



Total Maximum Daily Loads

For

Mud Creek – Loup River Basin

Parameters of Concern: Atrazine & *E. coli*

LO4-10100 - Atrazine

LO4-10100 - *E. coli*

LO4-10200 - *E. coli*

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Planning Unit, Water Quality Division

May 2012

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Executive Summary

One segment (LO4-10100) of Mud Creek was listed in the 2008 and 2010 Nebraska Surface Water Quality Integrated Report (NDEQ 2008a, NDEQ 2010b) as a Category 5 waterbody impaired by excessive atrazine. For the 2010 Integrated Report, two segments (LO4-10100, LO4-10200) of Mud Creek are also listed in Category 5 for *E. coli*. As such, total maximum daily loads (TMDLs) must be developed for each parameter in accordance with the Clean Water Act. The information contained herein should be considered three (3) TMDLs. These TMDLs have been prepared to comply with the current (1992) regulations found at 40 CFR Part 130.7.

1. Name and geographic location of the impaired waterbody for which the TMDLs are being developed.

Loup River Basin: Mud Creek LO4-10100, LO4-10200

2. Identification of the pollutant and applicable water quality standard

The pollutants causing the impairment(s) of the water quality standards and designated beneficial uses (for which TMDLs will be developed) are atrazine and *E. coli*. Designated uses assigned to the above-identified segments include: Primary Contact Recreation, Warmwater Class B Aquatic Life, Class A Agricultural Water Supply, and Aesthetics (NDEQ 2006). Excessive atrazine and *E. coli* have been determined to be impairing the aquatic life and primary contact recreation beneficial uses, respectively.

3. Quantification of the pollutant load that may be present in the waterbody and still allows attainment and maintenance of the water quality standards.

The allowable pollutant load is based upon the available stream flow volume. That is, loading capacities are developed for each flow by multiplying the water quality standard (WQS) by the selected stream flow and a conversion factor (C) with the equation being:

$$\text{Loading capacity} = \text{WQS} \times \text{Flow} \times C$$

4. Quantification of the amount or degree by which the current pollutant load in the waterbody, including upstream sources that are being accounted for as background loading deviates from the pollutant load needed to attain and maintain water quality standards.

Assessment of May-June atrazine data for segment LO4-10100 indicates 5 of 24 values exceed the chronic criteria. The deviation from the *E. coli* criteria for LO4-10100 and LO4-10200 is presented in the table below.

Segment	<i>E. coli</i> cfu/100ml (above WQS)
LO4-10100	979
LO4-10200	880

5. Identification of the pollutant source categories.

The entire atrazine pollutant source has been determined to originate from nonpoint sources. Both point and nonpoint sources (including natural sources) have been identified to be contributing to the *E. coli* loads being delivered to both Mud Creek segments.

6. Wasteload allocations for pollutants from point sources.

The wasteload allocation for atrazine will be zero (0). For *E. coli*, the wasteload allocations for point source discharges will be equivalent to the water quality criteria associated with the primary contact recreation beneficial use – a geometric mean of 126 cfu (colony forming units)/100 ml.

7. Load allocations for pollutants from nonpoint sources.

Load allocations (LA) assigned to these TMDLs will be based upon the stream flow volume, applicable water quality standard and a unit conversion factor (a numeric factor used to multiply or divide a quantity when converting from one system of units to another) and will be defined using the following general formula:

$$LA_i = Q_i \times WQS \times C$$

Where:

LA_i = pollutant load allocation at the ith flow
Q_i = stream flow at the ith flow
WQS = Applicable water quality standard
C = unit conversion factor

Therefore the load allocation assigned to the atrazine TMDL will be defined as:

$$LA_i = Q_i \times (12 \mu\text{g/l}) \times 0.002446$$

Where:

LA_i = load allocations (in kg) at the ith flow
Q_i = stream flow (in cfs) at the ith flow
12 μg/l = chronic water quality criteria for atrazine in micrograms/liter (μg/l) from Title 117
0.002446 = constant used to convert cfs times μg/l to kg/day

And the load allocations assigned to the *E. coli* TMDLs will be defined as:

$$LA_i = Q_i \times 35,683.2 \text{ cfu/ft}^3 \times 86,400$$

Where:

LA_i = load allocations (in cfu/day) at the ith flow
Q_i = stream flow (in cfs) at the ith flow
35,683.2 cfu/ft³ = 126/100ml (applicable/target water quality criteria for *E. coli* from Title 117) x 283.2 (factor to convert cfu/100ml to cfu/ft³).
86,400 = value to convert cfs times cfu to cfu/day

8. Margin of safety.

For atrazine the margin of safety will be implicit in that the average load reduction calculated is based upon events with exceedances during the months of May & June. This timeframe represents the critical conditions when runoff of atrazine is likely to occur. For *E. coli*, an explicit

MOS of 10% will be utilized. Implementation of controls for both parameters will also result in year-round protection of water quality. This will be important should application practices change in the future.

9. Consideration for seasonal variation.

In Nebraska atrazine application can occur as early as late April and continues into the month of June. Runoff however is more typical during the May-June timeframe. For atrazine, assessment and analysis of the data, as well as the TMDL, was based on the May-June timeframe when deviations from the water quality criteria have been historically observed.

For *E. coli*, the water quality criteria are only applicable during the Title 117 defined recreation season that starts May 1 and ends September 30. Because of this, the water quality and stream volume data was limited to this time period.

10. Allowances for reasonably foreseeable increases in pollutant loads.

There was no allowance for future growth included in these TMDL.

11. Implementation Plan

Reductions of *E. coli* will be targeted through a combination of regulatory and non-regulatory activities. Point sources will be regulated under the auspice of Title 119: National Pollutant Discharge Elimination System (NPDES) (NDEQ 2005) and the Rules and Regulations Pertaining to Title 130: Livestock Waste Control (LWC) (NDEQ 2008b). Nonpoint source pollution will be addressed using available programs, technical advice, information and education and financial incentives such as cost share. The lead agency for water quality pesticide issues in Nebraska is the Department of Agriculture (NDA). Implementation of the reductions for atrazine will be coordinated with the NDA.

The TMDLs included in the following text can be considered “phased TMDLs” and as such are an iterative approach to managing water quality based on the feedback mechanism of implementing a required monitoring plan that will determine the adequacy of load reductions to meet water quality standards and revision of the TMDLs in the future if necessary. A description of the future monitoring (Section 5.0) that is planned has been included.

Monitoring is essential to all TMDLs in order to:

- Assess the future beneficial use status;
- Determine if the water quality is improving, degrading or remaining status quo;
- Evaluate the effectiveness of implemented best management practices.

The additional data collected should be used to determine if the implemented TMDL has been or is effective in addressing the identified water quality impairments. As well the data and information can be used to determine if the TMDLs have accurately identified the required components (i.e. loading capacity, load allocations, etc.) and if revisions are appropriate.

1.0 Introduction

Mud Creek, segment LO4-10100, was identified as a Category 5 waterbody in Nebraska's 2008 and 2010 Water Quality Integrated Reports (IR) (NDEQ 2008a, NDEQ 2010b). Category 5 waterbodies comprise the Clean Water Acts 303(d) list of impaired waters and are required to have TMDLs. Data collected from 2003-2008 indicate aquatic life and the primary contact recreation beneficial use is impaired with the parameters of concern being atrazine and *E. coli* respectively.

Based on the above, and as required by Section 303(d) of the Clean Water Act and 40 CFR Part 130, TMDLs have been developed for Mud Creek to address both atrazine and *E. coli*. Therefore, the information contained herein should be considered three (3) TMDLs. Although only the two segments that comprise Mud Creek are considered impaired, the relationship of water quality at the monitoring location and the watershed's contributions will be recognized. Concentration and load reduction activities will not be limited to the segments, rather the watershed as a whole.

1.1 Background Information

Mud Creek is a tributary of the South Loup River (LO4-10000) within sub-basin 4 of the Loup River Basin (Figure 1.1). The creeks headwaters originate just west of Broken Bow, Nebraska and generally flow in a southeasterly direction before the confluence with the South Loup River near Ravenna, Nebraska. There are two designated segments of Mud Creek included in Title 117 – Nebraska Surface Water Quality Standards (NDEQ 2006) along with three designated tributaries (Figure 1.1).

1.1.1 Waterbody Description

1.1.1.1 Waterbody Name: Mud Creek (LO4-10100 & LO4-10200)

1.1.1.2 Major River Basin: Missouri

1.1.1.3 Minor River Basin: Loup

1.1.1.4 Hydrologic Unit Code: 10210005

1.1.1.5 Assigned Beneficial Uses: Primary Contact Recreation, Warmwater aquatic life - class B, Agriculture water supply class A, and aesthetics (Title 117 - Nebraska Surface Water Quality Standards).

1.1.1.6 Major Tributaries: Clear Creek (LO4-10120), Dutchman Valley (LO4-10210), and Spring Branch (LO4-10110)

1.1.2 Watershed Characterization

1.1.2.1 Physical Features: Mud Creek watershed encompasses approximately 740 mi² (473,773 acres) in the central part of the state. The basin originates in middle of Custer County to the north and west of Merna and ends at the confluence with South Loup River southeast of Ravenna. The Mud Creek Watershed lies on the northern edge of the Central Great Plains ecoregion adjacent to the Nebraska Sand hills ecoregion (Chapman, et. al. 2001).

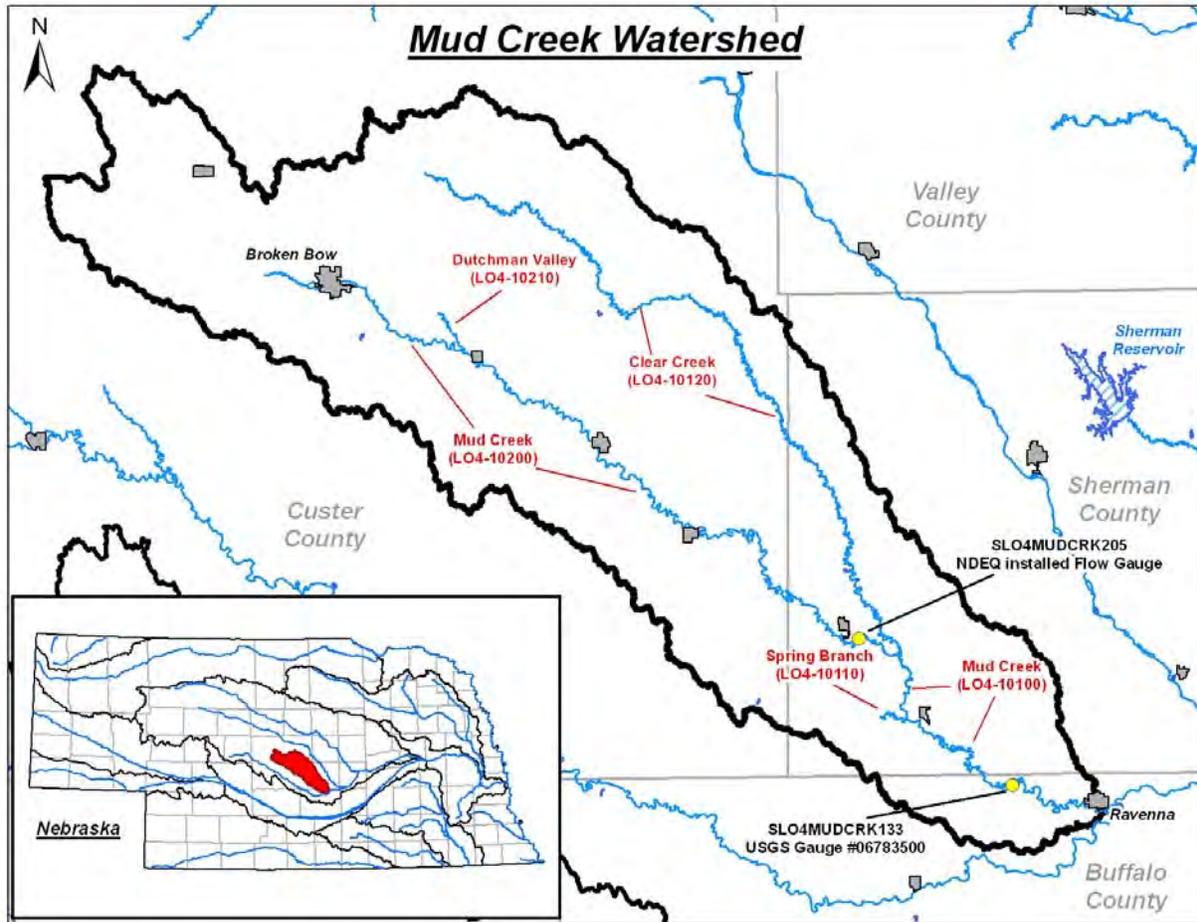


Figure 1.1: Mud Creek Watershed in the Loup River Basin

The upper portion of the watershed, northwest of Broken Bow, is comprised of the Kenesaw and Valentine soil series, characteristic of the Sand Hills. These are well drained, low sloped soils, which generally have undefined and sometimes nonexistent surface drainage patterns (NNRC 1975). In the middle and lower portions of the Mud Creek, watershed drainage patterns are defined and composed of gently sloping to very steep, loess-covered uplands (NNRC 1975). In the lower portion of the watershed near Hazard, the valley begins to broaden before joining the South Loup River downstream of Ravenna. Alluvial lowlands are moderately permeable and well drained throughout the entire watershed (USDA 1990).

1.1.2.2 Climate: Based on data from automated weather stations operated by Nebraska, average annual precipitation in the watershed is approximately 23 inches (HPRCC 2010) with a majority of the precipitation occurring during the spring and summer months. On average more than 75% of the annual precipitation falls in the spring (April – June) and summer (July – September) months. Temperatures in the basin range from an average high between 80 - 90°F during the summer to average lows between 10 - 20°F during the winter.

1.1.2.3 Demographics: Ten municipal communities, including two unincorporated, Sweetwater and Westerville, reside in the watershed. Incorporated communities include: Broken Bow

population 3,491, Ravenna – population 1,341, Ansley – population 520, Merna – population 391, Litchfield – population 280, Mason City – population 178, Berwyn – population 134, and Hazard – population 66. Statewide about 22% of Nebraskans live outside of an incorporated community on ranches, farmsteads and acreages.

1.1.2.4 Land Uses: The upland areas of the basin are generally devoted to grassland and pasture with more suitable areas utilized for cultivated crop production. The alluvial lowlands of the Mud Creek valley are primarily used for cultivated crops. This is evident in the lower portions of the watershed southeast of Hazard to Ravenna where Mud Creek nears the confluence with the South Loup River at Ravenna. Table 1.1.2.4 and Figure 1.1.2.4a below summarize land use within Mud Creek watershed for 2008. Active registered wells from the Nebraska Department of Natural Resources (NDNR 2010) are presented in Figure 1.1.2.4b below.

General Land Use Class	Area in Acres	Percent of Watershed
Grassland/Pasture/CRP	318,726	67.2%
Cultivated Cropland	121,615	25.7%
Roads/Developed	25,736	5.4%
Forest	7,137	1.5%
Open Water & Wetland	558.2	0.1%
TOTALS	473,773	100.0%

Table 1.1.2.4: 2008 Land use for Mud Creek watershed (USDA 2009)

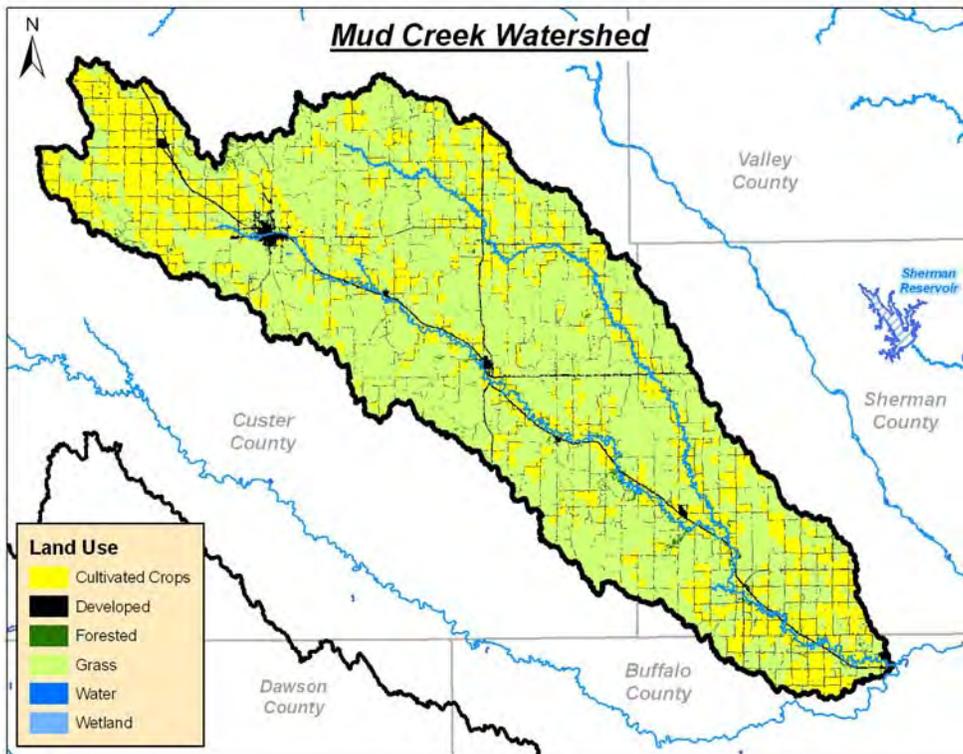


Figure 1.1.2.4a: 2008 Land use in the Mud Creek watershed (USDA 2009)

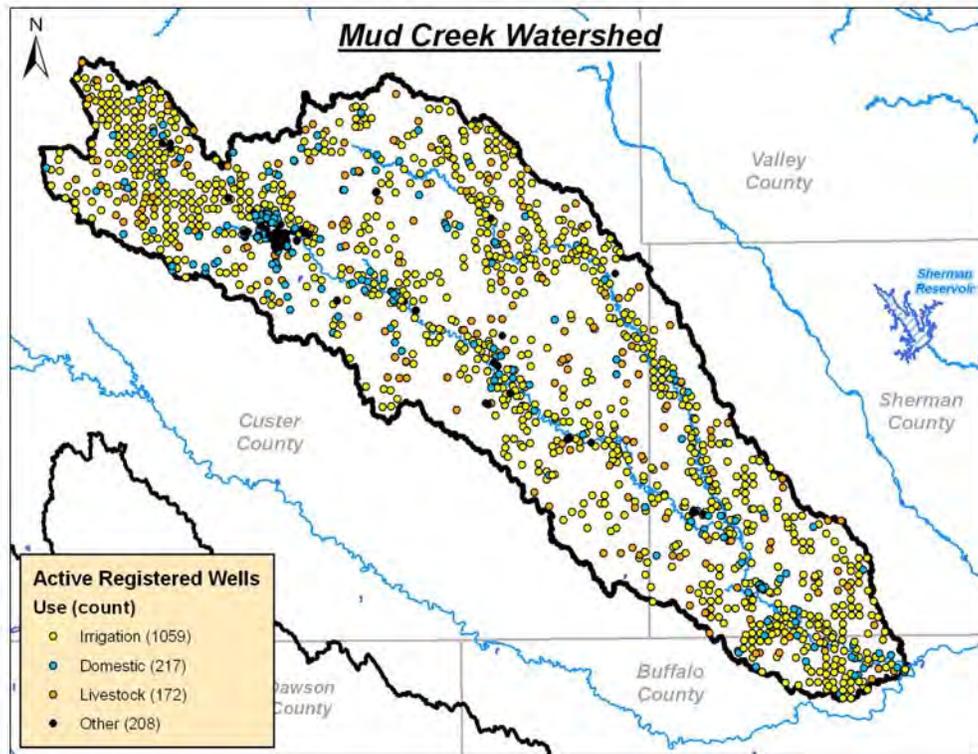


Figure 1.1.2.4b: Registered Wells in the Mud Creek Watershed (NDNR 2010)

2.0 Atrazine TMDL

2.1 Problem Identification

Segment LO4-10100 was identified as a Category 5 waterbody in the 2008 and 2010 Integrated Reports as having an impaired aquatic life beneficial use with the parameter of concern being atrazine. This section deals with the extent and nature of the water quality impairments caused by excessive atrazine in the Mud Creek watershed.

2.1.1 Water Quality Criteria Violated and/or Beneficial Uses Impaired

The Warmwater B - Aquatic Life beneficial use has been deemed impaired within LO4-10100. The Warmwater B Aquatic Life beneficial use applies to surface waters where a variety of warmwater biota is presently limited by water volume of flow, water quality (natural or irretrievable human-induced conditions), substrate composition, or other habitat conditions. These waters are only capable of maintaining year-round populations of tolerant warmwater fish and associated vertebrate and invertebrate organisms and plants. Key species may be supported on a seasonal or intermittent basis (e.g., during high flows) but year round populations cannot be maintained (NDEQ 2006).

2.1.2 Data Sources

Atrazine data is collected as part of the Nebraska Ambient Stream Monitoring network. Within the Ambient Stream Network, atrazine samples are collected bi-weekly April through September. From October through March atrazine is sampled only once per month. Data from the ambient station

SLO4MUDCR133 will be utilized for this TMDL (Figure 1.1). In 2008 the Loup Basin was also sampled as part of NDEQ's Basin Rotation Monitoring program. As a result atrazine data was collected weekly at station SLO4MUDCR133 from May through September in 2008. A USGS gauging station (USGS #06783500) is also located at the same location just off US Highway 2 Bridge one mile southeast of the unincorporated village of Sweetwater, NE.

2.1.3 Water Quality Assessment

Water quality data assessments were based upon the beneficial use assessment procedures used to identify Category 5/impaired waters for the 2010 Integrated Report. The procedures are based on the application of the “binomial distribution” method that applies a confidence interval to the exceedance rate in an effort to determine the true exceedance of the waterbody versus the data set. A complete description of the water quality data assessment procedures can be found in the *Methodologies for Waterbody Assessments and Development the 2010 Integrated Report for Nebraska* (NDEQ 2009b).

In the assessment process, all data will be initially assessed for seasonal variability in concentration or occurrence. This process will be accomplished by creating charts of time-series plots for each parameter of interest. These charts will be created from data gathered within the most recent 5-year monitoring period, or where continuous datasets exist (i.e., no more than a 2-year gap in data availability) over longer periods of time. If review of these charts reveals that seasonal differences occur, the NDEQ will focus its assessment efforts within the season(s) where parameter concentrations/occurrences are evident. By examining only the timeframe (seasons) where parameters appear in detectable levels, or at or near levels of concern, a waterbody can be more accurately assessed for use support / impairment. In contrast, when seasonal differences are present, but a long-term database is used to assess beneficial use support, the impacts to beneficial uses are underestimated and waters where real seasonal concerns exist may be overlooked.

The details of the assessment process to determine the use support of the Aquatic Life beneficial use can be found in table 2.1.3 below.

Supported	Impaired
≤10% of samples exceed acute or chronic water quality criteria	>10% of samples exceed acute or chronic water quality criteria

Table 2.1.3: Assessment of the Aquatic Life Beneficial Use using Chemical Water Quality data

2.1.4 Water Quality Conditions

Atrazine data collected from 2003-2008 was assessed to determine the beneficial use support for the warmwater B aquatic life designation. Table 2.1.4 and figure 2.1.4 present this information.

Date Range	# of Samples	# of samples >WQS required to list as impaired	# of Samples >12 µg/l
January - December	93	14	5
May - June	24	5	5

Table 2.1.4: Mud Creek (LO4-10100) 2003 - 2008 Atrazine Data Assessment

From the data assessment process a seasonal concern/impairment (May-June) exists for atrazine, which coincides with observed periods of increased precipitation and application of the herbicide. Because the impairment is seasonal, this TMDL will focus on that period.

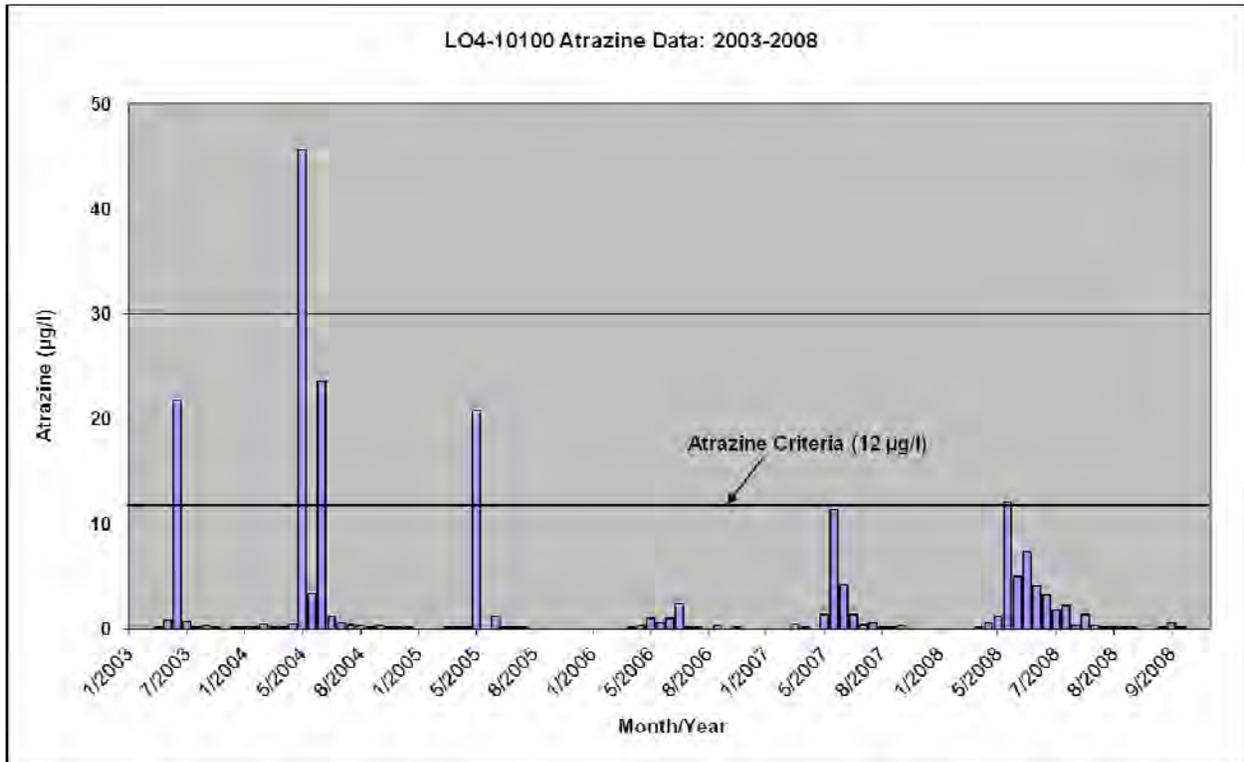


Figure 2.1.4: Mud Creek (LO4-10100) Atrazine Data 2003-2008

2.1.5 Potential Pollutant Sources

Atrazine is a triazine herbicide currently registered for use against broadleaf and some grassy weeds. Atrazine is currently registered for use on corn (field and sweet); sorghum; range grasses for the establishment of permanent grass cover on rangelands and pastures under USDA's Conservation Reserve Program (CRP) in OK, NE, TX, and OR; wheat (where application is to wheat stubble on fallow land following wheat harvests; wheat is not the target crop); conifer forests; Christmas tree farms; sod farms; and golf courses (EPA 2006).

Atrazine is one of the most heavily used pesticides in North America (EPA 2003). Given this usage and source, point and natural sources are likely not contributing atrazine to surface waters in Nebraska. Therefore, for this TMDL the entire load will be considered the result of nonpoint source discharges.

2.2 TMDL Endpoint

The endpoint for this TMDL will be based on the numeric criteria associated with the Class B Warmwater Aquatic Life Beneficial Use.

2.2.1 Numeric Water Quality Criteria

Water quality criteria established for the Class B – Warmwater Aquatic Life protection of the beneficial use can be found in Title 117, Chapter 4 (NDEQ 2006). Assessment of the data and the TMDL are based on the chronic criterion of 12 µg/l.

2.2.2 Selection of Critical Environmental Conditions

The critical environmental conditions for this TMDL have been identified in the assessment process. Specifically, the data and information will be limited to the May-June timeframe when the deviations from the water quality criteria were observed.

2.2.3 Waterbody Pollutant Loading Capacity

Defining waterbody pollutant loading capacity implies a steady state. This TMDL recognizes that loadings are dynamic and can vary with stream flow. As well, the above section indicates a potentially wide range of environmental conditions that must be accounted for.

The method chosen to account for the variation in flow is based upon a TMDL curve (NDEQ 2002). TMDL curves are initiated by the development of a stream's hydrograph using the long-term gage information. The flow information (curve) is then translated into a load curve by multiplying the flow values by the water quality standard (WQS) and a conversion factor (C). The acceptable "load" is then plotted graphically. Appendix B provides a table with the 0-100th percentile flow values and associated daily load values extrapolated to the terminus of waterbody segment LO4-10100.

Therefore, the loading capacity for each of the segments will be defined by:

$$\text{Loading Capacity} = \text{Flow} \times \text{WQS} \times \text{C}$$

2.3 Pollution Source Assessment

As indicated in Section 2.1.5, the only source of atrazine considered for this TMDL is nonpoint source discharges. Although the source has been determined, it is important to illustrate the existing conditions.

2.3.1 Existing Pollutant Conditions

The existing pollutant conditions are shown in the TMDL curve (Figure 2.3.1) provided for LO4-10100 at station SLO4MUDCR133. Points plotted above the acceptable loading indicate a deviance from the water quality criteria.

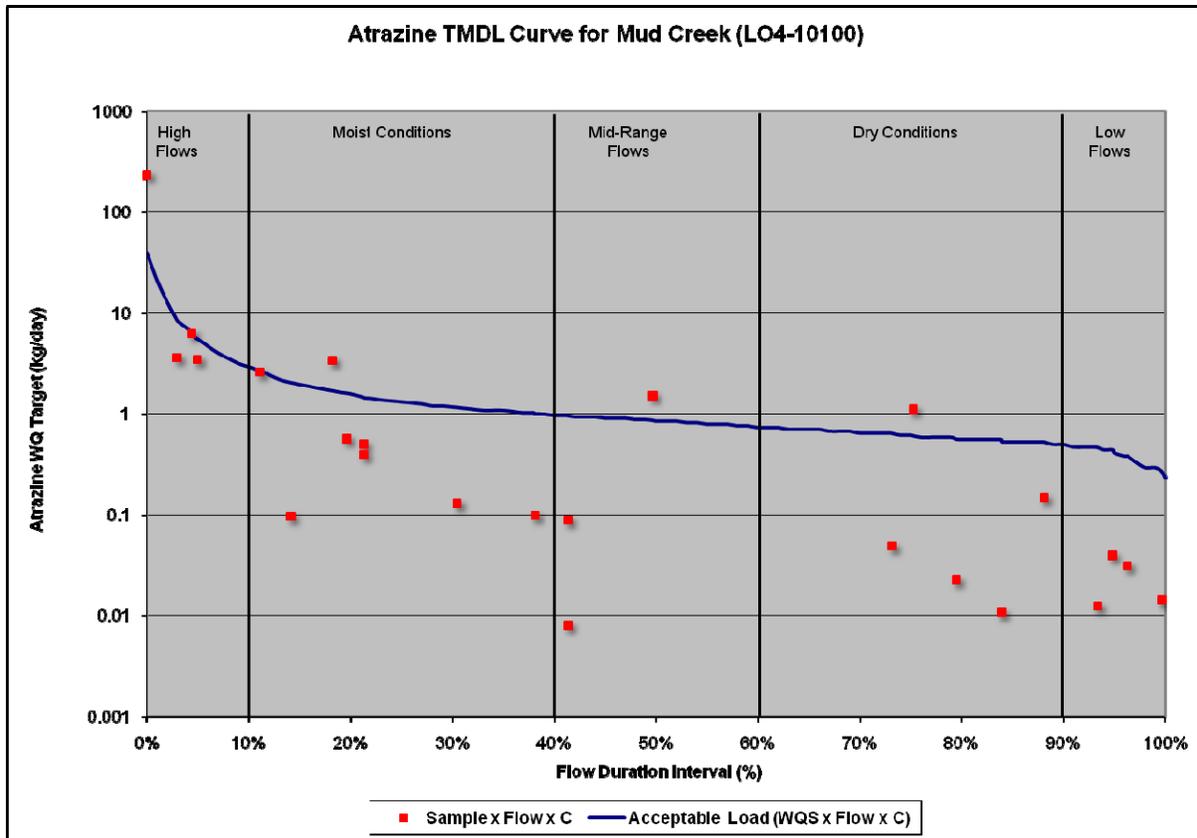


Figure 2.3.1: May & June Atrazine TMDL Curve for Mud Creek (LO4-10100) at SLO4MUDCR133

2.4 Pollutant Allocation

A TMDL is defined as:

$$\text{TMDL} = \text{Loading Capacity} = \text{WLA} + \text{LA} + \text{Background} + \text{MOS}$$

As stated above, the loading capacity is based upon flow position in the hydrograph and is defined by:

$$\text{Loading Capacity} = \text{Flow} \times \text{WQS} \times \text{C}$$

Where:

Flow = cfs = Stream flow volume as cubic feet per second

WQS = 12 µg/l = Chronic water quality criteria for atrazine in micrograms/liter (µg/l) from Title 117

C = 0.002446 = constant used to convert cfs times µg/l to kg/day

2.4.1 Wasteload Allocation

As stated previously, elevated atrazine concentrations are typically not the result of point source discharges. For this TMDL the wasteload allocation (WLA) will be zero (0).

2.4.2 Load Allocation

The load allocations (LA) assigned to this TMDL will be based upon the stream flow volume and will be defined as:

$$LA_i = Q_i \times (12 \mu\text{g/l}) \times C$$

Where:

LA_i = load allocations at the i^{th} flow

Q_i = stream flow at the i^{th} flow

12 $\mu\text{g/l}$ = applicable/target water quality criteria for atrazine from Title 117

$C = 0.002446$ = constant used to convert cfs times $\mu\text{g/l}$ to kg/day

Because the WLA and natural background are zero (0) the entire loading capacity is the LA and can be found in Appendix B.

2.4.3 Natural Background

Atrazine does not occur naturally in the environment therefore the allocation for natural background will be zero (0).

2.4.4 Margin of Safety

A margin of safety (MOS) must be incorporated into TMDLs in an attempt to account for uncertainty in the data analysis or targeted allocations. The MOS for this TMDL will be implicit.

For atrazine the margin of safety will be implicit in that the average load reduction calculated is based upon events with exceedances during the months of May & June. This timeframe represents the critical conditions when runoff and exceedances of atrazine are likely to occur.

2.4.5 Load Reduction to Meet Water Quality Criteria

It is important to report the reductions necessary to meet the water quality criteria. The necessary reductions were determined based upon the 2003 - 2008 data, which is considered representative information. The targeted reductions provide water quality managers with a quantitative endpoint by which implementation planning can be carried out. In order to meet water quality standard full support status, there are to be no more than one (2) sample collected in May and June that exceeds 12 $\mu\text{g/l}$ of atrazine over the course of the next two ambient sampling seasons (2009, 2010) to be reported on the 2012 Integrated Report.

2.4.6 Expression of TMDLs as Daily Loads

The April 25, 2006 decision by the U.S. District Court of Appeals for the D.C. Circuit in "Friends of the Earth, Inc. vs. EPA et. al." recommends that all TMDLs and associated wasteload allocations and load allocations include a daily expression. The approach for these TMDLs will be based upon the conversion of the targeted concentration of atrazine to kilograms per day. The daily expression for each TMDL segment can be found in Appendix B.

3.0 E. coli TMDL

3.1 Problem Identification

Segments LO4-10100 and LO4-10200 of Mud Creek have been included in Category 5 of the 2010 Integrated Report as having an impaired primary contact recreation beneficial use with the parameter of concern being *E. coli* bacteria. This section deals with the extent and nature of the water quality impairments caused by excessive *E. coli* bacteria in the Mud Creek Watershed.

3.1.1 Water Quality Criteria Violated and/or Beneficial Uses Impaired

The Primary Contact Recreation beneficial use has been deemed impaired on the segments of Mud Creek identified above. Stream segments LO4-10100 and LO4-10200 are the only two segments assigned the primary contact recreation beneficial use in the Mud Creek watershed. Primary Contact Recreation beneficial use applies to surface waters which are used or have the potential to be used for primary contact recreation that includes activities where the body may come into prolonged or intimate contact with the water such that water may be accidentally ingested or sensitive body organs (e.g. eyes, ears, nose) may be exposed (NDEQ 2006).

3.1.2 Data Sources

The Nebraska Department of Environmental Quality monitors surface waters based upon a rotating basin scheme, whereby monitoring is limited to two or three river basins each year with all 13 basins being visited in a six year period. Under the auspice of the rotating basin plan, data was collected from the Loup River Basin in 2008. Ambient station SLO4MUDCR133 was utilized for segment LO4-10100 and Basin Rotation station SLO4MUDCR205 was utilized for segment LO4-10200 (Figure 1.1). Stream discharge (volume) data was acquired in 2008 and will be used for these TMDLs. Stream flow data was obtained from the United States Geological Survey gauge #06783500 at Sweetwater, NE and utilized for segment LO4-10100. Stream flow data for segment LO4-10200 was collected from an NDEQ installed staff gauge station.

3.1.3 Water Quality Assessment

Water quality data assessments were based upon the beneficial use assessment procedures used to identify Category 5 (impaired waters) for the 2010 Integrated Report. A complete description of the water quality data assessment procedures can be found in the *Methodologies for Waterbody Assessments and Development of the 2010 Integrated Report for Nebraska* (NDEQ 2009b).

The details of the assessment process to determine the use support of the Primary Contact Recreation beneficial use can be found in table 3.1.3.

Parameter	Criteria: Season Geometric Mean	Supported	Impaired
<i>E. coli</i>	≤126/100 ml	Season geometric mean ≤126/100 ml	Season geometric mean >126/100 ml

Table 3.1.3: Assessment of the Primary Contact Recreation beneficial use using *E. coli* bacteria data

3.1.4 Water Quality Conditions

E. coli data collected during the 2008 Recreation season (May 1 through September 30) was assessed to determine the beneficial use support for primary contact recreation. Table 3.1.4 below presents this information.

Segment	Station Number	Site Location	Gauge associated with site	Number of Samples	Season Geometric Mean (#/100ml)
LO4-10100	SLO4MUDCR133	Mud Creek @ Sweetwater	USGS 06783500	19	1105
LO4-10200	SLO4MUDCR205	Mud Creek east of Litchfield	NDEQ Installed Gauge	19	1006

Table 3.1.4: 2008 *E. coli* Data and Assessments - Category 5 waterbodies

3.1.5 Potential Pollutant Sources

3.1.5.1 Point Sources: Point sources discharge or have the potential to discharge to waters in the Loup River basin. Facility types include: municipal wastewater treatment facilities, commercial and industrial facilities. The facilities that have been issued a National Pollutant Discharge Elimination System Permit (according to EPA's Enforcement & Compliance History Online) in the Mud Creek Watershed are shown in Figure 3.1.5.1a.

Illicit connections, discharges, combined sewer overflows, sanitary sewer overflows, straight pipes from septic tanks or other on-site wastewater systems can also be sources of *E. coli* bacteria.

Active animal feeding operations that have been issued State of Nebraska permits, which are required for construction and operation of livestock waste control facilities (LWCF) if the operation has discharged, or has the potential to discharge, livestock waste to waters of the State are also considered potential sources. Figure 3.1.5.1b shows the facilities within the Mud Creek watershed that have been entered into the NDEQ database by a permit being issued or requested. These facilities are designed to contain any run-off that is generated by storm events that are less in intensity than the 25-year, 24-hour rainfall. Appendix D also provides facility ID, HUC12 and County information for each facility within the watershed. As of June 2010 there were 109 permitted LWC facilities within the Mud Creek watershed.

3.1.5.2 Nonpoint Sources: Several nonpoint sources of *E. coli* exist in the Mud Creek watershed. These sources include: failing septic tanks or other on-site wastewater systems, run-off from livestock pastures, improper or over-application of biosolids (wastewater treatment facility sludge, septage or manure) and urban stormwater runoff not regulated by an NPDES permit.

3.1.5.3 Natural Sources: The primary natural source of *E. coli* is wildlife. A variety of wildlife is native to or have adapted to the diverse habitat of the Mud Creek watershed. Big game, upland game, furbearers, waterfowl and non-game species have been documented to reside within the basin.

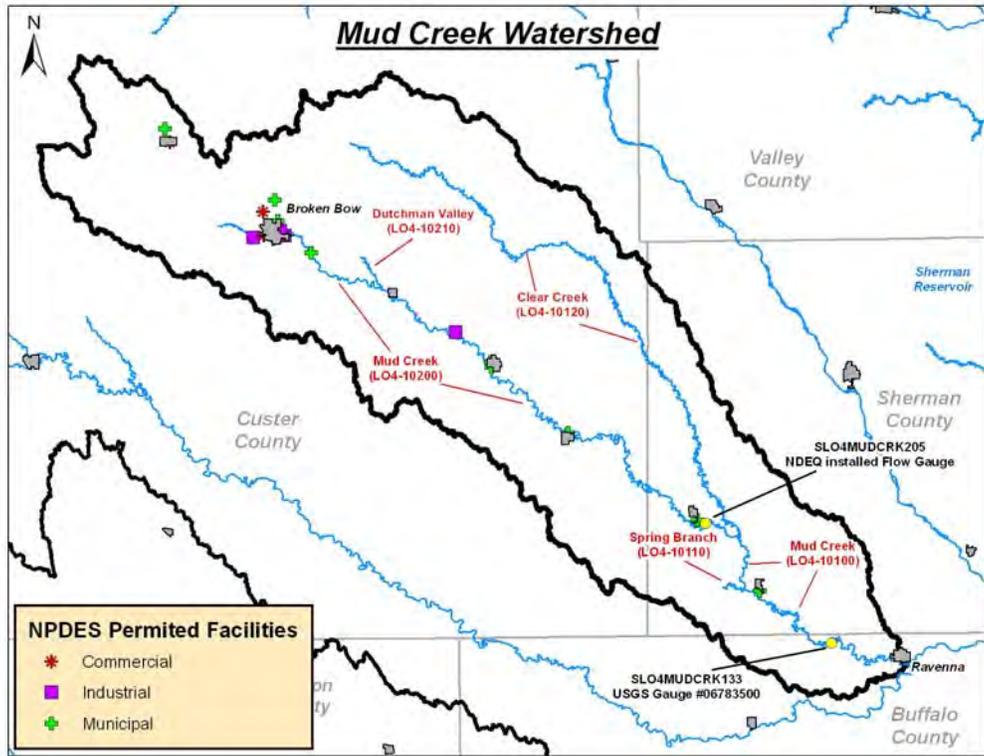


Figure 3.1.5.1a: NPDES Permitted Facilities in Mud Creek Watershed

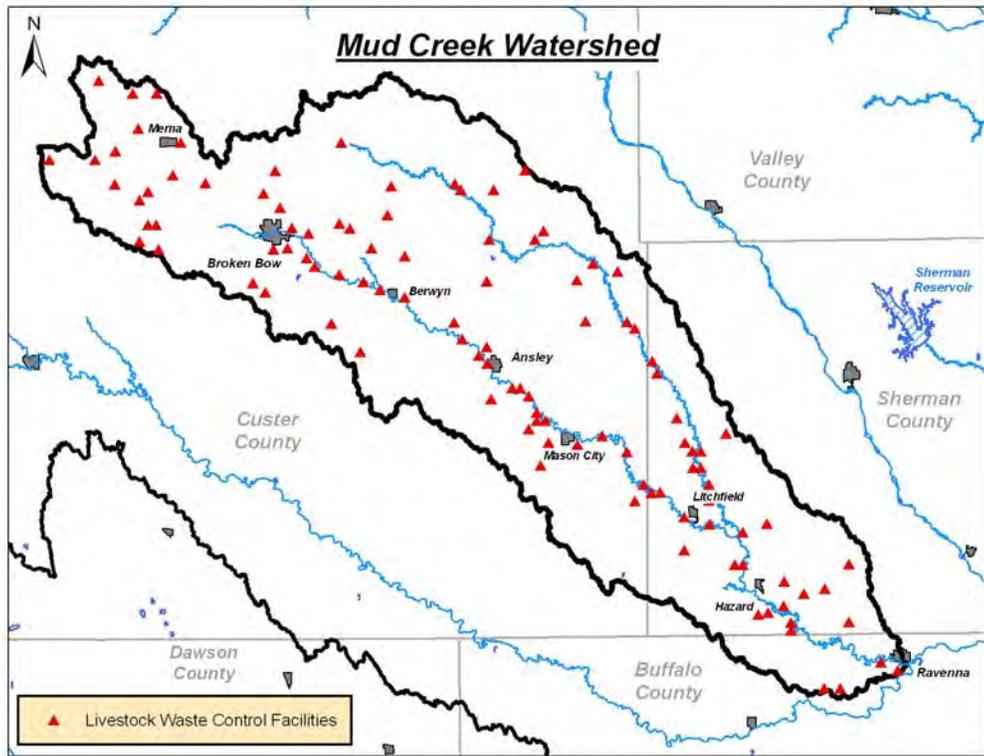


Figure 3.1.5.1b: Active Animal Feeding Operations in the Mud Creek Watershed

3.2 TMDL Endpoint

The endpoint for these TMDLs will be based on the numeric criteria associated with the Primary Contact Recreation beneficial use.

3.2.1 Numeric Water Quality Criteria

Water quality criteria established for the protection of the Primary Contact Recreation beneficial use can be found in Title 117, Chapter 4 and are as follows:

002.01 E. coli.

E. coli bacteria shall not exceed a geometric mean of 126/100 ml. For increased confidence of the criteria, the geometric mean should be based on a minimum of five samples taken within a 30-day period. This does not preclude fecal coliform limitations based on effluent guidelines. The following single sample maxima shall be used solely for issuing periodic public advisories regarding use of waterbodies for Primary Contact Recreation.

002.01A 235/100 ml at designated bathing beaches

002.01B 298/100 ml at moderately used recreational waters

002.01C 406/100 ml at lightly used recreational waters

002.01D 576/100 ml at infrequently used recreational waters

The November 16, 2004 Federal Register (Volume 69, No. 220) contained information regarding the final rule for "Water Quality Standards for Coastal and Great Lakes Recreational Waters". This rule includes a discussion on the use of the single season maximum (SSM). Specifically:

"EPA expects that the single season maximum values would be used for making beach notification and closure decisions. EPA recognizes however that States and Territories also use criteria in their water quality standards for other purposes under the Clean Water Act in order to protect and improve water quality. Other than in the beach notification and closure decision context, the geometric mean is the more relevant value for ensuring that appropriate actions are taken to protect and improve water quality because it is a more reliable measure, being less subject to random variation and more directly linked to the underlying studies on which the 1986 criteria were based."

Given this discussion and recommendation regarding the use of single season maximum in TMDLs and waterbody assessments, these TMDLs will focus on meeting the *E. coli* recreation season geometric mean of 126/100 ml.

3.2.2 Selection of Critical Environmental Conditions

The water quality criteria associated with the Primary Contact Recreation beneficial use only applies from May 1 through September 30. Therefore, the critical conditions for these TMDLs will be those occurring from May 1 through September 30.

3.2.3 Waterbody Pollutant Loading Capacity

Defining waterbody pollutant loading capacity implies a steady state. These TMDLs recognize that loadings are dynamic and can vary with stream flow. As well, section 3.1.5 above indicates a wide range of environmental conditions that must be accounted for.

The method chosen to account for the variation in flow is based upon a data assessment (TMDL) curve. Data assessment curves are initiated by the development a stream's hydrograph using the long-term gage information. The flow information (curve) is then translated into a load curve by multiplying the flow values by the water quality standard (WQS) and a conversion factor (C). The acceptable "load" is then plotted graphically. Therefore, the loading capacity for each of the segments will be defined by:

$$\text{Loading capacity} = \text{WQS} \times \text{Flow} \times \text{C}$$

The waterbody pollutant loading capacities can be found in Appendix C.

3.3 Pollutant Source Assessment

For these TMDLs the source loading is based upon the position of the monitoring data points in relation to the boundary established on the data assessment curve between point source and nonpoint source influences. This process for selecting the load point is described in the document entitled *Nebraska's Approach for Developing TMDLs for Streams Using the Load Duration Curve Methodology* (NDEQ 2002). In the situation where a boundary has not been included on a data assessment curve, the information indicates no point source facilities discharge to the contributing watershed. For these waterbodies, the pollutant will be considered derived from nonpoint and natural sources.

3.3.1 Existing Pollutant Conditions

The existing pollutant conditions are shown in the data assessment curves (Figure 3.3.1a and 3.3.1b) provided for each of the segments where a TMDL is being developed. The points plotted above the acceptable loading indicate a deviance from the water quality criteria. It is recognized that with *E. coli* bacteria a load cannot be calculated. The purpose for inclusion of the data assessment curves for these waterbodies is to present a comparison of the water quality data to the stream flow and attempt to explain the conditions under which the data was collected.

3.3.2 Deviation from Acceptable Pollutant Loading Capacity

Table 3.3.2 describes the deviation from the acceptable water quality standards based upon the 2008 *E. coli* monitoring information.

Segment	Observed Season Geometric Mean (#/100ml)	#100ml Above WQS
LO4-10100	1105	979
LO4-10200	1006	880

Table 3.3.2: Deviation from the Applicable Water Quality Criteria

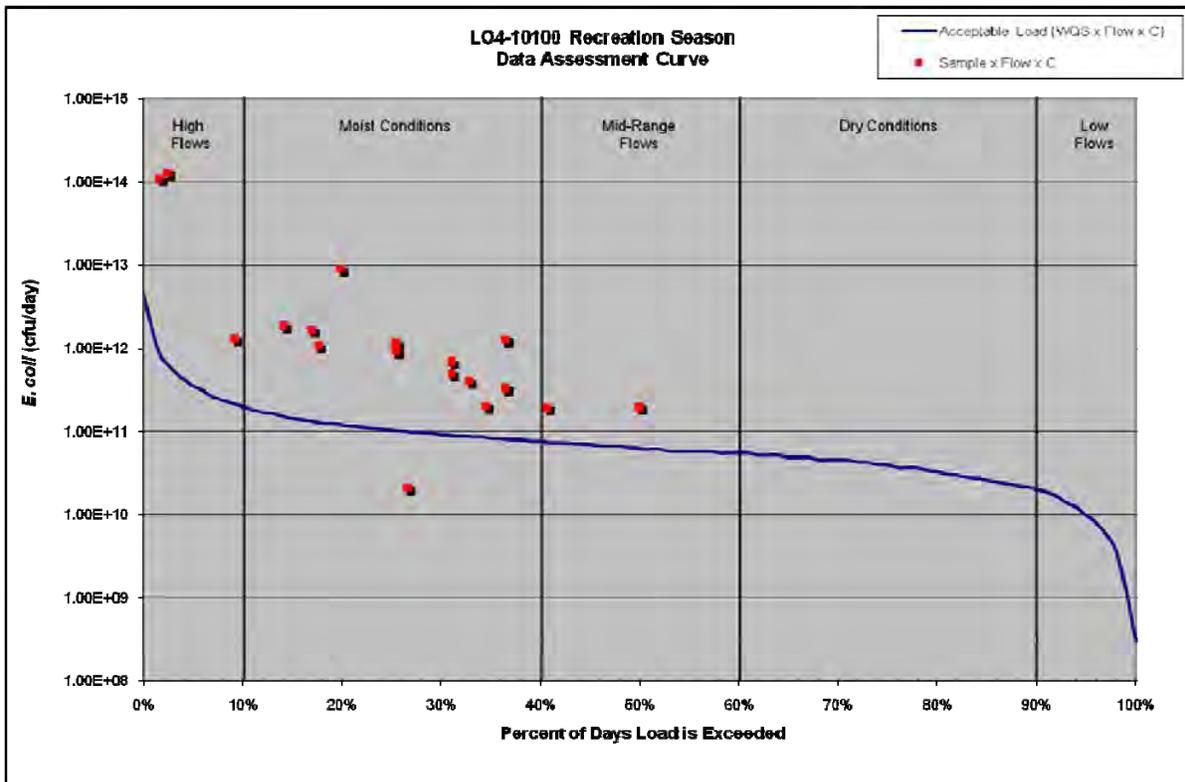


Figure 3.3.1a: Data Assessment Curve for Mud Creek segment LO4-10100

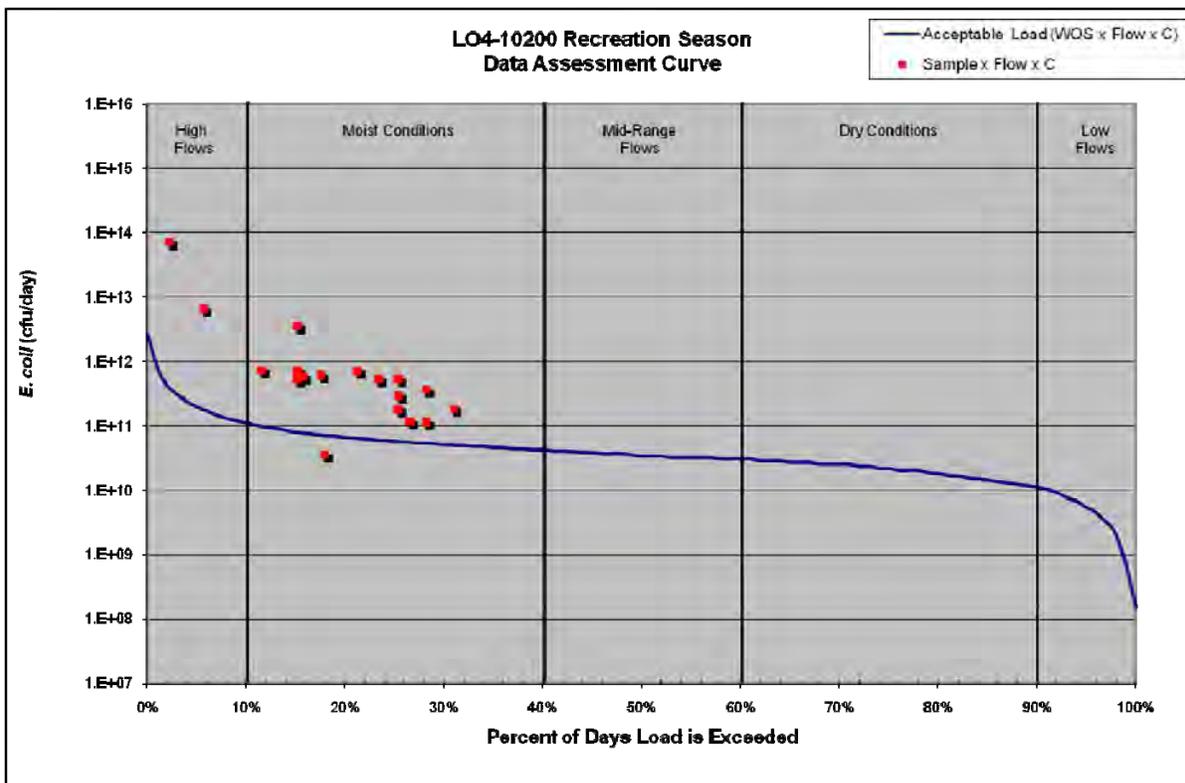


Figure 3.3.1b: Data Assessment Curve for Mud Creek segment LO4-10200

3.3.3 Identification of Pollutant Sources

Both point and nonpoint sources are known to exist along the segment and within the contributing watersheds. Due to the size of the watersheds, the somewhat limited data, the delivery methods and the location of the potential sources in relation to the impaired waterbody, it is difficult to definitively identify specific sources. It is important to note that all potential sources may not contribute to the water quality impairments and some sources may contribute at a greater degree than others.

The method utilized to determine the contributions of the sources will be based upon a demarcation where point source discharges are not expected to further impact the waterbody. That is, based on the concept of a continuous and relatively constant effluent volume, a dilution or flow value can be determined where point sources are no longer expected to contribute to water quality excursions. The process is explained in the document entitled *Nebraska's Approach for Developing TMDLs for Streams Using the Load Duration Curve Methodology* (NDEQ 2002).

E. coli concentrations in wastewater can vary greatly, depending upon treatment technology, wastewater strength, industrial contributions, treatment efficiency and season. The selection of an all-encompassing effluent density value must then account for these and other variables. To that end, the NDEQ has collected effluent *E. coli* information from several facilities not providing disinfection of the wastewater discharge. The data was obtained from 24 facilities that include both mechanical and lagoon facilities and as seen in Figure 3.3.3a, exhibits a normal distribution. The median value was selected as the input for the "expected pollutant concentration". The equation to determine the point source/nonpoint source boundary then becomes:

$$Q_s = (8,400/100 \text{ ml} \times \Sigma Q_e) / 126/100 \text{ ml}$$

Where:

Q_s	= stream flow volume necessary to meet water quality standards
8,400/100 ml	= expected <i>E. coli</i> coliform density from point sources
ΣQ_e	= sum of all design flows from point sources discharging to the segment (direct or via tributaries)
126/100 ml	= water quality standard

The values for ΣQ_e as well as the boundary flows can be found in Table 3.3.3b. The identification of pollutant sources and impacts are shown in figure 3.3.3.c. No pollutant source chart will be presented for segment LO4-10100 as there are no point source discharges to the segment.

3.3.3.1 Point Sources of *E. coli*: Based upon the Data Assessment curves and the position of the monitoring data points, it appears point sources are contributing to the *E. coli* impairment within segment LO4-10200. Facilities that discharge either directly to or into a tributary of the Mud Creek watershed recreation segments that are a potential source are listed in Table 3.3.3.1 below.

3.3.3.2 Nonpoint Sources of *E. coli*: Due to the diverse nature, distribution and delivery method, nonpoint and natural sources will not be separated. Therefore, the monitoring data that fall to the left of the boundary are considered to be the result of nonpoint and natural background sources. Mix

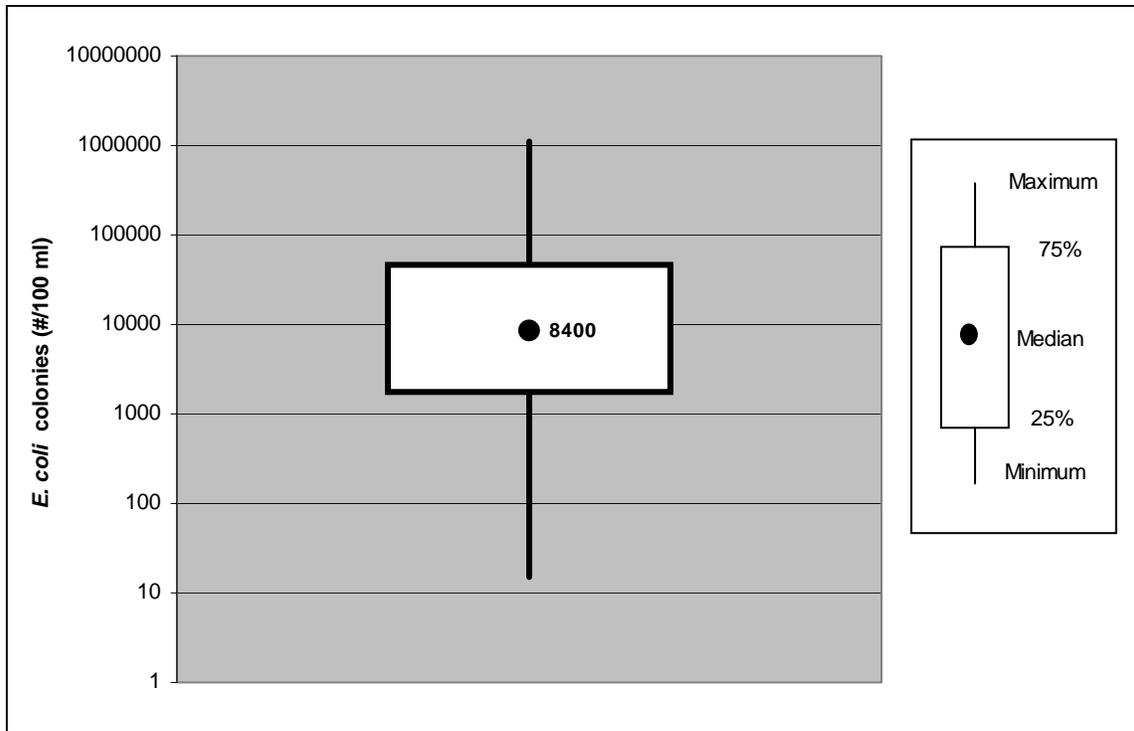


Figure 3.3.3a: *E. coli* Data from 24 Wastewater Treatment Facilities

Segment	Total Number Of Facilities	Sum of Contributing Facility Design Flows (cfs)	Median Flow Value for Point vs. Nonpoint Boundary (cfs)
LO4-10100	0	-	-
LO4-10200	2	1.097	74.18

Table 3.3.3b: Sum of Wastewater Treatment Facility Design Flows in the Mud Creek Watershed

Recreation Segment	Receiving Water	Facility Name	NPDES Permit Number	Facility Design Flow (cfs)	Facility Discharge Directly to Recreation Segment?	E. coli/Fecal coliform Limits in NPDES permit?
LO4-10200	LO4-10200	Broken Bow WWTF	NE0027260	1.021	Yes	Yes
	LO4-10200	Ansley WWTF	NE0043249	0.076	Yes	Yes

Table 3.3.3.1: NPDES Permitted Facilities with *E. coli* limits in the Mud Creek Watershed

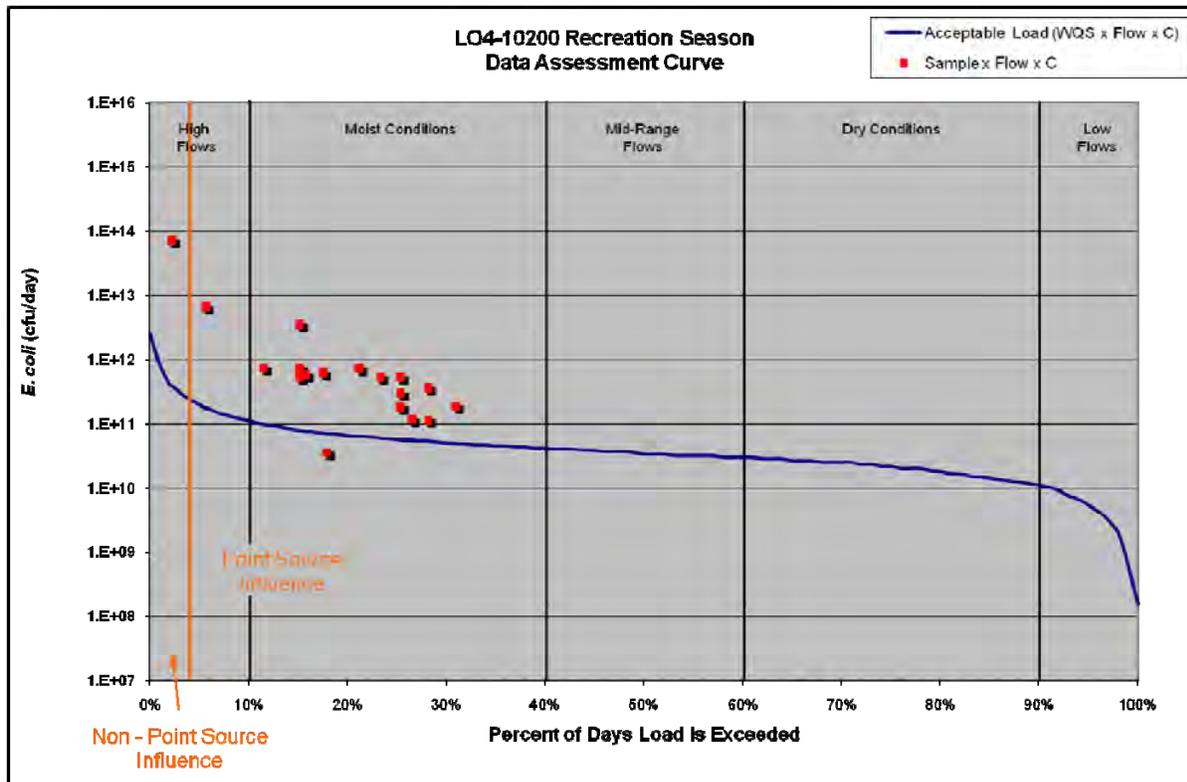


Figure 3.3.3c: Identification of Pollutant Sources using the Data Assessment Curve for LO4-10200

The source identification process utilized was done so in order to get a general idea of the source category. This simplified numeric process should not be considered exclusive as an overlap of source contributions is recognized during periods where run-off is contributing to stream volume. In the future, expanded sampling may target specific source identification. Future monitoring and assessment will also take into account the controls (i.e. wastewater disinfection) that have been instituted. When considered, the demarcation may fluctuate and the source contributions re-evaluated.

3.4 Pollutant Allocation

A TMDL is defined as:

$$\text{TMDL} = \text{Loading Capacity} = \text{WLA} + \text{LA} + \text{Background} + \text{MOS}$$

As stated above, the loading capacity is based upon flow position in the hydrograph and is defined by:

$$\text{Load Capacity} = \text{Flow} \times 126/100 \text{ ml} \times C$$

Where:

Flow = Stream flow volume (cubic feet per second)

126/100 ml = applicable/target water quality criteria for *E. coli* from Title 117

C = conversion factor.

By federal regulation, a TMDL requires a loading capacity value for the pollutant of concern. In the case of *E. coli*, a "load" (flow rate x concentration x conversion factor) could be calculated, but the approach may not be appropriate for expressing this non-conservative parameter. Therefore, for the purposes of these TMDLs, a loading capacity will not be "calculated" but will be expressed as the water quality standard. Because the water quality is expressed as a concentration, the LC will not equal the WLA + the LA. The flow hydrographs (0-100th Percentile) used in the *E. coli* TMDLs are provided in Table 3.4.

Percentile	LO4-10100 (cfs)	LO4-10200 (cfs)
0	0.1	0.1
10	6.9	3.7
20	11.3	6.0
30	15.7	8.3
40	18.8	10.0
50	20.9	11.1
60	26.1	13.8
70	31.4	16.6
80	40.8	21.6
90	69.0	36.6
100	1578.0	836.5

Table 3.4: Recreation Season Hydrograph for Mud Creek Watershed *E. coli* TMDLs

To achieve the desired loading capacities requires the following allocations:

3.4.1 Wasteload Allocations

3.4.1.1 NPDES Permitted Facilities: Title 117 does not allow for the application of a mixing zone for the initial assimilation of effluents in order to meet the criteria associated with the recreation beneficial use. Because of this, the water quality criteria are applied to the "end-of-pipe" concentrations and are applicable at all stream flows >7q10 (lowest stream flow for seven consecutive days that would be expected to occur once in ten years). Therefore, the *E. coli* wasteload allocation established by this TMDL will be the monthly geometric mean 126/100 ml.

The wasteload allocation will initially be applied to all facilities that discharge directly to a recreational segment. Meeting the WLA will be achieved by adhering to the existing compliance schedules for bacteria, included within both communities NPDES permits.

Typically, to achieve NPDES compliance for bacteria, discharging facilities need to provide for some form of disinfection. Disinfection systems are often designed and operated to achieve 100% reduction in the indicator bacteria or 0/100ml. Thus, the actual NPDES permitted point source contributions, upon meeting compliance schedules, is likely to be less than the WLA assigned above (126/100ml). Future monitoring and evaluation will be utilized to determine if *E. coli* limitations are necessary for facilities discharging to the recreation segment's tributaries.

3.4.1.2 Dry Weather Discharges: Dry weather discharges can both be from illicit sources, cross-connections or mechanical failure and often exhibit the greatest influence on the base flow conditions of the stream. Thus, it is most appropriate to group these discharges and limit similarly to the WWTFs. Specifically, the wasteload allocations assigned to these discharges shall be a seasonal geometric mean of 126/100 ml.

3.4.1.3 Non-Discharging Facilities: Several facilities including confined animal feeding operations (CAFOs) and lagoons are designed for “zero” discharge. In the case of animal feeding operations, discharges may only occur as the result of a 25 year 24 hour storm event or a chronic wet period with an accumulative precipitation equivalent to a 25 year 24 hour storm. Based on this permitting provision, the WLA for facilities classified as non-discharging will be zero (0).

3.4.2 Load Allocations

The load allocations assigned to these TMDLs will be based upon the stream flow volume and will be defined as:

$$LA_i = Q_i \times 126/100 \text{ ml} \times C$$

Where:

LA_i = load allocations at the i^{th} flow

Q_i = stream flow at the i^{th} flow

126/100 ml = applicable/target water quality criteria for *E. coli* from Title 117

C = conversion factor

3.4.3 Margin of Safety

A margin of safety (MOS) must be incorporated into TMDLs in an attempt to account for uncertainty in the data, analysis or targeted allocations. The MOS can either be explicit or implicit and for these TMDLs are as follows:

- To account for uncertainty in the nonpoint source load reduction, the targeted reductions will be set at 90% of the water quality target (126/100 ml). Specifically the reductions shall be applied to meet a seasonal geometric mean of $\leq 113/100$ ml.
- Decay and/or die off of *E. coli* were not accounted for in either the source assessment or in establishment of the load reduction. That is, the entire concentration/load from the source was assumed to be present within the waterbody and the reductions should focus on the load.
- These TMDLs assumed the effluents discharge the *E. coli* density allowed by the WLA or 126/100 ml. WWTF disinfection systems are often designed and operated to achieve 100% reduction in the indicator bacteria or 0/100ml. Thus, the actual NPDES permitted point source contribution is likely less than expected by the TMDL.

3.4.4 Load Reduction to Meet Water Quality Criteria

It is important to report the reductions necessary to meet the water quality criteria. The necessary reductions were determined based upon 2008 data, which is considered representative information. The targeted reductions found in Table 3.4.4 provide water quality managers with a quantitative endpoint by which implementation planning can be carried out. The noted reductions along with including the application of point source controls if achieved should result in the waterbodies fully supporting the primary contact recreation beneficial use. The reductions stated in the table also include the margin of safety described below.

Segment	Targeted Reduction	Expected Season Geometric Mean
LO4-10100	90%	111/100ml
LO4-10200	89%	111/100ml

Table 3.4.4: Targeted *E. coli* Load Reductions

3.4.5 Expression of TMDLs as Daily Loads

The April 25, 2006 decision by the U.S. District Court of Appeals for the D.C. Circuit in “Friends of the Earth, Inc. vs. EPA et. al.” recommends that all TMDLs and associated wasteload allocations and load allocations include a daily expression. The approach for these TMDLs will be based upon the conversion of the targeted concentration of *E. coli* to counts per day. The daily expression for each TMDL segment can be found in Appendix C.

4.0 Implementation Plan

The implementation of controls to manage atrazine and *E. coli* within the Mud Creek watershed includes but is not limited to:

4.1 Nebraska Department of Agriculture

The Nebraska Pesticide Act provides that the Nebraska Department of Agriculture (NDA) shall serve as the lead state agency in matters relating to pesticides as they relate to water quality. It further provides that NDA shall work closely with the Nebraska Department of Environmental Quality, Nebraska Department of Natural Resources, and the Nebraska Department of Health and Human Services in matters relating to water quality.

Since 1995, the NDA has been the lead agency for the regulation of pesticides that might enter or pollute water and is responsible for development and implementation of state management plans for the prevention, evaluation and mitigation of occurrences of pesticides, or pesticide breakdown products, in ground and surface water. By working closely with those state agencies listed above as well as the Natural Resources Districts and others, NDA can be assured that the plans will be more comprehensive and effective in addressing these issues.

The NDA has been consulted in the completion of this TMDL and will be provided a copy upon EPA approval.

4.2 Section 319 - Nonpoint Source Management Program

The United States Environmental Protection Agency supplies grant funds to states to aid in managing nonpoint source pollution. When grant applications are submitted for review, an effort should be made to include the control of atrazine and surface run-off for the proposed projects in the Mud Creek watershed. As well, an effort will be made to redirect applicants to develop proposals consistent with the goals of this TMDL.

4.3 USDA - Natural Resource Conservation Service

The USDA-Natural Resource Conservation Service provides assistance utilizing programs under the control of the Service such as Conservation Reserve Program, Environmental Quality Incentives Program, Conservation Farm Option, Conservation of Private Grazing Land Initiative, the Wetlands Reserve Program and others that aid in the maintenance and improvement of water quality. The TMDL will be forwarded to NRCS for consideration in the implementation of these programs.

4.4 Non-Government Organizations

Several non-governmental organizations with an emphasis on agriculture disseminate information to their members on a regular basis. As well, some of the organizations have established environmental education programs to assist in the understanding of environmental regulations and topics. The NDEQ will communicate with these entities in an attempt to utilize the membership distribution process as a means of providing information on the water quality impairments, the TMDL and suggestions to assist in solving the identified problems.

4.5 NPDES Permitted Point Sources

Facilities that discharge directly to all segments within the Mud Creek Watershed designated with the primary contact recreation use will be required to meet the wasteload allocations – *E. coli* = 126/100 ml – at the end of the pipe. Facilities discharging to designated or undesignated tributaries will be evaluated to determine the extent of the effluent's impact on immediate downstream recreation segment. If deemed significant, a request will be made to limit the *E. coli* concentration discharged from these facilities in the NPDES permit.

In 2009 the city of Broken Bow began construction on upgrades to their WWTF going from a lagoon system to a Sequencing Batch Reactor (SBR) system. These upgrades, with disinfection scheduled to be operational in mid to late 2010, will provide reductions to *E. coli* concentrations within the Mud Creek Watershed. The village of Ansley was recently awarded a Community Development Block Grant that will be utilized to build a new WWTF. These upgrades, along with disinfection, will ensure that the village of Ansley meets bacteria limits imposed in their NPDES permit.

In the course of compliance audits, deficiencies in the operation of the WWTF disinfection appurtenances and noncompliance with the NPDES permit limits should be noted and corrective action pursued.

Biosolids (sludge) generated by municipal and industrial facilities are regulated under 40 CFR Part 257 and 40 CFR Part 503, respectively. 40 CFR part 257 requires that facilities and practices not cause nonpoint source pollution of waters of the United States. Part 503 specifically requires that sludge applications be not less than 10 meters from waters of the United States and that the sludge not be applied to frozen, flooded or snow covered ground if the sludge can enter into waters of the United States.

Consistent with Section 4.7 below, a recommendation will be made that all relevant NPDES permittees adhere to the setback requirements identified in Title 130 Chapter 9 sections 007 for land application activities taking place either during or 10 days prior to the recreation season (May 1 – September 30).

4.6 Dry Weather Discharges

Title 119 – Rules and Regulations pertaining to the Issuance of Permits under the National Pollutant Discharge Elimination System, Chapter 2 states:

“All persons discharging pollutants from a point source into any waters of the State are required to apply for and have a permit to discharge.”

Discharges not permitted should be required to obtain the proper authorization to discharge. All discharges are then subject to the appropriate limitations consistent with the WLAs established by this TMDL. Elimination of the discharge should be undertaken in the event permitting and control is not feasible.

4.7 Animal Feeding Operations

The Livestock Waste Control Program administers two types of permitting programs, under the authority of Title 130 - Livestock Waste Control Regulations, for livestock waste control facilities in Nebraska: The federal National Pollutant Discharge Elimination System (NPDES) permitting program and the state Construction and Operating Permit program. NDEQ Livestock program issues individual NPDES permits, as well as coverage under a General NPDES permit.

Chapter 2, titled “Animal Feeding Operations: Requirements and Prohibitions” states:

001 Any small animal feeding operation is exempt from the inspection, and construction and operating permit requirements, unless the animal feeding operation has discharged pollutants to waters of the State, or the Department has determined that such a discharge is more likely than not to occur. Operations with animals that are in contact with, or which have direct access to, surface waters, or operations with a man-made ditch, pipe, or other conveyance from the operation to surface waters are considered to be discharging. Animal feeding operations for other species not listed (e.g. bison, elk) that confine animals with a total animal weight of less than 300,000 pounds are considered small animal feeding operations.

002 Any person owning or operating a large or medium animal feeding operation that does not have a NPDES permit, construction approval, operating permit or construction and operating permit, has not been notified that no permit is required, or is not exempt under Nebr. Rev. Stat. 54-2422 shall submit an inspection request to the Department on a form provided by the Department (see Appendix A). The inspection fee established in Chapter 3 shall accompany the inspection request.

003 A livestock waste control facility is required for an existing or proposed animal feeding operation when livestock wastes have discharged or have the potential to discharge in a manner that is not lawfully authorized by permit or these regulations.

004 When livestock waste control facilities are required by the Department, the owner or operator of the animal feeding operation is required to apply for construction and operating permit as provided in Chapter 4. In the case of an existing animal feeding operation, the owner or operator will be notified in writing following an inspection by the Department whether or not a facility is

required and, if required, the applicant shall submit an application according to the compliance dates in the notification.

And,

008 Any person who owns or operates an animal feeding operation shall not:

008.01 Provide or present false or misleading information to the Department or omit relevant facts when submitting reports or applications to the Department;

008.02 Allow livestock at an animal feeding operation to come into direct contact with waters of the State, apply livestock waste on or into waters of the State, or to otherwise allow or cause a discharge;

008.03 Apply manure, litter, or process wastewater to land in a manner that results in a discharge to waters of the State or that is not in accordance with nutrient management practices that ensure appropriate agricultural utilization of the nutrients in the manure, litter, or process wastewater;

008.04 Stockpile livestock waste in a drainage way or other location where it is likely to impact waters of the State;

Chapter 8, titled "Waste Control Methods: Design Criteria and Construction Requirements" also states:

002.01 For open lot animal feeding operations, the minimum storage period capacity shall be no less than the calculated average runoff for the month of June, runoff from a 25-year, 24-hour rainfall event, and any manure, litter, and process wastewater produced for the month of June.

002.02 The minimum storage period for totally housed operations shall be no less than 180 days. Except, the applicant may request the Director to establish a substantially equivalent alternative storage period which is less than 180 days based upon a satisfactory demonstration that the proposed alternative time period will achieve overall environmental performance which is at least equal to that achieved by providing adequate storage for the specified 180 days. The Director may require any additional supporting information deemed necessary to support such a request.

005 Surface drainage shall be diverted around the production area and livestock waste control facility to the maximum extent possible by diversion terrace, berm, ditch, or similar diversion, subject to Department approval. Any such diversion shall be designed and constructed to convey at least the runoff and the direct precipitation from the peak discharge of a 25-year, 24-hour rainfall event or a 100-year, 24-hour rainfall event (whichever rainfall event is applicable as identified in Chapter 7). Any open diversion will not be less than 1.5 feet in channel depth.

Meeting these regulation requirements should equate to "zero" discharge during conditions less than a 25 year 24 hour precipitation event, or a chronic wet period.

Wastewater and biosolids (manure) produced by the animal feeding operations are most often land applied for beneficial reuse. Permitted facilities are required to follow stockpile and application setbacks identified in Title 130 Chapter 9.

007 For large concentrated animal feeding operations, manure, litter, and process wastewater may not be stockpiled or applied closer than 100 feet to any down-gradient surface waters, open tile line intake structures, well heads, or other conduits to surface or ground water, except that one of the following two compliance alternatives may be substituted for the application setback requirement:

007.01 A 35-foot-wide vegetated buffer where the application of manure, litter, or process wastewater is prohibited. For the purposes of these regulations vegetated buffer means a permanent strip of dense perennial vegetation established parallel to the contours of and perpendicular to the dominant slope of the field for the purposes of slowing water runoff, enhancing water infiltration, and minimizing the risk of any potential nutrients or pollutants from leaving the field and reaching surface waters of the state; or

007.02 A satisfactory demonstration that a setback or buffer is not necessary because implementation of alternative conservation practices will provide pollutant reductions equal to or better than reductions that would be achieved by the 100-foot setback.

008 For small and medium concentrated animal feeding operations and animal feeding operations not required to seek permit coverage, manure, litter, and process wastewater may not be stockpiled or applied closer than 30 feet of any streams, lakes and impounded waters identified in Chapter 6 and Chapter 7 of Title 117 (Nebraska Administrative Code) – Nebraska Surface Water Quality Standards, unless in accordance with a Department approved nutrient management plan.

Permitted facilities are also required to follow best management practices (BMPs) for the land application of livestock wastes as defined in Title 130, Chapter 11, and those BMPs include:

001 Animal feeding operations and livestock waste control facilities shall be operated and maintained to prevent water pollution and to protect the environment of the State. Best management practices shall be implemented using the most effective methods based on the best available technology achievable for specific sites to prevent or reduce the discharge of pollutants to waters of the State and control odor where appropriate.

And,

005 All livestock wastes removed from the facility and the animal feeding operation itself shall be land applied or stockpiled in a manner which will not contribute to water pollution. The owner or authorized representative shall remain responsible for wastes removed from the operation to land under his or her control.

Based upon the above regarding land application, it shall be recommended that the NDEQ's Agriculture Section stipulate in the state operating or other permits, for facilities located in the Mud Creek Basin, that the application of livestock waste occurring 10 days prior or during the Recreation Season (May 1 – September 30) be consistent with Title 130 Chapter 9 sections 007 and 008 mentioned above with the inclusion of streams identified in Chapter 5 of Title 117. In addition, a recommendation will be made to

the NDEQ's Agriculture Section that the application setback be the minimum of 30 feet regardless of the status of the comprehensive nutrient management plan for all small and medium concentrated animal feeding operations. And finally, for all small and medium concentrated animal feeding operations, in those areas where land slope or drainage is such where the application has a greater potential to run-off, or where application has been observed to have run-off, the recommendation will be a minimum setback of 100 feet, or complying with sections 007.01 and 007.02 of Title 130 Chapter 9.

4.8 Exempt Facilities/Other Agricultural Sources

Animal feeding operations are exempt from regulations set forth in Title 130 if:

- The operation is classified as a small animal feeding operation, and
- There has not been a confirmed discharge to waters of the State, and/or
- The Department has determined that because of conditions at the livestock operation there is not a high potential for discharge to waters of the state.

Periodically, the NDEQ will receive a complaint on or a request for an inspection from a facility operating as a small animal feeding operation. Should deficiencies be noted during the on-site visit, the owners/operator will often be given an opportunity to make corrections prior to enforcement or permit action being taken. In the event the efforts at voluntary compliance fail, civil enforcement or the issuance of a permit will be pursued to bring about the necessary corrective measures.

Because these facilities are "non-regulated", it is difficult to assess the impacts to the environment. As well, pastures or other temporary feeding practices may contribute to the *E. coli* impairments if conditions are such that run-off from the site occurs. In lieu of regulatory requirements, the NDEQ will first look to the USDA-Natural Resource Conservation Service for assistance utilizing programs under the control of the Service such as Conservation Reserve Program, Environmental Quality Incentives Program, Conservation Farm Option, Conservation of Private Grazing Land Initiative, the Wetlands Reserve Program and others that aid in the maintenance and improvement of water quality.

4.9 Reasonable Assurance

As stated above, the NDA is the lead agency that deals with pesticide water quality issues. This TMDL was provided to the NDA prior to submittal to EPA for approval/disapproval. Once approved, coordination with the NDA will continue, including data collection and prioritization and nonpoint source program administration.

The NDEQ is responsible for the issuance of NPDES or state operating permits for industrial and municipal wastewater discharges, regulated stormwater discharges and livestock operations (open lot or confined). Issued permits must be consistent with or more stringent than the wasteload allocations set forth by this TMDL. Compliance with the permit may require construction or modification of a facility and the issued permits may account for this through the inclusion of a compliance schedule or administrative order.

Effective management of nonpoint source pollution in Nebraska necessarily requires a cooperative and coordinated effort by many agencies and organizations, both public and private. Each organization is uniquely equipped to deliver specific services and assistance to the citizens of Nebraska to help reduce the effects of nonpoint source pollution on the State's water resources. While a few of the organizations

have been previously identified, Appendix A contains a more complete compilation of those entities that may be included in the implementation process. These agencies have been identified as being responsible for program oversight or fund allocation that may be useful in addressing and reducing atrazine and *E. coli* contributions to the Mud Creek watershed. Participation will depend on the agency/organization's program capabilities.

5.0 Future Monitoring

Future monitoring will generally be consistent with the ambient monitoring and rotating basin monitoring programs. The Loup River Basin was monitored in 2008 and will again be targeted in 2013. An effort will be made to expand the monitoring to isolate areas of concern and to focus resources to address identified problems.

Periodically, compliance monitoring will be conducted at NPDES permitted facilities to verify permit limitations are being adhered to. Facilities are selected either randomly or in response to inspection or reported information.

As well, the NPDES permits require self-monitoring of the effluent by the permittee with the frequency of the monitoring being based on the discharge characteristics. The data are then reported to NDEQ quarterly, semiannually or annually and entered into the EPA's Permitting Compliance System. The compliance monitoring and self-monitoring information will be used in assessing the success of the TMDL.

Recently, analytical techniques have been introduced that may provide a greater level of confidence in the identification of pollutant sources. These techniques include microbial source tracking and specialized sampling the targets human wastewater. As the science progresses the application of these analytical techniques may become a valuable tool for source identification and pollutant reduction.

6.0 Public Participation

The availability of the TMDLs in draft form was published on NDEQ's Internet site with the public comment period running from approximately September 07, 2011 to October 07, 2011. Interested stakeholders (Appendix A) were also informed via email of the availability of the draft TMDLs.

7.0 References

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Appendix A

Federal, State Agency and Private Organizations Included in TMDL Implementation.

FEDERAL

- Bureau of Reclamation
- Environmental Protection Agency
- Fish and Wildlife Service
- Geological Survey
- Department of Agriculture - Farm Services Agency
- Department of Agriculture - Natural Resources Conservation Service

STATE

- Nebraska Association of Resources Districts
- Department of Agriculture
- Department of Environmental Quality
- Department of Roads
- Department of Water Resources
- Department of Health and Human Services
- Environmental Trust
- Game and Parks Commission
- Natural Resources Commission
- University of Nebraska Institute of Agriculture and Natural Resources (IANR)
- UN-IANR: Agricultural Research Division
- UN-IANR: Cooperative Extension Division
- UN-IANR: Conservation and Survey Division
- UN-IANR: Nebraska Forest Service
- UN-IANR: Water Center and Environmental Programs

LOCAL

- Natural Resources Districts
- County Governments (Zoning Board)
- City/Village Governments

NON-GOVERNMENTAL ORGANIZATIONS

- Nebraska Wildlife Federation
- Pheasants Forever
- Nebraska Water Environment Association
- Nebraska Corn Growers Association, Wheat Growers, etc.
- Nebraska Cattlemen's Association, Pork Producers, etc
- Other specialty interest groups
- Local Associations (i.e. homeowners associations)

Appendix B

Example of Maximum Daily Loadings for May - June Atrazine at various Mud Creek (LO4-10100) flows. These values are extrapolated to the terminus of LO4-10100 to represent a total load for the segment. Again, given the usage and source of atrazine, point and natural sources are likely not contributing to surface waters in Nebraska. Consequently the WLA and Natural Background for this TMDL are set at zero (0). The entire load below is therefore considered the Load Allocation.

Percent Of Flows Exceed	20 Year Flow Percentile	May - June Flow Value (cfs)	Atrazine Maximum Daily Load (kg/day)
100%	0	8	0.24
90%	0.1	18	0.52
80%	0.2	20	0.58
70%	0.3	23	0.67
60%	0.4	26	0.77
50%	0.5	30	0.89
40%	0.6	35	1.01
30%	0.7	42	1.23
20%	0.8	56	1.66
10%	0.9	105	3.07
0%	1.0	1421	41.72

Table B1: Percentile flows and Maximum Daily Atrazine Loading for the Mud Creek Watershed

Appendix C

Loading capacities and wasteload allocations will be expressed as daily counts using the following equations:

$$Q \times 35683.2 \text{ colony forming unit (cfu)/ft}^3 \times 86400 \text{ seconds/day}$$

Daily expression of the margin of safety will be 10% of the loading capacity. The load allocation will be the remaining load available after accounting for the wasteload allocation and the margin of safety. The tables and charts below are the daily expressions for the TMDLs contained in this document.

Percent of Flows Exceed	20 Year Flow Percentile	May-Sept. Segment Flow (cfs)	LC (Loading Capacity in cfu/day)	WLA (Wasteload Allocation in cfu/day)	MOS (Margin of Safety in cfu/day)	LA (Load Allocation in cfu/day)
100%	0	0.1	3.083E+08	0.000E+00	3.083E+07	2.775E+08
90%	0.1	6.9	2.126E+10	0.000E+00	2.126E+09	1.914E+10
80%	0.2	11.3	3.480E+10	0.000E+00	3.480E+09	3.132E+10
70%	0.3	15.7	4.833E+10	0.000E+00	4.833E+09	4.349E+10
60%	0.4	18.8	5.799E+10	0.000E+00	5.799E+09	5.219E+10
50%	0.5	20.9	6.444E+10	0.000E+00	6.444E+09	5.799E+10
40%	0.6	26.1	8.054E+10	0.000E+00	8.054E+09	7.249E+10
30%	0.7	31.4	9.665E+10	0.000E+00	9.665E+09	8.699E+10
20%	0.8	40.8	1.256E+11	0.000E+00	1.256E+10	1.131E+11
10%	0.9	69.0	2.126E+11	0.000E+00	2.126E+10	1.914E+11
0%	1	1578.0	4.865E+12	0.000E+00	4.865E+11	4.378E+12

Table C1: Daily TMDL Expression from LO4-10100

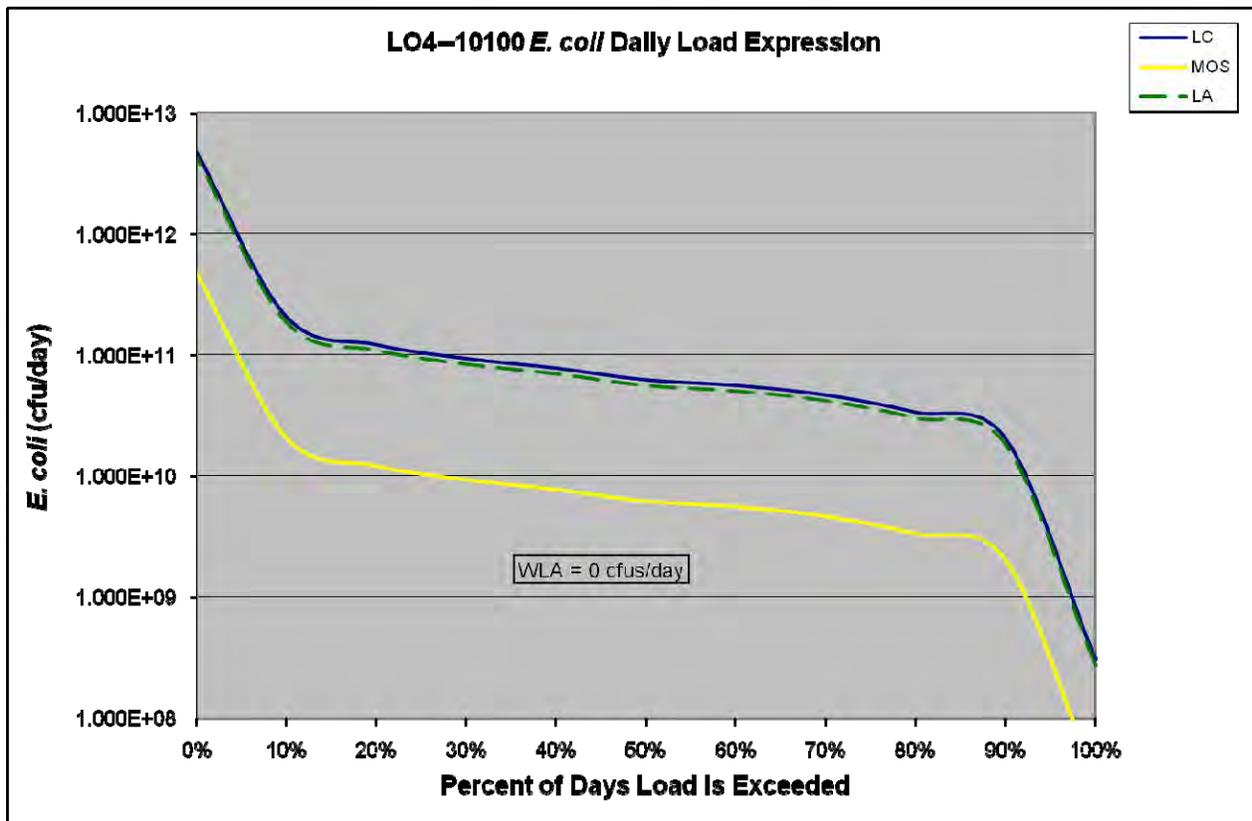


Figure C1: LO4-10100 Daily Load Expression Chart

Percent of Flows Exceed	20 Year Flow Percentile	May-Sept. Segment Flow (cfs)	LC (Load Capacity in cfu/day)	WLA (Wasteload Allocation in cfu/day)	MOS (Margin of Safety in cfu/day)	LA (Load Allocation in cfu/day)
100%	0	0.1	3.083E+08	2.775E+08	3.083E+07	0.000E+00
93%	0.07	2.5	7.708E+09	3.382E+09	7.708E+08	3.555E+09
90%	0.1	3.7	1.141E+10	3.382E+09	1.141E+09	6.884E+09
80%	0.2	6.0	1.850E+10	3.382E+09	1.850E+09	1.327E+10
70%	0.3	8.3	2.559E+10	3.382E+09	2.559E+09	1.965E+10
60%	0.4	10.0	3.083E+10	3.382E+09	3.083E+09	2.437E+10
50%	0.5	11.1	3.422E+10	3.382E+09	3.422E+09	2.742E+10
40%	0.6	13.8	4.255E+10	3.382E+09	4.255E+09	3.491E+10
30%	0.7	16.6	5.118E+10	3.382E+09	5.118E+09	4.268E+10
20%	0.8	21.6	6.659E+10	3.382E+09	6.659E+09	5.655E+10
10%	0.9	36.6	1.128E+11	3.382E+09	1.128E+10	9.817E+10
0%	1	836.5	2.579E+12	3.382E+09	2.579E+11	2.318E+12

Table C2: Daily TMDL Expression from LO4-10200

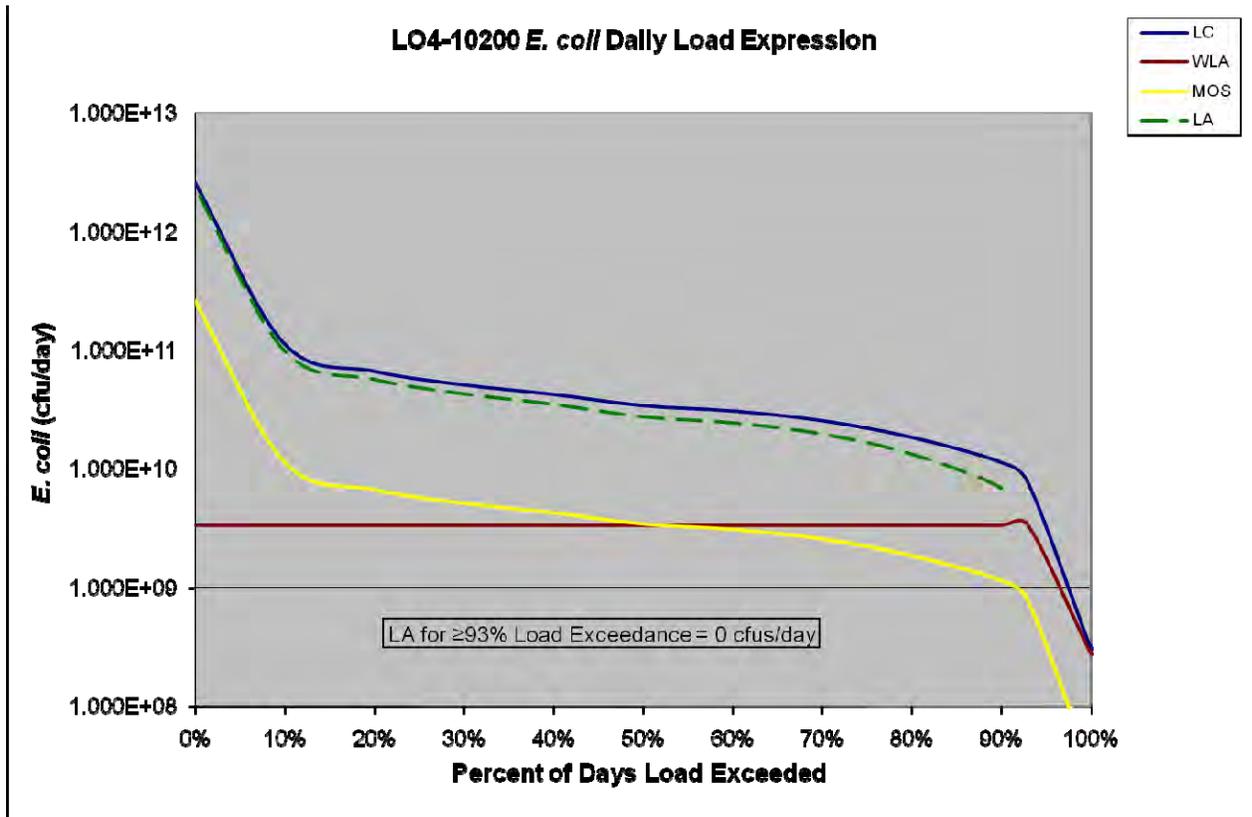


Figure C2: LO4-10200 Daily Load Expression Chart

Appendix D

This data was extracted from NDEQ's IMS website on June 02, 2010 and lists all Livestock Waste Control Facilities within the Mud Creek watershed.

County	HUC 12	Permit Number
Buffalo	102100050405	72575
Buffalo	102100050405	74743
Buffalo	102100050405	74773
Buffalo	102100050405	78392
Custer	102100050101	61363
Custer	102100050101	61365
Custer	102100050101	69588
Custer	102100050101	72385
Custer	102100050101	72386
Custer	102100050101	72414
Custer	102100050101	75337
Custer	102100050101	75341
Custer	102100050101	84676
Custer	102100050101	90614
Custer	102100050102	69603
Custer	102100050102	69754
Custer	102100050102	72360
Custer	102100050102	75339
Custer	102100050102	75342
Custer	102100050102	81378
Custer	102100050103	61705
Custer	102100050103	69710
Custer	102100050103	72364
Custer	102100050103	72387
Custer	102100050103	74901
Custer	102100050103	75216
Custer	102100050103	81370
Custer	102100050103	81381
Custer	102100050103	81496
Custer	102100050103	81575
Custer	102100050103	81657
Custer	102100050103	92813
Custer	102100050104	69713
Custer	102100050104	76500
Custer	102100050104	81578
Custer	102100050104	81656
Custer	102100050105	69595
Custer	102100050105	69718
Custer	102100050105	72420
Custer	102100050105	81531
Custer	102100050201	72653
Custer	102100050202	69760
Custer	102100050202	81605

County	HUC 12	Permit Number
Custer	102100050202	85920
Custer	102100050202	92814
Custer	102100050203	81584
Custer	102100050203	81595
Custer	102100050203	92022
Custer	102100050204	69505
Custer	102100050204	69711
Custer	102100050204	69752
Custer	102100050204	81512
Custer	102100050204	81620
Custer	102100050204	88783
Custer	102100050205	81488
Custer	102100050205	89940
Custer	102100050301	69503
Custer	102100050301	81355
Custer	102100050301	81583
Custer	102100050302	69755
Custer	102100050302	81503
Custer	102100050302	81607
Custer	102100050302	81643
Custer	102100050302	82049
Custer	102100050303	72422
Custer	102100050303	81389
Custer	102100050303	81528
Custer	102100050303	81532
Custer	102100050306	69504
Custer	102100050306	69717
Custer	102100050306	72396
Custer	102100050306	81390
Custer	102100050306	81477
Custer	102100050306	81534
Custer	102100050306	81544
Custer	102100050306	81610
Custer	102100050306	81625
Custer	102100050308	81641
Custer	102100050308	81654
Sherman	102100050205	80830
Sherman	102100050205	80840
Sherman	102100050206	66595
Sherman	102100050206	80831
Sherman	102100050206	80846
Sherman	102100050206	80850
Sherman	102100050206	80856
Sherman	102100050207	66597
Sherman	102100050207	66613
Sherman	102100050207	77809
Sherman	102100050207	77821
Sherman	102100050207	77839
Sherman	102100050207	77845

County	HUC 12	Permit Number
Sherman	102100050307	80854
Sherman	102100050308	66592
Sherman	102100050308	77813
Sherman	102100050308	77826
Sherman	102100050308	80859
Sherman	102100050401	77808
Sherman	102100050401	80829
Sherman	102100050402	66617
Sherman	102100050403	66590
Sherman	102100050403	66618
Sherman	102100050403	77822
Sherman	102100050403	77832
Sherman	102100050403	80833
Sherman	102100050403	80858
Sherman	102100050404	80828
Sherman	102100050405	66601
Sherman	102100050405	77820