PHASE I
WATERSHED ASSESSMENT AND TMDL
FINAL REPORT

LEWIS AND CLARK BASIN,
NEBRASKA AND SOUTH DAKOTA

South Dakota Watershed Protection Program
Division of Financial and Technical Assistance
South Dakota Department of Environment and Natural Resources
Steven M. Pirner, Secretary

April, 2011

SECTION 319 NONPOINT SOURCE POLLUTION CONTROL PROGRAM ASSESSMENT/PLANNING PROJECT FINAL REPORT

LEWIS AND CLARK LAKE WATERSHED ASSESSMENT FINAL REPORT

By

Sponsor

Randall RC & D

This project was conducted in cooperation with the State of Nebraska, the State of South Dakota, and the United States Environmental Protection Agency.

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EXECUTIVE SUMMARY

Project Title: Lewis and Clark Waterhsed Assessment

Project Start Date: March 2003 Project Completion: January 2007

Funding: Total Budget: $289,100.00

Total EPA Grant:	$273,500.00
Total Expenditures of EPA Funds:	$273,500.00
Total Expenditures:	$281,605.09

The Lewis and Clark project began as a result of a local request for assistance formally submitted from the Randall RC &D in January of 2003. Progress towards goal accomplishment was attained from initialization in 2003 through 2005. Completion of this report was delayed until completion of the TMDLs that this watershed assessment also addressed.

The primary goals of the project were to collect data to locate critical portions of watersheds draining to Lewis and Clark Lake as well as collecting data necessary to complete South Dakota TMDLs within the boundaries of the study area. These goals were attained with critical sediment locations and restoration alternatives determined for tributaries to Lewis and Clark Lake as well as the development of TMDLs for the region.

While critical areas were identified and the installation of BMPs will result in significant changes to waterbodies, the overall affects of these BMPs on Lewis and Clark Lake will be relatively insignificant. The volumes of water and natural sources of sediment will mask the majority of BMPs. Restoration activities recommended in this report were done with regard to their impacts on the local waterbody. Little if any impact on the annual loading to Lewis and Clark Lake would be expected as a result of their installation.

The following TMDLs were completed through this study effort. Details of each individual TMDL are contained in separate documents (available from SDDENR at http://denr.sd.gov/dfta/wp/tmdlpage.aspx) addressing the individual impairments:

- Choteau Creek Total Suspended Solids
- Emanuel Creek Total Suspended Solids
- Emanuel Creek Fecal Coliform
- Ponca Creek Total Suspended Solids
- Ponca Creek Fecal Coliform
- Keya Paha Total Suspended Solids
- Keya Paha Fecal Coliform
- Corsica Lake Trophic State

LEWIS AND CLARK WATERSHED

INTRODUCTION

PURPOSE OF STUDY

The main purpose of the Lewis and Clark Assessment was to locate critical sediment producing portions of watersheds draining to Lewis and Clark Lake. Those areas were to be targeted for implementation of BMPs to reduce sediment and nutrient loads. Cooperation with the state of Nebraska was included as a critical component of the study. Sedimentation of Lewis and Clark Lake is the main focus of the assessment, but all relevant TMDLs in the South Dakota portion of the drainage were to be developed as part of the study. The data collected during this assessment provided background information for an implementation plan targeting the critical areas.

Figure 1. Lewis and Clark Watershed below Fort Randall Dam

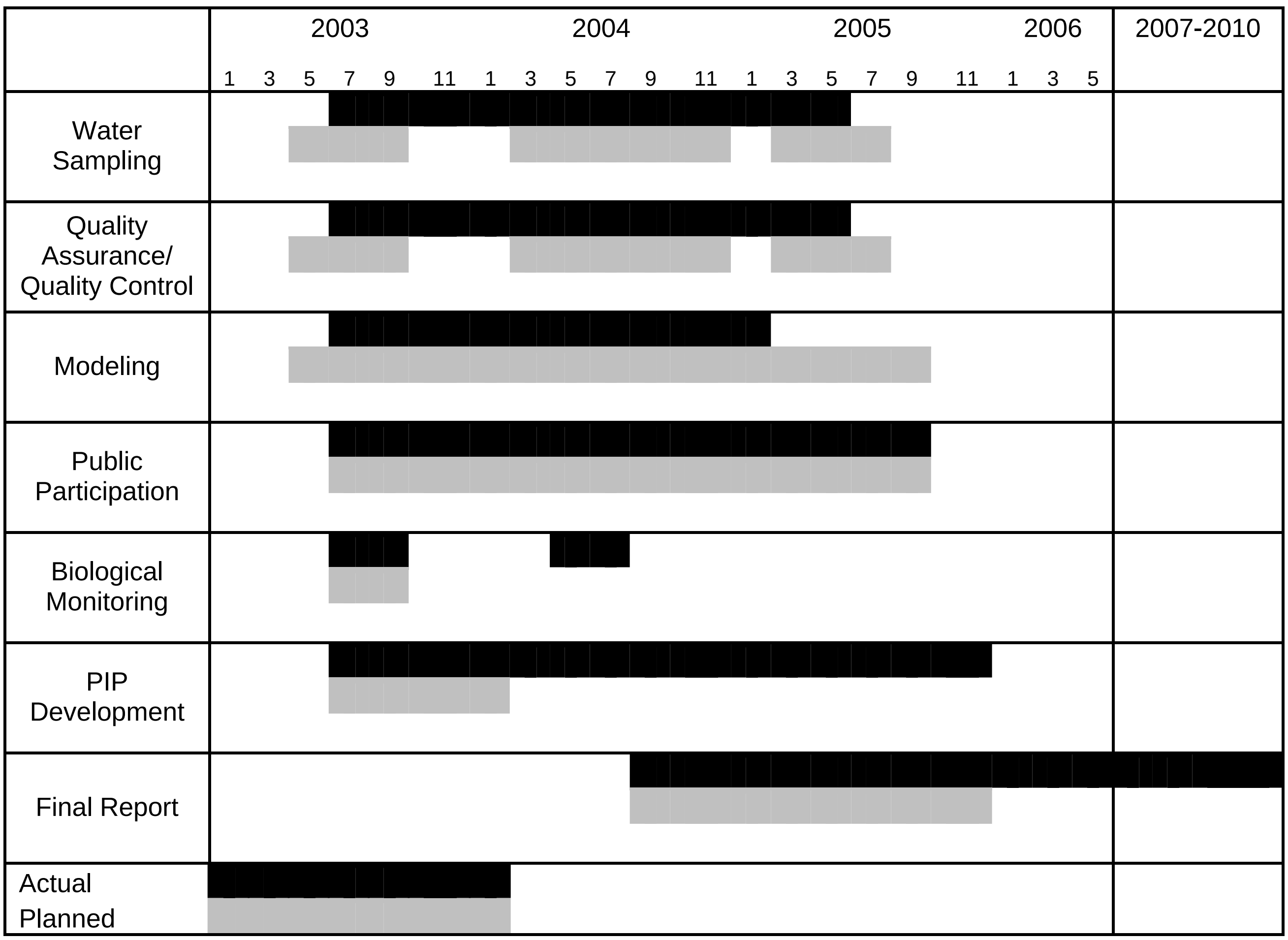
PROJECT GOALS, OBJECTIVES, AND ACTIVITIES

The primary goal of the assessment activities carried out in the Lewis and Clark watershed was to address the source of sediments entering Lewis and Clark Lake and determine the feasibility of reducing the amount of sediment entering the reservoir through best management practices. An additional goal of the project included the development of TMDLs for all impaired waterbodies located within the drainage.

PLANNED AND ACCOMPLISHED MILESTONES

The following table depicts the planned milestones in grey and the actual completion of those objectives in black. The final report task includes the development of the eight TMDL documents

Table 1. Planned and Actual Milestones



Objective 1 Tributary and Lake Sampling

Tributary and lake sampling was conducted from spring of 2003 through spring of 2005. A total of 223 samples were collected through the South Dakota funded portions of the project. An additional 390 samples were collected through projects in Nebraska that were used in some of the analysis in this report. Stream stage and discharge data were also collected and aided in the analysis of the water quality data. The sampling was completed in an acceptable timeframe and a sufficient number of samples from various flows were collected to reach the primary goals of the project.

Objective 2 Quality Assurance and Quality Control

Quality assurance and quality control samples were sufficient in quantity, but fewer in number than required by the states testing procedures. Water quality samples could be assumed to be of good quality and highly accurate allowing for valid result conclusions. Testing personnel routinely become confused between the need for 10% blanks and 10% replicates and collect a total of 10%. A lack of verifiable accuracy for in-situ testing meters also created some issues with the pH of the lakes in the study. While procedures have been implemented at the state level to better track the number of QA/QC samples collected, issues with the meters were not resolved prior to the completion of this report.

Objective 3 Modeling

Due to the size of the watershed below Fort Randall Dam (approximately 10 million acres) some modifications to the standard (for South Dakota) application of the AnnAGNPS model had to be made. Those modifications included using more general soil (STATSGO) and landuse (1992 NLCD) layers, as well as only modeling the lower two-thirds of the drainage; leaving out those portions located in the far western parts of the Niobrara basin. The AnnAGNPS model was completed ahead of schedule, the extra time allowed the data to be supplemented with Rapid Geomorphic Assessments (RGAs), a precursor to the CONCEPTS model. The information from the RGAs will help describe the sediment loading occurring in many of the drainages. The use of the Elevation Derivatives for National Applications (EDNA) model was added after completion of the project as a standardized method for comparing stream flows throughout the basin.

Objective 4 Public Participation

Public participation in all phases of this project was beyond the requirements of the PIP. The involvement of many organizations was facilitated by the Randall RC&D. A website was developed and maintained and project updates and progress were presented at a variety of organizations throughout the region. The details of this may be found in the public involvement section.

Objective 5 Biological Monitoring

Macro invertebrate and habitat data were collected from primary sites in the assessment and analyzed at Natural Resource Solutions in Brookings. The lack of defined reference sites in the state as well as the single sampling occurrence limit what could be inferred from the populations. The data will become more useful as the State’s biological assessment program evolves, not only adding to the archive of collected samples, but in the future may also be analyzed retrospectively to further describe and understand these waterbodies.

Objective 6 Final Report/ TMDL/ and PIP Development

The final report for this project was finished after the predicted deadline with the TMDLs following. Development of a PIP began on schedule during the project and an initial phase of implementation began prior to the completion of the final report. It was expected that after completion of the final report that further implementation plans would be developed and implemented in the South Dakota portion of the watershed.

EVALUATION OF GOAL ACHIEVEMENT

Completion of the overall final report was delayed while the eight individual TMDLs were developed. Each of these TMDLs represented a significant body of work, with the final one receiving approval from EPA in 2010. The remainder of the goals set forth for the assessment were achieved as planned.

MONITORING RESULTS

SURFACE WATER CHEMISTRY (ALL TRIBUTARIES)

FLOW CALCULATIONS

A total of seven tributary sites were selected throughout the watershed. In addition to the seven tributary sites to the Missouri, four additional sites were monitored at the inlets and outlets to Rahn and Roosevelt Dams. Sites were selected to determine the portions of the watershed that were contributing the greatest amounts of sediment and nutrients to Lewis and Clark Lake. All sites were equipped with ISCO 4230 stage recorders or OTT Thalimedes level loggers. Flow measurements were taken using an Aquacalc 5000 and a Model AA flow wheel or a Marsh McBirney Model 201D velocity meter. The stages and flows were then used to create stage-to-discharge tables for each site.

LOAD CALCULATIONS

Load calculations were completed through use of the USGS based Elevation Derivatives for National Applications (EDNA) model. This model calculates average annual flows based on a regional curve and localized rainfall data. The load was then estimated by taking the median of each sample concentration and multiplying it by the average annual flow. This method was chosen based on the following factors; including sample years with below average precipitation, inconsistent rainfall across the watershed, and a lack of a relationship between flow and concentration for some of the parameters. Sample data collected during the project may be found in Appendix B.

TRIBUTARY SAMPLING SCHEDULE

Samples were collected using a suspended sediment sampler from the spring of 2003 to the completion of the project. Water samples were filtered, preserved, and packed in ice for shipping to the State Health Lab in Pierre, SD. The laboratory then assessed the following parameters:

Fecal Coliform Bacteria	Alkalinity
Total Solids	Total Suspended Solids
Ammonia	Total Phosphorus
Total Kjeldahl Nitrogen (TKN)	Total Dissolved Phosphorus
Volatile Total Suspended Solids (VTSS)	Nitrate
E. *coli* Bacteria	

Personnel conducting the sampling at each site recorded visual observations of weather and stream characteristics. The following parameters were observed:

Precipitation	Wind
Odor	Septic Conditions
Dead Fish	Film
Width	Water Depth
Ice Cover	Water Color

Parameters measured in the field by sampling personnel were:

Water Temperature	Air Temperature
Dissolved Oxygen	Field pH
Turbidity	Conductivity

QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance and quality control samples should include a minimum of 10% blanks and 10% replicates or 20% of all samples. While this fact is routinely expressed, sampling personnel frequently collect 10% of total samples for both blanks and replicates combined. This was the case for this project, where 13 blanks and 17 replicates were collected. Blank and replicate samples assist in determining the accuracy and precision of the data collected.

BLANKS

Blank samples for this project routinely had detectable levels of dissolved and or total phosphorus. Most of the detections were at, or slightly above the detection limit resulting in very little affect on the actual sample results. The only other detections came in the form of 2 ammonia hits and 1 nitrate hit, all of which were low enough to have minimal impacts on the results.

Table 2. QA/QC Blank Sample Data

Date	Specimen	Alk	Amm	E COLI	Fecal	Nit	TP	TDP	TSSol	TSol	TKN	VTSS
7/24/2003	E03EC005780	<6	0.05	<1	<10	<0.1	<0.002	0.004	<1	<7	<0.23	<1
7/31/2003	E03EC005968	<6	<0.02	<1	<10	<0.1	<0.002	<0.002	<1	<7	<0.23	<1
4/21/2004	E04EC002114	<6	0.07	<1	<10	<0.1	0.003	0.005	<1	<7	<0.23	<1
5/12/2004	E04EC002623	<6	<0.02	<1	<10	<0.1	0.006	<0.002	<1	<7	<0.23	<1
5/19/2004	E04EC002903	<6	<0.02	<1	<10	<0.1	0.005	0.002	<1	<7	<0.23	<1
6/3/2004	E04EC003322	<6	<0.02	<1	<10	<0.1	<0.002	0.032	<1	<7	<0.23	<1
6/29/2004	E04EC004154	<6	<0.02	<1	<10	<0.1	<0.002	0.002	<1	<7	<0.23	<1
7/29/2004	E04EC005211	<6	<0.02	<1	<10	<0.1	<0.002	<0.002	<1	<7	<0.23	<1
8/19/2004	E04EC005893	<6	<0.02	<1	<10	<0.1	0.002	0.004	<1	<7	<0.23	<1
4/27/2005	E05EC002010	<6	<0.02	<1	<10	<0.1	0.007	<0.002	<1	<7	<0.23	<1
6/15/2005	E05EC003471	<6	<0.02	<1	<10	0.1	0.005	0.005	<1	<7	<0.23	<1
7/7/2005	E05EC004356	<6	<0.02		<10	<0.1	<0.002		<1	<7	<0.23	<1

REPLICATES

Replicate samples indicate the degree of consistency or precision through which samples were collected. While the dataset did fall a few samples short, it is very evident that samples were collected in a very consistent manner. Nearly all of the samples and their replicates had very similar results. Based on the available replicates, it can be assumed that the data was collected in a consistent and reproducible manner. Table 3 lists each sample followed by its replicate.

Table 3. QA/QC Replicate Sample Data

Specimen	Type	Ammonia	E COLI	Fecal	Nitrate	TP	TDP	SusSol	Tsol	TKN	VTSS
E03EC003809	Grab	<0.02	649	650	<0.1	0.075	0.02	32	347	0.41	4
E03EC003810	Rep	<0.02	388	710	<0.1	0.083	0.025	38	346	0.41	6
E03EC004370	Grab	<0.02	272	510	<0.1	0.127	0.025	43	1681	0.42	13
E03EC004371	Rep	<0.02	345	290	<0.1	0.118	0.026	39	1676	0.29	7
E03EC004813	Grab	<0.02	62.2	200	<0.1	0.176	0.028	88	415	0.84	16
E03EC004814	Rep	<0.02	37.6	160	<0.1	0.202	0.03	114	436	0.94	18
E03EC005720	Grab	<0.02	31.4	90	<0.1	0.122	0.025	39	343	0.46	16
E03EC005721	Rep	<0.02	16.4	70	<0.1	0.126	0.016	41	338	0.39	16
E03EC005912	Grab	<0.02	7.4	40	<0.1	0.08	0.016	36	340	0.47	11
E03EC005913	Rep	<0.02	10.8	30	<0.1	0.1	0.012	59	357	0.34	16
E03EC006254	Grab	<0.02	5.1	240	<0.1	0.502	0.236	92	1334	1.25	26
E03EC006253	Rep	<0.02	10.6	230	<0.1	0.492	0.234	82	1324	1.25	22
E03EC007149	Grab	0.11	2420	52000	0.3	0.242	0.083	60	1305	1.1	14
E03EC007150	Rep	0.1	2420	51000	0.3	0.238	0.082	54	1299	0.96	14
E04EC001438	Grab	<0.02	1990	3200	0.1	0.21	0.04	196	466	1.68	20
E04EC001439	Rep	<0.02	2420	3000	0.1	0.217	0.051	162	452	1.67	30
E04EC002110	Grab	<0.02	<1	<10	<0.1	0.088	0.042	10	439	1.43	3
E04EC002111	Rep	<0.02	<1	<10	<0.1	0.093	0.042	11	450	1.47	3
E04EC002620	Grab	<0.02	2420	10000	0.2	0.41	0.024	305	482	2.01	50
E04EC002621	Rep	<0.02	2420	10000	0.2	0.372	0.028	280	485	2.04	50
E04EC002906	Grab	<0.02	3.1	<10	<0.1	0.093	0.053	3	446	1.35	<1
E04EC002907	Rep	<0.02	2	<10	<0.1	0.094	0.052	6	448	1.33	2
E04EC003321	Grab	<0.02	1	<10	<0.1	0.198	0.136	11	535	2.15	7
E04EC003323	Rep	<0.02	<1	<10	<0.1	0.086	0.073	7	422	1.3	5
E04EC004159	Grab	<0.02	4.1	<10	<0.1	0.284	0.193	15	546	1.9	7
E04EC004155	Rep	<0.02	2	<10	<0.1	0.261	0.194	15	542	1.96	8
E04EC005213	Grab	<0.02	2	<10	<0.1	0.378	0.213	22	550	3.21	15
E04EC005210	Rep	<0.02	3.1	30	0.4	0.376	0.224	21	553	3.21	15
E04EC005892	Grab	<0.02	3.1	10	<0.1	0.383	0.25	17	555	2.63	12
E04EC005894	Rep	<0.02	5.2	10	<0.1	0.387	0.264	16	551	2.77	9
E05EC001684	Grab	<0.02	488	240	<0.1	0.065	0.024	10	428	0.52	1
E05EC001683	Rep	<0.02	365	220	<0.1	0.061	0.025	11	424	0.54	5
E05EC003469	Grab	<0.02	308	300	<0.1	0.414	0.412	1	285	1.85	<1
E05EC003468	Rep	<0.02	250	230	<0.1	0.45	0.421	1	282	1.77	1

The water quality portion of the QA/QC samples indicate high levels of both precision and accuracy, there is a lack of methodology for verifying the accuracy of measurements collected with calibrated meters. Problems with pH values arose during the analysis of the data and a lack of documentation or processes through which to verify the accuracy of the meter resulted in difficulties in developing an appropriate TMDL.

A potential solution to this problem would be to implement a secondary testing procedure when violations of the state standards are encountered. In particular, pH could have been tested by the State Health Lab to verify the values. Additional checks could include recalibrating instruments or sending standards to the State Health Lab to verify accuracy.

ANNUAL LOADINGS

Loadings for Lewis and Clark Lake were calculated using the EDNA model in association with sample concentrations, contained in Table 4. Seasonal loadings are heavily influenced by runoff events that primarily occur during the spring.

Table 4 contains the EDNA derived average annual discharges (CMS), the number of samples collected during the project period, EDNA derived drainage area, median sample concentration, and the calculated loads and discharge coefficients based on these values. The section titled "Upstream Sites Subtracted" assumes that 100% of upstream loads are delivered downstream and subtracts the upstream load from the downstream load. Highlighted sites are those that discharge directly into Lewis and Clark Lake.

Table 4. Sediment Loading Sources and Export Coefficients

Site	Site Totals						Upstream Sites Subtracted		
	CMS	Sample Count	Area (KM2)	Sample Conc. Mg/L	Tons/ yr	Tons/ Km2	Local Load	Local Tons/ Km2	Local Area
Verdigree Creek @ Verdigree	**2.27**	**23**	**1363**	**118**	**9311**	**6.83**	**9311**	**6.83**	**1363**
Bone Creek @ Keller Park	**0.64**	**23**	**396**	**75**	**1669**	**4.21**	**1669**	**4.21**	**396**
Eagle Creek @ Oniell	0.39	23	197	53	719	3.65	719	3.65	197
Keya Paha @ Naper	4.8	23	4379	74	12348	2.82	4396	3.00	1465
Keya Paha @ Wewela (LAC2)	3.05	24	2914	75	7952	2.73	4570	2.97	1537
Long Pine @ Riverview	1.87	23	1282	52	3380	2.64	1159	4.26	272
Niobrara @ Verdel	**21.38**	**23**	**33205**	**116**	**86214**	**2.60**	**32622**	**12.41**	**2628**
Keya Paha @ Keya Paha (LAC1)	1.40	28	1377	69.5	3382	2.46	3382	2.46	1377
Emanuel (LAC6)	0.88	24	479	34	1040	2.17	1040	2.17	479
Choteau (LAC5)	2.42	20	2201	48.5	4080	1.85	4080	1.85	2201
Niobrara @ Mariaville	**15.14**	**23**	**26001**	**77**	**40525**	**1.56**	**23754**	**11.98**	**1983**
Snake @ Doughboy	0.92	23	1082	51	1631	1.51	1631	1.51	1082
Ponca @ State Line (LAC3)	1.83	18	971	23	1463	1.51	1463	1.51	971
Minnecheduza @ Valentine	0.93	23	978	44	1422	1.45	1422	1.45	978
Snatch (LAC7)	0.26	19	119	15	136	1.14	136	1.14	119
Long Pine @ State Rec Area	1.03	23	614	8.5	553	0.90	553	0.90	614
Slaughter (LAC4)	0.26	12	121	12	108	0.90	108	0.90	121
Plum Creek North Johnstown	1.37	23	1090	13.5	643	0.59	551	0.68	815
Niobrara @ Spark	11.46	23	21646	32	12748	0.59	2497	0.69	3617
Niobrara @ Nenzel	7.5	22	15488	32.75	8539	0.55	3338	0.87	3821
Niobrara @ Gordon	5.44	23	11667	27.5	5200	0.45	5200	0.45	11667
Plum Creek West Johnstown	0.44	23	275	6	92	0.33	92	0.33	275
*Snake Below Merrtt**	*1.39*	*23*	*1563*	*6*	*290*	*0.19*	*-1341*	*-2.79*	*481*
Ponca @ Verdel	3.44	Estimated	2105	Estimated	3179	1.51	1715	1.51	1134
Missouri	245.64	23	666332	5	42696	0.06	42696	0.06	666332

* Merrtt Reservoir acts as a sediment trap significantly reducing the sediment load from the Snake River

The data suggests that the vast majority of the sediment load originates from the lower portions of the Niobrara River, downstream of Sparks, and including the drainage areas of Verdigree and Bone Creeks.

Calculated loadings from this study (Figure 2) closely match estimates calculated by the US Army Corp of Engineers. "Sediment entering Lewis and Clark Lake is generated from major tributaries, small drainages, bed scour below Fort Randall Dam, and bank erosion along the Missouri River and Lewis and Clark Lake. Studies indicate that the Niobrara River is the source of most of the sediment, about 55%. Approximately 35% is split evenly between the Missouri River upstream of Ponca Creek, Ponca Creek, Bazile Creek, and erosion and drainages around Lewis and Clark Lake. The remaining 10% comes from other sources such as Choteau Creek, Emanuel Creek, and minor drainage's"(USACE, 2001). Strong agreement with the ACE loads indicates that the generalized methods used in this assessment produce valid results that allow for comparisons between the watersheds.

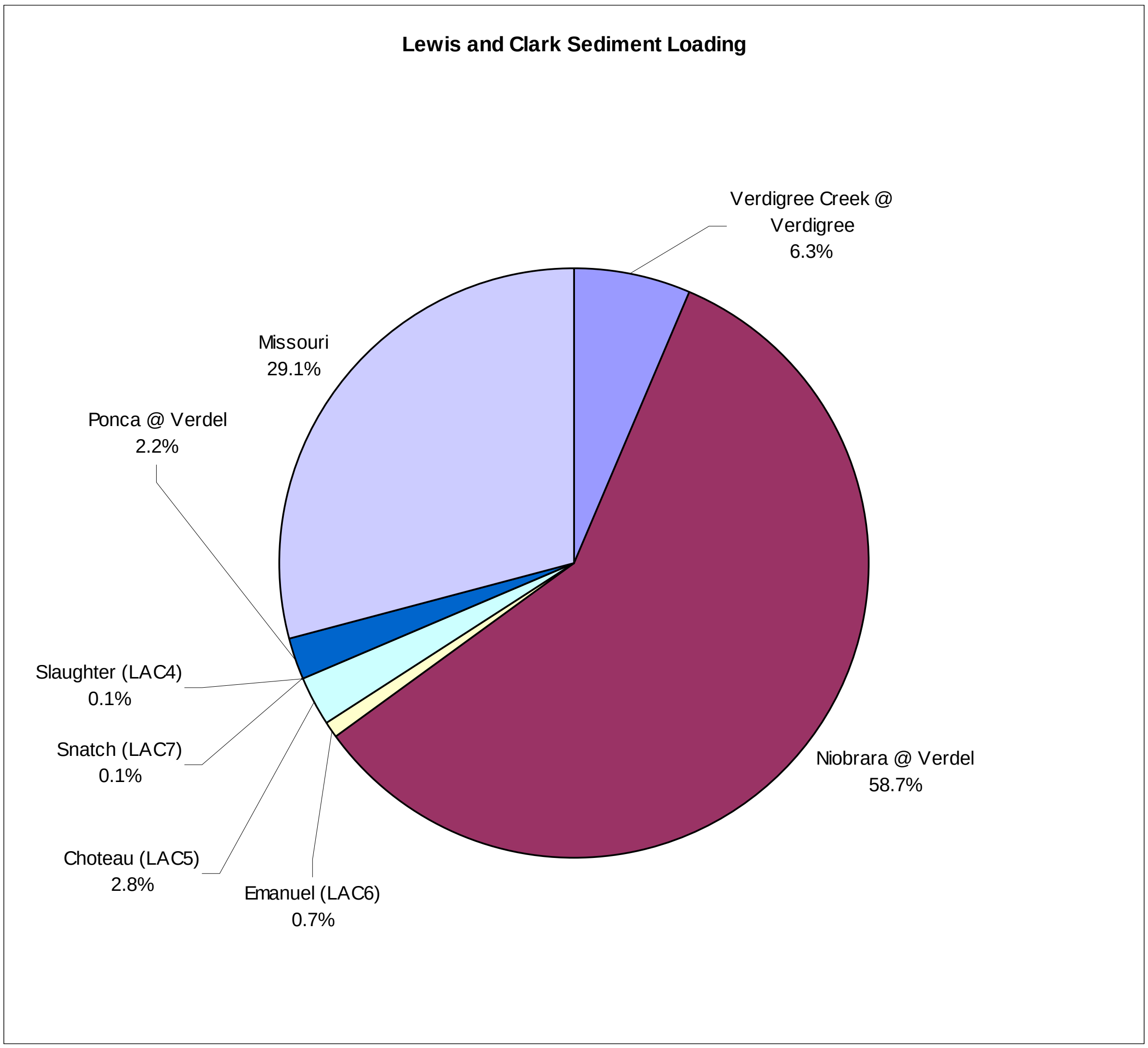


Figure 2. Sediment Loads to Lewis and Clark Reservoir

SURFACE WATER CHEMISTRY (KEYA PAHA RIVER)

Watershed Overview

The Keya Paha River drains over 1 million acres in south central South Dakota and discharges to the Niobrara River in Nebraska. The river receives runoff from agricultural operations, and experiences periods of degraded water quality due to total suspended solids concentrations. The land use in the watershed is predominately agricultural consisting of cropland (42%) and grazing (57%), with the remaining 1% of the watershed composed of water and wetlands, roads and housing, and forested lands. These percentages are considered representative of both the watershed as a whole, as well as the drainage area immediately surrounding the listed segment. The contributing drainage area is composed of 17% Nebraska Lands, 50% Tripp County SD Lands, and 33% Todd County SD Lands.

Segment SD-NI-R-KEYA_PAHA_01 is listed for fecal coliform bacteria and total suspended solids. The listed segment stretches across the boundary between Tripp County and the Rosebud Reservation. The majority of the segment is in Tripp County, this document focuses strictly on the portions of the reach that are located in Tripp County (see Figure 4).

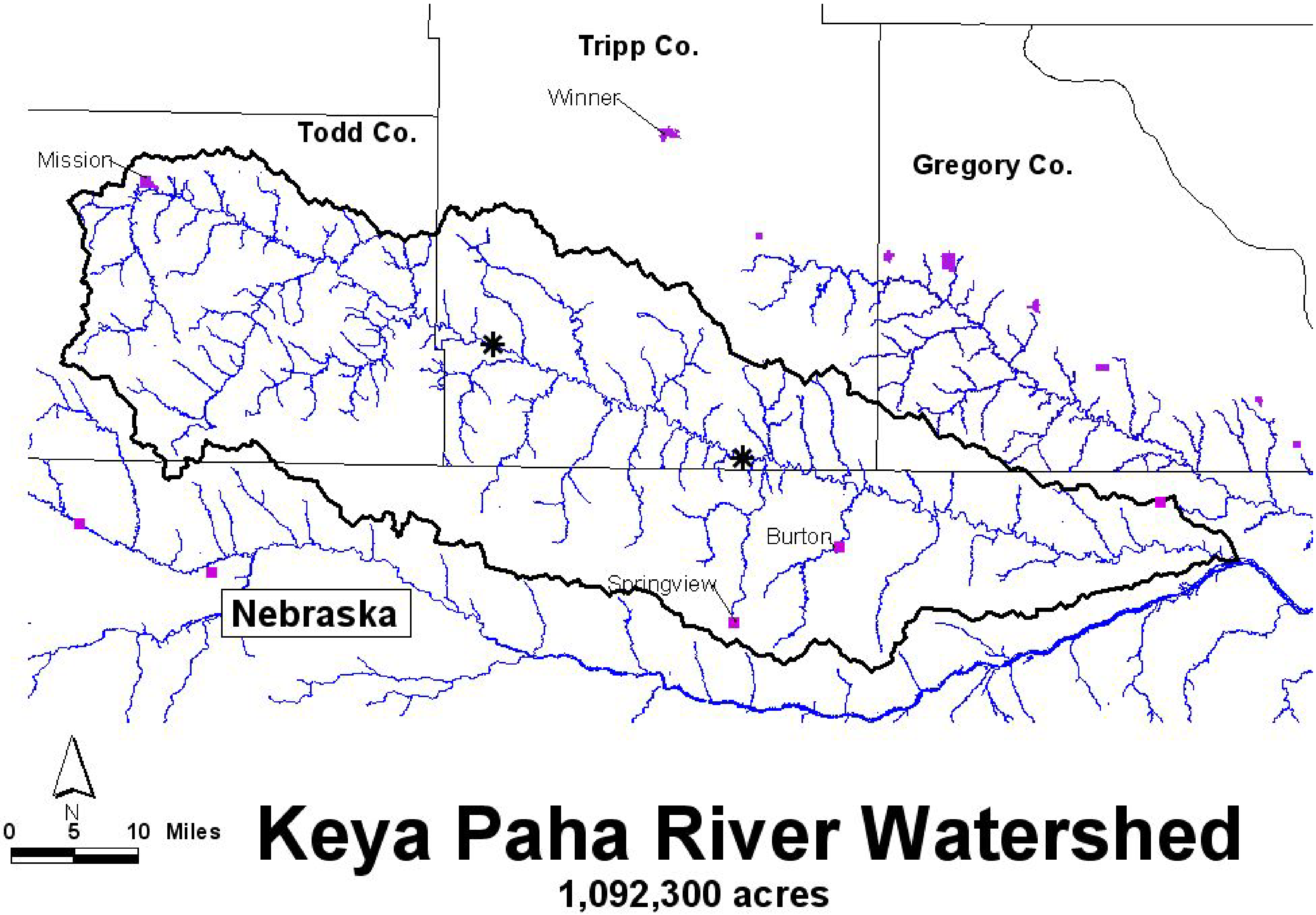


Figure 3. Keya Paha River Watershed from its Confluence with the Niobrara

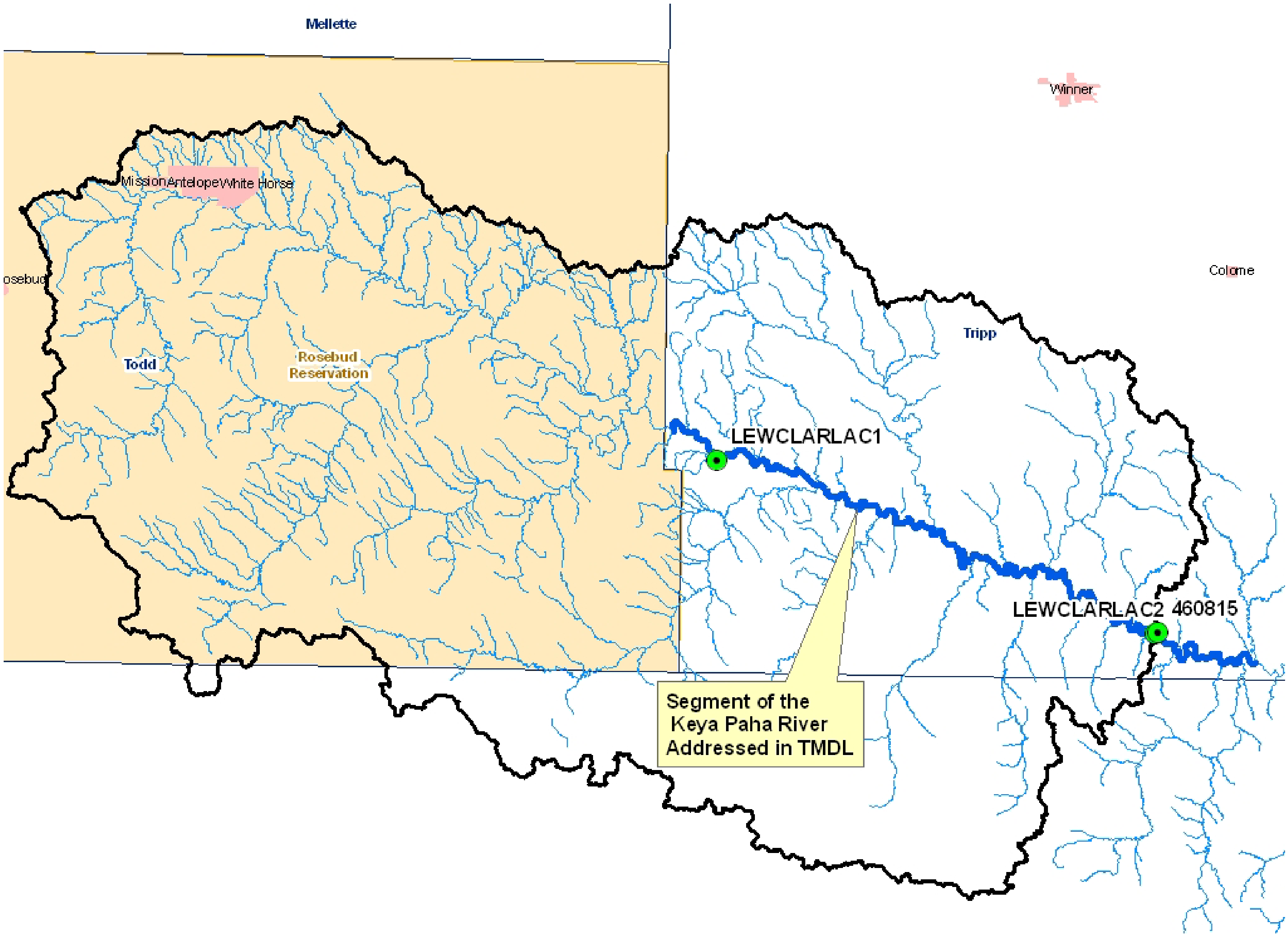


Figure 4. Segment of the Keya Paha Addressed in TMDL

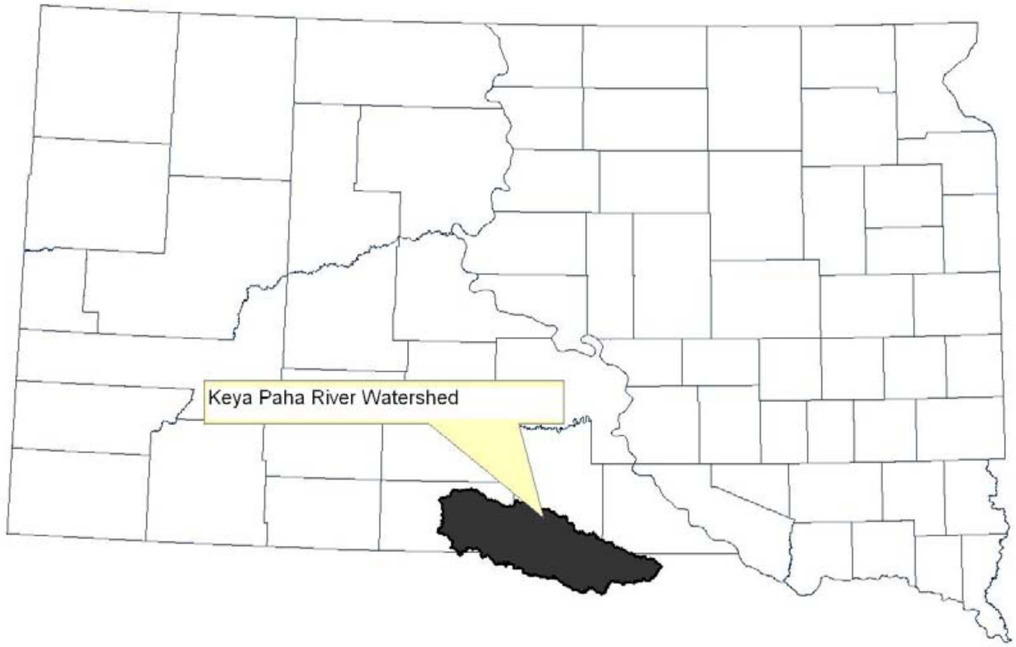


Figure 5 Keya Paha Watershed Location in South Dakota

South Dakota Water Quality Standards

Each waterbody within South Dakota is assigned beneficial uses. All waters (both lakes and streams) are designated the use of fish and wildlife propagation, recreation and stock watering. All streams are assigned the use of irrigation. Additional uses are assigned by the state based on a beneficial use analysis of each waterbody. Water quality standards have been defined in South Dakota state statutes in support of these uses. These standards consist of suites of numeric criteria that provide physical and chemical benchmarks from which management decisions can be developed.

The Keya Paha River from its confluence with Antelope Creek to the Nebraska border has been assigned the beneficial uses of: domestic water supply, warmwater semi-permanent fish life propagation; irrigation waters, limited contact recreation; and fish and wildlife propagation; recreation, and stock watering. Table 5 lists the criteria that must be met to support the specified beneficial uses. When multiple criteria exist for a particular parameter, the most stringent criterion is used.

Table 5. State Water Quality Standards for Keya Paha River.

Parameters	Criteria	Unit of Measure	Beneficial Use Requiring this Standard
Total ammonia nitrogen as N	Equal to or less than the result from Equation 3 in Appendix A of Surface Water Quality Standards	mg/L 30 average May 1 to October 31	Warmwater Semipermanent Fish Propagation
	Equal to or less than the result from Equation 4 in Appendix A of Surface Water Quality Standards	mg/L 30 average November 1 to April 31	
	Equal to or less than the result from Equation c in Appendix A of Surface Water Quality Standards	mg/L Daily Maximum	
Dissolved Oxygen	≥4.0	mg/L	Warmwater Semipermanent Fish Propagation
Total Suspended Solids	≤90 (mean) ≤158 (single sample)	mg/L	Warmwater Semipermanent Fish Propagation
Temperature	≤32	°C	Warmwater Semipermanent Fish Propagation
Fecal Coliform Bacteria (May 1- Sept 30)	≤1000 (geometric mean) ≤2000 (single sample)	count/100 mL	Limited Contact Recreation
Alkalinity ($CaCO_3$)	≤750 (mean) ≤1,313 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Conductivity	≤2,500 (mean) ≤4,375 (single sample)	µmhos/cm @ 25° C	Irrigation Waters
Nitrogen, nitrate as N	≤10	mg/L	Domestic Water Supply
pH (standard units)	≥6.5 to ≤9.0	units	Domestic Water Supply
Solids, total dissolved	≤1,000 (mean) ≤1,750 (single sample)	mg/L	Domestic Water Supply
Total Petroleum Hydrocarbon Oil and Grease	≤10 ≤10	mg/L	Wildlife Propagation and Stock Watering
Sodium Adsorption Ratio	<10	ratio	Irrigation Waters
Total Coliform	≤5,000 (mean) ≤20,000 (single sample)	count/100 mL	Domestic Water Supply
Barium	≤1.0	mg/L	Domestic Water Supply
Chloride	≤250	mg/L	Domestic Water Supply
Fluoride	≤4.0	mg/L	Domestic Water Supply
Sulfate	≤500 (mean) ≤875 (single sample)	mg/L	Domestic Water Supply
Total Petroleum Hydrocarbon	≤1.0	mg/L	Domestic Water Supply

Water Quality Results

WATER CHEMISTRIES MEETING STATE STANDARDS

The parameters summarized in Table 6 were measured during the assessment and found to fully support the beneficial uses of the Keya Paha River. Complete sample data may be found in Appendix B.

Table 6. Keya Paha River Water Quality Data

		Alkalinity	Specific Conductivity	Ammonia	Nitrogen as Nitrate	TKN	pH	Dissolved Oxygen	Phosphorus
LAC1	High (mg/L)	257	437	0.10	0.4	2.31	8.51	11.31	0.63
	Low (mg/L)	87	388	<0.02	<0.1	<0.11	7.73	8.08	0.042
	Average (mg/L)	209	411	<0.02	0.1	0.9	8.32	9.84	0.2
LAC2	High (mg/L)	251	448	<0.02	0.2	2.09	8.53	11.64	2.86
	Low (mg/L)	164	362	<0.02	<0.1	0.19	7.66	7.97	0.055
	Average (mg/L)	213	420	<0.02	<0.1	0.65	8.28	9.32	0.3

WATER TEMPERATURE

Water temperatures were collected 33 times from the two separate sites. The state standard of 32^{o} C was surpassed on a single occasion at site LAC2 on August, 20, 2003 with a value of 32.8^{o} C. All remaining samples were a full two degrees or more below the standard. This indicates full support of beneficial uses for temperature in the Keya Paha River.

SOLIDS

Analytical results from total suspended solids sampling suggests that the acute standard of 158 mg/L is exceeded approximately 15% of the time and the chronic standard of 90 mg/L approximately 30% of the time. The violations appear to be storm event driven with the highest concentrations occurring during high flow events. Table 7 represents the samples collected from the Keya Paha River at the downstream site. There are no municipalities or other point sources that discharge to the river. All of the loads are nonpoint source in nature.

Table 7 Keya Paha River Total Suspended Solids Samples at sites LAC2 and 460815

Date	Tot Sus Sol (mg/L)	Discharge (cfs)	Date	Tot Sus Sol (mg/L)	Discharge (cfs)	Date	Tot Sus Sol (mg/L)	Discharge (cfs)
03/27/1969	135	450	03/28/1979	685	199	07/20/1994	100	45
10/30/1973	17	46	04/12/1979	150	188	10/19/1994	64	49
03/21/1974	61	54	05/15/1979	55	105	01/20/1995	7	29
04/23/1974	60	77	06/19/1979	1000	197	04/20/1995	178	305
06/04/1974	58	31	07/05/1979	114	75	07/18/1995	126	75
07/23/1974	30	6	08/22/1979	58	29	10/17/1995	76	102
08/27/1974	20	5.9	09/19/1979	31	19	01/24/1996	9	74
09/23/1974	30	14	10/12/1979	17	25	04/16/1996	114	223
10/29/1974	9	22	01/28/1980	17	40	07/10/1996	120	63
11/19/1974	17	26	04/15/1980	75	84	10/21/1996	34	91
12/17/1974	3	17	07/25/1980	12	5.6	01/21/1997	92	164
01/27/1975	5	17	10/16/1980	86	23	04/21/1997	154	513
02/25/1975	98	16	01/13/1981	6	19	07/22/1997	26	79
03/18/1975	30	65	04/23/1981	31	33	10/22/1997	55	89
04/22/1975	63	68	04/20/1982	20	70	01/26/1998	20	99
05/21/1975	31	30	05/06/1982	3	47	04/20/1998	171	150
07/23/1975	829	74	07/19/1982	200	90	07/20/1998	168	65
08/19/1975	76	7.4	10/19/1982	60	90	10/19/1998	226	187
09/22/1975	47	13	01/18/1983	22	100	01/20/1999	352	100
10/15/1975	23	15	04/26/1983	92	89	04/21/1999	123	208
11/25/1975	8	3	07/19/1983	248	620	07/21/1999	184	78
12/16/1975	82	6	10/18/1983	31	42	10/28/1999	30	64
01/08/1976	17	10	01/17/1984	16	35	01/11/2000	24	80
02/12/1976	20	70	04/17/1984	136	481	04/17/2000	67	88
03/23/1976	24	49	07/17/1984	155	51	07/19/2000	128	75
04/21/1976	32	34	10/17/1984	154	42	10/10/2000	40	42
05/25/1976	41	54	04/16/1985	60	94	01/08/2001	15	35
06/24/1976	59	11	06/26/1985	50	39	04/16/2001	520	329
07/22/1976	20	1.2	07/16/1985	34	17	07/09/2001	246	144
09/16/1976	67	11	10/22/1985	12	38	10/22/2001	38	52
10/21/1976	8	11	01/22/1986	14	40	01/07/2002	7	65
11/04/1976	7	14	04/22/1986	162	271	04/01/2002	960	396
12/22/1976	9	8	07/14/1986	88	46	07/15/2002	53	22
01/19/1977	14	3	01/19/1987	16	52	10/15/2002	15	26
02/24/1977	8	18	04/13/1987	432	387	01/07/2003	17	49
03/31/1977	111	239	07/13/1987	168	185	04/15/2003	92	71
04/21/1977	265	605	10/19/1987	24	46	07/15/2003	70	26
05/19/1977	59	124	11/02/1988	23	45	10/14/2003	23	22
06/23/1977	102	97	04/17/1989	26	76	01/13/2004	10	24
07/21/1977	88	43	07/19/1989	180	35	04/13/2004	32	58
08/18/1977	60	36	10/18/1989	20	28	07/13/2004	94	28
09/20/1977	22	26	01/16/1990	4	45	10/12/2004	23	30
10/18/1977	41	40	04/17/1990	56	43	10/12/2004	21	30
11/23/1977	20	50	07/17/1990	160	44	01/11/2005	5	44
12/19/1977	9	32	10/16/1990	28	31	04/12/2005	180	105
01/18/1978	12	19	01/23/1991	14	5.5	04/12/2005	172	105
02/27/1978	18	19	04/16/1991	84	91	07/12/2005	84	41
03/29/1978	255	249	07/17/1991	100	28	07/12/2005	84	41
04/19/1978	375	595	10/22/1991	20	31	10/18/2005	19	27
05/16/1978	26	111	01/22/1992	6	32	01/26/2006	41	55
06/20/1978	74	57	04/07/1992	40	50	01/26/2006	40	55
07/19/1978	104	40	07/21/1992	164	70	04/13/2006	134	168
08/29/1978	48	24	10/20/1992	10	33	07/25/2006	23	15
09/19/1978	60	23	01/20/1993	11	16	09/30/2006	20	30
10/18/1978	29	26	04/20/1993	272	251	01/16/2007	3	26
11/29/1978	10	26	07/20/1993	92	51	04/17/2007	49	100
12/19/1978	13	24	10/19/1993	26	44	07/18/2007	68	28
01/17/1979	16	3.5	01/20/1994	18	27	10/15/2007	176	67
02/14/1979	170	5	04/18/1994	50	81			

The suspended solids load calculated from the water quality data for this project was approximately 7,952 tons/year for the downstream site. This was calculated based on an EDNA water load of 3.05 m^3/s and an average TSS concentration of 75 mg/L (75 mg/L was based on 24 samples collected during the project period, this was done to make the data more comparable to data collected in Nebraska during the same time period). This load is higher than the median sediment production rate for the rest of the Lewis and Clark basin. The rate of erosion for this site is equal to 2.73 tons/km^2.

The upstream site (LAC1) generated a load of 3,382 tons/ year based on 28 samples with a sample concentration of 69.5 mg/L and an EDNA water load of 1.4 m^3/s. The resulting rate of erosion is 2.46 tons/km^2. Further comparison of these sites may be found in Table 8. Average suspended solids concentrations, volatile solids concentrations, and the percent volatile all indicate that the water quality changes very little between the two sites.

Table 8. Solids Data collected during the Lewis and Clark Assessment for Sites LAC1 and LAC2

Site	Sample Date	Solids (Suspended) mg/L	VTSS mg/L	% Volatiles	Site	Sample Date	Solids (Suspended mg/L)	VTSS mg/L	% Volatiles
LAC1	06/10/2004	352	60	17%	LAC 2	06/25/2003	272	40	15%
LAC1	05/12/2004	305	50	16%	LAC 2	06/15/2005	252	32	13%
LAC1	05/12/2004	280	50	18%	LAC 2	03/29/2004	232	32	14%
LAC1	04/13/2005	220	38	17%	LAC 2	04/26/2005	196	20	10%
LAC1	06/15/2005	210	28	13%	LAC 2	05/13/2004	166	28	17%
LAC1	03/29/2004	196	20	10%	LAC 2	06/10/2004	156	32	21%
LAC1	03/29/2004	162	30	19%	LAC 2	08/20/2003	136	26	19%
LAC1	04/27/2005	123	15	12%	LAC 2	06/16/2003	118	26	22%
LAC1	06/25/2003	114	18	16%	LAC 2	07/01/2003	114	18	16%
LAC1	06/16/2003	100	24	24%	LAC 2	04/13/2005	104	19	18%
LAC1	07/01/2003	96	18	19%	LAC 2	05/16/2003	92	22	24%
LAC1	05/13/2004	96	17	18%	LAC 2	07/01/2003	88	16	18%
LAC1	06/09/2004	84	24	29%	LAC 2	06/09/2004	62	18	29%
LAC1	07/10/2003	70	8	11%	LAC 2	07/17/2003	61	13	21%
LAC1	05/16/2003	69	12	17%	LAC 2	06/11/2003	57	14	25%
LAC1	07/30/2003	59	16	27%	LAC 2	05/12/2004	57	10	18%
LAC1	06/11/2003	46	11	24%	LAC 2	05/20/2003	50	7	14%
LAC1	05/20/2003	43	6	14%	LAC 2	07/23/2003	49	19	39%
LAC1	07/23/2003	41	16	39%	LAC 2	05/29/2003	45	9	20%
LAC1	07/23/2003	39	16	41%	LAC 2	06/05/2003	42	4	10%
LAC1	06/05/2003	38	6	16%	LAC 2	07/30/2003	38	15	39%
LAC1	07/30/2003	36	11	31%	LAC 2	08/07/2003	31	5	16%
LAC1	05/29/2003	35	4	11%	LAC 2	08/13/2003	25	6	24%
LAC1	08/07/2003	35	5	14%	LAC 2	08/26/2003	23	6	26%
LAC1	06/05/2003	32	4	13%					
LAC1	08/13/2003	21	6	29%					
LAC1	08/26/2003	19	3	16%					
LAC1	08/20/2003	14	6	43%					
Average		**105**	**19**	**20%**	**Average**		**103**	**18**	**20%**

AnnAGNPs analysis of the subwatersheds in the Keya Paha basin indicates low rates of sediment production for a majority of the basin when compared to the greater Lewis and Clark drainage (Table 9). Figure 6 depicts a relative ranking with the subwatersheds that the model suggested were producing higher erosion rates (as compared against other drainages within the Keya Paha drainage and not against the greater Lewis and Clark basin) represented by darker shading.

Table 9. Results of AnnAGNPS modeling expressed by grouping sub-tributaries according to geographic area or "parent" tributary

Trib./ General Area	# of subwatersheds	Drainage area (acres)	Sediment prod. (tons)	Tons/acre
Ponca Creek	28	324,287	372,542	1.15
East River area (SD)	21	592,444	589,553	1.01
Keya Paha River	32	629,121	180,005	0.28
Niobrara River	21	2,386,284	144,809	0.06
Santee area (NE)	2	311,287	1,208,402	3.88

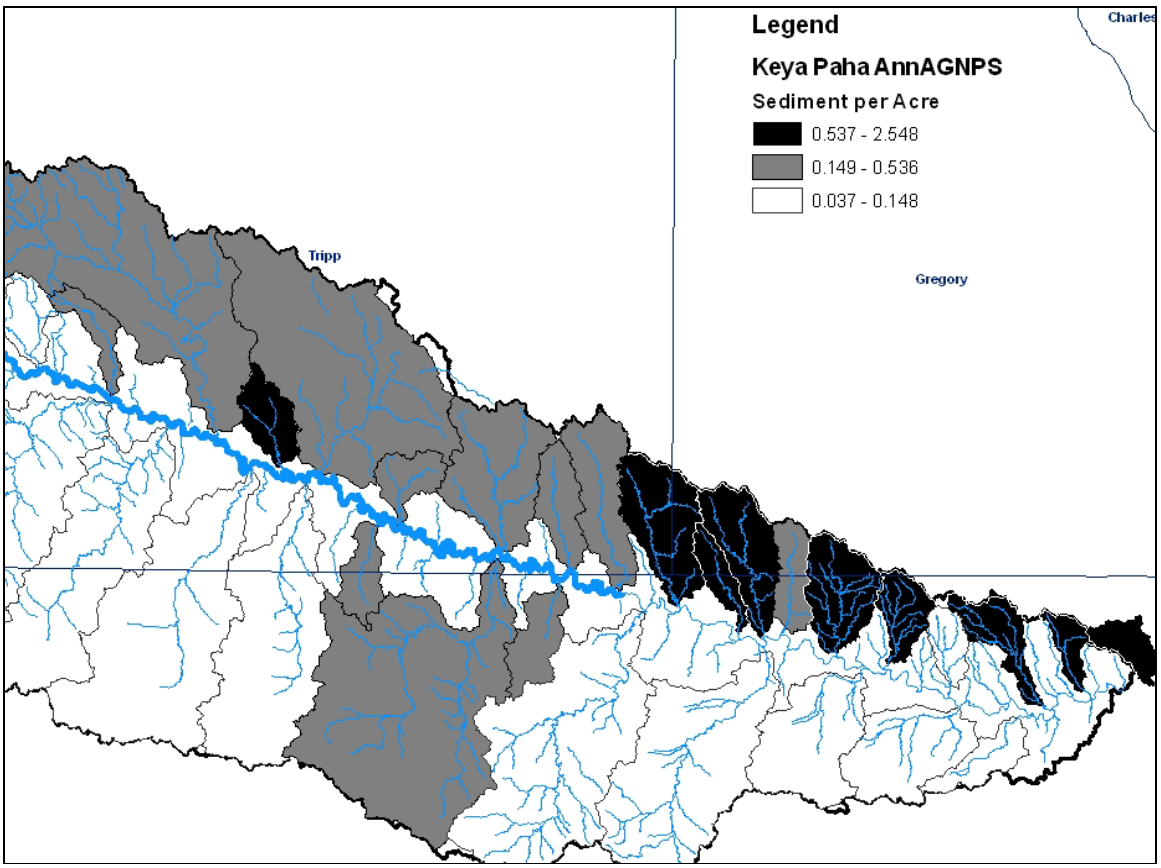


Figure 6. Keya Paha AnnAGNPS

Rapid Geomorphic Assessments (RGAs) were completed at 23 sites within the Keya Paha basin. Figure 7 depicts the areas where RGAs were completed with the AnnAGNPS results shaded. The results were broken into stable and unstable stream channels with approximately 12% of the sites ranking as unstable. The three unstable sites were located on tributaries.

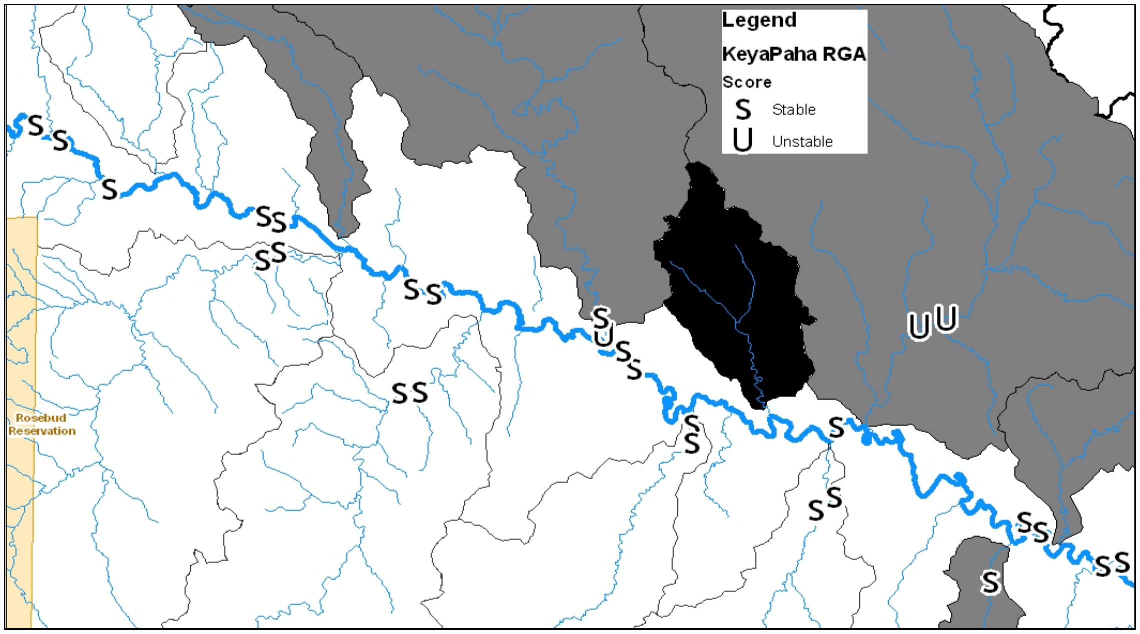


Figure 7. Keya Paha RGA Locations

The primary elements considered when allocating sources within the Keya Paha watershed were predicted sheet and rill erosion loads, potential for bank failure based on RGA assessment, and the natural soil conditions of both the listed segment as well as upstream contributions.

Sheet and rill erosion from the Keya Paha watershed was predicted by the AnnAGNPS model to be less than many of the other watersheds in the Lewis and Clark basin. There may be several factors contributing to this, but the primary reason suspected is the high percentage of native range, in particular in locations that may be more erosion prone.

The RGA analysis indicated a relatively stable channel. Aggravated banks on the outsides of the meanders were common, as were old meander scars on the floodplain indicating that the river has moved frequently over time. The primary soils through the stream corridor consist of the Invale Cass associations. These soils are characterized by loamy fine sands overlying fine to medium sands. These types of soils are typically non-cohesive and are more prone to failures, which is evident in the frequency of meander scars (See Figure 8). Particle size data collected by the USGS is insufficient to conduct analysis, but it does suggest that the high sand content in the streams bed and banks mobilizes during higher velocity events.

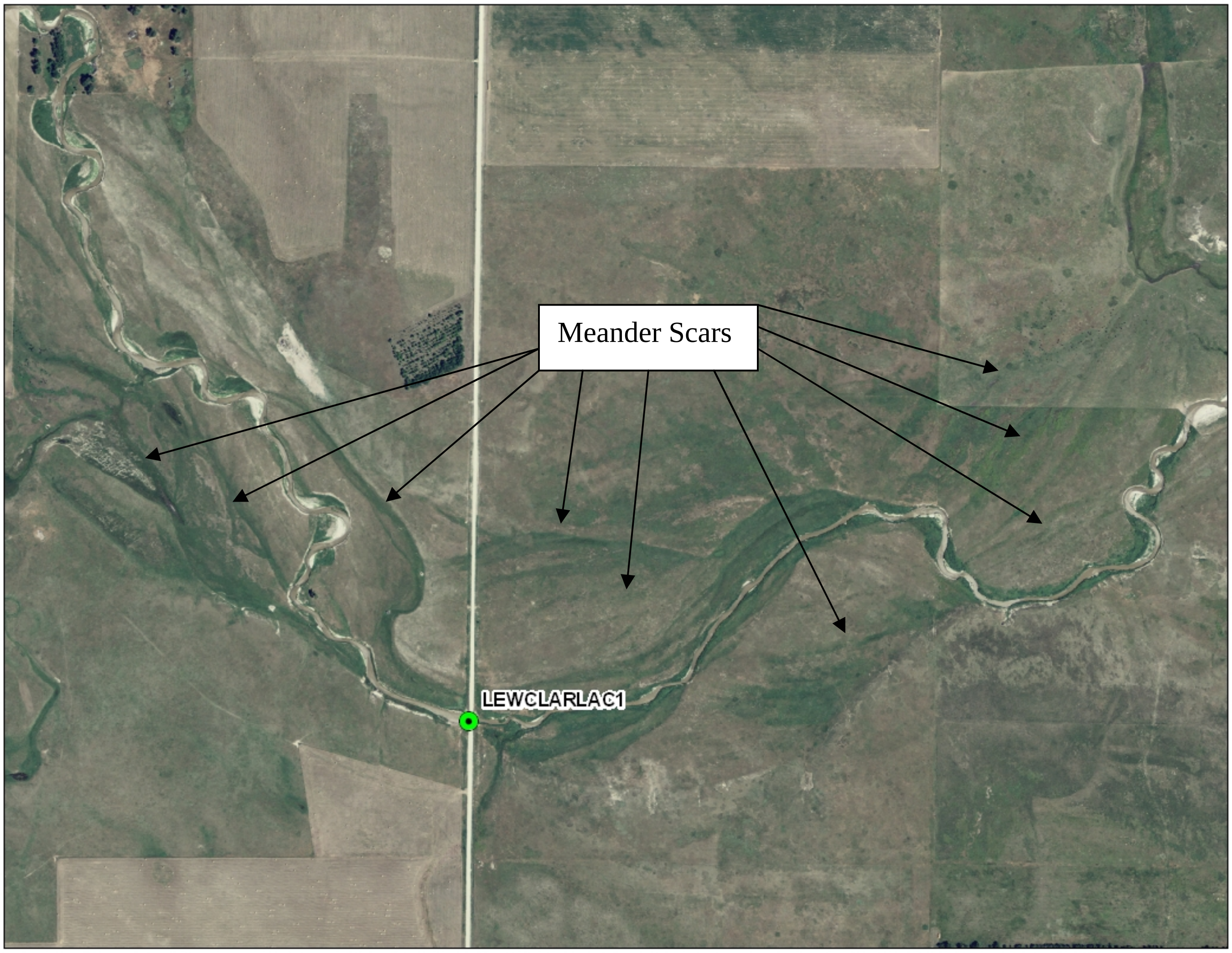


Figure 8. Aerial Photo of Site LAC1 with Numerous Channel Meander Scars Evident

Examination of the upstream and downstream (sites LAC1 vs. LAC2) concentrations and loads indicate that erosion rates are consistent throughout the entire basin suggesting no particular source is generating excessive loads. BMPs may be able to improve the condition of several tributaries, particularly those that scored poorly in the RGAs. This information taken in aggregate suggests that concentrations measured in the Keya Paha River are natural occurrences and that the current state standard may not be an appropriate measure for this stream.

BACTERIA

Table 10 is a summary of all available data collected from sites LAC1 and LAC2 during the project in addition to all of the WQM data that had been collected at the site since 1968. The table also indicates the average daily flow from the date that each of the samples was collected.

Analytical results from fecal coliform bacteria sampling exceeded the acute standard (2000 colonies/ 100mL) on nine of the 123 samples or 7% of the time. The violations do not appear to be storm event driven. Elevated and excessive concentrations were measured at a variety of flows. Similarly, when the data were examined for seasonal patterns, elevated concentrations were found throughout the growing season. Twenty of the 123 samples or 16% of the samples were above the chronic standard of 1000 colonies/ 100mL. It is important to note that the stream did not violate the chronic standard 16% of the time (samples were not collected within 30 days of each other); the waterbody was at risk of exceeding the chronic standard 16% of the time.

Flow data (Figure 9) were obtained from a nearby USGS gauging station (Station number 06464500, Keya Paha River at Wewela, SD). The extended gauge record available at this site provided sufficient data for the development of a load duration curve, located in the TMDL and Allocations for Fecal Coliform Bacteria section of this report.

South Dakota has adopted *Escherichia coli* criteria for the protection of the limited contact and immersion recreation uses. The Keya Paha Riverwas not listed as impaired for . *E. coli*. Because the two indicators are closely related, the fecal coliform bacteria TMDL and associated implementation strategy described in this document are expected to address both the fecal coliform bacteria and possible future *E. coli* impairments. BMPs targeting fecal coliform will ultimately result in reductions to any *E. coli* in the system as well, resulting in additional protection of the resource.

Table 10. Fecal Coliform Samples (Highlighted samples are in excess of the chronic standard and bolded samples are in excess of the acute standard)

Date	Station	Fecal Count	Flow	Date	Station	Fecal Count	Flow	Date	Station	Fecal Count	Flow
05/22/1968	460815	85	72	09/20/1977	460815	140	26	04/16/1985	460815	80	94
03/27/1969	460815	0	450	10/18/1977	460815	60	40	07/16/1985	460815	870	17
12/13/1972	460815	20	18	11/23/1977	460815	5	50	10/22/1985	460815	40	38
10/30/1973	460815	10	46	01/18/1978	460815	7	19	01/22/1986	460815	30	40
03/21/1974	460815	5	54	02/27/1978	460815	23	19	07/14/1986	460815	150	46
04/23/1974	460815	40	77	03/29/1978	460815	10	249	10/21/1986	460815	70	67
06/04/1974	460815	30	31	04/19/1978	460815	1700	595	01/19/1987	460815	5	52
07/23/1974	460815	600	6	05/16/1978	460815	17	111	04/13/1987	460815	300	387
08/27/1974	460815	73	5.9	06/20/1978	460815	140	57	07/13/1987	460815	1400	185
09/23/1974	460815	13	14	07/19/1978	460815	150	40	10/19/1987	460815	50	46
10/29/1974	460815	90	22	08/29/1978	460815	80	24	07/20/1993	460815	430	51
11/19/1974	460815	3	26	09/19/1978	460815	750	23	07/18/1995	460815	250	75
12/17/1974	460815	5	17	10/18/1978	460815	100	26	07/10/1996	460815	200	63
01/27/1975	460815	23	17	11/29/1978	460815	40	26	**07/22/1997**	**460815**	**4900**	**79**
02/25/1975	460815	13	16	12/19/1978	460815	33	24	07/20/1998	460815	1400	65
03/18/1975	460815	3	65	01/17/1979	460815	17	3.5	07/21/1999	460815	300	78
07/23/1975	**460815**	**24000**	**74**	02/14/1979	460815	5	5	07/19/2000	460815	360	75
08/19/1975	460815	210	7.4	03/28/1979	460815	30	199	07/09/2001	460815	370	144
09/22/1975	460815	430	13	04/12/1979	460815	190	188	07/15/2002	460815	30	22
10/15/1975	460815	37	15	05/15/1979	460815	120	105	07/15/2003	460815	90	26
11/25/1975	460815	90	3	06/19/1979	460815	1700	197	**05/12/2004**	**LEWCLART1**	**10000**	**38**
12/16/1975	460815	33	6	07/05/1979	460815	670	75	**05/12/2004**	**LEWCLART1**	**10000**	**38**
01/08/1976	460815	6	10	08/22/1979	460815	320	29	05/12/2004	LEWCLART2	5	38
02/12/1976	460815	5	70	09/19/1979	460815	400	19	05/12/2004	LEWCLART2	320	38
03/23/1976	460815	5	49	10/12/1979	460815	250	25	**05/13/2004**	**LEWCLART1**	**5700**	**71**
04/21/1976	460815	43	34	01/28/1980	460815	3	40	05/13/2004	LEWCLART2	1700	71
05/25/1976	460815	1200	54	04/15/1980	460815	17	84	06/09/2004	LEWCLART1	5	49
06/24/1976	460815	990	11	**10/16/1980**	**460815**	**8000**	**23**	06/09/2004	LEWCLART1	1700	49
07/22/1976	460815	300	1.2	01/13/1981	460815	5	19	06/09/2004	LEWCLART2	130	49
09/16/1976	**460815**	**2100**	**11**	04/23/1981	460815	90	33	07/13/2004	460815	180	28
10/21/1976	460815	220	11	04/20/1982	460815	6	70	04/13/2005	LEWCLART1	590	114
11/04/1976	460815	30	14	05/06/1982	460815	8	47	04/13/2005	LEWCLART2	750	114
12/22/1976	460815	110	8	10/19/1982	460815	130	90	04/26/2005	LEWCLART1	1000	330
01/19/1977	460815	30	3	01/18/1983	460815	5	100	04/26/2005	LEWCLART2	5	330
02/24/1977	460815	5	18	04/26/1983	460815	30	89	04/26/2005	LEWCLART2	900	330
03/31/1977	460815	110	239	07/19/1983	460815	1000	620	06/15/2005	LEWCLART1	1100	606
04/21/1977	**460815**	**9200**	**605**	10/18/1983	460815	240	42	06/15/2005	LEWCLART2	690	606
05/19/1977	460815	90	124	01/17/1984	460815	60	35	07/12/2005	460815	230	41
06/23/1977	460815	80	97	04/17/1984	460815	30	481	07/12/2005	460815	360	41
07/21/1977	460815	1000	43	07/17/1984	460815	160	51	07/18/2007	460815	580	28
08/18/1977	**460815**	**2000**	**36**	10/17/1984	460815	200	42	07/23/2008	460815	150	#N/A

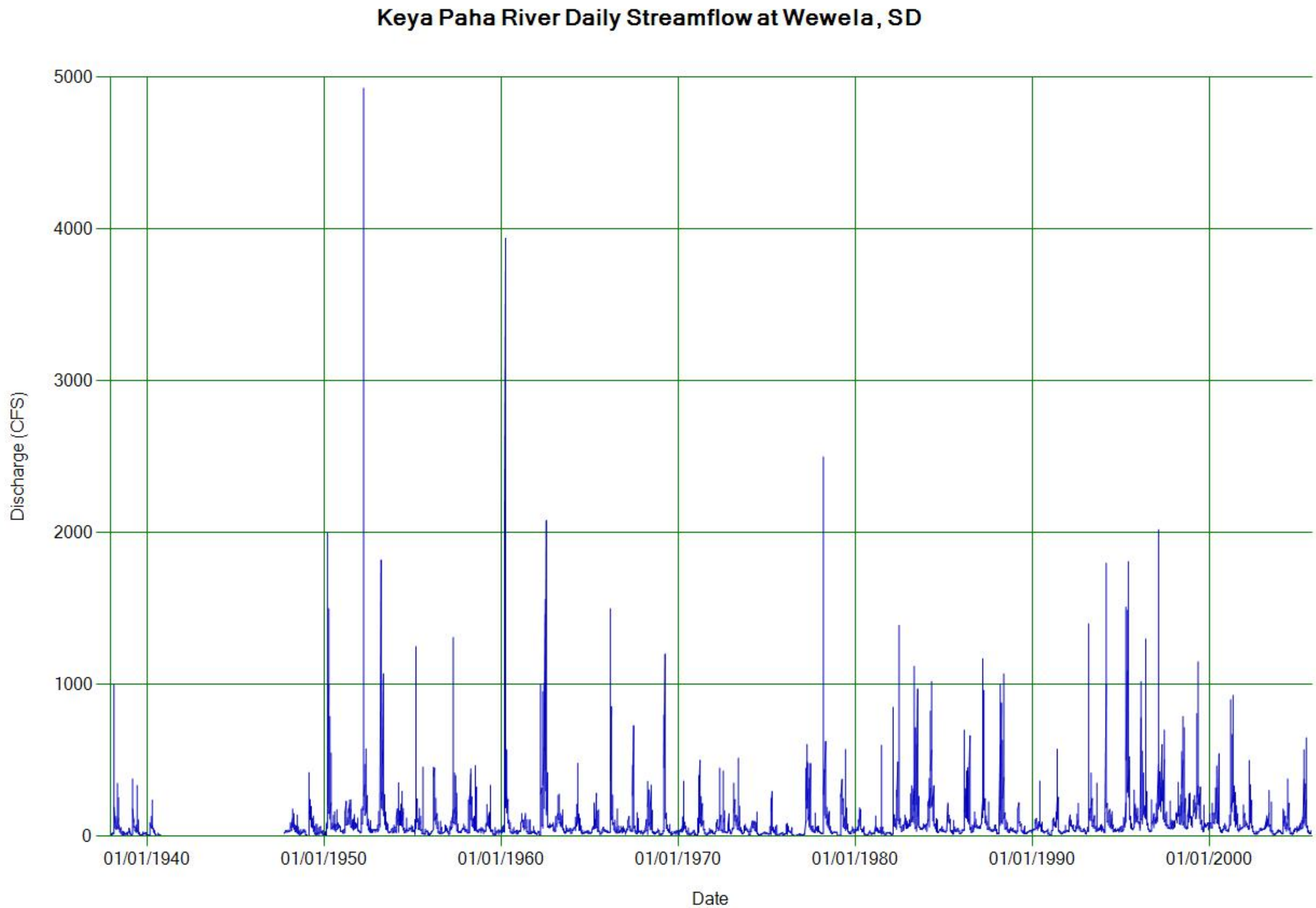


Figure 9. Keya Paya River Daily Streamflow at Wewela, SD

Mean daily flow generated through EDNA was estimated to be 3.05 m^3/s. Mean daily fecal concentrations (average of all samples) were calculated at 875 colonies/ 100 mL. Based on these numbers, the mean daily fecal load in the Keya Paha River could be calculated at 2.3 x 10^{12} colonies/ day. The result of calculating the mean daily load at the chronic water quality standard of 1000 colonies/ 100 mL yields a mean daily load of 2.6 x 10^{12} colonies/ day. These estimates suggest that the stream should meet the chronic criteria a majority of the time. Sufficient sample data to calculate geometric means were unavailable. To address the chronic standard, efforts to reduce all samples below the 1000 colonies/100mL threshold will provide assurance the stream meets both the chronic and acute standards at all times.

Table 11 allocates the sources for bacteria production in the watershed into three primary categories. These categories were derived from the use of the National Agricultural Statistics (NASS) data and the South Dakota Game Fish and Parks wildlife data (Huxoll, 2002). These data are further expanded in Table 12 on the following page. The summary is based on several assumptions. Feedlot numbers were calculated as the sum of all dairy, hog, and the NASS estimate of beef in feeding areas. All remaining livestock were assumed to be on grass.

Table 11. Fecal Source Allocation for Keya Paha River

Source	Percentage
Feedlots	33.1%
Livestock on Grass	64.3%
Wildlife	1.2%

Animal feeding operations are present within the watershed. Tripp County has an estimated 140,000 head of cattle with permitted animal feeding operations having the potential of holding a maximum population of over 40,000 animals. The permitted (zero discharge) facilities account for the majority of the animals allocated to the feedlots in Table 11. It is possible that some smaller operations do contribute to bacteria counts measured in the river, it is more likely that livestock utilizing the stream are the primary source of bacteria.

There are no municipalities or other point sources that discharge to the Keya Paha River. Septic systems were determined to be an insignificant contributing source to the fecal coliform loads in the river based on the following information. Human fecal production may be estimated at 1.95E+9 (Yagow et al, 2001). The human population of Keya Paha River watershed from the 2000 census was estimated at 3500 people, or 2/ square mile. When included as a total load in the table, human produced fecals account for less than 0.1% of all fecal coliforms produced in the watershed. These bacteria should all be delivered to a septic system, which if functioning correctly would result in no fecal coliforms entering the river.

Table 12 on the following page lists most animal sources of fecal coliform in the Keya Paha River Watershed. Wildlife densities were generated by the SD Game Fish and Parks in the 2002 County Wildlife Assessment. Livestock data were gathered from the National Agricultural Statistics publication for 2004. Assuming an equal distribution throughout the watershed, the percentages may be used as the source allocations for each species. There are no point sources of fecal coliform in this watershed and it is assumed that if failing septic systems are present they contribute a negligible load.

Table 12. Fecal Coliform Sources by Species in Keya Paha River

Species	#/mile	#/acre	FC/Animal/Day	FC/Acre	Percent
Dairy cow	0.8	1.3E-03	4.46E+10	55787500	0.8%
Beef	110.0	1.7E-01	3.90E+10	6703125000	91.1%
Hog	24.0	3.8E-02	1.08E+10	405000000	5.5%
Sheep	3.0	4.7E-03	1.96E+10	91875000	1.2%
Horse	1.3	2.0E-03	5.15E+10	104568750	1.4%
All Wildlife	Sum of all Wildlife			93226244	1.3%
Turkey (Wild)$_1$	1.10	1.7E-03	1.10E+08	189063	
Goose$_2$	0.43	6.7E-04	7.99E+08	536828	
Deer$_2$	5.09	8.0E-03	3.47E+08	2759734	
Beaver$_2$	1.23	1.9E-03	2.00E+05	384	
Raccoon$_2$	1.23	1.9E-03	5.00E+09	9609375	
Coyote/Fox$_3$	1.04	1.6E-03	1.75E+09	2843750	
Muskrat$_1$	0.55	8.6E-04	2.50E+07	21484	
Opossom$_4$	0.61	9.5E-04	5.00E+09	4765625	
Mink$_4$	0.29	4.5E-04	5.00E+09	2265625	
Skunk$_4$	0.37	5.8E-04	5.00E+09	2890625	
Badger$_4$	0.21	3.3E-04	5.00E+09	1640625	
Jackrabbit$_4$	1.84	2.9E-03	5.00E+09	14375000	
Cottontail$_4$	6.14	9.6E-03	5.00E+09	47968750	
Squirrel$_4$	0.43	6.7E-04	5.00E+09	3359375	
1 USEPA 2001					
2 Bacteria Indicator Tool Worksheet					
3 Best Professional Judgment based off of Dogs					
4 FC/Animal/Day copied from Raccon to provide a more conservative estimate of background affects of wildlife					

Summarizing the fecal coliform production in the watershed for all sources excluding human, a total daily fecal production of 8.15 x 10^{15} colonies/ day are produced. Comparing that with the average annual load of 2.3 x 10^{12} colonies/ day, the delivery rate may be calculated at 0.028% of the daily production. A low delivery rate suggests a high possibility for successfully mitigating the source of bacteria.

TRIBUTARY SITE SUMMARY

Site LAC1 exhibited more frequent impairment for fecal bacteria contamination and suspended solids loading than site LAC2. AnnAGNPS modeling in this watershed indicated that sheet and rill erosion accounted for only a small portion of sediments in the river. Photo points, visual surveys, and rapid geomorphic assessments in this watershed all indicate that grazing may be the most significant source of degradation on the stream channel. Feeding area surveys indicated a minimal number of animal feeding operations, most of which were limited to short duration use during the winter months.

It is likely that the fecal violations and the suspended sediment concentrations could be improved by implementing riparian grazing management practices, primarily along the main channel of the Keya Paha River. Emphasis should be placed on deferment or limited use during the growing season. Segments of the streams with higher RGA scores should be prioritized for restoration efforts.

Suspended solids concentrations in this segment appear to naturally exceed the state standard. Some mitigation efforts to control bacteria will also aid in reducing suspended solid concentrations. Further analysis should be directed at determining an appropriate high flow off ramp for the current suspended solids standard.

SURFACE WATER CHEMISTRY (PONCA CREEK)

Watershed Overview

The entire Ponca Creek watershed drains 520,000 acres in South Dakota and Nebraska and discharges to Lewis and Clark Lake near Verdel, Nebraska. The 303(d) listed segment that this TMDL addresses drains approximately 240,000 acres of Gregory and Tripp Counties in south central South Dakota (Figure 10).

The communities of Burke, Colome, Dallas, Gregory and Herrick all reside within the listed segments drainage. The population of the watershed is approximately 2,900 with nearly half residing in and around the community of Gregory.

The watershed climate is characterized by hot summers with temperatures occasionally reaching 100^{o}F or greater and cold winters with temperatures dipping down below 0^{o}F. Annual precipitation averages around 22 inches with 75% of it falling during the growing season, April through September. The average annual snowfall total is 50 inches.

The dominant soil associations located in the Ponca Creek drainage include the Reliance, Ree, Anselmo-Holt-Tassel, Meadin-Jansen, and Labu-Sansarc. The Ree and Reliance associations are dominated by cropland. Corn, small grain, grain sorghum, and alfalfa are the main cultivated crops. Anselmo-Holt-Tassel associations are dominated by rangelands with 85% of these soils supporting native vegetation. About 95% of Meadin-Jansen soils and Labu-Sansarc associations support native vegetation and are used for grazing. (USDA,1984)

Landuse in the watershed is predominately agricultural in nature. Major landuse categories are: 78% native rangelands, 8% row crops, 6% developed (this includes road right of ways), 3% small grains, 2% hay ground, 1% forested, and 1% water and wetlands.

Segment SD-MI-R-PONCA-01 was listed for TSS and Fecal Coliform in the 2006 Integrated Report (SDDENR, 2006).

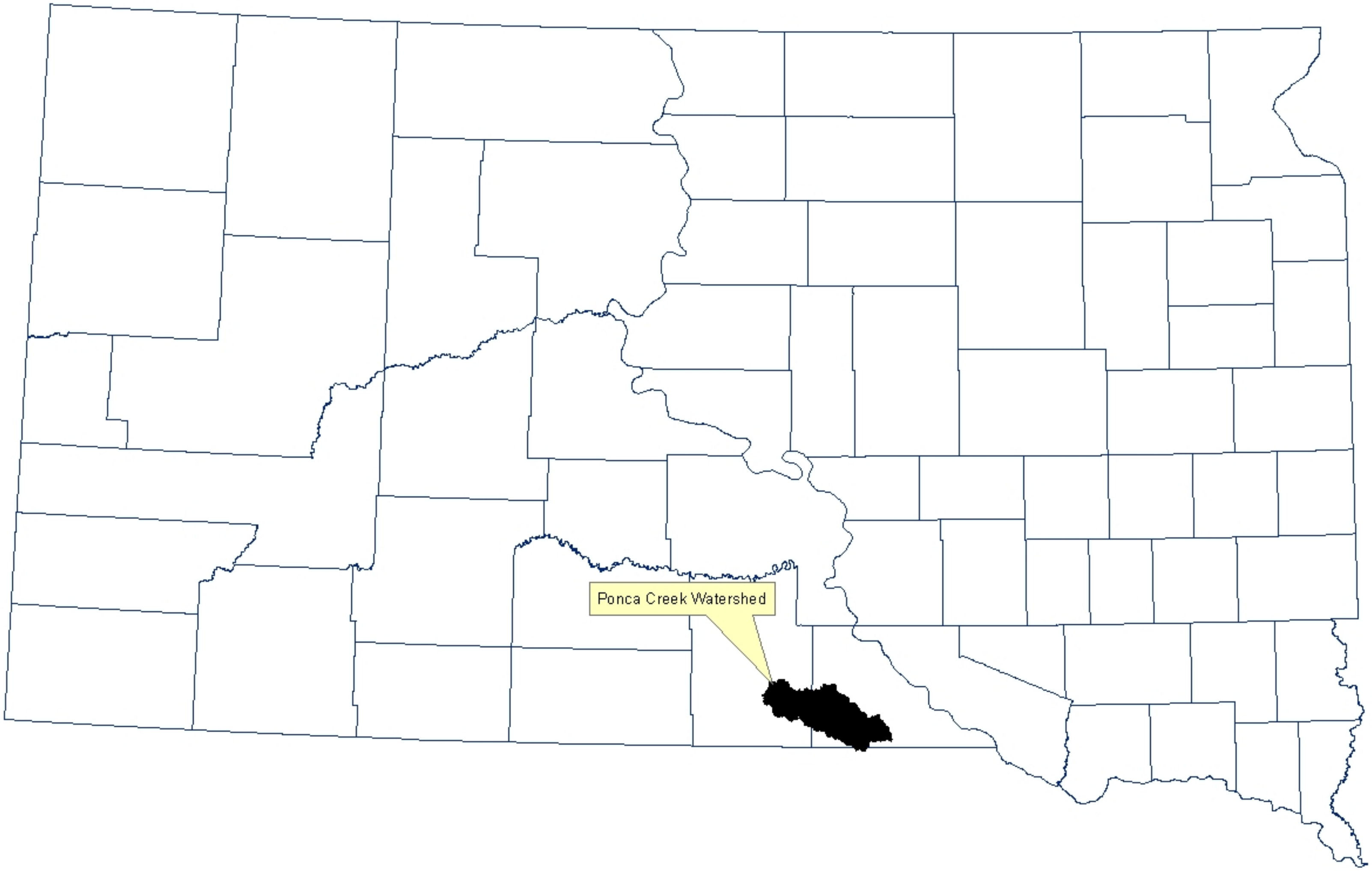


Figure 10. **Ponca Creek Watershed location in South Dakot**a

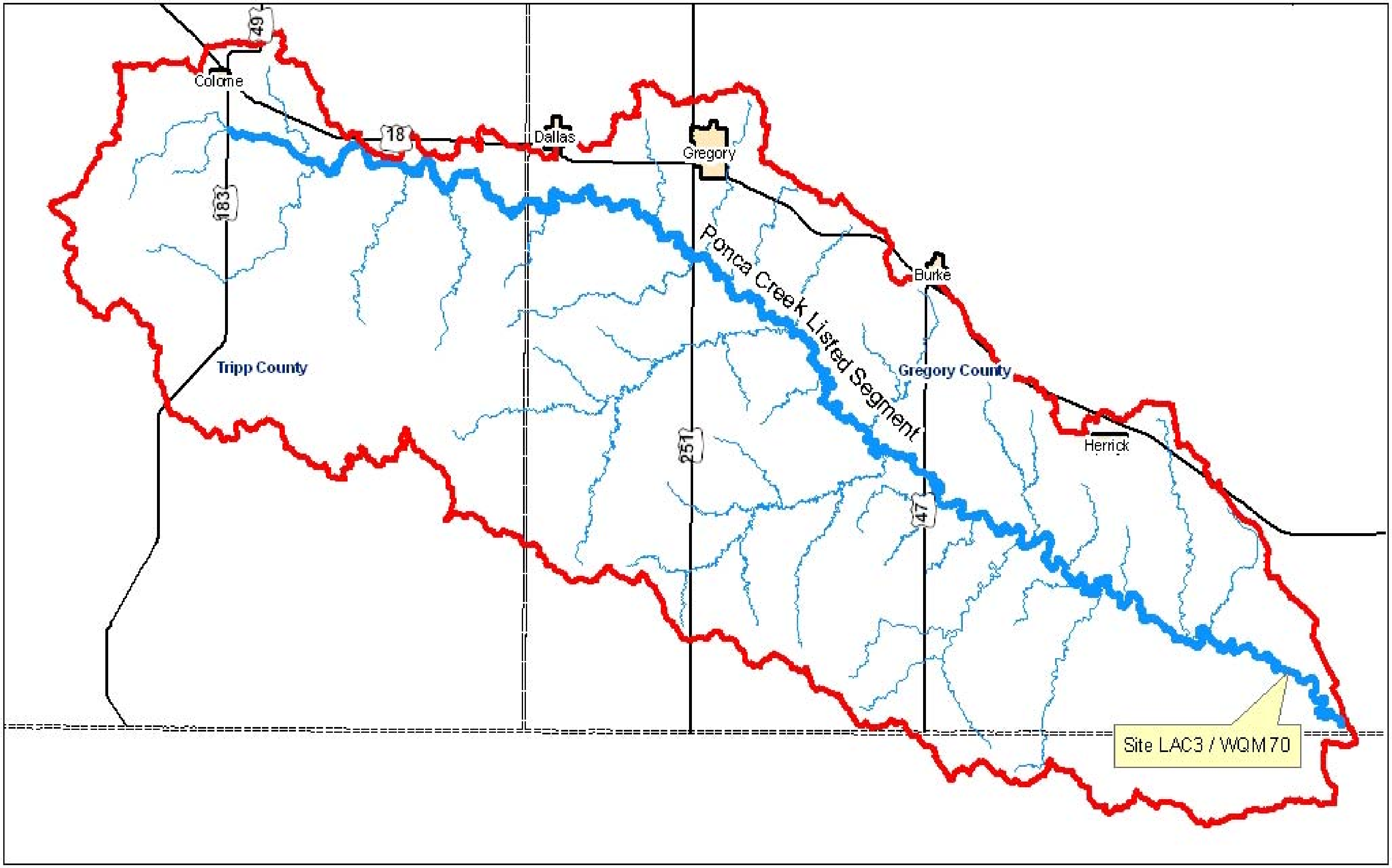


Figure 11. Ponca Creek Watershed

South Dakota Water Quality Standards

Each waterbody within South Dakota is assigned beneficial uses. All waters (both lakes and streams) are designated the use of fish and wildlife propagation, recreation and stock watering. All streams are assigned the use of irrigation. Additional uses may be assigned by the state based on a beneficial use analysis of each waterbody. Water quality standards have been defined in South Dakota state statutes in support of these uses. These standards consist of suites of numeric criteria that provide physical and chemical benchmarks from which management decisions can be developed.

Chronic standards, including geometric means and 30-day averages, are applied to a calendar month. While not explicitly described within the State's water quality standards, this is the method used in the State's Integrated Water Quality Report (IR) as well as in permit development.

Additional "narrative" standards that may apply can be found in the "Administrative rules of South Dakota: Articles 74:51:01:05; 06; 08; and 09". These contain language that generally prohibits the presence of materials causing pollutants to form, visible pollutants, and nuisance aquatic life.

Ponca Creek from Highway 183 downstream to the Nebraska border has been assigned the beneficial uses of, warmwater semi-permanent fish life propagation; irrigation waters, limited contact recreation; and fish and wildlife propagation, recreation, and stock watering. Table 13 lists the criteria that must be met to support the specified beneficial uses. When multiple criteria exist for a particular parameter, the most stringent criterion is used.

This segment of Ponca Creek is defined in section 74:51:01:30 as a low quality fishery. The design low flow for a low-quality fishery or irrigation water is the minimum 7-day average low flow that can be expected to occur once in every five years (7Q5) or 1.0 cubic foot per second, whichever is greater. During these low flow periods, the water quality regulating the fishery do not apply, which includes total suspended solids.

Table 13. State Water Quality Standards for Ponca Creek.

Parameters	Criteria	Unit of Measure	Beneficial Use Requiring this Standard
Total ammonia nitrogen as N	Equal to or less than the result from Equation 3 in Appendix A of Surface Water Quality Standards	mg/L 30 average May 1 to October 31	Warmwater Semipermanent Fish Propagation
	Equal to or less than the result from Equation 4 in Appendix A of Surface Water Quality Standards	mg/L 30 average November 1 to April 31	
	Equal to or less than the result from Equation c in Appendix A of Surface Water Quality Standards	mg/L Daily Maximum	
Dissolved Oxygen	≥4.0	mg/L	Warmwater Semipermanent Fish Propagation
Total Suspended Solids	≤90 (mean) ≤158 (single sample)	mg/L	Warmwater Semipermanent Fish Propagation
Temperature	≤32	°C	Warmwater Semipermanent Fish Propagation
Fecal Coliform Bacteria (May 1- Sept 30)	≤1000 (geometric mean) ≤2000 (single sample)	count/100 mL	Limited Contact Recreation
Escherichia Coli Bacteria (May 1- Sept 30)	≤630 (geometric mean) ≤1178 (single sample)	count/100 mL	Limited Contact Recreation
Alkalinity ($CaCO_3$)	≤750 (mean) ≤1,313 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Conductivity	≤2,500 (mean) ≤4,375 (single sample)	µmhos/cm @ 25° C	Irrigation Waters
Nitrogen, nitrate as N	≤50 (mean) ≤88 (single sample)	mg/L	Wildlife Propagation and Stock Watering
pH (standard units)	≥6.5 to ≤9.0	units	Warmwater Semipermanent Fish Propagation
Solids, total dissolved	≤2,500 (mean) ≤4,375 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Total Petroleum Hydrocarbon	≤10	mg/L	Wildlife Propagation and Stock Watering
Oil and Grease	≤10		
Sodium Adsorption Ratio	<10	ratio	Irrigation Waters

Water Quality Results

ALKALINITY, CONDUCTIVITY, NITROGEN, pH, AND DISSOLVED OXYGEN

These parameters did not exceed the state standard set for Ponca Creek. Table 14 shows the high, low, and mean for each parameter.

Table 14. Ponca Creek Water Quality Data

	Alkalinity	Specific Conductivity	Ammonia	Nitrogen as Nitrate	TKN	PH	Dissolved Oxygen
High (mg/L)	307	1,675	0.28	0.2	1.40	8.28	11.58
Low (mg/L)	173	514	<0.02	<0.1	<0.11	6.90	7.76
Average (mg/L)	240	991	0.03	0.06	0.67	7.98	9.72

Suspended Solids

Nonpoint sources of suspended solids in Ponca Creek come from two primary sources. sheet and rill erosion from the uplands (including grazing and croplands) or it may originate from degradations in the channel itself.

Upland Erosion

The Annualized Agricultural Nonpoint Source Pollution (AnnAGNPS) model was used to evaluate sheet and rill erosion in the Ponca Creek Watershed. Due to the large size of the watershed, it was broken into smaller subwatersheds to facilitate the execution of the model.

AnnAGNPS first analyzes the topography within a watershed (based on a Digital Elevation Model), and then splits the watershed into many smaller cells. Each cell becomes a data point that is processed individually. Landuse, soil type, and topograghy are assigned to each cell based on available digital data. Farming practices (e.g., crop rotations, fertilizer regimes, etc.) can be customized for each cell as desired. The same is true for Best Management Practices (BMPs), which can be simulated to analyze effects of conservation options. Historical climate data is used to simulate weather during the model run. All of these factors affect the amount of pollutants discharged from each cell. Individual cell outputs are routed through the length of the drainage basin, ultimately producing outputs for the entire watershed.

Estimates of sediment production were relatively high for the Ponca Creek drainage (1.15 tons/acre). Seventeen of the 28 tributaries (nine of which are located in South Dakota) within this larger drainage produced sediment production estimates of greater than 1 ton/acre. This indicates that much of this watershed is more susceptible to sheet and rill erosion than neighboring drainages.

Five tributaries produced sediment yield estimates of greater than 2 tons/acre. One of these (PC7, 2.3 tons/acre) is located in South Dakota. PC7 originates half way between Burke and Gregory and drains south into Ponca Creek, see Figure 12.

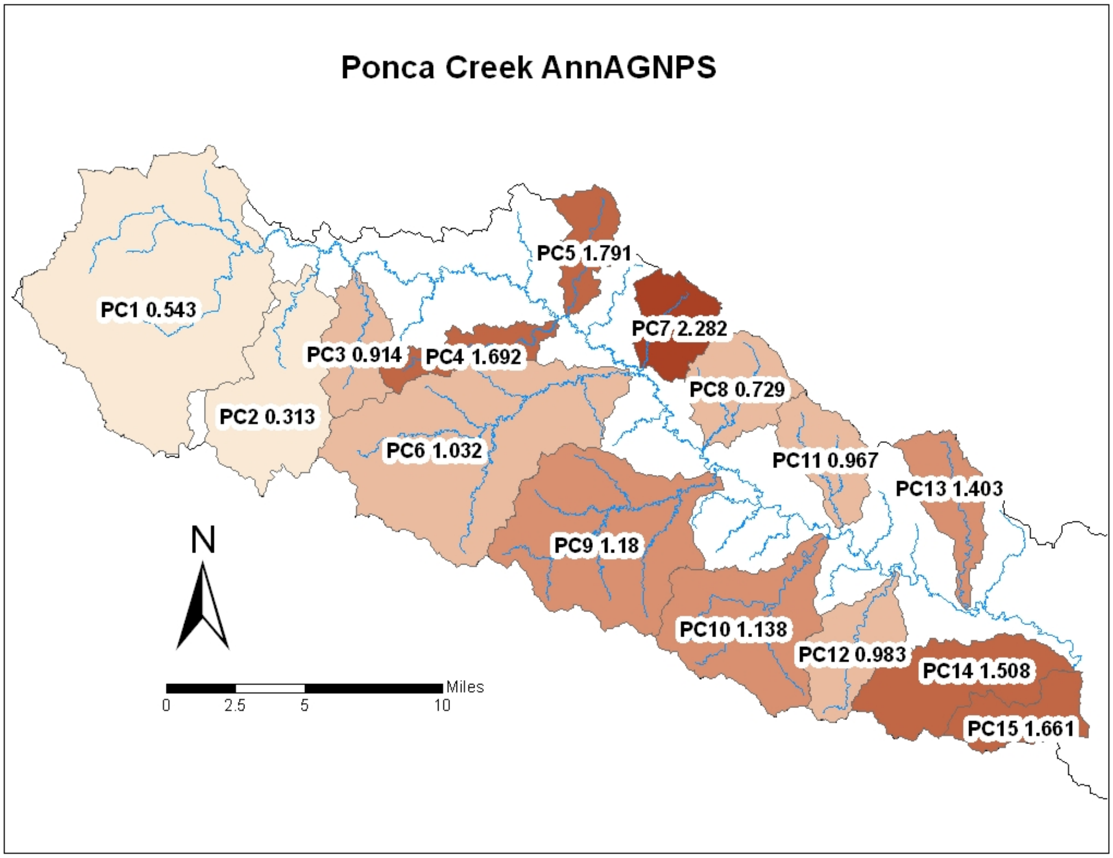


Figure 12. Ponca Creek AnnAGNPS

Bed and Bank Erosion

Channel stability in Ponca Creek is a critical component contributing to suspended solids loadings in the stream. To characterize channel stability in Ponca Creek, 56 Rapid Geomorphic Assessments (RGA's) were conducted. RGA's are a qualitative technique used to quickly identify and compare the evolutionary stage of channels. The values obtained are unitless and allow for a comparison between channels of different sizes. The assessment is not designed to generate a sediment or nutrient load from the channel, but may help identify portions of the stream that may benefit from additional analysis or BMPs.

The average RGA score for each stream segment was evaluated. For the purposes of this study, it was determined that a score less than 18.5 would be considered a stable channel while scores exceeding 18.5 would be considered unstable, and they were only completed within Gregory County for the Ponca Creek portion of the assessment.

The main stem of Ponca Creek consistently received scores indicating an unstable channel. Small tributaries to the main channel consistently received scores indicating that they were stable. During the assessment, some local concern was expressed regarding stream crossing structures (bridges and culverts) and their impact on channel stability. Reviewing the upstream and downstream scores suggests that there are localized areas of bank erosion that may be linked to the stream crossing structure.

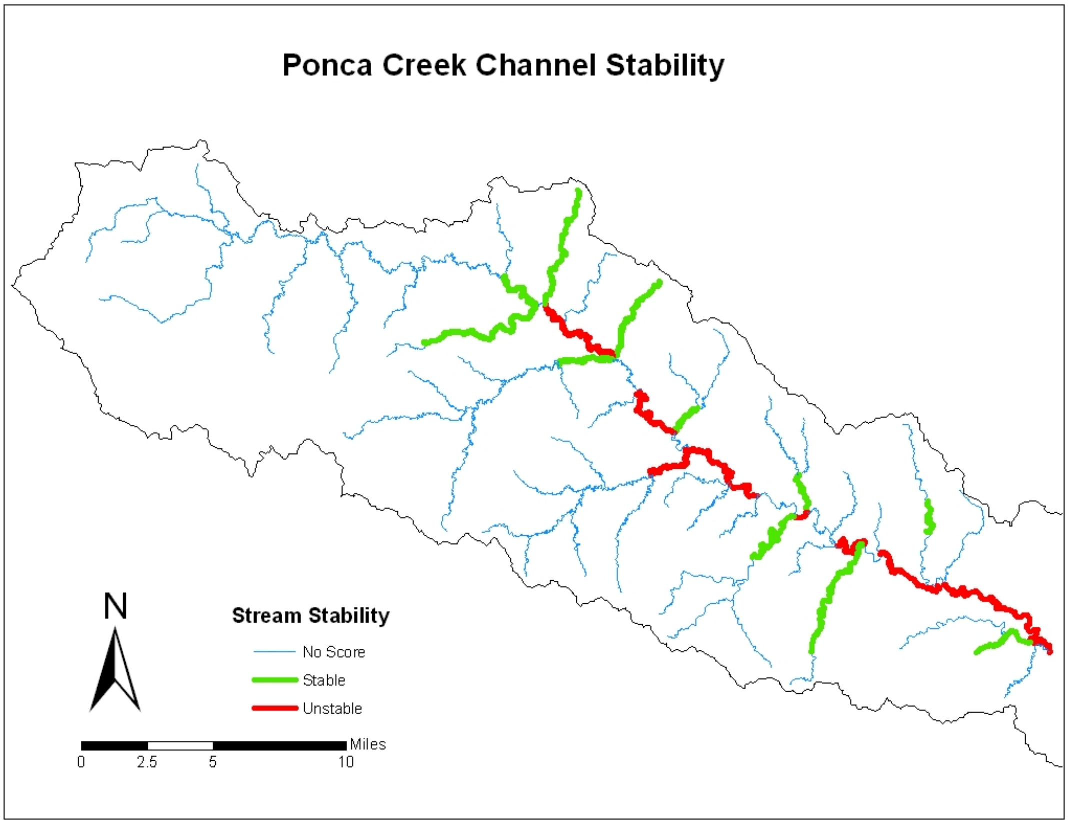


Figure 13. Ponca Creek Channel Stability

Streams within ecoregion 42 (including Ponca Creek) that are stable may be expected to generate annual suspended sediment loads ranging from 0.537 T/y/km^2 to 2.43 T/y/km^2 with a median load of 1.03 T/y/km^2 (Klimentz *et al*, 2009). The maximum measured annual load in a stable stream for this ecoregion was measured at 4.39 T/y/km^2.

Substituting suspended solids data for the suspended-sediment data, the same methodology used by Klimentz and Simon was utilized for the Ponca Creek data. A rating equation was developed to create daily yield values in tons per day from mean-daily discharge data. Mean-daily loads were summed for each complete calendar year, providing a mean annual load (T/y). To normalize data for watersheds of different size, sediment load was divided by drainage area, providing calculations of mean annual sediment yield (T/y/km^2).

A sediment load of 16.5 T/y/km^2 was calculated for the stream. Depending on the reduction target selected (maximum vs. median of stable channels) reduction in sediment transport of 73% to 93% may be expected. A similar comparison of the daily load measured that the $Q_{1.5}$ indicates that the load calculated for Ponca Creek of 0.63 T/d/km^2 would require similar reductions to reach reference conditions. This all indicates that primary sources for sediment loads in Ponca Creek are its bed and bank.

Bacteria

Data on Ponca Creek were collected from one sampling point located two miles upstream of the Nebraska border, this site was identified as site LEWCLARLAC3 (LAC3). The data collected during the assessment was used to supplement existing data from SD DENR ambient water quality monitoring site 460670 (WQM 70) which was co-located at site LAC3

A total of 26 samples were available for analysis. Comparing flow and concentration resulted in a very weak relationship that was inadequate for use in predicting daily loads. Ten of the 26 samples were above the chronic standard while nine of those exceeded the acute standard.

Table 15. Ponca Creek Fecal Coliform Bacteria Sample Data (Highlighted samples are in excess of the chronic standard and bolded samples are in excess of the acute standard.)

Date	Station	Fecal Coliform Bacteria (cfu/100 ml)	Flow	Flow Zone
05/25/1976	460670	510	22.0	2
06/24/1976	**460670**	**7300**	**3.0**	**4**
05/19/1977	460670	100	3.9	4
06/23/1977	460670	420	53.0	2
07/21/1977	**460670**	**2000**	**0.3**	**5**
08/18/1977	460670	170	4.3	4
05/20/2003	LEWCLARLAC3	80	12.5	3
05/29/2003	LEWCLARLAC3	420	12.6	3
06/05/2003	LEWCLARLAC3	610	7.1	4
06/10/2003	LEWCLARLAC3	1000	9.5	3
06/18/2003	LEWCLARLAC3	480	20.7	2
06/25/2003	**LEWCLARLAC3**	**4000**	**35.9**	**2**
07/01/2003	LEWCLARLAC3	300	7.4	4
07/15/2003	**460670**	**140000**	**0.6**	**5**
07/17/2003	**LEWCLARLAC3**	**3000**	**0.2**	**5**
07/23/2003	**LEWCLARLAC3**	**46000**	**0.1**	**5**
07/30/2003	**LEWCLARLAC3**	**41000**	**0.1**	**5**
06/09/2004	LEWCLARLAC3	780	2.1	4
05/12/2005	**LEWCLARLAC3**	**9900**	**13.0**	**3**
06/15/2005	**LEWCLARLAC3**	**3200**	**320.0**	**1**
07/07/2005	LEWCLARLAC3	360	17.0	3
07/12/2005	460670	380	9.6	3
07/18/2007	460670	350	4.6	4
07/23/2008	460670	180	11.0	3
05/12/2009	460670	120	29.0	2
08/13/2009	460670	410	32.0	2

Point Sources

There are two permitted facilities in the watershed which must be included in the Waste Load Allocation (WLA) of this TMDL.

The cities of Colome and Gregory wastewater treatment are comprised of retention pond systems that may periodically require a portion of the final pond to be discharged. Table 16 includes the basic system information and permit numbers for each of the facilities within the basin.

Table 16. Permitted Facilities within the Ponca Creek Drainage

Permit Number	Facility Name	System comments	Pond 1 (acres)	Pond 2 (acres)	Pond 3 (acres)
SD0023230	Colome	Pond system	2.0	2.0	
SD0022179	Gregory	Pond system	25	12.3	17.4

Table 17 includes the information used by SDDENR to calculate a maximum allowable discharge from each of these facilities. The WLA calculation was based on the effluent limits included in each city's surface water discharge permit, multiplied by the expected flow rate from each facility. The normal operation of these systems would typically result in only a portion of the calculated daily amounts actually being discharged. It is important to note that all discharges are required to meet the chronic water quality threshold for Ponca Creek.

Table 17. Waste Load Allocation for Facilities in the Ponca Creek Drainage

Facility Name	Flow (cfs) used in WLA	30-day Geometric Mean Fecal Coliform Bacteria (cfu/100ml) permit limit	Fecal Coliform WLA (cfu/day)
Colome	1.35	1000	3.30×10^{10}
Gregory	18.43	1000	4.51×10^{11}

Including the WLA in the load duration curve required several factors be taken into account. The maximum waste load for all systems in aggregate is 4.84×10^{11} cfu/day. Associated with this load is also a flow of 19.8 cfs, which is met or exceeded in Ponca Creek 40% of the time. Arbitrarily adding this load to the entire flow regime would be a misrepresentation of how the system(s) function, essentially suggesting a continuous discharge.

Nonpoint Sources

Nonpoint sources of fecal coliform bacteria in Ponca Creek come primarily from agricultural sources. Data from the 2009 National Agricultural Statistic Survey (NASS) and from the 2002 South Dakota Game Fish and Parks county wildlife assessment were utilized for livestock and wildlife densities. Animal density information was used to estimate relative source contributions of bacteria loads.

Agriculture

Manure from livestock is a potential source of fecal coliform to the stream. Livestock in the basin are predominantly beef cattle and hogs. Livestock can contribute fecal coliform bacteria directly to the stream by defecating while wading in the stream. They also can contribute by defecating while grazing on rangelands that get washed off during precipitation events. Table 18 allocates the sources for bacteria production in the watershed into three primary categories. The summary is based on several assumptions. Feedlot numbers were calculated as the sum of all dairy, hog, and the NASS estimate of beef in feeding areas, while all remaining livestock were assumed to be on grass.

Table 18. Fecal Source Allocation for Ponca Creek

Source	Percentage
Feedlots	9.1%
Livestock on Grass	90.5%
Wildlife	0.4%

Elevated counts The main source of fecal coliform bacteria is likely livestock, directly utilizing the stream or from livestock grazing on upland areas.

Human

Two point sources are located in the Ponca Creek watershed, Colome and Gregory. These systems account for about 1700 of the approximately 2900 people in the watershed. Septic systems are assumed to be the primary human source for the rest of the population in the watershed. Human fecal production may be estimated at 1.95E+9 (Yagow et al. 2001). When included as a total load in Table 19, the remaining population produced fecals accounting for less than 0.1% of all fecal coliforms produced in the watershed. These bacteria should all be delivered to a septic system; which, if functioning correctly would result in no fecal coliforms entering the creek.

Natural background/wildlife

Wildlife within the watershed is a natural background source of fecal coliform bacteria. Wildlife population density estimates were obtained from the South Dakota Department of Game, Fish, and Parks.

Table 19. Ponca Creek Nonpoint Sources

Species	#/sq mile	#/acre	FC/Animal/Day	Fecal Coliform	Percent
Dairy cow	1.70	2.7E-03	4.46E+10	1.19E+08	2.2%
Beef	78.32	1.2E-01	3.90E+10	4.77E+09	90.3%
Bison[1]	1.81	2.8E-03	4.46E+10	1.26E+08	2.4%
Hog	7.15	1.1E-02	1.08E+10	1.21E+08	2.3%
Sheep	0.69	1.1E-03	1.96E+10	2.11E+07	0.4%
Horse	1.20	1.9E-03	5.15E+10	9.65E+07	1.9%
All Wildlife	Sum of all Wildlife			2.92E+07	0.4%
Turkey (Wild)[2]	8.87	1.4E-02	1.10E+08	1.36E+06	
Sharptail grouse and prairie chicken[3]	9.20	1.4E-02	1.40E+08	3.31E+06	
Deer[4]	5.72	8.9E-03	3.47E+08	3.28E+06	
Beaver[4]	2.37	3.7E-03	2.00E+05	5.12E+02	
Raccoon[4]	2.03	3.2E-03	2.50E+08	1.26E+06	
Coyote/Fox[5]	1.99	3.1E-03	1.75E+09	7.60E+06	
Muskrat[2]	1.94	3.0E-03	2.50E+07	8.25E+04	
Opossom[6]	1.16	1.8E-03	2.50E+08	4.23E+05	
Mink[6]	1.36	2.1E-03	2.50E+08	5.33E+05	
Skunk[6]	2.13	3.3E-03	2.50E+08	9.44E+05	
Badger[6]	1.07	1.7E-03	2.50E+08	4.79E+05	
Jackrabbit[6]	2.23	3.5E-03	2.50E+08	1.36E+06	
Cottontail[6]	8.96	1.4E-02	2.50E+08	5.29E+06	
Squirrel[6]	6.49	1.0E-02	2.50E+08	3.26E+06	

1 FC/Animal/Day copied from Dairy Cow to provide a more conservative estimate of background affects of wildlife

2 USEPA 2001

3 FC/Animal/Day copied from Chicken (USEPA 2001) to provide an estimate of background affects of wildlife

4 Bacteria Indicator Tool Worksheet

5 Best Professional Judgment based off of Dogs

6 FC/Animal/Day copied from Raccoon to provide a more conservative estimate of background affects of wildlife

Water Temperature

Water temperatures were collected ten times from Ponca Creek during the assessment. The samples collected on July 17th and 23rd both exceeded the temperature standard for the stream with values of 32.5 C and 35.2 C respectively. These samples were collected from flows of less than 0.5 CFS.

Tributary Site Summary

When considering all of the available data for the Ponca Creek watershed, the greatest sources of impairment appear to be associated directly with the channel. Road crossings and livestock grazing of the riparian zone may have the greatest impact on water quality. While there is a lack of traditional animal feeding operations or feedlots, a number of operations may benefit the water quality of the creek by moving or adjusting winter feeding routines. Additional benefit to the stream may come from improving the condition of upland areas to prevent increased water runoff from heavily grazed pastures.

SURFACE WATER CHEMISTRY (SLAUGHTER CREEK)

Watershed Overview

Slaughter Creek watershed is located in Charles Mix County and drains approximately 30,100 acres of land which flows into the Missouri River southeast of Marty, SD. It was the smallest of seven watersheds covered under the initial study. The watershed consists mainly of agricultural production with some livestock use. Marty is the only municipality in the watershed with a population of 421 (http://www.census.gov).

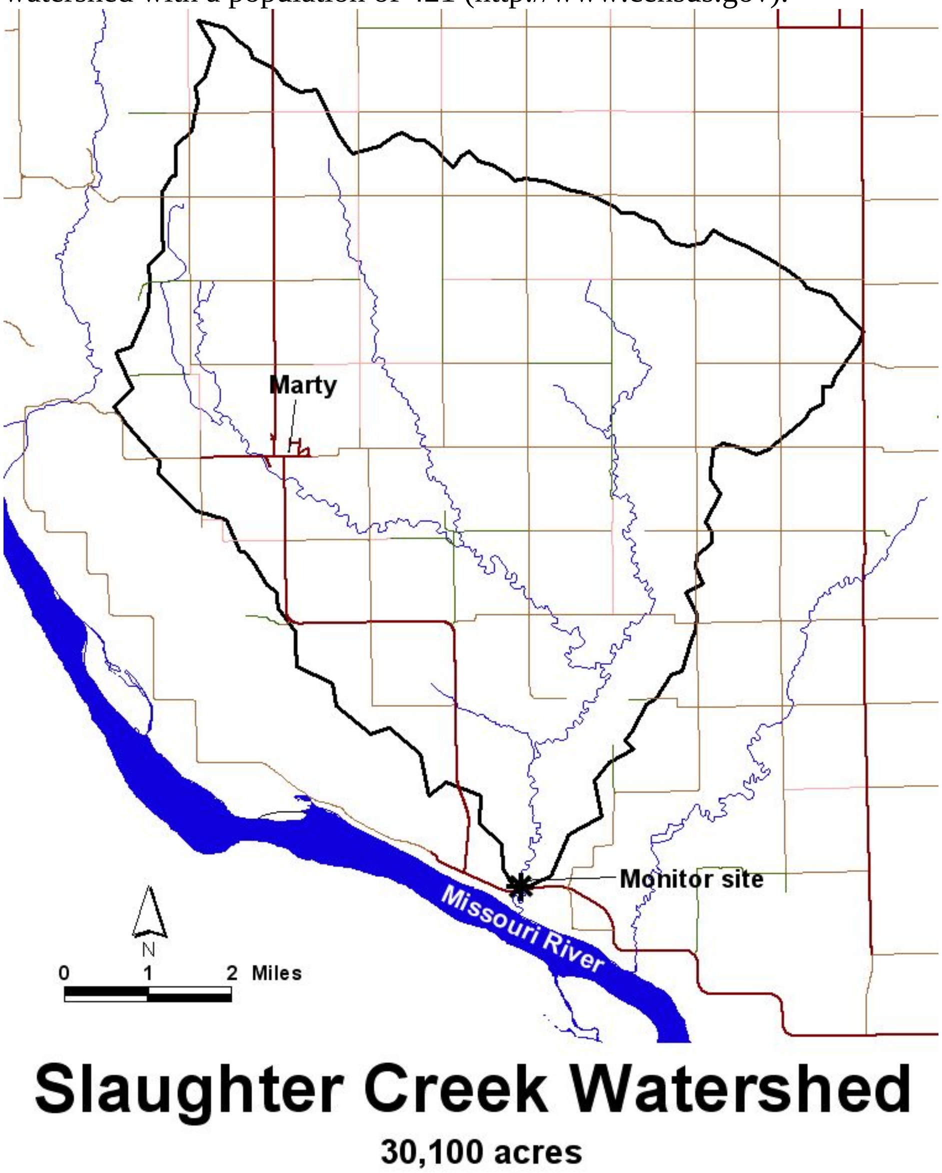


Figure 14. Slaughter Creek Watershed

South Dakota Water Quality Standards

The State of South Dakota assigns at least two beneficial uses to every waterbody in the state. Fish and wildlife propagation, recreation and stock watering as well as irrigation are assigned to all stream and rivers. All portions of Slaughter Creek must maintain the criteria that support these uses. There are seven standards that must be maintained. These standards, as well as the water quality values that must be met, are listed in Table 20.

Table 20. State Water Quality Standards for Slaughter Creek

Parameters	Criteria	Units of Measure	Beneficial Use Requiring this Standard
Alkalinity ($CaCO_3$)	≤750 (mean) ≤1,313 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Conductivity	≤2,500 (mean) ≤4,375 (single sample)	μmhos/cm @ 25° C	Irrigation Waters
Nitrogen, nitrate as N	≤50 (mean) ≤88 (single sample)	mg/L	Wildlife Propagation and Stock Watering
pH (standard units)	≥6.0 to ≤9.5	units	Wildlife Propagation and Stock Watering
Solids, total dissolved	≤2,500 (mean) ≤4,375 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Total Petroleum Hydrocarbon Oil and Grease	≤10 ≤10	mg/L	Wildlife Propagation and Stock Watering
Sodium Adsorption Ratio	<10	ratio	Irrigation Waters

Water Quality Results

SOLIDS

Total solids are the sum of all dissolved and suspended solids, as well as the organic and inorganic materials. Dissolved solids are typically found at higher concentrations in ground water, and typically constitute the majority of the total solids concentration. The total solids loadings most closely depict the dissolved portion of the solids load.

In the Slaughter Creek watershed, the suspended solids load was considerably less than the rest of the tributaries sampled. However, the dissolved solid samples surpassed the state standard. The average dissolved solid sample was 2,554 mg/L. The high concentrations are most likely attributed to groundwater discharge that kept the stream flowing consistently through periods of drought. Those measurements were collected at flows below 1 CFS. Table 21 contains the results of the solids samples collected in Slaughter Creek.

Table 21. Slaughter Creek Solid Samples

DATE	Total Solids (mg/L)	Suspended Solids (mg/L)	VTSS (mg/L)	Dissolved Solids (mg/L)
5/14/03	2706	15	3	2691
5/19/03	2833	11	7	2822
5/28/03	2916	12	4	2904
6/4/03	2994	7	2	2987
6/9/03	3028	2	1	3026
6/18/03	3106	10	7	3096
6/24/03	1036	11	3	1025
7/2/03	2271	12	4	2259
7/9/03	2189	12	11	2177
Averages	2564	10	5	2554
Annual Loads (Kg/Yr)	97131	15709	3032	NA

Figure 15 shows that as surface runoff increased, it diluted the groundwater flow to within the standard. The maximum flows of groundwater were about 0.5 to 0.7 cfs, and frequently lower. Flows greater than 1 cfs did not exceed the standard for dissolved solids, indicating that even a small amount of clean surface water diluted the groundwater to well within standard.

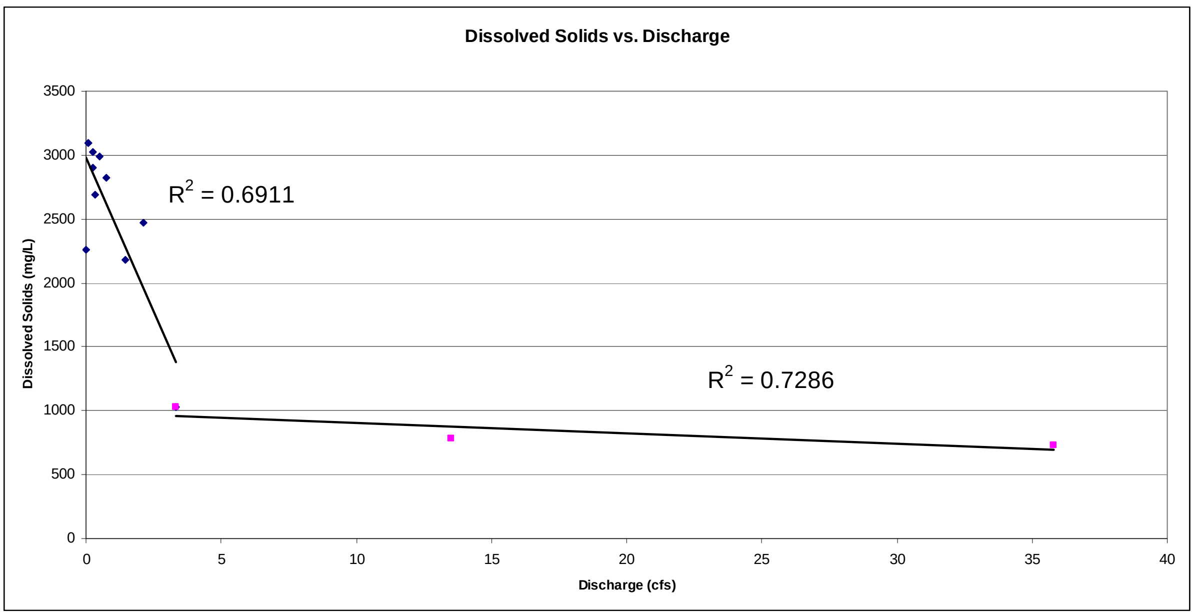


Figure 15. Dissolved Solids vs. Discharge

CONDUCTIVITY

Conductivity is a measure of waters ability to conduct an electrical current. Geology of the watershed is the most likely source of high conductivity levels. Streams that run through areas with clay soils tend to have higher conductivity levels due to the abundance of solids that wash off the soils. The presence of dissolved solids, such as: sodium, calcium, magnesium, iron, nitrate, sulfate, and phosphorus, also affect the conductivity of a waterbody. Conductivity is also affected by temperature, and specific conductance is used when the values are adjusted to a standard temperature of 25°C.

The Slaughter Creek watershed has many clay soils throughout the watershed and lies above Pierre Shale and the Niobrara Formation, two forms of bedrock with predominately clay structures. The highest conductivity level was taken on June 4, 2003 with a specific conductivity of 3,058 µmhos/cm. The average for conductivity for Slaughter Creek exceeds the standard set for the creek. Since there were only four conductivity measurements taken due to instrument difficulties, the average is not statistically reliable. Table 22 shows the four samples for conductivity and the averages for them.

Table 22. Slaughter Creek Conductivity Samples

DATE	Water Temperature (°C)	Conductivity (mmhos/cm)	Specific Conductivity (mmhos/cm at 25° C)
6/4/03	14.59	2,447	3,058
6/9/03	22.69	2,764	2,891
6/18/03	26.54	3,006	2,910
7/16/03	24.60	NA	2,760
Average	22.11	2,739	2,905

ALKALINITY, NITROGEN, pH, PHOSPHORUS, WATER TEMPERATURE, AND DISSOLVED OXYGEN

There were no exceedences of the state standard with any of the following parameters. Table 23 contains the high, low, average, and load for each parameter.

Table 23. Slaughter Creek Water Quality Data

	Alkalinity	Ammonia	Nitrogen as Nitrate	TKN	pH	Total Phosphorus	Dissolved Phosphorus	Water Temperature	Dissolved Oxygen
High (mg/L)	205	0.04	0.6	1.32	7.83	0.107	0.062	26.54	14.07
Low (mg/L)	128	<0.02	<0.1	<0.11	7.18	0.023	0.009	14.59	10.48
Average (mg/L)	192	<0.02	0.14	0.56	7.56	0.041	0.024	22.11	12.42
Yearly Load (kg/yr)	28,726	2.5	14.2	149.1	NA	48.7	6.7	NA	NA

Tributary Site Summary

When comparing all of the data from the assessment, it appears that Slaughter Creek is in relatively good condition, particularly in comparison to other waters in the drainage. Benefits from BMPs could still improve water quality of the watershed.

The problems with the conductivity and dissolved solids can be attributed to the geology of the watershed, in particular groundwater seepages that occur creating a low flow situation during times of drought. Clay soils and clay bedrock materials influence the high solids which in turn increase conductivity. Sediment loads for Slaughter Creek were the lowest throughout the project. The best course of action for dealing with naturally high conditions found in this stream would either be a low flow exception to the standard or a site specific standard.

While Slaughter Creek appears to be the “Reference” watershed in respect to water chemistry, it does suffer from some local abuse as a refuse dump. On numerous occasions the water was found to be littered with garbage as well as dead pets. A strong information and education program may be the most effective method of dealing with this type of pollution.

SURFACE WATER CHEMISTRY (CHOTEAU CREEK)

Watershed Overview

Choteau Creek drains 375,000 acres in southeast South Dakota (Figure 16) and discharges to Lewis and Clark Lake on the Bon Homme and Charles Mix County line (Figure 17). The stream receives runoff from agricultural operations. During the assessment, data were collected indicating the creek experiences periods of degraded water quality as a result of TSS loads. Land use in the watershed is predominately agricultural consisting of 45% grass, 40% row crops, 7% small grains, 6% developed (including farmsteads, roads, and small communities), 1% forested, and 1% water and wetlands.

There are four small communities within the watershed that have permitted waste water treatment facilities. These include Wagner, Delmont, Avon and Armour. The two small communities of Dante and Ravinia are not serviced by community water treatment facilities that discharge to the Choteau Creek watershed.

The largest portion of the Choteau Creek Drainage lies within Charles Mix County. Common soil associations on the uplands in the drainage include the Homme-Ethan-Onita, Highmore- Eakin, Eakin-Highmore-Ethan, Ethan-Betts-Clarno. Soil associations found in the floodplain of the stream include the Bon and Salmo associations. Bon soils are typically characterized by cropping practices while Salmo soils are more likely to be kept in native vegetation and utilized as grazing lands (USDA, 1982).

Charles Mix County is usually warm in summer, but hot spells are frequent and cool days occasional. The county is cold in winter, when arctic air frequently surges over the area. Most precipitation falls during the warm period, and rainfall is normally heaviest late in spring and early summer. Average annual precipitation is 21.5 inches, of this, 17 inches usually falls between April and September. Snowfall accumulations typically total 25 inches annually (USDA, 1982).

Choteau Creek was assessed as an individual portion of the larger Lewis and Clark Watershed Assessment, which looked at individual streams such as Choteau Creek as well as the entire drainage basin and the cumulative effects of the individual waterbodies.

Segment SD-MI-R-CHOTEAU-01 was listed for TSS and dissolved oxygen in the 2006 Integrated Report (SDDENR, 2006). This document will address the TSS listing on non tribal lands. The dissolved oxygen listing was removed in the 2008 Integrated Report (SDDENR, 2008) as a result of new data indicating that it was in full support of the standard.

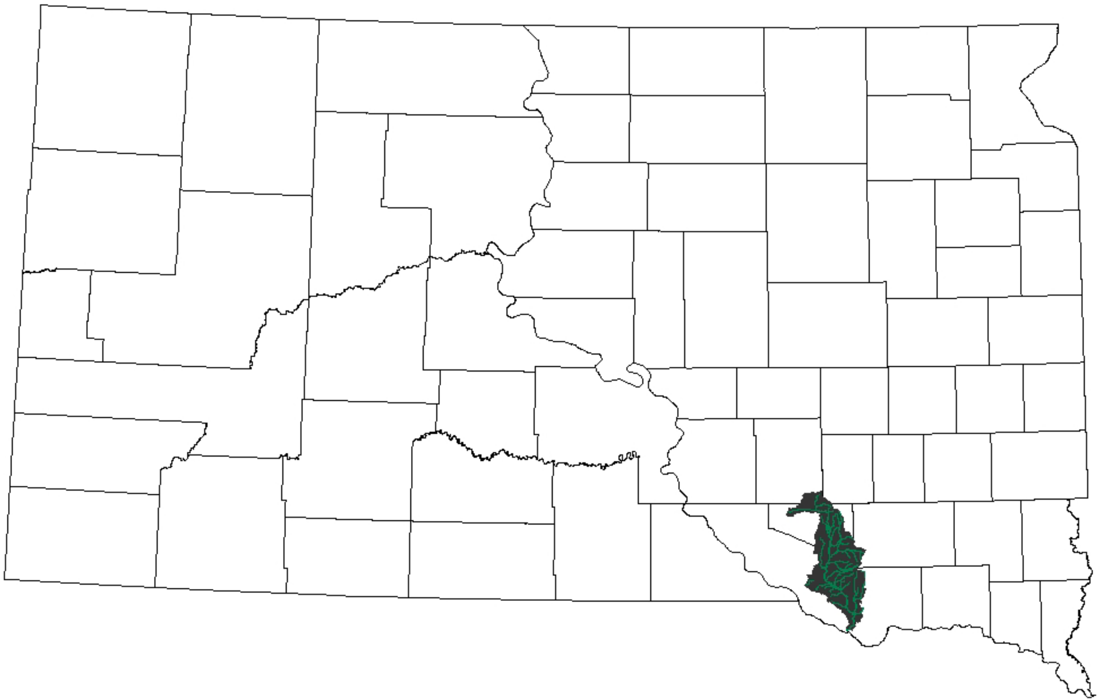


Figure 16. Choteau Creek Watershed Location in South Dakota

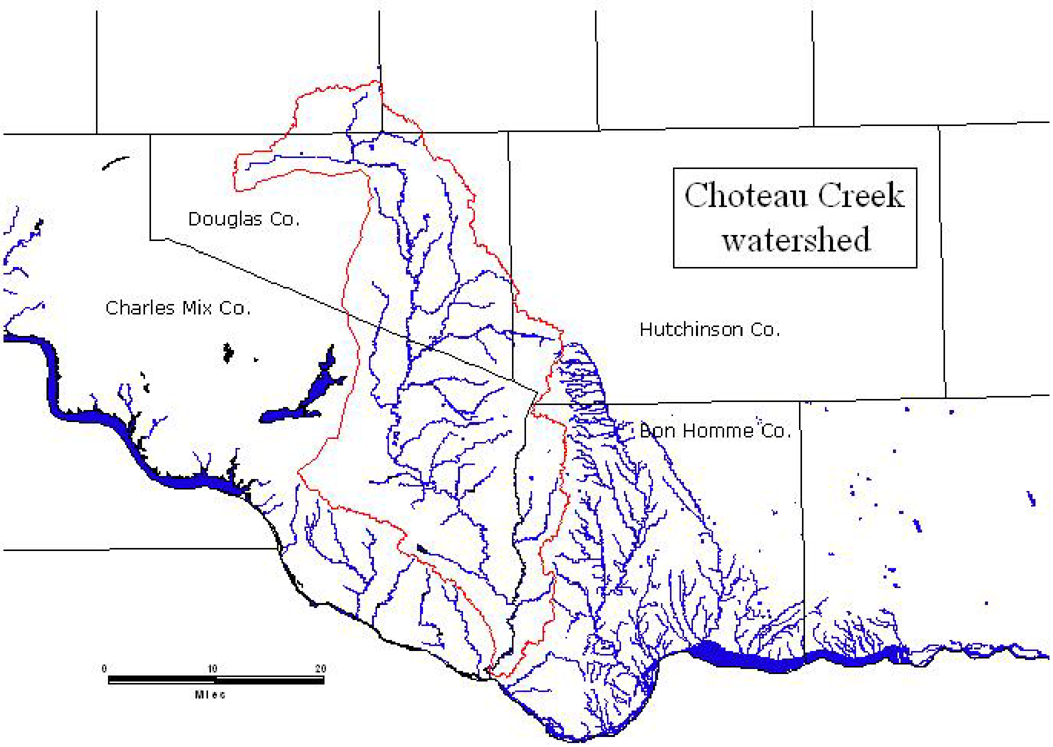


Figure 17. Choteau Creek Watershed

SOUTH DAKOTA WATER QUALITY STANDARDS

Each waterbody within South Dakota is assigned beneficial uses. All waters (both lakes and streams) are designated the use of fish and wildlife propagation, recreation and stock watering. All streams are assigned the use of irrigation. Additional uses may be assigned by the state based on a beneficial use analysis of each waterbody. Water quality standards have been defined in South Dakota state statutes in support of these uses. These standards consist of suites of numeric criteria that provide physical and chemical benchmarks from which management decisions can be developed.

Chronic standards, including geometric means and 30-day averages, are applied to a calendar month. While not explicitly described within the states water quality standards, this is the method used in the State's Integrated Water Quality Report (IR) as well as in permit development.

Additional "narrative" standards that may apply can be found in the "Administrative rules of South Dakota: Articles 74:51:01:05; 06; 08; and 09". These contain language that generally prohibits the presence of materials causing pollutants to form, visible pollutants, and nuisance aquatic life.

Choteau Creek from Wagner to its confluence with Lewis and Clark Lake and Dry Choteau Creek from Highway 50 to its confluence with Choteau Creek have been assigned the beneficial uses of, warmwater semi-permanent fish life propagation; irrigation waters, limited contact recreation; and fish and wildlife propagation, recreation, and stock watering. Table 24 lists the criteria that must be met to support the specified beneficial uses. When multiple criteria exist for a particular parameter, the most stringent criterion is used.

South Dakota Water Quality Standards criteria do not apply when a low quality fishery (marginal and semipermanent warmwater fisheries) is below the 7 day average low flow that can be expected to occur once in five years (7Q5) or 1.0 cubic foot per second, whichever is greater. Choteau Creek is defined as a low quality fisher making this criterion applicable. A flow of 1 cfs will be used as the cutoff for the fishery standard because the 7Q5 for Choteau Creek is equal to approximately 0.25 cfs

Table 24. State Water Quality Standards for Choteau Creek.

Parameters	Criteria	Unit of Measure	Beneficial Use Requiring this Standard
Total ammonia nitrogen as N	Equal to or less than the result from Equation 3 in Appendix A of Surface Water Quality Standards	mg/L 30 average May 1 to October 31	Warmwater Semipermanent Fish Propagation
	Equal to or less than the result from Equation 4 in Appendix A of Surface Water Quality Standards	mg/L 30 average November 1 to April 31	
	Equal to or less than the result from Equation c in Appendix A of Surface Water Quality Standards	mg/L Daily Maximum	
Dissolved Oxygen	≥4.0	mg/L	Warmwater Semipermanent Fish Propagation
Total Suspended Solids	≤90 (mean) ≤158 (single sample)	mg/L	Warmwater Semipermanent Fish Propagation
Temperature	≤32	°C	Warmwater Semipermanent Fish Propagation
Fecal Coliform Bacteria (May 1- Sept 30)	≤1000 (geometric mean) ≤2000 (single sample)	count/100 mL	Limited Contact Recreation
Escherichia Coli Bacteria (May 1- Sept 30)	≤630 (geometric mean) ≤1178 (single sample)	count/100 mL	Limited Contact Recreation
Alkalinity ($CaCO_3$)	≤750 (mean) ≤1,313 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Conductivity	≤2,500 (mean) ≤4,375 (single sample)	mhos/cm @ 25° C	Irrigation Waters
Nitrogen, nitrate as N	≤50 (mean) ≤88 (single sample)	mg/L	Wildlife Propagation and Stock Watering
pH (standard units)	≥6.5 to ≤9.0	units	Warmwater Semipermanent Fish Propagation
Solids, total dissolved	≤2,500 (mean) ≤4,375 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Total Petroleum Hydrocarbon Oil and Grease	≤10 ≤10	mg/L	Wildlife Propagation and Stock Watering
Sodium Adsorption Ratio	<10	ratio	Irrigation Waters

Water Quality Results

ALKALINITY, CONDUCTIVITY, WATER TEMPERATURE, pH, AND DISSOLVED OXYGEN

Table 25 shows the high, low, and average for each parameter. These parameters did not exceed the state standard set for this waterbody.

Table 25. Choteau Creek Water Quality Data

	Alkalinity	Conductivity	Water Temperature	pH	Dissolved Oxygen
High (mg/L)	340	2,530	25.97	8.15	13.71
Low (mg/L)	177	941	15.87	7.24	4.98
Average (mg/L)	255	1,566	22.71	7.76	7.65

SOLIDS

There were a total of 37 suspended solids samples available for analysis of the suspended solids standard. Table 26 has the available suspended solids samples and the dates they were collected. Four of the 37 samples exceeded the state standard of 158 mg/L (highlighted samples) and represent total violations of greater than 10% of the total number of samples.

Table 26. Suspended Solids Samples collected on Choteau Creek

Sample Date	Solids (Suspended mg/L)	Sample Date	Solids (Suspended mg/L)
01/26/1999	22	5/28/2003	26
04/14/1999	**856**	6/4/2003	25
07/29/1999	**200**	6/19/2003	39
10/25/1999	18	6/19/2003	43
01/26/2000	3	6/24/2003	23
04/24/2000	49	7/2/2003	55
07/25/2000	33	7/9/2003	38
10/23/2000	29	7/24/2003	64
01/08/2001	7	7/31/2003	49
04/18/2001	146	8/8/2003	62
07/19/2001	44	8/12/2003	82
10/30/2001	10	8/12/2003	92
01/15/2002	21	8/21/2003	48
04/08/2002	22	8/27/2003	31
07/15/2002	56	**6/13/2005**	**196**
10/22/2002	6	**6/21/2005**	**2700**
5/7/2003	20	7/7/2005	72
5/14/2003	36	07/16/2007	36
5/19/2003	76		

The data in Table 27 was gathered from the USGS web site and presents the maximum daily flow recorded during each year at the USGS gauge near Avon, approximately 15 miles upstream of the sample site. The event that occurred on June 21, 2005 was the largest event in four years time and exceeds 99% of the mean daily flows. The four preceding years of drought conditions may help explain the extraordinarily large concentration measured on this date.

Table 27. Peak Discharges for Choteau Creek at Avon, Provided by USGS Web Site

Water Year	Date	Stream-flow (cfs)	Water Year	Date	Stream-flow (cfs)
1983	Apr. 01, 1983	703	1995	May 30,-1995	4,120
1984	Jun. 12, 1984	7,280	1996	Jun. 17, 1996	594
1985	Mar. 13, 1985	287	1997	Mar. 13, 1997	1,320
1986	Jun. 13, 1986	3,200	1998	Jul. 06, 1998	2,150
1987	Mar. 27, 1987	5,530	1999	Jun. 04, 1999	1,330
1988	Feb. 28, 1988	354	2000	May 18, 2000	310[E]
1989	Mar. 09, 1989	3,002	2001	Apr. 25, 2001	2,820
1990	May 24, 1990	679	2002	Aug. 21, 2002	70
1991	May 30, 1991	256	2003	Jul. 06, 2003	104
1992	May 15, 1992	100	2004	2004	200[2,B]
1993	May 08, 1993	5,120	2005	Jun. 21, 2005	1,040
1994	Mar. 07, 1994	1,080	2006	Apr. 04, 2006	8.2

- 2 -- Discharge is an Estimate
- B -- Month or Day of occurrence is unknown or not exact
- E -- Only Annual Maximum Peak available for this year

Good discharge data at this site was very limited. Samples collected for the ambient monitoring project do not have associated stages or discharges with them. The project data only had eight concentration discharge pairs. In place of using the site data, a gauge 15 miles upstream (USGS on Choteau Creek at Avon, SD) was used to get an estimate of the significance of event flows in exceeding the standard. This correlation may be found in Figure 18.

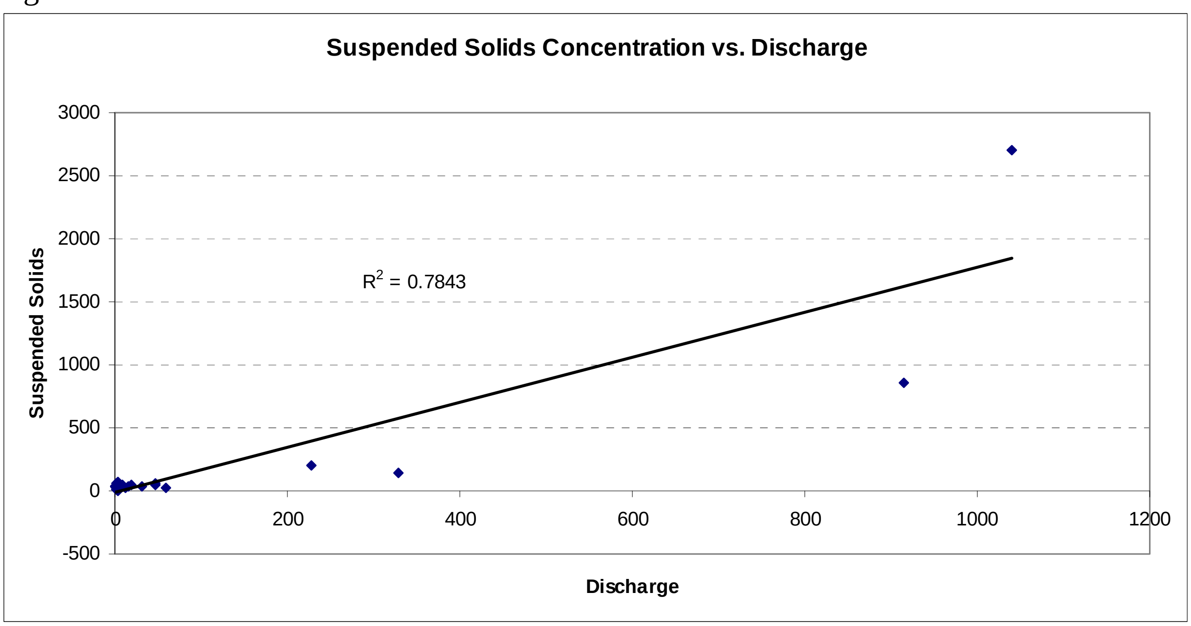


Figure 18. Suspended Solids vs Discharge Relationship for Choteau Creek

Based on data from the USGS gauge and the 26 sampled flows, it is estimated that the standard is exceeded between 200 and 400 cfs on Choteau Creek. While this is a large variation in flow, the frequency of flow recurrence between events of these magnitudes is only about 2%. Estimates of the $Q_{1.5}$ flow for Choteau Creek are about 800 cfs. Figure 19 depicts the flow duration curve for Choteau Creek. Included in this curve is the data for the waste load allocations that are described in greater detail in the following section.

Due in part to targeting the highest flows; the percentage of samples exceeding the standard (4 measured but only 3 with flow pairings to plot) is disproportionate to the frequency the standard was exceeded. While 11% of the samples exceeded the standard, the load duration curve in Figure 19 suggests that the violations only occur during 5% of the flows.

A 5% exceedence may not be sufficient to mandate the development of a TMDL; however the original intent of this study was focused on the reduction of sediment loading to Lewis and Clark Reservoir. An ideal target would be to target reductions resulting in full attainment of the standard at and below the $Q_{1.5}$ flow. To reach this an estimated 78% reduction in the load would be required. This may be unobtainable in this system.

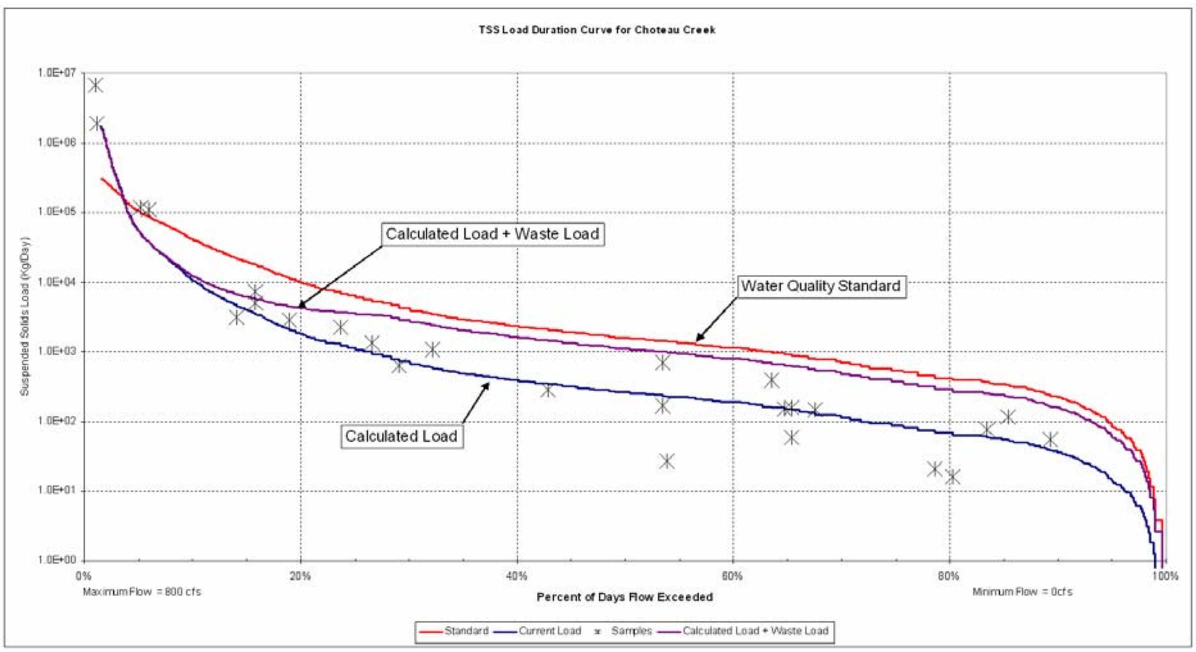


Figure 19. Load Duration Curve for Choteau Creek

Permitted Discharge Facilities

In addition to non point sources of suspended solids, the Choteau Creek drainage also has four permitted wastewater facilities. Of the four facilities, the city of Delmont is permitted as a zero discharge facility and thus should be treated as a zero in any waste load allocations. The remaining three facilities of Avon, Armour, and Wagner are all comprised of a retention pond system that may periodically require a portion of the final pond to be discharged. Table 28 includes the basic system information and permit numbers for each of the facilities within the basin.

Table 28. Permitted Facilities within the Choteau Creek Drainage

Permit Number	Facility Name	System comments	Pond 1 (acres)	Pond 2 (acres)	Pond 3 (acres)	Pond 4 (acres)	Artfcl Wtlnd 1 (acres)	Artfcl Wtlnd 2 (acres)
SD0020222	Armour	Pond/wetland system	10	9.7			8.3	
SD0022730	Avon	Pond system	4.1	2		3.8		
SD0021822	Delmont	Pond system						
SD0020184	Wagner (EPA facility)	Pond/IP basin	20.4	12.95	4.4		2.05	2.9

Table 29 includes the information used by SDDENR to calculate a maximum allowable discharge from each of these facilities. The calculation was based on the assumption that in some instance a complete discharge from the facility may be necessary; however the normal operation of these systems would typically result in only a small fraction of the calculated amounts actually being discharged. It is important to note that all discharges are required to meet state water quality concentration standards.

Table 29. Waste Load Allocation for Facilities in the Choteau Creek Drainage

Facility Name	Flow using drop of 1 foot/day (MGD)	Flow (gpd) used in WLA	30-day Avg TSS permit limit	TSS permit limit converted to lb/ft3	TSS variance allowed?	TSS WLA (lb/day)
Armour	2.70	6098424	110	0.006867	Yes-taken	5598
Avon	1.24	2156228	90	0.005618	Yes-taken	1620
Delmont		0	0	0.000000		0
Wagner (EPA facility)		9300096	30	0.001873	No	2328

Including the waste load allocation in the load duration curve required several factors be taken into account. The maximum waste load for all systems in aggregate is 9,546 pounds (4,329 Kg). Associated with this load is also a flow of 27 cfs of water. A flow of 27 cfs is met or exceeded in Choteau Creek 20% of the time. Arbitrarily adding this load to the entire curve would be a misrepresentation for the lower 80% of the flows, however smaller discharges may impact these flows.

To calculate the impact of the discharge at the lower flows, the measured load and waste load were aggregated and a new concentration was calculated based on this aggregated load, including the additional 27 cfs of flow. The frequency for the stream was then used to plot the new load which was produced by multiplying the new concentration by the stream flow at that frequency. The original stream flow frequency was used since it was based on 20 years of continuous flow data which includes all discharges, however sample data very likely does not reflect periods of discharge. The resulting curve shows that as stream flow increases beyond approximately 200 cfs and nonpoint source loads increase, the waste load and flows actually act to dilute the natural system a small amount (approximately 3 mg/L at 300 cfs).

Non Point Sources

Upland Erosion

To accommodate the large acreage in the Choteau Creek drainage, the watershed was broken into two segments for modeling with AnnAGNPS. The roughly 40,000 acre eastern portion of the basin from the confluence of Choteau and Dry Choteau Creeks was analyzed separately. The AnnAGNPS model suggested that a disproportionate percentage of the TSS load may originate from the Dry Choteau drainage, which generated an erosion rate of 2.3 tons/ acre annually. The 335,000 acres in the western portion of the basin generated an erosion rate of 0.44 tons/acre. These values are erosion rates and may not be used to calculate a delivered load of sediment at the outlet of the watershed. Not only were the erosion rates for Dry Choteau higher than the mainstem, but when compared with the greater Lewis and Clark basin, these loadings were among the highest modeled.

The Choteau Creek drainage contains approximately 258 animal feeding operations. The Dry Choteau drainage area contains only 25 of these operations, four of which are in close enough proximity to the stream to have a potential for contributing suspended solids. These four lots have implementation priority rankings of 25, 38, 86, and 130 (out of 502) in the Lewis and Clark Implementation Project. The relatively high rankings of the top two will result in further analysis and potential remediation during implementation. However, it is unlikely this will significantly affect TSS loadings, as their combined acreage is estimated to be less than 7 acres.

Bed and Bank Erosion

There were 262 individual Rapid Geomorphic Assessments (RGAs) completed in the Choteau Creek drainage. Figure 20 depicts the locations of each of the RGAs and also represents their relative stability scores. Each RGA was completed on both upstream and downstream portions of a road crossing, resulting in what appears to be some sites receiving both a stable and unstable score. These are treated as two separate scores for each crossing, one upstream and the other downstream. This was done to determine potential impacts of culverts and bridges under the assumption that a stable score upstream and an unstable score downstream may be a localized effect of the road crossing.

Culverts on small streams such as Choteau Creek may at times create more instability immediately downstream of the structure than bridges do, when installed in similar situations. All of the road crossings along the Dry Choteau segment having the unstable RGA scores have bridges installed. The upstream sites at these road crossings also received unstable scores, indicating that it is unlikely that the road crossings along this portion of the stream are contributing to channel instability.

Using a gross score of 20 as the dividing line between stable and unstable channels, it appears that the lower reaches of Choteau Creek are more unstable than the rest of the watershed. Based on a combination of RGA scores and the best professional judgment of the local coordinators, approximately 50 miles of the 420 stream miles (12%) were identified as having intermittent segments of degraded channel stability (see the bolded stream segments in Figure 20).

These unstable portions of stream may have a variety of causes including increased runoff from adjacent upland areas, poorly designed road crossings, and agricultural pressures in and around the stream riparian area. It is suspected that all of these factors in addition to natural channel erosion processes may be contributing factors in various portions of the watershed.

RGA scores throughout the remainder of the basin indicate a range of conditions. Unstable sites found upstream of the highlighted section in Figure 3 appear to be localized in nature. Remediation success is more likely on localized area such as these, however many of them are located a significant distance upstream of the listed segment. Due to this distance, best management practices applied to these areas are unlikely to result in measurable improvements in the listed segment.

Streams within ecoregion 42 (including Choteau Creek) that are stable may be expected to generate annual suspended sediment loads ranging from 0.537 T/y/km^2 to 2.43 T/y/km^2 with a median load of 1.03 T/y/km^2 (Klimentz *et al,* 2009). The maximum measured annual load in a stable stream for this ecoregion was measured at 4.39 T/y/km^2.

Substituting suspended solids data for the suspended-sediment data, the same methodology used by Klimentz and Simon was utilized for the Choteau Creek data. A rating equation was developed to create daily yield values in tons per day from mean-daily discharge data. Mean-daily loads were summed for each complete calendar year, providing a mean annual load (T/y). To normalize data for watersheds of different size, sediment load was divided y drainage area, providing calculations of mean annual sediment yield (T/y/km^2).

A sediment load of 22.5 T/y/km^2 was calculated for the stream. Depending on the reduction target selected (maximum vs. median of stable channels) reduction in sediment transport of 81% to 95% is necessary to reach the expected loading in a stable channel.

Considering all of the assessment data, it appears that the smaller Dry Choteau drainage may be the primary source of impairment for the greater drainage area. Nonpoint source modeling indicated Dry Choteau was more likely to generate excess sediment loads and RGA analysis indicated most of its primary channel is unstable. It is possible that as the channel in Dry Choteau degraded, it resulted in a head cut that moved up the mainstem of Choteau Creek. Implementation priority should focus on the Dry Choteau drainage with particular emphasis placed on riparian areas along the unstable segments of the stream.

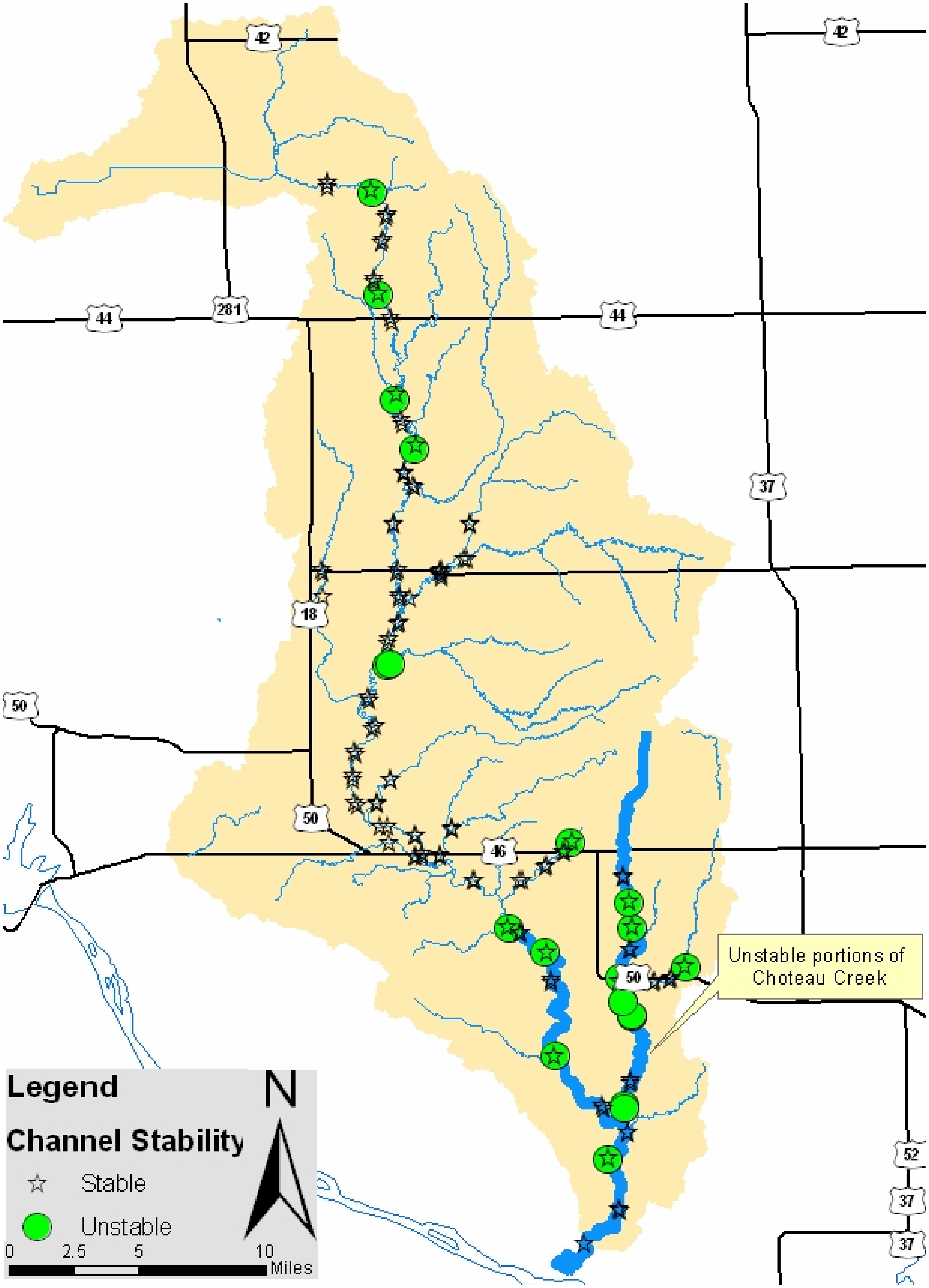


Figure 20. Choteau Creek Channel Stability based on RGA Scores

Fecal Coliform Bacteria

Fecal coliform only exceeded the standard on a single occasion during routine and project funded sampling of Choteau Creek. The standard was exceeded during the June 21, 2005 runoff event. Table 30 lists all available E. coli and Fecal Coliform data along with the corresponding suspended solids concentration for each of these samples. The single violation from the 23 samples suggests the stream is adequately supporting its beneficial uses in regards to bacteria.

There is a weak correlation between suspended solids concentration and fecal coliform concentration. There is a good correlation between solids and flow. High fecal counts during low flow conditions are typically attributed to livestock accessing the stream. High flow violations are frequently attributed to feeding areas and overstocked and degraded pasture areas. The concentration measured on June 21, 2005, while still above the standard, is not of a magnitude to suggest severe impairment. BMPs targeting bacteria reduction are not necessary, but bacteria concentrations will be indirectly addressed through efforts to reduce suspended solids concentrations in the basin. There are 7 feeding operations located within the drainage that made the assessment report top 20 for highest risk of causing impairment. It is recommended that these be addressed to provide additional protection for the resource.

Table 30. Fecal Coliform Data in Choteau Creek

SampleDate	E COLI	Fecal Coliform - MF	Solids (Suspended)
07/29/1999		1200	200
07/25/2000		640	33
07/15/2002		500	56
5/7/2003	16	20	20
5/14/2003	56.9	100	36
5/19/2003	108	160	76
5/28/2003	33.7	60	26
6/4/2003	114	140	25
6/19/2003	272	510	43
6/19/2003	345	290	39
6/24/2003	68.3	240	23
7/2/2003	145	400	55
7/9/2003	24.8	1140	38
7/24/2003	8.3	160	64
7/31/2003	15.8	250	49
8/12/2003	10.6	230	82
8/12/2003	5.1	240	92
8/21/2003	20.9	240	48
8/27/2003	4.1	100	31
6/13/2005	1203	1200	196
6/21/2005	>2420	22000	2700
7/7/2005		600	72
07/16/2007		20	36

Tributary Site Summary

Determining the exact source of high suspended solids loads is somewhat problematic for Choteau Creek with the amount of data available at the end of this assessment. Modeling would suggest the primary impairment for the basin is the 40,000 acre Dry Choteau drainage. RGAs seem to suggest that the problem may actually be channel driven in the lower 50 miles of the stream, about ½ of which is located in the Dry Choteau drainage.

The distinct similarities seen between Choteau and Emanuel Creek suggest that a similar TMDL goal and target would be an excellent start towards improving water quality in Choteau Creek. Setting a goal of eliminating the suspended solids violations during all events smaller than the $Q_{1.5}$ may be accomplished by reducing the load by approximately 40%. The primary focus of implementation efforts should be targeted at the lower 50 reach miles with special emphasis placed on the Dry Choteau Creek drainage. As a result of the generalities used in developing the AnnAGNPS model, it may be beneficial to re-evaluate the Dry Choteau drainage either as a part of the implementation or as part of a post implementation project to help identify critical locations more precisely.

The Choteau Creek watershed is characterized by a large number of animal feeding operations, both wintering and traditional finishing lots. While no bacteria standard issues were documented, continued observance of elevated counts suggests that mitigation of a few of the highest ranked areas will result in greater protection of the resource. It is also likely that BMPs targeted to reduce erosion will also result in additional reductions in bacteria counts.

SURFACE WATER CHEMISTRY (EMANUEL CREEK)

Watershed Overview

Emanuel Creek drains 120,000 acres in southeast South Dakota and discharges to Lewis and Clark Lake in Bon Homme County. The stream receives runoff from agricultural operations. During the Lewis and Clark Watershed Assessment, it was determined that the creek experiences periods of degraded water quality due to total suspended solids and bacteria concentrations. The land use in the watershed is predominately agricultural consisting of cropland (61%) and grazing (32%), with the remaining portions of the watershed composed of water and wetlands (2%), roads and housing (4%), and forested lands (1%). These percentages are considered representative of both the watershed as a whole, as well as the drainage area immediately surrounding the listed segment. Segment SD-MI-R-EMANUEL_01 is listed for fecal coliform bacteria and total suspended solids. .

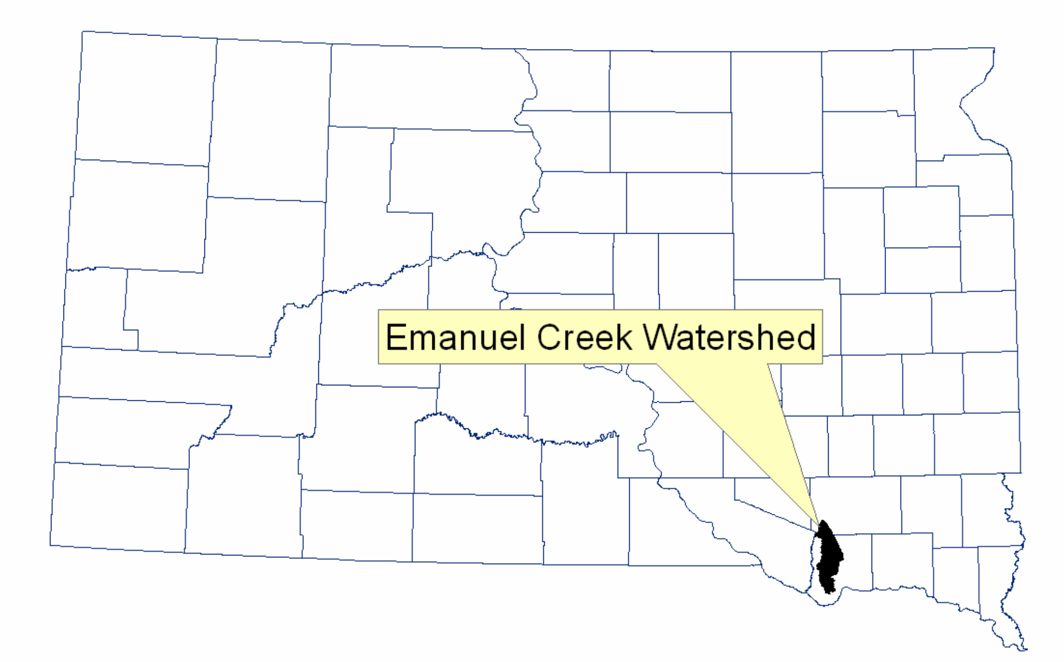


Figure 21. Emanuel Creek Watershed Location in South Dakota

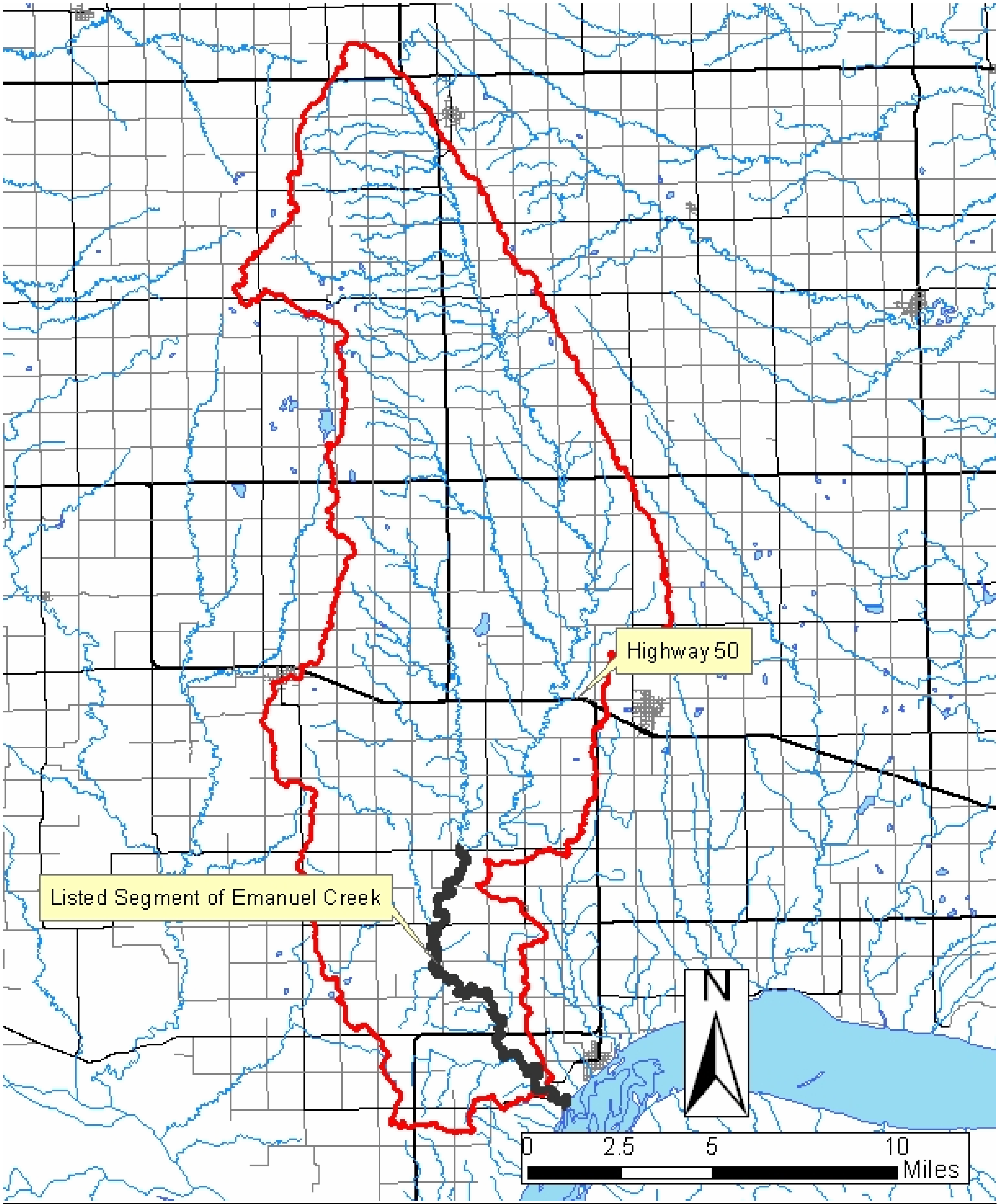


Figure 22. Emanuel Creek Watershed

Description of Applicable Water Quality Standards & Numeric Water Quality Targets

Each waterbody within South Dakota is assigned beneficial uses. All waters (both lakes and streams) are designated the use of fish and wildlife propagation, recreation and stock watering. All streams are assigned the use of irrigation. Additional uses may be assigned by the state based on a beneficial use analysis of each waterbody. Water quality standards have been defined in South Dakota state statutes in support of these uses. These standards consist of suites of numeric criteria that provide physical and chemical benchmarks from which management decisions can be developed.

Emanuel Creek has been assigned the beneficial uses of: warmwater semi-permanent fish life propagation; irrigation waters, limited contact recreation; and fish and wildlife propagation; recreation, and stock watering. Table 31 lists the criteria that must be met to support the specified beneficial uses. When multiple criteria exist for a particular parameter, the most stringent criterion is used.

The criteria for the semipermanent fish life propagation beneficial use requires that 1) no sample exceeds 158 mg/L and 2) during a 30-day period, the mean of minimum of 3 samples collected during separate 24-hour periods must not exceed 90 mg/L. This criterion is applicable throughout the year.

Table 31. State Water Quality Standards for Emanuel Creek.

Parameters	Criteria	Unit of Measure	Beneficial Use Requiring this Standard
Total ammonia nitrogen as N	Equal to or less than the result from Equation 3 in Appendix A of Surface Water Quality Standards	mg/L 30 average May 1 to October 31	Warmwater Semipermanent Fish Propagation
	Equal to or less than the result from Equation 4 in Appendix A of Surface Water Quality Standards	mg/L 30 average November 1 to April 31	
	Equal to or less than the result from Equation c in Appendix A of Surface Water Quality Standards	mg/L Daily Maximum	
Dissolved Oxygen	≥4.0	mg/L	Warmwater Semipermanent Fish Propagation
Total Suspended Solids	≤90 (mean) ≤158 (single sample)	mg/L	Warmwater Semipermanent Fish Propagation
Temperature	≤32	°C	Warmwater Semipermanent Fish Propagation
Fecal Coliform Bacteria (May 1- Sept 30)	≤1000 (geometric mean) ≤2000 (single sample)	count/100 mL	Limited Contact Recreation
Alkalinity ($CaCO_3$)	≤750 (mean) ≤1,313 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Conductivity	≤2,500 (mean) ≤4,375 (single sample)	µmhos/cm @ 25° C	Irrigation Waters
Nitrogen, nitrate as N	≤50 (mean) ≤88 (single sample)	mg/L	Wildlife Propagation and Stock Watering
pH (standard units)	≥6.5 to ≤9.0	units	Warmwater Semipermanent Fish Propagation
Solids, total dissolved	≤2,500 (mean) ≤4,375 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Total Petroleum Hydrocarbon Oil and Grease	≤10 ≤10	mg/L	Wildlife Propagation and Stock Watering
Sodium Adsorption Ratio	<10	ratio	Irrigation Waters

Water Quality Results

ALKALINITY, CONDUCTIVITY, NITROGEN, WATER TEMPERATURE, pH, PHOSPHORUS AND DISSOLVED OXYGEN

These parameters did not exceed the state standard set for Emanuel Creek. Table 32 shows the high, low, and average for each parameter.

Table 32. Emanuel Creek Water Quality Data

	Alkalinity	Specific Conductivity	Ammonia	Nitrogen as Nitrate	TKN	Water Temperature	pH	Phosphorus	Dissolved Oxygen
High (mg/L)	410	1,895	0.18	0.5	1.61	27.82	8.08	2.02	11.70
Low (mg/L)	107	1,410	<0.02	<0.1	0.28	14.28	7.35	.048	7.15
Average (mg/L)	250	1,686	0.04	0.15	0.73	21.10	7.83	.30	10.17

SOLIDS

Solids are assessed in four separate forms (dissolved, total, suspended and organic). Of these forms, state standards exist for two, dissolved and suspended. Dissolved solids did not exceed state standards in any of the samples collected during the project. Four of the 24 suspended solids samples were above the standard. These samples did occur during runoff events and coincided with elevated values for nutrients and bacteria.

Table 33 contains all of the suspended solids data collected from Emanuel Creek during the project. The four samples that exceeded the state standard of 158 mg/L were collected during peak flow events which were beyond the abilities of the equipment and coordinator to safely collect a discharge. Stage measurements were taken at these discharges placing them 2 to 3 times deeper than the peak discharges measured. Best estimates of discharge during these events place them between 500 and 1500 cfs.

Table 33. Suspended Solids Concentrations in Emanuel Creek

SampleDate	Discharge (flow)	Solids (Suspended mg/L)
7/16/2003	22.9	
9/15/2003	3.1	
5/22/2003	14.8	21
5/7/2003		42
5/14/2003	20.4	101
5/27/2003	10.8	17
6/4/2003	11.5	16
6/19/2003	8.6	28
6/23/2003		31
6/30/2003	15.0	25
7/8/2003	28.5	98
7/24/2003	7.6	37
7/31/2003	3.7	31
8/6/2003	2.6	25
8/12/2003	3.0	24
8/21/2003	2.3	18
8/27/2003	2.5	13
9/10/2003	19.4	60
9/10/2003	19.4	54
5/17/2004		14
8/24/2004		330
8/25/2004	37.0	80
6/6/2005		384
6/13/2005		288
6/21/2005		2140
7/7/2005	19.4	43

Plotting discharges against suspended solids (Figure 23) a trend emerges indicating that as flow increases so does the suspended solids concentration. Sampling during the project was conducted to target runoff events, thus over representing high flow situations. The highest concentrations do not have good discharge measurements, but estimates based on field notes suggest that these concentrations fall relatively close to the trend line for the data with good discharge measurements. Extending the trend line in Figure 23, it appears that the suspended solids standard is exceeded during flow events greater than 60 to 70 cfs.

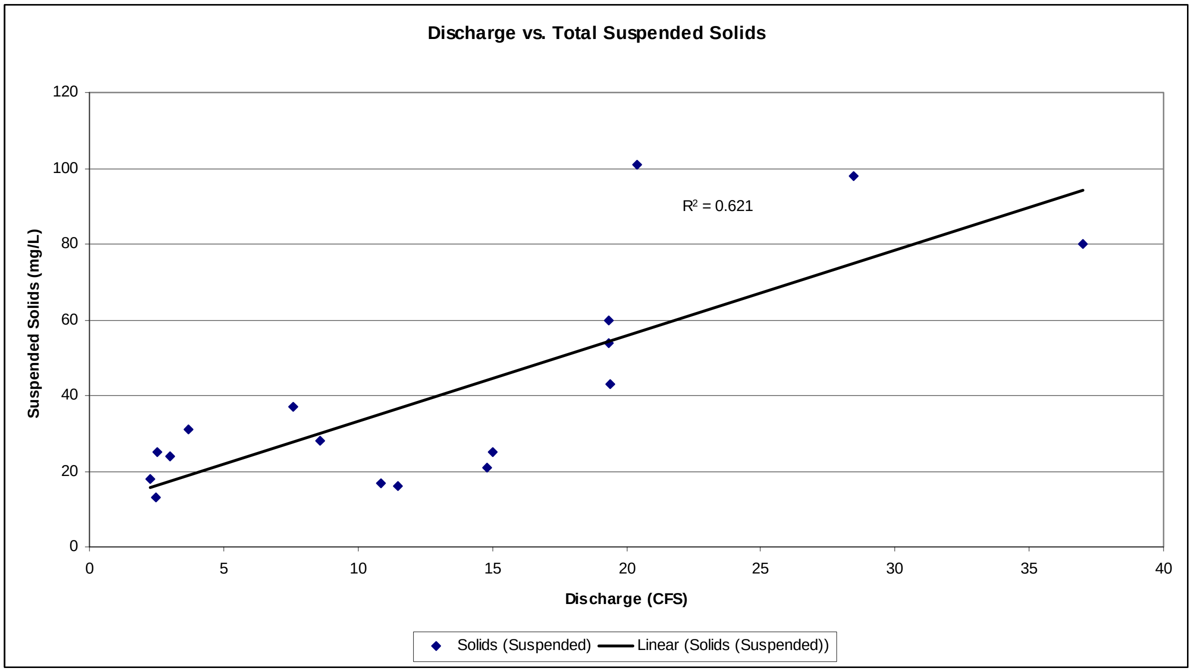


Figure 23. Suspended Solids vs. Discharge in Emanuel Creek

Emanuel Creek created a challenging situation for the application the South Dakota water quality standards. When simply looking at flow frequency, the stream was in full support of the standard 95% of the time, which were essentially all flows less than 70 cfs. The challenge arises when comparing the loads to the flows, the 5% of the flows that do exceed the standard carry approximately 97% of the average annual load. The original intent of the study was to document and reduce sediment loadings to Lewis and Clark Reservoir. To maintain the intent of the study, a TMDL was developed for a reduction in sediment loadings. The suggested goal was to reduce concentrations at all flows occurring at or below the $Q_{1.5}$ flow. This will require a 40% reduction in loadings and will increase the frequency that the stream has full support of the water quality standards from 95% to 99% of the time.

The suspended solids load calculated from water quality data for this project estimated a total suspended solids load of approximately 1040 tons/year. This places Emanuel Creek at approximately double the median load for the greater Lewis and Clark basin. The AnnAGNPS model suggested something different, compared with the other watersheds in the Lewis and Clark drainage that Emanuel Creek should be expected to carry lower than average loads of solids.

A number of rapid geomorphic assessments (RGAs) were conducted on portions of Emanuel Creek located downstream of Highway 50 (Figure 24). Scores from the RGAs indicated an unstable channel. Since the AnnAGNPS model does not address channel stability or erosion, the high RGA scores help explain the source of sediments in Emanuel Creek. The scoring technique used during this assessment places any channel with a score of 20 or greater into the unstable category. Using this as the basis to target stream miles, 50 % or approximately 30 km of the stream located downstream of Highway 50 are unstable and contributing to increased sediment loading.

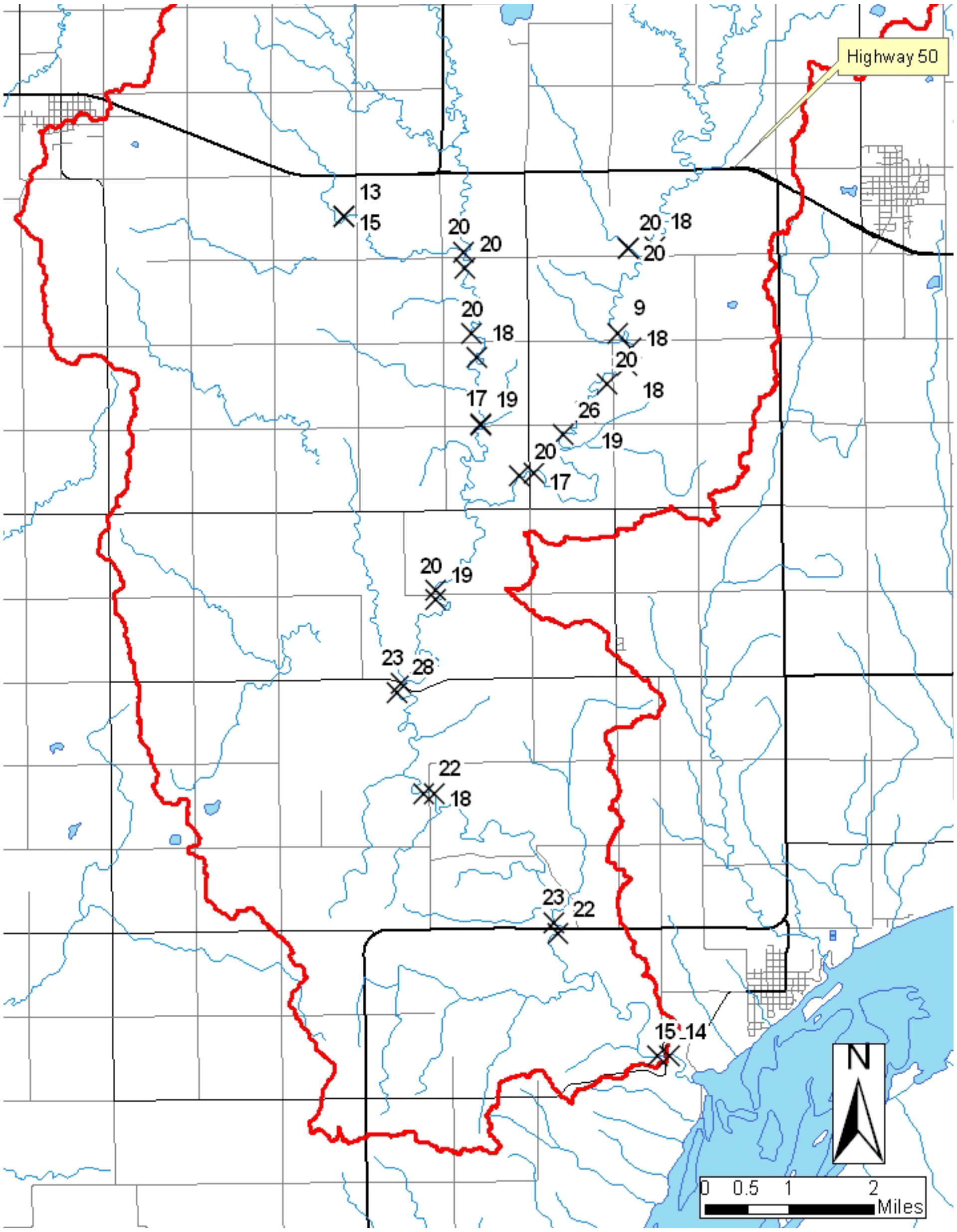


Figure 24. Emanuel Creek RGA Locations

FECAL COLIFORM BACTERIA

Fecal coliform bacteria exceeded the standard on six of the 23 samples or 25% of the time. The violations do appear to be primarily storm event driven with the highest counts occurring at or above 20 CFS, however counts that were elevated, but not in excess of the standard were routinely measured during base-flow conditions also suggesting some riparian issues exist along this stream. Mean daily fecal coliform loading in Emanuel Creek was calculated to be 7.56 x 10^{12} colonies/ day. The maximum mean daily load allowable under the state standard of 1000 colonies/ 100mL is 7.59 x 10^{11} colonies/ day. To reach this load, a 90% reduction in fecal loading is required.

Table 34 lists most animal sources of fecal coliform in the Emanuel Creek Watershed. Wildlife densities were generated by the SD Game Fish and Parks in the 2002 County Wildlife Assessment. Livestock data was gathered from the National Agricultural Statistics publication for 2004. Assuming an equal distribution throughout the watershed, the percentages may be used as the source allocations for each species. There are no point sources of fecal coliform in this watershed and it is assumed that if failing septic systems are present they contribute a negligible load.

Table 34. Fecal Coliform Sources by Species in Emanuel Creek

Species	#/mile	#/acre	FC/Animal/Day	FC/Acre	Percent
Dairy cow	24.00	3.8E-02	4.46E+10	1673625000	17.8%
Beef	108.00	1.7E-01	3.90E+10	6581250000	70.0%
Hog	35.00	5.5E-02	1.08E+10	590625000	6.3%
Sheep	4.00	6.3E-03	1.96E+10	122500000	1.3%
Horse	1.00	1.6E-03	5.15E+10	80437500	0.9%
Poultry	100.00	1.6E-01	1.36E+08	21250000	0.2%
All Wildlife	Sum of all Wildlife			325710622	3.5%
Turkey (Wild)	1.57	2.5E-03	9.30E+07	228141	
Goose	0.02	3.1E-05	7.99E+08	24969	
Deer	3.06	4.8E-03	3.47E+08	1659094	
Beaver	2.44	3.8E-03	2.00E+05	763	
Raccoon	5.24	8.2E-03	5.00E+09	40937500	
Coyote/Fox	2.27	3.5E-03	1.85E+09	6561719	
Muskrat	5.24	8.2E-03	2.50E+07	204688	
*Opossum**	1.92	3.0E-03	5.00E+09	15000000	
*Mink**	1.48	2.3E-03	5.00E+09	11562500	
*Skunk**	2.27	3.5E-03	5.00E+09	17734375	
*Badger**	1.22	1.9E-03	5.00E+09	9531250	
*Jackrabbit**	1.92	3.0E-03	5.00E+09	15000000	
*Cottontail**	19.2	3.0E-02	5.00E+09	150000000	
*Squirrel**	7.33	1.1E-02	5.00E+09	57265625	

** FC/Animal/Day copied from Raccon to provide a more conservative estimate of background affects of wildlife*

There are an estimated 97 animal feeding operations in the Emanuel Creek Watershed, many of which are contributors to the bacteria load, particularly during runoff events. Based on the National Agricultural Statistics report, approximately 40% of the cattle present in the watershed may be found in feedlots. Rankings and contributions from each feeding operation may be found in Appendix C. The majority of pigs in the watershed may also be assumed to be in some type of confined feeding area. Table 35 is a summary of Table 34 allocating all sources into three primary categories.

Table 35. Fecal Source Allocation for Emanuel Creek

Source	Percentage
Feedlots	41.7%
Livestock on Grass	54.9%
Wildlife	3.5%

The lower 26 kilometers of Emanuel Creek have the more restrictive beneficial use standards of semipermanent fish life propagation and limited contact recreation. Mean daily fecal counts of less than 1000 colonies/100 mL and maximum counts of 2000 colonies/100mL must be maintained for the entire segment in order for it to fully support its beneficial uses.

It is established that an overall 90% reduction is necessary and that natural background will account for 3.5% of the load. A 93% reduction will be required from human induced sources to reach the target of a mean daily load of 7.59×10^{11} colonies/ day.

Fecal coliforms mortality in streams occurs at a rate of 90% in the first 2 to 5 days. Transport in Emanuel Creek is calculated to be between 15 km and 25 km per day at base flow when lower velocities are present. Runoff event discharges exhibiting higher velocities may be expected to transport organisms 20 km to 30 km per day. The farthest reaches of the watershed are 75 km from the start of the listed segment resulting in a potential die off of 90% of the organisms before they reach the listed segment.

Available data makes it impossible to allocate specific loads to particular portions of the watershed. It is likely that the load may be significantly reduced through the mitigation of sources closest to the listed segment of Emanuel Creek. This segment may be found in Figure 25 and restoration activities should make all sources within one kilometer of the listed segment their first priority. Second priority should target all sources south of Highway 50, which is 18 km upstream of the listed segment. Sources north of Highway 50 should be considered on a case by case basis.

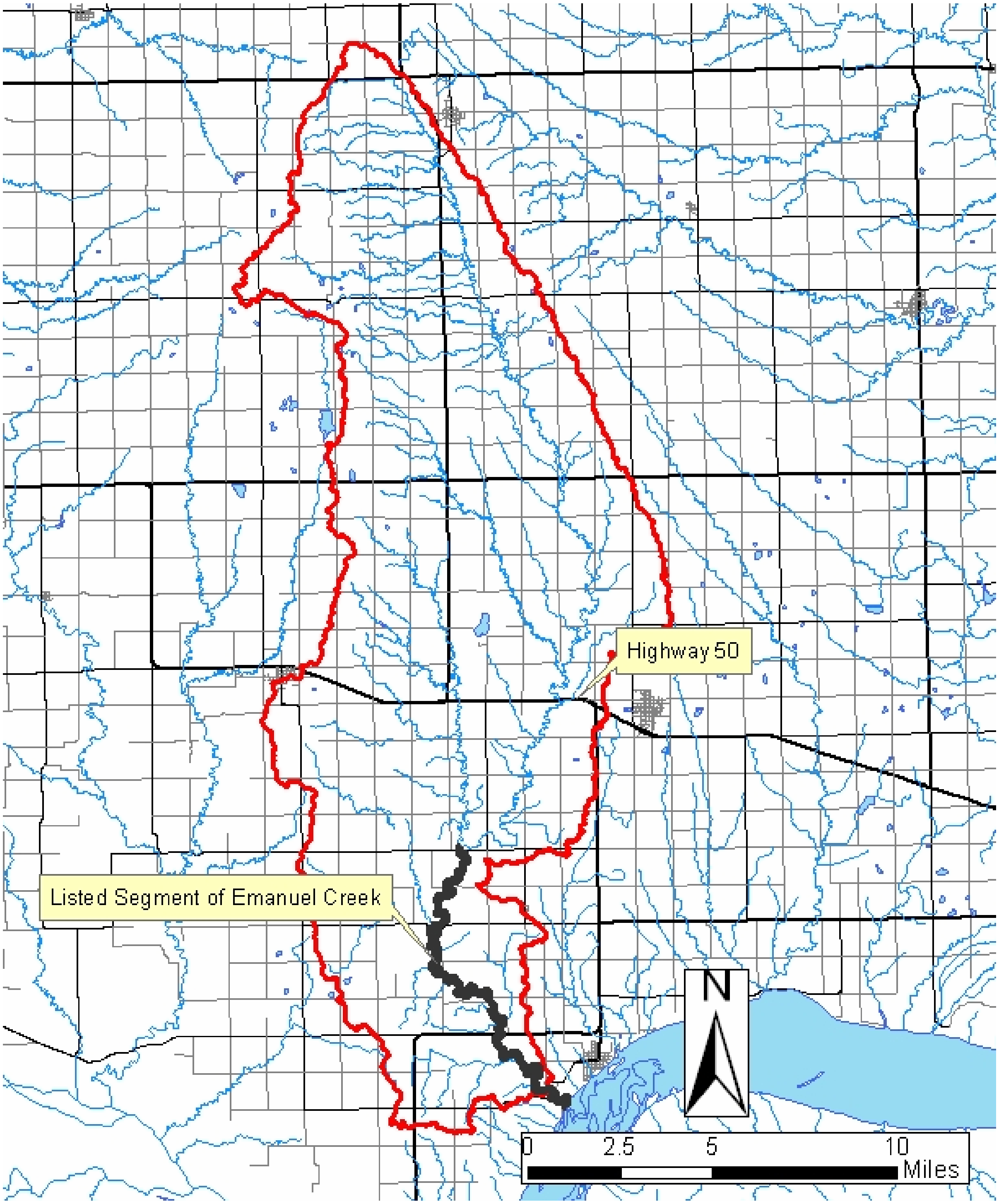


Figure 25. Portions of Emanuel Creek Listed as having Recreational and Fishery uses.

Tributary Site Summary

The two greatest impairments to Emanuel Creek appear to be animal feeding operations during runoff events and riparian zone management of the lower 25 km of the stream during baseflow. The BMPs recommended for this watershed include cleaning up priority animal feeding operations and riparian buffers. Bacteria issues will be addressed by both BMPs while elevated suspended solids loads will be addressed primarily by riparian buffers.

Targeting the highest ranked feeding operations south of Highway 50 and the riparian zone along the listed segments of the creek should be a first priority. Fecal coliform monitoring at the outlet and the start of the listed segment should be conducted on a regular basis throughout the implementation to track impacts of BMPs. It is expected that by targeting priority areas a 90% reduction in fecal loads may be achieved by treating 7% of the watershed.

Riparian buffers upstream of the listed segment, but south of Highway 50 will also provide significant reductions for bacteria and should be a second priority for BMPs. It is likely that the portions of the stream corridor contributing the greatest amounts of bacteria are also the most unstable portions of the channel and are contributing the largest portions of suspended sediment loads.

Riparian buffers and feeding operations north of Highway 50 may also provide reductions, but should be evaluated on a case by case basis with preference given to those located further downstream.

Some impairment may also be the result of cropping practices, but is likely limited and should be investigated on a case by case basis. A survey of crop fields indicated that approximately 75% to 90% of operators in this part of the state are using some sort of conservation tillage. While an encouraging sign, this limits potential improvements from BMPs directed at these practices.

SURFACE WATER CHEMISTRY (SNATCH CREEK)

Snatch Creek drains approximately 30,000 acres of southeastern South Dakota and enters Lewis and Clark Lake downstream of Springfield South Dakota. A public access area is located at its confluence with the Lewis and Clark Lake. This site was observed during the project to be a popular fishing and swimming area for local youth. The beneficial uses of Snatch Creek do not include a fishery classification. The watershed is characterized by production agriculture consisting mainly of row crops and animal feeding operations with grazing confined to stream corridors and uplands considered marginal for crop production.

Watershed Overview

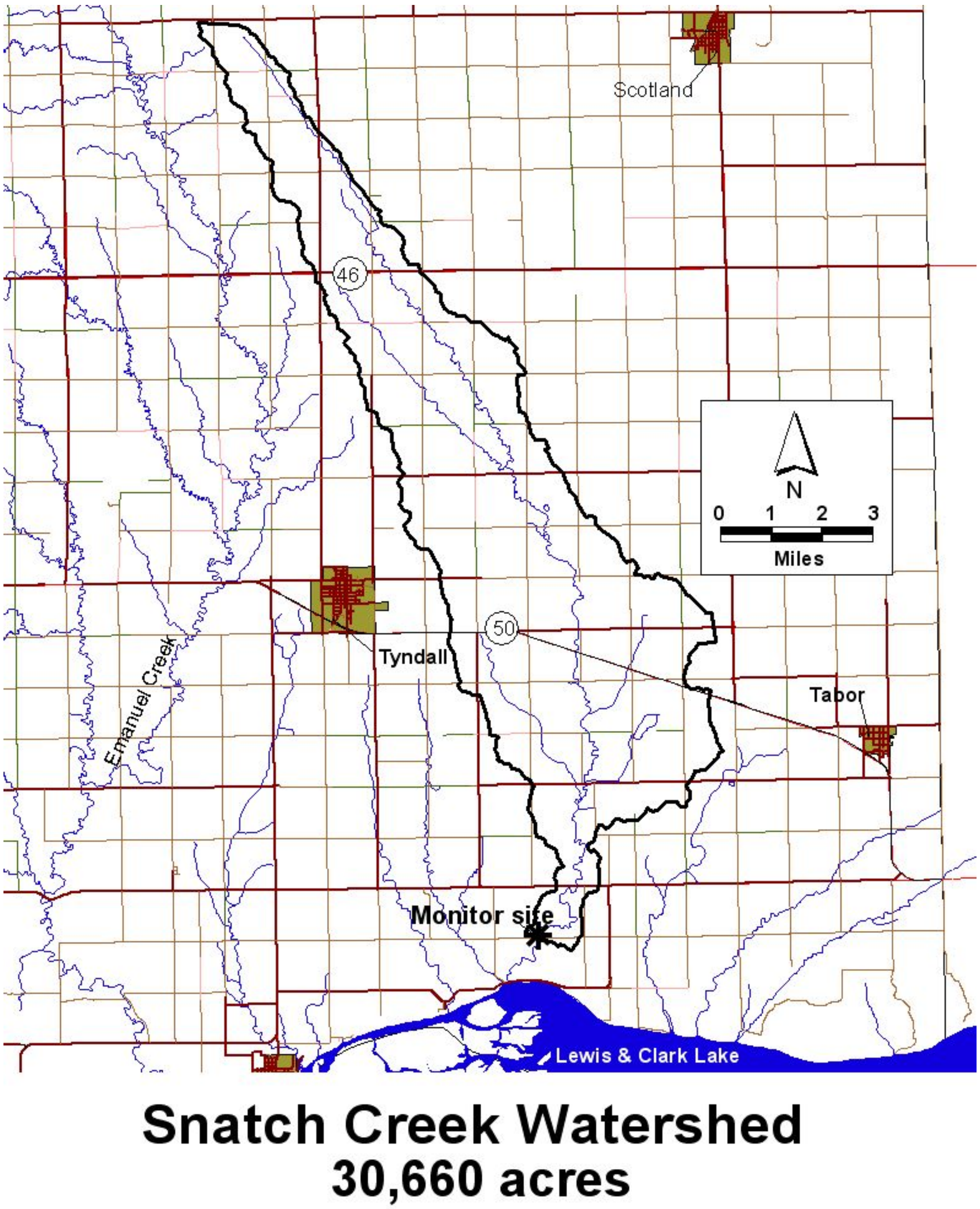


Figure 26. Snatch Creek Watershed

South Dakota Water Quality Standards

The State of South Dakota assigns at least two beneficial uses to every waterbody in the state. Fish and wildlife propagation, recreation and stock watering as well as irrigation are assigned to all stream and rivers. All portions of Snatch Creek must maintain the criteria that support these uses. There are seven standards that must be maintained. These standards, as well as the water quality values that must be met, are listed in Table 36.

Table 36. State Water Quality Standards for Snatch Creek

Parameters	Criteria	Units of Measure	Beneficial Use Requiring this Standard
Alkalinity ($CaCO_3$)	≤750 (mean) ≤1,313 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Conductivity	≤2,500 (mean) ≤4,375 (single sample)	µmhos/cm @ 25° C	Irrigation Waters
Nitrogen, nitrate as N	≤50 (mean) ≤88 (single sample)	mg/L	Wildlife Propagation and Stock Watering
pH (standard units)	≥6.0 to ≤9.5	units	Wildlife Propagation and Stock Watering
Solids, total dissolved	≤2,500 (mean) ≤4,375 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Total Petroleum Hydrocarbon Oil and Grease	≤10 ≤10	mg/L	Wildlife Propagation and Stock Watering
Sodium Adsorption Ratio	<10	ratio	Irrigation Waters

Water Quality Results

None of the water quality parameters tested exceeded the state standards for Snatch Creek. With the exception of very high bacterial counts, most of the water quality standards would have been low enough to meet the states most restrictive fishery standards.

Fecal Coliform Bacteria

No bacteria standard exists for Snatch Creek; however samples were collected slightly upstream from Lewis and Clark Lake that maintains a fecal standard of 400 colonies/100mL for a single sample, or 200 colonies/100mL as a geometric mean. Samples collected from Snatch Creek frequently had concentrations high enough to result in localized impairments to Lewis and Clark Lake at the confluence of the two waterbodies. Median concentrations were nearly double that of any other site sampled during the assessment.

Slightly elevated coliform counts occurred at baseflow, likely only having a minimal affect on Lewis and Clark Lake. Storm event flows had significantly higher concentrations, coupled with increased flows; these samples most likely had a much more significant impact on the water quality of Lewis and Clark Lake, particularly in and around the public access area. These event driven counts are most likely the result of animal feeding operation runoff.

Tributary Site Summary

The water quality of Snatch Creek is technically within the standards set for it. Due to lack of consistent flow, none of the more restrictive fishery or recreation standards exist for this stream. Snatch Creek may be causing localized impairments (high bacteria counts) within portions of Lewis and Clark Lake.

As part of implementation activities in the greater Lewis and Clark Watershed, some time should be devoted to examining feeding operations in this watershed more closely. It is possible that there are just a few significant contributors that are driving up concentrations and may result in significant reductions if mitigated.

SURFACE WATER CHEMISTRY (RAHN DAM)

Rahn Dam is a 13 acre man-made impoundment in Tripp County, South Dakota (Figure 27). The Rahn Dam watershed is approximately 37,700 acres (2,900:1 watershed to lake ratio) and consists predominately of rangelands with little row crop agriculture.

The watershed is located within Major Land Resource Area (MLRA) 66 and is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA's location near the geographic center of North America. There are few natural barriers on the Northern Great Plains and the winds move freely across the plains and account for rapid changes in temperature.

Annual precipitation ranges from 22 to 25 inches per year. The normal average annual temperature is about 48°F. January is the coldest month with average temperatures ranging from about 19°F (Bonesteel, South Dakota (SD)), to about 23°F (Ainsworth, Nebraska (NE)). July is the warmest month with temperatures averaging from about 74°F (Lynch, NE), to about 75°F (Gregory, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 54°F. This large annual range attests to the continental nature of this area's climate. Hourly winds average about 10 miles per hour annually, ranging from about 11 miles per hour during the spring to about 9 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour. (eFTOG, 2011)

Major soil associations consist of the Anselmo-Holt and Doger-Elsmere. Anselmo-Holt soils are uplands soils that are found on level landscapes overtop of sandstone bedrock. They are well drained, have moderate fertility and are droughty at times. Crops may be grown in some of the Anselmo soils, but the primary enterprises are livestock and dairy farming. Doger Elsmere soils are found on bottomlands and uplands. They are sandy soils that are well drained and prone to wind erosion. Cropping is limited, the majority of these soils are maintained in native range with the primary management concern consisting of wind erosion.

An endangered species, the American burying beetle(*Nicrophorus americanus*) has been located in the Rahn Dam watershed. The estimated population in South Dakota exceeds 500 individuals, mostly in Tripp County (Backlund et al. 2008). In south central South Dakota there is an estimated 800 square miles of suitable habitat. The entire Rahn Dam watershed is included in that suitable habitat. The American burying beetle in northern Nebraska and South Dakota are found in areas with low human densities, minimal light pollution, and land use is primarily grazing for beef cattle (Bedick et al. 1999). Habitat conditions in southern Tripp County, South Dakota appear to be stable (US FWS 2008). Carlton and Rothwein (1998) suggest that South Dakota populations of the American burying beetle represent a robust population that should be investigated further for the physical and biological conditions that are favorable for proliferation of the species.

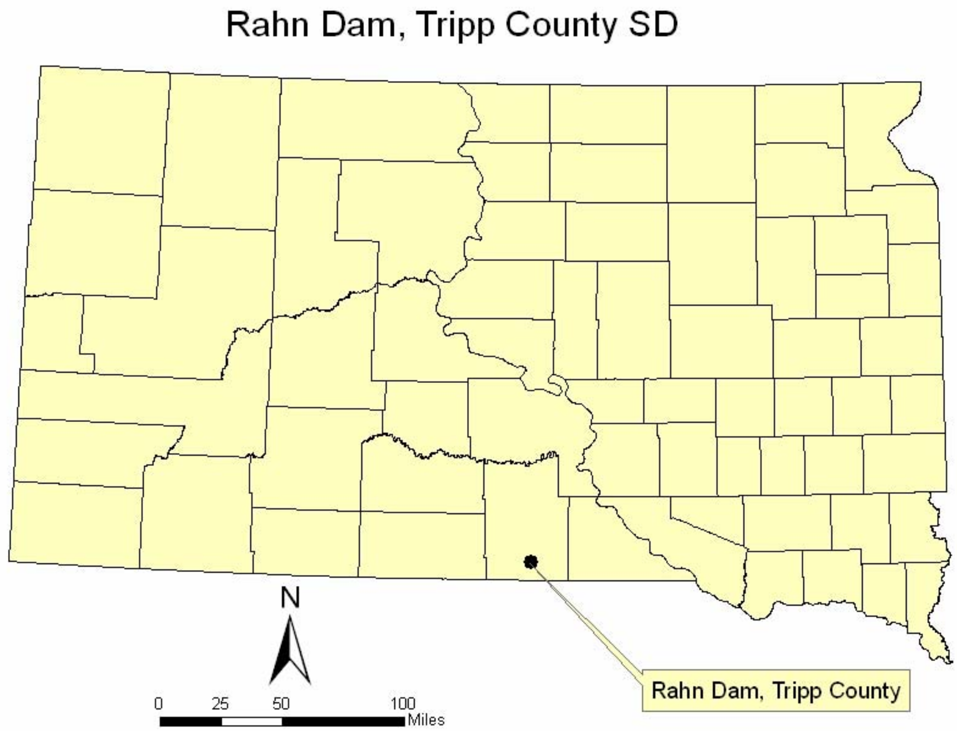


Figure 27. Rahn Dam Location in South Dakota

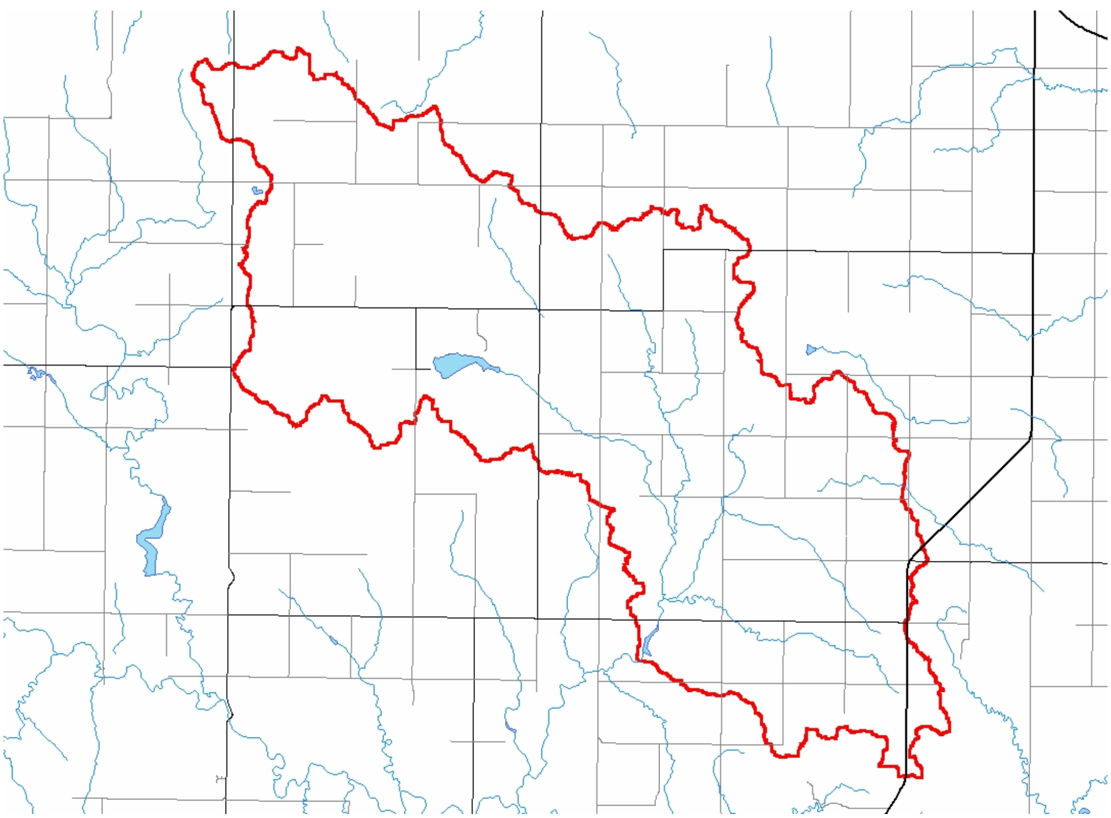


Figure 28. Rahn Dam Watershed

South Dakota Water Quality Standards

Each waterbody within South Dakota is assigned beneficial uses. All waters (both lakes and streams) are designated the use of fish and wildlife propagation, recreation and stock watering. All streams are assigned the use of irrigation. Additional uses may be assigned by the state based on a beneficial use analysis of each waterbody. Water quality standards have been defined in South Dakota state statutes in support of these uses. These standards consist of suites of numeric criteria that provide physical and chemical benchmarks from which management decisions can be developed.

Chronic standards, including geometric means and 30-day averages, are applied to a calendar month. While not explicitly described within the states water quality standards, this is the method used in the states Integrated Water Quality Report (IR) as well as in permit development.

Additional "narrative" standards that may apply can be found in the "Administrative rules of South Dakota: Articles 74:51:01:05; 06; 08; and 09". These contain language that generally prohibits the presence of materials causing pollutants to form, visible pollutants, and nuisance aquatic life.

Rahn Dam has been assigned the beneficial uses of: permanent fish life propagation, limited contact recreation, immersion recreation, and fish and wildlife propagation, recreation, and stock watering. Table 37 lists the criteria that must be met to support the specified beneficial uses. When multiple criteria exist for a particular parameter, the most stringent criterion is used.

Table 37. State Water Quality Standards for Ponca Creek.

Parameters	Criteria	Unit of Measure	Beneficial Use Requiring this Standard
Total ammonia nitrogen as N	Equal to or less than the result from Equation 3 in Appendix A of Surface Water Quality Standards	mg/L 30 average March 1 to October 31	Warmwater Permanent Fish Propagation
	Equal to or less than the result from Equation 4 in Appendix A of Surface Water Quality Standards	mg/L 30 average November 1 to February 29	
	Equal to or less than the result from Equation c in Appendix A of Surface Water Quality Standards	mg/L Daily Maximum	
Dissolved Oxygen	≥5.0	mg/L	Warmwater Permanent Fish Propagation
Total Suspended Solids	≤90 (mean) ≤158 (single sample)	mg/L	Warmwater Permanent Fish Propagation
Temperature	≤26.6	°C	Warmwater Permanent Fish Propagation
Fecal Coliform Bacteria (May 1- Sept 30)	≤200 (geometric mean) ≤400 (single sample)	count/100 mL	Immersion Recreation
Escherichia coli Bacteria (May 1- Sept 30)	≤126 (geometric mean) ≤235 (single sample)	count/100 mL	Immersion Recreation
Alkalinity ($CaCO_3$)	≤750 (mean) ≤1,313 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Conductivity	≤2,500 (mean) ≤4,375 (single sample)	µmhos/cm @ 25° C	Irrigation Waters
Nitrogen, nitrate as N	≤50 (mean) ≤88 (single sample)	mg/L	Wildlife Propagation and Stock Watering
pH (standard units)	≥6.5 to ≤9.0	units	Warmwater Permanent Fish Propagation
Solids, total dissolved	≤2,500 (mean) ≤4,375 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Total Petroleum Hydrocarbon Oil and Grease	≤10 ≤10	mg/L	Wildlife Propagation and Stock Watering

Landuse

Landuses in the watershed were divided between four general groups (Table 38). Rangelands consist of native range, pastures, and both native and tame hay. It composes the majority (92%) of the landuse within the watershed. Cropland consists of both row crops and close seeded grains. Approximately 2% of the watershed is used for cropping. Water and wetlands include open water as well as emergent and submergent wetlands. Roads and farmsteads include the road corridors as well as the farm sites that have a measurable percentage of impervious surfaces such as roofs and driveways.

Table 38. Watershed Landuses

Landuse	Acres	Percentage
Rangeland	34,700	92%
Cropland	900	2%
Water/Wetlands	800	2%
Roads/ Farmsteads	1,300	3%

General land use categories utilized in the modeling scenario were limited to water, cropland, and a majority rangeland. Although the landuse analysis indicated that three percent of the watershed is composed of roads and farmsteads, these landuses were not a majority of any of the cells. The three percent estimate is an overestimation that results from the production of the landuse maps. Typically road layers are artificially reinforced on LANDSAT derived products, which results in a somewhat skewed estimation in rural areas. Summing cell acreages used in the model, water accounted for 0.2%, cropland 4.2%, and rangeland 95.6%.

Cropland in the watershed is used primarily for the production of wheat and corn. Rangeland makes up the majority of the landuse in the watershed. Many of the soils in Tripp County are poorly suited for cropping and a majority of the county is maintained in native rangelands. Tripp county ranks first in cattle production for South Dakota Counties with an estimated 147,000 animals present on farms (USDA, 2010). Roughly 1/3 of these animals are confined to permitted feeding facilities located in the northern portion of the county. The remaining animals constitute a stocking density of approximately 1 animal for every 6 acres (based on NASS estimates of rangeland).

Accurately modeling changes in the watershed required the evolution of the plant communities under various management scenarios to be included. Several range sites were described by NRCS, each of which has its own community relationships. Of particular importance in the Rahn Dam watershed were the sandy site descriptions, which will be described in greater detail. Other sites are present; but constitute a minority of the acreage.

Historically, these sites were composed of large areas of blowing sand which resulted in the active movement of sand dunes. Evaporation from the soil surface was extremely high due to the large areas of bare ground, lack of litter and sparse plant populations. The transpiration rate of these sparse plant populations was also high due to the harsh soil environment. Occasional wild fires, severe grazing by transient bison herds and drought contributed to the lack of stability of the sand dunes. This lack of stability caused the dunes to go back and forth through multiple stages of plant succession over the course of time. Early perennial plants such as sandhill muhly, blowout grass, and blowout penstemon were common due to their ability to tolerate the movement of the sand and droughty conditions. As these plants began to colonize and stabilize the sand movement, other perennials such as prairie sandreed, sand bluestem, hairy grama, lemon scurfpea, and rose slowly became evident on the site. Annual native plants such as sandbur, woolly Indianwheat, annual eriogonum, and annual sunflower eventually colonized the areas between the perennials. (eFOTG, 2011)

As this site deteriorates, prairie sandreed, sand dropseed, and blue grama will increase. Species such as sand bluestem and switchgrass will decrease in frequency and production. The site is extremely resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought resistance. (eFOTG, 2011)

The climax community found under the best management conditions consists of Bluestem/ Prairie Sandreed. Heavy grazing may shift this community to a Bluestem/Prairie Sandreed/ Switchgrass community; however this is still considered a healthy range condition that has minimal implications for erosion and nutrient loss. These communities evolved with grazing by large herbivores and are well suited for grazing domestic livestock.

Prolonged lack of use results in an excessive litter condition that impedes plant growth and range production. Restoration of a healthy and diverse community is achieved through prescribed grazing. Although heavy litter limits erosion and nutrient loss, biological diversity decreases under these conditions. This decrease may be of special concern to the American Burying Beetle and should be investigated prior to the implementation of BMPs that might encourage this condition.

Annual season long grazing with lack of rest can further shift this community to a Prairie Sandreed/ Ragweed community. Production decreases under this community by 30% increasing erosion rates.

Water Quality Results

The complete water quality results for Rahn Dam may be found in Appendix B. Concentrations of dissolved oxygen, alkalinity, fecal coliform, suspended solids, ammonia, and nitrogen were all found to adequately support the beneficial uses of Rahn Dam.

Water quality data was collected from one monitoring site within the Rahn Dam watershed and three sites within the lake. Samples were taken according to South Dakota's Standard Operating Procedures for Field Samplers. Water samples were sent to the State Health Laboratory in Pierre for analysis. Data collected for Rahn Dam was done as a part of a larger project resulting in Quality Assurance/Quality Control samples being collected at sites outside of this watershed. Based on the QA/QC data from the greater project, the data for this watershed is considered to be of sufficient quality to adequately evaluate the lake.

In addition to water quality monitoring, data was collected to complete a watershed landuse model. The Annualized Agriculture Nonpoint Pollution Source (AnnAGNPS) model was used to provide comparative values for each of the land uses and animal feeding operations located in the watershed. The impacts of phosphorus reductions on the condition of Rahn Dam were calculated using BATHTUB, an Army Corps of Engineers model.

Unless otherwise noted, analysis was completed with modeling programs according to the most recent version of the Water Quality Modeling in South Dakota document (SDDENR, 2009).

Hydrology and Loadings

Rahn Dam presented several challenges that required a number of assumptions be made during the analysis. During the course of the project, runoff occurred during three storm events in 2005, allowing for sample collection on a limited basis at the inlet.

An absence of runoff data and the short duration of the project resulted in an insufficient measured hydrograph to calculate hydraulic loadings. Estimates of average annual discharge from the USGS Elevation Derivatives for National Applications (EDNA) model yield an average flow rate of 10 cfs for Rahn Dam.

EDNA utilizes a regional curve number combined with estimates of rainfall and contributing drainage area. Comparisons of EDNA derived numbers to neighboring gauges on the Keya Paha suggest that model estimates for the area are generally 20% to 30% too high.

Drainage area estimates for Rahn Dam are difficult due to the soil types in the watershed. There are several small stream segments that terminate in the sandy soils before they reach the main drainage network leading to Rahn Dam. These segments account for approximately 30% of the lakes drainage area. The watershed is also influenced by Dog Ear Lake which intercepts runoff from approximately 50% of the watershed before it reaches Rahn Dam. The Keya Paha drainage area has a much lower percentage of its watershed comprised of terminal streams (<5%), suggesting that the EDNA overestimate should be compounded with the reduced drainage area. Considering these factors, flow rates for the Rahn Dam watershed were expected to be less than 5 cfs on an average annual basis.

As an alternative approach to estimating water volumes for the watershed, flow rates on the Keya Paha were compared to the known flow dates at the inlet to Rahn Dam. The samples collected at the inlet to Rahn Dam in 2005 were collected on dates that produced distinct storm event driven peaks on the Keya Paha. Utilizing these peaks, the contributing drainage area of the Rahn Dam watershed, and the long term gauge data from the Keya Paha, an estimate of 2.3 cfs was generated. Converting this to a surface runoff depth, 0.52 inches was calculated. As a best estimate, this runoff volume was used to calibrate the AnnAGNPs model.

Samples were collected from three separate dates in the watershed (Table 39). Due to the small number of runoff events, replicates were collected multiple times. From 2002 through 2004, Rahn Dam experienced a significant drought, during this time, water levels in the lake dropped 2 to 3 feet below the spillway. Runoff events that occurred on April 26th and May 12th were both relatively small, and neither provided sufficient volume to generate a discharge at the outlet.

Table 39. Tributary Water Chemistry for Rahn Dam

StationID	Date	TN	TP	TDP
Inlet	04/26/2005	0.94	0.072	0.05
Inlet	05/12/2005	2.81	0.672	
Inlet	05/12/2005	2.71	0.672	
Inlet	06/16/2005	1.23	0.273	0.251
Inlet	06/16/2005	1.26	0.276	0.247
Outlet	06/16/2005	1.28	0.305	0.27
Outlet	06/16/2005	1.36	0.304	0.267
Inlet Mean		**1.79**	**0.393**	**0.183**
Inlet Median		1.99	0.474	0.249
Inlet Standard Dev		0.89	0.268	0.115
CV		**0.50**	**0.681**	**0.629**

During the second week of June, over 4 inches of rain were recorded from multiple events at the Winner weather station (20 miles north of the watershed). The resulting runoff event created flows at both the inlet and outlet. Samples collected at the outlet were typical of what may be expected from lake surface samples during June. Inlet sample concentrations varied greatly, however utilizing the mean and the flow volume calculated previously, an average annual load of 1,815 lbs or 825 kgs was calculated.

The 1,815 lb load will be used for the BATHTUB model, but it is important to note the uncertainty involved with this load. Loads calculated on the same data set within 1 standard deviation result in a range of potential loads from 579 lbs to 3,051 lbs.

Annualized Agricultural Non Point Source (AnnAGNPs) Modeling

The original assessment of the Lewis and Clark Watershed involved a significant modeling effort utilizing the AnnAGNPs model. That particular effort made use of a simplified approach to cropping and rainfall estimations, which provided a comparable analysis for all of the simulated watersheds. A secondary modeling simulation was utilized with measured rainfall and watershed specific cropping and rangeland conditions for calculating reduction responses.

Within the Keya Paha drainage, many of the individual tributaries such as the one feeding Rahn Dam were modeled. Erosion rates for these tributaries are displayed in Figure 29. Erosion rates for the Rahn Dam watershed were calculated at 0.184 tons/ acre, which was less than both the mean (0.596 tons/ acre) and median (0.271 tons/ acre) for the watersheds as a group.

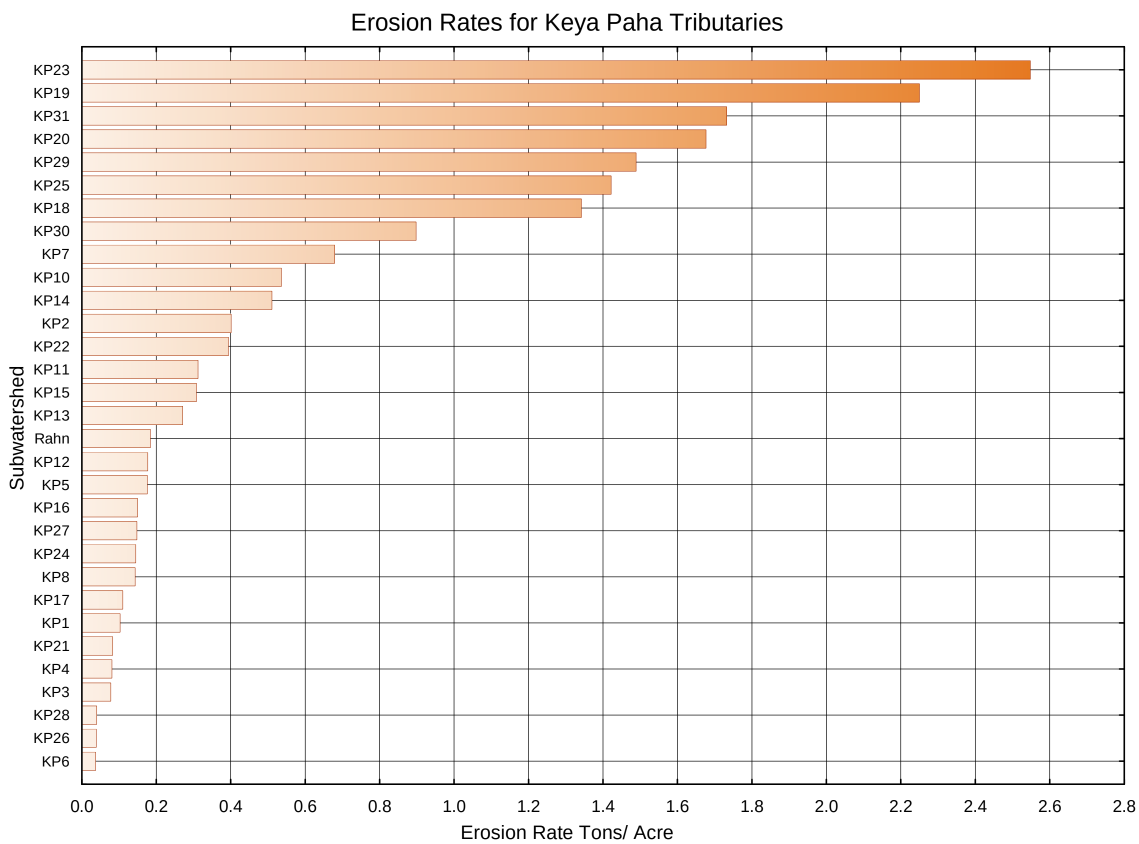


Figure 29. Erosion Rates for Keya Paha River Subwatershed Tributaries

A secondary modeling simulation was completed which included greater focus on measured rainfall from Winner, range conditions, cropping, and management practices found specifically in the Rahn Dam watershed. This model was calibrated to the water load of 0.52 inches calculated in the hydrology and loadings section. Field specific rangeland conditions were unavailable. A range of variables were identified based on potential ecological site conditions and the modeling scenarios were completed assuming both best and worst case scenarios for rangeland management. The results of the AnnAGNPs estimated loads and the measured load from the hydrology and loadings section should not be compared directly. Although the values are close, sample variability is too great.

Table 40 includes the results of the four simulations completed for the watershed. The simulations were completed with weather data from Winner, SD From 1982 through 2006, which includes the project period and the entire sample data set used for the report. LANDSAT derived landuses from 2001 and 2002 were verified using aerial photography from 2005 through 2010.

Table 40. AnnAGNPs Modeling Results

Model	Scenario	Phosphorus	Nitrogen
1	Current conditions assuming range in good to excellent condition	1,094	12,395
2	Current conditions assuming range in poor condition	1,653	17,448
3	Watershed with all cropland converted to range in good to excellent condition	292	3,279
4	Watershed with all cropland converted to range in poor condition	860	8,388
	Reductions from model 1 to 3	73%	74%
	Reductions from model 2 to 3	82%	81%

Model 1 is considered the best estimate of current conditions within the watershed. It represents current crop rotations, management practices and assumes that a high percentage of the grassland is in good to excellent condition.

Model 2 is identical to model 1 in all assumptions except the condition of the range land in the watershed. Based on the ecological site descriptions, a poor condition of rangeland similar to the Sandreed/ Ragweed community described previously was used. Comparing models 1 and 2, the impact of impaired range may be calculated. Based on the model, for every 50 acres of severely impaired range, the lake will receive an extra pound of phosphorus and 10 pounds of nitrogen.

Model 3 simulated the conversion of all row crop agriculture to range land. Reductions from model 1 to model 3 may be considered the best estimate of the anthropogenic influences on the watershed. As a round number, 75% reductions in phosphorus and nitrogen may be the maximum obtainable.

Comparing models 2 and 3 may not be realistic, however the percent reductions may be considered a cap for the watershed. Based on the data available, it is unlikely that reduction of 80% or more is possible.

Although estimates of 75% to 80% were calculated by the model, these values may be gross overestimations. Much of the cropland is located upstream of the terminal drainages. The AnnAGNPS model is not designed to simulate these situations. Regardless of their true fate on the landscape, the model routes all water and nutrients through to the outlet. Considering the hydrologic estimates of the uncalibrated model were over three times the best measured estimates, reductions could potentially be less than half of the predicted maximums.

BATHTUB Modeling

Inlake reduction response modeling was conducted with BATHTUB, an Army Corps of Engineers eutrophication response model (Walker, 1999). System responses were calculated using reductions in the loading of phosphorus to the lake from its primary tributary.

BATHTUB provides numerous models for the calculation of inlake concentrations of phosphorus, nitrogen, chlorophyll *a*, and Secchi depth. Models are selected that most closely predict current inlake conditions from the loading data provided. As reductions in the phosphorus load are predicted in the loading data, the selected models will closely mimic the response of the lake to these reductions.

Data requirements for the model include atmospheric, watershed, and inlake variables. Section 4.2 addressed the calculations of loadings to the lake which were utilized in the model. Pool water quality data was based on all available growing season data. Of particular importance to Rahn Dam were the internal loading calculations.

The BATHTUB model has options to use either implicit or explicit internal loading calculations. The reservoir received no runoff from June through the end of lake sampling in September, however internal phosphorus and nitrogen concentrations increased during this period. This increase provided a basis from which an internal load calculation could be completed and included within the model. Figures 30 and 31 depict the daily increases of nitrogen and phosphorus respectively.

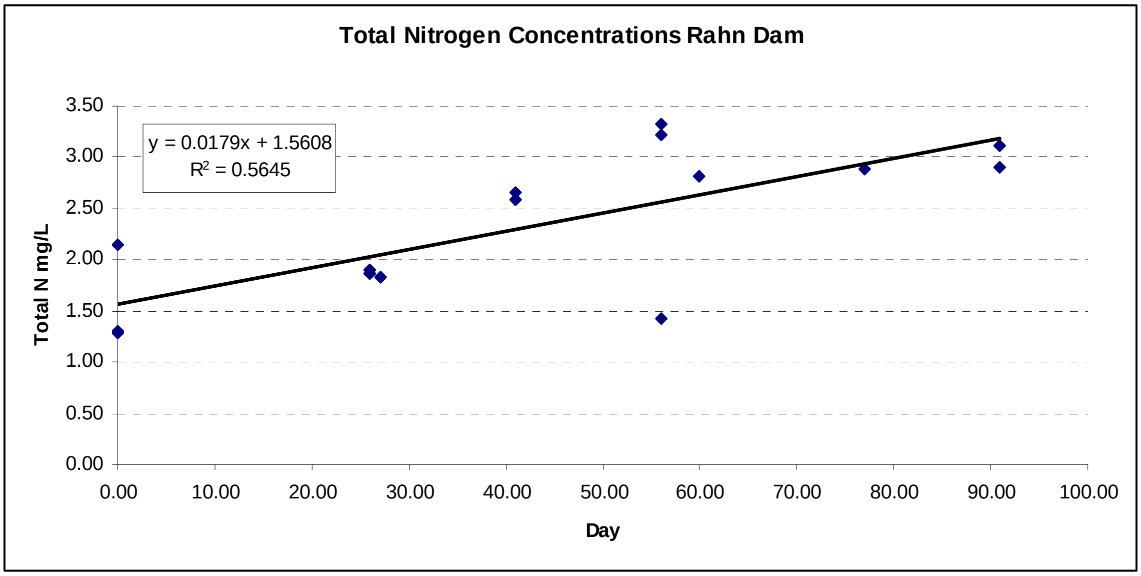


Figure 30. Nitrogen Concentration in Rahn Dam During 2004

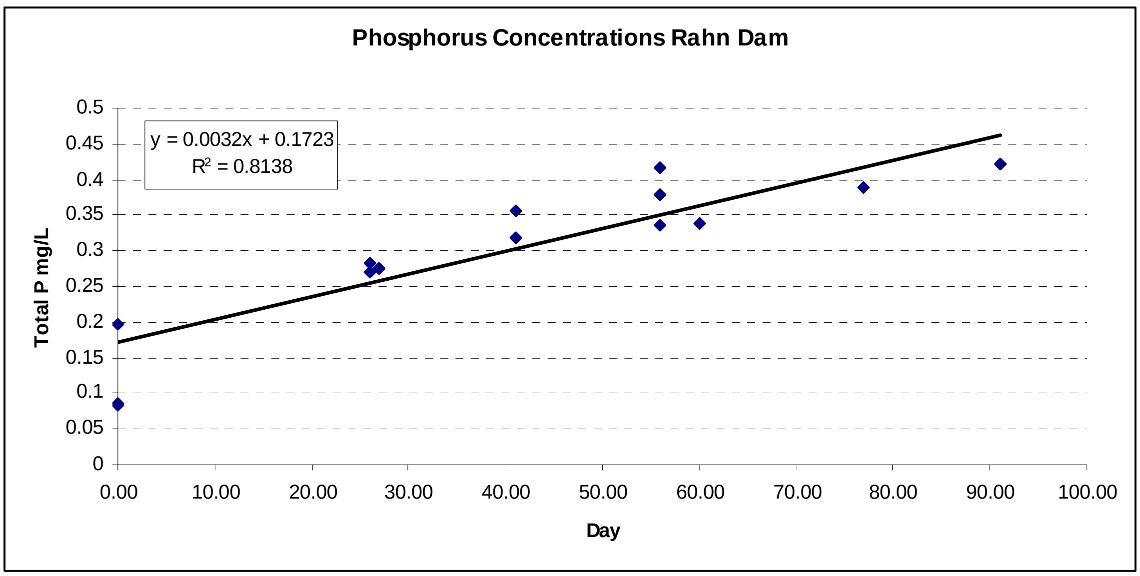


Figure 31. Phosphorus Concentration in Rahn Dam During 2004

Utilizing the slope in the trend line equations from Figures 30 and 31 as a release rate, a daily loading of 6 mg/m^2/day and 34 mg/m^2/day for phosphorus and nitrogen were calculated. Nürnburg (Nürnburg, 1984) found that release rates for phosphorus in anoxic reservoirs ranged from 6 to 28 mg/m^2/day. Rahn Dam does experience anoxic conditions in portions of the hypolimnion during the growing season. To better simulate this seasonality, the averaging period for the model was limited to the growing season.

Water chemistry samples from Rahn Dam were used to calibrate the BATHTUB model. All available surface sample data were summarized and may be found in Table 41. Mean values were used with a coefficient of variance which was calculated as the standard deviation divided by the mean for the data set.

Table 41. Lake Water Chemistry used for BATHTUB Calibration

	SD	Amm	TKN	NIT	TP	TDP	Chloro-a
CoVar	0.528	2.089	0.314	1.033	0.380	0.426	0.380
StdDev	0.48	0.04	0.67	0.08	0.10	0.08	19.25
Median	0.8	0.0	2.090	0.1	0.280	0.194	49.9
Mean	0.9	0.0	2.1	0.1	0.276	0.2	50.7

BATHTUB not only predicts the inlake concentrations of nutrients; it also produces a number of diagnostic variables that help to explain the lake responses. Table 42 lists the diagnostic calculations generated for Rahn Dam. The variables (N-150)/P and INORGANIC N/P are both indicators of phosphorus and nitrogen limitation. The first, (N-150)/P, is a ratio of total nitrogen to total phosphorus. Values less than 10 are indicators of a nitrogen-limited system. The second variable, INORGANIC N/P, is an inorganic nitrogen to ortho-phosphorus ratio. Values less than 7 are nitrogen-limited. The models prediction suggests that the lake is nitrogen limited.

Table 42. BATHTUB Response Models

	Predicted Values		Observed Values	
Variable	**Mean**	**CV**	**Mean**	**CV**
TOTAL P MG/M3	263.0	0.62	263.0	0.39
TOTAL N MG/M3	2385.0	0.71	2385.0	0.31
C.NUTRIENT MG/M3	152.0	0.53	152.0	0.34
CHL-A MG/M3	50.7	0.50	50.7	0.38
SECCHI M	0.5	0.36	0.9	0.53
ORGANIC N MG/M3	1361.9	0.43	2100.0	0.23
(N - 150) / P	8.5	1.00	8.5	0.50
INORGANIC N / P	6.3	1.99	1.1	3.11
FREQ(CHL-a>10) %	98.9	0.02	98.9	0.02
FREQ(CHL-a>20) %	88.3	0.18	88.3	0.13
FREQ(CHL-a>30) %	70.4	0.40	70.4	0.29
FREQ(CHL-a>40) %	52.9	0.61	52.9	0.45
FREQ(CHL-a>50) %	38.7	0.80	38.7	0.60
FREQ(CHL-a>60) %	28.0	0.97	28.0	0.74
CARLSON TSI-P	84.5	0.10	84.5	0.07
CARLSON TSI-CHLA	69.1	0.07	69.1	0.05
CARLSON TSI-SEC	69.4	0.07	61.5	0.12

Figure 32 depicts the model predictions for reductions in phosphorus loadings. The current condition is represented by the dot located at the intersection of the 825 kg/ yr loading and the 51 mg/ L chlorophyll *a* concentration. AnnAGNPs modeling suggested the greatest attainable reductions for this watershed were 80%. The line (and its error bars at one standard deviation) project back to the predicted concentrations at an 80% reduction. The predicted best attainable condition for the lake through a reduction in loadings is predicted to be a chlorophyll *a* concentration of 37 mg/ L.

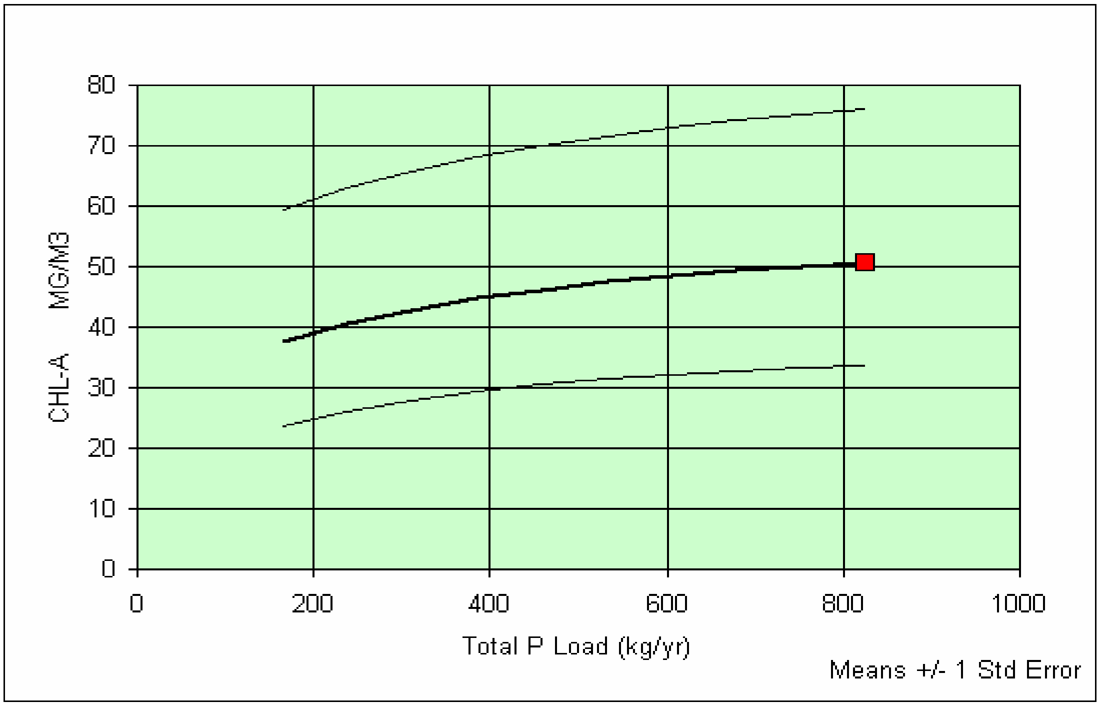


Figure 32. BATHTUB Reduction Response Predictions for Chlorophyll a

The variables FREQ (CHL-a)% represent the predicted algal nuisance frequencies or bloom frequencies. Blooms are often associated with concentrations of 30 to 40 ppb of total phosphorus. These frequencies are the percentage of days during the growing season that algal concentrations may be expected to exceed the respective values.

Rahn Dam Summary

The Rahn Dam watershed is characterized by native rangelands with very little row crop agriculture. Modeling of this watershed indicates there is limited potential for reductions in nutrient and sediment loads from improved range conditions. Impacts on the endangered burying beetle as a result of grazing changes must be considered, further limiting modified grazing practices as a potential source of reductions.

Reductions from the conversion of all cropland to range could yield as much as an 80% reduction, however a great deal of uncertainty surrounds this estimate and true reductions may be 40% or less.

Rahn Dam was listed by EPA as impaired in the 2010 integrated report for a chlorophyll a concentration in excess of 30 ppb. Considering all factors in the watershed, the watershed is one of the least impacted in the region and could be considered a high quality reference site. Reduction response modeling suggests that the listing criterion is unattainable under any conditions.

SURFACE WATER CHEMISTRY (ROOSEVELT DAM)

Roosevelt Dam is an 85 acre manmade impoundment located in Tripp County South Dakota that drains approximately 7000 acres of agricultural land. The watershed is composed primarily of rangeland that is in good to excellent condition. There are no animal feeding operations, and visual surveys of landuse indicate the potential for this as a reference condition watershed in respect to nutrient loading.

SOUTH DAKOTA WATER QUALITY STANDARDS

The State of South Dakota assigns at least two beneficial uses to every waterbody in the state. Fish and wildlife propagation, recreation and stock watering as well as irrigation are assigned to all stream and rivers. Roosevelt Dam must maintain the criteria that support these uses. There are eleven standards that must be maintained. These standards, as well as the water quality values that must be met, are listed in Table 43.

Table 43. State Water Quality Standards for Roosevelt Dam

Parameters	Criteria	Unit of Measure	Beneficial Use Requiring this Standard
Total ammonia nitrogen as N	Equal to or less than the result from Equation 3 in Appendix A of Surface Water Quality Standards	mg/L 30 average May 1 to October 31	Warmwater Permanent Fish Propagation
	Equal to or less than the result from Equation 4 in Appendix A of Surface Water Quality Standards	mg/L 30 average November 1 to April 31	
	Equal to or less than the result from Equation c in Appendix A of Surface Water Quality Standards	mg/L Daily Maximum	
Dissolved Oxygen	≥5.0	mg/L	Warmwater Permanent Fish Propagation
Total Suspended Solids	≤90 (mean) ≤158 (single sample)	mg/L	Warmwater Permanent Fish Propagation
Temperature	≤26	°C	Warmwater Permanent Fish Propagation
Fecal Coliform Bacteria (May 1- Sept 30)	≤200 (mean) ≤400 (single sample)	count/100 mL	Immersion Recreation
Alkalinity ($CaCO_3$)	≤750 (mean) ≤1,313 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Nitrogen, nitrate as N	≤50 (mean) ≤88 (single sample)	mg/L	Wildlife Propagation and Stock Watering
pH (standard units)	≥6.5 to ≤9.0	units	Warmwater Permanent Fish Propagation
Solids, total dissolved	≤2,500 (mean) ≤4,375 (single sample)	mg/L	Wildlife Propagation and Stock Watering
Total Petroleum Hydrocarbon	≤10	mg/L	
Oil and Grease	≤10		Wildlife Propagation and Stock Watering

WATER QUALITY RESULTS

The complete water quality results for Roosevelt Dam may be found in Appendix B. Concentrations of dissolved oxygen, alkalinity, fecal coliform, suspended solids, ammonia, and nitrogen were all found to adequately support the beneficial uses of Roosevelt Dam. Reduction response modeling was not completed for this lake because of its relatively low TSI values when compared to similar waterbodies.

pH

The only parameter that regularly exceeded the state standard during the course of the study was pH (Table 44). Historically, Roosevelt Dam has not had a problem with high pH values, but during June and July of the assessment project, recorded values were consistently above the state standard. Samples collected after the projects were again recorded below the state standard. Typically high pH values may be attributed to increased photosynthesis from algae associated with hypereutrophic conditions. The trophic state of Roosevelt Lake is low enough that this is not likely the case.

Samples collected during the same time period from Rahn Dam as a portion of this project also exhibited unusually high pH values. Unlike Rahn Dam, nutrient reducing BMPs are not likely to result in reductions in the pH at Roosevelt. It is possible that the calibration standards used during this two month time period became contaminated; however there is no way to verify whether or not these samples are accurate. Local soils tend to have a neutral to an acidic pH, making them an unlikely influencing factor.

There is no identifiable source of the high pH values and there is some question as to the accuracy of the data collected. As a result of this, prior to restudying this lake to determine specific pH impairment, it may be more effective to continue evaluating this waterbody as part of the states annual lakes survey to determine if a pH impairment is present or not.

Table 44 Roosevelt Dam pH values

Date	Depth	pH		Date	Depth	pH		Date	Depth	pH
6-Jul-89	Surface	8.74		8/15/2001	Surface	8.74		7/14/2004	Surface	9.40
6-Jul-89	Surface	8.70		5/19/2004	Bottom	8.61		7/14/2004	Surface	9.40
3-Aug-89	Surface	8.49		6/3/2004	Surface	9.09		7/14/2004	Surface	9.40
7-Aug-91	Surface	9.09		6/3/2004	Surface	8.90		7/14/2004	Surface	9.40
7-Aug-91	Surface	8.92		6/3/2004	Bottom	9.09		7/14/2004	Bottom	9.4
24-Sep-91	Surface	8.84		6/29/2004	Surface	9.60		7/29/2004	Surface	9.00
24-Sep-91	Surface	8.80		6/29/2004	Surface	9.60		7/29/2004	Surface	8.80
15-Jun-94	Surface	8.31		6/29/2004	Surface	9.50		7/29/2004	Bottom	9
15-Aug-94	Surface	8.48		6/29/2004	Surface	9.50		6/15/2005	Surface	8.98
6/28/2001	Surface	8.74		6/29/2004	Bottom	9.5		7/14/2005	Bottom	8.82
								08/03/2005	Surface	8.89

Roosevelt Dam Summary

Roosevelt Dam is meeting all of the standards that affect its beneficial uses with the exception of pH. The lack of historic supporting data and coinciding elevated values collected by the same field crew at other water bodies on the same dates suggests that the best course of action is continued monitoring prior to restudying the waterbody to determine the validity of the high pH readings.

BIOLOGICAL MONITORING

MACROPHYTE SURVEYS OF RAHN AND ROOSEVELT DAMS

A survey of the submergent and floating leaved vegetation was conducted on Rahn and Roosevelt lakes during the summers of 2002 and 2004. The survey on Roosevelt Lake was conducted by SDSU (Wilson, 2002). The survey of Rahn Lake was conducted by project staff utilizing a plant grapple and identifying all species and extent of total submergent coverage.

Rahn Lake – Early August 2004 30-35% submergent coverage

Coontail *Ceratophyllum demersum*
Millfoil *Myriophyllum siberica*
Potamogeton pusillus

Roosevelt Lake – July 2002 – 42% submergent coverage

Ceratophyllum demersum
Myriophyllum siberica
Potamogeton pectinatus
Potamogeton richardsonii
Potamogeton nodosus

No invasive species of submergent or terrestrial plants were documented in either of the surveys. While no maps were completed, plants consistently covered the majority of the shallow littoral zones with little or no vegetation found in the deeper portions of the lake. Each of these lakes appear to be macrophyte dominant systems, which will result in a limited algal community.

INVERTEBRATE ASSESSMENT (Rebecca Spawn-Stroup, Natural Resources Solutions)

INTRODUCTION

Benthic macroinvertebrate populations are known to be key indicators of stream ecosystem health. Life spans for some of these organisms can be as long as three years, and their complex life cycles and limited mobility provide ample time for the community to respond to cumulative effects of environmental perturbations. The analysis of benthic macroinvertebrate communities can thus be related to a stream's biological health, or integrity, defined by Karr and Dudley (1981) as "the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity and functional organization comparable to that of the natural habitat of the region."

The multimetric approach to bioassessment using benthic macroinvertebrates uses attributes of the assemblage in an integrated way to reflect overall biotic condition. Community attributes, which can contribute meaningfully to bioassessment, include assemblage structure, sensitivity of community members to stress or pollution, and functional feeding traits. Each metric component contributes an independent measure of the biotic integrity of a stream site.

METHODS

Benthic macroinvertebrate samples were collected from the Lewis and Clark watershed by Randall RC& D personnel. Samples were collected at various times during 2003 and 2004.

Macroinvertebrate Sample Processing and Identification

Laboratory sample processing, benthic macroinvertebrate taxonomic identifications, data compilation, and metrics computations were contracted by the Randall RC&D to Natural Resource Solutions, Inc. The benthic macroinvertebrate samples were processed and identified using the U.S. Environmental Protection Agency's techniques for RBP III (Plafkin et al.1989), and the Randall RC&D's SOP, which was taken from the South Dakota Department of Environment and Natural Resource's (SD-DENR's) SOP for South Dakota Benthic Macroinvertebrate sample processing.

Sample processing consisted of obtaining approximately a 300-organism subsample. Organisms were then enumerated and identified whenever possible to the taxonomic level specified in the Randall RC&D's (SD-DENR's) SOP. The requirements for subsampling and taxonomic resolution were deviated from only when the quality of the specimen was lacking due either to immaturity, or when body parts needed for identification were missing. In either case, when organisms could not be confidently taken to the taxonomic level outlined in the SOP, they were more conservatively identified. Taxonomic identification of the Chironomidae and Oligochaeta were subcontracted by Natural Resource Solutions, Inc. to McBride Benthic Consulting, Inc.

Following is a description of the subsampling procedure: Each sample was rinsed in a 0.30 mm sieve to remove preservative. The washed sample was then transferred to an appropriately sized invertebrate sorting tray marked into square quadrants. Water was added to the tray to allow complete dispersion of the sample and even distribution of the organisms. Quadrants were randomly selected and organisms removed from each quadrant until the total number of organisms fell within the range of 270 to 330 (±10% of 300 organisms), or until there were no more invertebrates to remove, whichever occurred first. When a sample was very large (greater than 1 Liter of sand and/or sediment), the sample was split into halves or fourths before proceeding with processing. When a sample had an abundance of mineral, the organic portion was floated apart from the mineral portion using standard floatation methods.

Data Analysis

Community structure, function and sensitivity to impact were characterized for each sample, using whenever possible a specific battery of metrics requested by the Randall RC&D. The data were entered into the "Ecological Data Analysis System (EDAS), a metrics analysis program designed by Tetra Tech, Inc., which functions within the Microsoft Access database.

Because reference conditions for streams in the Lewis and Clark watershed area were not available, the metrics could not be scored in order to determine a standardized impairment rating for each site. Thus, the overall biotic health and the final impairment rating reported for each site were determined based upon best professional judgment, after careful review of the entire suite of metrics results. The biotic health for each site was reported using the following scale, from worst to best: Poor, Fair, Good, Very Good, and Excellent. A general impairment rating for each site was reported as follows: Severe Impairment, Moderate Impairment, Minimum Impairment, and Slight Impairment. If results indicate biotic health and/or impairment that falls between the ratings, both ratings will be listed, for example, "Fair to Good," "Moderate to Minimum."

Tolerance values and Functional Feeding Group determinations used for this analysis were taken from the U.S. Environmental Protection Agency's Rapid Bioassessment Protocols for Streams and Rivers, Appendix B (Plafkin et al.1989). Tolerance values are given on a 0 to 10 scale, with 0 representing an extremely sensitive, or intolerant organism, and 10 representing a highly tolerant organism. Please see Table 6, "Benthic Macroinvertebrates of the Lewis and Clark Watershed, SD" for all raw data for each site, and Table 7 for a listing of benthic macroinvertebrate tolerance values and functional feeding group (FFG) traits.

LAC-01 Keya Paha River

Table 45 Metric results utilized for analysis of site LAC-01

METRIC	VALUE	Resp *	METRIC / TAXA	Tolerance Value	FFG+
Taxa Richness	18	(↓)	1st Dom. Ceratopogoninae 27 %	6	Predator
EPT Taxa Richness	3	(↓)	2nd Dom. *Dubiraphia* sp. 26 %	6	Collector
Ephemeroptera Taxa	2	(↓)	3rd Dom. Leptohyphidae 7 %	4	Collector
Plecoptera Taxa	0	(↓)	**METRIC**	**Value**	Resp*
Trichoptera Taxa	1	(↓)	Hilsenhoff Biotic Index (HBI)	5.36	(↑)
Diptera Taxa	13	(↑)	Shannon-Weiner Diversity (Log 10)	0.981	(↓)
Chironomidae Taxa	9	(↑)	Biotic Index	9	(↓)
Predator Taxa	4	(↑)	% EPT	14.41	(↓)
Intolerant Taxa	2	(↓)	% Ephemeroptera	9.91	(↓)
Total Abundance	111	(↓)	% Plecoptera	0.00	(↓)
Extrapolated Abundance	111	(↓)	% Trichoptera	4.50	(↓)
EPT Abundance	16	(↓)	% Hydropsychidae/Trichoptera	0.00	(↑)
Chiro Abundance	23	(↑)	% Chironomidae	20.72	(↑)
EPT/Chiro Abundance	0.70	(↓)	% Odonata	0.90	(↑)
% Shredders	5.41	(↓)	% Diptera	58.56	(↑)
% Grazers+Scrapers	0.00	(↓)	% Non-Insects	0.00	(↑)
% Scrapers/Scrapers+Filterers	0.00	(↓)	% Oligochaeta	0.00	(↑)
% Scrapers/Filterers	0.00	(↓)	% Intolerant Organisms	5.41	(↓)
% Omnivores+Scavengers	62.16	(↑)	% Tolerant Organisms	10.81	(↑)
% Predators	36.94	(↑)	% Sediment Tolerant Organisms	32.43	(↑)
% Collector-Gatherers	49.55	(↓)	Biotic Health Assessment: Fair to good		
% Filterers	7.21	(↑)	Impairment Rating: Moderate to minimum		

* Arrows (↑↓) indicate each metric's expected response to environmental perturbation and/or impairment.
+ FFG = Functional Feeding Group

***Overall assessment for LAC-01*:** Fair to good biotic condition, supporting a marginally sensitive benthic macroinvertebrate community. Cumulative metric data suggests moderate to possibly minimum impairment at this site.

LAC-02 Keya Paha River

Table 46. Metric results utilized for analysis of site LAC-02.

METRIC	VALUE	Resp *	METRIC / TAXA	Tolerance Value	FFG+
Taxa Richness	22	(↓)	1st Dom. *Paratendipes* sp. 18 %	8	Collector
EPT Taxa Richness	5	(↓)	2nd Dom. Simuliidae 15 %	6	Filterer
Ephemeroptera Taxa	2	(↓)	3rd Dom. *Simulium* sp. 10 %	6	Filterer
Plecoptera Taxa	1	(↓)	**METRIC**	**Value**	**Resp***
Trichoptera Taxa	2	(↓)	Hilsenhoff Biotic Index (HBI)	6.47	(↑)
Diptera Taxa	13	(↑)	Shannon-Weiner Diversity (Log 10)	1.164	(↓)
Chironomidae Taxa	10	(↑)	Biotic Index	4	(↓)
Predator Taxa	4	(↑)	% EPT	11.7	(↓)
Intolerant Taxa	0	(↓)	% Ephemeroptera	3.3	(↓)
Total Abundance	60	(↓)	% Plecoptera	5.0	(↓)
Extrapolated Abundance	60	(↓)	% Trichoptera	3.3	(↓)
EPT Abundance	7	(↓)	% Hydropsychidae/Trichoptera	50.0	(↑)
Chiro Abundance	27	(↑)	% Chironomidae	45.0	(↑)
EPT/Chiro Abundance	0.26	(↓)	% Odonata	0.0	(↑)
% Shredders	1.7	(↓)	% Diptera	76.7	(↑)
% Grazers+Scrapers	1.7	(↓)	% Non-Insects	8.3	(↑)
% Scrapers/Scrapers+Filterers	4.2	(↓)	% Oligochaeta	1.7	(↑)
% Scrapers/Filterers	0.0	(↓)	% Intolerant Organisms	0.0	(↓)
% Omnivores+Scavengers	73.3	(↑)	% Tolerant Organisms	28.3	(↑)
% Predators	16.7	(↑)	% Sediment Tolerant Organisms	66.7	(↑)
% Collector-Gatherers	31.7	(↓)	Biotic Health Assessment: Poor to Fair		
% Filterers	38.3	(↑)	Impairment Rating: Moderate		

* Arrows (↑↓) indicate each metric's expected response to environmental perturbation and/or impairment.
+ FFG = Functional Feeding Group

***Overall assessment for LAC-02*:** Poor to possibly fair biotic condition, supporting a tolerant benthic macroinvertebrate community. Cumulative metric data suggests moderate impairment at this site.

LAC-05 Choteau Creek

Table 47. Metric results utilized for analysis of site LAC-05.

METRIC	VALUE	Resp *	METRIC / TAXA	Tolerance Value	FFG+
Taxa Richness	16	(↓)	1st Dom. Corixidae (immature) 61.5 %	10	Predator
EPT Taxa Richness	3	(↓)	2nd Dom. Caenidae (immature) 15.5 %	7	Collector
Ephemeroptera Taxa	2	(↓)	3rd Dom. *Glyptotendipes* sp. 5.0 %	10	Filterer
Plecoptera Taxa	0	(↓)	**METRIC**	**Value**	Resp*
Trichoptera Taxa	1	(↓)	Hilsenhoff Biotic Index (HBI)	9.1	(↑)
Diptera Taxa	8	(↑)	Shannon-Weiner Diversity (Log 10)	0.638	(↓)
Chironomidae Taxa	7	(↑)	Biotic Index	2	(↓)
Predator Taxa	6	(↑)	% EPT	17.2	(↓)
Intolerant Taxa	0	(↓)	% Ephemeroptera	16.1	(↓)
Total Abundance	174	(↓)	% Plecoptera	0.0	(↓)
Extrapolated Abundance	174	(↓)	% Trichoptera	1.15	(↓)
EPT Abundance	30	(↓)	% Hydropsychidae/Trichoptera	0.0	(↑)
Chiro Abundance	26	(↑)	% Chironomidae	14.9	(↑)
EPT/Chiro Abundance	1.15	(↓)	% Odonata	0.57	(↑)
% Shredders	1.72	(↓)	% Diptera	15.5	(↑)
% Grazers+Scrapers	0.0	(↓)	% Non-Insects	1.7	(↑)
% Scrapers/Scrapers+Filterers	0.0	(↓)	% Oligochaeta	1.7	(↑)
% Scrapers/Filterers	0.0	(↓)	% Intolerant Organisms	0.0	(↓)
% Omnivores+Scavengers	31.0	(↑)	% Tolerant Organisms	91.4	(↑)
% Predators	68.9	(↑)	% Sediment Tolerant Organisms	17.8	(↑)
% Collector-Gatherers	22.9	(↓)	Biotic Health Assessment: Poor		
% Filterers	6.3	(↑)	Impairment Rating: Data indicates severe impairment		

* Arrows (↑↓) indicate each metric's expected response to environmental perturbation and/or impairment.
+ FFG = Functional Feeding Group

***Overall assessment for LAC-05*:** Poor biotic condition, able to support only a highly tolerant benthic macroinvertebrate community here. Cumulative metric data suggests severe impairment at this site.

LAC-06 Emanuel Creek

Table 48. Metric results utilized for analysis of site LAC-06.

METRIC	VALUE	Resp *	METRIC / TAXA	Tolerance Value	FFG+
Taxa Richness	40	(↓)	1st Dom. Tubificidae 25 %	10	Collector
EPT Taxa Richness	9	(↓)	2nd Dom. *Saetheria* sp. 15 %	4	Collector
Ephemeroptera Taxa	6	(↓)	3rd Dom. *Caenis* sp. 8 %	7	Collector
Plecoptera Taxa	0	(↓)	**METRIC**	**Value**	**Resp***
Trichoptera Taxa	3	(↓)	Hilsenhoff Biotic Index (HBI)	6.98	(↑)
Diptera Taxa	21	(↑)	Shannon-Weiner Diversity (Log 10)	1.198	(↓)
Chironomidae Taxa	19	(↑)	Biotic Index	7	(↓)
Predator Taxa	6	(↑)	% EPT	15.3	(↓)
Intolerant Taxa	3	(↓)	% Ephemeroptera	10.9	(↓)
Total Abundance	496	(↓)	% Plecoptera	0.0	(↓)
Extrapolated Abundance	496	(↓)	% Trichoptera	4.4	(↓)
EPT Abundance	76	(↓)	% Hydropsychidae/Trichoptera	13.6	(↑)
Chiro Abundance	261	(↑)	% Chironomidae	52.6	(↑)
EPT/Chiro Abundance	0.29	(↓)	% Odonata	0.20	(↑)
% Shredders	17.9	(↓)	% Diptera	53.0	(↑)
% Grazers+Scrapers	1.01	(↓)	% Non-Insects	27.6	(↑)
% Scrapers/Scrapers+Filterers	8.9	(↓)	% Oligochaeta	24.8	(↑)
% Scrapers/Filterers	0	(↓)	% Intolerant Organisms	4.03	(↓)
% Omnivores+Scavengers	90.9	(↑)	% Tolerant Organisms	54.6	(↑)
% Predators	6.25	(↑)	% Sediment Tolerant Organisms	96.8	(↑)
% Collector-Gatherers	61.7	(↓)	Biotic Health Assessment: Fair		
% Filterers	10.3	(↑)	Impairment Rating: Moderate		

* Arrows (↑↓) indicate each metric's expected response to environmental perturbation and/or impairment.
+ FFG = Functional Feeding Group

***Overall assessment for LAC-06*:** Fair biotic condition, supporting a marginally tolerant benthic macroinvertebrate community overall. Metric data suggests moderate impairment at this site.

LAC-07 Snatch Creek

Table 49. Metric results utilized for analysis of site LAC-07.

METRIC	VALUE	Resp *	METRIC / TAXA	Tolerance Value	FFG+
Taxa Richness	17	(↓)	1st Dom. Corixidae (immature) 55 %	10	Predator
EPT Taxa Richness	2	(↓)	2nd Dom. *Tanypus* sp. 18 %	10	Predator
Ephemeroptera Taxa	2	(↓)	3rd Dom. Tubificidae 6 %	10	Collector
Plecoptera Taxa	0	(↓)	**METRIC**	**Value**	**Resp***
Trichoptera Taxa	0	(↓)	Hilsenhoff Biotic Index (HBI)	9.53	(↑)
Diptera Taxa	7	(↑)	Shannon-Weiner Diversity (Log 10)	0.674	(↓)
Chironomidae Taxa	6	(↑)	Biotic Index	1	(↓)
Predator Taxa	6	(↑)	% EPT	0.93	(↓)
Intolerant Taxa	0	(↓)	% Ephemeroptera	0.93	(↓)
Total Abundance	430	(↓)	% Plecoptera	0.0	(↓)
Extrapolated Abundance	14,319	(↓)	% Trichoptera	0.0	(↓)
EPT Abundance	4	(↓)	% Hydropsychidae/Trichoptera	0.0	(↑)
Chiro Abundance	85	(↑)	% Chironomidae	19.8	(↑)
EPT/Chiro Abundance	0.05	(↓)	% Odonata	1.16	(↑)
% Shredders	0.23	(↓)	% Diptera	23.0	(↑)
% Grazers+Scrapers	6.05	(↓)	% Non-Insects	16.7	(↑)
% Scrapers/Scrapers+Filterers	92.9	(↓)	% Oligochaeta	10.7	(↑)
% Scrapers/Filterers	13	(↓)	% Intolerant Organisms	0.0	(↓)
% Omnivores+Scavengers	19.1	(↑)	% Tolerant Organisms	93.7	(↑)
% Predators	80.5	(↑)	% Sediment Tolerant Organisms	37.2	(↑)
% Collector-Gatherers	12.3	(↓)	Biotic Health Assessment: Poor		
% Filterers	0.47	(↑)	Impairment Rating: Severe impairment		

* Arrows (↑↓) indicate each metric's expected response to environmental perturbation and/or impairment.
[+] FFG = Functional Feeding Group

***Overall assessment for LAC-07*:** Poor biotic health, able to support only very highly tolerant benthic macroinvertebrates at this site. Cumulative metric data suggests that this site is severely impaired.

Table 50 Benthic Macroinvertebrates of the Lewis and Clark Watershed, SD

Natural Resource Solutions, Inc.								
Project: LAC Benthic Macroinvertebrates								
Locality: Lewis and Clark Watershed, SD								
Client: Randall RC & D		**Sample Date:**		10/06/04	10/06/04	09/24/03	08/14/03	09/04/03
		Percent subsampled:		100%	100%	100%	100%	33%
CLASS/ORDER	**FAMILY**	**FINAL DETERMINATION**	**Life Stage**	**LAC-01**	**LAC-02**	**LAC-05**	**LAC-06**	**LAC-07**
Pelecypoda	Sphaeriidae	*Musculium* sp.					6	
Pelecypoda	Sphaeriidae	*Pisidium* sp.					1	
Gastropoda	Physidae	*Physella* sp.					5	26
Amphipoda	Hyalellidae	*Hyalella* sp.					1	
Ephemeroptera	Ephemeroptera	Ephemeroptera (damaged)	L		4		1	
Ephemeroptera	Baetidae	Baetidae (imm./damaged)	L			1	5	2
Ephemeroptera	Baetidae	*Fallceon quilleri*	L				1	
Ephemeroptera	Caenidae	Caenidae (immature)	L	3	1	27		
Ephemeroptera	Caenidae	*Caenis* sp.	L				39	2
Ephemeroptera	Caenidae	*Cercobrachys* sp.	L				3	
Ephemeroptera	Heptageniidae	Heptageniidae (imm./damaged)	L		1			
Ephemeroptera	Isonychiidae	*Isonychia* sp.	L				1	
Ephemeroptera	Leptohyphidae	Leptohyphidae (immature)	L	8				
Ephemeroptera	Leptohyphidae	*Tricorythodes* sp.	L				5	
Plecoptera	Plecoptera	Plecoptera (immature)	L		3			
Trichoptera	Brachycentridae	*Brachycentrus* sp.	L	5				
Trichoptera	Hydropsychidae	*Cheumatopsyche* sp.	L				3	
Trichoptera	Hydropsychidae	Hydropsychidae (immature)	L		1			
Trichoptera	Leptoceridae	Leptoceridae (damaged)	P			2		
Trichoptera	Leptoceridae	Leptoceridae (immature)	L		1			
Trichoptera	Leptoceridae	*Nectopsyche* sp. (immature)	L				10	
Trichoptera	Leptoceridae	*Nectopsyche diarina*	L				9	
Coleoptera	Elmidae	*Dubiraphia* sp.	L	29	1	5	1	1
Coleoptera	Elmidae	*Dubiraphia* sp.	A				5	
Coleoptera	Elmidae	Elmidae (head only)	A		1			
Coleoptera	Hydrophilidae	*Berosus* sp.	L					2
Odonata	Calopterygidae	*Hetaerina* sp.	L				1	
Odonata	Coenagrionidae	*Argia* sp. (damaged)	L			1		
Odonata	Coenagrionidae	*Coenagrio/Enallagma* sp.	L					5
Odonata	Gomphidae	Gomphidae (immature)	L	1				
Hemiptera	Corixidae	Corixidae (immature)	L			107	6	237
Hemiptera	Corixidae	*Trichocorixa* sp.	A					10
Hemiptera	Veliidae	*Microvelia* sp.	A			1		
Hemiptera	Veliidae	*Rhagovelia* sp.	A				7	
Diptera	Ceratopogonidae	Ceratopogoninae	L	30	4	1	1	14
Diptera	Dolochopodidae	Dolochopodidae	L	7				
Diptera	Simuliidae	Simuliidae (immature)	L		9			
Diptera	Simuliidae	*Simulium* sp.	L		6		1	
Diptera	Simuliidae	*Simulium* sp.	P	3				
Diptera	Tipulidae	Limoniinae (imm.)	L	2				
Diptera	Chironomidae	*Ablabesmyia* sp.	L				1	
Diptera	Chironomidae	*Chernovskia* sp.	L	1	2		8	
Diptera	Chironomidae	*Cladotanytarsus* sp.	L	1	1		21	1
Diptera	Chironomidae	*Cricotopus/Orthocladius* sp.	L	3	1		26	
Diptera	Chironomidae	*Cricotopus* sp.	L	1				
Diptera	Chironomidae	*Cricotopus* sp.	P				3	
Diptera	Chironomidae	*Cricotopus bicinctus*	L				3	
Diptera	Chironomidae	*Cryptochironomus* sp.	L	3	2	4	11	
Diptera	Chironomidae	*Cryptochironomus* sp.	P			1		
Diptera	Chironomidae	*Cryptotendipes* sp.	L				10	
Diptera	Chironomidae	*Cryptotendipes* sp.	P			1	2	
Diptera	Chironomidae	*Dicrotendipes* sp.	L			1	3	1
Diptera	Chironomidae	*Endochironomus* sp.	L					1
Diptera	Chironomidae	*Glyptotendipes* sp.	L			9	5	2
Diptera	Chironomidae	*Limnophyes* sp.	L				1	
Diptera	Chironomidae	*Lopescladius* sp.	L	3	1			
Diptera	Chironomidae	*Parakiefferiella* sp.	L	4			4	
Diptera	Chironomidae	*Paralauterborniella* sp.	L				6	
Diptera	Chironomidae	*Paratendipes* sp.	L	1	11			
Diptera	Chironomidae	*Polypedilum* sp.	L			3	37	
Diptera	Chironomidae	*Polypedilum* sp.	P				4	
Diptera	Chironomidae	*Rheotanytarsus* sp.	L		1			
Diptera	Chironomidae	*Saetheria* sp.	L	6			70	
Diptera	Chironomidae	*Saetheria* sp.	P				4	
Diptera	Chironomidae	*Stictochironomus* sp.	L				2	2
Diptera	Chironomidae	*Tanypus* sp.	L			5		78
Diptera	Chironomidae	*Tanytarsus* sp.	L		6		31	
Diptera	Chironomidae	*Tanytarsus* sp.	P			2	3	
Diptera	Chironomidae	*Thienemanniella* sp.	P		1		1	
Diptera	Chironomidae	*Thienemannimyia* gp.	L		1		5	
Oligochaeta	Naididae	*Dero digitata*						19
Oligochaeta	Tubificidae	Tubificidae (imm. W/O CC)			1	3	122	26

Table 51 Benthic Macroinvertebrate Tolerance Values and Functional Feeding Groups

Class	Order	Family	Genus species (Final ID)	TolVal	FFG
Gastropoda	Basomatophora	Physidae	Physella	8	Scraper
Insecta	Coleoptera	Elmidae	Dubiraphia	6	Collector
Insecta	Coleoptera	Elmidae	Elmidae	5	Collector
Insecta	Coleoptera	Hydrophilidae	Berosus	7	Predator
Insecta	Diptera	Ceratopogonidae	Ceratopogoninae	6	Predator
Insecta	Diptera	Chironomidae	Ablabesmyia	8	Collector
Insecta	Diptera	Chironomidae	Chernovskia	--	--
Insecta	Diptera	Chironomidae	Cladotanytarsus	7	Collector
Insecta	Diptera	Chironomidae	Cricotopus	7	Shredder
Insecta	Diptera	Chironomidae	Cricotopus bicinctus	7	Scavenger
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	7	Shredder
Insecta	Diptera	Chironomidae	Cryptochironomus	8	Predator
Insecta	Diptera	Chironomidae	Cryptotendipes	8	Collector
Insecta	Diptera	Chironomidae	Dicrotendipes	10	Collector
Insecta	Diptera	Chironomidae	Endochironomus	10	Shredder
Insecta	Diptera	Chironomidae	Glyptotendipes	10	Filterer
Insecta	Diptera	Chironomidae	Limnophyes	3	Collector
Insecta	Diptera	Chironomidae	Lopescladius	4	Collector
Insecta	Diptera	Chironomidae	Parakiefferiella	4	Collector
Insecta	Diptera	Chironomidae	Paralauterborniella	8	Collector
Insecta	Diptera	Chironomidae	Paratendipes	8	Collector
Insecta	Diptera	Chironomidae	Polypedilum	6	Shredder
Insecta	Diptera	Chironomidae	Rheotanytarsus	6	Filterer
Insecta	Diptera	Chironomidae	Saetheria	4	Collector
Insecta	Diptera	Chironomidae	Stictochironomus	9	Scavenger
Insecta	Diptera	Chironomidae	Tanypus	10	Predator
Insecta	Diptera	Chironomidae	Tanytarsus	6	Filterer
Insecta	Diptera	Chironomidae	Thienemanniella	6	Collector
Insecta	Diptera	Chironomidae	Thienemannimyia	6	Predator
Insecta	Diptera	Dolichopodidae	Dolichopodidae	4	Predator
Insecta	Diptera	Simuliidae	Simuliidae	6	Filterer
Insecta	Diptera	Simuliidae	Simulium	6	Filterer
Insecta	Diptera	Tipulidae	Limoniinae	6	Shredder

Class	Order	Family	Genus species (Final ID)	TolVal	FFG
Insecta	Ephemeroptera	Baetidae	Baetidae	4	Collector
Insecta	Ephemeroptera	Baetidae	Fallceon quilleri	5	Collector
Insecta	Ephemeroptera	Caenidae	Caenidae	7	Collector
Insecta	Ephemeroptera	Caenidae	Caenis	7	Collector
Insecta	Ephemeroptera	Caenidae	Cercobrachys	7	Collector
Insecta	Ephemeroptera	Heptageniidae	Heptageniidae	4	Scraper
Insecta	Ephemeroptera	Isonychiidae	Isonychia	2	Filterer
Insecta	Ephemeroptera	Leptohyphidae	Leptohyphidae	4	Collector
Insecta	Ephemeroptera	Tricorythidae	Tricorythodes	4	Collector
Insecta	Hemiptera	Corixidae	Corixidae	10	Predator
Insecta	Hemiptera	Corixidae	Trichocorixa	5	Predator
Insecta	Hemiptera	Veliidae	Microvelia	6	Predator
Insecta	Hemiptera	Veliidae	Rhagovelia	6	Predator
Insecta	Odonata	Calopterygidae	Hetaerina	6	Predator
Insecta	Odonata	Coenagrionidae	Argia	8	Predator
Insecta	Odonata	Coenagrionidae	Coenagrio/Enallagma	8	Predator
Insecta	Odonata	Gomphidae	Gomphidae	1	Predator
Insecta	Trichoptera	Brachycentridae	Brachycentrus	1	Filterer
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	5	Filterer
Insecta	Trichoptera	Hydropsychidae	Hydropsychidae	4	Filterer
Insecta	Trichoptera	Leptoceridae	Leptoceridae	4	Collector
Insecta	Trichoptera	Leptoceridae	Nectopsyche	3	Shredder
Insecta	Trichoptera	Leptoceridae	Nectopsyche diarina	3	Shredder
Malacostraca	Amphipoda	Gammaridae	Gammarus	4	Scavenger
Malacostraca	Amphipoda	Hyalellidae	Hyalella	6	Collector
Oligochaeta	Tubificida	Naididae	Dero digitata	10	Collector
Oligochaeta	Tubificida	Tubificidae	Tubificidae	10	Collector
Pelecypoda	Veneroida	Pisidiidae	Musculium	5	Filterer
Pelecypoda	Veneroida	Pisidiidae	Pisidium	8	Filterer

Monday, July 11, 2005

THREATENED AND ENDANGERED SPECIES

There has only been one federally threatened or endangered species documented in the watershed. The US Fish and Wildlife Service lists numeraous species that could potentially be found in the area. None of these species were encountered during this study; however, care should be taken when conducting mitigation projects in the watershed.

Species that may be encountered in parts or all of the watershed may include:

- Bald eagles
- Whooping cranes
- Western prairie fringed orchid
- Black-footed ferret
- American Burying Beetle
- Topeka Shiner
- Piping Plover
- Least tern
- Pallid Sturgeon

OTHER MONITORING

Annualized Agricultural Nonpoint Source (AnnAGNPS) Model

Nonpoint source pollution is difficult to predict over a wide area without the use of modeling tools. One such tool is the AnnAGNPS pollutant loading model. AnnAGNPS is capable of breaking a large watershed into smaller pieces, and analyzing them individually. This model predicts the following loadings: (1) water; (2) sediment by particle size and source of erosion; and (3) chemicals like nitrogen, phosphorus, organic carbon, & pesticides. Loadings are generated from land areas (cells) and routed through stream systems on a daily basis.

AnnAGNPS first analyzes the topography within a watershed (based on a Digital Elevation Model), and then splits the watershed into many smaller cells. Each cell becomes a data point that is processed individually. Landuse, soil type, and topology are assigned to each cell based on available digital data. Farming practices (e.g., crop rotations, fertilizer regimes, etc.) can be customized for each cell as desired. The same is true for Best Management Practices (BMP's), which can be simulated to analyze effects of conservation options. Historical climate data is used to simulate weather during the model run. All of these factors affect the amount of pollutants discharged from each cell. Individual cell outputs are routed through the length of the drainage basin, ultimately producing outputs for the entire watershed.

It should be noted that the AnnAGNPS model is designed *only* to simulate upland erosion. AnnAGNPS only routes sediment to a stream. It does not simulate sediment transport within the stream. AnnAGNPS also does not estimate in-stream erosion processes. These facts are important to consider when looking at the results presented below.

Given the vast size of the Lewis and Clark Watershed (over 10 million acres total), AnnAGNPS was applied differently than in typical South Dakota watershed assessments. The model simply could not process the entire area as one unit. In fact, it could not even handle any of the 4 largest tributaries (Niobrara River, Keya Paha River, Ponca Creek, and Choteau Creek) as individual units. This expansive scale led to several modifications in the assessment approach.

First, the extent of our analysis was limited to areas mostly east of the western border of Cherry County, Nebraska (roughly 102° latitude). This coincided with the western limit of the project sponsors. Secondly, the largest sub-watersheds were broken into smaller pieces. Four major tributaries were handled by processing their individual side tributaries. Choteau Creek was split into 2 parts, Ponca Creek 28 parts, Keya Paha River 32 parts, and Niobrara River 21 parts. In all, 104 tributary watersheds were processed within the Lewis and Clark Watershed (Figure 33).

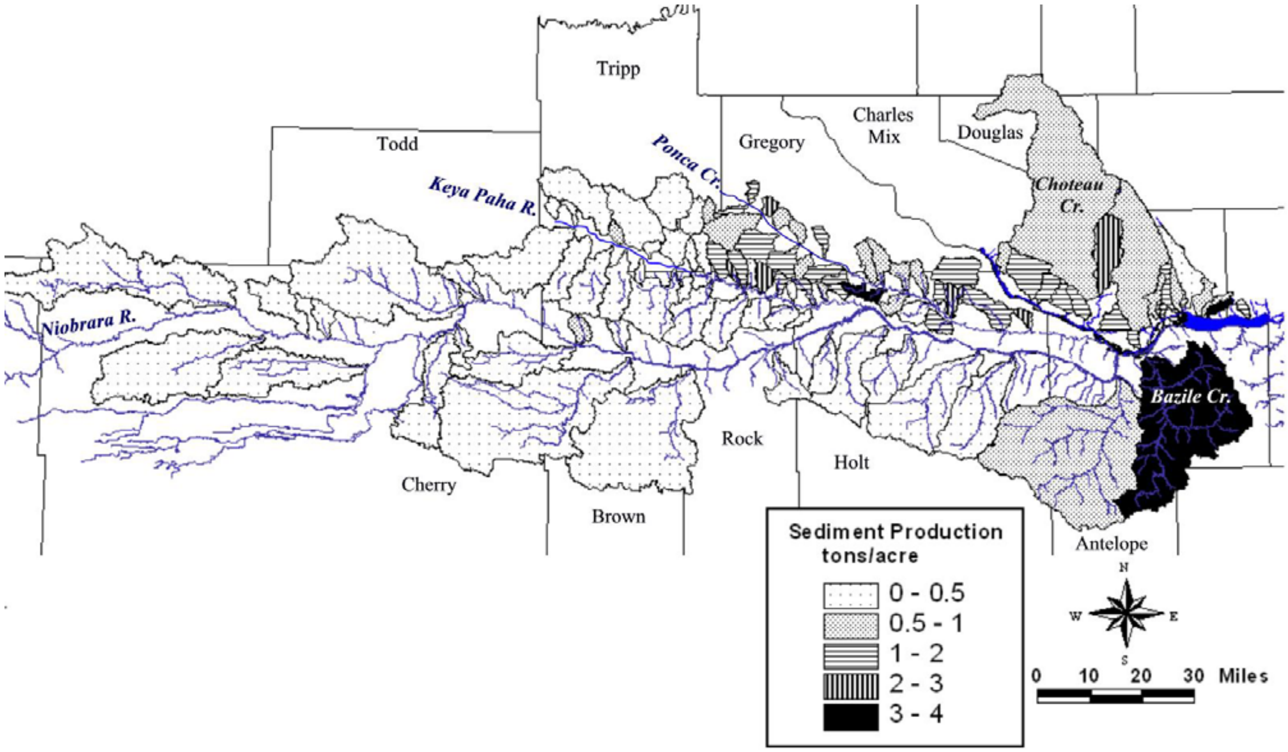


Figure 33. Sediment production for each of the 110 sub-watersheds modeled with AnnAGNPS

Many tributaries were unnamed; therefore a nomenclature system to assist with communication was created (Table 52). In this section of the report, tributaries will be referred to using the system that was created. Thirdly, AnnAGNPS analysis focused solely on sediment production. The sediment problem in Lewis and Clark Lake was the driving factor that led to this assessment. Lastly, identical field management settings were used for all 104 watersheds. This was a compromise necessitated by time constraints.

Table 52 Naming system used for tributaries in the Lewis and Clark assessment

Official name	Code	Location	Watershed	X coor.	Y coor.
Choteau (west fork)	CT1		Choteau Creek	571924	4753530
Dry Choteau	CT2		Choteau Creek	572756	4754501
Alkali	KP26		Keya Paha River	478777	4752144
Big	KP28		Keya Paha River	483351	4749095
Buffalo	KP18		Keya Paha River	456599	4758936
Burton	KP17		Keya Paha River	453826	4757550
Coon	KP24		Keya Paha River	471014	4752144
Cottonwood	KP8		Keya Paha River	427490	4766976
Deer	KP15		Keya Paha River	448282	4761847
Dry	KP19		Keya Paha River	461727	4756025
Holt	KP12		Keya Paha River	442460	4761570
Lost	KP6		Keya Paha River	423470	4768362
Lost (Boyd Co)	KP30		Keya Paha River	488895	4751590
Indian	KP20		Keya Paha River	463529	4756025

Table 52 (cont.). Naming system used for tributaries in the Lewis and Clark assessment

Official name	Code	Location	Watershed	X coor.	Y coor.
Jordan	KP14		Keya Paha River	448005	4759491
Lute	KP16		Keya Paha River	452024	4760738
Morse	KP29		Keya Paha River	484876	4750619
Oak	KP27		Keya Paha River	478915	4749926
Rock Bridge	KP13		Keya Paha River	442876	4763095
Sand	KP3		Keya Paha River	411688	4773906
Shadely	KP4		Keya Paha River	415986	4771689
Shingle	KP22		Keya Paha River	465332	4755887
Spotted Tail	KP25		Keya Paha River	474341	4753530
Spring	KP21		Keya Paha River	463668	4754085
Timber	KP10		Keya Paha River	432342	4764619
unnamed	KP7	3 mi. E. of Millboro	Keya Paha River	425411	4769887
unnamed	KP31	3.5 mi. SW. Naper	Keya Paha River	494163	4752144
unnamed	KP1	2 mi. NW of Keya Paha	Keya Paha River	406282	4777649
unnamed	KP9	Rahn Dam tributary	Keya Paha River	432203	4768085
unnamed	KP11	2 mi. NW. of Wewela	Keya Paha River	434837	4765312
unnamed	KP2	Sargent Dam tributary	Keya Paha River	412105	4775154
Willow	KP5		Keya Paha River	420976	4772521
Wolf	KP23	-	Keya Paha River	469212	4754639
Bazile	LC23		Lewis & Clark	586658	4733825
Bull	LC5		Lewis & Clark	567627	4746184
Charley	LC18		Lewis & Clark	602719	4747318
Coffee	LC8		Lewis & Clark	572479	4742441
Deadman	LC15		Lewis & Clark	597452	4748363
Emanuel	LC10		Lewis & Clark	587176	4744021
Randall	LC22		Lewis & Clark	535054	4764342
Sevenmile	LC1		Lewis & Clark	542804	4761027
Silver	LC14		Lewis & Clark	595799	4748014
Slaughter	LC2		Lewis & Clark	551548	4751728
Snatch	LC17		Lewis & Clark	598889	4749711
Spring	LC4		Lewis & Clark	562914	4748125
Tobacco	LC3		Lewis & Clark	553766	4750897
unnamed	LC19	1 mi. W. of Bon Homme Colony	Lewis & Clark	603720	4746708
unnamed	LC20	0.5 mi. W. of Bon Homme Colony	Lewis & Clark	605113	4746709
unnamed	LC21	Gavin's Pt. Rec. Area	Lewis & Clark	618039	4746404
unnamed	LC9	1 mi. NE. of Runningwater	Lewis & Clark	584538	4737175
unnamed	LC16	trib. to Snatch Cr.	Lewis & Clark	598192	4749929
unnamed	LC12	Tributary to LC11(from east)	Lewis & Clark	590576	4746665
unnamed	LC13	Springfield Golf Course	Lewis & Clark	591751	4746535
unnamed	LC11	E. edge of Springfield	Lewis & Clark	590358	4746316
Weigand	LC24	-	Lewis & Clark	615820	4742574
Beaver	NR16		Niobrara River	489866	4742303
Big Sandy	NR17		Niobrara River	506499	4743550
Ash	NR15		Niobrara River	473094	4735650

Table 53. Naming system used for tributaries in the Lewis and Clark assessment

Official name	Code	Location	Watershed	X coor.	Y coor.
Bear	NR1		Niobrara River	307729	4749649
Brush	NR18		Niobrara River	514677	4740778
Coon	NR9		Niobrara River	383689	4751590
Cub	NR12		Niobrara River	427490	4736204
Eagle	NR19		Niobrara River	535608	4735233
Fairfield	NR10		Niobrara River	412105	4737313
Long Pine	NR14		Niobrara River	447312	4729829
Medicine	NR2		Niobrara River	316462	4740639
Middle	NR11		Niobrara River	413352	4738006
Minnecheduza	NR8		Niobrara River	377867	4750204
Plum	NR13		Niobrara River	428877	4732878
Redbird	NR20		Niobrara River	545588	4734263
Schlagel	NR6		Niobrara River	372184	4742025
unnamed	NR7	2 mi. SE. of Valentine	Niobrara River	376065	4744105
unnamed	NR3	15 air miles W. of Snake R. mouth	Niobrara River	329907	4740501
unnamed	NR4	11 air miles W. of Snake R. mouth	Niobrara River	336699	4740362
unnamed	NR5	7 mi. N. of Merrit Dam	Niobrara River	348758	4731075
Verdigree	NR21	-	Niobrara River	578023	4727333
Beaver	PC25		Ponca Creek	527291	4746877
Blueeyes	PC10		Ponca Creek	480025	4768778
Crooked	PC26		Ponca Creek	525628	4744798
Dizzy	PC21		Ponca Creek	513014	4754085
Dry	PC20		Ponca Creek	513014	4755332
Hay	PC12		Ponca Creek	484044	4766005
Masdon	PC6		Ponca Creek	468381	4778342
Murphy	PC9		Ponca Creek	473648	4771827
Spring	PC23		Ponca Creek	521747	4749926
Squaw	PC14		Ponca Creek	494163	4761431
Tobacco	PC22		Ponca Creek	519113	4753392
unnamed	PC18	1 mi. S. of Bonesteel	Ponca Creek	506222	4757134
unnamed	PC19	5-6 mi. W. of Butte	Ponca Creek	506499	4754916
unnamed	PC8	drains S. side of Burke	Ponca Creek	473926	4774877
unnamed	PC7	just west of Burke GC	Ponca Creek	469905	4779589
unnamed	PC4	Lake Dolton	Ponca Creek	464500	4781115
unnamed	PC3	4 mi. SW. of Dallas	Ponca Creek	453133	4783609
unnamed	PC5	1 mi. E. of Gregory	Ponca Creek	465886	4782223
unnamed	PC24	2 mi. NW. of Spencer	Ponca Creek	522855	4751313
unnamed	PC15	1/2 mi. N. of Naper	Ponca Creek	494856	4760046
unnamed	PC17	3 mi. SW. of Bonesteel	Ponca Creek	503311	4757411
unnamed	PC2	Roosevelt Dam	Ponca Creek	450223	4784302
unnamed	PC16	drains area 3 mi. E. of Naper	Ponca Creek	500401	4756718
unnamed	PC28	5 mi. E. of Lynch	Ponca Creek	550855	4743134
unnamed	PC11	2-3 mi. W of Herrick	Ponca Creek	481133	4770718
unnamed	PC1	Upstream from PC2	Ponca Creek	441713	4785966
Whiskey	PC27		Ponca Creek	543093	4742857
Willow	PC13		Ponca Creek	488202	4765590

Model inputs came from several sources. A grid taken from the National Elevation Dataset (NED) was used to analyze topography. The National Landcover Dataset (NLCD) was used to provide landuse data. STATSGO soil layers were used, along with NASIS data tables, to provide soil input. Weather data was generated using a synthetic weather generator based on climate information from a station in Huron, SD.

Model outputs are based on a 25-year simulation time. This allows time for variable weather conditions. Such an approach tempers the effects of extremely dry or wet years, yet allows such years to influence model predictions.

Because of its size, an analysis of sediment production in the Lewis and Clark watershed should start at a broad scale. Combining sub-watersheds based on their geographic location or "parent" tributary does this. Sub-watersheds were combined into 5 different groups (Table 49). Sediment production was calculated for each group. Complete modeling results for individual tributaries can be found in Table 55. Only a few of the more critical watersheds will be discussed in the text.

Table 54. Results of AnnAGNPS modeling expressed by grouping sub-tributaries according to geographic area or "parent" tributary

Trib./ General Area	# of subwatersheds	Drainage area (acres)	Sediment prod. (tons)	Tons/acre
Ponca Creek	28	324,287	372,542	1.15
East River area (SD)	21	592,444	589,553	1.01
Keya Paha River	32	629,121	180,005	0.28
Niobrara River	21	2,386,284	144,809	0.06
Santee area (NE)	2	311,287	1,208,402	3.88

AnnAGNPS indicates that the area east of Niobrara, NE (termed the "Santee area" in table 54) produces more upland sediment (3.88 tons/acre) than any other area in the entire watershed. LC23 and LC24 (Bazile and Weigand creeks) were modeled from this area. It was estimated that sediment production in their watersheds was 3.9 and 4.2 tons/acre, respectively. These watersheds account for 2 of the three most erosive out of the 104 modeled for this assessment. Both of these watersheds have relatively high proportions of agricultural land located on, or near topographical slopes. These watersheds certainly need further scrutiny and increased conservation efforts.

Estimates of sediment production were also relatively high for Ponca Creek (1.15 tons/acre). Seventeen of the 28 tributaries within this larger drainage produced sediment production estimates of greater than 1 ton/acre. This indicates that much of this watershed is susceptible to erosion. Best Management Practices should be implemented wherever possible. Five tributaries produced sediment production estimates of greater than 2 tons/acre. One of these (PC7, 2.3 tons/acre) is located in South Dakota. PC7 originates half way between Burke and Gregory and drains south into Ponca Creek. PC 19 and PC28 produced especially high sediment estimates (3.5 and 3.0 tons/acre, respectively). These adjacent watersheds are located between Naper and Butte, NE.

Table 55.. Results of AnnAGNPS modeling for individual tributaries

Tributary WS	Drainage area (acres)	Sediment Production (tons)	Tons/ acre	Tributary WS	Drainage area (acres)	Sediment Production (tons)	Tons/ acre
CT1	335,077	212,944	0.44	LC22	27,011	38,656	1.43
CT2	39,365	90,499	2.30	LC23	291,821	1,126,222	3.86
KP1	5,370	554	0.10	LC24	19,466	82,180	4.22
KP2	4,195	1,681	0.40	NR1	220,647	3,977	0.02
KP3	90,978	7,112	0.08	NR2	185,162	802	0.01
KP4	36,844	2,995	0.08	NR3	35,547	630	0.02
KP5	55,985	9,854	0.18	NR4	12,681	1,047	0.08
KP6	48,729	1,811	0.04	NR5	126,349	554	0.01
KP7	5,957	4,046	0.68	NR6	78,390	306	0.01
KP8	32,613	4,648	0.14	NR7	11,654	1,798	0.15
KP9	52,500	9,685	0.18	NR8	256,710	33,072	0.13
KP10	4,801	2,575	0.54	NR9	18,716	882	0.05
KP11	4,580	1,431	0.31	NR10	66,604	303	0.01
KP12	59,814	10,591	0.18	NR11	10,552	8,278	0.78
KP13	17,743	4,802	0.27	NR12	11,432	4,823	0.42
KP14	5,378	2,746	0.51	NR13	319,415	27,261	0.09
KP15	6,609	2,038	0.31	NR14	267,694	37,343	0.14
KP16	11,576	1,734	0.15	NR15	27,552	2,225	0.08
KP17	47,369	5,189	0.11	NR16	28,698	3,287	0.11
KP18	13,054	17,518	1.34	NR17	68,214	7,254	0.11
KP19	3,791	8,530	2.25	NR18	51,655	9,786	0.19
KP20	10,427	17,481	1.68	NR19	132,215	1,181	0.01
KP21	36,313	3,028	0.08	NR20	101,939	16465	0.16
KP22	5,174	2,038	0.39	NR21	354,458	268874	0.76
KP23	10,118	25,784	2.55	PC1	38,638	20,974	0.54
KP24	17,053	2,472	0.15	PC2	14,540	4,557	0.31
KP25	5,305	7,544	1.42	PC3	5,875	5,368	0.91
KP26	3,617	142	0.04	PC4	4,680	7,918	1.69
KP27	14,493	2,149	0.15	PC5	4,245	7,602	1.79
KP28	5,075	205	0.04	PC6	30,561	31,547	1.03
KP29	6,184	9,210	1.49	PC7	5,548	12,659	2.28
KP30	3,038	2,727	0.90	PC8	7,429	5,414	0.73
KP31	4,438	7,685	1.73	PC9	22,705	26,782	1.18
LC1	7,099	5,104	0.72	PC10	15,299	17,412	1.14
LC2	29,893	42,584	1.42	PC11	13,757	13,306	0.97
LC3	10,920	13,497	1.24	PC12	7,107	6,983	0.98
LC4	10,573	16,745	1.58	PC13	6,916	9,703	1.40
LC5	9,987	17,695	1.77	PC14	11,220	16,916	1.51
LC8	12,187	14,905	1.22	PC15	5,641	9,370	1.66
LC9	4,018	6,524	1.62	PC16	5,037	18,314	3.64
LC10	118,713	84,714	0.71	PC17	11,031	11,509	1.04
LC11	8,832	7,880	0.89	PC18	12,081	11,281	0.93
LC12	1,433	1,895	1.32	PC19	5,416	19,104	3.53
LC13	1,751	2,814	1.61	PC20	8,652	8,331	0.96
LC14	8,971	11,591	1.29	PC21	8,734	7,250	0.83
LC15	9,492	9,013	0.95	PC22	9,201	7,867	0.86
LC16	1,695	2,842	1.68	PC23	13,757	6,944	0.51
LC17	28,795	12,613	0.44	PC24	5,016	7,963	1.59
LC18	4,565	4,229	0.93	PC25	10,384	21,714	2.09
LC19	10,873	6,217	0.57	PC26	10,905	11,905	1.09
LC20	5,681	18,302	3.22	PC27	25,079	29,201	1.16
LC21	3,523	6,946	1.97	PC28	4,833	14,648	3.03

The group of tributaries located in eastern South Dakota produced a sediment production estimate of 1.01 tons/acre. Fourteen of 22 tributaries in this group produced more than 1 ton/acre. Most of these have relatively small watersheds (<30,000 acres) and they are located in close proximity to Lewis and Clark Lake. LC20 (3.2 tons/acre) produced the highest estimate of sediment production in this group. It is a narrow watershed located on the west side of the Bon Homme Hutterite Colony in Bon Homme Co. CT2 (Dry Choteau Creek) produced an estimate of 2.3 tons/acre. This is significantly higher than the estimate for CT1 (main-stem Choteau Creek). Part of this difference may be attributed to topography.

Upland erosion estimates were low for the Keya Paha River watershed as a whole (0.28 tons/acre). Only 7 of the 31 tributaries in this group produced more than 1 ton of sediment per acre. However, these 7 tributaries are found in a small geographic area located along the SD/NE border in Tripp, Gregory, Keya Paha, and Boyd counties. All of these tributaries drain into the river from the north. When considering these Keya Paha tributaries with the adjacent tributaries to Ponca Creek, this general area seems prone to erosion.

The Niobrara River had the lowest estimated sediment production of all the groups (0.06 tons/acre). Individually, very little upland erosion was predicted for Niobrara tributaries. None of the 21 tributary watersheds produced more than 1 ton of sediment per acre. As has been mentioned, AnnAGNPS predicts only upland erosion. It is likely that there is a significant amount of sediment produced from in-channel erosion along the length of the Niobrara and its numerous tributaries. The amount of this caused by anthropogenic effects was not covered within the scope of this study.

Rapid Geomorphic Assessments

Rapid Geomorphic Assessments (RGAs) are a qualitative technique used to quickly identify and compare the evolutionary stage of channels. Values obtained are unitless and allow for a comparison between channels of different sizes. The assessment is not designed to generate a sediment or nutrient load from the channel, but may help identify portions of the stream that may need additional analysis or may benefit from BMPs.

The assessment is comprised of nine separate data sections. Each one is scored independently of the others. In general, a higher score is associated with a condition that may represent or increase the risk of a degraded channel. Totaling the scores may give a good representation of the channels overall condition, but scores for each watershed should be examined independently as some parameters may not be good indicators. As an example, prairie streams in good condition may not typically have woody vegetations, so increasing scores as a result of a lack of woody vegetation may not be applicable in these streams.

The first condition scored is the primary bed material. Channels composed primarily of silts and clays are typically more susceptible to degradation and therefore receive a score of 4 points. Decreasing risk is associated with increasing material size; sands score 3 points, gravels 2 points, cobbles 1 point, and a bedrock stream bottom scores 0 points.

The second condition scored is the presence or absence of bed and bank protection. If the bed of the channel is protected, either through the placement of rock, concrete, or the presence of bedrock, this section will score a 0. When the bottom of the channel is protected, there is very little chance of the channel becoming incised or downcut. If the bottom of the channel is unprotected, and neither bank is protected, the channel receives 1 point. An unprotected bed with one bank protected receives 2 points and an unprotected bed with two banks protected receives 3 points. As more of the bank becomes protected, it prevents lateral migration of the channel and increases the potential for vertical migration or downcutting.

The next condition scored is the degree of incision, how much access the channel has to its floodplain. This is scored based on an estimated “normal” water depth divided by the bank height. A channel that is severely incised may have a “normal” water level of 1 foot of depth, while the tops of the banks may be 10 feet high. The degree of incision for this bank would be 1 divided by 10 or as a percentage, 10%. This example stream would have very poor or limited access to the floodplain and would score a 4. Streams with better access to their floodplains are less likely to impart excessive stress on the bed and banks and are thus likely to migrate less. The remaining categories are broken out as percentages, 0% to 10 % = 4, 11% to 25% = 3, 26% to 50% = 2, 51% to 75% = 1 and > 75% = 0.

The next condition is the degree of constriction. This may best be defined as the limitation of a streams floodplain. Manmade or natural features may result in a constriction of a floodplain. Examples of floodplain constriction include narrow canyons and bridge embankments that create an increase in flood flow velocities. This condition is scored in much the same way as the degree of incision with the width of the constriction divided by the normal width of the floodplain.

The next four sections are scored separately for each bank of the stream. Each bank may receive a score of up to 2 points. Banks may be divided in one of two ways. For channels that are relatively straight, such as those modified for increased drainage, it is easiest to assess right and left bank conditions. For natural meandering streams, channels may be evaluated as inside or outside in reference to the curve of the meander.

The first parameter to evaluate in this section is the presence and type of erosion. Banks that are not eroding receive 0 points, those with fluvial or sheet type erosion receive a score of 1 point, and those banks with mass wasting present receive 2 points.

The next condition scored (streambank instability) under this section is the percent of the stream bank that is eroding. Based strictly on percentage, a bank with less than 10%

eroding receives 0 points while one with more than 75% receives 2 points, with scores and percentages evenly distributed between these values..

The presence and absence of woody vegetation on the stream bank is scored based on a percentage of the bank covered by this type of vegetation. This parameter may not be particularly accurate for prairie streams that would not normally have this type of vegetation. It was scored for all streams in this study to maintain a consistency with those streams that would normally have been populated with this type of vegetation.

The final parameter scored is frequency of bank accretion or deposition along each of the banks. This condition is scored inversely to that of streambank instability. A high percentage of accretion results in a low score while a low percentage of accretion results in a high score.

The final section scored is the stage of channel evolution. Through the analysis of each of the steps leading up to this, a condition is usually already identified. The channel condition is based on Simons channel evolution (Simon, 2004). A stable channel that has never undergone the process of incision is a stage I and scores 0 points. The next stage of channel evolution (Stage II Constructed) is characterized by a trapezoidal shape and is often straightened to improve drainage. Stage III is the occurrence of a knick-point or head-cut. This is the beginning of an incised channel and is the first sign of an unstable stream channel. Stage IV occurs as the head-cut begins to widen while continuing to cut down. Stage V starts when downcutting is no longer occurring and channel widening is not yet complete. The most distinct difference between a stage IV and V is that the instant that deposition or accretion begins the channel becomes a stage V. The final stage of channel evolution is VI in which a stable channel has been developed within the boundaries of the old floodplain.

Assessments were completed on 564 sites throughout the South Dakota portion of the watershed. Site by site comparisons of scores to AnnAGNPs did not yield a correlation indicating that incised channels were not necessarily a function of excessive runoff from uplands. Table 56 summarizes the mean, maximum, minimum and number of sites assessed on each creek. Creek locations may be found by utilizing the tables in the AnnAGNPS section of this report.

Table 56. RGA Summary for Tributaries

Waterbody	Average	Maximum	Minimum	Sample Count
Spring	15.6	18	13	8
Springfield	16.0	23.5	9	8
Choteau	16.6	27	9	266
Slaughter	17.3	23	9.5	12
Keya Paha	17.3	22.5	10	58
Snatch	17.4	22	14	8
Charley	17.9	22	14	8
Bull Creek	18.0	21	11	8
Colony (Bon Homme Co.)	18.1	20	17	8
Ponca Creek	18.5	28	9.5	68
Emanuel	18.8	27.5	9	60
Deadman	19.0	19	19	4
Tobacco	20.3	21	19.5	4
Coffe	20.5	22	19	4
Colony east (Bon Homme Co)	21.0	27.5	17	8
Randall Creek	23.4	27.5	20	24
Silver	24.8	29	22	8

The table format used to summarize the data should not necessarily be used to identify creeks that are impaired with the exception of extremes. Channels that generate scores entirely under 15 may be considered fairly stable. The other extreme are those streams that generate scores consistently above 20, which indicate a persisting degraded state.

Randall Creek may be the best example in the project of a stream with consistent extremes. This tributary was not targeted as part of the original study effort due to its location. The mouth of this creek is located immediately downstream of the dam at Pickstown, South Dakota. Watershed modeling did not highlight this stream as particularly degraded, making it uncertain what the cause of channel impairment may be. It was the recommendation of the coordinators that this stream be looked at more closely as a part of any implementation activities.

For the majority of the streams, there were both good and poor reaches that were identified. It is recommended that those sites scoring greater than 22 (approximately 70 sites) be examined more closely during implementation to develop site specific restoration alternatives.

Animal Feeding Area Assessment

The initial scope of the assessment project did not include an assessment of animal feeding operations. Water quality samples collected at the start of the project indicated that an assessment of animal feeding areas throughout the watershed would be essential to understanding impairments in the drainages. Water quality data indicated TMDLs for fecal coliform bacteria would need to be developed for the Keya Paha River, Ponca Creek, Choteau Creek, and Emanuel Creek gauging sites. High fecal coliform counts were also detected in the Snatch Creek drainage; however no standards for bacteria exist for this waterbody.

Analysis of sample data suggests that primary causes for impairment in tributaries west of the Missouri River are strongly linked to grazing and background levels resulting in minimal analysis of the feeding operation data from this area. Data from the tributaries east of the Missouri River strongly linked bacterial impairment to the feeding operations located in the drainages. Feeding area locations may be found in Figure 34.

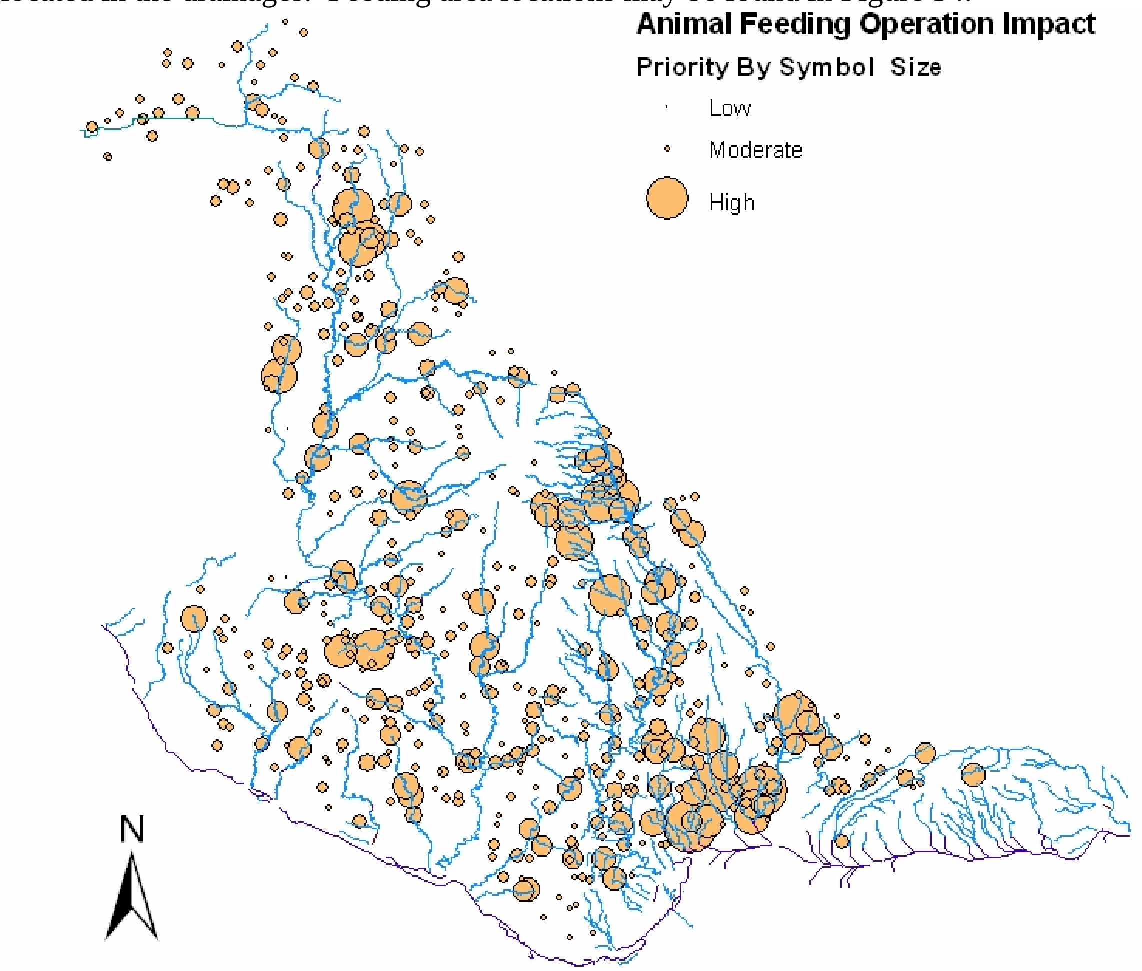


Figure 34. Feeding Operation Location and Impact

Feeding areas were prioritized using two categories. The distance of the lot was calculated to the nearest stream segment from the National Hydrograph Dataset and broken into groups of less than 100 meters to the stream, 100 to 200 meters, 300 to 500 meters, and greater than 500 meters. The second factor was the amount of manure produced by each feeding operation. When these two factors were compounded, it was possible to prioritize the lots for the entire drainage.

Due to the changing nature of priorities between the subwatersheds, an additional field was added indicating which watershed the lot was located in. Table 57 is the first portion of the table contained in Appendix C. The rank includes both the overall rank, and the rank of the feeding area within its subwatershed. The rating number is the AGNPS feeding area assessment rating number based on chemical oxygen demand (COD) which ignores phosphorus and stream proximity. The percent reductions are for feeding areas only and do not take into account pastured livestock or other background sources of bacteria which may account for a considerable portion of fecal bacteria counts in streams.

The percent reductions are based on a unitless number generated in the ranking process that takes into account both proximity to the stream as well as the manure generated by the feeding operation. The manure load is based on phosphorus and takes into account the various animal types. The majority of feeding areas consist of beef cattle, as a result bacteria loads may be assumed to be comparable to the manure loads.

Table 57. Animal Feeding Area Priorities

Rank	Phosphorus Load (Pounds)	Rating	Animal Type	LotID	Watershed	Distance to Stream (Meters)	Percent of Total Load	Cumulative Percent	Percent of Subwatershed Load	Subwatershed Cumulative Percent
1-MS-1	333	68	Beef Cattle	F432	Missouri	<100	2.60%	2.60%	10.13%	10.13%
2-MS-2	292	67	Beef Cattle	F436	Missouri	<100	2.28%	4.88%	8.88%	19.02%
3-MS-3	287	67	Beef Cattle	F79	Missouri	<100	2.24%	7.12%	8.73%	27.75%
4-EM-1	231	52	Beef Cattle	F333	Emanuel	<100	1.80%	8.92%	7.02%	7.02%
5-SN-1	417	72	Beef Cattle	F55	Snatch	100-200	1.63%	10.55%	29.20%	29.20%
6-CH-1	203	60	Beef Cattle	F298	Choteau	<100	1.58%	12.14%	3.93%	3.93%
7-EM-2	190	61	Beef Cattle	F335	Emanuel	<100	1.48%	13.62%	5.77%	12.79%
8-EM-3	188	61	Beef Cattle	F367	Emanuel	<100	1.47%	15.09%	5.71%	18.50%
9-CH-2	176	57	Beef Cattle	F135	Choteau	<100	1.37%	16.46%	3.41%	7.34%
10-CH-3	336	68	Beef Cattle	F228	Choteau	100-200	1.31%	17.77%	3.25%	10.60%
11-CH-4	167	59	Beef Cattle	F169	Choteau	<100	1.30%	19.08%	3.24%	13.83%
12-EM-4	152	55	Beef Cattle	F358	Emanuel	<100	1.19%	20.26%	4.62%	23.12%
13-MS-4	292	66	Beef Cattle	F78	Missouri	100-200	1.14%	21.40%	4.44%	32.19%
14-MS-5	292	67	Beef Cattle	F379	Missouri	100-200	1.14%	22.54%	4.44%	36.63%
15-CH-5	286	80	Dairy Cattle	F112	Choteau	100-200	1.12%	23.66%	2.77%	16.60%
16-CH-6	134	56	Beef Cattle	F17	Choteau	<100	1.05%	24.71%	2.60%	19.20%
17-EM-5	250	65	Beef Cattle	F97	Emanuel	100-200	0.98%	25.68%	3.80%	26.92%
18-CH-7	125	55	Beef Cattle	F292	Choteau	<100	0.98%	26.66%	2.42%	21.62%
19-EM-6	243	65	Beef Cattle	F182	Emanuel	100-200	0.95%	27.61%	3.69%	30.61%
20-EM-7	119	48	Beef Cattle	F385	Emanuel	<100	0.93%	28.54%	3.62%	34.23%

PUBLIC INVOLVEMENT AND COORDINATION

STATE AGENCIES

South Dakota Department of Environment and Natural Resources (SD DENR) was the primary state agency involved in completion of this assessment. SD DENR provided technical support and equipment throughout the course of the project.

FEDERAL AGENCIES

Environmental Protection Agency (EPA) provided the primary source of funds for completion of the assessment on Lewis and Clark Lake.

Natural Resource Conservation Service (NRCS) provided technical assistance, particularly in the collection of soils data for the AnnAGNPS portion of the report.

The Farm Service Agency provided a great deal of information that was utilized in the completion of the AnnAGNPS modeling portion of the assessment.

LOCAL GOVERNMENT, INDUSTRY, ENVIRIONMENTAL, AND OTHER GROUPS, AND PUBLIC AT LARGE

The project was presented at many meetings during the assessment period. With Randall Resource, Conservation, and Development Associated, Inc, (RC&D) as the leading sponsor, the project was not limited by state boundaries. The project had many partners from both South Dakota as well as Nebraska: Many of the organizations listed below saw several updated presentations as the project progressed. In addition to the many meetings that were attended, a website was also developed and maintained throughout the project.

South Dakota Conservation Districts: Aurora, Bennett, Bon Homme, Charles Mix, Clearfield-Keya Paha, Douglas, Gregory, Hutchinson, Todd, Yankton

Nebraska Natural Resource Districts:
Lewis and Clark, Lower Niobrara, Middle Niobrara, Upper Elkhorn

Government: National Park Service, Nebraska DEQ, NRCS, SD DENR, SD Department of Agriculture, SD GF&P, USACOE, USGS

Organizations: Bon Homme - Yankton Rural Water, Cedar-Knox Rural Water, Cities of Yankton and Springfield, Knox Co. Commission, Lewis and Clark SD-NE Preservation Association, Rosebud Cattlemen's Association, Spring/Bull Creek Watershed District, So. Central Water Development District, Village of Niobrara, Yankton and Rosebud Sioux Tribes

R.C.&D's
Badlands, Lower James, Northeast Nebraska, North Central Nebraska, South Central SD

Industry: Natural Resource Solutions, Brooking South Dakota

Project progress and data were presented at the following public meetings:

Spring/Bull Creek watershed tour – May 2003

Randall RCD board – May 2003

C.M. County Conservation District – May 2003

Douglas County Conservation District – June 2003

Missouri River "issues" meeting, Springfield – Sept 2003

Yankton City Council – August 2003

Gregory Co. Conservation District -- August 2003

Clearfield /KP Cons. District – August 2003

Todd Co/ RS Tribe – February 2004

SD GIS Consortium – October 2003

Hutchinson Co. Cons. Dist. – February 2004

Lake Francis Case Interagency – March 2004

Lewis & Clark Lake SDNEPA – April 2004

Lower James RC&D – May 2004

Clearfield /KP Cons. District – May 2004

South Central Water – May 2004

Yankton Kiwanis – July 2004

Yankton City Council – August 2004

LCSDNEPA – November 2004

Randall RCD Council – December 2004

CM Cons. Dist – December 2004

S. Central Water – December 2004

North Cent. NRD – February 2005

LCSDNEPA – February 2005

North Cent. RC&D and Mid Niobr NRD – April 2005

Northeast Nebraska RC&D – April 2005

SD NRCS Management Steering Team – May 2005

9th Annual Missouri River Natural Resource Conference – May 2005

Gregory Conservation District – June 2005

LITERATURE CITED

Huxoll, Cory, 2002, South Dakota Game Fish and Parks; South Dakota Game Report No. 2003-11; 2002 Annual Report County Wildlife Assessments with a summary of the 1991-2002 Assessments.

Klimentz, L., Simon, A., Schwartz, J., 2009. Characterization of Suspended-Sediment Transport Conditions for Stable, "Reference" Streams in Selected Ecoregions of EPA Region 8.

Missouri, State of Web Site, 2001. www.conservation.state.mo.us/nathis/endangered/endanger/orchid/index.htm

Novotny and Olem, V. and H., 1994. Water Quality, Prevention, Identification, and Management of Diffuse Pollution, Van Nostrand Reinhold, New York.

Simon, A., Dickerson, W., Heins, A., 2004 Suspended-sediment transport rates at the 1.5-year recurrence interval for ecoregions of the United States: transport conditions at the bankful and effective discharge. Geomorphology Vol 58 issues 1-4 March 2004.

SDDENR (South Dakota Department of Environment and Natural Resources). 2006. The 2006 South Dakota Integrated Report for Surface Water Quality Assessment Pierre, SD.

U.S Census Bureau, http://factfinder.census.gov/servlet/SAFFPopulation?_event=Search&_name=marty&_state=04000US46&_county=marty&_cityTown=marty&_zip=&_sse=on&_lang=en&pctxt=fph

USACE, 2001. United States Army Corp of Engineers, "Niobrara and Missouri Rivers, South Dakota and Nebraska, Sediment Strategies"

USDA (United States Department of Agriculture) 1982, Soil Survey of Charles Mix County, South Dakota

USDA (United States Department of Agriculture). 1984. Soil Survey of Gregory County, South Dakota.

U.S. Department of Interior, Fish and Wildlife Service and U.S. Department of Commerce, Bureau of Census 1997.

U.S. Environmental Protection Agency, 1990. Clean Lakes Program Guidance Manual. EPA-44/4-90-0006. Washington D.C.

U.S. Environmental Protection Agency website, 2005. www.epa.gov

Walker, W.W., 1999. Simplified Procedures for Eutrophication Assessment and Prediction: User Manual, U.S. Army Corps of Engineers.

Wilson, Stephen K. 2002. Relation of Habitat to Fish Community Characteristics in Small South Dakota Impoundments. M.S. Thesis. South Dakota State University, Dept. of Wildlife and Fisheries Sciences. Brookings.

Yagow, G., Dillaha, T., Mostaghimi, S., Brannan, K., Heatwole, C. and Wolfe, M.L., 2001. *TMDL modeling of fecal coliform bacteria with HSPF*. ASAE meeting paper No.01-2066. St.Joseph, Mich.

APPENDICES

Appendix A. Macroinvertebrate Data

Natural Resource Solutions, Inc.
Project: LAC Benthic Macroinvertebrates
Locality: Lewis and Clark Watershed, SD
Client: Randall RC & D

CLASS/ORDER	FAMILY	FINAL DETERMINATION	Life Stage	LAC-01	LAC-02	LAC-05	LAC-06	LAC-07
			Sample Date:	10/06/04	10/06/04	09/24/03	08/14/03	09/04/03
			Percent subsampled:	100%	100%	100%	100%	33%
Pelecypoda	Sphaeriidae	***Musculium*** sp.					6	-
Pelecypoda	Sphaeriidae	***Pisidium*** sp.					1	-
Gastropoda	Physidae	***Physella*** sp.					5	26
Amphipoda	Hyalellidae	***Hyalella*** sp.					1	-
Ephemeroptera	Ephemeroptera	Ephemeroptera (damaged)	L		4		1	-
Ephemeroptera	Baetidae	Baetidae (imm./damaged)	L			1	5	2
Ephemeroptera	Baetidae	*Fallceon quilleri*	L				1	-
Ephemeroptera	Caenidae	Caenidae (immature)	L	3	1	27		-
Ephemeroptera	Caenidae	***Caenis*** sp.	L				39	2
Ephemeroptera	Caenidae	***Cercobrachys*** sp.	L				3	-
Ephemeroptera	Heptageniidae	Heptageniidae (imm./damaged)	L		1			-
Ephemeroptera	Isonychiidae	***Isonychia*** sp.	L				1	-
Ephemeroptera	Leptohyphidae	Leptohyphidae (immature)	L	8				-
Ephemeroptera	Leptohyphidae	***Tricorythodes*** sp.	L				5	-
Plecoptera	Plecoptera	Plecoptera (immature)	L		3			-
Trichoptera	Brachycentridae	***Brachycentrus*** sp.	L	5				-
Trichoptera	Hydropsychidae	***Cheumatopsyche*** sp.	L				3	-
Trichoptera	Hydropsychidae	Hydropsychidae (immature)	L		1			-
Trichoptera	Leptoceridae	Leptoceridae (damaged)	P			2		-
Trichoptera	Leptoceridae	Leptoceridae (immature)	L		1			-
Trichoptera	Leptoceridae	***Nectopsyche*** sp. (immature)	L				10	-
Trichoptera	Leptoceridae	*Nectopsyche diarina*	L				9	-
Coleoptera	Elmidae	***Dubiraphia*** sp.	L	29	1	5	1	1

Coleoptera	Elmidae	***Dubiraphia*** sp.	A				5	-

Natural Resource Solutions, Inc.
Project: LAC Benthic Macroinvertebrates
Locality: Lewis and Clark Watershed, SD
Client: Randall RC & D

			Sample Date:	10/06/04	10/06/04	09/24/03	08/14/03	09/04/03
			Percent subsampled:	100%	100%	100%	100%	33%
CLASS/ORDER	**FAMILY**	**FINAL DETERMINATION**	**Life Stage**	**LAC-01**	**LAC-02**	**LAC-05**	**LAC-06**	**LAC-07**
Coleoptera	Elmidae	Elmidae (head only)	A		1			-
Coleoptera	Hydrophilidae	***Berosus*** sp.	L					2
Odonata	Calopterygidae	***Hetaerina*** sp.	L				1	-
Odonata	Coenagrionidae	***Argia*** sp. (damaged)	L			1		-
Odonata	Coenagrionidae	***Coenagrio/Enallagma*** sp.	L					5
Odonata	Gomphidae	Gomphidae (immature)	L	1				-
Hemiptera	Corixidae	Corixidae (immature)	L			107	6	237
Hemiptera	Corixidae	***Trichocorixa*** sp.	A					10
Hemiptera	Veliidae	***Microvelia*** sp.	A			1		-
Hemiptera	Veliidae	***Rhagovelia*** sp.	A				7	-
Diptera	Ceratopogonidae	Ceratopogoninae	L	30	4	1	1	14
Diptera	Dolochopodidae	Dolochopodidae	L	7				-
Diptera	Simuliidae	Simuliidae (immature)	L		9			-
Diptera	Simuliidae	***Simulium*** sp.	L		6		1	-
Diptera	Simuliidae	***Simulium*** sp.	P	3				-
Diptera	Tipulidae	Limoniinae (imm.)	L	2				-
Diptera	Chironomidae	***Ablabesmyia*** sp.	L				1	-
Diptera	Chironomidae	***Chernovskia*** sp.	L	1	2		8	-
Diptera	Chironomidae	***Cladotanytarsus*** sp.	L	1	1		21	1
Diptera	Chironomidae	***Cricotopus/Orthocladius*** sp.	L	3	1		26	-
Diptera	Chironomidae	***Cricotopus*** sp.	L	1				-
Diptera	Chironomidae	***Cricotopus*** sp.	P				3	-
Diptera	Chironomidae	*Cricotopus bicinctus*	L				3	-
Diptera	Chironomidae	***Cryptochironomus*** sp.	L	3	2	4	11	-
Diptera	Chironomidae	***Cryptochironomus*** sp.	P			1		-

Diptera	Chironomidae	***Cryptotendipes*** **sp.**	L				10	

Natural Resource Solutions, Inc.
Project: LAC Benthic Macroinvertebrates
Locality: Lewis and Clark Watershed, SD
Client: Randall RC & D

			Sample Date:	10/06/04	10/06/04	09/24/03	08/14/03	09/04/03
			Percent subsampled:	100%	100%	100%	100%	33%
CLASS/ORDER	**FAMILY**	**FINAL DETERMINATION**	**Life Stage**	**LAC-01**	**LAC-02**	**LAC-05**	**LAC-06**	**LAC-07**
Diptera	Chironomidae	***Cryptotendipes*** sp.	P			1	2	
Diptera	Chironomidae	***Dicrotendipes*** sp.	L			1	3	1
Diptera	Chironomidae	***Endochironomus*** sp.	L					1
Diptera	Chironomidae	***Glyptotendipes*** sp.	L			9	5	2
Diptera	Chironomidae	***Limnophyes*** sp.	L				1	
Diptera	Chironomidae	***Lopescladius*** sp.	L	3	1			
Diptera	Chironomidae	***Parakiefferiella*** sp.	L	4			4	
Diptera	Chironomidae	***Paralauterborniella*** sp.	L				6	
Diptera	Chironomidae	***Paratendipes*** sp.	L	1	11			
Diptera	Chironomidae	***Polypedilum*** sp.	L			3	37	
Diptera	Chironomidae	***Polypedilum*** sp.	P				4	
Diptera	Chironomidae	***Rheotanytarsus*** sp.	L		1			
Diptera	Chironomidae	***Saetheria*** sp.	L	6			70	
Diptera	Chironomidae	***Saetheria*** sp.	P				4	
Diptera	Chironomidae	***Stictochironomus*** sp.	L				2	2
Diptera	Chironomidae	***Tanypus*** sp.	L			5		78
Diptera	Chironomidae	***Tanytarsus*** sp.	L		6		31	
Diptera	Chironomidae	***Tanytarsus*** sp.	P			2	3	
Diptera	Chironomidae	***Thienemanniella*** sp.	P		1		1	
Diptera	Chironomidae	***Thienemannimyia*** gp.	L		1		5	
Oligochaeta	Naididae	*Dero digitata*						19
Oligochaeta	Tubificidae	Tubificidae (imm. W/O CC)			1	3	122	26
Oligochaeta	Tubificidae	Tubificidae (imm. W/ CC)					1	1
		total:		111	60	174	496	430

Specimen Number	Relative Depth	Sample Date	Sample Time	Station ID	TypeOfSample	Waterbody	Air Temp	Alkalinity-M	Ammonia
E03EC003164	SURFACE	5/16/2003		LEWCLARLAC1	Grab	Keya Paha		257	<0.02
E03EC003225	SURFACE	5/20/2003		LEWCLARLAC1	Grab	Keya Paha		248	<0.02
E03EC003549	SURFACE	5/29/2003		LEWCLARLAC1	Grab	Keya Paha		232	<0.02
E03EC003809	SURFACE	6/5/2003	9:30 AM	LEWCLARLAC1	Grab	Keya Paha		227	<0.02
E03EC003810	SURFACE	6/5/2003	9:30 AM	LEWCLARLAC1	REPLICATE	Keya Paha		227	<0.02
E03EC004054	SURFACE	6/11/2003	10:20 AM	LEWCLARLAC1	Grab	Keya Paha		226	<0.02
E03EC004186	SURFACE	6/16/2003	12:00 PM	LEWCLARLAC1	Grab	Keya Paha		212	<0.02
E03EC004558	SURFACE	6/25/2003	2:00 PM	LEWCLARLAC1	Grab	Keya Paha		207	<0.02
E03EC004816	SURFACE	7/1/2003	10:30 AM	LEWCLARLAC1	Grab	Keya Paha		233	<0.02
E03EC005250	SURFACE	7/10/2003	9:45 AM	LEWCLARLAC1	Grab	Keya Paha		229	<0.02
E03EC005720	SURFACE	7/23/2003	10:15 AM	LEWCLARLAC1	Grab	Keya Paha		222	<0.02
E03EC005721	SURFACE	7/23/2003	10:15 AM	LEWCLARLAC1	REPLICATE	Keya Paha		221	<0.02
E03EC005912	SURFACE	7/30/2003	1:30 PM	LEWCLARLAC1	Grab	Keya Paha		210	<0.02
E03EC005913	SURFACE	7/30/2003	1:30 PM	LEWCLARLAC1	REPLICATE	Keya Paha		210	<0.02
E03EC006160	SURFACE	8/7/2003	11:50 AM	LEWCLARLAC1	Grab	Keya Paha		203	<0.02
E03EC006313	SURFACE	8/13/2003	1:15 PM	LEWCLARLAC1	Grab	Keya Paha		201	<0.02
E03EC006577	SURFACE	8/20/2003	10:30 AM	LEWCLARLAC1	Grab	Keya Paha		192	<0.02
E03EC006721	SURFACE	8/26/2003	12:30 PM	LEWCLARLAC1	Grab	Keya Paha		194	<0.02
9903T1200LAC1	SURFACE	9/9/2003	12:00 PM	LEWCLARLAC1	Grab	Keya Paha			
91703T1000LAC1	SURFACE	9/17/2003	10:00 AM	LEWCLARLAC1	Grab	Keya Paha			
E04EC001438	SURFACE	3/29/2004	2:00 PM	LEWCLARLAC1	Grab	Keya Paha		217	<0.02
E04EC001439	SURFACE	3/29/2004	2:00 PM	LEWCLARLAC1	REPLICATE	Keya Paha		217	<0.02
E04EC002620	SURFACE	5/12/2004	11:30 AM	LEWCLARLAC1	Grab	Keya Paha		157	<0.02
E04EC002621	SURFACE	5/12/2004	11:30 AM	LEWCLARLAC1	REPLICATE	Keya Paha		155	<0.02
E04EC002692	SURFACE	5/13/2004	1:30 PM	LEWCLARLAC1	Grab	Keya Paha	6	219	<0.02
E04EC003492	SURFACE	6/9/2004	12:45 PM	LEWCLARLAC1	Grab	Keya Paha	17	<6	<0.02
E04EC003493	SURFACE	6/9/2004	12:45 PM	LEWCLARLAC1	Grab	Keya Paha	17	230	<0.02
E04EC003529	SURFACE	6/10/2004	12:00 PM	LEWCLARLAC1	Grab	Keya Paha	21	87	0.1
E05EC001681	SURFACE	4/13/2005	2:30 PM	LEWCLARLAC1	Grab	Keya Paha		238	<0.02
E05EC002008	SURFACE	4/27/2005	9:00 AM	LEWCLARLAC1	Grab	Keya Paha	7	236	<0.02
E05EC003466	SURFACE	6/15/2005	3:00 PM	LEWCLARLAC1	Grab	Keya Paha	29	219	<0.02
E03EC003165	SURFACE	5/16/2003		LEWCLARLAC2	Grab	Keya Paha		251	<0.02
E03EC003226	SURFACE	5/20/2003		LEWCLARLAC2	Grab	Keya Paha		243	<0.02
E03EC003550	SURFACE	5/29/2003		LEWCLARLAC2	Grab	Keya Paha		232	<0.02
E03EC003808	SURFACE	6/5/2003	11:30 AM	LEWCLARLAC2	Grab	Keya Paha		226	<0.02
E03EC004055	SURFACE	6/11/2003	12:40 PM	LEWCLARLAC2	Grab	Keya Paha		223	<0.02
E03EC004187	SURFACE	6/16/2003	1:45 PM	LEWCLARLAC2	Grab	Keya Paha		213	<0.02

E03EC004560	SURFACE	6/25/2003	12:00 PM	LEWCLARLAC2	Grab	Keya Paha		167	<0.02
E03EC004813	SURFACE	7/1/2003	11:50 AM	LEWCLARLAC2	Grab	Keya Paha		238	<0.02
E03EC004814	SURFACE	7/1/2003	11:50 AM	LEWCLARLAC2	REPLICATE	Keya Paha		237	<0.02
E03EC005553	SURFACE	7/17/2003	2:00 PM	LEWCLARLAC2	Grab	Keya Paha		222	<0.02
E03EC005722	SURFACE	7/23/2003	12:15 PM	LEWCLARLAC2	Grab	Keya Paha		216	<0.02
E03EC005915	SURFACE	7/30/2003	11:15 AM	LEWCLARLAC2	Grab	Keya Paha		207	<0.02
E03EC006159	SURFACE	8/7/2003	10:30 AM	LEWCLARLAC2	Grab	Keya Paha		197	<0.02
E03EC006314	SURFACE	8/13/2003	11:15 AM	LEWCLARLAC2	Grab	Keya Paha		208	<0.02
E03EC006578	SURFACE	8/20/2003	12:30 PM	LEWCLARLAC2	Grab	Keya Paha		164	<0.02
E03EC006722	SURFACE	8/26/2003	10:30 AM	LEWCLARLAC2	Grab	Keya Paha		207	<0.02
9903T1030LAC2	SURFACE	9/9/2003	10:30 AM	LEWCLARLAC2	Grab	Keya Paha			
91703T1115LAC2	SURFACE	9/17/2003	11:15 AM	LEWCLARLAC2	Grab	Keya Paha			
E04EC001440	SURFACE	3/29/2004	12:15 PM	LEWCLARLAC2	Grab	Keya Paha		213	<0.02
E04EC002622	SURFACE	5/12/2004	1:45 PM	LEWCLARLAC2	Grab	Keya Paha		196	<0.02
E04EC002623	SURFACE	5/12/2004	1:45 PM	LEWCLARLAC2	BLANK	Keya Paha		<6	<0.02
E04EC002693	SURFACE	5/13/2004	12:30 PM	LEWCLARLAC2	Grab	Keya Paha	6	177	<0.02
E04EC003491	SURFACE	6/9/2004	11:40 AM	LEWCLARLAC2	Grab	Keya Paha	17	235	<0.02
E04EC003530	SURFACE	6/10/2004	1:30 PM	LEWCLARLAC2	Grab	Keya Paha	26	207	<0.02
E05EC001682	SURFACE	4/13/2005	1:15 PM	LEWCLARLAC2	Grab	Keya Paha		222	<0.02
E05EC002009	SURFACE	4/26/2005	11:00 AM	LEWCLARLAC2	Grab	Keya Paha		237	<0.02
E05EC002010	SURFACE	4/27/2005	11:00 AM	LEWCLARLAC2	BLANK	Keya Paha		<6	<0.02
E05EC003467	SURFACE	6/15/2005	2:00 PM	LEWCLARLAC2	Grab	Keya Paha	29	215	<0.02
E03EC003166	SURFACE	5/16/2003		LEWCLARLAC3	Grab	Ponca Creek		260	<0.02
E03EC003224	SURFACE	5/20/2003		LEWCLARLAC3	Grab	Ponca Creek		279	<0.02
E03EC003551	SURFACE	5/29/2003		LEWCLARLAC3	Grab	Ponca Creek		235	<0.02
E03EC003807	SURFACE	6/5/2003	1:40 PM	LEWCLARLAC3	Grab	Ponca Creek		214	<0.02
E03EC003970	SURFACE	6/10/2003	1:15 PM	LEWCLARLAC3	Grab	Ponca Creek		<6	<0.02
E03EC003971	SURFACE	6/10/2003	1:15 PM	LEWCLARLAC3	Grab	Ponca Creek		244	<0.02
61303T1020LAC3	SURFACE	6/13/2003	10:20 AM	LEWCLARLAC3	Grab	Ponca Creek			
E03EC004315	SURFACE	6/18/2003	10:15 AM	LEWCLARLAC3	Grab	Ponca Creek		173	<0.02
E03EC004561	SURFACE	6/25/2003	9:40 AM	LEWCLARLAC3	Grab	Ponca Creek		198	<0.02
E03EC004815	SURFACE	7/1/2003	1:30 PM	LEWCLARLAC3	Grab	Ponca Creek		248	<0.02
E03EC005554	SURFACE	7/17/2003	12:00 PM	LEWCLARLAC3	Grab	Ponca Creek		242	<0.02
E03EC005723	SURFACE	7/23/2003	2:30 PM	LEWCLARLAC3	Grab	Ponca Creek		268	0.04
E03EC005914	SURFACE	7/30/2003	9:30 AM	LEWCLARLAC3	Grab	Ponca Creek		307	0.28
8703T920LAC3	SURFACE	8/7/2003	9:20 AM	LEWCLARLAC3	Grab	Ponca Creek			
E04EC001441	SURFACE	3/29/2004	10:00 AM	LEWCLARLAC3	Grab	Ponca Creek		193	<0.02
E04EC003490	SURFACE	6/9/2004	9:10 AM	LEWCLARLAC3	Grab	Ponca Creek	17	253	<0..02
E05EC001683	SURFACE	4/13/2005	11:30 AM	LEWCLARLAC3	REPLICATE	Ponca Creek		205	<0.02

E05EC001684	SURFACE	4/13/2005	11:30 AM	LEWCLARLAC3	Grab	Ponca Creek		205	<0.02
E05EC002533	SURFACE	5/12/2005	9:45 AM	LEWCLARLAC3	Grab	Ponca Creek	45	199	0.4
E05EC003470	SURFACE	6/15/2005	9:30 AM	LEWCLARLAC3	Grab	Ponca Creek	25	122	0.1
E05EC004355	SURFACE	7/7/2005	9:20 AM	LEWCLARLAC3	Grab	Ponca Creek		295	<0.02
E03EC003120	SURFACE	5/14/2003		LEWCLARLAC4	Grab	Slaughter Creek		199	<0.02
E03EC003167	SURFACE	5/19/2003		LEWCLARLAC4	Grab	Slaughter Creek		199	<0.02
E03EC003475	SURFACE	5/28/2003		LEWCLARLAC4	Grab	Slaughter Creek		197	<0.02
E03EC003744	SURFACE	6/4/2003	9:00 AM	LEWCLARLAC4	Grab	Slaughter Creek		205	<0.02
E03EC003888	SURFACE	6/9/2003	1:20 PM	LEWCLARLAC4	Grab	Slaughter Creek		202	<0.02
E03EC004316	SURFACE	6/18/2003	1:05 PM	LEWCLARLAC4	Grab	Slaughter Creek		204	<0.02
E03EC004523	SURFACE	6/24/2003	1:30 PM	LEWCLARLAC4	Grab	Slaughter Creek		128	0.04
E03EC004871	SURFACE	7/2/2003	2:30 PM	LEWCLARLAC4	Grab	Slaughter Creek		200	<0.02
E03EC005103	SURFACE	7/9/2003	12:00 PM	LEWCLARLAC4	Grab	Slaughter Creek		197	<0.02
71603T1500LAC4	SURFACE	7/16/2003	3:00 PM	LEWCLARLAC4	Grab	Slaughter Creek			
E05EC003268	SURFACE	6/13/2005	3:45 PM	LEWCLARLAC4	Grab	Slaughter Creek		147	0.07
E05EC003795	SURFACE	6/21/2005	10:45 AM	LEWCLARLAC4	Grab	Slaughter Creek		117	0.34
E05EC004354	SURFACE	7/7/2005	10:45 AM	LEWCLARLAC4	Grab	Slaughter Creek		205	<0.02
E03EC002808	SURFACE	5/7/2003		LEWCLARLAC5	Grab	Choteau Creek		229	<0.02
E03EC003121	SURFACE	5/14/2003		LEWCLARLAC5	Grab	Choteau Creek		215	<0.02
E03EC003168	SURFACE	5/19/2003		LEWCLARLAC5	Grab	Choteau Creek		244	<0.02
E03EC003476	SURFACE	5/28/2003		LEWCLARLAC5	Grab	Choteau Creek		232	<0.02
E03EC003745	SURFACE	6/4/2003	10:15 AM	LEWCLARLAC5	Grab	Choteau Creek		242	<0.02
E03EC004370	SURFACE	6/19/2003	1:05 PM	LEWCLARLAC5	Grab	Choteau Creek		242	<0.02
E03EC004371	SURFACE	6/19/2003	1:05 PM	LEWCLARLAC5	REPLICATE	Choteau Creek		242	<0.02
E03EC004522	SURFACE	6/24/2003	10:45 AM	LEWCLARLAC5	Grab	Choteau Creek		177	<0.02
E03EC004872	SURFACE	7/2/2003	1:45 PM	LEWCLARLAC5	Grab	Choteau Creek		203	<0.02
E03EC005104	SURFACE	7/9/2003	1:10 PM	LEWCLARLAC5	Grab	Choteau Creek		183	<0.02
71603T1300LAC5	SURFACE	7/16/2003	1:00 PM	LEWCLARLAC5	Grab	Choteau Creek			
E03EC005779	SURFACE	7/24/2003	9:45 AM	LEWCLARLAC5	Grab	Choteau Creek		289	0.16
E03EC005968	SURFACE	7/31/2003	10:45 AM	LEWCLARLAC5	Blank	Choteau Creek		<6	<0.02
E03EC005969	SURFACE	7/31/2003	10:45 AM	LEWCLARLAC5	Grab	Choteau Creek		326	0.06
E03EC006186	SURFACE	8/8/2003	11:30 AM	LEWCLARLAC5	Grab	Choteau Creek		340	<0.02
E03EC006253	SURFACE	8/12/2003	10:15 AM	LEWCLARLAC5	REPLICATE	Choteau Creek		337	<0.02
E03EC006254	SURFACE	8/12/2003	10:15 AM	LEWCLARLAC5	Grab	Choteau Creek		332	<0.02
E03EC006646	SURFACE	8/21/2003	9:30 AM	LEWCLARLAC5	Grab	Choteau Creek		264	0.03
E03EC006770	SURFACE	8/27/2003	9:15 AM	LEWCLARLAC5	Grab	Choteau Creek		238	<0.02
91003T915LAC5	SURFACE	9/10/2003	9:15 AM	LEWCLARLAC5	Grab	Choteau Creek			
91503T1415LAC5	SURFACE	9/15/2003	2:15 PM	LEWCLARLAC5	Grab	Choteau Creek			
E05EC003269	SURFACE	6/13/2005	12:30 PM	LEWCLARLAC5	Grab	Choteau Creek		222	0.13

E05EC003796	SURFACE	6/21/2005	12:00 PM	LEWCLARLAC5	Grab	Choteau Creek		503	0.56
E05EC004353	SURFACE	7/7/2005	12:00 PM	LEWCLARLAC5	Grab	Choteau Creek		301	<0.02
E03EC002807	SURFACE	5/7/2003		LEWCLARLAC6	Grab	Emanuel Creek		275	<0.02
E03EC003122	SURFACE	5/14/2003		LEWCLARLAC6	Grab	Emanuel Creek		289	<0.02
E030C003359	SURFACE	5/22/2003		LEWCLARLAC6	Grab	Emanuel Creek		410	<0.02
E03EC003424	SURFACE	5/27/2003		LEWCLARLAC6	Grab	Emanuel Creek		275	<0.02
E03EC003746	SURFACE	6/4/2003	12:30 PM	LEWCLARLAC6	Grab	Emanuel Creek		279	<0.02
E03EC004374	SURFACE	6/19/2003	11:30 AM	LEWCLARLAC6	Grab	Emanuel Creek		255	0.03
E03EC004464	SURFACE	6/23/2003	1:15 PM	LEWCLARLAC6	Grab	Emanuel Creek		273	0.18
E03EC004963	SURFACE	6/30/2003	11:35 AM	LEWCLARLAC6	Grab	Emanuel Creek		255	0.05
E03EC005101	SURFACE	7/8/2003	12:15 PM	LEWCLARLAC6	Grab	Emanuel Creek		165	0.15
71603T1100LAC6	SURFACE	7/16/2003	11:00 AM	LEWCLARLAC6	Grab	Emanuel Creek			
E03EC005780	SURFACE	7/24/2003	11:45 AM	LEWCLARLAC6	Blank	Emanuel Creek		<6	0.05
E03EC005781	SURFACE	7/24/2003	11:45 AM	LEWCLARLAC6	Grab	Emanuel Creek		247	<0.02
E03EC005971	SURFACE	7/31/2003	2:15 PM	LEWCLARLAC6	Grab	Emanuel Creek		249	<0.02
E03EC006086	SURFACE	8/6/2003	1:00 PM	LEWCLARLAC6	Grab	Emanuel Creek		242	<0.02
E03EC006251	SURFACE	8/12/2003	12:30 PM	LEWCLARLAC6	Grab	Emanuel Creek		234	<0.02
E03EC006645	SURFACE	8/21/2003	11:15 AM	LEWCLARLAC6	Grab	Emanuel Creek		245	<0.02
E03EC006769	SURFACE	8/27/2003	10:15 AM	LEWCLARLAC6	Grab	Emanuel Creek		263	<0.02
E03EC007149	SURFACE	9/10/2003	11:45 AM	LEWCLARLAC6	Grab	Emanuel Creek		202	0.11
E03EC007150	SURFACE	9/10/2003	11:45 AM	LEWCLARLAC6	REPLICATE	Emanuel Creek		203	0.1
91503T1300LAC6	SURFACE	9/15/2003	1:00 PM	LEWCLARLAC6	Grab	Emanuel Creek			
E04EC002745	SURFACE	5/17/2004	11:45 AM	LEWCLARLAC6	Grab	Emanuel Creek		281	<0.02
E04EC005990	SURFACE	8/24/2004	12:15 PM	LEWCLARLAC6	Grab	Emanuel Creek		109	0.04
E04EC006030	SURFACE	8/25/2004	12:15 PM	LEWCLARLAC6	Grab	Emanuel Creek		107	0.04
E05EC003034	SURFACE	6/6/2005	10:45 AM	LEWCLARLAC6	Grab	Emanuel Creek		173	0.1
E05EC003270	SURFACE	6/13/2005	11:30 AM	LEWCLARLAC6	Grab	Emanuel Creek	25	205	0.03
E05EC003797	SURFACE	6/21/2005	1:00 PM	LEWCLARLAC6	Grab	Emanuel Creek		333	0.13
E05EC004352	SURFACE	7/7/2005	1:00 PM	LEWCLARLAC6	Grab	Emanuel Creek		245	<0.02
E03EC003360	SURFACE	5/22/2003		LEWCLARLAC7	Grab	Snatch Creek		488	<0.02
E03EC003425	SURFACE	5/27/2003		LEWCLARLAC7	Grab	Snatch Creek		304	<0.02
E03EC003747	SURFACE	6/4/2003	1:15 PM	LEWCLARLAC7	Grab	Snatch Creek		309	<0.02
E03EC003889	SURFACE	6/9/2003	11:00 AM	LEWCLARLAC7	Grab	Snatch Creek		304	<0.02
E03EC004375	SURFACE	6/19/2003	10:20 AM	LEWCLARLAC7	Grab	Snatch Creek		273	<0.02
E03EC004465	SURFACE	6/23/2003	11:45 AM	LEWCLARLAC7	Grab	Snatch Creek		263	<0.02
E03EC004964	SURFACE	6/30/2003	1:00 PM	LEWCLARLAC7	Grab	Snatch Creek		272	<0.02
E03EC005102	SURFACE	7/8/2003	10:10 AM	LEWCLARLAC7	Grab	Snatch Creek		246	<0.02
E03EC005782	SURFACE	7/24/2003	1:15 PM	LEWCLARLAC7	Grab	Snatch Creek		310	0.22
E03EC005970	SURFACE	7/31/2003	1:05 PM	LEWCLARLAC7	Grab	Snatch Creek		272	0.07

E03EC006085	SURFACE	8/6/2003	12:00 PM	LEWCLARLAC7	Grab	Snatch Creek		278	<0.02
E03EC006252	SURFACE	8/12/2003	2:00 PM	LEWCLARLAC7	Grab	Snatch Creek		252	<0.02
91003T1130LAC7	SURFACE	9/10/2003	11:30 AM	LEWCLARLAC7	Grab	Snatch Creek			
91003T1130LAC7	SURFACE	9/15/2003	12:00 PM	LEWCLARLAC7	Grab	Snatch Creek			
E04EC002746	SURFACE	5/17/2004	11:45 AM	LEWCLARLAC7	Grab	Snatch Creek		254	<0.02
E04EC005991	SURFACE	8/24/2004	10:45 AM	LEWCLARLAC7	Grab	Snatch Creek		74	<0.02
E04EC006031	SURFACE	8/25/2004	1:30 PM	LEWCLARLAC7	Grab	Snatch Creek		103	<0.02
E05EC003035	SURFACE	6/6/2005	12:15 PM	LEWCLARLAC7	Grab	Snatch Creek	32	129	<0.02
E05EC003271	SURFACE	6/13/2005	10:30 AM	LEWCLARLAC7	Grab	Snatch Creek	23	172	0.02
E05EC003798	SURFACE	6/21/2005	2:00 PM	LEWCLARLAC7	Grab	Snatch Creek		105	0.1
E05EC004351	SURFACE	7/7/2005	2:15 PM	LEWCLARLAC7	Grab	Snatch Creek		344	<0.02
E05EC004356	SURFACE	7/7/2005	3:00 PM	LEWCLARLAC7	BLANK	Snatch Creek		<6	<0.02
E04EC002113	Bottom	4/21/2004	11:00 AM	LEWCLARRHNL2	Grab	Rahn Lake	99	214	<0.02
E04EC002904	Bottom	5/19/2004	10:30 AM	LEWCLARRHNL2	Grab	Rahn Lake	17	215	<0.02
E04EC003322	Bottom	6/3/2004	10:00 AM	LEWCLARRHNL2	BLANK	Rahn Lake		<6	<0.02
E04EC003324	Bottom	6/3/2004	10:00 AM	LEWCLARRHNL2	Grab	Rahn Lake	24	232	<0.02
E04EC004154	Bottom	6/29/2004	10:30 AM	LEWCLARRHNL2	BLANK	Rahn Lake		<6	<0.02
E04EC004158	Bottom	6/29/2004	10:30 AM	LEWCLARRHNL2	Grab	Rahn Lake	30	216	<0.02
E04EC004659	Bottom	7/14/2004	11:00 AM	LEWCLARRHNL2	Grab	Rahn Lake	21	216	<0.02
E04EC005212	Bottom	7/29/2004	10:30 AM	LEWCLARRHNL2	Grab	Rahn Lake	27	208	<0.02
E04EC005891	Bottom	8/19/2004	11:00 AM	LEWCLARRHNL2	Grab	Rahn Lake		215	<0.02
E04EC005893	Bottom	8/19/2004	11:00 AM	LEWCLARRHNL2	BLANK	Rahn Lake		<6	<0.02
E04EC006209	Bottom	9/2/2004	9:45 AM	LEWCLARRHNL2	Grab	Rahn Lake	24	222	<0.02
E05EC004564	Bottom	7/14/2005	10:30 AM	LEWCLARRHNL2	Grab	Rahn Lake	28	207	<0.02
E04EC002112	Surface	4/21/2004	11:00 AM	LEWCLARRHNL3	Grab	Rahn Lake	59 F	214	<0.02
E04EC002114	Surface	4/21/2004	11:00 AM	LEWCLARRHNL3	BLANK	Rahn Lake	59	<6	0.07
E04EC002905	Surface	5/19/2004	10:30 AM	LEWCLARRHNL3	Grab	Rahn Lake	17	221	<0.02
E04EC003321	Surface	6/3/2004	10:00 AM	LEWCLARRHNL3	Grab	Rahn Lake	24	219	<0.02
E04EC003323	Surface	6/3/2004	10:00 AM	LEWCLARRHNL3	REPLICATE	Rahn Lake	24	226	<0.02
E04EC004155	Surface	6/29/2004	10:30 AM	LEWCLARRHNL3	REPLICATE	Rahn Lake	30	215	<0.02
E04EC004159	Surface	6/29/2004	10:30 AM	LEWCLARRHNL3	Grab	Rahn Lake	30	220	<0.02
E04EC004658	Surface	7/14/2004	11:00 AM	LEWCLARRHNL3	Grab	Rahn Lake	21	215	<0.02
E04EC005210	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	REPLICATE	Rahn Lake	27	207	<0.02
E04EC005211	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	BLANK	Rahn Lake		<6	<0.02
E04EC005213	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	Grab	Rahn Lake	27	207	<0.02
E04EC005892	Surface	8/19/2004	11:00 AM	LEWCLARRHNL3	Grab	Rahn Lake		216	<0.02
E04EC005894	Surface	8/19/2004	11:00 AM	LEWCLARRHNL3	REPLICATE	Rahn Lake		215	<0.02
E04EC006210	Surface	9/2/2004	9:45 AM	LEWCLARRHNL3	Grab	Rahn Lake	24	223	<0.02
E05EC004565	Surface	7/14/2005	10:30 AM	LEWCLARRHNL3	Grab	Rahn Lake	28	207	<0.02

E05EC003623	Surface	6/16/2005	11:00 AM	LEWCLARRHNT1	Grab	Outlet To Rahn Dam	29	187	<0.02
E05EC003624	Surface	6/16/2005	11:00 AM	LEWCLARRHNT1	Grab	Outlet To Rahn Dam	29	187	<0.02
E05EC002011	Surface	4/26/2005	10:30 AM	LEWCLARRHNT4	Grab	Inlet Site To Rahn Dam	7	332	<0.02
E05EC002538	Surface	5/12/2005	1:00 PM	LEWCLARRHNT4	Grab	Inlet Site To Rahn Dam		150	0.21
E05EC003621	Surface	6/16/2005	12:30 PM	LEWCLARRHNT4	Grab	Inlet Site To Rahn Dam	30	239	<0.02
E05EC003622	Surface	6/16/2005	12:30 PM	LEWCLARRHNT4	Grab	Inlet Site To Rahn Dam	30	238	<0.02
E04EC002110	Bottom	4/21/2004	12:45 PM	LEWCLARROSL2	Grab	Roosevelt Dam	59 F	242	<0.02
E04EC002111	Bottom	4/21/2004	12:45 PM	LEWCLARROSL2	REPLICATE	Roosevelt Dam	59	242	<0.02
E04EC002902	Bottom	5/19/2004	1:00 PM	LEWCLARROSL2	Grab	Roosevelt Dam	17	243	<0.02
E04EC003325	Bottom	6/3/2004	12:00 PM	LEWCLARROSL2	Grab	Roosevelt Dam	24	220	<0.02
E04EC004156	Bottom	6/29/2004	12:00 PM	LEWCLARROSL2	Grab	Roosevelt Dam	30	197	<0.02
E04EC004654	Bottom	7/14/2004	12:00 PM	LEWCLARROSL2	Grab	Roosevelt Dam	23	189	<0.02
E04EC005208	Bottom	7/29/2004	12:30 PM	LEWCLARROSL2	Grab	Roosevelt Dam	29	189	<0.02
E04EC005895	Bottom	8/19/2004	12:15 PM	LEWCLARROSL2	Grab	Roosevelt Dam			
E05EC004562	Bottom	7/14/2005	1:00 PM	LEWCLARROSL2	Grab	Roosevelt Dam	32	215	<0.02
E04EC002109	Surface	4/21/2004	12:45 PM	LEWCLARROSL3	Grab	Roosevelt Dam	59 F	250	<0.02
E04EC002903	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	BLANK	Roosevelt Dam	17	<6	<0.02
E04EC002906	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	Grab	Roosevelt Dam	17	237	<0.02
E04EC002907	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	REPLICATE	Roosevelt Dam	17	235	<0.02
E04EC003326	Surface	6/3/2004	12:00 PM	LEWCLARROSL3	Grab	Roosevelt Dam	24	219	<0.02
E04EC004157	Surface	6/29/2004	12:00 PM	LEWCLARROSL3	Grab	Roosevelt Dam	30	198	<0.02
E04EC004655	Surface	7/14/2004	12:00 PM	LEWCLARROSL3	Grab	Roosevelt Dam	23	187	<0.02
E04EC005209	Surface	7/29/2004	12:30 PM	LEWCLARROSL3	Grab	Roosevelt Dam	29	189	<0.02
E04EC005896	Surface	8/19/2004	12:15 PM	LEWCLARROSL3	Grab	Roosevelt Dam			
E05EC004563	Surface	7/14/2005	1:00 PM	LEWCLARROSL3	Grab	Roosevelt Dam	32	215	<0.02
E05EC002534	Surface	5/12/2005	11:30 AM	LEWCLARROST4	Grab	Inlet To Roosevelt Lake		176	<0.02
E05EC002535	Surface	5/12/2005	11:30 AM	LEWCLARROST4	Grab	Inlet To Roosevelt Lake		176	<0.02
E05EC003468	Surface	6/15/2005	12:20 PM	LEWCLARROST4	REPLICATE	Inlet To Roosevelt Lake	28	156	<0.02
E05EC003469	Surface	6/15/2005	12:20 PM	LEWCLARROST4	Grab	Inlet To Roosevelt Lake	28	156	<0.02
E05EC003471	Surface	6/15/2005	12:20 PM	LEWCLARROST4	BLANK	Inlet To Roosevelt Lake	28	<6	<0.02

Specimen Number	Relative Depth	Sample Date	Sample Time	Station ID	Conductivity	Discharge (flow)	Dissolved Oxygen	Dissolved Oxygen Charge	E COLI
E03EC003164	SURFACE	5/16/2003		LEWCLARLAC1		45.41			
E03EC003225	SURFACE	5/20/2003		LEWCLARLAC1		34.3			36.8
E03EC003549	SURFACE	5/29/2003		LEWCLARLAC1		58.23			168
E03EC003809	SURFACE	6/5/2003	9:30 AM	LEWCLARLAC1	357	47.71	10.27	48.2	649
E03EC003810	SURFACE	6/5/2003	9:30 AM	LEWCLARLAC1	357	47.71	10.27	48.2	388
E03EC004054	SURFACE	6/11/2003	10:20 AM	LEWCLARLAC1	366	61.82	9.94	51.2	436
E03EC004186	SURFACE	6/16/2003	12:00 PM	LEWCLARLAC1		41.26			2420
E03EC004558	SURFACE	6/25/2003	2:00 PM	LEWCLARLAC1					2420
E03EC004816	SURFACE	7/1/2003	10:30 AM	LEWCLARLAC1					48.4
E03EC005250	SURFACE	7/10/2003	9:45 AM	LEWCLARLAC1		22.99			204
E03EC005720	SURFACE	7/23/2003	10:15 AM	LEWCLARLAC1	399	14.06	9.19	43.1	31.4
E03EC005721	SURFACE	7/23/2003	10:15 AM	LEWCLARLAC1	399	14.06	9.19	43.1	16.4
E03EC005912	SURFACE	7/30/2003	1:30 PM	LEWCLARLAC1	447	14.13	9.98	55.3	7.4
E03EC005913	SURFACE	7/30/2003	1:30 PM	LEWCLARLAC1	447	14.13	9.98	55.3	10.8
E03EC006160	SURFACE	8/7/2003	11:50 AM	LEWCLARLAC1	431	10.92	10.56	53.3	4.1
E03EC006313	SURFACE	8/13/2003	1:15 PM	LEWCLARLAC1	415	10	9.55	49.2	1
E03EC006577	SURFACE	8/20/2003	10:30 AM	LEWCLARLAC1	381	9.3	10.51	49.2	36.8
E03EC006721	SURFACE	8/26/2003	12:30 PM	LEWCLARLAC1	424	10.37	10.32	48.2	22.6
9903T1200LAC1	SURFACE	9/9/2003	12:00 PM	LEWCLARLAC1	377	8.58	9.66	51.2	
91703T1000LAC1	SURFACE	9/17/2003	10:00 AM	LEWCLARLAC1	349	10.9	8.81	47.1	
E04EC001438	SURFACE	3/29/2004	2:00 PM	LEWCLARLAC1		102.56			1990
E04EC001439	SURFACE	3/29/2004	2:00 PM	LEWCLARLAC1		102.56			2420
E04EC002620	SURFACE	5/12/2004	11:30 AM	LEWCLARLAC1					2420
E04EC002621	SURFACE	5/12/2004	11:30 AM	LEWCLARLAC1					2420
E04EC002692	SURFACE	5/13/2004	1:30 PM	LEWCLARLAC1	478		11.31		2420
E04EC003492	SURFACE	6/9/2004	12:45 PM	LEWCLARLAC1	423		9.82		<1
E04EC003493	SURFACE	6/9/2004	12:45 PM	LEWCLARLAC1	423		9.82		2420
E04EC003529	SURFACE	6/10/2004	12:00 PM	LEWCLARLAC1	168		8.08		2420
E05EC001681	SURFACE	4/13/2005	2:30 PM	LEWCLARLAC1		CHECK USGS			1730
E05EC002008	SURFACE	4/27/2005	9:00 AM	LEWCLARLAC1		CHECK USGS			649
E05EC003466	SURFACE	6/15/2005	3:00 PM	LEWCLARLAC1	333		7.72	42	1990
E03EC003165	SURFACE	5/16/2003		LEWCLARLAC2		95.34			
E03EC003226	SURFACE	5/20/2003		LEWCLARLAC2		81.12			201
E03EC003550	SURFACE	5/29/2003		LEWCLARLAC2		137.525			69.5
E03EC003808	SURFACE	6/5/2003	11:30 AM	LEWCLARLAC2	399	113.57	9.44	49.2	80.8
E03EC004055	SURFACE	6/11/2003	12:40 PM	LEWCLARLAC2	412	113.62	8.98	53.3	102

E03EC004187	SURFACE	6/16/2003	1:45 PM	LEWCLARLAC2		98.18			2420
E03EC004560	SURFACE	6/25/2003	12:00 PM	LEWCLARLAC2		204.34			2420
E03EC004813	SURFACE	7/1/2003	11:50 AM	LEWCLARLAC2					62.2
E03EC004814	SURFACE	7/1/2003	11:50 AM	LEWCLARLAC2					37.6
E03EC005553	SURFACE	7/17/2003	2:00 PM	LEWCLARLAC2	501	30.68	10.41	35.9	30.5
E03EC005722	SURFACE	7/23/2003	12:15 PM	LEWCLARLAC2	429	25.58	9.06	45.1	3
E03EC005915	SURFACE	7/30/2003	11:15 AM	LEWCLARLAC2		24.37			45.2
E03EC006159	SURFACE	8/7/2003	10:30 AM	LEWCLARLAC2	454	18.68	7.97	50.2	5.2
E03EC006314	SURFACE	8/13/2003	11:15 AM	LEWCLARLAC2	420	15.51	8.78	47.1	17.9
E03EC006578	SURFACE	8/20/2003	12:30 PM	LEWCLARLAC2	416	27.4	8.49	48.2	198
E03EC006722	SURFACE	8/26/2003	10:30 AM	LEWCLARLAC2	441	11.02	9.58	45.1	12
9903T1030LAC2	SURFACE	9/9/2003	10:30 AM	LEWCLARLAC2	390	9.04	8.29	48.2	
91703T1115LAC2	SURFACE	9/17/2003	11:15 AM	LEWCLARLAC2	364	14.67	8.34	49.2	
E04EC001440	SURFACE	3/29/2004	12:15 PM	LEWCLARLAC2		145.21			579
E04EC002622	SURFACE	5/12/2004	1:45 PM	LEWCLARLAC2	442		BAD	101.3	201
E04EC002623	SURFACE	5/12/2004	1:45 PM	LEWCLARLAC2					<1
E04EC002693	SURFACE	5/13/2004	12:30 PM	LEWCLARLAC2	388		11.64		1200
E04EC003491	SURFACE	6/9/2004	11:40 AM	LEWCLARLAC2	433		10.35		111
E04EC003530	SURFACE	6/10/2004	1:30 PM	LEWCLARLAC2	386		9.82		1200
E05EC001682	SURFACE	4/13/2005	1:15 PM	LEWCLARLAC2					1730
E05EC002009	SURFACE	4/26/2005	11:00 AM	LEWCLARLAC2					1050
E05EC002010	SURFACE	4/27/2005	11:00 AM	LEWCLARLAC2					<1
E05EC003467	SURFACE	6/15/2005	2:00 PM	LEWCLARLAC2	329		7.9	43.1	866
E03EC003166	SURFACE	5/16/2003		LEWCLARLAC3		28.27			
E03EC003224	SURFACE	5/20/2003		LEWCLARLAC3		12.53			68.3
E03EC003551	SURFACE	5/29/2003		LEWCLARLAC3		12.56			816
E03EC003807	SURFACE	6/5/2003	1:40 PM	LEWCLARLAC3	843	7.07	10.67	53.3	816
E03EC003970	SURFACE	6/10/2003	1:15 PM	LEWCLARLAC3	723	9.48	10.16	53.3	<1
E03EC003971	SURFACE	6/10/2003	1:15 PM	LEWCLARLAC3	723		10.16	53.3	1200
61303T1020LAC3	SURFACE	6/13/2003	10:20 AM	LEWCLARLAC3	712	9.55	9.23	51.2	
E03EC004315	SURFACE	6/18/2003	10:15 AM	LEWCLARLAC3	499	20.65	8.64	51.2	649
E03EC004561	SURFACE	6/25/2003	9:40 AM	LEWCLARLAC3		35.92			>2420
E03EC004815	SURFACE	7/1/2003	1:30 PM	LEWCLARLAC3					361
E03EC005554	SURFACE	7/17/2003	12:00 PM	LEWCLARLAC3	1560	0.18	11.58	46.1	1990
E03EC005723	SURFACE	7/23/2003	2:30 PM	LEWCLARLAC3	1315	0.05	9.49	51.2	>2420
E03EC005914	SURFACE	7/30/2003	9:30 AM	LEWCLARLAC3	1490	0.05	7.76	46.1	>2420
8703T920LAC3	SURFACE	8/7/2003	9:20 AM	LEWCLARLAC3		0			
E04EC001441	SURFACE	3/29/2004	10:00 AM	LEWCLARLAC3		23.96			816
E04EC003490	SURFACE	6/9/2004	9:10 AM	LEWCLARLAC3	757		9.8		980

E05EC001683	SURFACE	4/13/2005	11:30 AM	LEWCLARLAC3					365
E05EC001684	SURFACE	4/13/2005	11:30 AM	LEWCLARLAC3					488
E05EC002533	SURFACE	5/12/2005	9:45 AM	LEWCLARLAC3		45.43			>2420
E05EC003470	SURFACE	6/15/2005	9:30 AM	LEWCLARLAC3	235		5.57	46.1	>2420
E05EC004355	SURFACE	7/7/2005	9:20 AM	LEWCLARLAC3		12.7			
E03EC003120	SURFACE	5/14/2003		LEWCLARLAC4		0.33			33.6
E03EC003167	SURFACE	5/19/2003		LEWCLARLAC4		0.75			60.1
E03EC003475	SURFACE	5/28/2003		LEWCLARLAC4		0.25			135
E03EC003744	SURFACE	6/4/2003	9:00 AM	LEWCLARLAC4	2447	0.5	12.24	25.7	101
E03EC003888	SURFACE	6/9/2003	1:20 PM	LEWCLARLAC4	2764	0.25	10.48	53.3	122
E03EC004316	SURFACE	6/18/2003	1:05 PM	LEWCLARLAC4	3006	0.08	14.07	62.5	260
E03EC004523	SURFACE	6/24/2003	1:30 PM	LEWCLARLAC4		3.33			921
E03EC004871	SURFACE	7/2/2003	2:30 PM	LEWCLARLAC4		0.003			123
E03EC005103	SURFACE	7/9/2003	12:00 PM	LEWCLARLAC4		1.45			173
71603T1500LAC4	SURFACE	7/16/2003	3:00 PM	LEWCLARLAC4		0.4	12.9	45.6	
E05EC003268	SURFACE	6/13/2005	3:45 PM	LEWCLARLAC4		13.52			>2420
E05EC003795	SURFACE	6/21/2005	10:45 AM	LEWCLARLAC4		35.8			>2420
E05EC004354	SURFACE	7/7/2005	10:45 AM	LEWCLARLAC4		2.11			
E03EC002808	SURFACE	5/7/2003		LEWCLARLAC5					16
E03EC003121	SURFACE	5/14/2003		LEWCLARLAC5		15.2			56.9
E03EC003168	SURFACE	5/19/2003		LEWCLARLAC5		3.83			108
E03EC003476	SURFACE	5/28/2003		LEWCLARLAC5		2.46			33.7
E03EC003745	SURFACE	6/4/2003	10:15 AM	LEWCLARLAC5	1642	2.52	13.71	49.2	114
E03EC004370	SURFACE	6/19/2003	1:05 PM	LEWCLARLAC5	1702		9.01	56.3	272
E03EC004371	SURFACE	6/19/2003	1:05 PM	LEWCLARLAC5	1702		9.01	56.3	345
E03EC004522	SURFACE	6/24/2003	10:45 AM	LEWCLARLAC5					68.3
E03EC004872	SURFACE	7/2/2003	1:45 PM	LEWCLARLAC5					145
E03EC005104	SURFACE	7/9/2003	1:10 PM	LEWCLARLAC5		66.36			24.8
71603T1300LAC5	SURFACE	7/16/2003	1:00 PM	LEWCLARLAC5	2606	30.59	12.42	43.1	
E03EC005779	SURFACE	7/24/2003	9:45 AM	LEWCLARLAC5	905	47.34	5.86	43.1	8.3
E03EC005968	SURFACE	7/31/2003	10:45 AM	LEWCLARLAC5	1098	19.37	6.32	47.1	<1
E03EC005969	SURFACE	7/31/2003	10:45 AM	LEWCLARLAC5	1098	19.37	6.32	47.1	15.8
E03EC006186	SURFACE	8/8/2003	11:30 AM	LEWCLARLAC5	1397	2.62	6.66	59.4	
E03EC006253	SURFACE	8/12/2003	10:15 AM	LEWCLARLAC5	1444	0	6.9	92.1	10.6
E03EC006254	SURFACE	8/12/2003	10:15 AM	LEWCLARLAC5	1444	0	6.9	92.1	5.1
E03EC006646	SURFACE	8/21/2003	9:30 AM	LEWCLARLAC5	1802	0	4.98	52.3	20.9
E03EC006770	SURFACE	8/27/2003	9:15 AM	LEWCLARLAC5	1812	0	5.51	43.1	4.1
91003T915LAC5	SURFACE	9/10/2003	9:15 AM	LEWCLARLAC5	1709	0	5.57	44.1	
91503T1415LAC5	SURFACE	9/15/2003	2:15 PM	LEWCLARLAC5	1556	0	7.93	47.1	

E05EC003269	SURFACE	6/13/2005	12:30 PM	LEWCLARLAC5					1203
E05EC003796	SURFACE	6/21/2005	12:00 PM	LEWCLARLAC5					>2420
E05EC004353	SURFACE	7/7/2005	12:00 PM	LEWCLARLAC5		24.04			
E03EC002807	SURFACE	5/7/2003		LEWCLARLAC6					501
E03EC003122	SURFACE	5/14/2003		LEWCLARLAC6		20.38			921
E030C003359	SURFACE	5/22/2003		LEWCLARLAC6		14.785			249
E03EC003424	SURFACE	5/27/2003		LEWCLARLAC6		10.84			260
E03EC003746	SURFACE	6/4/2003	12:30 PM	LEWCLARLAC6	1478	11.5	11.12	51.2	980
E03EC004374	SURFACE	6/19/2003	11:30 AM	LEWCLARLAC6	1296	8.57	10.74	58.4	727
E03EC004464	SURFACE	6/23/2003	1:15 PM	LEWCLARLAC6	1532		10.79	57.4	1120
E03EC004963	SURFACE	6/30/2003	11:35 AM	LEWCLARLAC6		15			
E03EC005101	SURFACE	7/8/2003	12:15 PM	LEWCLARLAC6		28.47			866
71603T1100LAC6	SURFACE	7/16/2003	11:00 AM	LEWCLARLAC6		22.93	10.4	36.9	
E03EC005780	SURFACE	7/24/2003	11:45 AM	LEWCLARLAC6	1802	7.57	10.86	49.2	<1
E03EC005781	SURFACE	7/24/2003	11:45 AM	LEWCLARLAC6	1802	7.57	10.86	49.2	5.1
E03EC005971	SURFACE	7/31/2003	2:15 PM	LEWCLARLAC6	1925	3.71	10.53	61.4	980
E03EC006086	SURFACE	8/6/2003	1:00 PM	LEWCLARLAC6		2.55			46.7
E03EC006251	SURFACE	8/12/2003	12:30 PM	LEWCLARLAC6	1627	3.03	10.46	77.8	22.7
E03EC006645	SURFACE	8/21/2003	11:15 AM	LEWCLARLAC6	1807	2.28	11.2	56.3	50.5
E03EC006769	SURFACE	8/27/2003	10:15 AM	LEWCLARLAC6	1753	2.5	9.98	48.2	80.5
E03EC007149	SURFACE	9/10/2003	11:45 AM	LEWCLARLAC6	1321	19.35	7.15	47.1	2420
E03EC007150	SURFACE	9/10/2003	11:45 AM	LEWCLARLAC6	1321	19.35	7.15	47.1	2420
91503T1300LAC6	SURFACE	9/15/2003	1:00 PM	LEWCLARLAC6	1452	3.05	11.77	52.3	
E04EC002745	SURFACE	5/17/2004	11:45 AM	LEWCLARLAC6	1888		10.12		1730
E04EC005990	SURFACE	8/24/2004	12:15 PM	LEWCLARLAC6					>2420
E04EC006030	SURFACE	8/25/2004	12:15 PM	LEWCLARLAC6		36.98			1410
E05EC003034	SURFACE	6/6/2005	10:45 AM	LEWCLARLAC6	763		6.6	40	>2420
E05EC003270	SURFACE	6/13/2005	11:30 AM	LEWCLARLAC6	848		7.03	48.2	1414
E05EC003797	SURFACE	6/21/2005	1:00 PM	LEWCLARLAC6					>2420
E05EC004352	SURFACE	7/7/2005	1:00 PM	LEWCLARLAC6		19.38			
E03EC003360	SURFACE	5/22/2003		LEWCLARLAC7		1.149			2420
E03EC003425	SURFACE	5/27/2003		LEWCLARLAC7		0.63			579
E03EC003747	SURFACE	6/4/2003	1:15 PM	LEWCLARLAC7	2350	0.44	10.56	51.2	687
E03EC003889	SURFACE	6/9/2003	11:00 AM	LEWCLARLAC7	2131	0.61	9.44	51.2	816
E03EC004375	SURFACE	6/19/2003	10:20 AM	LEWCLARLAC7	316	1.5	8.55	52.3	687
E03EC004465	SURFACE	6/23/2003	11:45 AM	LEWCLARLAC7	2424	0.375	12.02	64.5	160
E03EC004964	SURFACE	6/30/2003	1:00 PM	LEWCLARLAC7		0.79			
E03EC005102	SURFACE	7/8/2003	10:10 AM	LEWCLARLAC7		1.98			2420
E03EC005782	SURFACE	7/24/2003	1:15 PM	LEWCLARLAC7	653	0.224	4.39	43.1	2420

E03EC005970	SURFACE	7/31/2003	1:05 PM	LEWCLARLAC7	1820	0.125	9.06	53.3	1200
E03EC006085	SURFACE	8/6/2003	12:00 PM	LEWCLARLAC7		0			2420
E03EC006252	SURFACE	8/12/2003	2:00 PM	LEWCLARLAC7	2093	0	10.5	49.2	1990
91003T1130LAC7	SURFACE	9/10/2003	11:30 AM	LEWCLARLAC7	1565	0	0.91	40	
91003T1130LAC7	SURFACE	9/15/2003	12:00 PM	LEWCLARLAC7	1667	0	1.04	36.9	
E04EC002746	SURFACE	5/17/2004	11:45 AM	LEWCLARLAC7	3011		9.1		613
E04EC005991	SURFACE	8/24/2004	10:45 AM	LEWCLARLAC7		96.75			>2420
E04EC006031	SURFACE	8/25/2004	1:30 PM	LEWCLARLAC7		40.32			1050
E05EC003035	SURFACE	6/6/2005	12:15 PM	LEWCLARLAC7	548		6.27	40	1414
E05EC003271	SURFACE	6/13/2005	10:30 AM	LEWCLARLAC7	630		3.13	51.2	1200
E05EC003798	SURFACE	6/21/2005	2:00 PM	LEWCLARLAC7					>2420
E05EC004351	SURFACE	7/7/2005	2:15 PM	LEWCLARLAC7		7.4			
E05EC004356	SURFACE	7/7/2005	3:00 PM	LEWCLARLAC7		7.4			
E04EC002113	Bottom	4/21/2004	11:00 AM	LEWCLARRHNL2					4.1
E04EC002904	Bottom	5/19/2004	10:30 AM	LEWCLARRHNL2	713		6.06		3
E04EC003322	Bottom	6/3/2004	10:00 AM	LEWCLARRHNL2	748		10.66		<1
E04EC003324	Bottom	6/3/2004	10:00 AM	LEWCLARRHNL2	748		10.66		<1
E04EC004154	Bottom	6/29/2004	10:30 AM	LEWCLARRHNL2					<1
E04EC004158	Bottom	6/29/2004	10:30 AM	LEWCLARRHNL2	703		13.9		1
E04EC004659	Bottom	7/14/2004	11:00 AM	LEWCLARRHNL2	706		8.2		42.2
E04EC005212	Bottom	7/29/2004	10:30 AM	LEWCLARRHNL2	657		7.5		2
E04EC005891	Bottom	8/19/2004	11:00 AM	LEWCLARRHNL2					3.1
E04EC005893	Bottom	8/19/2004	11:00 AM	LEWCLARRHNL2					<1
E04EC006209	Bottom	9/2/2004	9:45 AM	LEWCLARRHNL2	658		9		3.1
E05EC004564	Bottom	7/14/2005	10:30 AM	LEWCLARRHNL2	412		2.04		<1
E04EC002112	Surface	4/21/2004	11:00 AM	LEWCLARRHNL3					<1
E04EC002114	Surface	4/21/2004	11:00 AM	LEWCLARRHNL3					<1
E04EC002905	Surface	5/19/2004	10:30 AM	LEWCLARRHNL3	?		8.57		8.6
E04EC003321	Surface	6/3/2004	10:00 AM	LEWCLARRHNL3	750		10.62		1
E04EC003323	Surface	6/3/2004	10:00 AM	LEWCLARRHNL3	750		10.62		<1
E04EC004155	Surface	6/29/2004	10:30 AM	LEWCLARRHNL3	709		12.6		2
E04EC004159	Surface	6/29/2004	10:30 AM	LEWCLARRHNL3	709		12.6		4.1
E04EC004658	Surface	7/14/2004	11:00 AM	LEWCLARRHNL3	713		10.6		3.1
E04EC005210	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	658		8.5		3.1
E04EC005211	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3					<1
E04EC005213	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	658		8.5		2
E04EC005892	Surface	8/19/2004	11:00 AM	LEWCLARRHNL3					3.1
E04EC005894	Surface	8/19/2004	11:00 AM	LEWCLARRHNL3					5.2
E04EC006210	Surface	9/2/2004	9:45 AM	LEWCLARRHNL3	657		13.8		2

E05EC004565	Surface	7/14/2005	10:30 AM	LEWCLARRHNL3	412		7.22		<1
E05EC003623	Surface	6/16/2005	11:00 AM	LEWCLARRHNT1	380	7.27	6.85	48.2	79.4
E05EC003624	Surface	6/16/2005	11:00 AM	LEWCLARRHNT1	380	7.27	6.85	48.2	86.6
E05EC002011	Surface	4/26/2005	10:30 AM	LEWCLARRHNT4					250
E05EC002538	Surface	5/12/2005	1:00 PM	LEWCLARRHNT4		5.45			>2420
E05EC003621	Surface	6/16/2005	12:30 PM	LEWCLARRHNT4	421		6.78	99.2	365
E05EC003622	Surface	6/16/2005	12:30 PM	LEWCLARRHNT4	421		6.78	99.2	488
E04EC002110	Bottom	4/21/2004	12:45 PM	LEWCLARROSL2					<1
E04EC002111	Bottom	4/21/2004	12:45 PM	LEWCLARROSL2					<1
E04EC002902	Bottom	5/19/2004	1:00 PM	LEWCLARROSL2	649		9.25		<1
E04EC003325	Bottom	6/3/2004	12:00 PM	LEWCLARROSL2	644		11.8		<1
E04EC004156	Bottom	6/29/2004	12:00 PM	LEWCLARROSL2	573		11.2		1
E04EC004654	Bottom	7/14/2004	12:00 PM	LEWCLARROSL2	567		8.9		<1
E04EC005208	Bottom	7/29/2004	12:30 PM	LEWCLARROSL2	528		8.5		<1
E04EC005895	Bottom	8/19/2004	12:15 PM	LEWCLARROSL2					3.1
E05EC004562	Bottom	7/14/2005	1:00 PM	LEWCLARROSL2	462		6.73		<1
E04EC002109	Surface	4/21/2004	12:45 PM	LEWCLARROSL3					30.9
E04EC002903	Surface	5/19/2004	1:00 PM	LEWCLARROSL3					<1
E04EC002906	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	634		10.69		3.1
E04EC002907	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	634		10.7		2
E04EC003326	Surface	6/3/2004	12:00 PM	LEWCLARROSL3	644		13.5		1
E04EC004157	Surface	6/29/2004	12:00 PM	LEWCLARROSL3	568		13.6		<1
E04EC004655	Surface	7/14/2004	12:00 PM	LEWCLARROSL3	561		9		<1
E04EC005209	Surface	7/29/2004	12:30 PM	LEWCLARROSL3	531		9.6		<1
E04EC005896	Surface	8/19/2004	12:15 PM	LEWCLARROSL3					<1
E05EC004563	Surface	7/14/2005	1:00 PM	LEWCLARROSL3	462		3.66		1
E05EC002534	Surface	5/12/2005	11:30 AM	LEWCLARROST4	448	3.83	6.9	36.9	>2420
E05EC002535	Surface	5/12/2005	11:30 AM	LEWCLARROST4	448	3.83	6.9	36.9	>2420
E05EC003468	Surface	6/15/2005	12:20 PM	LEWCLARROST4	239	17.54	4.45	38	250
E05EC003469	Surface	6/15/2005	12:20 PM	LEWCLARROST4	239	17.54	4.45	38	308
E05EC003471	Surface	6/15/2005	12:20 PM	LEWCLARROST4	239	17.54	4.45	38	<1

Specimen Number	Relative Depth	Sample Date	Sample Time	Station ID	Phosphorous,total	Phosphorous, Total Dissolved	Secchi Disk	Solids (Suspended)	Solids,Total
E03EC003164	SURFACE	5/16/2003		LEWCLARLAC1	0.132	0.032		69	413
E03EC003225	SURFACE	5/20/2003		LEWCLARLAC1	0.092	0.03		43	376
E03EC003549	SURFACE	5/29/2003		LEWCLARLAC1	0.09	0.024		35	355
E03EC003809	SURFACE	6/5/2003	9:30 AM	LEWCLARLAC1	0.075	0.02		32	347
E03EC003810	SURFACE	6/5/2003	9:30 AM	LEWCLARLAC1	0.083	0.025		38	346
E03EC004054	SURFACE	6/11/2003	10:20 AM	LEWCLARLAC1	0.089	0.023		46	341
E03EC004186	SURFACE	6/16/2003	12:00 PM	LEWCLARLAC1	0.157	0.067		100	366
E03EC004558	SURFACE	6/25/2003	2:00 PM	LEWCLARLAC1	0.264	0.204		114	414
E03EC004816	SURFACE	7/1/2003	10:30 AM	LEWCLARLAC1	0.163	0.031		96	410
E03EC005250	SURFACE	7/10/2003	9:45 AM	LEWCLARLAC1	0.175	0.022		70	383
E03EC005720	SURFACE	7/23/2003	10:15 AM	LEWCLARLAC1	0.122	0.025		39	343
E03EC005721	SURFACE	7/23/2003	10:15 AM	LEWCLARLAC1	0.126	0.016		41	338
E03EC005912	SURFACE	7/30/2003	1:30 PM	LEWCLARLAC1	0.08	0.016		36	340
E03EC005913	SURFACE	7/30/2003	1:30 PM	LEWCLARLAC1	0.1	0.012		59	357
E03EC006160	SURFACE	8/7/2003	11:50 AM	LEWCLARLAC1	0.071	0.018		35	318
E03EC006313	SURFACE	8/13/2003	1:15 PM	LEWCLARLAC1	0.058	0.014		21	297
E03EC006577	SURFACE	8/20/2003	10:30 AM	LEWCLARLAC1	0.042	0.013		14	2488
E03EC006721	SURFACE	8/26/2003	12:30 PM	LEWCLARLAC1	0.049	0.007		19	294
9903T1200LAC1	SURFACE	9/9/2003	12:00 PM	LEWCLARLAC1					
91703T1000LAC1	SURFACE	9/17/2003	10:00 AM	LEWCLARLAC1					
E04EC001438	SURFACE	3/29/2004	2:00 PM	LEWCLARLAC1	0.21	0.04		196	466
E04EC001439	SURFACE	3/29/2004	2:00 PM	LEWCLARLAC1	0.217	0.051		162	452
E04EC002620	SURFACE	5/12/2004	11:30 AM	LEWCLARLAC1	0.41	0.024		305	482
E04EC002621	SURFACE	5/12/2004	11:30 AM	LEWCLARLAC1	0.372	0.028		280	485
E04EC002692	SURFACE	5/13/2004	1:30 PM	LEWCLARLAC1	0.198	0.058		96	407
E04EC003492	SURFACE	6/9/2004	12:45 PM	LEWCLARLAC1	0.002	<0.002		<1	<7
E04EC003493	SURFACE	6/9/2004	12:45 PM	LEWCLARLAC1	0.181	0.038		84	399
E04EC003529	SURFACE	6/10/2004	12:00 PM	LEWCLARLAC1	0.63	0.209		352	488
E05EC001681	SURFACE	4/13/2005	2:30 PM	LEWCLARLAC1	0.21	0.02		220	500
E05EC002008	SURFACE	4/27/2005	9:00 AM	LEWCLARLAC1	0.242	0.061		123	448
E05EC003466	SURFACE	6/15/2005	3:00 PM	LEWCLARLAC1	0.39	0.158		210	515
E03EC003165	SURFACE	5/16/2003		LEWCLARLAC2	0.158			92	405
E03EC003226	SURFACE	5/20/2003		LEWCLARLAC2	0.105	0.067		50	383
E03EC003550	SURFACE	5/29/2003		LEWCLARLAC2	0.106	0.027		45	352
E03EC003808	SURFACE	6/5/2003	11:30 AM	LEWCLARLAC2	0.11	0.029		42	360
E03EC004055	SURFACE	6/11/2003	12:40 PM	LEWCLARLAC2	0.106	0.028		57	356
E03EC004187	SURFACE	6/16/2003	1:45 PM	LEWCLARLAC2	0.194	0.02		118	386

E03EC004560	SURFACE	6/25/2003	12:00 PM	LEWCLARLAC2	0.376	0.048	272	498
E03EC004813	SURFACE	7/1/2003	11:50 AM	LEWCLARLAC2	0.176	0.028	88	415
E03EC004814	SURFACE	7/1/2003	11:50 AM	LEWCLARLAC2	0.202	0.03	114	436
E03EC005553	SURFACE	7/17/2003	2:00 PM	LEWCLARLAC2	0.141	0.019	61	358
E03EC005722	SURFACE	7/23/2003	12:15 PM	LEWCLARLAC2	0.113	0.021	49	347
E03EC005915	SURFACE	7/30/2003	11:15 AM	LEWCLARLAC2	0.08	0.009	38	339
E03EC006159	SURFACE	8/7/2003	10:30 AM	LEWCLARLAC2	0.075	0.012	31	312
E03EC006314	SURFACE	8/13/2003	11:15 AM	LEWCLARLAC2	0.078	0.016	25	312
E03EC006578	SURFACE	8/20/2003	12:30 PM	LEWCLARLAC2	0.228	0.012	136	300
E03EC006722	SURFACE	8/26/2003	10:30 AM	LEWCLARLAC2	0.055	0.01	23	311
9903T1030LAC2	SURFACE	9/9/2003	10:30 AM	LEWCLARLAC2				
91703T1115LAC2	SURFACE	9/17/2003	11:15 AM	LEWCLARLAC2				
E04EC001440	SURFACE	3/29/2004	12:15 PM	LEWCLARLAC2	2.86	0.04	232	532
E04EC002622	SURFACE	5/12/2004	1:45 PM	LEWCLARLAC2	0.107	0.017	57	328
E04EC002623	SURFACE	5/12/2004	1:45 PM	LEWCLARLAC2	0.006	<0.002	<1	<7
E04EC002693	SURFACE	5/13/2004	12:30 PM	LEWCLARLAC2	0.236	0.04	166	396
E04EC003491	SURFACE	6/9/2004	11:40 AM	LEWCLARLAC2	0.117	0.017	62	368
E04EC003530	SURFACE	6/10/2004	1:30 PM	LEWCLARLAC2	0.211	0.025	156	407
E05EC001682	SURFACE	4/13/2005	1:15 PM	LEWCLARLAC2	0.166	0.019	104	404
E05EC002009	SURFACE	4/26/2005	11:00 AM	LEWCLARLAC2	0.314	0.046	196	524
E05EC002010	SURFACE	4/27/2005	11:00 AM	LEWCLARLAC2	0.007	<0.002	<1	<7
E05EC003467	SURFACE	6/15/2005	2:00 PM	LEWCLARLAC2	0.335	0.116	252	496
E03EC003166	SURFACE	5/16/2003		LEWCLARLAC3	0.345	0.214	98	627
E03EC003224	SURFACE	5/20/2003		LEWCLARLAC3	0.191	0.069	46	670
E03EC003551	SURFACE	5/29/2003		LEWCLARLAC3	0.037	0.028	9	644
E03EC003807	SURFACE	6/5/2003	1:40 PM	LEWCLARLAC3	0.015	0.012	5	635
E03EC003970	SURFACE	6/10/2003	1:15 PM	LEWCLARLAC3	0.025	0.018	<1	<7
E03EC003971	SURFACE	6/10/2003	1:15 PM	LEWCLARLAC3	<.002	0.002	1	606
61303T1020LAC3	SURFACE	6/13/2003	10:20 AM	LEWCLARLAC3				
E03EC004315	SURFACE	6/18/2003	10:15 AM	LEWCLARLAC3	0.132	0.037	32	388
E03EC004561	SURFACE	6/25/2003	9:40 AM	LEWCLARLAC3	0.317	0.054	116	520
E03EC004815	SURFACE	7/1/2003	1:30 PM	LEWCLARLAC3	0.079	0.047	18	644
E03EC005554	SURFACE	7/17/2003	12:00 PM	LEWCLARLAC3	0.037	0.032	10	1092
E03EC005723	SURFACE	7/23/2003	2:30 PM	LEWCLARLAC3	0.495	0.115	164	1575
E03EC005914	SURFACE	7/30/2003	9:30 AM	LEWCLARLAC3	0.062	0.023	19	1460
8703T920LAC3	SURFACE	8/7/2003	9:20 AM	LEWCLARLAC3				
E04EC001441	SURFACE	3/29/2004	10:00 AM	LEWCLARLAC3	0.638	0.052	34	445
E04EC003490	SURFACE	6/9/2004	9:10 AM	LEWCLARLAC3	0.055	0.039	9	587
E05EC001683	SURFACE	4/13/2005	11:30 AM	LEWCLARLAC3	0.061	0.025	11	424

E05EC001684	SURFACE	4/13/2005	11:30 AM	LEWCLARLAC3	0.065	0.024	10	428
E05EC002533	SURFACE	5/12/2005	9:45 AM	LEWCLARLAC3	0.17	0.083	46	506
E05EC003470	SURFACE	6/15/2005	9:30 AM	LEWCLARLAC3	1.78	0.398	610	974
E05EC004355	SURFACE	7/7/2005	9:20 AM	LEWCLARLAC3	0.29		27	683
E03EC003120	SURFACE	5/14/2003		LEWCLARLAC4	0.032	0.018	15	2706
E03EC003167	SURFACE	5/19/2003		LEWCLARLAC4	0.031	0.017	11	2833
E03EC003475	SURFACE	5/28/2003		LEWCLARLAC4	0.031	0.018	12	2916
E03EC003744	SURFACE	6/4/2003	9:00 AM	LEWCLARLAC4	0.028	0.016	7	2994
E03EC003888	SURFACE	6/9/2003	1:20 PM	LEWCLARLAC4	0.033	0.009	2	3028
E03EC004316	SURFACE	6/18/2003	1:05 PM	LEWCLARLAC4	0.023	0.013	10	3106
E03EC004523	SURFACE	6/24/2003	1:30 PM	LEWCLARLAC4	0.052	0.039	11	1036
E03EC004871	SURFACE	7/2/2003	2:30 PM	LEWCLARLAC4	0.036	0.022	12	2271
E03EC005103	SURFACE	7/9/2003	12:00 PM	LEWCLARLAC4	0.107	0.062	12	2189
71603T1500LAC4	SURFACE	7/16/2003	3:00 PM	LEWCLARLAC4				
E05EC003268	SURFACE	6/13/2005	3:45 PM	LEWCLARLAC4	0.854	0.503	142	927
E05EC003795	SURFACE	6/21/2005	10:45 AM	LEWCLARLAC4	1.25	0.131	1040	1766
E05EC004354	SURFACE	7/7/2005	10:45 AM	LEWCLARLAC4	0.138		39	2506
E03EC002808	SURFACE	5/7/2003		LEWCLARLAC5	0.092		20	1637
E03EC003121	SURFACE	5/14/2003		LEWCLARLAC5	0.026	0.026	36	1785
E03EC003168	SURFACE	5/19/2003		LEWCLARLAC5	0.186	0.031	76	2002
E03EC003476	SURFACE	5/28/2003		LEWCLARLAC5	0.09	0.01	26	1900
E03EC003745	SURFACE	6/4/2003	10:15 AM	LEWCLARLAC5	0.084	0.021	25	1756
E03EC004370	SURFACE	6/19/2003	1:05 PM	LEWCLARLAC5	0.127	0.025	43	1681
E03EC004371	SURFACE	6/19/2003	1:05 PM	LEWCLARLAC5	0.118	0.026	39	1676
E03EC004522	SURFACE	6/24/2003	10:45 AM	LEWCLARLAC5	0.092	0.021	23	1223
E03EC004872	SURFACE	7/2/2003	1:45 PM	LEWCLARLAC5	0.177	0.03	55	1649
E03EC005104	SURFACE	7/9/2003	1:10 PM	LEWCLARLAC5	0.148	0.032	38	1238
71603T1300LAC5	SURFACE	7/16/2003	1:00 PM	LEWCLARLAC5				
E03EC005779	SURFACE	7/24/2003	9:45 AM	LEWCLARLAC5	2.25	1.63	64	817
E03EC005968	SURFACE	7/31/2003	10:45 AM	LEWCLARLAC5	<0.002	<0.002	<1	<7
E03EC005969	SURFACE	7/31/2003	10:45 AM	LEWCLARLAC5	1.25	0.932	49	946
E03EC006186	SURFACE	8/8/2003	11:30 AM	LEWCLARLAC5	0.64	0.402	62	1170
E03EC006253	SURFACE	8/12/2003	10:15 AM	LEWCLARLAC5	0.492	0.234	82	1324
E03EC006254	SURFACE	8/12/2003	10:15 AM	LEWCLARLAC5	0.502	0.236	92	1334
E03EC006646	SURFACE	8/21/2003	9:30 AM	LEWCLARLAC5	0.287	0.16	48	1521
E03EC006770	SURFACE	8/27/2003	9:15 AM	LEWCLARLAC5	0.182	0.094	31	1604
91003T915LAC5	SURFACE	9/10/2003	9:15 AM	LEWCLARLAC5				
91503T1415LAC5	SURFACE	9/15/2003	2:15 PM	LEWCLARLAC5				
E05EC003269	SURFACE	6/13/2005	12:30 PM	LEWCLARLAC5	0.486	0.114	196	1330

E05EC003796	SURFACE	6/21/2005	12:00 PM	LEWCLARLAC5	2.8	0.056	2700	3809
E05EC004353	SURFACE	7/7/2005	12:00 PM	LEWCLARLAC5	0.899		72	990
E03EC002807	SURFACE	5/7/2003		LEWCLARLAC6	0.146	0.049	42	2543
E03EC003122	SURFACE	5/14/2003		LEWCLARLAC6	0.263	0.05	101	2231
E030C003359	SURFACE	5/22/2003		LEWCLARLAC6	0.069	0.02	21	1853
E03EC003424	SURFACE	5/27/2003		LEWCLARLAC6	0.071	0.029	17	1696
E03EC003746	SURFACE	6/4/2003	12:30 PM	LEWCLARLAC6	0.057	0.026	16	1499
E03EC004374	SURFACE	6/19/2003	11:30 AM	LEWCLARLAC6	0.15	0.048	28	1257
E03EC004464	SURFACE	6/23/2003	1:15 PM	LEWCLARLAC6	0.117	0.05	31	1365
E03EC004963	SURFACE	6/30/2003	11:35 AM	LEWCLARLAC6	0.197	0.082	25	1736
E03EC005101	SURFACE	7/8/2003	12:15 PM	LEWCLARLAC6	0.29	0.078	98	1022
71603T1100LAC6	SURFACE	7/16/2003	11:00 AM	LEWCLARLAC6				
E03EC005780	SURFACE	7/24/2003	11:45 AM	LEWCLARLAC6	<0.002	0.004	<1	<7
E03EC005781	SURFACE	7/24/2003	11:45 AM	LEWCLARLAC6	0.168	0.028	37	1688
E03EC005971	SURFACE	7/31/2003	2:15 PM	LEWCLARLAC6	0.128	0.019	31	1653
E03EC006086	SURFACE	8/6/2003	1:00 PM	LEWCLARLAC6	0.092	0.017	25	1592
E03EC006251	SURFACE	8/12/2003	12:30 PM	LEWCLARLAC6	0.116	0.017	24	1442
E03EC006645	SURFACE	8/21/2003	11:15 AM	LEWCLARLAC6	0.085	0.03	18	1611
E03EC006769	SURFACE	8/27/2003	10:15 AM	LEWCLARLAC6	0.061	0.017	13	1617
E03EC007149	SURFACE	9/10/2003	11:45 AM	LEWCLARLAC6	0.242	0.083	60	1305
E03EC007150	SURFACE	9/10/2003	11:45 AM	LEWCLARLAC6	0.238	0.082	54	1299
91503T1300LAC6	SURFACE	9/15/2003	1:00 PM	LEWCLARLAC6				
E04EC002745	SURFACE	5/17/2004	11:45 AM	LEWCLARLAC6	0.048	0.027	14	1509
E04EC005990	SURFACE	8/24/2004	12:15 PM	LEWCLARLAC6	0.651	0.078	330	615
E04EC006030	SURFACE	8/25/2004	12:15 PM	LEWCLARLAC6	0.306	0.098	80	495
E05EC003034	SURFACE	6/6/2005	10:45 AM	LEWCLARLAC6	0.882	0.292	384	1621
E05EC003270	SURFACE	6/13/2005	11:30 AM	LEWCLARLAC6	0.658	0.255	288	1179
E05EC003797	SURFACE	6/21/2005	1:00 PM	LEWCLARLAC6	2.02	0.086	2140	3330
E05EC004352	SURFACE	7/7/2005	1:00 PM	LEWCLARLAC6	0.172		43	1832
E03EC003360	SURFACE	5/22/2003		LEWCLARLAC7	0.077	0.038	17	2430
E03EC003425	SURFACE	5/27/2003		LEWCLARLAC7	0.082	0.058	6	2433
E03EC003747	SURFACE	6/4/2003	1:15 PM	LEWCLARLAC7	0.084	0.058	6	2486
E03EC003889	SURFACE	6/9/2003	11:00 AM	LEWCLARLAC7	0.086	0.026	3	2516
E03EC004375	SURFACE	6/19/2003	10:20 AM	LEWCLARLAC7	0.153	0.109	9	2336
E03EC004465	SURFACE	6/23/2003	11:45 AM	LEWCLARLAC7	0.116	0.086	6	2371
E03EC004964	SURFACE	6/30/2003	1:00 PM	LEWCLARLAC7	0.104	0.076	9	2274
E03EC005102	SURFACE	7/8/2003	10:10 AM	LEWCLARLAC7	0.142	0.085	20	1787
E03EC005782	SURFACE	7/24/2003	1:15 PM	LEWCLARLAC7	0.296	0.098	78	1435
E03EC005970	SURFACE	7/31/2003	1:05 PM	LEWCLARLAC7	0.143	0.095	7	1555

E03EC006085	SURFACE	8/6/2003	12:00 PM	LEWCLARLAC7	0.175	0.096		8	690
E03EC006252	SURFACE	8/12/2003	2:00 PM	LEWCLARLAC7	0.265	0.073		17	1810
91003T1130LAC7	SURFACE	9/10/2003	11:30 AM	LEWCLARLAC7					
91003T1130LAC7	SURFACE	9/15/2003	12:00 PM	LEWCLARLAC7					
E04EC002746	SURFACE	5/17/2004	11:45 AM	LEWCLARLAC7	0.069	0.039		10	2694
E04EC005991	SURFACE	8/24/2004	10:45 AM	LEWCLARLAC7	0.368	0.282		27	269
E04EC006031	SURFACE	8/25/2004	1:30 PM	LEWCLARLAC7	0.359	0.308		15	361
E05EC003035	SURFACE	6/6/2005	12:15 PM	LEWCLARLAC7	0.361	0.246		89	1052
E05EC003271	SURFACE	6/13/2005	10:30 AM	LEWCLARLAC7	0.416	0.351		37	693
E05EC003798	SURFACE	6/21/2005	2:00 PM	LEWCLARLAC7	0.858	0.276		340	833
E05EC004351	SURFACE	7/7/2005	2:15 PM	LEWCLARLAC7	0.32			18	1988
E05EC004356	SURFACE	7/7/2005	3:00 PM	LEWCLARLAC7	<0.002			<1	<7
E04EC002113	Bottom	4/21/2004	11:00 AM	LEWCLARRHNL2	0.133	0.055	1.37	7	518
E04EC002904	Bottom	5/19/2004	10:30 AM	LEWCLARRHNL2	0.166	0.101	1	8	533
E04EC003322	Bottom	6/3/2004	10:00 AM	LEWCLARRHNL2	<0.002	0.032		<1	<7
E04EC003324	Bottom	6/3/2004	10:00 AM	LEWCLARRHNL2	0.084	0.07		3	435
E04EC004154	Bottom	6/29/2004	10:30 AM	LEWCLARRHNL2	<0.002	0.002		<1	<7
E04EC004158	Bottom	6/29/2004	10:30 AM	LEWCLARRHNL2	0.27	0.188	1.0	13	545
E04EC004659	Bottom	7/14/2004	11:00 AM	LEWCLARRHNL2	0.355	0.194	.85	25	546
E04EC005212	Bottom	7/29/2004	10:30 AM	LEWCLARRHNL2	0.416	0.22	0.3	19	546
E04EC005891	Bottom	8/19/2004	11:00 AM	LEWCLARRHNL2	0.39	0.255		18	557
E04EC005893	Bottom	8/19/2004	11:00 AM	LEWCLARRHNL2	0.002	0.004		<1	<7
E04EC006209	Bottom	9/2/2004	9:45 AM	LEWCLARRHNL2	0.422	0.29	0.5	16	565
E05EC004564	Bottom	7/14/2005	10:30 AM	LEWCLARRHNL2	0.348	0.298		2	370
E04EC002112	Surface	4/21/2004	11:00 AM	LEWCLARRHNL3	0.145	0.049	1.37	8	517
E04EC002114	Surface	4/21/2004	11:00 AM	LEWCLARRHNL3	0.003	0.005		<1	<7
E04EC002905	Surface	5/19/2004	10:30 AM	LEWCLARRHNL3	0.182	0.096	1	8	537
E04EC003321	Surface	6/3/2004	10:00 AM	LEWCLARRHNL3	0.198	0.136	1	11	535
E04EC003323	Surface	6/3/2004	10:00 AM	LEWCLARRHNL3	0.086	0.073		7	422
E04EC004155	Surface	6/29/2004	10:30 AM	LEWCLARRHNL3	0.261	0.194	2	15	542
E04EC004159	Surface	6/29/2004	10:30 AM	LEWCLARRHNL3	0.284	0.193	2	15	546
E04EC004658	Surface	7/14/2004	11:00 AM	LEWCLARRHNL3	0.319	0.179	.75	22	549
E04EC005210	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	0.376	0.224	03	21	553
E04EC005211	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	<0.002	<0.002		<1	<7
E04EC005213	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	0.378	0.213	0.3	22	550
E04EC005892	Surface	8/19/2004	11:00 AM	LEWCLARRHNL3	0.383	0.25		17	555
E04EC005894	Surface	8/19/2004	11:00 AM	LEWCLARRHNL3	0.387	0.264	.75	16	551
E04EC006210	Surface	9/2/2004	9:45 AM	LEWCLARRHNL3	0.422	0.227	0.5	23	574
E05EC004565	Surface	7/14/2005	10:30 AM	LEWCLARRHNL3	0.312	0.27		7	369

E05EC003623	Surface	6/16/2005	11:00 AM	LEWCLARRHNT1	0.305	0.27		9	366
E05EC003624	Surface	6/16/2005	11:00 AM	LEWCLARRHNT1	0.304	0.267		7	367
E05EC002011	Surface	4/26/2005	10:30 AM	LEWCLARRHNT4	0.072	0.05		5	775
E05EC002538	Surface	5/12/2005	1:00 PM	LEWCLARRHNT4	0.672			47	407
E05EC003621	Surface	6/16/2005	12:30 PM	LEWCLARRHNT4	0.273	0.251		2	414
E05EC003622	Surface	6/16/2005	12:30 PM	LEWCLARRHNT4	0.276	0.247		2	410
E04EC002110	Bottom	4/21/2004	12:45 PM	LEWCLARROSL2	0.088	0.042	1.37	10	439
E04EC002111	Bottom	4/21/2004	12:45 PM	LEWCLARROSL2	0.093	0.042	1.37	11	450
E04EC002902	Bottom	5/19/2004	1:00 PM	LEWCLARROSL2	0.09	0.053	2	3	441
E04EC003325	Bottom	6/3/2004	12:00 PM	LEWCLARROSL2	0.222	0.149		5	530
E04EC004156	Bottom	6/29/2004	12:00 PM	LEWCLARROSL2	0.122	0.1	3.0	4	409
E04EC004654	Bottom	7/14/2004	12:00 PM	LEWCLARROSL2	0.196	0.17	4.0	2	382
E04EC005208	Bottom	7/29/2004	12:30 PM	LEWCLARROSL2	0.336	0.309	2.0	11	403
E04EC005895	Bottom	8/19/2004	12:15 PM	LEWCLARROSL2		0.38	1.0		
E05EC004562	Bottom	7/14/2005	1:00 PM	LEWCLARROSL2	0.416	0.377		2	400
E04EC002109	Surface	4/21/2004	12:45 PM	LEWCLARROSL3	0.142	0.066	1.37	13	448
E04EC002903	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	0.005	0.002	1.6	<1	<7
E04EC002906	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	0.093	0.053	1.6	3	446
E04EC002907	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	0.094	0.052	1.6	6	448
E04EC003326	Surface	6/3/2004	12:00 PM	LEWCLARROSL3	0.196	0.14	2	10	536
E04EC004157	Surface	6/29/2004	12:00 PM	LEWCLARROSL3	0.115	0.079	2.5	4	406
E04EC004655	Surface	7/14/2004	12:00 PM	LEWCLARROSL3	0.177	0.142	2.0	6	383
E04EC005209	Surface	7/29/2004	12:30 PM	LEWCLARROSL3	0.335	0.295	2M	10	402
E04EC005896	Surface	8/19/2004	12:15 PM	LEWCLARROSL3		0.387	1.5		
E05EC004563	Surface	7/14/2005	1:00 PM	LEWCLARROSL3	0.427	0.391		1	398
E05EC002534	Surface	5/12/2005	11:30 AM	LEWCLARROST4	0.75	0.511		56	476
E05EC002535	Surface	5/12/2005	11:30 AM	LEWCLARROST4	0.722	0.558		56	476
E05EC003468	Surface	6/15/2005	12:20 PM	LEWCLARROST4	0.45	0.421		1	282
E05EC003469	Surface	6/15/2005	12:20 PM	LEWCLARROST4	0.414	0.412		1	285
E05EC003471	Surface	6/15/2005	12:20 PM	LEWCLARROST4	0.005	0.005		<1	<7

Specimen Number	Relative Depth	Sample Date	Sample Time	Station ID	Barometric Pressure	Specific Conductance	TKN	Turbidity	VTSS
E03EC003164	SURFACE	5/16/2003		LEWCLARLAC1			0.62		12
E03EC003225	SURFACE	5/20/2003		LEWCLARLAC1			0.51		6
E03EC003549	SURFACE	5/29/2003		LEWCLARLAC1			0.43		4
E03EC003809	SURFACE	6/5/2003	9:30 AM	LEWCLARLAC1	28.97	0.437	0.41	34.3	4
E03EC003810	SURFACE	6/5/2003	9:30 AM	LEWCLARLAC1	28.97	0.437	0.41	34.3	6
E03EC004054	SURFACE	6/11/2003	10:20 AM	LEWCLARLAC1	28.84	0.411	0.42	47.5	11
E03EC004186	SURFACE	6/16/2003	12:00 PM	LEWCLARLAC1			0.49		24
E03EC004558	SURFACE	6/25/2003	2:00 PM	LEWCLARLAC1			0.84		18
E03EC004816	SURFACE	7/1/2003	10:30 AM	LEWCLARLAC1			0.67		18
E03EC005250	SURFACE	7/10/2003	9:45 AM	LEWCLARLAC1			0.73		8
E03EC005720	SURFACE	7/23/2003	10:15 AM	LEWCLARLAC1		0.425	0.46	42.7	16
E03EC005721	SURFACE	7/23/2003	10:15 AM	LEWCLARLAC1		0.425	0.39	42.7	16
E03EC005912	SURFACE	7/30/2003	1:30 PM	LEWCLARLAC1		0.411	0.47	38.1	11
E03EC005913	SURFACE	7/30/2003	1:30 PM	LEWCLARLAC1		0.411	0.34	38.1	16
E03EC006160	SURFACE	8/7/2003	11:50 AM	LEWCLARLAC1		0.41	0.44	30.2	5
E03EC006313	SURFACE	8/13/2003	1:15 PM	LEWCLARLAC1		0.395	0.16	25.1	6
E03EC006577	SURFACE	8/20/2003	10:30 AM	LEWCLARLAC1		0.388	<0.11	13.8	6
E03EC006721	SURFACE	8/26/2003	12:30 PM	LEWCLARLAC1		0.4	0.29	18.2	3
9903T1200LAC1	SURFACE	9/9/2003	12:00 PM	LEWCLARLAC1		0.388		12.4	
91703T1000LAC1	SURFACE	9/17/2003	10:00 AM	LEWCLARLAC1		0.402		12	
E04EC001438	SURFACE	3/29/2004	2:00 PM	LEWCLARLAC1			1.68		20
E04EC001439	SURFACE	3/29/2004	2:00 PM	LEWCLARLAC1			1.67		30
E04EC002620	SURFACE	5/12/2004	11:30 AM	LEWCLARLAC1			2.01		50
E04EC002621	SURFACE	5/12/2004	11:30 AM	LEWCLARLAC1			2.04		50
E04EC002692	SURFACE	5/13/2004	1:30 PM	LEWCLARLAC1			1.42	30.7	17
E04EC003492	SURFACE	6/9/2004	12:45 PM	LEWCLARLAC1			<0.23	27.3	<1
E04EC003493	SURFACE	6/9/2004	12:45 PM	LEWCLARLAC1			1.39	27.3	24
E04EC003529	SURFACE	6/10/2004	12:00 PM	LEWCLARLAC1			2.31	108.4	60
E05EC001681	SURFACE	4/13/2005	2:30 PM	LEWCLARLAC1			1.17		38
E05EC002008	SURFACE	4/27/2005	9:00 AM	LEWCLARLAC1			1.1		15
E05EC003466	SURFACE	6/15/2005	3:00 PM	LEWCLARLAC1		0.356	1.77		28
E03EC003165	SURFACE	5/16/2003		LEWCLARLAC2			0.43		22
E03EC003226	SURFACE	5/20/2003		LEWCLARLAC2			0.26		7
E03EC003550	SURFACE	5/29/2003		LEWCLARLAC2			0.48		9
E03EC003808	SURFACE	6/5/2003	11:30 AM	LEWCLARLAC2	29.14	0.445	0.39	40.7	4
E03EC004055	SURFACE	6/11/2003	12:40 PM	LEWCLARLAC2	28.87	0.422	0.4	53.5	14
E03EC004187	SURFACE	6/16/2003	1:45 PM	LEWCLARLAC2			0.28		26

E03EC004560	SURFACE	6/25/2003	12:00 PM	LEWCLARLAC2			0.89		40
E03EC004813	SURFACE	7/1/2003	11:50 AM	LEWCLARLAC2			0.84		16
E03EC004814	SURFACE	7/1/2003	11:50 AM	LEWCLARLAC2			0.94		18
E03EC005553	SURFACE	7/17/2003	2:00 PM	LEWCLARLAC2		0.448	0.87	142	13
E03EC005722	SURFACE	7/23/2003	12:15 PM	LEWCLARLAC2		0.423	0.53	49.2	19
E03EC005915	SURFACE	7/30/2003	11:15 AM	LEWCLARLAC2			0.56		15
E03EC006159	SURFACE	8/7/2003	10:30 AM	LEWCLARLAC2		0.415	0.38	36.8	5
E03EC006314	SURFACE	8/13/2003	11:15 AM	LEWCLARLAC2		0.419	0.26	32	6
E03EC006578	SURFACE	8/20/2003	12:30 PM	LEWCLARLAC2		0.362	0.19	154.9	26
E03EC006722	SURFACE	8/26/2003	10:30 AM	LEWCLARLAC2		0.435	0.3	24.8	6
9903T1030LAC2	SURFACE	9/9/2003	10:30 AM	LEWCLARLAC2		0.424		13.9	
91703T1115LAC2	SURFACE	9/17/2003	11:15 AM	LEWCLARLAC2		0.407		34.9	
E04EC001440	SURFACE	3/29/2004	12:15 PM	LEWCLARLAC2			2.09		32
E04EC002622	SURFACE	5/12/2004	1:45 PM	LEWCLARLAC2			0.56	17.6	10
E04EC002623	SURFACE	5/12/2004	1:45 PM	LEWCLARLAC2			<0.23		<1
E04EC002693	SURFACE	5/13/2004	12:30 PM	LEWCLARLAC2			1.12	46.2	28
E04EC003491	SURFACE	6/9/2004	11:40 AM	LEWCLARLAC2			0.61	17.2	18
E04EC003530	SURFACE	6/10/2004	1:30 PM	LEWCLARLAC2			1.34	41.8	32
E05EC001682	SURFACE	4/13/2005	1:15 PM	LEWCLARLAC2			0.95		19
E05EC002009	SURFACE	4/26/2005	11:00 AM	LEWCLARLAC2			1.38		20
E05EC002010	SURFACE	4/27/2005	11:00 AM	LEWCLARLAC2			<0.50		<1
E05EC003467	SURFACE	6/15/2005	2:00 PM	LEWCLARLAC2		0.355	1.88		32
E03EC003166	SURFACE	5/16/2003		LEWCLARLAC3			0.74		22
E03EC003224	SURFACE	5/20/2003		LEWCLARLAC3			0.53		7
E03EC003551	SURFACE	5/29/2003		LEWCLARLAC3			0.43		4
E03EC003807	SURFACE	6/5/2003	1:40 PM	LEWCLARLAC3	29.28	0.868	0.24	3	<1
E03EC003970	SURFACE	6/10/2003	1:15 PM	LEWCLARLAC3	29.26	0.805	<0.11	4.2	<1
E03EC003971	SURFACE	6/10/2003	1:15 PM	LEWCLARLAC3	29.26	0.805	<0.11	4.2	<1
61303T1020LAC3	SURFACE	6/13/2003	10:20 AM	LEWCLARLAC3	29.26	0.801		5.7	
E03EC004315	SURFACE	6/18/2003	10:15 AM	LEWCLARLAC3	29.3	0.514	0.66	39	14
E03EC004561	SURFACE	6/25/2003	9:40 AM	LEWCLARLAC3			0.73		18
E03EC004815	SURFACE	7/1/2003	1:30 PM	LEWCLARLAC3			0.54		4
E03EC005554	SURFACE	7/17/2003	12:00 PM	LEWCLARLAC3		1.363	0.32	6.1	2
E03EC005723	SURFACE	7/23/2003	2:30 PM	LEWCLARLAC3		1.099	1.16	100.5	64
E03EC005914	SURFACE	7/30/2003	9:30 AM	LEWCLARLAC3		1.675	1.4	6.8	9
8703T920LAC3	SURFACE	8/7/2003	9:20 AM	LEWCLARLAC3					
E04EC001441	SURFACE	3/29/2004	10:00 AM	LEWCLARLAC3			0.92		3
E04EC003490	SURFACE	6/9/2004	9:10 AM	LEWCLARLAC3			0.36	1.4	8
E05EC001683	SURFACE	4/13/2005	11:30 AM	LEWCLARLAC3			0.54		5

E05EC001684	SURFACE	4/13/2005	11:30 AM	LEWCLARLAC3			0.52		1
E05EC002533	SURFACE	5/12/2005	9:45 AM	LEWCLARLAC3			0.68		3
E05EC003470	SURFACE	6/15/2005	9:30 AM	LEWCLARLAC3		0.272	3.6		60
E05EC004355	SURFACE	7/7/2005	9:20 AM	LEWCLARLAC3			0.91		4
E03EC003120	SURFACE	5/14/2003		LEWCLARLAC4			0.49		3
E03EC003167	SURFACE	5/19/2003		LEWCLARLAC4			0.11		7
E03EC003475	SURFACE	5/28/2003		LEWCLARLAC4			0.17		4
E03EC003744	SURFACE	6/4/2003	9:00 AM	LEWCLARLAC4	29.66	3.058	0.45	3.5	2
E03EC003888	SURFACE	6/9/2003	1:20 PM	LEWCLARLAC4	29.6	2.891	0.49	1.3	1
E03EC004316	SURFACE	6/18/2003	1:05 PM	LEWCLARLAC4	29.7	2.91	<.11	0.8	7
E03EC004523	SURFACE	6/24/2003	1:30 PM	LEWCLARLAC4			0.89		3
E03EC004871	SURFACE	7/2/2003	2:30 PM	LEWCLARLAC4			<0.11		4
E03EC005103	SURFACE	7/9/2003	12:00 PM	LEWCLARLAC4			1.32		11
71603T1500LAC4	SURFACE	7/16/2003	3:00 PM	LEWCLARLAC4		2.76		53.7	
E05EC003268	SURFACE	6/13/2005	3:45 PM	LEWCLARLAC4			2.01		14
E05EC003795	SURFACE	6/21/2005	10:45 AM	LEWCLARLAC4			5.27		200
E05EC004354	SURFACE	7/7/2005	10:45 AM	LEWCLARLAC4			1.15		8
E03EC002808	SURFACE	5/7/2003		LEWCLARLAC5			0.6		6
E03EC003121	SURFACE	5/14/2003		LEWCLARLAC5			0.138		11
E03EC003168	SURFACE	5/19/2003		LEWCLARLAC5			0.64		24
E03EC003476	SURFACE	5/28/2003		LEWCLARLAC5			0.75		9
E03EC003745	SURFACE	6/4/2003	10:15 AM	LEWCLARLAC5	29.66	1.986	0.53	35.5	9
E03EC004370	SURFACE	6/19/2003	1:05 PM	LEWCLARLAC5	29.82	1.801	0.42	45.2	13
E03EC004371	SURFACE	6/19/2003	1:05 PM	LEWCLARLAC5	29.82	1.801	0.29	45.2	7
E03EC004522	SURFACE	6/24/2003	10:45 AM	LEWCLARLAC5			0.88		4
E03EC004872	SURFACE	7/2/2003	1:45 PM	LEWCLARLAC5			0.84		20
E03EC005104	SURFACE	7/9/2003	1:10 PM	LEWCLARLAC5			1.06		21
71603T1300LAC5	SURFACE	7/16/2003	1:00 PM	LEWCLARLAC5		2.53			
E03EC005779	SURFACE	7/24/2003	9:45 AM	LEWCLARLAC5		0.941	2.58	113.8	18
E03EC005968	SURFACE	7/31/2003	10:45 AM	LEWCLARLAC5		1.106	<0.11	97.3	<1
E03EC005969	SURFACE	7/31/2003	10:45 AM	LEWCLARLAC5		1.106	1.89	97.3	9
E03EC006186	SURFACE	8/8/2003	11:30 AM	LEWCLARLAC5		1.416	1.82	96.1	8
E03EC006253	SURFACE	8/12/2003	10:15 AM	LEWCLARLAC5		1.497	1.25	135.7	22
E03EC006254	SURFACE	8/12/2003	10:15 AM	LEWCLARLAC5		1.497	1.25	135.7	26
E03EC006646	SURFACE	8/21/2003	9:30 AM	LEWCLARLAC5		1.77	0.84	82	10
E03EC006770	SURFACE	8/27/2003	9:15 AM	LEWCLARLAC5		1.845	0.53	52.8	10
91003T915LAC5	SURFACE	9/10/2003	9:15 AM	LEWCLARLAC5		1.862		44.6	
91503T1415LAC5	SURFACE	9/15/2003	2:15 PM	LEWCLARLAC5		1.814		16	
E05EC003269	SURFACE	6/13/2005	12:30 PM	LEWCLARLAC5			1.79		24

E05EC003796	SURFACE	6/21/2005	12:00 PM	LEWCLARLAC5			4.73		360
E05EC004353	SURFACE	7/7/2005	12:00 PM	LEWCLARLAC5			2.42		22
E03EC002807	SURFACE	5/7/2003		LEWCLARLAC6			0.87		10
E03EC003122	SURFACE	5/14/2003		LEWCLARLAC6			0.87		16
E030C003359	SURFACE	5/22/2003		LEWCLARLAC6			0.5		5
E03EC003424	SURFACE	5/27/2003		LEWCLARLAC6			0.37		6
E03EC003746	SURFACE	6/4/2003	12:30 PM	LEWCLARLAC6	29.7	1.742	0.41	17.5	8
E03EC004374	SURFACE	6/19/2003	11:30 AM	LEWCLARLAC6	29.84	1.41	0.51	37	10
E03EC004464	SURFACE	6/23/2003	1:15 PM	LEWCLARLAC6	29.64	1.641	0.65	39.6	12
E03EC004963	SURFACE	6/30/2003	11:35 AM	LEWCLARLAC6			0.66		6
E03EC005101	SURFACE	7/8/2003	12:15 PM	LEWCLARLAC6			1.14		16
71603T1100LAC6	SURFACE	7/16/2003	11:00 AM	LEWCLARLAC6				45.9	
E03EC005780	SURFACE	7/24/2003	11:45 AM	LEWCLARLAC6		1.861	<0.11	41.5	<1
E03EC005781	SURFACE	7/24/2003	11:45 AM	LEWCLARLAC6		1.861	1.12	41.5	14
E03EC005971	SURFACE	7/31/2003	2:15 PM	LEWCLARLAC6		1.826	0.59	31.1	12
E03EC006086	SURFACE	8/6/2003	1:00 PM	LEWCLARLAC6			0.57		9
E03EC006251	SURFACE	8/12/2003	12:30 PM	LEWCLARLAC6		1.639	0.87	18.7	13
E03EC006645	SURFACE	8/21/2003	11:15 AM	LEWCLARLAC6		1.892	0.3	13.8	4
E03EC006769	SURFACE	8/27/2003	10:15 AM	LEWCLARLAC6		1.895	0.46	28.4	6
E03EC007149	SURFACE	9/10/2003	11:45 AM	LEWCLARLAC6		1.477	1.1	118.2	14
E03EC007150	SURFACE	9/10/2003	11:45 AM	LEWCLARLAC6		1.477	0.96	118.2	14
91503T1300LAC6	SURFACE	9/15/2003	1:00 PM	LEWCLARLAC6		1.681		10.3	
E04EC002745	SURFACE	5/17/2004	11:45 AM	LEWCLARLAC6			0.28	3.6	5
E04EC005990	SURFACE	8/24/2004	12:15 PM	LEWCLARLAC6			1.61		90
E04EC006030	SURFACE	8/25/2004	12:15 PM	LEWCLARLAC6			1.02		12
E05EC003034	SURFACE	6/6/2005	10:45 AM	LEWCLARLAC6		0.826	2.09		56
E05EC003270	SURFACE	6/13/2005	11:30 AM	LEWCLARLAC6		0.938	1.66		28
E05EC003797	SURFACE	6/21/2005	1:00 PM	LEWCLARLAC6			5.87		300
E05EC004352	SURFACE	7/7/2005	1:00 PM	LEWCLARLAC6			1.19		15
E03EC003360	SURFACE	5/22/2003		LEWCLARLAC7			0.45		2
E03EC003425	SURFACE	5/27/2003		LEWCLARLAC7			0.54		5
E03EC003747	SURFACE	6/4/2003	1:15 PM	LEWCLARLAC7	29.7	2.661	0.61	2.5	2
E03EC003889	SURFACE	6/9/2003	11:00 AM	LEWCLARLAC7	29.6	2.403	0.74	1.6	1
E03EC004375	SURFACE	6/19/2003	10:20 AM	LEWCLARLAC7	29.79	0.349	0.49	2.4	5
E03EC004465	SURFACE	6/23/2003	11:45 AM	LEWCLARLAC7	29.53	2.551	0.65	1.5	<1
E03EC004964	SURFACE	6/30/2003	1:00 PM	LEWCLARLAC7			0.4		4
E03EC005102	SURFACE	7/8/2003	10:10 AM	LEWCLARLAC7			0.75		10
E03EC005782	SURFACE	7/24/2003	1:15 PM	LEWCLARLAC7		0.639	2.54	79.3	16
E03EC005970	SURFACE	7/31/2003	1:05 PM	LEWCLARLAC7		1.774	0.87	6.7	3

E03EC006085	SURFACE	8/6/2003	12:00 PM	LEWCLARLAC7		0.98		4
E03EC006252	SURFACE	8/12/2003	2:00 PM	LEWCLARLAC7	2.063	1.63	16.1	14
91003T1130LAC7	SURFACE	9/10/2003	11:30 AM	LEWCLARLAC7	1.748		269.4	
91003T1130LAC7	SURFACE	9/15/2003	12:00 PM	LEWCLARLAC7	2.108		20.6	
E04EC002746	SURFACE	5/17/2004	11:45 AM	LEWCLARLAC7		0.45	0.6	4
E04EC005991	SURFACE	8/24/2004	10:45 AM	LEWCLARLAC7		0.68		9
E04EC006031	SURFACE	8/25/2004	1:30 PM	LEWCLARLAC7		0.72		4
E05EC003035	SURFACE	6/6/2005	12:15 PM	LEWCLARLAC7	0.584	1.31		14
E05EC003271	SURFACE	6/13/2005	10:30 AM	LEWCLARLAC7	0.698	1.16		6
E05EC003798	SURFACE	6/21/2005	2:00 PM	LEWCLARLAC7		2.62		40
E05EC004351	SURFACE	7/7/2005	2:15 PM	LEWCLARLAC7		1.12		6
E05EC004356	SURFACE	7/7/2005	3:00 PM	LEWCLARLAC7		<0.50		<1
E04EC002113	Bottom	4/21/2004	11:00 AM	LEWCLARRHNL2		2.24		5
E04EC002904	Bottom	5/19/2004	10:30 AM	LEWCLARRHNL2		2.39	3.9	2
E04EC003322	Bottom	6/3/2004	10:00 AM	LEWCLARRHNL2		<0.23	3	<1
E04EC003324	Bottom	6/3/2004	10:00 AM	LEWCLARRHNL2		1.28	3	3
E04EC004154	Bottom	6/29/2004	10:30 AM	LEWCLARRHNL2		<0.23		<1
E04EC004158	Bottom	6/29/2004	10:30 AM	LEWCLARRHNL2		1.87	4.7	6
E04EC004659	Bottom	7/14/2004	11:00 AM	LEWCLARRHNL2		2.65	TD	14
E04EC005212	Bottom	7/29/2004	10:30 AM	LEWCLARRHNL2		3.33	TD	14
E04EC005891	Bottom	8/19/2004	11:00 AM	LEWCLARRHNL2		2.88		12
E04EC005893	Bottom	8/19/2004	11:00 AM	LEWCLARRHNL2		<0.23		<1
E04EC006209	Bottom	9/2/2004	9:45 AM	LEWCLARRHNL2		3.12	TD	12
E05EC004564	Bottom	7/14/2005	10:30 AM	LEWCLARRHNL2		1.62		<1
E04EC002112	Surface	4/21/2004	11:00 AM	LEWCLARRHNL3		2.5		5
E04EC002114	Surface	4/21/2004	11:00 AM	LEWCLARRHNL3		<0.23		<1
E04EC002905	Surface	5/19/2004	10:30 AM	LEWCLARRHNL3		2.55	3.4	2
E04EC003321	Surface	6/3/2004	10:00 AM	LEWCLARRHNL3		2.15	3.5	7
E04EC003323	Surface	6/3/2004	10:00 AM	LEWCLARRHNL3		1.3	3.5	5
E04EC004155	Surface	6/29/2004	10:30 AM	LEWCLARRHNL3		1.96	4.2	8
E04EC004159	Surface	6/29/2004	10:30 AM	LEWCLARRHNL3		1.9	4.2	7
E04EC004658	Surface	7/14/2004	11:00 AM	LEWCLARRHNL3		2.58	TD	15
E04EC005210	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3		3.21	TD	15
E04EC005211	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3		<0.23		<1
E04EC005213	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3		3.21	TD	15
E04EC005892	Surface	8/19/2004	11:00 AM	LEWCLARRHNL3		2.63		12
E04EC005894	Surface	8/19/2004	11:00 AM	LEWCLARRHNL3		2.77		9
E04EC006210	Surface	9/2/2004	9:45 AM	LEWCLARRHNL3		2.91	TD	16
E05EC004565	Surface	7/14/2005	10:30 AM	LEWCLARRHNL3		1.41		3

E05EC003623	Surface	6/16/2005	11:00 AM	LEWCLARRHNT1	404	1.27		4
E05EC003624	Surface	6/16/2005	11:00 AM	LEWCLARRHNT1	404	1.35		3
E05EC002011	Surface	4/26/2005	10:30 AM	LEWCLARRHNT4		0.93		2
E05EC002538	Surface	5/12/2005	1:00 PM	LEWCLARRHNT4		2.6		9
E05EC003621	Surface	6/16/2005	12:30 PM	LEWCLARRHNT4	450	1.22		2
E05EC003622	Surface	6/16/2005	12:30 PM	LEWCLARRHNT4	450	1.25		2
E04EC002110	Bottom	4/21/2004	12:45 PM	LEWCLARROSL2		1.43		3
E04EC002111	Bottom	4/21/2004	12:45 PM	LEWCLARROSL2		1.47		3
E04EC002902	Bottom	5/19/2004	1:00 PM	LEWCLARROSL2		1.32	1.8	<1
E04EC003325	Bottom	6/3/2004	12:00 PM	LEWCLARROSL2		2.11	1.4	5
E04EC004156	Bottom	6/29/2004	12:00 PM	LEWCLARROSL2		1.03	2.6	<1
E04EC004654	Bottom	7/14/2004	12:00 PM	LEWCLARROSL2		1.71	TD	1
E04EC005208	Bottom	7/29/2004	12:30 PM	LEWCLARROSL2		1.45	TD	4
E04EC005895	Bottom	8/19/2004	12:15 PM	LEWCLARROSL2				
E05EC004562	Bottom	7/14/2005	1:00 PM	LEWCLARROSL2		1.73		<1
E04EC002109	Surface	4/21/2004	12:45 PM	LEWCLARROSL3		1.62		4
E04EC002903	Surface	5/19/2004	1:00 PM	LEWCLARROSL3		<0.23		<1
E04EC002906	Surface	5/19/2004	1:00 PM	LEWCLARROSL3		1.35	3.4	<1
E04EC002907	Surface	5/19/2004	1:00 PM	LEWCLARROSL3		1.33	3.4	2
E04EC003326	Surface	6/3/2004	12:00 PM	LEWCLARROSL3		2.18	2.1	7
E04EC004157	Surface	6/29/2004	12:00 PM	LEWCLARROSL3		0.98	2.3	<1
E04EC004655	Surface	7/14/2004	12:00 PM	LEWCLARROSL3		1.44	TD	2
E04EC005209	Surface	7/29/2004	12:30 PM	LEWCLARROSL3		1.42	TD	4
E04EC005896	Surface	8/19/2004	12:15 PM	LEWCLARROSL3				
E05EC004563	Surface	7/14/2005	1:00 PM	LEWCLARROSL3		1.56		<1
E05EC002534	Surface	5/12/2005	11:30 AM	LEWCLARROST4	321	2.39		8
E05EC002535	Surface	5/12/2005	11:30 AM	LEWCLARROST4	321	2.39		8
E05EC003468	Surface	6/15/2005	12:20 PM	LEWCLARROST4	267	1.77		1
E05EC003469	Surface	6/15/2005	12:20 PM	LEWCLARROST4	267	1.85		<1
E05EC003471	Surface	6/15/2005	12:20 PM	LEWCLARROST4	267	<0.50		<1

Specimen Number	Relative Depth	Sample Date	Sample Time	Station ID	Fecal Coliform - MF	Nitrate	pH	Water Temp
E03EC003164	SURFACE	5/16/2003		LEWCLARLAC1		<0.1		
E03EC003225	SURFACE	5/20/2003		LEWCLARLAC1	80	0.2		
E03EC003549	SURFACE	5/29/2003		LEWCLARLAC1	320	<0.1		
E03EC003809	SURFACE	6/5/2003	9:30 AM	LEWCLARLAC1	650	<0.1	8.37	15.48
E03EC003810	SURFACE	6/5/2003	9:30 AM	LEWCLARLAC1	710	<0.1	8.37	15.48
E03EC004054	SURFACE	6/11/2003	10:20 AM	LEWCLARLAC1	420	<0.1	8.44	19.39
E03EC004186	SURFACE	6/16/2003	12:00 PM	LEWCLARLAC1	1700	<0.1		
E03EC004558	SURFACE	6/25/2003	2:00 PM	LEWCLARLAC1	2900	0.1		
E03EC004816	SURFACE	7/1/2003	10:30 AM	LEWCLARLAC1	260	<0.1		
E03EC005250	SURFACE	7/10/2003	9:45 AM	LEWCLARLAC1	580	0.1		
E03EC005720	SURFACE	7/23/2003	10:15 AM	LEWCLARLAC1	90	<0.1	8.51	21.82
E03EC005721	SURFACE	7/23/2003	10:15 AM	LEWCLARLAC1	70	<0.1	8.51	21.82
E03EC005912	SURFACE	7/30/2003	1:30 PM	LEWCLARLAC1	40	<0.1	8.46	29.64
E03EC005913	SURFACE	7/30/2003	1:30 PM	LEWCLARLAC1	30	<0.1	8.46	29.64
E03EC006160	SURFACE	8/7/2003	11:50 AM	LEWCLARLAC1	20	<0.1	8.29	27.68
E03EC006313	SURFACE	8/13/2003	1:15 PM	LEWCLARLAC1	40	<0.1	8.38	27.59
E03EC006577	SURFACE	8/20/2003	10:30 AM	LEWCLARLAC1	140	<0.1	7.73	23.95
E03EC006721	SURFACE	8/26/2003	12:30 PM	LEWCLARLAC1	40	<0.1	8.27	28.27
9903T1200LAC1	SURFACE	9/9/2003	12:00 PM	LEWCLARLAC1			8.15	23.55
91703T1000LAC1	SURFACE	9/17/2003	10:00 AM	LEWCLARLAC1			8.46	18.07
E04EC001438	SURFACE	3/29/2004	2:00 PM	LEWCLARLAC1	3200	0.1		
E04EC001439	SURFACE	3/29/2004	2:00 PM	LEWCLARLAC1	3000	0.1		
E04EC002620	SURFACE	5/12/2004	11:30 AM	LEWCLARLAC1	10000	0.2		
E04EC002621	SURFACE	5/12/2004	11:30 AM	LEWCLARLAC1	10000	0.2		
E04EC002692	SURFACE	5/13/2004	1:30 PM	LEWCLARLAC1	5700	<0.1	8.29	11.39
E04EC003492	SURFACE	6/9/2004	12:45 PM	LEWCLARLAC1	<10	<0.1	8.39	16.72
E04EC003493	SURFACE	6/9/2004	12:45 PM	LEWCLARLAC1	1700	0.2	8.39	16.72
E04EC003529	SURFACE	6/10/2004	12:00 PM	LEWCLARLAC1	5000	0.4	8.04	16.3
E05EC001681	SURFACE	4/13/2005	2:30 PM	LEWCLARLAC1	590	0.1		
E05EC002008	SURFACE	4/27/2005	9:00 AM	LEWCLARLAC1	1000	<0.1		
E05EC003466	SURFACE	6/15/2005	3:00 PM	LEWCLARLAC1	1100	0.1	8.06	21.67
E03EC003165	SURFACE	5/16/2003		LEWCLARLAC2		<0.1		
E03EC003226	SURFACE	5/20/2003		LEWCLARLAC2	150	0.1		
E03EC003550	SURFACE	5/29/2003		LEWCLARLAC2	110	<0.1		
E03EC003808	SURFACE	6/5/2003	11:30 AM	LEWCLARLAC2	250	<0.1	8.36	19.64
E03EC004055	SURFACE	6/11/2003	12:40 PM	LEWCLARLAC2	250	<0.1	8.4	23.77
E03EC004187	SURFACE	6/16/2003	1:45 PM	LEWCLARLAC2	1500	<0.1		

E03EC004560	SURFACE	6/25/2003	12:00 PM	LEWCLARLAC2	2600	0.1		
E03EC004813	SURFACE	7/1/2003	11:50 AM	LEWCLARLAC2	200	<0.1		
E03EC004814	SURFACE	7/1/2003	11:50 AM	LEWCLARLAC2	160	<0.1		
E03EC005553	SURFACE	7/17/2003	2:00 PM	LEWCLARLAC2	80	<0.1	8.25	31.16
E03EC005722	SURFACE	7/23/2003	12:15 PM	LEWCLARLAC2	100	<0.1	8.34	25.7
E03EC005915	SURFACE	7/30/2003	11:15 AM	LEWCLARLAC2	180	<0.1		
E03EC006159	SURFACE	8/7/2003	10:30 AM	LEWCLARLAC2	40	<0.1	8.44	29.96
E03EC006314	SURFACE	8/13/2003	11:15 AM	LEWCLARLAC2	120	<0.1	8.31	25.29
E03EC006578	SURFACE	8/20/2003	12:30 PM	LEWCLARLAC2	580	<0.1	8.11	32.81
E03EC006722	SURFACE	8/26/2003	10:30 AM	LEWCLARLAC2	120	<0.1	8.09	25.7
9903T1030LAC2	SURFACE	9/9/2003	10:30 AM	LEWCLARLAC2			7.66	20.83
91703T1115LAC2	SURFACE	9/17/2003	11:15 AM	LEWCLARLAC2			8.28	19.78
E04EC001440	SURFACE	3/29/2004	12:15 PM	LEWCLARLAC2	520	0.2		
E04EC002622	SURFACE	5/12/2004	1:45 PM	LEWCLARLAC2	320	<0.1	8.53	14.79
E04EC002623	SURFACE	5/12/2004	1:45 PM	LEWCLARLAC2	<10	<0.1		
E04EC002693	SURFACE	5/13/2004	12:30 PM	LEWCLARLAC2	1700	<0.1	8.15	12.27
E04EC003491	SURFACE	6/9/2004	11:40 AM	LEWCLARLAC2	130	<0.1	8.52	16.95
E04EC003530	SURFACE	6/10/2004	1:30 PM	LEWCLARLAC2	1100	<0.1	8.46	22.12
E05EC001682	SURFACE	4/13/2005	1:15 PM	LEWCLARLAC2	750	0.1		
E05EC002009	SURFACE	4/26/2005	11:00 AM	LEWCLARLAC2	900	0.1		
E05EC002010	SURFACE	4/27/2005	11:00 AM	LEWCLARLAC2	<10	<0.1		
E05EC003467	SURFACE	6/15/2005	2:00 PM	LEWCLARLAC2	690	0.2	8.02	21.1
E03EC003166	SURFACE	5/16/2003		LEWCLARLAC3		0.2		
E03EC003224	SURFACE	5/20/2003		LEWCLARLAC3	80	<0.1		
E03EC003551	SURFACE	5/29/2003		LEWCLARLAC3	420	<0.1		
E03EC003807	SURFACE	6/5/2003	1:40 PM	LEWCLARLAC3	610	<0.1	8.22	23.48
E03EC003970	SURFACE	6/10/2003	1:15 PM	LEWCLARLAC3	<10	<0.1	8.24	19.67
E03EC003971	SURFACE	6/10/2003	1:15 PM	LEWCLARLAC3	1000	<0.1	8.24	19.67
61303T1020LAC3	SURFACE	6/13/2003	10:20 AM	LEWCLARLAC3			8.21	19.15
E03EC004315	SURFACE	6/18/2003	10:15 AM	LEWCLARLAC3	480	<0.1	7.92	23.44
E03EC004561	SURFACE	6/25/2003	9:40 AM	LEWCLARLAC3	4000	<0.1		
E03EC004815	SURFACE	7/1/2003	1:30 PM	LEWCLARLAC3	300	<0.1		
E03EC005554	SURFACE	7/17/2003	12:00 PM	LEWCLARLAC3	3000	<0.1	6.9	32.52
E03EC005723	SURFACE	7/23/2003	2:30 PM	LEWCLARLAC3	46000	<0.1	7.85	35.32
E03EC005914	SURFACE	7/30/2003	9:30 AM	LEWCLARLAC3	41000	<0.1	8.28	19.28
8703T920LAC3	SURFACE	8/7/2003	9:20 AM	LEWCLARLAC3				
E04EC001441	SURFACE	3/29/2004	10:00 AM	LEWCLARLAC3	830	<0.1		
E04EC003490	SURFACE	6/9/2004	9:10 AM	LEWCLARLAC3	780	0.1	8.12	16.81
E05EC001683	SURFACE	4/13/2005	11:30 AM	LEWCLARLAC3	220	<0.1		

E05EC001684	SURFACE	4/13/2005	11:30 AM	LEWCLARLAC3	240	<0.1		
E05EC002533	SURFACE	5/12/2005	9:45 AM	LEWCLARLAC3	9900	<0.1		
E05EC003470	SURFACE	6/15/2005	9:30 AM	LEWCLARLAC3	3200	0.3	7.67	17.9
E05EC004355	SURFACE	7/7/2005	9:20 AM	LEWCLARLAC3	360	<0.1		
E03EC003120	SURFACE	5/14/2003		LEWCLARLAC4	30	<0.1		
E03EC003167	SURFACE	5/19/2003		LEWCLARLAC4	40	<0.1		
E03EC003475	SURFACE	5/28/2003		LEWCLARLAC4	150	<0.1		
E03EC003744	SURFACE	6/4/2003	9:00 AM	LEWCLARLAC4	70	<0.1	7.18	14.59
E03EC003888	SURFACE	6/9/2003	1:20 PM	LEWCLARLAC4	110	<0.1	7.63	22.69
E03EC004316	SURFACE	6/18/2003	1:05 PM	LEWCLARLAC4	150	<0.1	7.6	26.54
E03EC004523	SURFACE	6/24/2003	1:30 PM	LEWCLARLAC4	520	0.6		
E03EC004871	SURFACE	7/2/2003	2:30 PM	LEWCLARLAC4	260	<0.1		
E03EC005103	SURFACE	7/9/2003	12:00 PM	LEWCLARLAC4	540	0.3		
71603T1500LAC4	SURFACE	7/16/2003	3:00 PM	LEWCLARLAC4			7.83	24.6
E05EC003268	SURFACE	6/13/2005	3:45 PM	LEWCLARLAC4	4000	0.3		
E05EC003795	SURFACE	6/21/2005	10:45 AM	LEWCLARLAC4	37000	0.7		
E05EC004354	SURFACE	7/7/2005	10:45 AM	LEWCLARLAC4	1200	<0.1		
E03EC002808	SURFACE	5/7/2003		LEWCLARLAC5	20	<0.1		
E03EC003121	SURFACE	5/14/2003		LEWCLARLAC5	100	<0.1		
E03EC003168	SURFACE	5/19/2003		LEWCLARLAC5	160	<0.1		
E03EC003476	SURFACE	5/28/2003		LEWCLARLAC5	60	<0.1		
E03EC003745	SURFACE	6/4/2003	10:15 AM	LEWCLARLAC5	140	<0.1	7.57	15.87
E03EC004370	SURFACE	6/19/2003	1:05 PM	LEWCLARLAC5	510	<0.1	7.82	23.21
E03EC004371	SURFACE	6/19/2003	1:05 PM	LEWCLARLAC5	290	<0.1	7.82	23.21
E03EC004522	SURFACE	6/24/2003	10:45 AM	LEWCLARLAC5	240	0.6		
E03EC004872	SURFACE	7/2/2003	1:45 PM	LEWCLARLAC5	400	<0.1		
E03EC005104	SURFACE	7/9/2003	1:10 PM	LEWCLARLAC5	1140	<0.1		
71603T1300LAC5	SURFACE	7/16/2003	1:00 PM	LEWCLARLAC5			7.99	24.1
E03EC005779	SURFACE	7/24/2003	9:45 AM	LEWCLARLAC5	160	0.1	7.84	22.99
E03EC005968	SURFACE	7/31/2003	10:45 AM	LEWCLARLAC5	<10	<0.1	7.94	24.59
E03EC005969	SURFACE	7/31/2003	10:45 AM	LEWCLARLAC5	250	0.3	7.94	24.59
E03EC006186	SURFACE	8/8/2003	11:30 AM	LEWCLARLAC5		<0.1	8.15	24.35
E03EC006253	SURFACE	8/12/2003	10:15 AM	LEWCLARLAC5	230	<0.1	7.24	23.35
E03EC006254	SURFACE	8/12/2003	10:15 AM	LEWCLARLAC5	240	<0.1	7.24	23.35
E03EC006646	SURFACE	8/21/2003	9:30 AM	LEWCLARLAC5	240	<0.1	7.89	25.97
E03EC006770	SURFACE	8/27/2003	9:15 AM	LEWCLARLAC5	100	<0.1	7.86	24.06
91003T915LAC5	SURFACE	9/10/2003	9:15 AM	LEWCLARLAC5			7.76	20.71
91503T1415LAC5	SURFACE	9/15/2003	2:15 PM	LEWCLARLAC5			7.52	17.58
E05EC003269	SURFACE	6/13/2005	12:30 PM	LEWCLARLAC5	1200	0.1		

E05EC003796	SURFACE	6/21/2005	12:00 PM	LEWCLARLAC5	22000	0.4		
E05EC004353	SURFACE	7/7/2005	12:00 PM	LEWCLARLAC5	600	<0.1		
E03EC002807	SURFACE	5/7/2003		LEWCLARLAC6	380	<0.1		
E03EC003122	SURFACE	5/14/2003		LEWCLARLAC6	670	0.1		
E030C003359	SURFACE	5/22/2003		LEWCLARLAC6	250	<0.1		
E03EC003424	SURFACE	5/27/2003		LEWCLARLAC6	420	<0.1		
E03EC003746	SURFACE	6/4/2003	12:30 PM	LEWCLARLAC6	830	<0.1	7.87	17.05
E03EC004374	SURFACE	6/19/2003	11:30 AM	LEWCLARLAC6	600	0.1	8.08	20.78
E03EC004464	SURFACE	6/23/2003	1:15 PM	LEWCLARLAC6	840	0.2	8.01	21.6
E03EC004963	SURFACE	6/30/2003	11:35 AM	LEWCLARLAC6		0.3		
E03EC005101	SURFACE	7/8/2003	12:15 PM	LEWCLARLAC6	600	0.5		
71603T1100LAC6	SURFACE	7/16/2003	11:00 AM	LEWCLARLAC6			7.71	24.2
E03EC005780	SURFACE	7/24/2003	11:45 AM	LEWCLARLAC6	<10	<0.1	7.96	23.35
E03EC005781	SURFACE	7/24/2003	11:45 AM	LEWCLARLAC6	420	<0.1	7.96	23.35
E03EC005971	SURFACE	7/31/2003	2:15 PM	LEWCLARLAC6	1300	<0.1	7.87	27.82
E03EC006086	SURFACE	8/6/2003	1:00 PM	LEWCLARLAC6	250	0.1		
E03EC006251	SURFACE	8/12/2003	12:30 PM	LEWCLARLAC6	390	<0.1	7.55	24.65
E03EC006645	SURFACE	8/21/2003	11:15 AM	LEWCLARLAC6	490	<0.1	7.99	22.64
E03EC006769	SURFACE	8/27/2003	10:15 AM	LEWCLARLAC6	410	0.2	7.84	21.08
E03EC007149	SURFACE	9/10/2003	11:45 AM	LEWCLARLAC6	52000	0.3	7.89	19.48
E03EC007150	SURFACE	9/10/2003	11:45 AM	LEWCLARLAC6	51000	0.3	7.89	19.48
91503T1300LAC6	SURFACE	9/15/2003	1:00 PM	LEWCLARLAC6			7.35	17.88
E04EC002745	SURFACE	5/17/2004	11:45 AM	LEWCLARLAC6	950	0.1	7.83	14.28
E04EC005990	SURFACE	8/24/2004	12:15 PM	LEWCLARLAC6	8600	0.3		
E04EC006030	SURFACE	8/25/2004	12:15 PM	LEWCLARLAC6	4100	0.3		
E05EC003034	SURFACE	6/6/2005	10:45 AM	LEWCLARLAC6	2900	2	7.72	21.04
E05EC003270	SURFACE	6/13/2005	11:30 AM	LEWCLARLAC6	1100	0.4	7.95	20.01
E05EC003797	SURFACE	6/21/2005	1:00 PM	LEWCLARLAC6	100000	0.7		
E05EC004352	SURFACE	7/7/2005	1:00 PM	LEWCLARLAC6	240	<0.1		
E03EC003360	SURFACE	5/22/2003		LEWCLARLAC7	1890	<0.1		
E03EC003425	SURFACE	5/27/2003		LEWCLARLAC7	290	<0.1		
E03EC003747	SURFACE	6/4/2003	1:15 PM	LEWCLARLAC7	650	<0.1	7.7	18.86
E03EC003889	SURFACE	6/9/2003	11:00 AM	LEWCLARLAC7	480	<0.1	6.95	19.02
E03EC004375	SURFACE	6/19/2003	10:20 AM	LEWCLARLAC7	540	<0.1	7.95	20.22
E03EC004465	SURFACE	6/23/2003	11:45 AM	LEWCLARLAC7	350	<0.1	7.99	21.55
E03EC004964	SURFACE	6/30/2003	1:00 PM	LEWCLARLAC7		<0.1		
E03EC005102	SURFACE	7/8/2003	10:10 AM	LEWCLARLAC7	2600	<0.1		
E03EC005782	SURFACE	7/24/2003	1:15 PM	LEWCLARLAC7	12000	<0.1	7.79	26.05
E03EC005970	SURFACE	7/31/2003	1:05 PM	LEWCLARLAC7	1300	<0.1	7.89	26.38

E03EC006085	SURFACE	8/6/2003	12:00 PM	LEWCLARLAC7	1900	<0.1		
E03EC006252	SURFACE	8/12/2003	2:00 PM	LEWCLARLAC7	1760	<0.1	7.66	25.68
91003T1130LAC7	SURFACE	9/10/2003	11:30 AM	LEWCLARLAC7			7.69	19.46
91003T1130LAC7	SURFACE	9/15/2003	12:00 PM	LEWCLARLAC7			7.33	14.08
E04EC002746	SURFACE	5/17/2004	11:45 AM	LEWCLARLAC7	390	<0.1	7.9	15.42
E04EC005991	SURFACE	8/24/2004	10:45 AM	LEWCLARLAC7	20000	<0.1		
E04EC006031	SURFACE	8/25/2004	1:30 PM	LEWCLARLAC7	940	<0.1		
E05EC003035	SURFACE	6/6/2005	12:15 PM	LEWCLARLAC7	1400	1.4	7.53	21.67
E05EC003271	SURFACE	6/13/2005	10:30 AM	LEWCLARLAC7	840	0.4	7.85	19.88
E05EC003798	SURFACE	6/21/2005	2:00 PM	LEWCLARLAC7	18000	1.4		
E05EC004351	SURFACE	7/7/2005	2:15 PM	LEWCLARLAC7	1000	<0.1		
E05EC004356	SURFACE	7/7/2005	3:00 PM	LEWCLARLAC7	<10	<0.1		
E04EC002113	Bottom	4/21/2004	11:00 AM	LEWCLARRHNL2	<10	<0.1		
E04EC002904	Bottom	5/19/2004	10:30 AM	LEWCLARRHNL2	<10	<0.1	8.42	16.23
E04EC003322	Bottom	6/3/2004	10:00 AM	LEWCLARRHNL2	<10	<0.1	8.79	18.31
E04EC003324	Bottom	6/3/2004	10:00 AM	LEWCLARRHNL2	<10	<0.1	8.79	18.31
E04EC004154	Bottom	6/29/2004	10:30 AM	LEWCLARRHNL2	<10	<0.1		
E04EC004158	Bottom	6/29/2004	10:30 AM	LEWCLARRHNL2	<10	<0.1	9.1	20.9
E04EC004659	Bottom	7/14/2004	11:00 AM	LEWCLARRHNL2	10	<0.1	9.1	25.9
E04EC005212	Bottom	7/29/2004	10:30 AM	LEWCLARRHNL2	<10	<0.1	8.7	22.6
E04EC005891	Bottom	8/19/2004	11:00 AM	LEWCLARRHNL2	<10	<0.1		
E04EC005893	Bottom	8/19/2004	11:00 AM	LEWCLARRHNL2	<10	<0.1		
E04EC006209	Bottom	9/2/2004	9:45 AM	LEWCLARRHNL2	<10	<0.1	8.7	20.1
E05EC004564	Bottom	7/14/2005	10:30 AM	LEWCLARRHNL2	<10	<0.1	8.2	25.43
E04EC002112	Surface	4/21/2004	11:00 AM	LEWCLARRHNL3	<10	<0.1		
E04EC002114	Surface	4/21/2004	11:00 AM	LEWCLARRHNL3	<10	<0.1		
E04EC002905	Surface	5/19/2004	10:30 AM	LEWCLARRHNL3	<10	<0.1	8.66	17.62
E04EC003321	Surface	6/3/2004	10:00 AM	LEWCLARRHNL3	<10	<0.1	8.78	18.18
E04EC003323	Surface	6/3/2004	10:00 AM	LEWCLARRHNL3	<10	<0.1	8.78	18.18
E04EC004155	Surface	6/29/2004	10:30 AM	LEWCLARRHNL3	<10	<0.1	9	21.4
E04EC004159	Surface	6/29/2004	10:30 AM	LEWCLARRHNL3	<10	<0.1	9	21.4
E04EC004658	Surface	7/14/2004	11:00 AM	LEWCLARRHNL3	<10	<0.1	9.2	25.9
E04EC005210	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	30	0.4	8.8	22.4
E04EC005211	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	<10	<0.1		
E04EC005213	Surface	7/29/2004	10:30 AM	LEWCLARRHNL3	<10	<0.1	8.8	22.4
E04EC005892	Surface	8/19/2004	11:00 AM	LEWCLARRHNL3	10	<0.1		
E04EC005894	Surface	8/19/2004	11:00 AM	LEWCLARRHNL3	10	<0.1		
E04EC006210	Surface	9/2/2004	9:45 AM	LEWCLARRHNL3	<10	<0.1	9	21.4
E05EC004565	Surface	7/14/2005	10:30 AM	LEWCLARRHNL3	<10	<0.1	8.63	26.57

E05EC003623	Surface	6/16/2005	11:00 AM	LEWCLARRHNT1	70	0.1	7.89	21.98
E05EC003624	Surface	6/16/2005	11:00 AM	LEWCLARRHNT1	20	0.1	7.89	21.98
E05EC002011	Surface	4/26/2005	10:30 AM	LEWCLARRHNT4	150	<0.1		
E05EC002538	Surface	5/12/2005	1:00 PM	LEWCLARRHNT4	320000	0.6		
E05EC003621	Surface	6/16/2005	12:30 PM	LEWCLARRHNT4	620	0.3	7.8	21.71
E05EC003622	Surface	6/16/2005	12:30 PM	LEWCLARRHNT4	530	0.3	7.8	21.71
E04EC002110	Bottom	4/21/2004	12:45 PM	LEWCLARROSL2	<10	<0.1		
E04EC002111	Bottom	4/21/2004	12:45 PM	LEWCLARROSL2	<10	<0.1		
E04EC002902	Bottom	5/19/2004	1:00 PM	LEWCLARROSL2	<10	<0.1	8.61	15.35
E04EC003325	Bottom	6/3/2004	12:00 PM	LEWCLARROSL2	<10	<0.1	9.09	16.7
E04EC004156	Bottom	6/29/2004	12:00 PM	LEWCLARROSL2	<10	<0.1	9.5	20.6
E04EC004654	Bottom	7/14/2004	12:00 PM	LEWCLARROSL2	<10	<0.1	9.4	24.8
E04EC005208	Bottom	7/29/2004	12:30 PM	LEWCLARROSL2	<10	0.1	9	21.9
E04EC005895	Bottom	8/19/2004	12:15 PM	LEWCLARROSL2	10			
E05EC004562	Bottom	7/14/2005	1:00 PM	LEWCLARROSL2	<10	<0.1	8.82	26.17
E04EC002109	Surface	4/21/2004	12:45 PM	LEWCLARROSL3	20	<0.1		
E04EC002903	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	<10	<0.1		
E04EC002906	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	<10	<0.1	8.66	15.89
E04EC002907	Surface	5/19/2004	1:00 PM	LEWCLARROSL3	<10	<0.1	8.66	15.89
E04EC003326	Surface	6/3/2004	12:00 PM	LEWCLARROSL3	<10	<0.1	8.9	16.7
E04EC004157	Surface	6/29/2004	12:00 PM	LEWCLARROSL3	<10	<0.1	9.6	19.8
E04EC004655	Surface	7/14/2004	12:00 PM	LEWCLARROSL3	<10	<0.1	9.4	25.1
E04EC005209	Surface	7/29/2004	12:30 PM	LEWCLARROSL3	<10	<0.1	9	22
E04EC005896	Surface	8/19/2004	12:15 PM	LEWCLARROSL3	<10			
E05EC004563	Surface	7/14/2005	1:00 PM	LEWCLARROSL3	<10	<0.1	8.56	25.49
E05EC002534	Surface	5/12/2005	11:30 AM	LEWCLARROST4	13000	0.3	7.72	10.15
E05EC002535	Surface	5/12/2005	11:30 AM	LEWCLARROST4	97000	0.4	7.72	10.15
E05EC003468	Surface	6/15/2005	12:20 PM	LEWCLARROST4	230	<0.1	7.36	19.41
E05EC003469	Surface	6/15/2005	12:20 PM	LEWCLARROST4	300	<0.1	7.36	19.41
E05EC003471	Surface	6/15/2005	12:20 PM	LEWCLARROST4	<10	0.1	7.36	19.41

Appendix C. Feeding Area Rankings

Rank	Phosphorus Load (Pounds)	Rating	Animal Type	LotID	Watershed	Distance to Stream (Meters)	Percent of Total Load	Cumulative Percent	Percent of Subwatershed Load	Subwatershed Cumulative Percent
1-MS-1	333	68	Beef Cattle	F432	Missouri	<100	2.60%	2.60%	10.13%	10.13%
2-MS-2	292	67	Beef Cattle	F436	Missouri	<100	2.28%	4.88%	8.88%	19.02%
3-MS-3	287	67	Beef Cattle	F79	Missouri	<100	2.24%	7.12%	8.73%	27.75%
4-EM-1	231	52	Beef Cattle	F333	Emanuel	<100	1.80%	8.92%	7.02%	7.02%
5-SN-1	417	72	Beef Cattle	F55	Snatch	100-200	1.63%	10.55%	29.20%	29.20%
6-CH-1	203	60	Beef Cattle	F298	Choteau	<100	1.58%	12.14%	3.93%	3.93%
7-EM-2	190	61	Beef Cattle	F335	Emanuel	<100	1.48%	13.62%	5.77%	12.79%
8-EM-3	188	61	Beef Cattle	F367	Emanuel	<100	1.47%	15.09%	5.71%	18.50%
9-CH-2	176	57	Beef Cattle	F135	Choteau	<100	1.37%	16.46%	3.41%	7.34%
10-CH-3	336	68	Beef Cattle	F228	Choteau	100-200	1.31%	17.77%	3.25%	10.60%
11-CH-4	167	59	Beef Cattle	F169	Choteau	<100	1.30%	19.08%	3.24%	13.83%
12-EM-4	152	55	Beef Cattle	F358	Emanuel	<100	1.19%	20.26%	4.62%	23.12%
13-MS-4	292	66	Beef Cattle	F78	Missouri	100-200	1.14%	21.40%	4.44%	32.19%
14-MS-5	292	67	Beef Cattle	F379	Missouri	100-200	1.14%	22.54%	4.44%	36.63%
15-CH-5	286	80	Dairy Cattle	F112	Choteau	100-200	1.12%	23.66%	2.77%	16.60%
16-CH-6	134	56	Beef Cattle	F17	Choteau	<100	1.05%	24.71%	2.60%	19.20%
17-EM-5	250	65	Beef Cattle	F97	Emanuel	100-200	0.98%	25.68%	3.80%	26.92%
18-CH-7	125	55	Beef Cattle	F292	Choteau	<100	0.98%	26.66%	2.42%	21.62%
19-EM-6	243	65	Beef Cattle	F182	Emanuel	100-200	0.95%	27.61%	3.69%	30.61%
20-EM-7	119	48	Beef Cattle	F385	Emanuel	<100	0.93%	28.54%	3.62%	34.23%
21-MS-6	117	54	Beef Cattle	F434	Missouri	<100	0.91%	29.45%	3.56%	40.19%
22-EM-8	209	61	Beef Cattle	F93	Emanuel	100-200	0.82%	30.27%	3.18%	37.40%
23-MS-7	103	46	Beef Cattle	F443	Missouri	<100	0.80%	31.07%	3.13%	43.32%
24-CH-8	193	58	Beef Cattle	F110	Choteau	100-200	0.75%	31.82%	1.87%	23.49%
25-CH-9	191	60	Beef Cattle	F256	Choteau	100-200	0.75%	32.57%	1.85%	25.34%
26-MS-8	286	62	Beef Cattle	F75	Missouri	200-300	0.74%	33.31%	2.90%	46.22%
27-CH-10	94	44	Beef Cattle	F353	Choteau	<100	0.73%	34.05%	1.82%	27.16%
28-EM-9	92	49	Beef Cattle	F355	Emanuel	<100	0.72%	34.77%	2.80%	40.20%
29-MS-9	84	46	Beef Cattle	F213	Missouri	<100	0.66%	35.42%	2.56%	48.78%
30-EM-10	167	57	Beef Cattle	F96	Emanuel	100-200	0.65%	36.07%	2.54%	42.74%
31-CH-11	167	59	Beef Cattle	F115	Choteau	100-200	0.65%	36.72%	1.62%	28.78%
32-CH-12	83	48	Beef Cattle	F166	Choteau	<100	0.65%	37.37%	1.61%	30.38%
33-MS-10	83	49	Beef Cattle	F409	Missouri	<100	0.65%	38.02%	2.53%	51.31%
34-MS-11	83	48	Beef Cattle	F492	Missouri	<100	0.65%	38.67%	2.53%	53.83%
35-SN-2	165	56	Beef Cattle	F330	Snatch	100-200	0.64%	39.31%	11.55%	40.76%
36-SL-1	77	53	Beef Cattle	F189	Slaughter	<100	0.60%	39.91%	21.74%	21.74%
37-EM-11	152	57	Beef Cattle	F334	Emanuel	100-200	0.59%	40.51%	2.31%	45.05%
38-CH-13	74	44	Beef Cattle	F257	Choteau	<100	0.58%	41.09%	1.43%	31.82%
39-MS-12	146	57	Beef Cattle	F491	Missouri	100-200	0.57%	41.66%	2.22%	56.05%
40-CH-14	145	51	Beef Cattle	F468	Choteau	100-200	0.57%	42.22%	1.40%	33.22%
41-CH-15	67	46	Beef Cattle	F354	Choteau	<100	0.52%	42.74%	1.30%	34.52%
42-CH-16	190	53	Beef Cattle	F196	Choteau	200-300	0.49%	43.24%	1.23%	35.75%
43-CH-17	63	42	Beef Cattle	F80	Choteau	<100	0.49%	43.73%	1.22%	36.97%
44-EM-12	63	44	Beef Cattle	F94	Emanuel	<100	0.49%	44.22%	1.91%	46.96%
45-MS-13	63	44	Beef Cattle	F211	Missouri	<100	0.49%	44.71%	1.92%	57.97%
46-CH-18	63	45	Beef Cattle	F248	Choteau	<100	0.49%	45.21%	1.22%	38.19%
47-EM-13	63	51	Dairy Cattle	F339	Emanuel	<100	0.49%	45.70%	1.91%	48.87%
48-EM-14	63	44	Beef Cattle	F467	Emanuel	<100	0.49%	46.19%	1.91%	50.79%
49-MS-14	188	56	Beef Cattle	F27	Missouri	200-300	0.49%	46.68%	1.91%	59.88%
50-CH-19	125	56	Beef Cattle	F82	Choteau	100-200	0.49%	47.17%	1.21%	39.40%
51-MS-15	125	56	Beef Cattle	F159	Missouri	100-200	0.49%	47.66%	1.90%	61.78%
52-EM-15	125	52	Beef Cattle	F212	Emanuel	100-200	0.49%	48.14%	1.90%	52.69%

53-EM-16	125	55	Beef Cattle	F366	Emanuel	100-200	0.49%	48.63%	1.90%	54.59%
54-MS-16	125	55	Beef Cattle	F387	Missouri	100-200	0.49%	49.12%	1.90%	63.68%
55-MS-17	125	55	Beef Cattle	F473	Missouri	100-200	0.49%	49.61%	1.90%	65.58%
56-EM-17	125	54	Beef Cattle	F477	Emanuel	100-200	0.49%	50.09%	1.90%	56.49%
57-SN-3	62	46	Beef Cattle	F501	Snatch	<100	0.48%	50.58%	8.68%	49.44%
58-CH-20	59	51	Dairy Cattle	F138	Choteau	<100	0.46%	51.04%	1.14%	40.54%
59-SN-4	117	61	Dairy Cattle	F56	Snatch	100-200	0.46%	51.50%	8.19%	57.63%
60-EM-18	58	42	Beef Cattle	F98	Emanuel	<100	0.45%	51.95%	1.76%	58.25%
61-EM-19	58	45	Beef Cattle	F404	Emanuel	<100	0.45%	52.40%	1.76%	60.01%
62-EM-20	58	43	Beef Cattle	F419	Emanuel	<100	0.45%	52.85%	1.76%	61.77%
63-EM-21	57	40	Beef Cattle	F340	Emanuel	<100	0.45%	53.30%	1.73%	63.50%
64-MS-18	55	46	Beef Cattle	F500	Missouri	<100	0.43%	53.73%	1.67%	67.25%
65-CH-21	54	44	Beef Cattle	F249	Choteau	<100	0.42%	54.15%	1.05%	41.59%
66-SL-2	155	59	Beef Cattle	F162	Slaughter	200-300	0.40%	54.55%	14.59%	36.33%
67-CH-22	50	41	Beef Cattle	F133	Choteau	<100	0.39%	54.94%	0.97%	42.56%
68-MS-19	100	51	Beef Cattle	F313	Missouri	100-200	0.39%	55.33%	1.52%	68.77%
69-CH-23	50	42	Beef Cattle	F318	Choteau	<100	0.39%	55.73%	0.97%	43.52%
70-EM-22	50	40	Beef Cattle	F341	Emanuel	<100	0.39%	56.12%	1.52%	65.02%
71-CH-24	50	41	Beef Cattle	F350	Choteau	<100	0.39%	56.51%	0.97%	44.49%
72-MS-20	50	42	Beef Cattle	F433	Missouri	<100	0.39%	56.90%	1.52%	70.30%
73-MS-21	50	41	Beef Cattle	F464	Missouri	<100	0.39%	57.29%	1.52%	71.82%
74-MS-22	100	52	Beef Cattle	F465	Missouri	100-200	0.39%	57.68%	1.52%	73.34%
75-CH-25	49	44	Beef Cattle	F21	Choteau	<100	0.38%	58.06%	0.95%	45.44%
76-CH-26	95	51	Beef Cattle	F268	Choteau	100-200	0.37%	58.43%	0.92%	46.36%
77-CH-27	45	37	Beef Cattle	F229	Choteau	<100	0.35%	58.78%	0.87%	47.23%
78-SN-5	85	43	Beef Cattle	F76	Snatch	100-200	0.33%	59.11%	5.95%	63.59%
79-CH-28	42	39	Beef Cattle	F12	Choteau	<100	0.33%	59.44%	0.81%	48.05%
80-SN-6	42	39	Beef Cattle	F57	Snatch	<100	0.33%	59.77%	5.88%	69.47%
81-EM-23	42	37	Beef Cattle	F71	Emanuel	<100	0.33%	60.10%	1.28%	66.30%
82-MS-23	42	39	Beef Cattle	F77	Missouri	<100	0.33%	60.43%	1.28%	74.62%
83-CH-29	42	39	Beef Cattle	F83	Choteau	<100	0.33%	60.75%	0.81%	48.86%
84-CH-30	42	39	Beef Cattle	F85	Choteau	<100	0.33%	61.08%	0.81%	49.67%
85-CH-31	42	37	Beef Cattle	F238	Choteau	<100	0.33%	61.41%	0.81%	50.49%
86-CH-32	42	39	Beef Cattle	F260	Choteau	<100	0.33%	61.74%	0.81%	51.30%
87-EM-24	42	38	Beef Cattle	F401	Emanuel	<100	0.33%	62.06%	1.28%	67.58%
88-EM-25	42	39	Beef Cattle	F448	Emanuel	<100	0.33%	62.39%	1.28%	68.85%
89-MS-24	208	63	Beef Cattle	F33	Missouri	300-500	0.32%	62.72%	1.27%	75.88%
90-EM-26	83	46	Beef Cattle	F91	Emanuel	100-200	0.32%	63.04%	1.26%	70.11%
91-SN-7	83	48	Beef Cattle	F329	Snatch	100-200	0.32%	63.37%	5.81%	75.28%
92-MS-25	83	48	Beef Cattle	F472	Missouri	100-200	0.32%	63.69%	1.26%	77.14%
93-CH-33	39	46	Dairy Cattle	F100	Choteau	<100	0.30%	63.99%	0.76%	52.06%
94-CH-34	38	35	Beef Cattle	F230	Choteau	<100	0.30%	64.29%	0.74%	52.79%
95-CH-35	38	35	Beef Cattle	F273	Choteau	<100	0.30%	64.59%	0.74%	53.53%
96-EM-27	190	61	Beef Cattle	F277	Emanuel	300-500	0.30%	64.88%	1.15%	71.27%
97-EM-28	75	48	Beef Cattle	F343	Emanuel	100-200	0.29%	65.18%	1.14%	72.41%
98-CH-36	72	48	Beef Cattle	F251	Choteau	100-200	0.28%	65.46%	0.70%	54.23%
99-EM-29	108	53	Beef Cattle	F408	Emanuel	200-300	0.28%	65.74%	1.09%	73.50%
100-MS-26	341	64	Beef Cattle	F40	Missouri	>500	0.27%	66.01%	1.04%	78.18%
101-MS-27	100	51	Beef Cattle	F375	Missouri	200-300	0.26%	66.27%	1.01%	79.20%
102-EM-30	333	68	Beef Cattle	F384	Emanuel	>500	0.26%	66.53%	1.01%	74.51%
103-SN-8	33	35	Beef Cattle	F48	Snatch	<100	0.26%	66.78%	4.62%	79.90%
104-CH-37	32	32	Beef Cattle	F299	Choteau	<100	0.25%	67.03%	0.62%	54.85%
105-EM-31	158	59	Beef Cattle	F396	Emanuel	300-500	0.25%	67.28%	0.96%	75.47%
106-EM-32	63	44	Beef Cattle	F59	Emanuel	100-200	0.25%	67.53%	0.96%	76.43%
107-CH-38	63	45	Beef Cattle	F139	Choteau	100-200	0.25%	67.77%	0.61%	55.46%
108-CH-39	63	44	Beef Cattle	F146	Choteau	100-200	0.25%	68.02%	0.61%	56.07%
109-CH-40	315	60	Beef Cattle	F188	Choteau	>500	0.25%	68.26%	0.61%	56.68%

110-MS-28	63	44	Beef Cattle	F493	Missouri	100-200	0.25%	68.51%	0.96%	80.15%
111-MS-29	305	52	Beef Cattle	F310	Missouri	>500	0.24%	68.75%	0.93%	81.08%
112-CH-41	89	48	Beef Cattle	F240	Choteau	200-300	0.23%	68.98%	0.57%	57.25%
113-CH-42	59	50	Dairy Cattle	F267	Choteau	100-200	0.23%	69.21%	0.57%	57.82%
114-CH-43	146	57	Beef Cattle	F61	Choteau	300-500	0.23%	69.44%	0.57%	58.39%
115-CH-44	58	43	Beef Cattle	F317	Choteau	100-200	0.23%	69.66%	0.56%	58.95%
116-MS-30	84	47	Beef Cattle	F30	Missouri	200-300	0.22%	69.88%	0.85%	81.93%
117-CH-45	83	48	Beef Cattle	F89	Choteau	200-300	0.22%	70.10%	0.54%	59.49%
118-CH-46	274	55	Beef Cattle	F295	Choteau	>500	0.21%	70.31%	0.53%	60.02%
119-CH-47	79	49	Beef Cattle	F243	Choteau	200-300	0.21%	70.52%	0.51%	60.53%
120-EM-33	78	53	Dairy Cattle	F208	Emanuel	200-300	0.20%	70.72%	0.79%	77.22%
121-CH-48	254	64	Beef Cattle	F132	Choteau	>500	0.20%	70.92%	0.49%	61.02%
122-CH-49	127	53	Beef Cattle	F259	Choteau	300-500	0.20%	71.12%	0.49%	61.51%
123-CH-50	254	62	Beef Cattle	F266	Choteau	>500	0.20%	71.32%	0.49%	62.00%
124-CH-51	251	74	Dairy Cattle	F179	Choteau	>500	0.20%	71.51%	0.49%	62.49%
125-EM-34	25	33	Beef Cattle	F72	Emanuel	<100	0.20%	71.71%	0.76%	77.98%
126-CH-52	125	55	Beef Cattle	F158	Choteau	300-500	0.20%	71.90%	0.48%	62.97%
127-CH-53	250	65	Beef Cattle	F174	Choteau	>500	0.20%	72.10%	0.48%	63.46%
128-SL-3	125	54	Beef Cattle	F184	Slaughter	300-500	0.20%	72.29%	7.06%	43.39%
129-CH-54	25	32	Beef Cattle	F203	Choteau	<100	0.20%	72.49%	0.48%	63.94%
130-CH-55	50	40	Beef Cattle	F280	Choteau	100-200	0.20%	72.68%	0.48%	64.43%
131-EM-35	50	41	Beef Cattle	F336	Emanuel	100-200	0.20%	72.88%	0.76%	78.74%
132-EM-36	50	41	Beef Cattle	F342	Emanuel	100-200	0.20%	73.07%	0.76%	79.50%
133-EM-37	25	31	Beef Cattle	F406	Emanuel	<100	0.20%	73.27%	0.76%	80.26%
134-CH-56	25	31	Beef Cattle	F462	Choteau	<100	0.20%	73.46%	0.48%	64.91%
135-CH-57	23	39	Dairy Cattle	F109	Choteau	<100	0.18%	73.64%	0.45%	65.36%
136-CH-58	229	63	Beef Cattle	F106	Choteau	>500	0.18%	73.82%	0.44%	65.80%
137-CH-59	67	44	Beef Cattle	F237	Choteau	200-300	0.17%	74.00%	0.43%	66.23%
138-EM-38	67	45	Beef Cattle	F338	Emanuel	200-300	0.17%	74.17%	0.68%	80.94%
139-EM-39	67	45	Beef Cattle	F363	Emanuel	200-300	0.17%	74.35%	0.68%	81.62%
140-CH-60	42	40	Beef Cattle	F16	Choteau	100-200	0.16%	74.51%	0.41%	66.64%
141-CH-61	42	39	Beef Cattle	F20	Choteau	100-200	0.16%	74.67%	0.41%	67.05%
142-MS-31	21	29	Beef Cattle	F43	Missouri	<100	0.16%	74.84%	0.64%	82.57%
143-CH-62	42	39	Beef Cattle	F67	Choteau	100-200	0.16%	75.00%	0.41%	67.45%
144-EM-40	42	40	Beef Cattle	F70	Emanuel	100-200	0.16%	75.16%	0.64%	82.25%
145-CH-63	42	40	Beef Cattle	F81	Choteau	100-200	0.16%	75.33%	0.41%	67.86%
146-EM-41	63	43	Beef Cattle	F92	Emanuel	200-300	0.16%	75.49%	0.64%	82.89%
147-EM-42	42	38	Beef Cattle	F95	Emanuel	100-200	0.16%	75.66%	0.64%	83.53%
148-EM-43	42	37	Beef Cattle	F177	Emanuel	100-200	0.16%	75.82%	0.64%	84.17%
149-CH-64	21	29	Beef Cattle	F221	Choteau	<100	0.16%	75.98%	0.41%	68.27%
150-CH-65	63	45	Beef Cattle	F239	Choteau	200-300	0.16%	76.15%	0.41%	68.67%
151-CH-66	63	44	Beef Cattle	F274	Choteau	200-300	0.16%	76.31%	0.41%	69.08%
152-SN-9	42	39	Beef Cattle	F332	Snatch	100-200	0.16%	76.48%	2.94%	82.84%
153-CH-67	42	39	Beef Cattle	F348	Choteau	100-200	0.16%	76.64%	0.41%	69.49%
154-CH-68	21	29	Beef Cattle	F372	Choteau	<100	0.16%	76.80%	0.41%	69.89%
155-EM-44	21	28	Beef Cattle	F399	Emanuel	<100	0.16%	76.97%	0.64%	84.81%
156-MS-32	21	28	Beef Cattle	F439	Missouri	<100	0.16%	77.13%	0.64%	83.21%
157-MS-33	21	29	Beef Cattle	F452	Missouri	<100	0.16%	77.30%	0.64%	83.85%
158-CH-69	21	29	Beef Cattle	F461	Choteau	<100	0.16%	77.46%	0.41%	70.30%
159-SL-4	63	44	Beef Cattle	F487	Slaughter	200-300	0.16%	77.62%	5.93%	49.32%
160-SL-5	42	38	Beef Cattle	F497	Slaughter	100-200	0.16%	77.79%	5.93%	55.25%
161-CH-70	209	60	Beef Cattle	F129	Choteau	>500	0.16%	77.95%	0.40%	70.71%
162-EM-45	104	52	Beef Cattle	F58	Emanuel	300-500	0.16%	78.11%	0.63%	85.44%
163-MS-34	208	61	Beef Cattle	F161	Missouri	>500	0.16%	78.28%	0.63%	84.48%
164-EM-46	100	51	Beef Cattle	F412	Emanuel	300-500	0.16%	78.43%	0.61%	86.05%
165-CH-71	58	43	Beef Cattle	F275	Choteau	200-300	0.15%	78.58%	0.37%	71.08%
166-CH-72	190	59	Beef Cattle	F264	Choteau	>500	0.15%	78.73%	0.37%	71.45%

167-CH-73	57	40	Beef Cattle	F276	Choteau	200-300	0.15%	78.88%	0.37%	71.82%
168-MS-35	188	55	Dairy Cattle	F39	Missouri	>500	0.15%	79.03%	0.57%	85.06%
169-MS-36	92	50	Beef Cattle	F376	Missouri	300-500	0.14%	79.17%	0.56%	85.62%
170-MS-37	92	50	Beef Cattle	F485	Missouri	300-500	0.14%	79.31%	0.56%	86.18%
171-MS-38	183	61	Beef Cattle	F311	Missouri	>500	0.14%	79.46%	0.56%	86.73%
172-CH-74	177	60	Beef Cattle	F114	Choteau	>500	0.14%	79.60%	0.34%	72.16%
173-CH-75	86	43	Beef Cattle	F199	Choteau	300-500	0.13%	79.73%	0.33%	72.49%
174-CH-76	171	43	Beef Cattle	F253	Choteau	>500	0.13%	79.86%	0.33%	72.82%
175-CH-77	17	26	Beef Cattle	F195	Choteau	<100	0.13%	80.00%	0.33%	73.15%
176-EM-47	170	53	Beef Cattle	F202	Emanuel	>500	0.13%	80.13%	0.52%	86.56%
177-CH-78	17	25	Beef Cattle	F373	Choteau	<100	0.13%	80.26%	0.33%	73.48%
178-EM-48	17	26	Beef Cattle	F400	Emanuel	<100	0.13%	80.39%	0.52%	87.08%
179-CH-79	167	58	Beef Cattle	F9	Choteau	>500	0.13%	80.52%	0.32%	73.81%
180-MS-39	167	59	Beef Cattle	F46	Missouri	>500	0.13%	80.65%	0.51%	87.24%
181-CH-80	167	58	Beef Cattle	F86	Choteau	>500	0.13%	80.78%	0.32%	74.13%
182-CH-81	167	59	Beef Cattle	F201	Choteau	>500	0.13%	80.92%	0.32%	74.45%
183-SL-6	167	59	Beef Cattle	F424	Slaughter	>500	0.13%	81.05%	4.72%	59.96%
184-MS-40	167	59	Beef Cattle	F489	Missouri	>500	0.13%	81.18%	0.51%	87.75%
185-EM-49	83	48	Beef Cattle	F74	Emanuel	300-500	0.13%	81.31%	0.50%	87.58%
186-CH-82	83	48	Beef Cattle	F84	Choteau	300-500	0.13%	81.44%	0.32%	74.77%
187-CH-83	83	48	Beef Cattle	F148	Choteau	300-500	0.13%	81.56%	0.32%	75.10%
188-CH-84	83	50	Beef Cattle	F207	Choteau	300-500	0.13%	81.69%	0.32%	75.42%
189-CH-85	83	49	Beef Cattle	F254	Choteau	300-500	0.13%	81.82%	0.32%	75.74%
190-EM-50	83	48	Beef Cattle	F450	Emanuel	300-500	0.13%	81.95%	0.50%	88.09%
191-MS-41	33	35	Beef Cattle	F63	Missouri	100-200	0.13%	82.08%	0.50%	88.25%
192-CH-86	165	54	Beef Cattle	F154	Choteau	>500	0.13%	82.21%	0.32%	76.06%
193-CH-87	165	57	Beef Cattle	F315	Choteau	>500	0.13%	82.34%	0.32%	76.38%
194-EM-51	33	35	Beef Cattle	F337	Emanuel	100-200	0.13%	82.47%	0.50%	88.59%
195-CH-88	158	58	Beef Cattle	F7	Choteau	>500	0.12%	82.59%	0.31%	76.68%
196-MS-42	79	48	Beef Cattle	F377	Missouri	300-500	0.12%	82.72%	0.48%	88.73%
197-CH-89	78	55	Dairy Cattle	F157	Choteau	300-500	0.12%	82.84%	0.30%	76.99%
198-CH-90	78	53	Dairy Cattle	F170	Choteau	300-500	0.12%	82.96%	0.30%	77.29%
199-SL-7	156	66	Dairy Cattle	F192	Slaughter	>500	0.12%	83.08%	4.40%	64.37%
200-CH-91	31	40	Dairy Cattle	F151	Choteau	100-200	0.12%	83.20%	0.30%	77.59%
201-EM-52	155	58	Beef Cattle	F210	Emanuel	>500	0.12%	83.32%	0.47%	89.06%
202-SL-8	154	58	Beef Cattle	F423	Slaughter	>500	0.12%	83.44%	4.35%	68.72%
203-CH-92	76	49	Beef Cattle	F68	Choteau	300-500	0.12%	83.56%	0.29%	77.88%
204-CH-93	152	55	Beef Cattle	F165	Choteau	>500	0.12%	83.68%	0.29%	78.18%
205-CH-94	152	53	Beef Cattle	F173	Choteau	>500	0.12%	83.80%	0.29%	78.47%
206-CH-95	151	59	Dairy Cattle	F153	Choteau	>500	0.12%	83.92%	0.29%	78.77%
207-MS-43	151	43	Beef Cattle	F321	Missouri	>500	0.12%	84.04%	0.46%	89.19%
208-MS-44	29	34	Beef Cattle	F44	Missouri	100-200	0.11%	84.15%	0.44%	89.63%
209-SN-10	29	39	Beef Cattle	F53	Snatch	100-200	0.11%	84.26%	2.03%	84.87%
210-CH-96	141	55	Beef Cattle	F168	Choteau	>500	0.11%	84.37%	0.27%	79.04%
211-SN-11	42	37	Beef Cattle	F51	Snatch	200-300	0.11%	84.48%	1.96%	86.83%
212-EM-53	42	38	Beef Cattle	F73	Emanuel	200-300	0.11%	84.59%	0.43%	89.49%
213-CH-97	42	38	Beef Cattle	F219	Choteau	200-300	0.11%	84.70%	0.27%	79.31%
214-CH-98	140	54	Beef Cattle	F306	Choteau	>500	0.11%	84.81%	0.27%	79.58%
215-EM-54	42	38	Beef Cattle	F360	Emanuel	200-300	0.11%	84.92%	0.43%	89.91%
216-EM-55	70	55	Dairy Cattle	F374	Emanuel	300-500	0.11%	85.03%	0.43%	90.34%
217-MS-45	137	50	Beef Cattle	F41	Missouri	>500	0.11%	85.13%	0.42%	90.05%
218-MS-46	136	50	Beef Cattle	F209	Missouri	>500	0.11%	85.24%	0.41%	90.46%
219-SL-9	136	50	Beef Cattle	F490	Slaughter	>500	0.11%	85.35%	3.84%	72.56%
220-SN-12	67	50	Beef Cattle	F52	Snatch	300-500	0.10%	85.45%	1.88%	88.71%
221-SL-10	134	61	Beef Cattle	F193	Slaughter	>500	0.10%	85.56%	3.78%	76.34%
222-EM-56	67	45	Beef Cattle	F407	Emanuel	300-500	0.10%	85.66%	0.41%	90.74%
223-CH-99	130	57	Beef Cattle	F120	Choteau	>500	0.10%	85.76%	0.25%	79.83%

224-CH-100	39	44	Dairy Cattle	F172	Choteau	200-300	0.10%	85.86%	0.25%	80.08%
225-MS-47	128	49	Beef Cattle	F454	Missouri	>500	0.10%	85.96%	0.39%	90.85%
226-CH-101	127	54	Beef Cattle	F235	Choteau	>500	0.10%	86.06%	0.25%	80.33%
227-CH-102	63	51	Beef Cattle	F64	Choteau	300-500	0.10%	86.16%	0.24%	80.57%
228-CH-103	125	56	Beef Cattle	F23	Choteau	>500	0.10%	86.26%	0.24%	80.82%
229-MS-48	25	30	Beef Cattle	F499	Missouri	100-200	0.10%	86.36%	0.38%	91.23%
230-CH-104	125	52	Beef Cattle	F116	Choteau	>500	0.10%	86.45%	0.24%	81.06%
231-CH-105	125	55	Beef Cattle	F152	Choteau	>500	0.10%	86.55%	0.24%	81.30%
232-CH-106	125	52	Beef Cattle	F217	Choteau	>500	0.10%	86.65%	0.24%	81.54%
233-EM-57	125	53	Beef Cattle	F359	Emanuel	>500	0.10%	86.75%	0.38%	91.12%
234-EM-58	125	55	Beef Cattle	F364	Emanuel	>500	0.10%	86.84%	0.38%	91.50%
235-EM-59	25	31	Beef Cattle	F392	Emanuel	100-200	0.10%	86.94%	0.38%	91.88%
236-EM-60	125	55	Beef Cattle	F393	Emanuel	>500	0.10%	87.04%	0.38%	92.26%
237-EM-61	125	55	Beef Cattle	F395	Emanuel	>500	0.10%	87.14%	0.38%	92.64%
238-SL-11	125	55	Beef Cattle	F425	Slaughter	>500	0.10%	87.23%	3.53%	79.87%
239-MS-49	25	31	Beef Cattle	F438	Missouri	100-200	0.10%	87.33%	0.38%	91.61%
240-CH-107	125	55	Beef Cattle	F470	Choteau	>500	0.10%	87.43%	0.24%	81.79%
241-MS-50	125	56	Beef Cattle	F498	Missouri	>500	0.10%	87.53%	0.38%	91.99%
242-CH-108	122	43	Beef Cattle	F262	Choteau	>500	0.10%	87.62%	0.24%	82.02%
243-CH-109	121	72	Beef Cattle	F108	Choteau	>500	0.09%	87.72%	0.23%	82.26%
244-SL-12	119	48	Beef Cattle	F183	Slaughter	>500	0.09%	87.81%	3.36%	83.23%
245-CH-110	119	48	Beef Cattle	F245	Choteau	>500	0.09%	87.90%	0.23%	82.49%
246-CH-111	58	43	Beef Cattle	F349	Choteau	300-500	0.09%	87.99%	0.22%	82.71%
247-CH-112	114	52	Beef Cattle	F185	Choteau	>500	0.09%	88.08%	0.22%	82.93%
248-CH-113	33	37	Beef Cattle	F10	Choteau	200-300	0.09%	88.17%	0.21%	83.15%
249-MS-51	33	37	Beef Cattle	F49	Missouri	200-300	0.09%	88.25%	0.33%	92.33%
250-EM-62	33	35	Beef Cattle	F418	Emanuel	200-300	0.09%	88.34%	0.33%	92.98%
251-CH-114	108	55	Beef Cattle	F175	Choteau	>500	0.08%	88.42%	0.21%	83.35%
252-EM-63	108	52	Beef Cattle	F383	Emanuel	>500	0.08%	88.51%	0.33%	93.31%
253-EM-64	54	42	Beef Cattle	F403	Emanuel	300-500	0.08%	88.59%	0.33%	93.63%
254-MS-52	108	53	Beef Cattle	F440	Missouri	>500	0.08%	88.68%	0.33%	92.66%
255-CH-115	107	51	Beef Cattle	F107	Choteau	>500	0.08%	88.76%	0.21%	83.56%
256-MS-53	21	28	Beef Cattle	F28	Missouri	100-200	0.08%	88.84%	0.32%	92.98%
257-SN-13	21	28	Beef Cattle	F36	Snatch	100-200	0.08%	88.92%	1.47%	90.18%
258-MS-54	21	28	Beef Cattle	F42	Missouri	100-200	0.08%	89.01%	0.32%	93.29%
259-SN-14	21	28	Beef Cattle	F54	Snatch	100-200	0.08%	89.09%	1.47%	91.65%
260-CH-116	105	62	Dairy Cattle	F124	Choteau	>500	0.08%	89.17%	0.20%	83.76%
261-CH-117	105	50	Beef Cattle	F181	Choteau	>500	0.08%	89.25%	0.20%	83.97%
262-CH-118	105	54	Beef Cattle	F242	Choteau	>500	0.08%	89.33%	0.20%	84.17%
263-EM-65	21	28	Beef Cattle	F447	Emanuel	100-200	0.08%	89.42%	0.32%	93.95%
264-CH-119	104	49	Beef Cattle	F14	Choteau	>500	0.08%	89.50%	0.20%	84.37%
265-CH-120	104	51	Beef Cattle	F223	Choteau	>500	0.08%	89.58%	0.20%	84.57%
266-MS-55	104	52	Beef Cattle	F381	Missouri	>500	0.08%	89.66%	0.32%	93.61%
267-EM-66	104	54	Beef Cattle	F414	Emanuel	>500	0.08%	89.74%	0.32%	94.27%
268-CH-121	104	52	Beef Cattle	F469	Choteau	>500	0.08%	89.82%	0.20%	84.78%
269-CH-122	31	42	Dairy Cattle	F291	Choteau	200-300	0.08%	89.90%	0.20%	84.98%
270-CH-123	103	46	Beef Cattle	F283	Choteau	>500	0.08%	89.98%	0.20%	85.18%
271-CH-124	100	52	Beef Cattle	F261	Choteau	>500	0.08%	90.06%	0.19%	85.37%
272-MS-56	100	51	Beef Cattle	F394	Missouri	>500	0.08%	90.14%	0.30%	93.92%
273-CH-125	100	51	Beef Cattle	F431	Choteau	>500	0.08%	90.22%	0.19%	85.56%
274-MS-57	50	41	Beef Cattle	F437	Missouri	300-500	0.08%	90.30%	0.30%	94.22%
275-CH-126	98	50	Beef Cattle	F164	Choteau	>500	0.08%	90.37%	0.19%	85.75%
276-CH-127	98	51	Beef Cattle	F294	Choteau	>500	0.08%	90.45%	0.19%	85.94%
277-CH-128	96	51	Beef Cattle	F284	Choteau	>500	0.07%	90.52%	0.19%	86.13%
278-CH-129	95	50	Beef Cattle	F118	Choteau	>500	0.07%	90.60%	0.18%	86.31%
279-CH-130	95	50	Beef Cattle	F155	Choteau	>500	0.07%	90.67%	0.18%	86.50%
280-CH-131	95	47	Beef Cattle	F269	Choteau	>500	0.07%	90.75%	0.18%	86.68%

281-EM-67	47	43	Beef Cattle	F69	Emanuel	300-500	0.07%	90.82%	0.29%	94.55%
282-SL-13	94	44	Beef Cattle	F191	Slaughter	>500	0.07%	90.89%	2.65%	85.88%
283-CH-132	94	50	Beef Cattle	F204	Choteau	>500	0.07%	90.97%	0.18%	86.86%
284-MS-58	94	44	Beef Cattle	F308	Missouri	>500	0.07%	91.04%	0.29%	94.51%
285-CH-133	92	58	Dairy Cattle	F198	Choteau	>500	0.07%	91.11%	0.18%	87.04%
286-CH-134	90	53	Beef Cattle	F11	Choteau	>500	0.07%	91.18%	0.17%	87.22%
287-CH-135	90	51	Beef Cattle	F130	Choteau	>500	0.07%	91.25%	0.17%	87.39%
288-CH-136	45	42	Beef Cattle	F150	Choteau	300-500	0.07%	91.32%	0.17%	87.56%
289-CH-137	86	43	Beef Cattle	F215	Choteau	>500	0.07%	91.39%	0.17%	87.73%
290-CH-138	85	43	Beef Cattle	F137	Choteau	>500	0.07%	91.46%	0.16%	87.90%
291-CH-139	85	43	Beef Cattle	F309	Choteau	>500	0.07%	91.52%	0.16%	88.06%
292-EM-68	17	26	Beef Cattle	F368	Emanuel	100-200	0.07%	91.59%	0.26%	94.81%
293-CH-140	42	38	Beef Cattle	F90	Choteau	300-500	0.07%	91.65%	0.16%	88.22%
294-CH-141	84	48	Beef Cattle	F104	Choteau	>500	0.07%	91.72%	0.16%	88.39%
295-CH-142	42	39	Beef Cattle	F111	Choteau	300-500	0.07%	91.79%	0.16%	88.55%
296-MS-59	42	38	Beef Cattle	F386	Missouri	300-500	0.07%	91.85%	0.26%	94.76%
297-EM-69	42	38	Beef Cattle	F397	Emanuel	300-500	0.07%	91.92%	0.26%	95.07%
298-SL-14	84	46	Beef Cattle	F430	Slaughter	>500	0.07%	91.98%	2.37%	88.25%
299-MS-60	42	38	Beef Cattle	F441	Missouri	300-500	0.07%	92.05%	0.26%	95.02%
300-MS-61	42	38	Beef Cattle	F449	Missouri	300-500	0.07%	92.11%	0.26%	95.27%
301-EM-70	25	31	Beef Cattle	F357	Emanuel	200-300	0.07%	92.18%	0.25%	95.32%
302-SN-15	83	49	Beef Cattle	F38	Snatch	>500	0.06%	92.24%	1.16%	92.82%
303-CH-143	83	47	Beef Cattle	F119	Choteau	>500	0.06%	92.31%	0.16%	88.71%
304-CH-144	83	58	Dairy Cattle	F134	Choteau	>500	0.06%	92.37%	0.16%	88.87%
305-CH-145	83	47	Beef Cattle	F136	Choteau	>500	0.06%	92.44%	0.16%	89.03%
306-CH-146	83	47	Beef Cattle	F142	Choteau	>500	0.06%	92.50%	0.16%	89.19%
307-CH-147	83	49	Beef Cattle	F171	Choteau	>500	0.06%	92.57%	0.16%	89.35%
308-CH-148	83	48	Beef Cattle	F180	Choteau	>500	0.06%	92.63%	0.16%	89.51%
309-CH-149	83	48	Beef Cattle	F186	Choteau	>500	0.06%	92.70%	0.16%	89.67%
310-SL-15	83	49	Beef Cattle	F197	Slaughter	>500	0.06%	92.76%	2.34%	90.60%
311-CH-150	83	49	Beef Cattle	F216	Choteau	>500	0.06%	92.83%	0.16%	89.83%
312-CH-151	83	50	Beef Cattle	F289	Choteau	>500	0.06%	92.89%	0.16%	90.00%
313-CH-152	83	49	Beef Cattle	F316	Choteau	>500	0.06%	92.96%	0.16%	90.16%
314-CH-153	83	49	Beef Cattle	F319	Choteau	>500	0.06%	93.02%	0.16%	90.32%
315-CH-154	83	48	Beef Cattle	F351	Choteau	>500	0.06%	93.09%	0.16%	90.48%
316-EM-71	83	48	Beef Cattle	F352	Emanuel	>500	0.06%	93.15%	0.25%	95.57%
317-MS-62	83	48	Beef Cattle	F378	Missouri	>500	0.06%	93.22%	0.25%	95.52%
318-MS-63	83	49	Beef Cattle	F435	Missouri	>500	0.06%	93.28%	0.25%	95.78%
319-EM-72	83	50	Beef Cattle	F446	Emanuel	>500	0.06%	93.35%	0.25%	95.83%
320-MS-64	83	50	Beef Cattle	F453	Missouri	>500	0.06%	93.41%	0.25%	96.03%
321-MS-65	83	48	Beef Cattle	F488	Missouri	>500	0.06%	93.47%	0.25%	96.28%
322-MS-66	83	49	Beef Cattle	F494	Missouri	>500	0.06%	93.54%	0.25%	96.53%
323-EM-73	82	50	Beef Cattle	F3	Emanuel	>500	0.06%	93.60%	0.25%	96.07%
324-EM-74	16	31	Dairy Cattle	F460	Emanuel	100-200	0.06%	93.67%	0.24%	96.32%
325-CH-155	79	48	Beef Cattle	F270	Choteau	>500	0.06%	93.73%	0.15%	90.63%
326-CH-156	77	46	Beef Cattle	F200	Choteau	>500	0.06%	93.79%	0.15%	90.78%
327-CH-157	76	45	Beef Cattle	F105	Choteau	>500	0.06%	93.85%	0.15%	90.93%
328-CH-158	76	47	Beef Cattle	F227	Choteau	>500	0.06%	93.91%	0.15%	91.07%
329-CH-159	76	45	Beef Cattle	F297	Choteau	>500	0.06%	93.97%	0.15%	91.22%
330-EM-75	38	36	Beef Cattle	F417	Emanuel	300-500	0.06%	94.03%	0.23%	96.55%
331-CH-160	75	47	Beef Cattle	F293	Choteau	>500	0.06%	94.08%	0.15%	91.37%
332-CH-161	75	47	Beef Cattle	F302	Choteau	>500	0.06%	94.14%	0.15%	91.51%
333-MS-67	75	47	Beef Cattle	F325	Missouri	>500	0.06%	94.20%	0.23%	96.76%
334-SN-16	75	47	Beef Cattle	F327	Snatch	>500	0.06%	94.26%	1.05%	93.87%
335-EM-76	75	46	Beef Cattle	F356	Emanuel	>500	0.06%	94.32%	0.23%	96.78%
336-SL-16	75	47	Beef Cattle	F427	Slaughter	>500	0.06%	94.38%	2.12%	92.72%
337-EM-77	75	47	Beef Cattle	F458	Emanuel	>500	0.06%	94.44%	0.23%	97.00%

338-CH-162	71	46	Beef Cattle	F8	Choteau	>500	0.06%	94.49%	0.14%	91.65%
339-CH-163	71	47	Beef Cattle	F131	Choteau	>500	0.06%	94.55%	0.14%	91.79%
340-CH-164	71	47	Beef Cattle	F214	Choteau	>500	0.06%	94.60%	0.14%	91.92%
341-EM-78	21	28	Beef Cattle	F398	Emanuel	200-300	0.05%	94.66%	0.21%	97.22%
342-EM-79	21	28	Beef Cattle	F411	Emanuel	200-300	0.05%	94.71%	0.21%	97.43%
343-CH-165	68	47	Beef Cattle	F2	Choteau	>500	0.05%	94.76%	0.13%	92.06%
344-CH-166	67	45	Beef Cattle	F87	Choteau	>500	0.05%	94.82%	0.13%	92.19%
345-CH-167	67	46	Beef Cattle	F125	Choteau	>500	0.05%	94.87%	0.13%	92.32%
346-CH-168	67	46	Beef Cattle	F232	Choteau	>500	0.05%	94.92%	0.13%	92.45%
347-CH-169	67	45	Beef Cattle	F320	Choteau	>500	0.05%	94.97%	0.13%	92.58%
348-CH-170	67	45	Beef Cattle	F421	Choteau	>500	0.05%	95.03%	0.13%	92.71%
349-CH-171	67	45	Beef Cattle	F463	Choteau	>500	0.05%	95.08%	0.13%	92.84%
350-CH-172	33	35	Beef Cattle	F22	Choteau	300-500	0.05%	95.13%	0.13%	92.96%
351-CH-173	66	53	Dairy Cattle	F225	Choteau	>500	0.05%	95.18%	0.13%	93.09%
352-SL-17	65	43	Beef Cattle	F194	Slaughter	>500	0.05%	95.23%	1.84%	94.55%
353-EM-80	13	21	Horse	F420	Emanuel	100-200	0.05%	95.28%	0.20%	97.63%
354-CH-174	64	46	Beef Cattle	F123	Choteau	>500	0.05%	95.33%	0.12%	93.21%
355-SN-17	63	43	Beef Cattle	F37	Snatch	>500	0.05%	95.38%	0.88%	94.75%
356-CH-175	63	44	Beef Cattle	F88	Choteau	>500	0.05%	95.43%	0.12%	93.34%
357-CH-176	63	46	Beef Cattle	F102	Choteau	>500	0.05%	95.48%	0.12%	93.46%
358-CH-177	63	45	Beef Cattle	F122	Choteau	>500	0.05%	95.53%	0.12%	93.58%
359-CH-178	63	43	Beef Cattle	F140	Choteau	>500	0.05%	95.58%	0.12%	93.70%
360-CH-179	63	44	Beef Cattle	F144	Choteau	>500	0.05%	95.63%	0.12%	93.83%
361-CH-180	63	45	Beef Cattle	F145	Choteau	>500	0.05%	95.68%	0.12%	93.95%
362-CH-181	63	45	Beef Cattle	F156	Choteau	>500	0.05%	95.73%	0.12%	94.07%
363-CH-182	63	42	Beef Cattle	F222	Choteau	>500	0.05%	95.77%	0.12%	94.19%
364-CH-183	63	42	Beef Cattle	F226	Choteau	>500	0.05%	95.82%	0.12%	94.31%
365-CH-184	63	45	Beef Cattle	F234	Choteau	>500	0.05%	95.87%	0.12%	94.44%
366-CH-185	63	42	Beef Cattle	F246	Choteau	>500	0.05%	95.92%	0.12%	94.56%
367-CH-186	63	44	Beef Cattle	F255	Choteau	>500	0.05%	95.97%	0.12%	94.68%
368-CH-187	63	46	Beef Cattle	F279	Choteau	>500	0.05%	96.02%	0.12%	94.80%
369-CH-188	63	44	Beef Cattle	F346	Choteau	>500	0.05%	96.07%	0.12%	94.92%
370-EM-81	63	43	Beef Cattle	F369	Emanuel	>500	0.05%	96.12%	0.19%	97.82%
371-SN-18	63	44	Beef Cattle	F388	Snatch	>500	0.05%	96.17%	0.88%	95.63%
372-CH-189	63	44	Beef Cattle	F428	Choteau	>500	0.05%	96.22%	0.12%	95.05%
373-SL-18	63	44	Beef Cattle	F496	Slaughter	>500	0.05%	96.27%	1.78%	96.33%
374-CH-190	62	46	Beef Cattle	F19	Choteau	>500	0.05%	96.32%	0.12%	95.17%
375-CH-191	59	42	Beef Cattle	F233	Choteau	>500	0.05%	96.36%	0.11%	95.28%
376-CH-192	58	43	Beef Cattle	F167	Choteau	>500	0.05%	96.41%	0.11%	95.39%
377-MS-68	29	33	Beef Cattle	F380	Missouri	300-500	0.05%	96.45%	0.18%	96.94%
378-SN-19	58	43	Beef Cattle	F391	Snatch	>500	0.05%	96.50%	0.81%	96.44%
379-EM-82	29	33	Beef Cattle	F415	Emanuel	300-500	0.05%	96.54%	0.18%	97.99%
380-MS-69	29	33	Beef Cattle	F483	Missouri	300-500	0.05%	96.59%	0.18%	97.12%
381-CH-193	57	34	Pig	F141	Choteau	>500	0.04%	96.63%	0.11%	95.50%
382-EM-83	54	41	Beef Cattle	F278	Emanuel	>500	0.04%	96.67%	0.16%	98.16%
383-EM-84	54	42	Beef Cattle	F361	Emanuel	>500	0.04%	96.72%	0.16%	98.32%
384-MS-70	54	42	Beef Cattle	F451	Missouri	>500	0.04%	96.76%	0.16%	97.28%
385-CH-194	51	41	Beef Cattle	F121	Choteau	>500	0.04%	96.80%	0.10%	95.60%
386-CH-195	50	50	Beef Cattle	F6	Choteau	>500	0.04%	96.84%	0.10%	95.70%
387-CH-196	50	41	Beef Cattle	F143	Choteau	>500	0.04%	96.88%	0.10%	95.80%
388-EM-85	50	44	Beef Cattle	F206	Emanuel	>500	0.04%	96.92%	0.15%	98.47%
389-CH-197	50	42	Beef Cattle	F252	Choteau	>500	0.04%	96.95%	0.10%	95.89%
390-CH-198	25	31	Beef Cattle	F265	Choteau	300-500	0.04%	96.99%	0.10%	95.99%
391-CH-199	50	41	Beef Cattle	F290	Choteau	>500	0.04%	97.03%	0.10%	96.09%
392-CH-200	50	42	Beef Cattle	F305	Choteau	>500	0.04%	97.07%	0.10%	96.18%
393-CH-201	50	41	Beef Cattle	F347	Choteau	>500	0.04%	97.11%	0.10%	96.28%
394-EM-86	50	40	Beef Cattle	F370	Emanuel	>500	0.04%	97.15%	0.15%	98.63%

395-MS-71	50	42	Beef Cattle	F410	Missouri	>500	0.04%	97.19%	0.15%	97.43%
396-EM-87	50	41	Beef Cattle	F413	Emanuel	>500	0.04%	97.23%	0.15%	98.78%
397-CH-202	50	41	Beef Cattle	F416	Choteau	>500	0.04%	97.27%	0.10%	96.38%
398-CH-203	50	41	Beef Cattle	F455	Choteau	>500	0.04%	97.31%	0.10%	96.47%
399-EM-88	50	42	Beef Cattle	F459	Emanuel	>500	0.04%	97.34%	0.15%	98.93%
400-EM-89	25	31	Beef Cattle	F478	Emanuel	300-500	0.04%	97.38%	0.15%	99.08%
401-MS-72	50	41	Beef Cattle	F482	Missouri	>500	0.04%	97.42%	0.15%	97.58%
402-CH-204	49	43	Beef Cattle	F101	Choteau	>500	0.04%	97.46%	0.09%	96.57%
403-CH-205	47	47	Dairy Cattle	F241	Choteau	>500	0.04%	97.50%	0.09%	96.66%
404-CH-206	47	48	Dairy Cattle	F456	Choteau	>500	0.04%	97.53%	0.09%	96.75%
405-CH-207	14	23	Horse	F288	Choteau	200-300	0.04%	97.57%	0.09%	96.84%
406-EM-90	46	55	Dairy Cattle	F205	Emanuel	>500	0.04%	97.61%	0.14%	99.22%
407-CH-208	45	38	Horse	F15	Choteau	>500	0.04%	97.64%	0.09%	96.93%
408-CH-209	45	41	Beef Cattle	F220	Choteau	>500	0.04%	97.68%	0.09%	97.01%
409-CH-210	44	37	Beef Cattle	F282	Choteau	>500	0.03%	97.71%	0.09%	97.10%
410-CH-211	43	46	Dairy Cattle	F286	Choteau	>500	0.03%	97.75%	0.08%	97.18%
411-CH-212	42	39	Beef Cattle	F5	Choteau	>500	0.03%	97.78%	0.08%	97.26%
412-CH-213	42	37	Beef Cattle	F18	Choteau	>500	0.03%	97.81%	0.08%	97.35%
413-CH-214	42	39	Beef Cattle	F24	Choteau	>500	0.03%	97.84%	0.08%	97.43%
414-MS-73	42	39	Beef Cattle	F29	Missouri	>500	0.03%	97.88%	0.13%	97.71%
415-MS-74	42	39	Beef Cattle	F32	Missouri	>500	0.03%	97.91%	0.13%	97.84%
416-MS-75	42	38	Beef Cattle	F502	Missouri	>500	0.03%	97.94%	0.13%	97.97%
417-EM-91	42	38	Beef Cattle	F60	Emanuel	>500	0.03%	97.97%	0.13%	99.35%
418-CH-215	42	39	Beef Cattle	F62	Choteau	>500	0.03%	98.01%	0.08%	97.51%
419-CH-216	42	37	Beef Cattle	F65	Choteau	>500	0.03%	98.04%	0.08%	97.59%
420-CH-217	42	39	Beef Cattle	F127	Choteau	>500	0.03%	98.07%	0.08%	97.67%
421-CH-218	42	38	Beef Cattle	F176	Choteau	>500	0.03%	98.11%	0.08%	97.75%
422-CH-219	42	38	Beef Cattle	F218	Choteau	>500	0.03%	98.14%	0.08%	97.83%
423-CH-220	42	40	Beef Cattle	F231	Choteau	>500	0.03%	98.17%	0.08%	97.92%
424-CH-221	42	39	Beef Cattle	F247	Choteau	>500	0.03%	98.20%	0.08%	98.00%
425-CH-222	42	38	Beef Cattle	F271	Choteau	>500	0.03%	98.24%	0.08%	98.08%
426-CH-223	42	39	Beef Cattle	F300	Choteau	>500	0.03%	98.27%	0.08%	98.16%
427-CH-224	42	38	Beef Cattle	F301	Choteau	>500	0.03%	98.30%	0.08%	98.24%
428-SN-20	42	39	Beef Cattle	F328	Snatch	>500	0.03%	98.34%	0.59%	97.03%
429-SN-21	42	38	Beef Cattle	F331	Snatch	>500	0.03%	98.37%	0.59%	97.62%
430-SN-22	42	38	Beef Cattle	F365	Snatch	>500	0.03%	98.40%	0.59%	98.21%
431-EM-92	42	37	Beef Cattle	F402	Emanuel	>500	0.03%	98.43%	0.13%	99.48%
432-EM-93	42	39	Beef Cattle	F405	Emanuel	>500	0.03%	98.47%	0.13%	99.60%
433-CH-225	42	39	Beef Cattle	F457	Choteau	>500	0.03%	98.50%	0.08%	98.32%
434-CH-226	42	38	Beef Cattle	F471	Choteau	>500	0.03%	98.53%	0.08%	98.40%
435-MS-76	42	38	Beef Cattle	F475	Missouri	>500	0.03%	98.57%	0.13%	98.10%
436-MS-77	42	38	Beef Cattle	F476	Missouri	>500	0.03%	98.60%	0.13%	98.22%
437-EM-94	42	38	Beef Cattle	F479	Emanuel	>500	0.03%	98.63%	0.13%	99.73%
438-MS-78	21	28	Beef Cattle	F484	Missouri	300-500	0.03%	98.66%	0.13%	98.35%
439-MS-79	42	38	Beef Cattle	F486	Missouri	>500	0.03%	98.70%	0.13%	98.48%
440-MS-80	42	38	Beef Cattle	F495	Missouri	>500	0.03%	98.73%	0.13%	98.61%
441-CH-227	41	46	Dairy Cattle	F13	Choteau	>500	0.03%	98.76%	0.08%	98.48%
442-MS-81	40	35	Beef Cattle	F34	Missouri	>500	0.03%	98.79%	0.12%	98.73%
443-EM-95	12	13	Pig	F178	Emanuel	200-300	0.03%	98.82%	0.12%	99.85%
444-MS-82	39	46	Dairy Cattle	F31	Missouri	>500	0.03%	98.85%	0.12%	98.85%
445-CH-228	39	44	Dairy Cattle	F117	Choteau	>500	0.03%	98.88%	0.08%	98.56%
446-MS-83	39	44	Dairy Cattle	F160	Missouri	>500	0.03%	98.91%	0.12%	98.97%
447-CH-229	38	37	Beef Cattle	F281	Choteau	>500	0.03%	98.94%	0.07%	98.63%
448-EM-96	38	36	Beef Cattle	F362	Emanuel	>500	0.03%	98.97%	0.12%	99.97%
449-CH-230	33	35	Beef Cattle	F1	Choteau	>500	0.03%	99.00%	0.06%	98.70%
450-CH-231	33	35	Beef Cattle	F4	Choteau	>500	0.03%	99.03%	0.06%	98.76%
451-SN-23	33	34	Beef Cattle	F50	Snatch	>500	0.03%	99.05%	0.46%	98.67%

452-CH-232	33	35	Beef Cattle	F224	Choteau	>500	0.03%	99.08%	0.06%	98.82%
453-CH-233	33	36	Beef Cattle	F263	Choteau	>500	0.03%	99.10%	0.06%	98.89%
454-CH-234	33	35	Beef Cattle	F285	Choteau	>500	0.03%	99.13%	0.06%	98.95%
455-CH-235	33	35	Beef Cattle	F296	Choteau	>500	0.03%	99.15%	0.06%	99.02%
456-CH-236	33	35	Beef Cattle	F314	Choteau	>500	0.03%	99.18%	0.06%	99.08%
457-MS-84	33	36	Beef Cattle	F322	Missouri	>500	0.03%	99.21%	0.10%	99.07%
458-SL-19	33	36	Beef Cattle	F426	Slaughter	>500	0.03%	99.23%	0.93%	97.26%
459-SL-20	33	34	Beef Cattle	F429	Slaughter	>500	0.03%	99.26%	0.93%	98.19%
460-CH-237	29	32	Beef Cattle	F66	Choteau	>500	0.02%	99.28%	0.06%	99.14%
461-CH-238	29	34	Beef Cattle	F147	Choteau	>500	0.02%	99.30%	0.06%	99.19%
462-SN-24	29	33	Beef Cattle	F389	Snatch	>500	0.02%	99.33%	0.41%	99.08%
463-SL-21	29	34	Beef Cattle	F422	Slaughter	>500	0.02%	99.35%	0.82%	99.01%
464-MS-85	29	33	Beef Cattle	F444	Missouri	>500	0.02%	99.37%	0.09%	99.15%
465-MS-86	29	33	Beef Cattle	F474	Missouri	>500	0.02%	99.39%	0.09%	99.24%
466-SN-25	25	31	Beef Cattle	F35	Snatch	>500	0.02%	99.41%	0.35%	99.43%
467-MS-87	25	32	Beef Cattle	F47	Missouri	>500	0.02%	99.43%	0.08%	99.32%
468-CH-239	25	32	Beef Cattle	F103	Choteau	>500	0.02%	99.45%	0.05%	99.24%
469-CH-240	25	32	Beef Cattle	F126	Choteau	>500	0.02%	99.47%	0.05%	99.29%
470-CH-241	5	22	Sheep/Goats	F187	Choteau	100-200	0.02%	99.49%	0.05%	99.34%
471-CH-242	25	32	Beef Cattle	F244	Choteau	>500	0.02%	99.51%	0.05%	99.39%
472-CH-243	25	31	Beef Cattle	F258	Choteau	>500	0.02%	99.53%	0.05%	99.43%
473-CH-244	25	31	Beef Cattle	F303	Choteau	>500	0.02%	99.55%	0.05%	99.48%
474-CH-245	25	32	Beef Cattle	F304	Choteau	>500	0.02%	99.57%	0.05%	99.53%
475-MS-88	25	31	Beef Cattle	F326	Missouri	>500	0.02%	99.59%	0.08%	99.39%
476-CH-246	25	31	Beef Cattle	F344	Choteau	>500	0.02%	99.61%	0.05%	99.58%
477-MS-89	25	31	Beef Cattle	F442	Missouri	>500	0.02%	99.63%	0.08%	99.47%
478-MS-90	25	31	Beef Cattle	F445	Missouri	>500	0.02%	99.65%	0.08%	99.55%
479-MS-91	25	32	Beef Cattle	F466	Missouri	>500	0.02%	99.67%	0.08%	99.62%
480-SN-26	24	37	Dairy Cattle	F382	Snatch	>500	0.02%	99.69%	0.34%	99.76%
481-CH-247	23	33	Beef Cattle	F149	Choteau	>500	0.02%	99.70%	0.04%	99.62%
482-CH-248	21	28	Beef Cattle	F25	Choteau	>500	0.02%	99.72%	0.04%	99.66%
483-MS-92	21	29	Beef Cattle	F45	Missouri	>500	0.02%	99.74%	0.06%	99.69%
484-SL-22	21	28	Beef Cattle	F190	Slaughter	>500	0.02%	99.75%	0.59%	99.60%
485-CH-249	21	29	Beef Cattle	F250	Choteau	>500	0.02%	99.77%	0.04%	99.71%
486-CH-250	21	29	Beef Cattle	F307	Choteau	>500	0.02%	99.79%	0.04%	99.75%
487-MS-93	21	29	Beef Cattle	F312	Missouri	>500	0.02%	99.80%	0.06%	99.75%
488-MS-94	21	29	Beef Cattle	F324	Missouri	>500	0.02%	99.82%	0.06%	99.81%
489-CH-251	21	30	Beef Cattle	F345	Choteau	>500	0.02%	99.83%	0.04%	99.79%
490-MS-95	21	28	Beef Cattle	F480	Missouri	>500	0.02%	99.85%	0.06%	99.88%
491-MS-96	21	28	Beef Cattle	F481	Missouri	>500	0.02%	99.87%	0.06%	99.94%
492-MS-97	19	27	Horse	F323	Missouri	>500	0.01%	99.88%	0.06%	100.00%
493-CH-252	18	25	Horse	F287	Choteau	>500	0.01%	99.90%	0.03%	99.82%
494-CH-253	17	25	Beef Cattle	F128	Choteau	>500	0.01%	99.91%	0.03%	99.85%
495-CH-254	17	26	Beef Cattle	F236	Choteau	>500	0.01%	99.92%	0.03%	99.89%
496-CH-255	17	25	Beef Cattle	F272	Choteau	>500	0.01%	99.94%	0.03%	99.92%
497-CH-256	17	26	Beef Cattle	F371	Choteau	>500	0.01%	99.95%	0.03%	99.95%
498-SN-27	17	25	Beef Cattle	F390	Snatch	>500	0.01%	99.96%	0.24%	100.00%
499-SL-23	14	22	Horse	F163	Slaughter	>500	0.01%	99.97%	0.40%	100.00%
500-CH-257	13	23	Beef Cattle	F113	Choteau	>500	0.01%	99.98%	0.03%	99.98%
501-CH-258	11	19	Horse	F26	Choteau	>500	0.01%	99.99%	0.02%	100.00%
502-EM-97	1	0	Beef Cattle	F99	Emanuel	<100	0.01%	100.00%	0.03%	100.00%

CHARLES MIX
CONSERVATION
DISTRICT

276 MAIN STREET * BOX 249 * LAKE ANDES, SD 57356
PHONE: (605) 487-7577
FAX : (605) 487-7651

RECEIVED
NOV 14 2002
Division of Financial
& Technical Assistance

"copy of Daschle Bill"
Mo. R. Restor. Act of 2000

November 13, 2002

Dave Templeton
South Dakota Department of Environment and Natural Resources
Joe Foss Building, 523 East Capitol Avenue
Pierre, SD 57501

Dear Mr. Templeton:

SD DENR staff assistance is requested to plan and draft a proposal to complete watershed assessments to determine the source(s) of water pollution entering the Missouri River between Ft. Randall Dam and Gavins Point Dam. Communities in South Dakota and Nebraska are concerned about:

1. ✓ Sedimentation in Lewis and Clark Lake.
2. Bank erosion in the reach below Ft. Randall Dam.
3. ✓ Protecting quality and quantity of domestic water supply.
4. Protecting quality of wildlife habitat.
5. Rising water table on Missouri River bottomland upstream of Niobrara River outlet.
6. Lowland flooding.
7. ✓ Channel and bank erosion in tributaries.
8. Protection of endangered species habitat.
9. Preservation of cultural and historical resources.

Watershed assessments such as those designed for the TMDL program provide a broad array of information for improving water quality. These are the type of assessments needed by people who live, work, and play in the watersheds we wish to address.

Lewis and Clark Lake formed by Gavins Point Dam (completed 1956) has an estimated life of between 75 years (Corps of Engineers 2000) and 135 years (Corps of Engineers 2001 study) due to receiving an estimated 4,235,000 CY of sediment per year. Many lifelong residents of the area believe the useful life of Lewis and Clark Lake to be 25 years or less.

The COE estimates between 45 and 70% of the sediment received by Lewis and Clark Lake comes from the Niobrara River drainage area, which is predominantly in Nebraska.

Area communities and organizations have met with the Corps of Engineers intensively since 2000 to develop a solution to sedimentation and other problems. In May of 2001 the COE completed the latest study addressing Niobrara River sediment and found no economically feasible method(s) to remove, divert, and/or pump <u>100% of the annual sediment load.</u>

Local leaders have recommended that the federal government extend the useful life of Lewis and Clark Lake by:

1. Reduce sediment delivery from the tributaries. Exact sediment sources or estimated potential reductions with the application of Best Management Practices has not been determined.
2. Remove sediment from the river - likely at a level less than the historical average annual delivery rate.
3. Manage sediment to deposit where it is an asset or no liability.

In order to reduce sedimentation from tributaries we need to know the sources of sediment, such as, bank, bed, or tributary and location of these sources (all drainages, specific drainages, lower part of drainages, etc.). Once we know what the sources are and where they are located, we can estimate the amount of reduction to be gained through application of Best Management Practices. This in turns allows Conservation Districts and others to develop realistic goals and objectives for sediment reduction in the contributing watersheds. This information is critical for the public to understand and support conservation technical and financial assistance programs that can be utilized in these watersheds.

We are familiar with watershed assessments being conducted with the leadership of SD DENR, such as the South Central Lakes Assessment in Charles Mix and Douglas Counties. Our estimate (draft) of the watershed for Lewis and Clark Lake is approximately 10,000,000 acres with roughly 2,000,000 acres in South Dakota and 8,000,000 acres in Nebraska.

About 59,000 acres of the South Central Lakes Assessment active 319 funded project is part of the Lewis and Clark Lake watershed - Dante Lake and Corsica Lake watersheds are included in the much larger Choteau Creek watershed. About 321,000 acres is in the Keya Paha River/Rahn Lake Watershed Assessment project, which was recently submitted to EPA for 319 funding.

We are coordinating our efforts with Nebraska Natural Resource Districts - Middle Niobrara River, Lower Niobrara River, plus Lewis and Clark NRD - and NRCS. We understand your staff is in contact with Nebraska Department of Environmental Quality to coordinate TMDL assessments, in particular, on the Keya Paha River Watershed. We applaud your and Nebraska's efforts and encourage that the Ponca Creek Watershed also be included in discussions with Nebraska. Our goal is to support Nebraska leaders in their efforts to identify sedimentation sources and locations in the Niobrara River Watershed.

The 9 South Dakota Conservation Districts in this area of the Missouri River Watershed feel you and your staff's expertise is critical to assist us in determining the source of sediments, plus establishing a realistic level at which sediment can be reduced. Your technical expertise and experience is needed to advise us on the appropriate science, methods, potential for good information, and estimated costs, as we develop this proposal.

The Conservation Districts, Communities, and partner organizations listed below join in this request for assistance.

Please contact Nick Stotz, Manager, Charles Mix Conservation District, P.O. Box 249, Lake Andes, SD 57356 (Phone 605-487-7577) on your thoughts related to this request.

Sincerely,

Dan Park
Chairman

List of supporting organizations - letters attached.

Bennett Conservation District
Yankton Conservation District
Bon Homme Conservation District
Hutchinson Conservation District
Douglas County Conservation District
Gregory County Conservation District
Clearfield-Keya Paha Conservation District
Aurora Conservation District
Lewis and Clark South Dakota-Nebraska Preservation Association
Village of Niobrara, Nebraska
Knox County Commissioners, Nebraska
City of Springfield
Yankton Area Chamber of Commerce
South Central Water Development District
Lower James Resource Conservation and Development Association, Inc.
Randall Resource Conservation and Development Association, Inc.
South Central Resource Conservation and Development Association, Inc.

BENNETT COUNTY CONSERVATION DISTRICT
HC 2, BOX C
MARTIN, SD 57551-9713
PHONE (605)685-1243
FAX (605)685-1071

October 16, 2002

Dan Park, Chairman
Charles Mix Conservation District
P.O. Box 249
Lake Andes, SD 57356-0249

Re: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

The Bennett County Conservation District supports requesting SD DENR assistance to develop a watershed assessments proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dam.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that our partners and we need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely,

Sharon Denison
Chairman

YANKTON COUNTY CONSERVATION DISTRICT
2914 BROADWAY
YANKTON, SD 57078
(605) 665-6704

September 26, 2002

Dan Park, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes, SD 57356

RE: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

Yankton County Conservation District supports requesting SD DENR assistance to develop a watershed assessments proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dam. We understand our organization will have opportunity to decide what level of commitment (cash, in-kind contribution, ect.) we are able to make after the proposal is developed.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that our partners and we need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely,

Jim Sonichsen

Jim Sonichsen
Yankton Conservation District Chairmen

October 15, 2002

Dan Park, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes, SD 57356

Re: Lewis and Clark Lake/Missouri River Watershed Assessment

The Bon Homme Conservation District supports requesting SD DENR assistance to develop a watershed assessment proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dam. We understand our organization will have opportunity to decide what level of commitment (cash, in-kind contribution, etc.) we are able to make after the proposal is developed.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that our partners and we need to address. It will serve as documentation for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely

Stanley Schuch

Stanley Schuch, Chairman
Bon Homme Conservation Distinct

October 25, 2002

Dan Parks, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes SD 57356

Re: Lewis & Clark/Missouri River Watershed Assessment

Dear Dan

Hutchinson Conservation District Supports requesting SD DENR assistance to develop a watershed assessment proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dame. We understand our organization will have opportunity to decide what level of commitment (cash, in-kind contribution, etc.) we are able to make after the proposal is developed.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that our partners and we need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely

Allen Gross

Allen Gross
Manager of HCD

DOUGLAS COUNTY CONSERVATION DISTRICT
PO BOX 28
606 1ST STREET
ARMOUR, SD 57313-0028

October 7, 2002

Dan Park, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes, SD 57356

RE: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Mr. Park,

The Douglas County Conservation District at their September 30, 2002 meeting approved the support for requesting SD DENR assistance to develop a watershed assessment proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dam. We understand our organization will have the opportunity to decide what level of commitment (cash, in-kind contribution, etc.) we are able to make after the proposal is developed.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that our partners and we need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely,

Elmer Goehring

Elmer Goehring, Chairman
For
Douglas County Conservation District

Gregory County Conservation District
P.O. Box 339 - Burke, SD 57523 - Phone 775-~~2685~~ 2770

September 26, 2002

Dan Park, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes, SD 57356

Re: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

The Gregory County Conservation District supports requesting SD DENR assistance to develop a watershed assessment proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dam. We understand our organization will have opportunity to decide what level of commitment (cash, in-kind contribution, etc.) we are able to make after the proposal is developed.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that we and our partners need to address. It will provide base data we can use as documentation of need for future financial and technical assistance to help private landowners and Indian Tribes.

Sincerely,

Larry Roggow
Chairman

Clearfield-Keyapaha &
Hamill Conservation Districts
113 S Madison Suite 100 – Winner SD 57580-1313

September 19, 2002

Dan Park, Chairman
Charles Mix conservation District
PO Box 249
Lake Andes, SD 57356

Re: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

Clearfield/Keyapaha supports requesting SD DENR assistance to develop a watershed assessments proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point dam. We understand our organization will have opportunity to decide what level of commitment (cash, in-kind contribution, etc.) we are able to make after the proposal is developed.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that we and our partners need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely,

Greg English
Chairman

Aurora County Conservation District
PO Box 277
Plankinton, SD 57368
605-942-7719 ext. 3

Dan Park, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes, SD 57356

Dear Dan:

The Aurora County Conservation District supports requesting SD DENR assistance to develop a watershed assessments proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dam. We understand our organization will have opportunity to decide what level of commitment (cash, in-kind contribution, etc.) we are able to make after the proposal is developed.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that we and our partners need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely,

Ron Glissendorf
Chairman, Aurora County Conservation District

LEWIS & CLARK SOUTH DAKOTA-NEBRASKA PRESERVATION ASSOCIATION

September 27th, 2002

Dan Park, Chairman
Charles Mix Conservation District
P.O. Box 249
Lake Andes, SD 57356

Re: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

The Lewis & Clark South Dakota-Nebraska Preservation Association supports requesting South Dakota Department of Environment & Natural Resources assistance to develop a watershed assessments proposal covering all South Dakota drainage entering the Missouri River from Fort Randall Dam to Gavins Point Dam. We understand our organization will have an opportunity to decide what level of commitment (cash, in-kind contribution, etc.) we are able to make after the proposal is developed.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that we and our partners need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian tribes.

Sincerely,

Rick Hurd
President
Lewis & Clark SD-NE Preservation Association
40110 County Road 2
Wagner, SD 57380
(605) 286-3373
E-mail: rmhurd@gwtc.net

Village of Niobrara

Niobrara, Nebraska 68760

October 17, 2002

Dan Park, Chairman
Charles Mix Conservation District
P.O. Box 249
Lake Andes, SD 57356

RE: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

The Niobrara Village Board supports requesting SD DENR assistance to develope a watershed assessments proposal covering all South Dakota drainage entering the Missouri River from Ft Randall to Gavins Point Dam. We understand our organization will have opportunity to decide what level of commitmwent (cash, in-kind contribution, etc.)we are able to make after the proposal is developed.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that we and our partners need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely yours,

Stanley O. Dryak

Stanley O. Dryak, Chairman
Village Board of Trustees
Village of Niobrara

Daniel Kaiser
District #1

Rayder Swanson
District #2

Matthiaes Kauth
District #3

KNOX COUNTY BOARD OF SUPERVISORS
Knox County Courthouse
P.O. Box 166
Center, NE 68724-0166

Rick McManigal
District #4, Chairman

Norman Mackeprang
District #5

Steven Banks
District #6

Jim Fuchtman
District #7

October 10, 2002

Dan Park, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes SD 57356

Re: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

The Knox County Board of Supervisors supports requesting SD DENR assistance to develop a watershed assessments proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dam. We understand our organization will have opportunity to decide what level of commitment (cash, in-kind contribution, etc.) we are able to make after the proposal is developed.

Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that we and our partners need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely,

Rick McManigal
Chairman of the
Knox County Board
Of Supervisors

Springfield Community Development

807 Eighth St. PO Box 329
Springfield, SD 57062

Phone: 605-369-2266
Cellular: 605-661-0723
Email: springfieldsd@gwtc.net
Web: www.gwtc.net/~springfieldsd

Dan Park, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes, SD 57356

Dear Mr. Park,

The Community Development Office of the City of Springfield supports requesting South Dakota DENR assistance to develop a watershed assessment proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dam.

We understand a decision regarding a local contribution toward this project can be made after a proposal is developed. Any city or chamber contribution would have to be considered by the governing board. In-kind contributions could also be explored.

Sediment entering Lewis and Clark Lake continues to be of concern to the community of Springfield. Developing ways to address the growing recreational and water intake problems are a priority. Watershed assessments will give us valuable information on sources of sediment and other pollutants that we all need to address. The information can serve the region as a building block or basis for future programs.

Sincerely,

Sandra Korkow
Springfield Community Development Coordinator

Yankton! Area Chamber of Commerce
218 W. Fourth Street • P.O. Box 588
Yankton, SD 57078 • 605 665-3636
Fax: 605 665-7501 • www.yanktonsd.com
e-mail: visitorinfo@yanktonsd.com

November 7, 2002

Dan Park
Charles Mix Conservation District
PO Box 249
Lake Andes, SD 57356

Dear Mr. Park;

Thank you for allowing us to participate in the effort to support lobby to assess the South Dakota drainage into the Lewis & Clark Lake.

I'm sure you are much aware of Yankton's concern about the future of Lewis & Clark Lake. Right now we in a "battle" if you will, to slow down the silt coming into the lake from the Niobrara River from Nebraska and supporting the effort to find a way to fund the dredging to improve the conditions at Niobrara-Springfield. Anything that can be done to extend the life of the lake, as we know it today, should be attempted. This is why we wish to support your effort.

The Lewis & Clark Lake represents nearly $12 million dollars to our visitor industry economy. It's going to be terrible for Yankton if no plan can be found to preserve the lake. We know efforts on various fronts need to be taken to maintain this beautiful landmark of South Dakota.

Please don't hesitate to call on me if you need further support for lobbying for the assessment project.

Sincerely,

Robert Cappel
Executive Director

SOUTH CENTRAL WATER DEVELOPMENT DISTRICT

Douglas County Courthouse P.O. Box 43 Armour, South Dakota 57313

(605) 724-2624

October 15, 2002

Dan Park, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes, SD 57356

Re: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

South Central Water Development District supports requesting SD DENR assistance to develop a watershed assessment proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dam.

SCWDD has been participating in the assessment arena by sponsoring South Central Lake Assessment Project. This project is nearing completion at this time. We feel assessment is the first step in addressing the problems in and along the Missouri River. Completion of a watershed assessment on the entire drainage will give us valuable information on sources of sediment and other pollutants that we and our partners need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely,

Cathy Wernke

Cathy Wernke
Chairman

Randall Resource Conservation and Development
ASSOCIATION, INCORPORATED
BOX 247 • LAKE ANDES, SD 57356 • PHONE (605) 487-7077 • FAX (605) 487-7651
Sponsors Include: County Commissions, Conservation Districts, Irrigation Districts, Tribal Agencies, Non-Profit Organizations, and Communities located in Bon Homme, Brule, Buffalo, Charles Mix, Douglas, and Gregory Counties

October 17, 2002

Dan Park, Chairman
Charles Mix Conservation District
P.O. Box 249
Lake Andes, SD 57356

Re: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

Randall Resource Conservation and Development Association, Inc., supports requesting SD DENR assistance to develop a watershed assessments proposal covering all South Dakota drainage entering into the Missouri River from Ft. Randall Dam to Gavins Point Dam. We understand our organization will have opportunity to decide what level of commitment (cash, in-kind contribution, etc.) we are able to provide after the proposal is developed.

Completion of the watershed assessment is necessary to identify potential sources of water pollution and at what level these sources are contributing. Our organization is especially concerned about documenting the sources and level of contribution of sediment. This assessment will provide base data to help our organization for future decision making in providing technical and financial assistance to private landowners and Indian Tribes.

Thank you to Charles Mix Conservation District for assuming the responsibility of leadership on this proposed project.

Sincerely,

Don Star

Don Star
Chairman

"To provide leadership and assistance to communities, local units of government, and individuals to conserve the natural resources, improve the environment, and develop economic opportunities"

Lower James RC&D

1820 NORTH KIMBALL, SUITE 4 • MITCHELL, SOUTH DAKOTA 57301 • 605 996-1031

October 1, 2002

Dan Park, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes, SD 57356

Re: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

Lower James RC&D supports requesting SD DENR assistance to develop a watershed assessments proposal covering all South Dakota drainage entering the Missouri River from Ft. Randall Dam to Gavins Point Dam. We understand our organization will have opportunity to decide what level of commitment (cash, in-kind contribution, etc.) we are able to make after the proposal is developed.

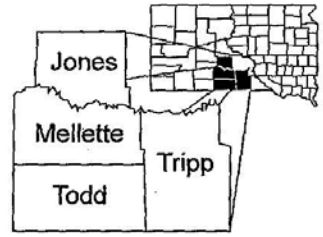
Completion of the watershed assessments will give us valuable information on sources of sediment and other pollutants that we and our partners need to address. It will provide base data we can use as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely,

Gary Herman

Gary Herman, President
Lower James RC&D Council

RESOURCE CONSERVATION AND DEVELOPMENT AREA FOR THE COUNTIES OF:
AURORA • DAVISON • HANSON • HUTCHINSON • JERAULD • SANBORN • YANKTON



SOUTH CENTRAL RC&D

Resource Conservation & Development Council, Inc.

P.O. Box 231
White River, SD 57579-0231
Phone (605) 259-3547
Fax (605) 259-3546

October 21, 2002

Dan Park, Chairman
Charles Mix Conservation District
PO Box 249
Lake Andes, SD 57356

Re: Lewis & Clark Lake/Missouri River Watershed Assessment

Dear Dan:

South Central Resource Conservation and Development Council Board of Directors supports requesting SD DENR assistance to develop a watershed assessments proposal covering all South Dakota drainage entering the Missouri River from the Ft. Randall Dam to Gavins Point Dam.

Completion of the watershed assessments will provide valuable information on sources of sediment and other pollutants needing to be addressed. It will provide base data that can be used as documentation of need for future financial and technical assistance requests to help private landowners and Indian Tribes.

Sincerely yours,

Leroy Hodge
President