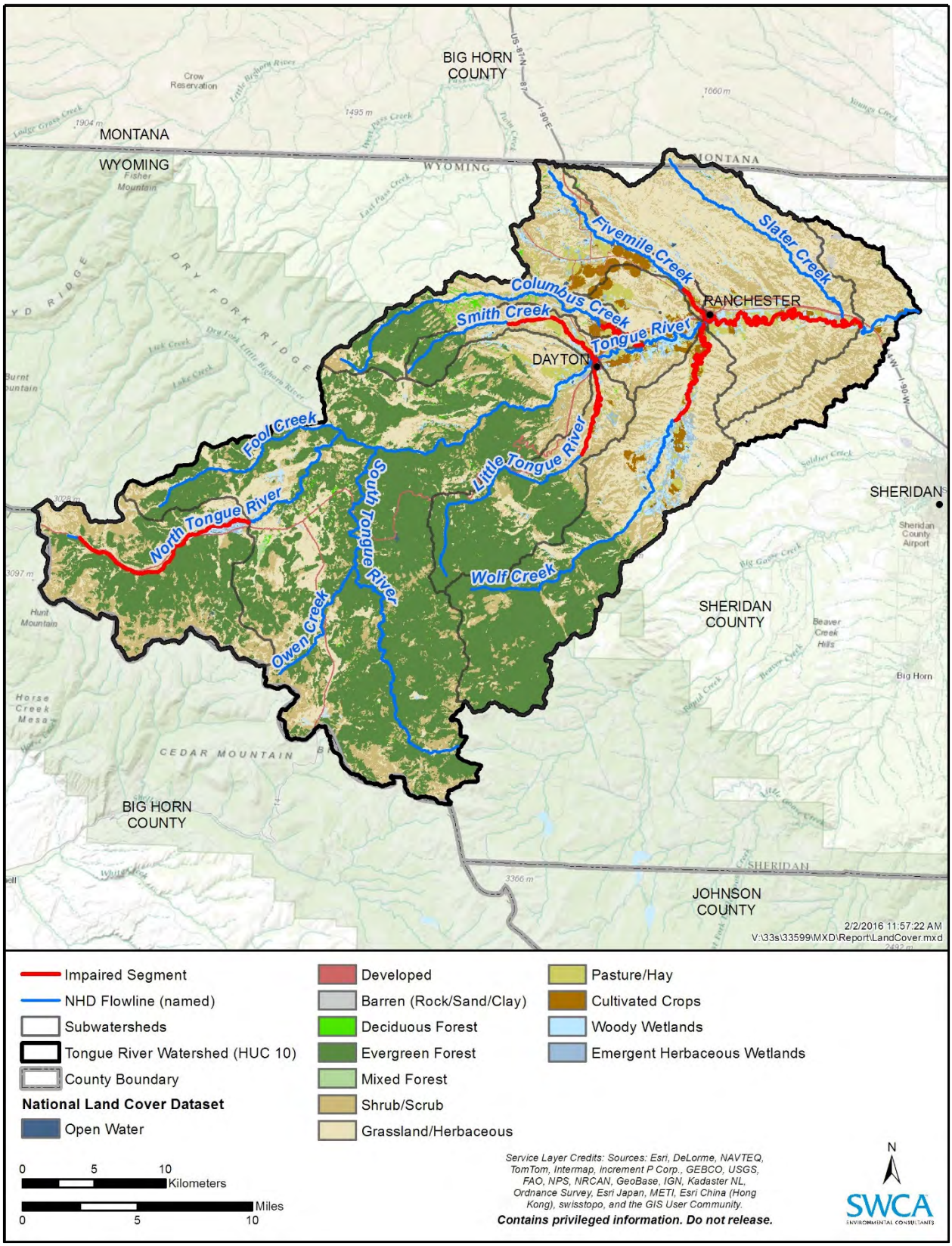
In the subwatersheds, the proportion of different land cover types varies greatly (see Map 8, see Tables 8 and 9). In general, subwatersheds located mostly in the national forest (e.g., North Tongue River, Little Tongue River, and Wolf Creek) exhibit a larger proportion of evergreen forest land cover, whereas subwatersheds in the lowlands (e.g., Fivemile Creek and Tongue River) exhibit more scrub/shrub and grasslands.

**Table 8.** Land Cover in the Tongue River Watershed (acres)

| Subwatershed | Land Cover (acres) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Barren Land | Cultivated Crops | Deciduous Forest | Developed | Emergent Herbaceous Wetlands | Evergreen Forest | Grassland/ Herbaceous | Mixed Forest | Open Water | Pasture/ Hay | Shrub/ Scrub | Woody Wetlands | Total |
| North Tongue River | 19 | 0 | 28 | 397 | 415 | 14,657 | 5,490 | 9 | 12 | 0 | 9,571 | 257 | **30,855** |
| Columbus Creek | 2 | 351 | 446 | 81 | 43 | 4,227 | 3,728 | 12 | 1 | 551 | 3,439 | 605 | **13,488** |
| Smith Creek | 2 | 1 | 32 | 55 | 85 | 2,286 | 1,707 | 7 | 17 | 836 | 1,345 | 346 | **6,719** |
| Little Tongue River | 20 | 41 | 39 | 393 | 178 | 12,911 | 3,384 | 4 | 2 | 208 | 4,111 | 436 | **21,727** |
| Fivemile Creek | 18 | 1,339 | 60 | 723 | 359 | 39 | 4,726 | 0 | 70 | 1,371 | 3,511 | 1,017 | **13,233** |
| Wolf Creek | 2 | 903 | 50 | 40 | 1,052 | 20,157 | 11,222 | 0 | 29 | 844 | 9,367 | 2,245 | **45,912** |
| Tongue River | 479 | 244 | 30 | 761 | 318 | 62 | 25,212 | 0 | 39 | 1,217 | 11,302 | 2,108 | **41,773** |
| **Tongue River Watershed** | **752** | **4,795** | **1,248** | **4,128** | **2,974** | **122,825** | **87,676** | **225** | **226** | **7,246** | **71,659** | **9,586** | **313,340** |

**Table 9.** Land Cover in the Tongue River Watershed (percentage)

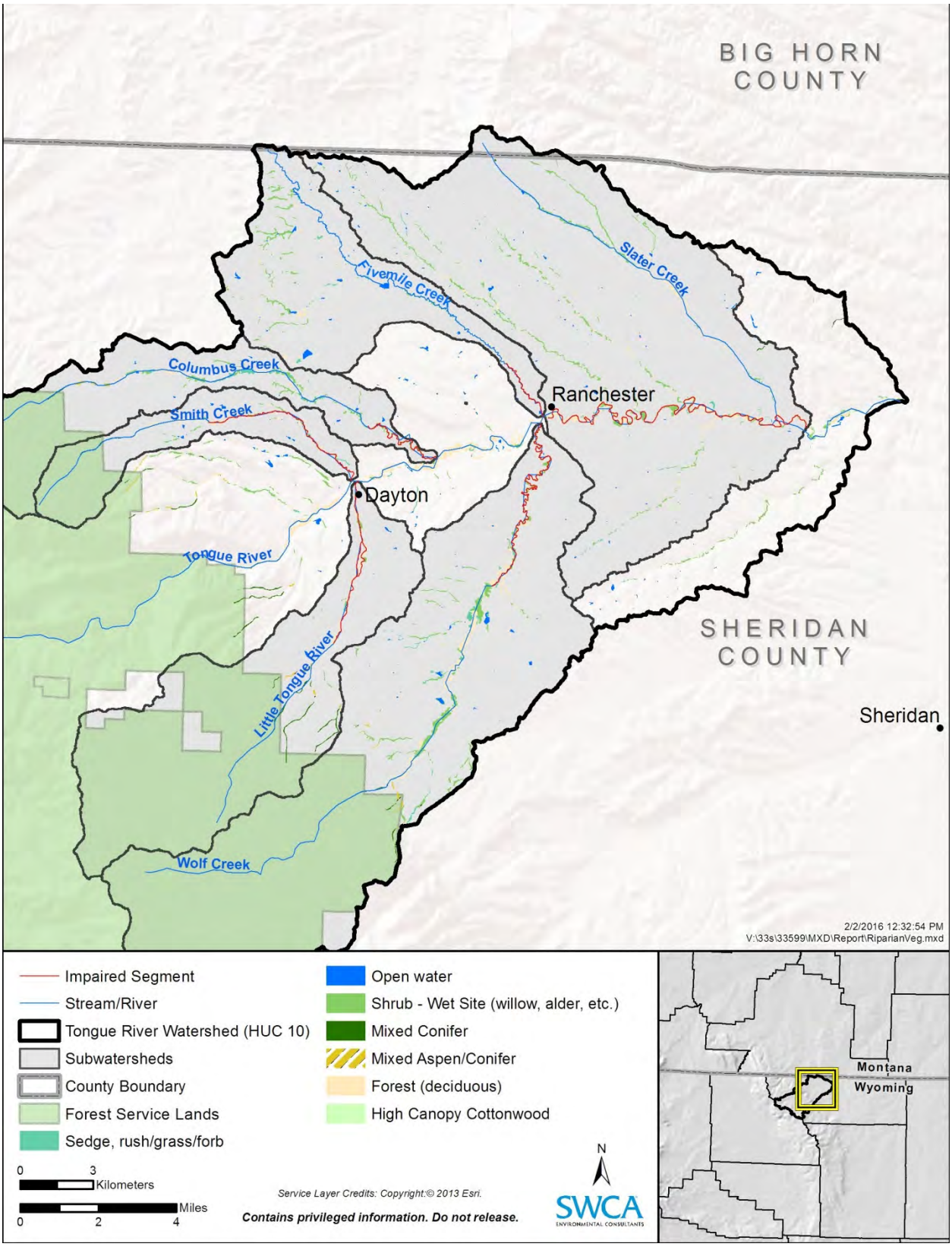
| Subwatershed | Land Cover (percentage) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Barren Land** | **Cultivated Crops** | **Deciduous Forest** | **Developed** | **Emergent Herbaceous Wetlands** | **Evergreen Forest** | **Grassland/ Herbaceous** | **Mixed Forest** | **Open Water** | **Pasture/ Hay** | **Shrub/ Scrub** | **Woody Wetlands** |
| North Tongue River | <1% | 0% | <1% | 1% | 1% | 48% | 18% | <1% | <1% | 0% | 31% | <1% |
| Columbus Creek | <1% | 3% | 3% | <1% | <1% | 31% | 28% | <1% | <1% | 4% | 26% | 5% |
| Smith Creek | <1% | <1% | 1% | 1% | 1% | 34% | 25% | <1% | <1% | 12% | 20% | 5% |
| Little Tongue River | <1% | <1% | <1% | 2% | 1% | 59% | 16% | <1% | <1% | 1% | 19% | 2% |
| Fivemile Creek | <1% | 10% | 1% | 6% | 3% | <1% | 36% | 0% | 1% | 10% | 27% | 8% |
| Wolf Creek | <1% | 2% | <1% | <1% | 2% | 44% | 24% | 0% | <1% | 2% | 20% | 5% |
| Tongue River | 1% | <1% | <1% | 2% | <1% | <1% | 60% | 0% | <1% | 3% | 27% | 5% |
| **Tongue River Watershed** | **<1%** | **2%** | **<1%** | **1%** | **1%** | **39%** | **28%** | **<1%** | **<1%** | **2%** | **23%** | **3%** |




**Map 8.** Land cover in the Tongue River Watershed.

## 3.3. Riparian Vegetation

The extent and health of riparian vegetation are important for the buffering capacity it can provide to filtering runoff, particularly alongside pasturelands that are used for grazing. High-resolution mapping of riparian vegetation was conducted by AECOM in the Tongue River Watershed in lands not owned by the USFS (Map 9). Most of the riparian vegetation in the watershed consists of shrub and deciduous forest (Table 10).




**Map 9.** Riparian vegetation in the Tongue River Watershed.

**Table 10.**Riparian Vegetation in the Tongue River Watershed

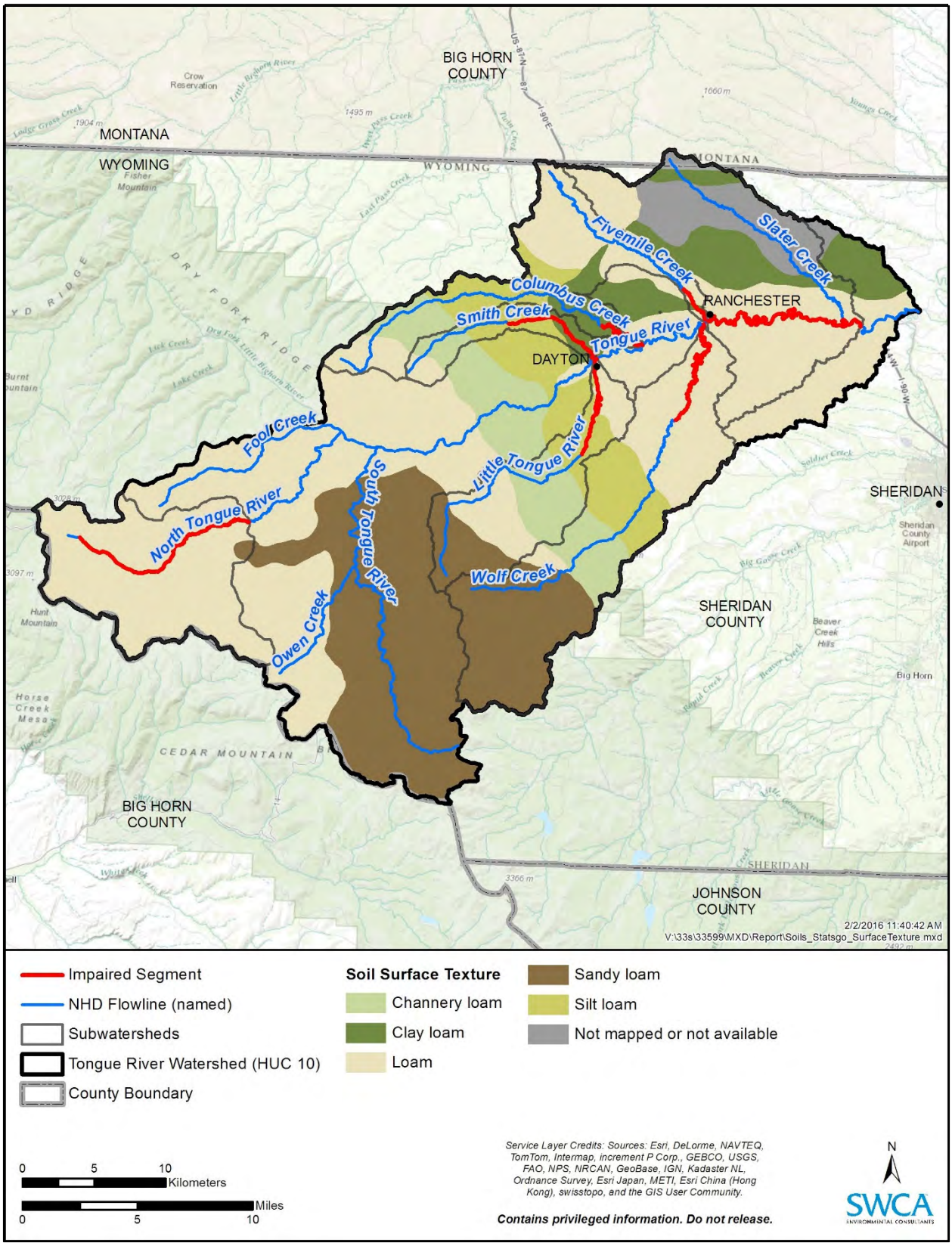
| Subwatershed | Riparian Vegetation (acres) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sedge | Open Water | Shrub | Mixed Conifer | Mixed Aspen/ Conifer | Forest (deciduous) | High Canopy Cottonwood | Total |
| Columbus Creek | 59 | 18 | 220 | 12 | 35 | 85 | 0 | **428** |
| Smith Creek | 16 | 19 | 69 | 17 | 10 | 103 | 0 | **233** |
| Little Tongue River | 5 | 11 | 35 | 81 | 30 | 126 | 0 | **289** |
| Fivemile Creek | 25 | 90 | 247 | 0 | 0 | 134 | 0 | **496** |
| Wolf Creek | 109 | 52 | 495 | 25 | 41 | 368 | 1 | **1,092** |
| Tongue River | 65 | 63 | 642 | 4 | 0 | 392 | 2 | **1,168** |
| **Tongue River Watershed** | **307** | **351** | **1,957** | **203** | **171** | **1,758** | **4** | **4,751** |

*Note*: The North Tongue subwatershed was not included as a part of this analysis due to lack of data.

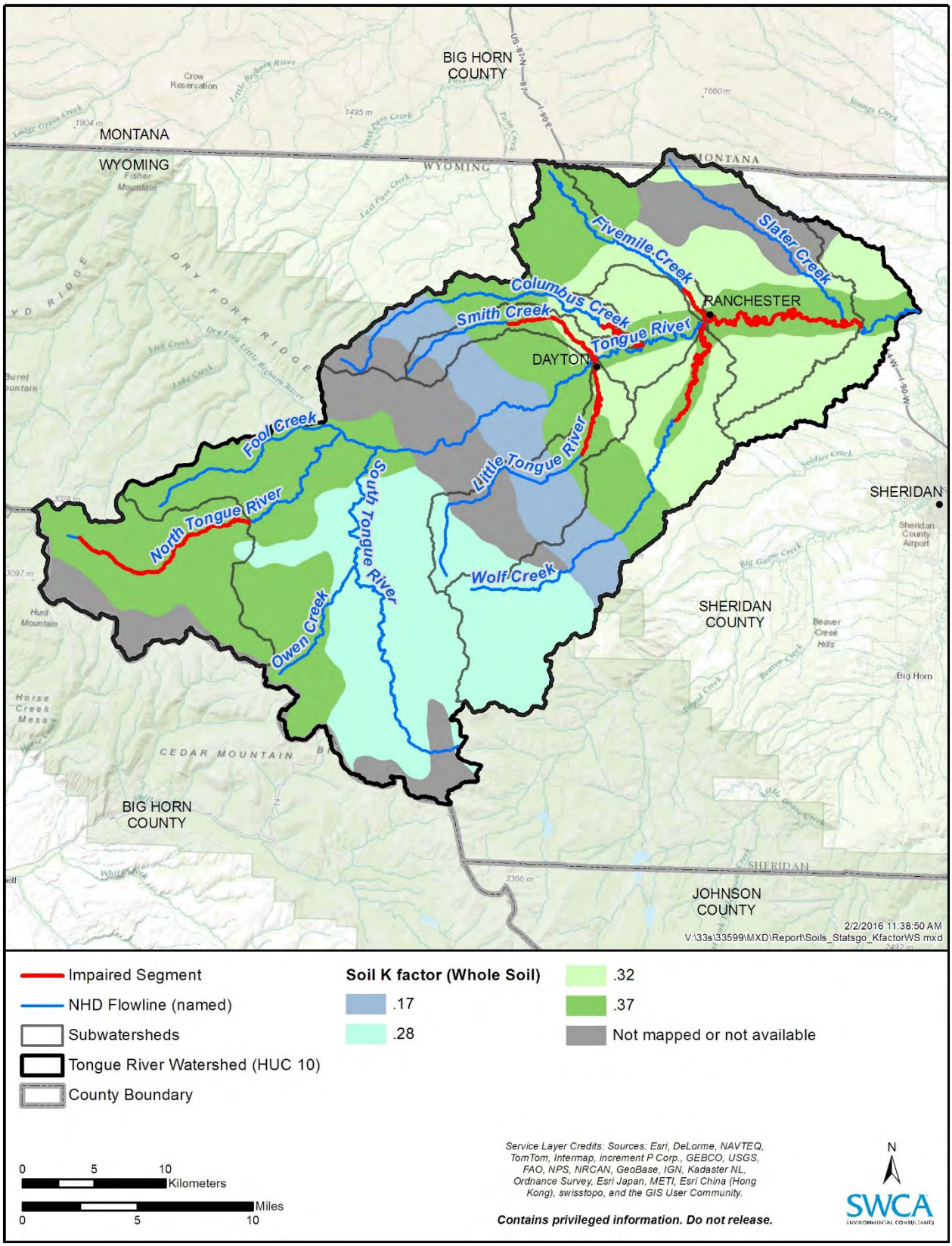
## 3.4. Soils

Soils in the Tongue River Watershed are primarily loams, which comprise approximately 50% of all classified soils (Map 10). Sandy loams make up approximately 23% of the remaining soils, with silt, clay, and channery loams existing throughout the remaining portion of the watershed.

Soil erodibility increases with its representative K factor, a function of soil organic matter, soil structure, particle size, soil permeability to water, and clay content. For example, soils high in clay content have a low K factor (0.05–0.15), whereas soils high in silt content generally have a high K factor (greater than 0.4) and are the most erodible type of soil. Map 11 illustrates the distribution of whole soil K factors throughout the Tongue River Watershed. Most soils found in the subwatersheds are loamy (i.e., a combination of sand, silt, and clay) with K factors ranging from 0.17 to 0.37 (Table 11). Soil erodibility is high (K = 0.37) adjacent to the North Tongue River, Columbus Creek, Wolf Creek, and Tongue River impaired segments. Adjacent to the impaired segments Smith Creek and Little Tongue River, the soil erodibility is moderate (K = 0.32) near the bottom of the segments and high near the top of the segments. Soil erodibility adjacent to the Fivemile Creek impaired segment is moderate (Table 12).




**Map 10.** Surface soil texture in the Tongue River Watershed.




**Map 11.** Soil erodibility in the Tongue River Watershed.

**Table 11.**Soil Erodibility in the Tongue River Watershed (acres)

| Subwatershed | Rating | | | | Not Mapped | Total |
|---|---|---|---|---|---|---|
| | 0.17 | 0.28 | 0.32 | 0.37 | | |
| North Tongue River | 0 | 374 | 0 | 23,767 | 6,668 | **30,809** |
| Columbus Creek | 3,271 | 0 | 2,366 | 4,710 | 3,119 | **13,466** |
| Smith Creek | 1,633 | 0 | 1,201 | 2,810 | 1,075 | **6,719** |
| Little Tongue River | 5,594 | 5,159 | 2,181 | 3,373 | 5,420 | **21,727** |
| Fivemile Creek | 0 | 0 | 4,210 | 9,009 | 0 | **13,219** |
| Wolf Creek | 5,104 | 18,110 | 11,730 | 10,119 | 804 | **45,868** |
| Tongue River | 0 | 0 | 18,370 | 11,730 | 11,648 | **41,748** |
| **Tongue River Watershed** | **24,374** | **65,569** | **59,265** | **115,630** | **48,505** | **313,343** |

**Table 12.**Soil Erodibility in the Tongue River Watershed (percentage)

| Subwatershed | Rating | | | | Not Mapped |
|---|---|---|---|---|---|
| | 0.17 | 0.28 | 0.32 | 0.37 | |
| North Tongue River | 0% | 1% | 0% | 77% | 22% |
| Columbus Creek | 24% | 0% | 18% | 35% | 23% |
| Smith Creek | 24% | 0% | 18% | 42% | 16% |
| Little Tongue River | 26% | 24% | 10% | 16% | 25% |
| Fivemile Creek | 0% | 0% | 32% | 68% | 0% |
| Wolf Creek | 11% | 39% | 26% | 22% | 2% |
| Tongue River | 0% | 0% | 44% | 28% | 28% |
| **Tongue River Watershed** | **8%** | **21%** | **19%** | **37%** | **15%** |

## 3.5. Hydrology

The Tongue River and its tributaries are part of the greater Powder/Tongue River Basin. The Tongue River originates at the confluence of the North Tongue River and the South Tongue River in the Bighorn National Forest, flows downstream through the towns of Dayton and Ranchester, and eventually discharges into the Yellowstone River in Montana. A number of tributaries join the Tongue River as it courses toward Montana, including Little Tongue River, Smith Creek, Columbus Creek, Wolf Creek, Fivemile Creek, and Slater Creek. Diversions and impoundments exist throughout the watershed and divert water to and from the mainstem of the river and its tributaries. Structures include dams, diversions, and wastewater treatment plants (WWTPs), all of which are discussed in more detail in later sections of this memorandum.

### *3.5.1. Sheridan County Conservation District Flow Data*

SCCD measured flow in cubic feet per second (cfs) at several sampling stations throughout the watershed as a part of their regular monitoring. Table 13 summarizes data collection, Figure 1 illustrates the number of data available by month for each sampling station on an impaired segment, and Map 12 shows the locations of these sampling stations. Most of the flow data were collected in May and August of each year.

**Table 13.** Sheridan County Conservation District Flow Data in the Tongue River Watershed

| Subwatershed | Station Code | Data Range | Number of Measurements | Flow (cfs) | | |
|---|---|---|---|---|---|---|
| | | | | Minimum | Maximum* | Average |
| Columbus Creek | CC01 | 1996–2013 | 78 | 0.03 | 84.91 | 8.23 |
| Smith Creek | SC01 | 1996–2013 | 79 | 0.03 | 73.15 | 4.16 |
| Little Tongue River | LTR01 | 1996–2013 | 79 | 0.06 | 58.27 | 11.88 |
| Fivemile Creek | FMC01 | 1996–2013 | 78 | 0.01 | 51.97 | 6.22 |
| Wolf Creek | WC01 | 1996–2013 | 76 | 0.36 | 221.14 | 27.94 |
| Tongue River | TR06 | 2006–2013 | 28 | 11.58 | 606.81 | 144.40 |
| | TR07 | 1996–2013 | 80 | 13.33 | 2,628.48 | 378.80 |
| **Tongue River Watershed** | **TR05** | **2006–2013** | **28** | **16.00** | **1,390.00** | **239.50** |
| | **TR08** | **1996–2013** | **79** | **25.24** | **2,852.48** | **393.83** |
| | **TR09** | **1996–2013** | **83** | **35.00** | **1,108.60** | **219.81** |

* With the exception of TR09, maximum flows were not recorded for each site because 1) the gage was submerged or 2) readings were outside of the calibrated relationship between depth and flow.

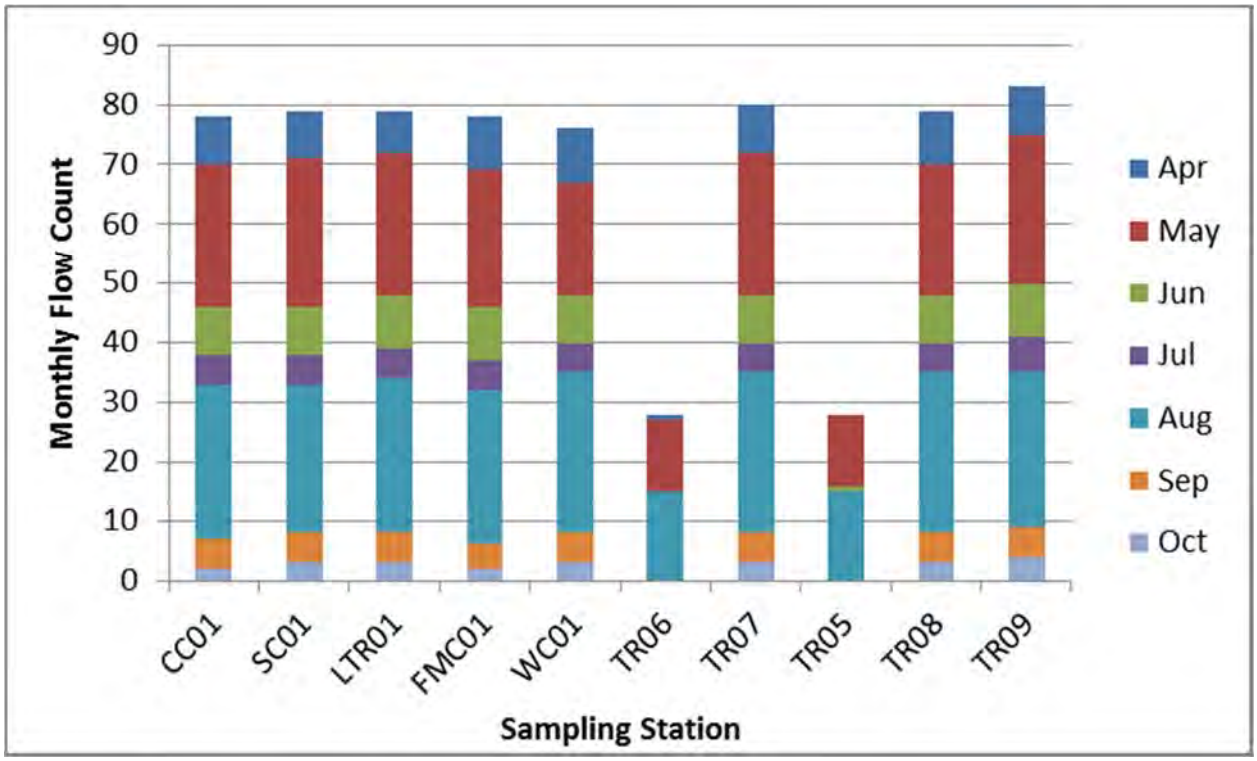
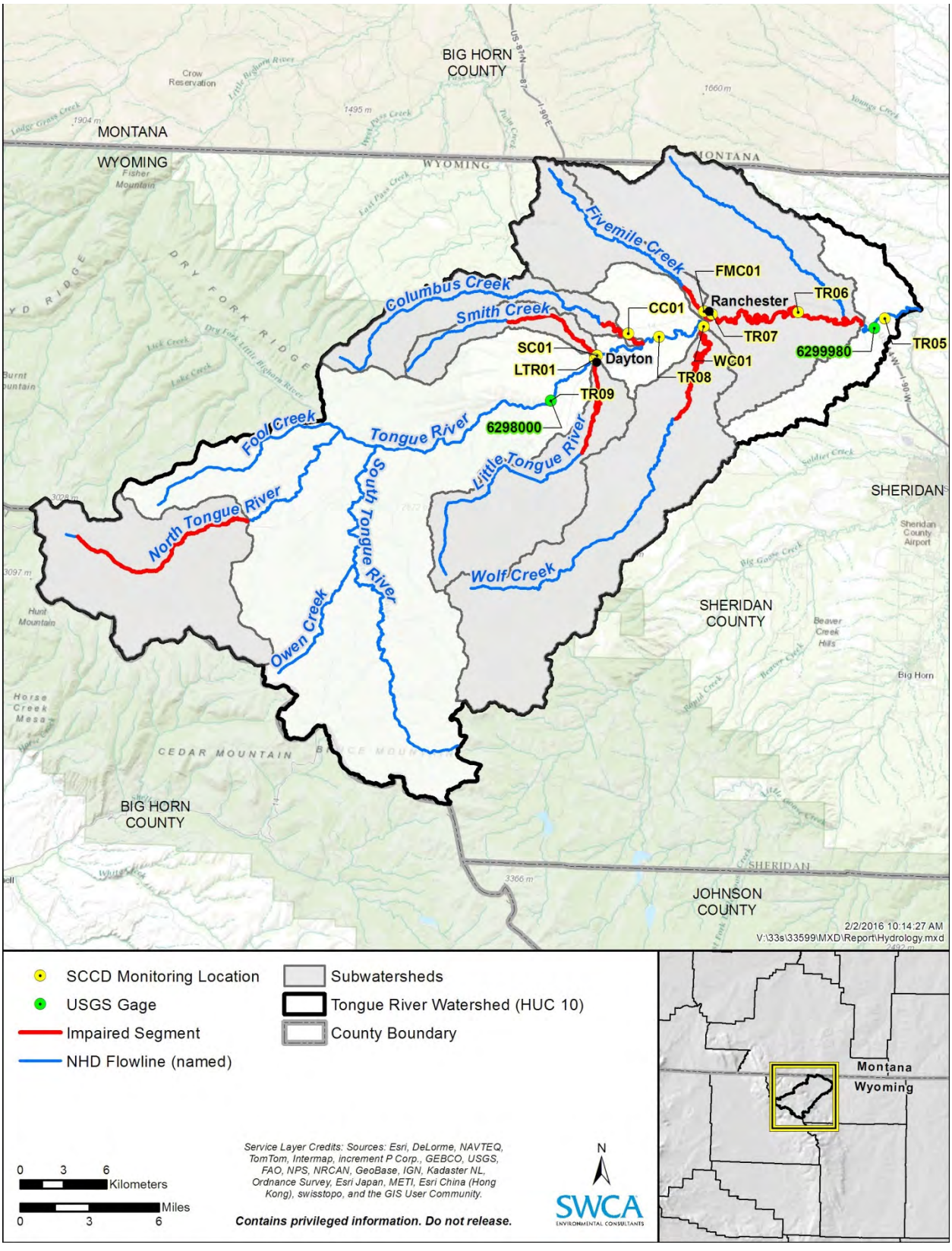



**Figure 1.** Number of monthly flow measurements collected at Sheridan County Conservation District sampling stations in the Tongue River Watershed.




**Map 12.** Sheridan County Conservation District sampling locations (monitoring locations) and U.S. Geological Survey flow gages in the Tongue River Watershed.

## 3.5.2. U.S. Geological Survey Flow Data

Within the watershed, two USGS flow gages (6298000 and 6299980) are located on the Tongue River (see Map 12). The gage upstream of Dayton (6298000) has been in operation since 1918, and the second gage (6299980), located downstream of the Tongue River subwatershed, has been in operation since 2004. A summary of flow data for each gage is provided in Table 14, and monthly mean hydrographs are presented in Figure 2. Monthly flow patterns in the Tongue River are typical of snowmelt-driven systems in the west in that flow peaks during the spring runoff and then decreases throughout the summer.

**Table 14.** U.S. Geological Survey Flow Data

| Gage Name | Gage Number | Data Range | Data Type |
|---|---|---|---|
| Tongue River Near Dayton, WY | 6298000 | 11/1/1918–present | Daily statistics |
| Tongue River At Monarch, WY | 6299980 | 05/01/2004–present | Daily statistics |

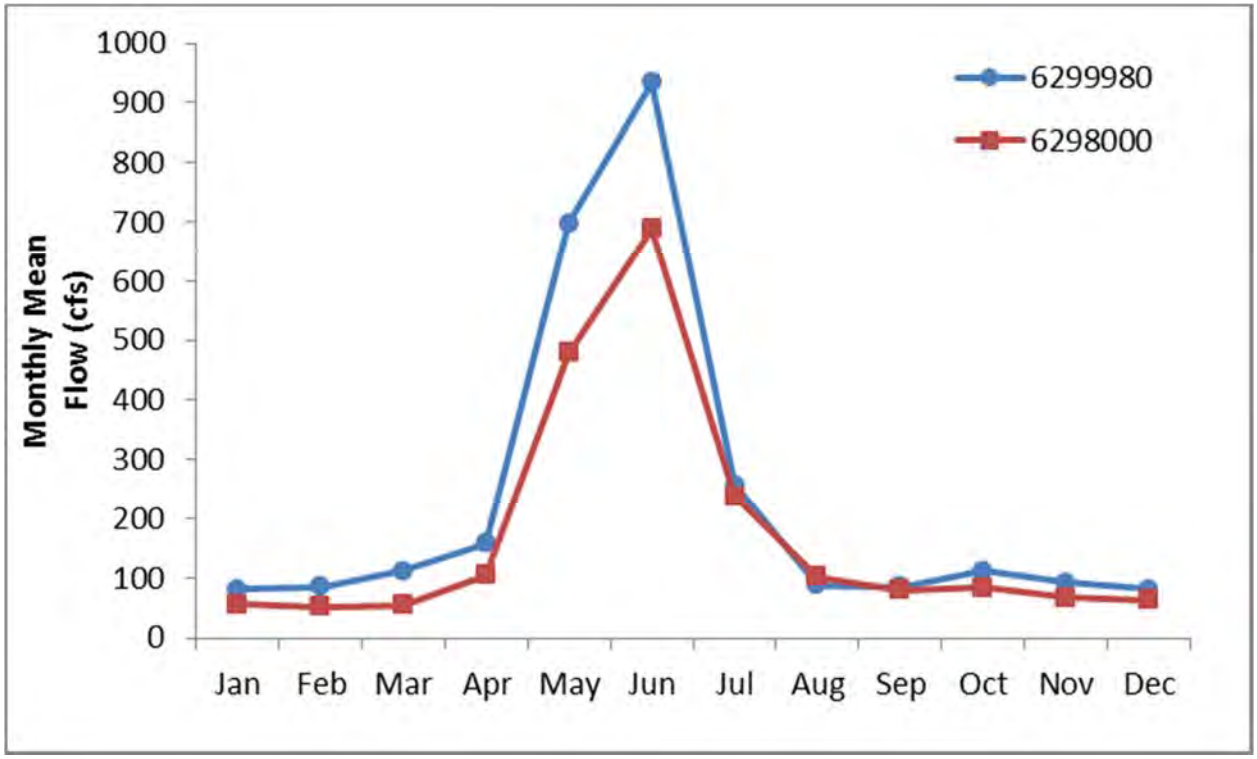



**Figure 2.** Monthly mean flow data for the U.S. Geological Survey gages, from 2004 to 2015.

## 3.5.3. Tongue River Hydrologic Model

A hydrologic model for the Tongue River was developed for the Wyoming Water Development Commission by HKM Engineering Inc. (HKM) as a part of the *Powder/Tongue River Basin Water Plan* (HKM et al. 2002). The model estimates monthly flow volumes within the watershed for normal, wet, or dry hydrologic conditions at multiple nodes in the watershed. Nodes indicate a specific point, such as a USGS gage or a stream reach, for which the net flow is calculated (based on flow in, net diversions, and flow out), and they provide an estimate of flow at multiple locations in the watershed. The model is intended to simulate water use and availability under existing conditions (HKM 2002a) and relies on

historical gage data from 1970 to 1999 to define the three hydrologic conditions for each year. The wettest 20% of years were considered wet, the driest 20% were classified as dry, and the remaining years were classified as normal (HKM 2002a). Model parameters include streamflow, estimated agricultural diversions, irrigation returns, and reservoir conditions. Four model nodes are present in the Tongue River Watershed: one on Wolf Creek, one on Little Tongue River, and two on the mainstem of the Tongue River (Figure 3).

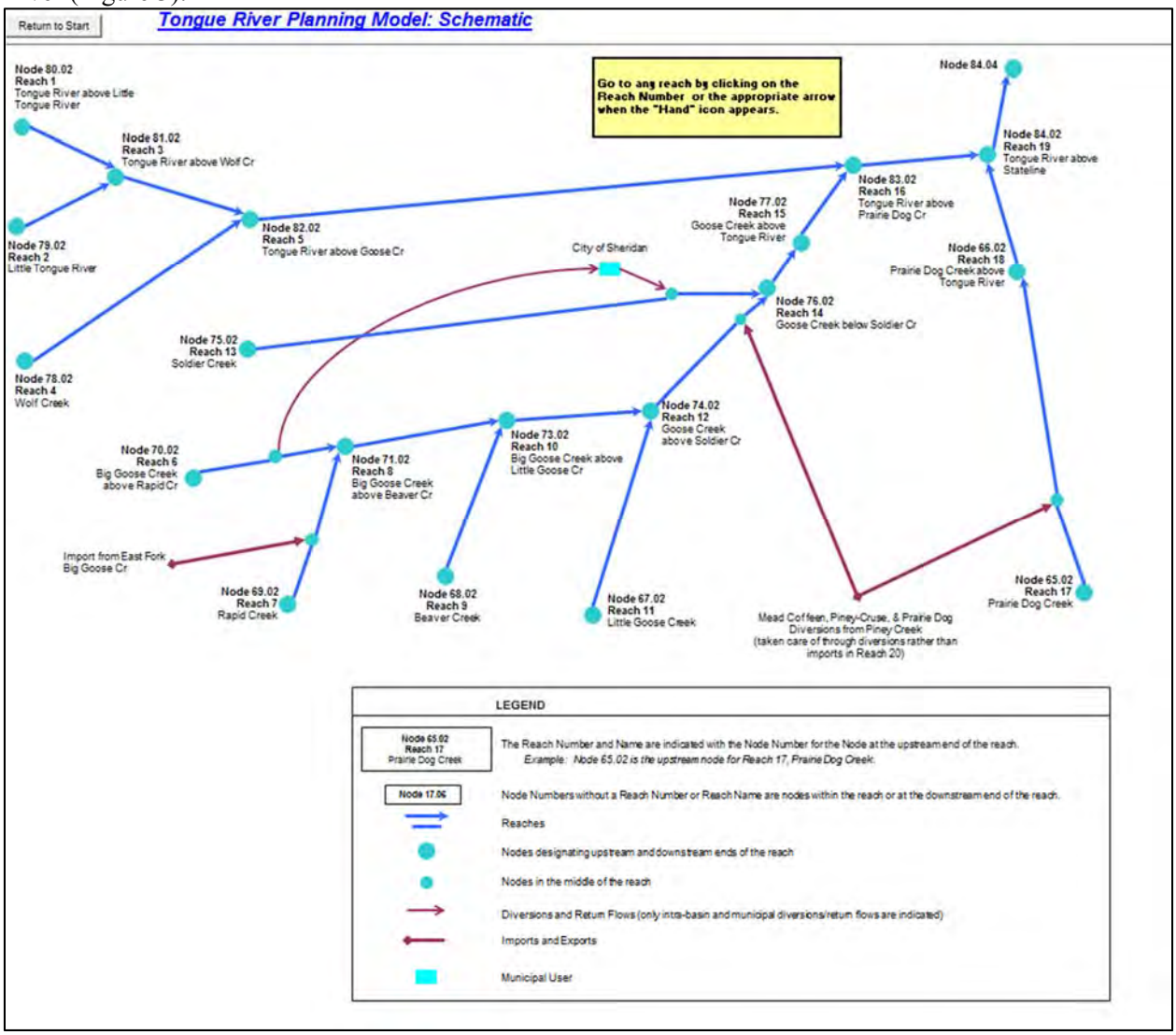



**Figure 3.** Node locations in the Tongue River hydrologic model.

## 3.5.4. Irrigation

Irrigation practices are widespread throughout the Tongue River Watershed and consist of a network of canals and diversions that transfer water from the mainstem of the Tongue River and its tributaries to agricultural lands throughout the watershed. Six percent of the Tongue River Watershed is characterized as irrigated land, with subwatersheds exhibiting a range from 5% in the Little Tongue River to 23% in Smith Creek (Table 15, Map 13). There are no irrigation diversions along the North Tongue River. A review of the *Powder/Tongue River Basin Plan Irrigation Diversion Operation and Description* memoranda (HKM 2002b) indicates that nine major water diversions are present throughout the

watershed. Six of these diversions draw from the mainstem of the Tongue River, one from Columbus Creek, and two from Wolf Creek (Table 16, Map 14) for a total of 158.42 cfs.

**Table 15.** Irrigated Lands in the Tongue River Watershed

| Subwatershed | Irrigated Land (acres) | Irrigated Land (%) |
|---|---|---|
| Columbus Creek | 978 | 7% |
| Smith Creek | 3,087 | 23% |
| Little Tongue River | 1,090 | 5% |
| Fivemile Creek | 1,217 | 18% |
| Wolf Creek | 2,939 | 7% |
| Tongue River | 4,219 | 9% |
| **Tongue River Watershed** | 18,694 | 6% |

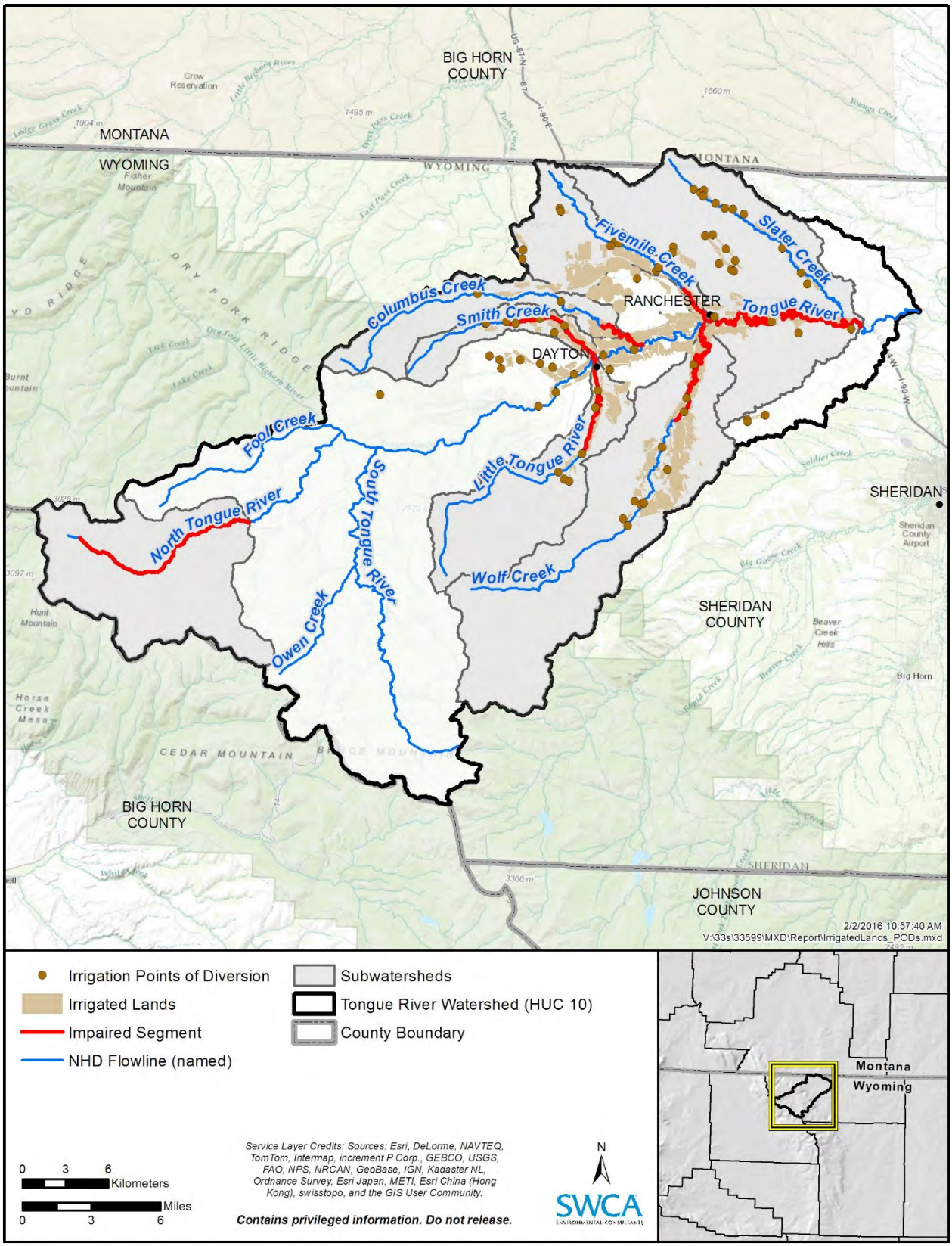
**Table 16.** Major Water Diversions in the Tongue River Watershed

| Diversion Name | Source | Latitude | Longitude | Allocated Water Amount* (cfs) |
|---|---|---|---|---|
| High Line Ditch | Tongue River | 44°50'48.9" | 107°18'50.7" | 13.81 |
| OZ & K | Tongue River | 44°52'49.2" | 107°15'29.9" | 26.05 |
| Hanover | Tongue River | 44°54'22.0" | 107°9'37.4" | 26.05† |
| South Side | Tongue River | 44°51'24.7" | 107°17'48.3" | 22.45 |
| Tongue River No. 1 | Tongue River | 44°52'4.5" | 107°16'55.2" | 7.57 |
| York Ditch | Tongue River | 44°52'57.1" | 107°13'43.9" | 13.27 |
| Fivemile Ditch | Columbus Creek | 44°55'1.2" | 107°22'15.4" | 34.61 |
| Garrard Ditch | Wolf Creek | 44°47'22.9" | 107°13'6.2" | 10.76 |
| Grinnel Ditch | Wolf Creek | 44°46'24.4" | 107°13'55.5" | 29.90 |
| **Total** | | | | **158.42** |

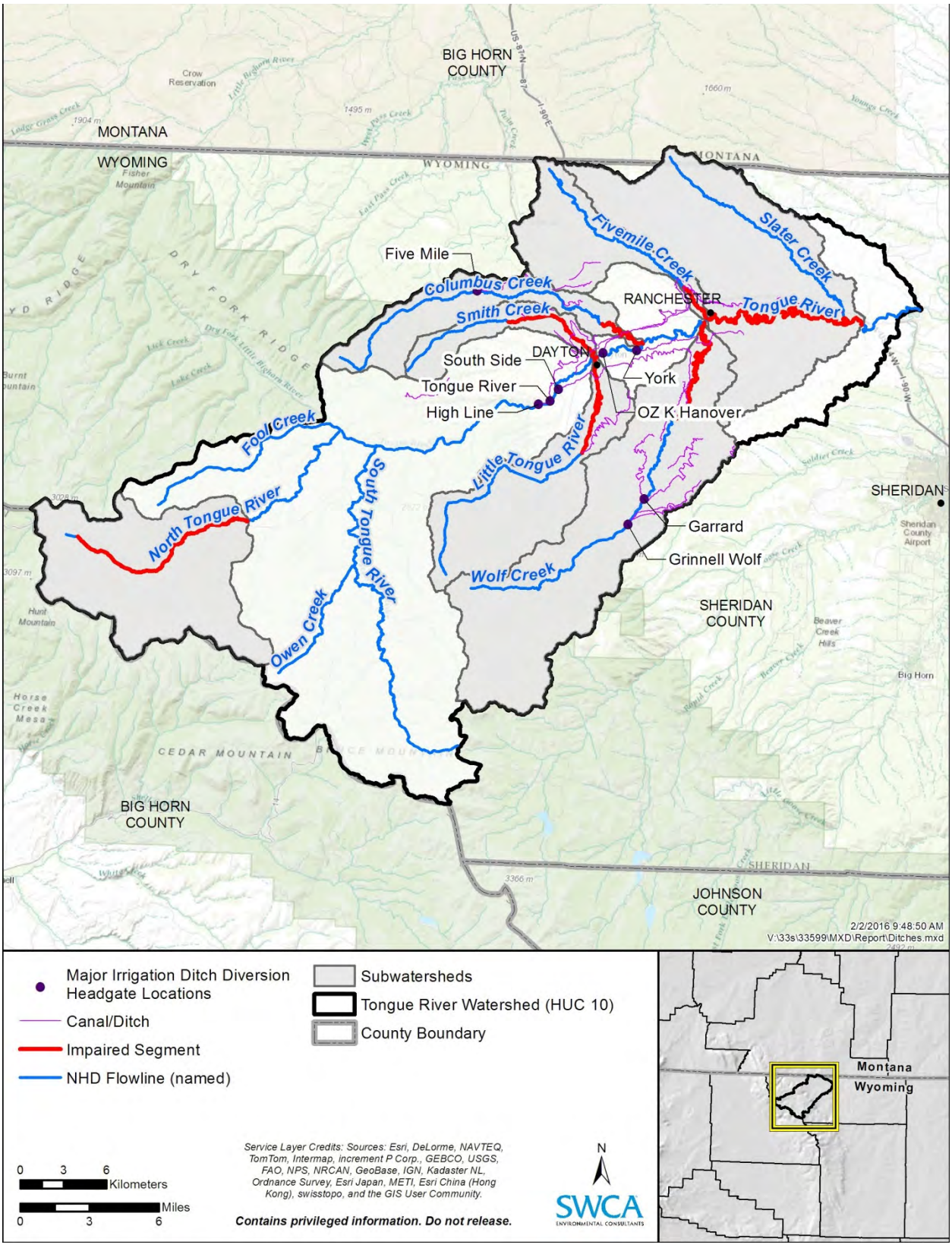
* Refers to the rights on record with the State Engineer's Office.

† The Hanover Ditch diverts water from the OZ & K.

*Source*: HKM (2002b).




**Map 13.** Irrigated lands and points of diversion in the Tongue River Watershed.




**Map 14.** Major ditches and headgate locations in the Tongue River Watershed.

# 3.6. Water Quality

## *3.6.1. Summary of Bacteria Data*

Several groups have contributed to monitoring efforts for bacteria (fecal coliform and *E. coli)* in the Tongue River Watershed. The SCCD has been actively monitoring since 1996, WDEQ since the late 1960s, and the USFS since the mid-1970s. Two maps are presented on the following pages showing bacteria sampling locations throughout the watershed. The first map, Map 15, is a comprehensive look at all of the sampling locations where data have been collected in the past. The second map, Map 16 illustrates those sampling locations that will be used moving forward in the TMDL analysis. Sampling locations that will be used in the TMDL analysis were selected based the existence of a flow measurement coupled with a bacteria measurement. Table 17 summarizes bacteria data that will be incorporated into the TMDL analysis and Figure 4 illustrates the number of samples collected by month for all of the subwatersheds.

**Table 17.** Number of Bacteria Observations at Monitoring Sites in the Tongue River Watershed

| Subwatershed | Monitoring Groups | Station Code | *E. coli* | | Fecal Coliform | |
|---|---|---|---|---|---|---|
| | | | Years Sampled | Number of Samples | Years Sampled | Number of Samples |
| North Tongue River | WDEQ | TR-1, TR-2, Upper, above Willows, Hideout, Bull Creek | 2003 | 38 | – | 0 |
| | USFS | Road 171, Tubes, Pole, Wallrock, Hidden Tepee, Hideout, Bull Creek | 2004–2008 | 479 | – | 0 |
| Columbus Creek | SCCD | CC01 | 2003, 2006, 2010, 2013 | 46 | 1996–1999, 2003, 2006 | 52 |
| Smith Creek | SCCD | SC01 | 2003, 2006, 2010, 2013 | 45 | 1996–1999, 2003, 2006 | 50 |
| Little Tongue River | SCCD | LTR01 | 2003, 2006, 2010, 2013 | 46 | 1996–1999, 2003, 2006 | 51 |
| Fivemile Creek | SCCD | FMC01 | 2003, 2006, 2010, 2013 | 43 | 1996–1999, 2003, 2006 | 49 |
| Wolf Creek | SCCD | WC01 | 2003, 2006, 2010, 2013 | 46 | 1996–1999, 2003, 2006 | 51 |
| Tongue River | SCCD | TR05, TR06, TR07, TR08, TR09 | 2003, 2006, 2010, 2013 | 200 | 1996–1999, 2003, 2006 | 177 |

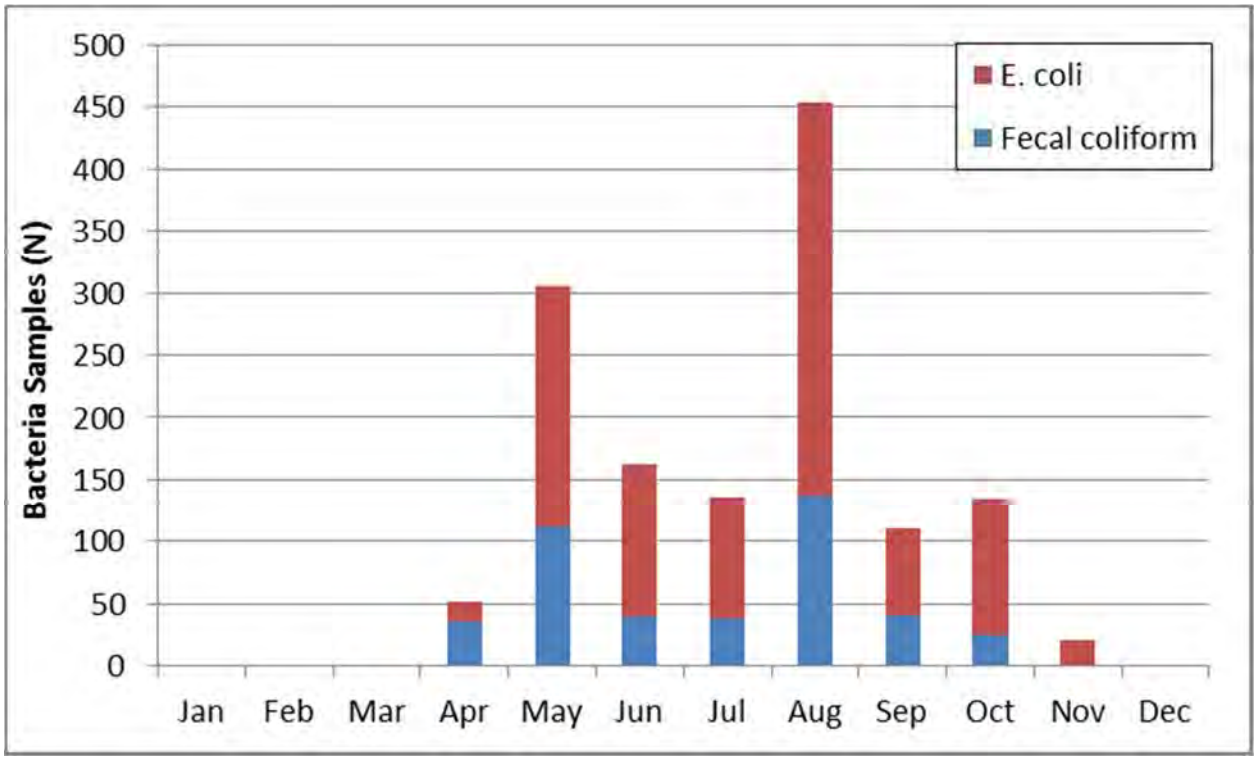
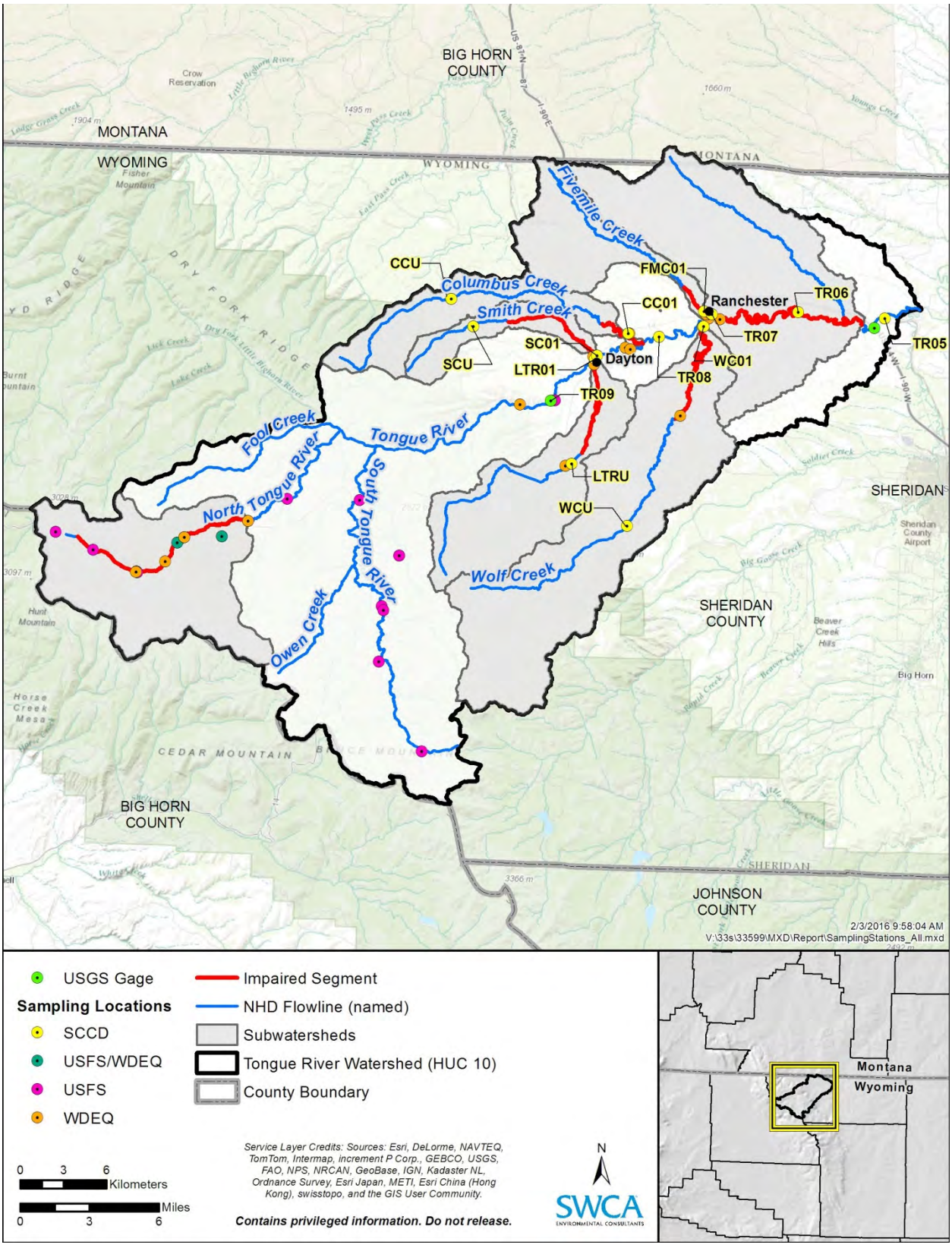
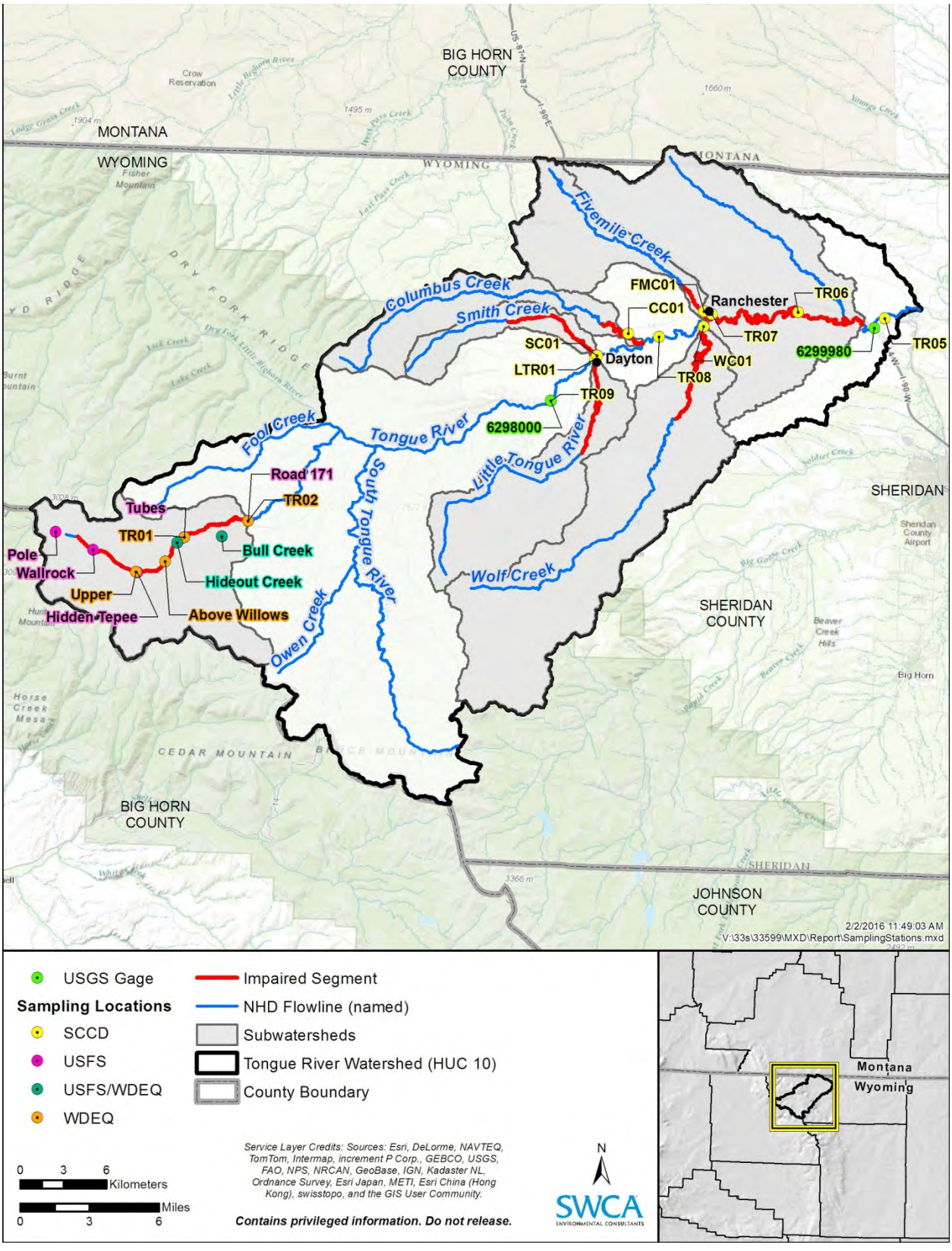



**Figure 4.** Number of bacteria samples by month for all subwatersheds.




**Map 15.** Bacteria sampling locations in the Tongue River Watershed.




**Map 16.** Bacteria monitoring locations in the Tongue River Watershed used in the TMDL analysis.

# 4. POLLUTANT SOURCE DATA

## 4.1. Point Source Data

Four permitted point sources in the Tongue River Watershed are regulated under Wyoming Pollutant Discharge Elimination System (WYPDES) permits (Map 17). Facilities comprise three WWTP and one concentrated animal feeding operation. Relevant data for each point source are summarized in Table 18, and a detailed description of each facility is provided below. Numeric data for the Town of Dayton and Town of Ranchester are summarized in Table 19 and were obtained from discharge monitoring reports, which are used as regulatory tools by the WYPDES program to monitor discharge and ensure permit compliance.

**Table 18.**Summary of Wyoming Pollutant Discharge Elimination System Permitted Discharges in the Tongue River Watershed

| Permittee | Permit Number | Expiration Year | Discharge Type | Receiving Water | Potential Pathogen Source? | Discharge to Impaired Segments? |
|---|---|---|---|---|---|---|
| Town of Dayton | WY0020435 | 2018 | Municipal | Tongue River | Yes | No |
| Town of Ranchester | WY0022161 | 2020 | Municipal | Tongue River | Yes | Yes |
| USFS-Bighorn National Forest | WY0020931 | 2019 | RV Dump Station | North Tongue River | No | No |
| Padlock Ranch Company | WY0022462 | 2018 | Agricultural | Columbus Creek | Yes | Yes |

### *4.1.1. Town of Dayton*

The town of Dayton operates a three-cell lagoon system with ultra-violet disinfection and aeration in the first cell. There are two discharge points, 001 and 002. Discharge point 001 is the outfall from the final lagoon, and discharge point 002 is the outfall from the underdrain system. Both of these outfalls drain to the mainstem of the Tongue River in the Tongue River subwatershed; however, this reach of the river is not impaired. The facility is designed to treat 0.20 million gallon per day (MGD) with most of the effluent discharging via outfall 001 (Table 19). As stated in the permit, the current *E.coli* concentration limit in effluent is 9,775 colonies/100 mL as a monthly average and 28,807 colonies/100 mL as a daily maximum during the recreation season. The current permit, WY0020435-RENEWAL, was issued on April 1, 2013, and is set to expire on March 31, 2018.

### *4.1.2. Town of Ranchester*

The town of Ranchester operates a three-cell aerated lagoon system with a chlorination contact basin; however, the basin is not currently in operation. Two outfalls (001 and 004) are connected to the lagoon system, with an additional three outfalls (002, 003, and 005) connected to an underdrain system. All five outfalls discharge to the Tongue River in the Tongue River subwatershed. Outfall 001 is used for most of the year; however, during spring runoff when the river is at a higher flow, effluent may be pumped to outfall 004. Twelve dewatering wells are in place to remove groundwater from around the cell liners during periods of high groundwater. These wells feed the underdrain system. The facility is designed to treat 0.179 MGD, with most of the effluent discharging via outfall 001 (see Table 19). As stated in the permit, the *E.coli* concentration limit in effluent is 126 colonies/100 mL as a monthly average and 235 colonies/100 mL as a daily maximum during the recreation season. However, these effluent limits do not go into effect until October 1, 2016. The current permit, WY0022161-RENEWAL, was issued on July 1, 2015, and is set to expire on June 30, 2020.

**Table 19.**Summary of Point Source Data for Discharges that are Likely to Discharge Pathogens in the Tongue River Watershed

| Permittee | Outfall | Parameter | Date Range | Number of Samples | Monthly Average |
|---|---|---|---|---|---|
| Town of Dayton | 001 | *E. coli* (colonies/100 mL) | 2009–2013 | 43 | 293 |
| | | Fecal coliform (#/100 mL) | 2008–2009 | 12 | 198 |
| | | Flow (MGD) | 2008–2015 | 84 | 0.15 |
| | 002 | *E. coli* (colonies/100 mL) | 2010 | 5 | 60 |
| | | Fecal coliform (#/100 mL) | 2008 | 3 | 1 |
| | | Flow (MGD) | 2008–2013 | 14 | 0.03 |
| Town of Ranchester | 001 | *E. coli* | 2010–2015 | 45 | 2,658* |
| | | Fecal coliform (#/100 mL) | 2005–2010 | 49 | 773 |
| | | Flow (MGD) | 2005–2015 | 104 | 0.14 |
| | 002 | *E. coli* | 2010–2012 | 12 | 274* |
| | | Fecal coliform (#/100 mL) | 2005–2010 | 8 | 6 |
| | | Flow (MGD) | 2005–2011 | 24 | 0.22 |
| | 003 | *E. coli* | 2010–2011 | 3 | 3* |
| | | Fecal coliform (#/100 mL) | 2006–2008 | 5 | 9 |
| | | Flow (MGD) | 2005–2011 | 26 | 0.40 |
| | 004 | *E. coli* | 2011–2015 | 9 | 1,177* |
| | | Fecal coliform (#/100 mL) | 2005–2010 | 15 | 2,069 |
| | | Flow (MGD) | 2005–2015 | 24 | 0.19 |

* Reported as a monthly geometric mean; monthly average data were not available.

Note: Outfall 005 is not included in the data summary table because only one sample for *E. coli* was reported from 2011-2014.

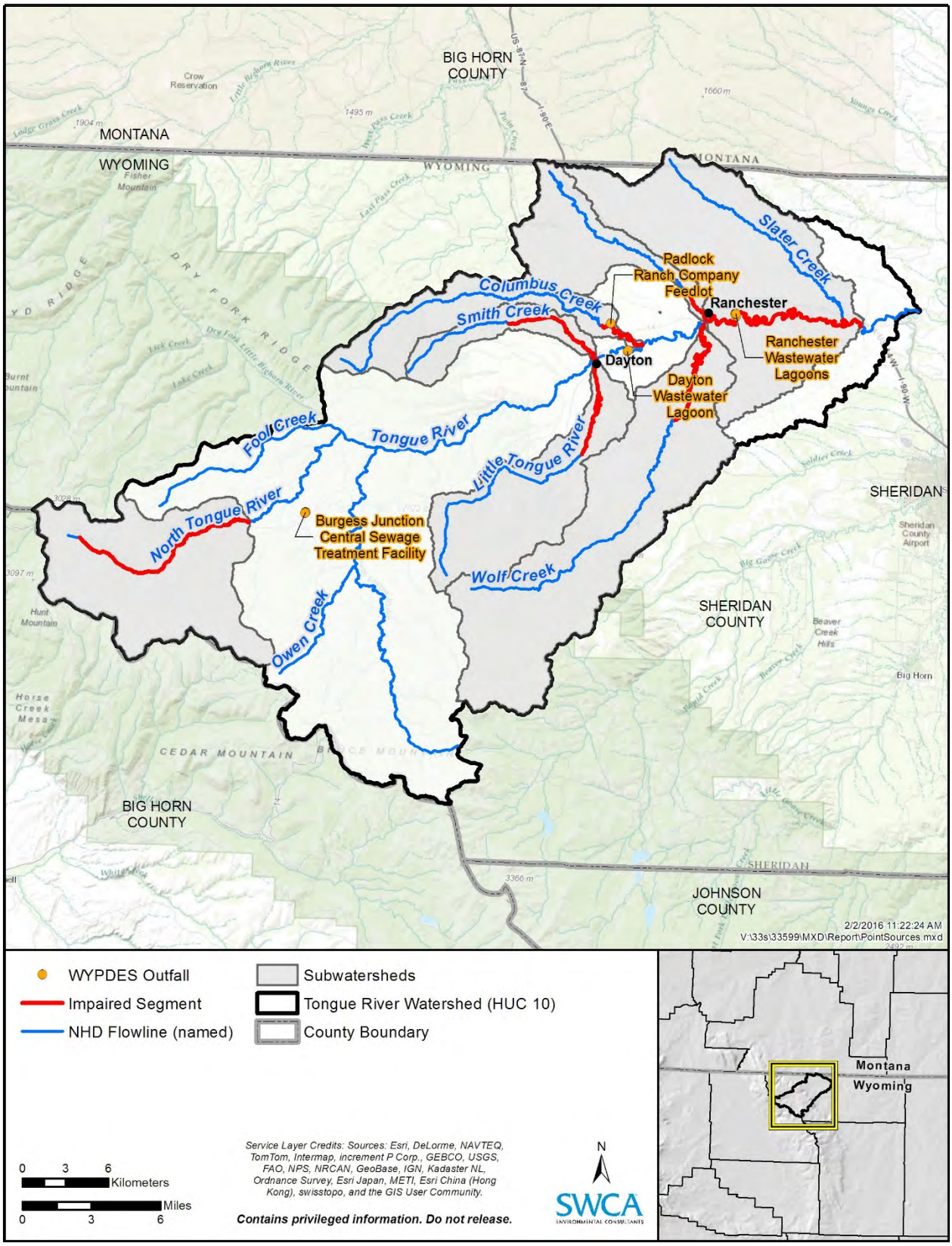
### *4.1.3. U.S. Forest Service-Bighorn National Forest*

USFS is the owner and operator of the Burgess Junction Central Sewage Treatment Facility located in the Bighorn National Forest. The facility is a dump station that accepts sewage from recreational vehicles (RVs) and commercial haul trucks associated with campgrounds from May through September. It consists of a two-cell non-aerated lagoon system with chlorination capabilities. Aeration equipment is available; however, because of the irregularity of discharge, it is not currently in operation: if discharge becomes consistent, aeration will commence. There are four outfalls (001, 002, 003, and 004), all of which discharge to an unnamed drainage that is tributary to the North Tongue River. Outfall 001 is the discharge point for treated effluent from the second cell, but is rarely used. Outfalls 002–004 are associated with the underdrain system that conveys groundwater away from the plant. Discharge from these outfalls reportedly does not reach the North Tongue River.

As described in the permit, because of the unlikelihood of discharges from this facility reaching the North Tongue River coupled with the fact that discharges occur downstream of the impaired segment, it is unlikely that this facility is contributing to the pathogen load. As such, point source data were not summarized in Table 19. The current permit, WY0020931-RENEWAL, is set to expire on June 30, 2019.

### *4.1.4. Padlock Ranch Company*

The Padlock Ranch Company feedlot is located approximately 2 miles north of Dayton in the Columbus Creek subwatershed. It is currently permitted for 11,000 beef cattle and operates approximately 180 days per year. Although permitted as a point source, it is reported that the facility does not have a direct discharge to surface waters of the state of Wyoming. Instead, all runoff is reported to be contained in two on-site storage ponds and reservoir totaling 19.5 million gallons. Stored water is used for irrigation in the spring, and any remaining runoff in the ponds/reservoirs is emptied before winter. Irrigation runoff is reported to be controlled with grass filters and buffers. Manure is also stored on-site and is applied every spring to cropland. All canals and waterways in the vicinity have a 35-foot vegetated set-back where no manure is applied. Details of the various implemented practices to reduce manure runoff to surface waters are described in the associated nutrient management plan (NRCS 2013). The facility is designed to contain all process wastewater plus runoff from a 25-year/24-hour storm event (3.3 inches). The current permit, WY0022462-RENEWAL was issued on August 5, 2013, and is set to expire on August 31, 2018.




**Map 17.** Point sources in the Tongue River Watershed.

# 4.2. Nonpoint Source Data

## *4.2.1. Livestock*

The quantity, locations, and seasonal movements of livestock in the watershed are important inputs to the TMDL analysis. Livestock in the watershed occur on private, BLM, and USFS land. Locations of BLM and USFS allotments are on Map 18, and data associated with each are summarized in Table 20 and Table 21below. In all, the USFS allotments provide grazing for 22 horses, 761 yearlings, 1,888 mature cows, 1,350 mature sheep, 18 bulls, and 900 ewe-lamb pairs primarily during the summer season. The BLM allotments provide grazing for 251 animal unit months of cattle year-round. Estimates of the number of livestock located within each subwatershed will be made as part of the source identification analysis. Generally speaking, the BLM grazing season is longer than the USFS season because BLM allotments are at lower elevations.

**Table 20.**Summary of Bureau of Land Management Allotment Data for the Tongue River Watershed

| Owner | Allotment Name | Animal Type | Animal Unit Months* | Season |
|---|---|---|---|---|
| BLM | Horseshoe Ranch | Cattle | 24 | 03/01–02/28 |
| | Padlock Ranch Co. | Cattle | 88 | 03/01–02/28 |
| | Slater Creek | Cattle | 72 | 03/01–02/28 |
| | Smith Creek | Cattle | 10 | 05/15–06/14 |
| | Wolf Mountain | Cattle | 57 | 03/01–02/28 |

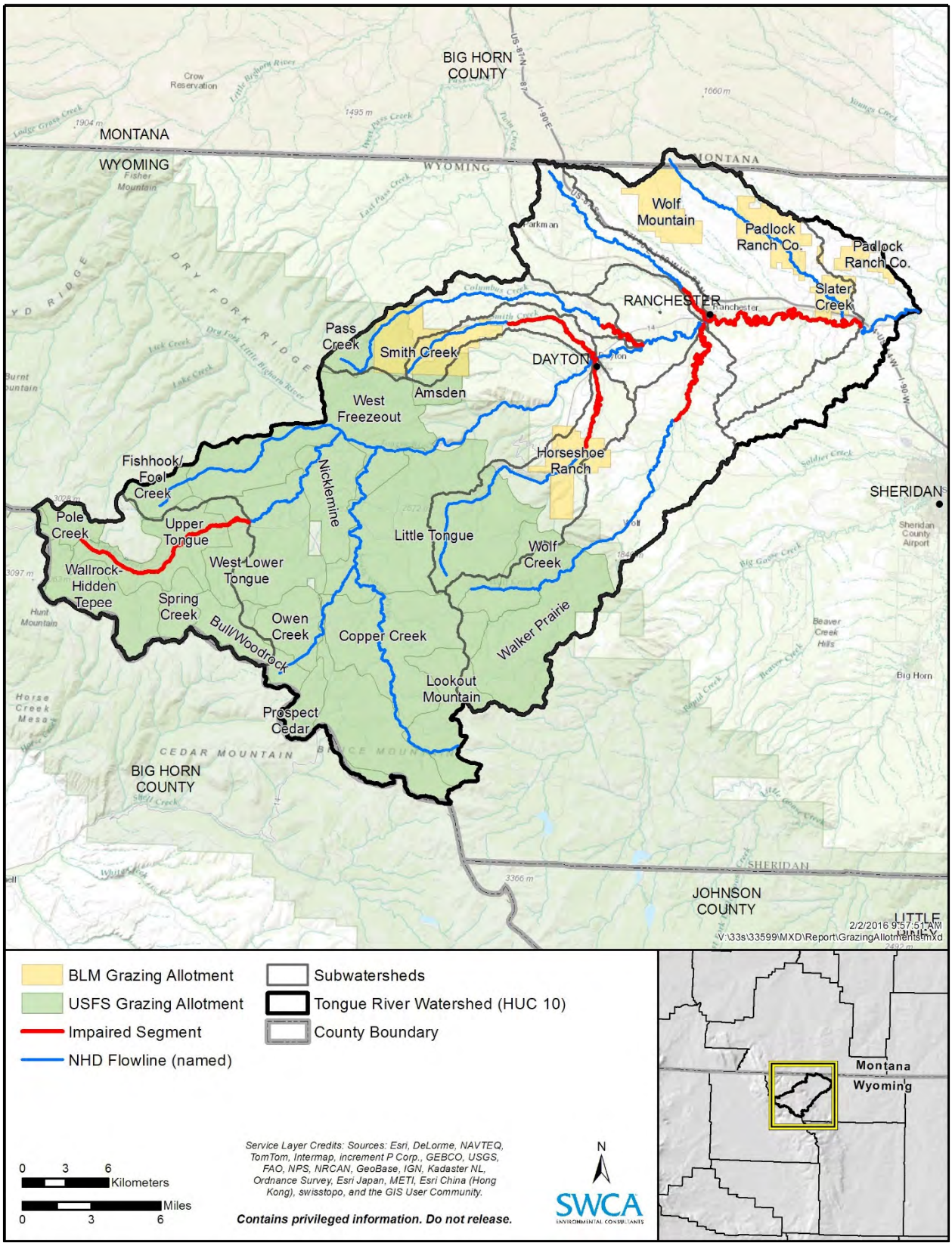
*Animal Unit Month is calculated by multiplying the number of animal units by the number of months of grazing where an animal unit is the amount of forage an animal consumes in a day based on its size.

**Table 21.**Summary of U.S. Forest Service Allotment Data for the Tongue River Watershed

| Owner | Allotment Name | Animal Type | Number | Season |
|---|---|---|---|---|
| USFS | Amsden | Mature | 103 | 7/11–9/12 |
| | | Yearlings | 11 | 7/11–9/12 |
| | | Horses | 2 | 7/1–10/7 |
| | Bull/Woodrock | Mature Sheep | 1,350 | 7/1–9/30 |
| | | Horses | 4 | 7/1–9/30 |
| | Copper Creek and Nicklemine | Yearlings | 450 | 7/20–10/1 |
| | | Bulls | 18 | 7/20–10/1 |
| | | Horses | 6 | 7/1–9/15 |
| | Little Tongue | Mature | 176 | 6/26–10/5 |
| | Nicklemine | Mature | 130 | 7/1–9/7 |
| | Owen Creek | Ewe-lambs | 900 | 7/16–9/13 |
| | | Yearlings | 300 | 7/16–9/13 |
| | | Horses | 2 | 7/16–9/30 |

**Table 21.**Summary of U.S. Forest Service Allotment Data for the Tongue River Watershed

| | | | |
|---|---|---|---|
| Pass Creek | Mature | 222 | 7/1–10/5 |
| | Horses | 2 | 7/1–10/5 |
| Upper Tongue | Mature | 134 | 7/1–10/10 |
| | Mature | 216 | 7/1–9/18 |
| | Horses | 6 | 7/1–10/10 |
| Walker Prairie | Mature | 86 | 7/18–9/27 |
| | Mature | 160 | 7/20–10/15 |
| West Freezeout | Mature | 459 | 7/16–10/10 |
| West Lower Tongue | Mature | 82 | 7/1–10/10 |
| Wolf Creek | Mature | 120 | 7/1–9/25 |




**Map 18.** Grazing allotments in the Tongue River Watershed.

Agricultural census data (National Agricultural Statistics Service 2012) are available at the county level for 2012. These data could also be used to estimate livestock numbers on private lands in the Tongue River Watershed, based on percentage of total grazeable area in the county that is located in the watershed. A summary of some selected agricultural census data is presented in Table 22.

**Table 22.** Summary of Selected Sheridan County Agricultural Census Data

| Statistic | Subcategory | Unit | 2012 |
|---|---|---|---|
| Farms | Total | Number | 702 |
| – | | Acres | 1,304,838 |
| Cropland | Total cropland | Acres | 74,600 |
| – | Harvested cropland | Acres | 57,787 |
| Irrigated land | Total irrigated land | Acres | 49,769 |
| Cattle and calves | Total | Number | 68,527 |
| Hogs and pigs | Total | Number | (D) |
| Poultry | Total | Number | 2,144 |
| Sheep and lambs | Total | Number | 3,565 |

(D) = data not reported

## *4.2.2. Wildlife*

### 4.2.2.1. BIG GAME

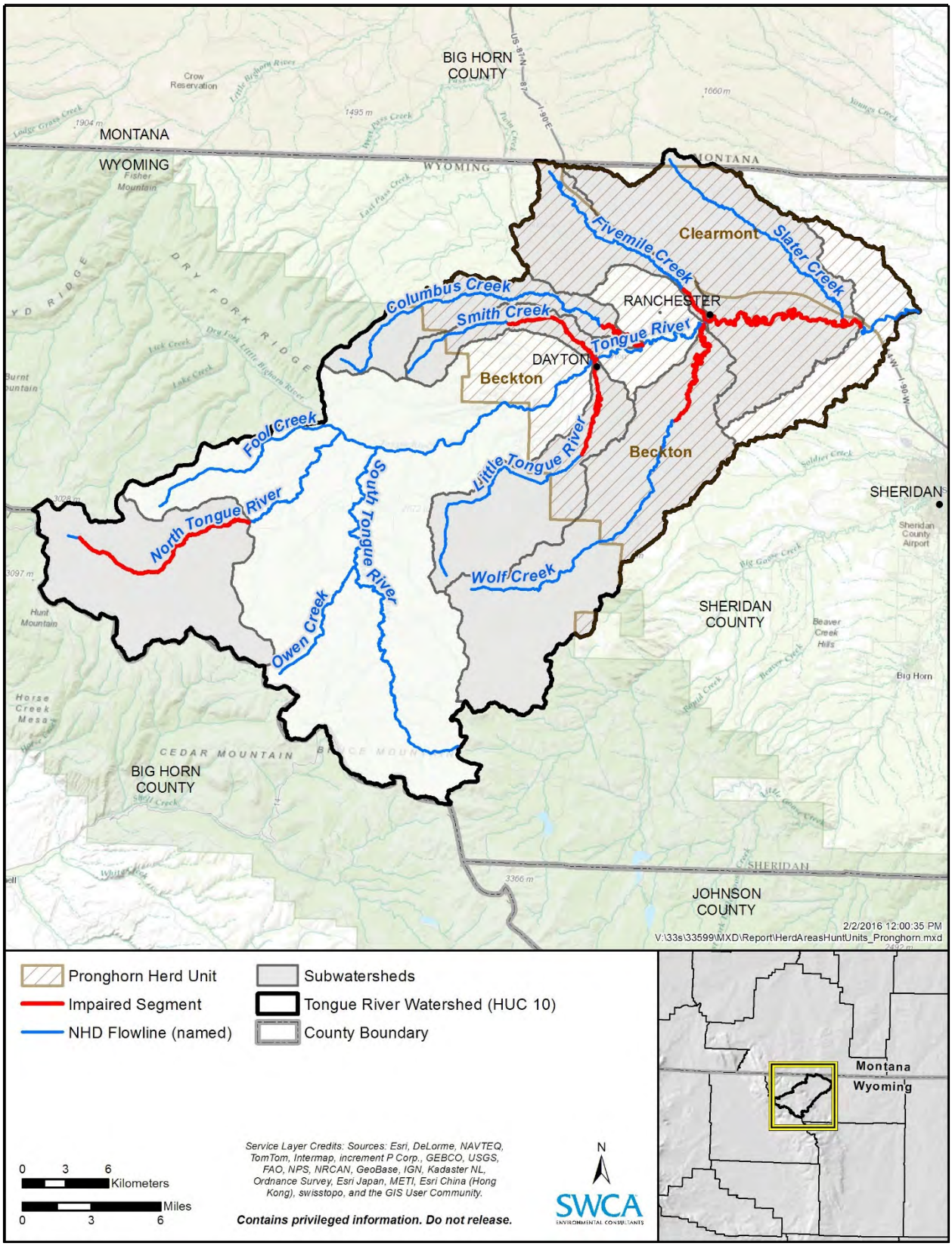
Maps of the herd unit areas and population estimates for pronghorn, deer, elk, and moose were obtained from the Wyoming Game and Fish Department and are presented below (Table 23, Maps 19–23) (Wyoming Game and Fish Department 2014). Population estimates of each big game species will be scaled proportionally to each subwatershed based on the intersection of herd unit area within the subwatershed.

**Table 23.** Herd Unit Acreage for each Subwatershed for Deer, Elk, Moose, and Pronghorn

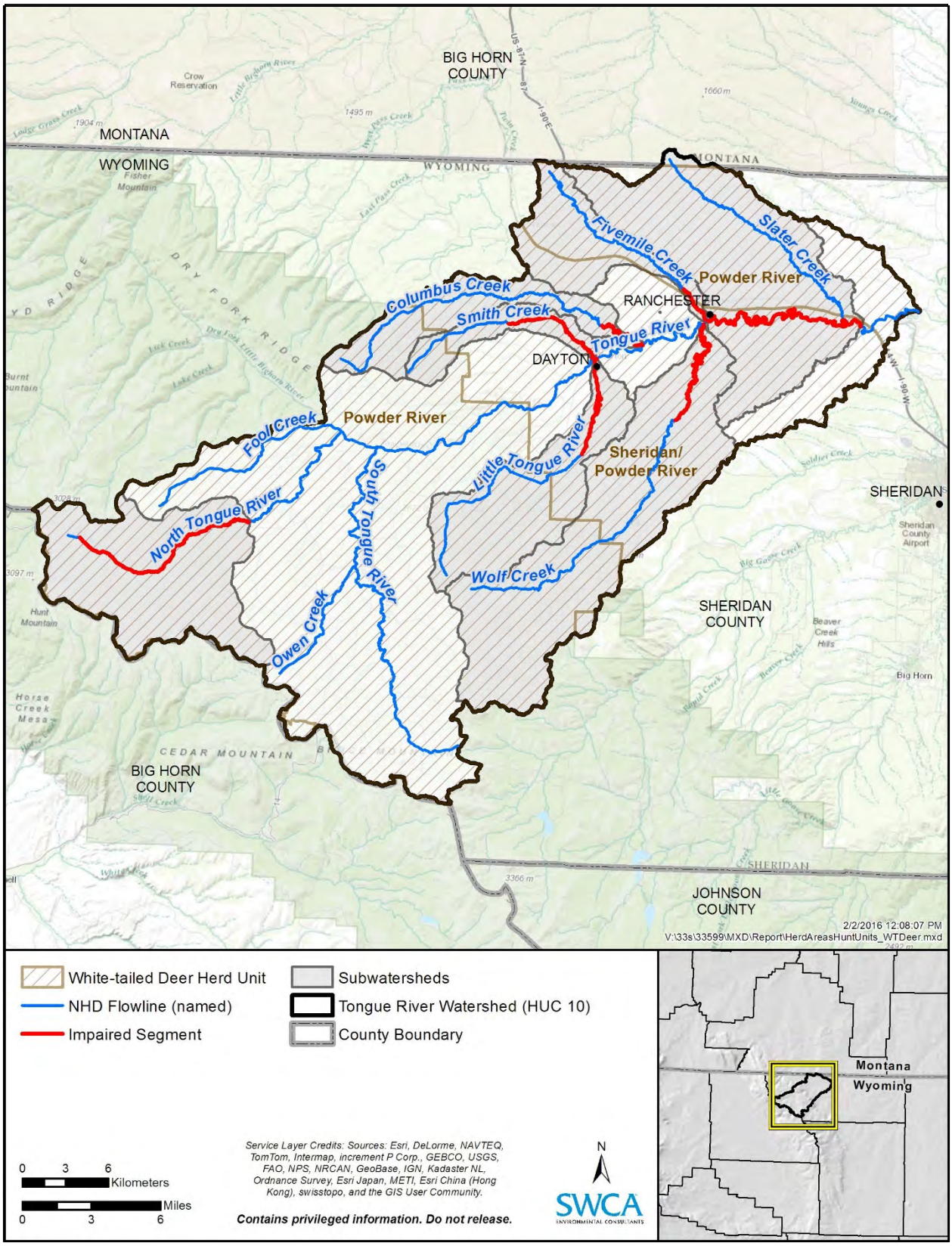
| Big Game | Herd Unit | Herd Unit Acreage in the Tongue River Watershed | Population Estimate |
|---|---|---|---|
| Pronghorn | Beckton | 102,392 | 2,100 |
| | Clearmont | 33,454 | (D) |
| White-tail Deer | Powder River | 311,923 | 20,000 |
| Mule Deer | North Bighorn | 279,536 | 13,100 |
| | Powder River | 33,248 | 29,113 |
| Elk | North Bighorn | 279,293 | 5,600 |
| Moose | Bighorn | 279,338 | 320 |

(D) = data not reported

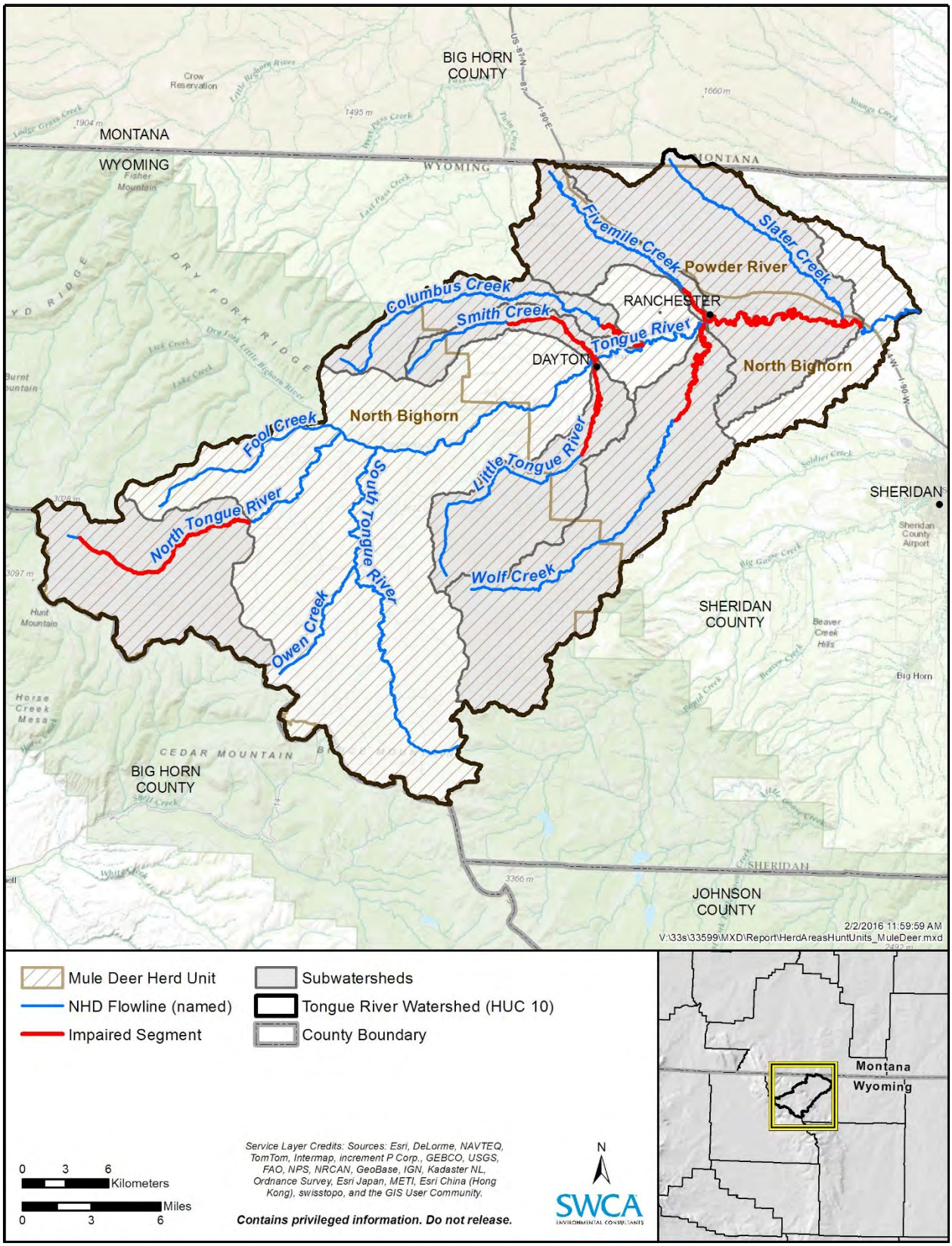
*Source*: Wyoming Game and Fish Department (2014).



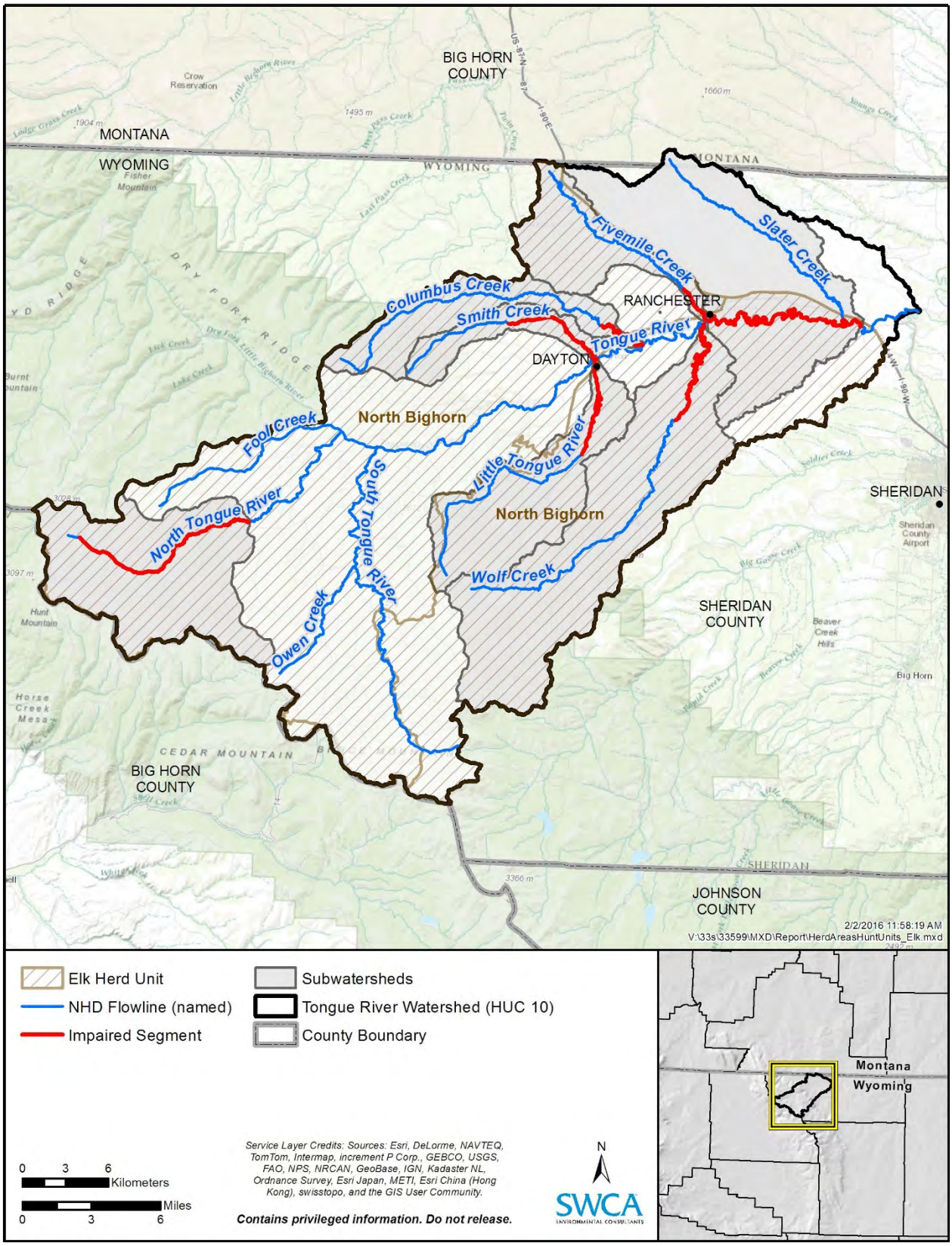

**Map 19.** Herd unit areas for pronghorn in the Tongue River Watershed.



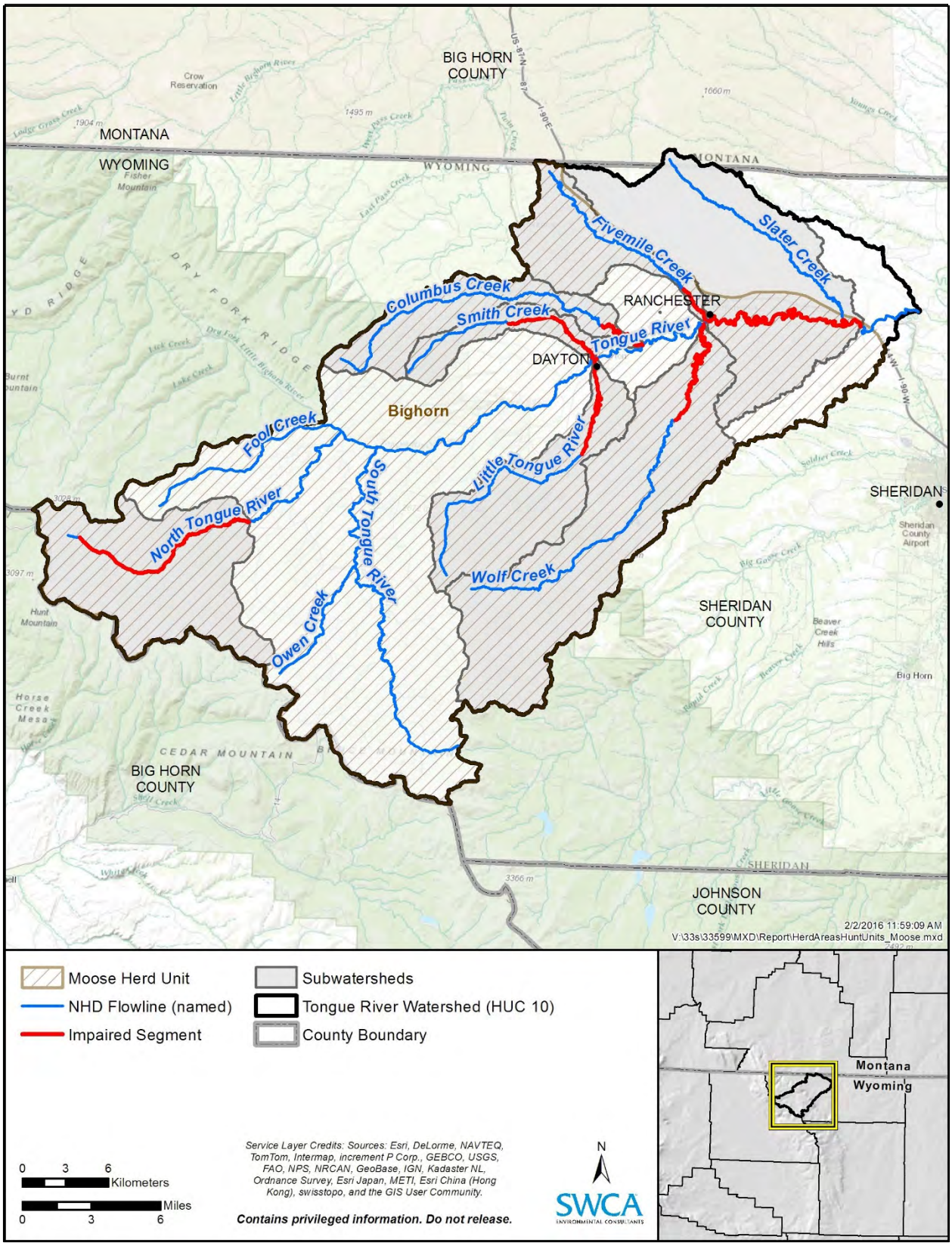

**Map 20.** Herd unit areas for white-tailed deer in the Tongue River Watershed.




**Map 21.** Herd unit areas for mule deer in the Tongue River Watershed.




**Map 22.** Herd unit areas for elk in the Tongue River Watershed.



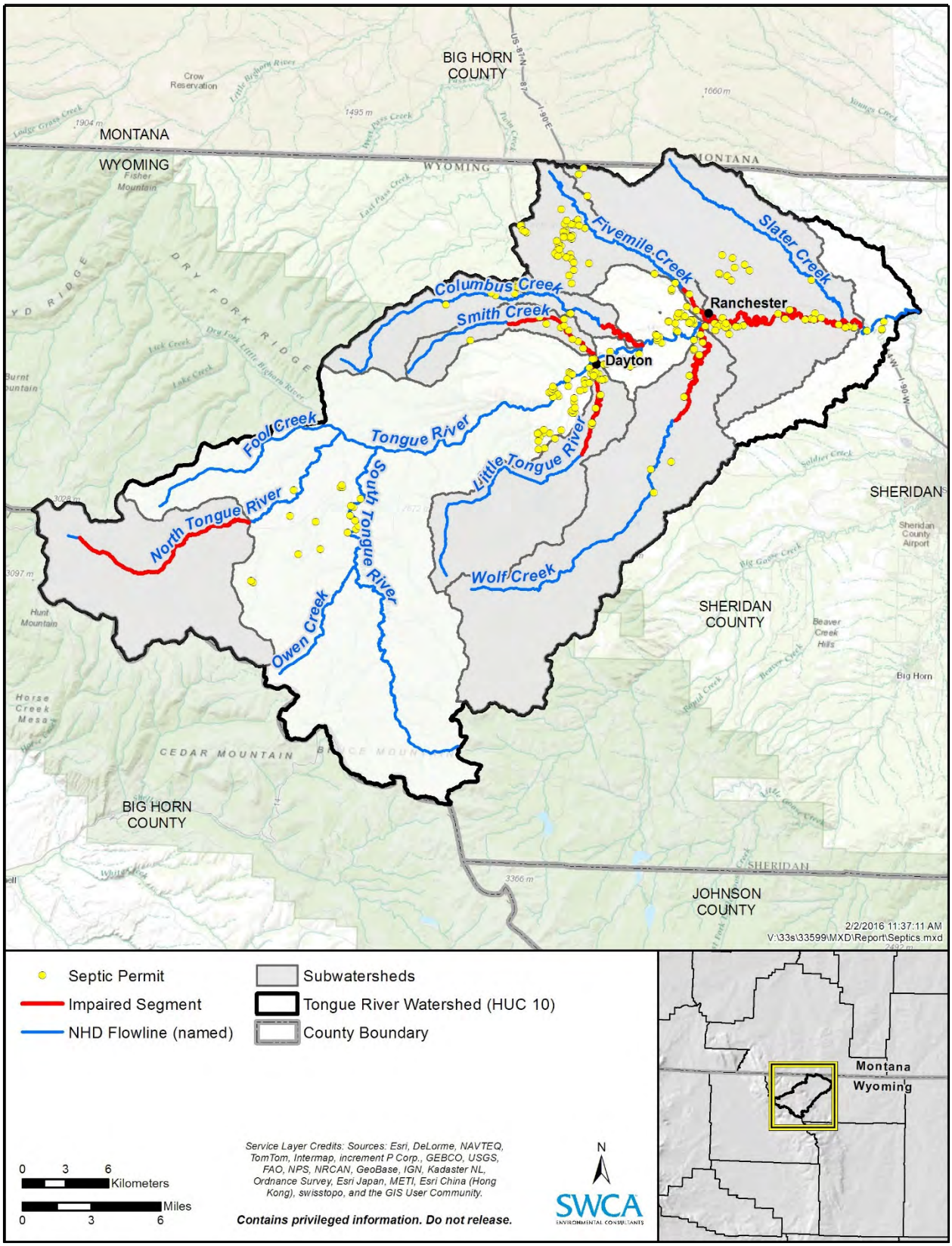

**Map 23.** Herd unit areas for moose in the Tongue River Watershed.

## *4.2.3. Septic Systems*

A spatial inventory of septic system permits was acquired from the Sheridan County geographic information systems department on January 13, 2016 (personal communication between Ken Muller [Sheridan County] and Lucy Parham [SWCA]). The GIS layer documents systems permitted from as early as 1978 through the present day. However, it should be noted that this layer is not completely updated, and additional measures will likely be taken to ensure that the septic system inventory is comprehensive. Total septic systems and septic system density by subwatershed are shown in Table 24 and Map 24.

**Table 24.** Total Septic Systems and Septic System Density for each Subwatershed

| Subwatershed | Total Septic Systems | Septic System Density (number/square mile) |
|---|---|---|
| North Tongue River | 0 | 0 |
| Columbus Creek | 17 | 1 |
| Smith Creek | 10 | 1 |
| Little Tongue River | 20 | < 1 |
| Fivemile Creek | 53 | 3 |
| Wolf Creek | 10 | < 1 |
| Tongue River | 44 | 1 |
| **Tongue River Watershed** | **254** | |




**Map 24.** Septic systems in the Tongue River Watershed.

# 5. RELATED REPORTS AND STUDIES

Several scientific and resource management reports written by local, state, and federal agencies provide data and information pertinent to the current TMDL process. Some reports provide background data on the setting and general conditions of the study watershed and impaired segments. Other reports provide relevant information on past watershed management efforts and surface water hydrology and water quality. All relevant information will be incorporated into the TMDLs and referenced appropriately. A list of pertinent reports is included in Table 25.

**Table 25.** Summary of Reports and Studies Relevant to the Tongue River Watershed Analysis and Implementation Planning

| Author | Year | Title | Summary of Key Findings Relevant to TMDL Analysis |
|---|---|---|---|
| SCCD | 2000 | Tongue River Watershed Assessment Final Report 1996-1999 | Report that summarizes water quality monitoring efforts in the Tongue River Watershed from 1996 to 1999. |
| | 2003 | Tongue River Monitoring Project | Report that summarizes water quality monitoring efforts in the Tongue River Watershed in 2003. |
| | 2007 | Tongue River Monitoring Project | Report that summarizes water quality monitoring efforts in the Tongue River Watershed in 2006. |
| | 2012 | Tongue River Monitoring Project | Report that summarizes water quality monitoring efforts in the Tongue River Watershed in 2010. |
| | 2012 | Tongue River Watershed Plan | Comprehensive resource management plan with a focus on addressing water quality issues. The document contains general information about the Tongue River Watershed, identifies specific watershed and water quality concerns, and lists specific actions to take to address concerns. |
| HKM | 2002 | Powder/Tongue River Basin Water Plan: Technical Memoranda | Comprehensive plan that presents current and projected future uses of water in the Powder/Tongue River Basin that include agricultural, municipal, industrial, environmental, and recreational use. A series of technical memoranda is provided along with the plan that document in detail various water uses in the basin. |
| HKM Engineering, Boyle Engineering Corporation, Anderson Consulting Engineers | 2001 | Tongue River Basin Planning Model | Spreadsheet flow model developed to determine average monthly streamflow in the basin during average, wet, and dry years. It is intended to simulate water use and availability under existing conditions. |
| EPA, Montana Operation Office, and Tetra Tech | 2007 | Modeling the Tongue River Watershed with LSPC and CE-QUAL-W2 | Technical document that describes the selection, set-up, calibration, and performance of a flow and water quality model for the Tongue River Watershed in both Wyoming and Montana. |
| Wyoming Game and Fish Department | 2014 | Annual Completion Report: Migratory Game Birds | Annual report that summarizes migratory gamebird health and population estimates for portions of the Central and Pacific flyways in Wyoming. |
| | 2014 | Sheridan Region: Annual Big Game Herd Unit Reports | Annual report that summarizes herd unit health and population estimates for big-game species (pronghorn, deer, elk, and moose) in the Sheridan region. |
| USFS-Bighorn National Forest | 2005 | Revised Land & Resource Management Plan | Resource management plan for the areas that the USFS owns/manages. |
| The North Tongue Steering Group | _ | North Tongue River Water Quality Management Plan | Report that provides the listing history and description of water quality data collected in the North Tongue River impaired segment. |
| WDEQ | 2003 | Summary Report for E. coli Sampling | Data summary report for an *E. coli* sampling event in 2003 (July–October) at six sites in the North Tongue River subwatershed. |

# 6. DATA DISCUSSION

## 6.1. Identified Data Gaps

The data available for the Tongue River Watershed TMDLs are robust and comprehensive. There are sufficient data across a variety of seasons and hydrologic conditions to develop TMDLs for different flow conditions. Further, *E. coli* and fecal coliform data for the major tributaries to each impaired segment are also robust. Nonetheless, several data gaps have been identified that, if filled, will improve the TMDLs. These data gaps are summarized in Table 26 along with recommendations to fill or mitigate the data gap.

**Table 26.** Identified Data Gaps for the Tongue River Watershed TMDLs

| Data Gap | Importance | Recommendation |
|---|---|---|
| Flow data on the North Tongue River. | To calculate accurate seasonal *E. coli* loads, flow data for the North Tongue River impaired segment are needed. | Flow and bacteria data were provided by the USFS; however, the flow data are from the USGS gage in Dayton and not representative of the conditions at the sampling location.<br><br>The Montana Department of Environmental Quality developed a flow model for sub-basins in the North Tongue River. This flow model may be used to develop seasonal flow duration curves. |
| Waterfowl population. | Waterfowl have the potential to contribute significantly to *E. coli* loading in surface waters and should be taken into consideration when conducting the pollution source analysis. | Discussions with the Wyoming Game and Fish Department indicate that waterfowl populations in the Tongue River Watershed are fewer than 1,000 birds per year, including ducks, geese, and cranes. When conducting the pollution source analysis using the Bacteria Source Load Calculator (BSLC), a series of scenarios will be run using multiple waterfowl populations (e.g., 0, 1,000, 5,000, and 10,000) to ensure that the *E. coli* load from waterfowl is taken into consideration. |
| Seasonal grazing patterns on private land. | Seasonal livestock population estimates by subwatershed is a critical input into the BSLC to model *E. coli* loading. Additionally, population estimates during various seasons are important for providing information on how *E. coli* loading varies as livestock are rotated from lowland pastures to grazing allotments. | Gather stakeholder input during the first public meeting coupled with counting cows in each subwatershed using aerial imagery during different seasons. |

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