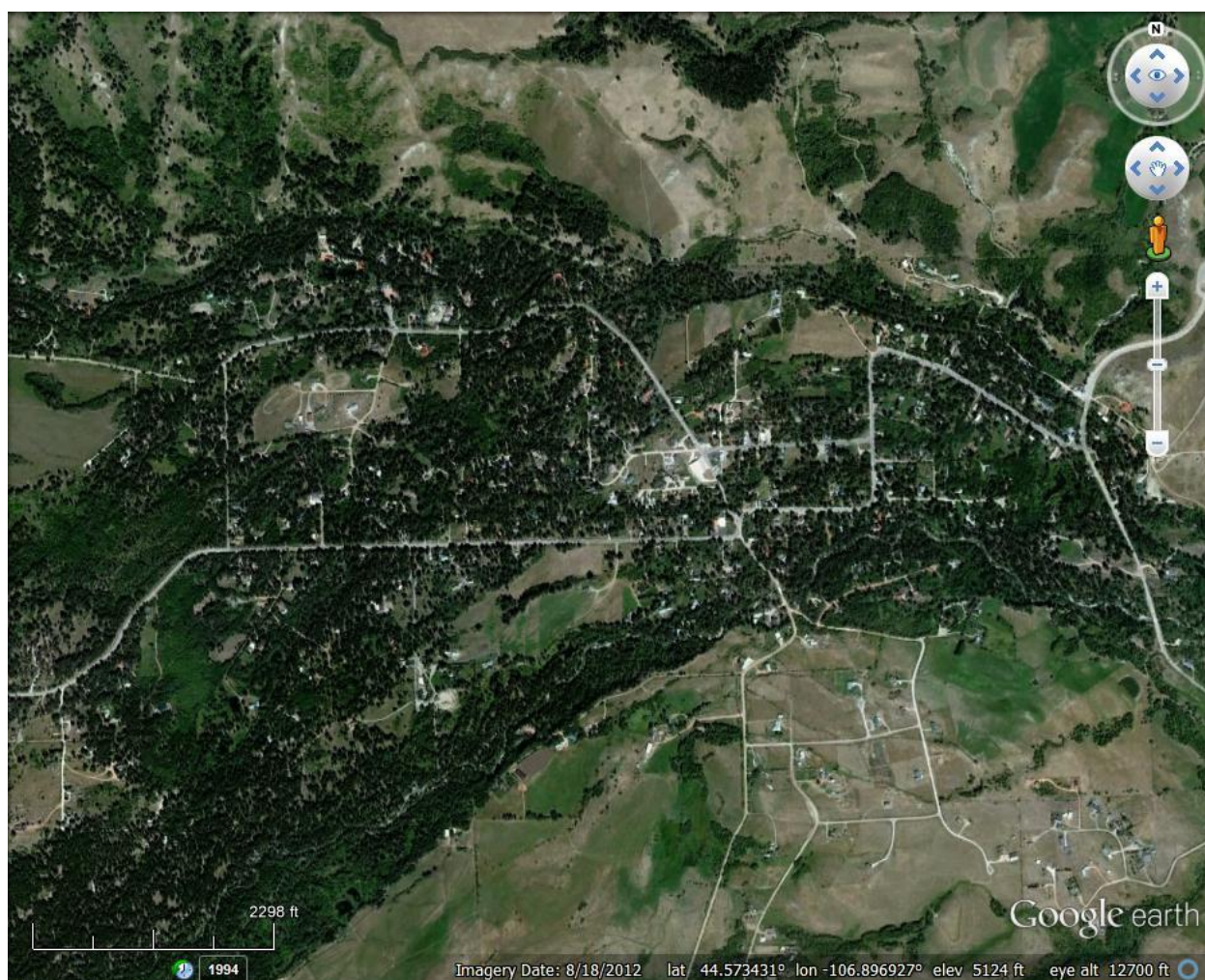


Water Quality Condition for Recreational Use of North Piney Creek and Dalton Ditch within Story, WY, 2005, 2008-10



Wyoming Department of Environmental Quality-Water Quality Division



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TABLE OF CONTENTS

INTRODUCTION	2
ENVIRONMENTAL SETTING	2
METHODS AND ANALYTICAL APPROACHES	4
Site Selection	4
Data Collection	4
Data Analysis	4
RESULTS	5
DISCUSSION and CONCLUSIONS	6
CHAPTER 1-SURFACE WATER STANDARDS ATTAINMENT/NON-ATTAINMENT	7
REFERENCES	10

FIGURES

Figure 1. Statistics of mean daily flow at USGS 06321500 North Piney Creek near Story, WY, 1952-82	3
Figure 2. Year 2005 sampling sites in Story, WY	5

TABLES

Table 1. Location of monitoring sites on North Piney Creek and Dalton Ditch with data included in this report.	5
Table 2. Sampling results for North Piney Creek and Dalton Ditch.	8
Table 3. Quality control sample results for North Piney Creek and Dalton Ditch.	9

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INTRODUCTION

The Federal Clean Water Act (CWA) § 305(b) requires States to describe the water quality condition of all their waters including all designated use determinations. In addition, CWA § 303(d) directs each State to develop a list of all waters which do not fully support designated uses and require development of a Total Maximum Daily Load (TMDL). The Watershed Protection Program of the Wyoming Department of Environmental Quality-Water Quality Division (WDEQ/WQD) assesses water quality and determines attainment of water quality standards for streams, rivers, lakes, reservoirs and wetlands in Wyoming. Findings from these assessments are then incorporated into the State's biennial Integrated 305(b) and 303(d) Report that is submitted to the U.S. Environmental Protection Agency (USEPA).

In 2005, allegations of surfacing sewage within Ponderosa Subdivision in Story, WY led to WDEQ/WQD staff collecting two single *Escherichia coli* (*E. coli*) grab samples on Dalton Ditch. Analysis of these samples showed that elevated concentrations of *E. coli* were present. Consequently, an expanded study that included Dalton Ditch and North Piney Creek was conducted that year to document the spatial extent and magnitude of *E. coli* contamination in Story, WY surface waters. Samples collected between July 18 and August 15, 2005 (data included in this report) indicated the *E. coli* criterion protective of primary contact recreation was exceeded. These findings led to Dalton Ditch and North Piney Creek being added to the 2006 303(d) list of impaired waters for non-support of primary contact recreation.

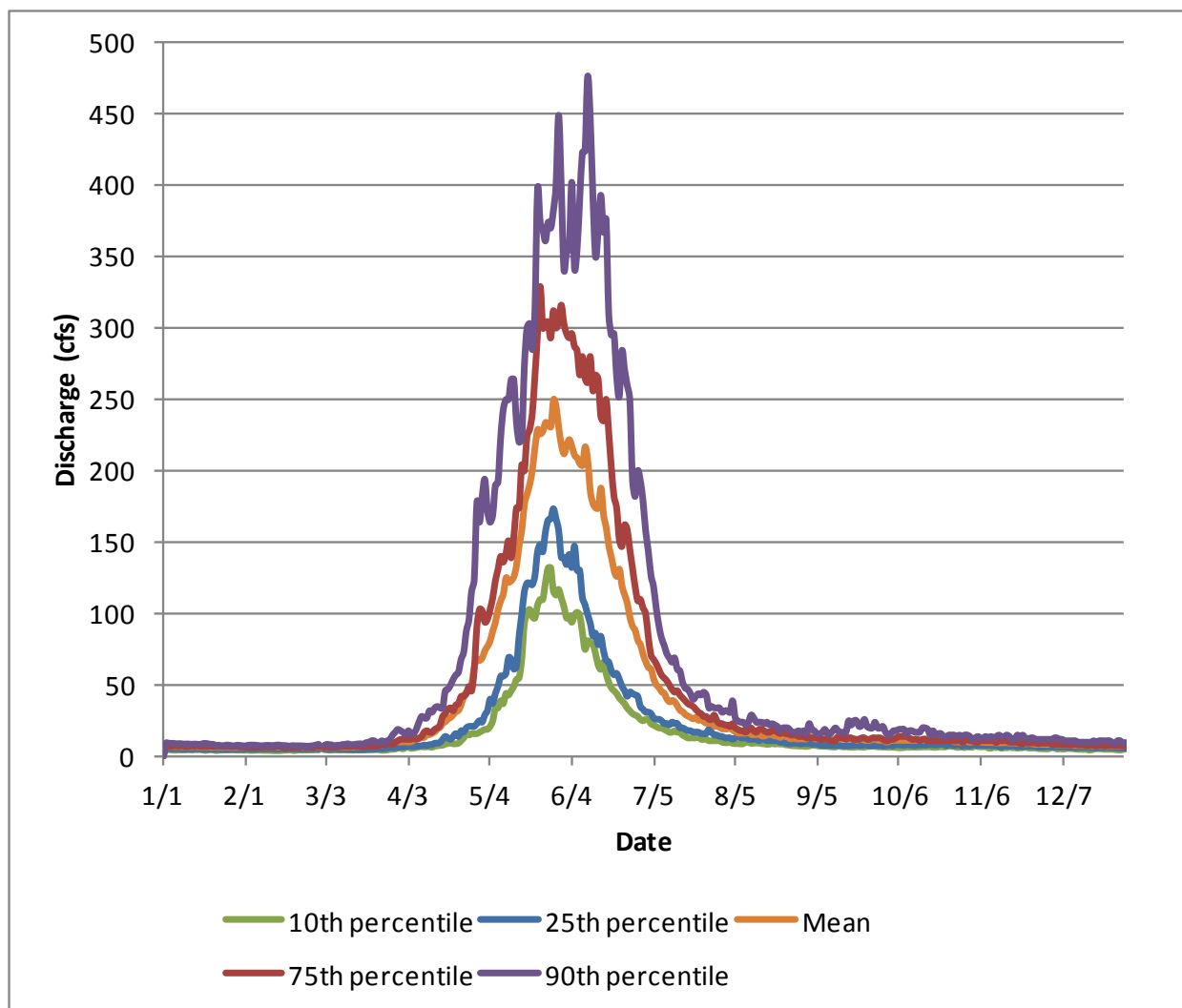
In part in response to the 303(d) listing of North Piney Creek and Dalton Ditch, Sheridan County completed a review of septic system permitting records within Story. This effort led to replacement or rehabilitation of multiple septic systems. At the request of Sheridan County, WDEQ/WQD completed follow up sampling on Dalton Ditch and North Piney Creek from 2008 to 2010 to determine if the impairments had been mitigated.

ENVIRONMENTAL SETTING

North Piney Creek is a perennial stream with flows derived primarily from snowmelt within the upper reaches of the watershed. Statistics of mean daily flow for the period 1952-1982 at USGS gage 06321500 (North Piney Creek near Story) are shown in Figure 1.

Upstream of the confluence of South and North Piney Creeks, early settlers and irrigators tunneled for hundreds of feet to daylight their ditches on the north side of the ridge bordering North Piney Creek. Three tunnels were dug; one each for the Meade-Coffeen, Piney-Cruse, and Prairie Dog ditches, along with crossover channels between South and North Piney Creeks for each ditch through what is now Story, to divert water from South Piney Creek. These cross over ditches, and smaller lateral conveyances such as Dalton Ditch, flow through residential neighborhoods within Story. The three cross over ditches are quite large, and, cumulatively, divert more water than any other single diversion in the Powder/Tongue Basins.

Figure 1. Statistics of mean daily flow at USGS 06321500 North Piney Creek near Story, WY, 1952-82



North Piney Creek originates above Penrose Park in the Big Horn Mountains southwest of Story, WY. Recreation and livestock grazing are the primary land uses in most of the watershed, whereas the lowermost four miles flows through the unincorporated community of Story. Land use within Story consists of residential and rural residential properties of $\frac{1}{4}$ to several acres as well as some larger agricultural properties. Story does not have a central water supply or waste water collection system therefore each property typically contains a private water supply well and septic system. Many properties owners in Story have horses or other domestic stock in small confined corrals. In addition, wildlife, particularly whitetail deer, are abundant throughout Story.

Dalton Ditch is an irrigation water conveyance with a point of diversion from Piney Cruse Ditch upstream of Fish Hatchery Road. Dalton Ditch flows through residential properties of 0.5 to several acres before reaching Ponderosa Subdivision where residential properties are less than 0.5 acre.

METHODS AND ANALYTICAL APPROACHES

Site Selection

In 2005, fourteen sites were located at accessible points near the upstream and downstream extent of each major waterbody flowing through Story (North Piney Creek (NP), South Piney Creek (SP), Meade-Coffeen Ditch (MCDL), Piney-Cruse Ditch (PCCDL), and Prairie Dog Ditch (PDWSC) as well as on two small lateral conveyances (Redman Ditch (R) and Dalton Ditch (D)) (Figure 2). In contrast to the other waterbodies included in this study, the two sites on Dalton Ditch were located on the upstream and downstream end of Ponderosa Subdivision, rather than the upstream and downstream extent of this ditch. The sites on Dalton Ditch coincided with sites used in the original investigation of surfacing sewage within Ponderosa Subdivision that prompted the initiation of this study (Sites D-4 and D-5 in Figure 2 and Table 1).

Of the fourteen sites from 2005, only sites on North Piney Creek and Dalton Ditch (current 303(d) listed streams) are included in this report. Results from all fourteen 2005 samples were documented in a previous report (Martineau and ZumBerge, 2005). In 2010, sampling on Dalton Ditch included three additional sites upstream of Ponderosa Subdivision (Sites D-1, D-2 and D-3 in Table 1). The three additional sites were added to possibly refine the listed segment and inform future source identification efforts.

Data Collection

E. coli was the only water quality parameter collected during the course of the study. Collection procedures followed approved WDEQ/WQD methods (WDEQ, 2011). Multiple grab samples were collected to provide a geometric mean concentration of five samples collected within 30 days, with each sample separated by at least 24 hours (WDEQ, 2007). The selected sampling period of July and/or August of each year approximately corresponds to the period when samples were collected in 2005, and the portion of the recreation season when the potential for non-support of recreation is greatest. When the recreation season begins on May 1, North Piney Creek stream flow has begun rising due to snowmelt in the mountains above Story. Streamflow typically peaks around June 1 and remains elevated until the latter half of June or early July. Due to the overwhelming dilution effect of mountain snowmelt between May 1 and July 1, *E. coli* concentrations are expected to be low in North Piney Creek. Moreover, elevated streamflow during this period is generally prohibitive of recreation involving full body contact.

Quality control samples were collected during all years according to the Watershed Protection Program Quality Assurance Project Plan (WDEQ, 2000). One set of replicates was collected per day or for every ten samples, whichever was greater. One blank was collected per day (field or trip).

Data Analysis

E. coli is reported in colony forming units (CFU) per 100 milliliters (mL). *E. coli* criteria are considered to be attained for primary contact recreation if the geometric mean of five samples collected at least 24-hours apart over a thirty day period does not exceed 126 cfu/100 mL (WDEQ, 2007a). Primary contact criteria apply during the summer recreation season of May 1 through September 30 (WDEQ, 2007a).

RESULTS

Results for all samples and associated geometric means on North Piney Creek and Dalton Ditch are shown in Table 2. In 2005, *E. coli* concentrations increased considerably from NP-1 to NP-2, with NP-2 exceeding the criterion of 126 CFU per 100 mL considered protective of primary contact recreation. From 2008 to 2010, *E. coli* concentrations continued to increase between NP-1 and NP-2, though concentrations at NP-2 were much lower and did not exceed the 126 CFU per 100 mL criterion.

Figure 2. Year 2005 sampling sites in Story, WY

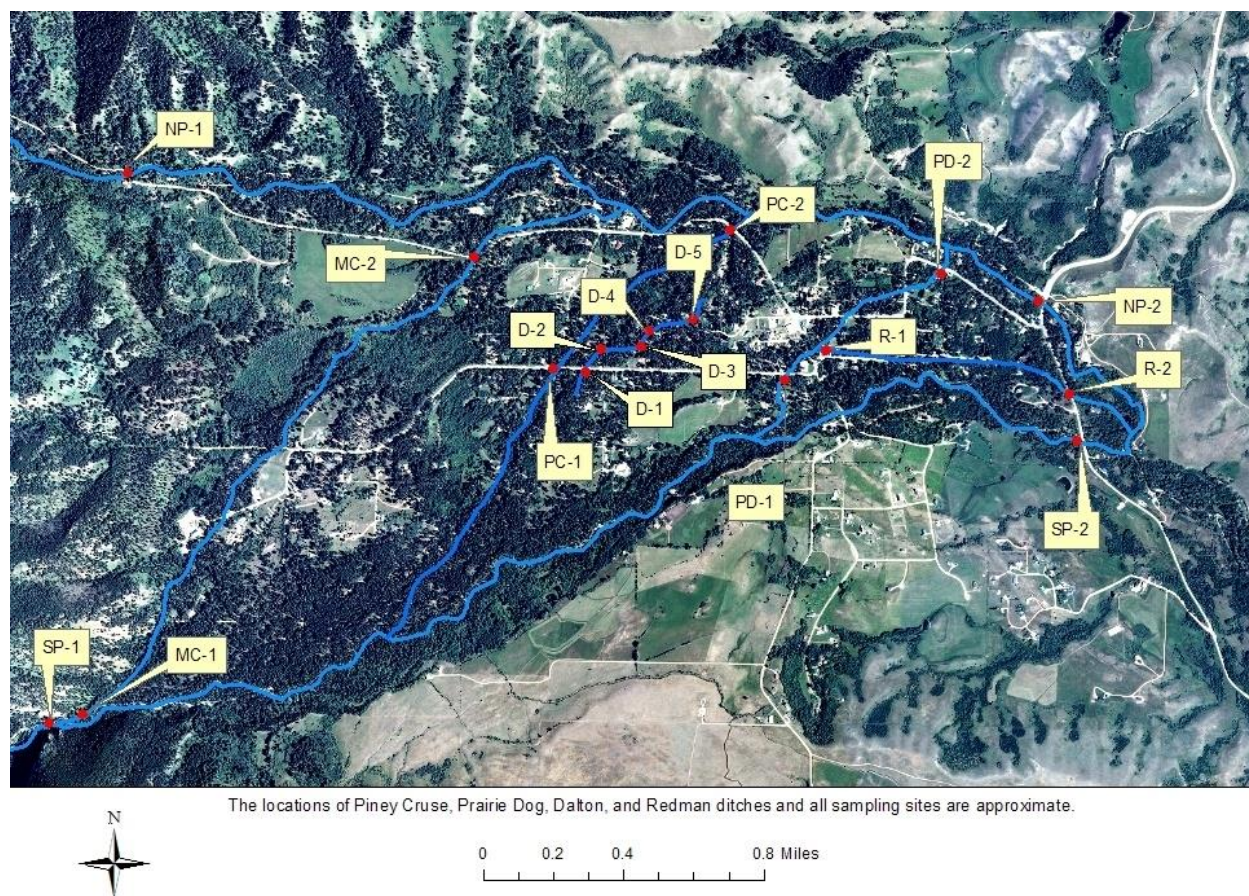


Table 1. Location of monitoring sites on North Piney Creek and Dalton Ditch with data included in this report.

Stream	North Piney Creek	North Piney Creek	Dalton Ditch	Dalton Ditch	Dalton Ditch	Dalton Ditch	Dalton Ditch
ID	NP-1	NP-2	D-1	D-2	D-3	D-4	D-5
Site	Above Story	Below Story	Fish Hatchery Road	Robertson Road	Cottage Grove	Upper Ponderosa	Lower Ponderosa
Latitude	44.5798	44.5755	44.5721	44.5731	44.5732	44.5738	44.5749
Longitude	-106.9324	-106.8791	-106.9055	-106.9046	-106.9024	-106.9016	-106.8977

In 2005, D-4 and D-5 had geometric mean concentrations that exceeded the criterion protective of primary contact recreation. The geometric mean concentration was higher at D-4, indicating a source or sources of *E. coli* upstream of the Ponderosa subdivision. In 2008, the source(s) of *E. coli* upstream of Ponderosa subdivision apparently were not present. Concentrations were much lower at D-4 and D-5, with only a slight increase in *E. coli* between the two sites and the primary contact recreation criterion was not exceeded. In 2009 and 2010, *E. coli* concentrations were again elevated in Dalton Ditch, with D-4 once again having higher *E. coli* concentrations than D-5 and the criterion protective of primary contact recreation was exceeded both years. Combined, these data indicate appreciable active source(s) of *E. coli* upstream of the Ponderosa subdivision, with the most persistent source(s) occurring between D-2 and D-3 (Robertson Road and Cottage Grove Road).

With one exception, collection of replicates and blanks achieved frequency criteria in WDEQ (2000). *E. coli* was not detected in any blanks, indicating that results were not influenced by contamination introduced during sampling, from reagent water or bottles, or during processing (Table 3). Replicate samples generally achieved the criterion for relative percent difference (RPD) of 50%, with some exceptions. In most cases where RPD exceeded 50%, sample concentrations were ≤ 126 CFU/100 mL and actual differences small. Three exceptions exist in the 2005 sample data where a RPD of greater than 50% occurred between replicate samples exceeding 126 CFU/100 mL. No definitive explanation exists for the elevated RPD. Results from blanks suggest the differences were not due to contamination introduced during sampling, from reagent water or bottles, or during processing.

DISCUSSION and CONCLUSIONS

North Piney Creek had *E. coli* concentrations in 2005 that exceeded primary contact recreation criteria at the downstream end of Story at site NP-2. Significant water is diverted from South Piney Creek through small acreage residential and mixed residential/agricultural properties in Story into North Piney Creek upstream of the NP-2 sampling site. Site NP-2 may cumulate many sources of *E. coli*, whether these sources occur on lateral conveyances between North and South Piney Creek or on North Piney Creek proper upstream of NP-2. It is unknown whether the septic system repair work completed following 2005 contributed to the current attainment of the primary contact recreation criterion. *E. coli* concentrations in North Piney Creek are likely to be, in part, dependent on natural and anthropogenic factors that influence discharge in the Creek. The USGS stream gaging station was not active during this study and discharge measurements were not made by WDEQ when samples were collected therefore relation of variability in stream discharge to *E. coli* concentrations in North Piney Creek could not be ascertained.

Dalton Ditch exceeded primary contact recreation criteria during three of four years of sample collection. It is unknown why one year (2008) was anomalous from the other three. Dalton Ditch is extremely small, therefore it would presumably be highly responsive to even one source of *E. coli*, such as a direct sewage discharge or contributions from a domestic animal corral. Sampling in 2010 showed that there is a source(s) of *E. coli* between Robertson Road and Cottage Grove Road that have a large influence on *E. coli* concentrations in the remainder of Dalton Ditch within the vicinity of the Ponderosa subdivision. Between these roads, Dalton Ditch spans only four small properties, therefore potential

sources are limited in number and would likely be easily discovered upon closer inspection of these properties. Other sources of *E. coli* exist on Dalton Ditch, as evidenced by occasional high concentrations in single samples elsewhere on the ditch, though the segment between Robertson Road and Cottage Grove Road appears to hold the most significant and persistent source(s).

CHAPTER 1-SURFACE WATER STANDARDS ATTAINMENT/NON-ATTAINMENT

Based on a weight-of-evidence evaluation and in accordance with Wyoming's Method for Determining Surface Water Quality Condition and TMDL Prioritization (WDEQ/WQD, 2007b), the following conclusions were made for Chapter 1 standards attainment on North Piney Creek and Dalton Ditch:

Attainment of Section 27 (*E. coli* Bacteria), Chapter 1 of the Wyoming Water Quality Rules and Regulations, for a segment of North Piney Creek that extends from the Bighorn National Forest boundary downstream to South Piney Creek. Five-sample geometric mean *E. coli* concentrations in 2008-10 indicated *E. coli* concentrations attained the criterion protective of primary contact recreation. The data are spatially and temporally representative of the portion of the recreation season when potential for non-support is greatest.

Non-attainment of Section 27 (*E. coli* Bacteria), Chapter 1 of the Wyoming Water Quality Rules and Regulations, for Dalton Ditch from Cottage Grove Road downstream to its terminus. Five-sample geometric mean *E. coli* concentrations at two sites in 2005 and 2009 and three sites in 2010 indicated *E. coli* concentrations exceeded the criterion protective of primary contact recreation.

Table 2. Sampling results for North Piney Creek and Dalton Ditch.

North Piney Creek above Story (NP1)			North Piney Creek below Story (NP2)		Dalton Ditch- Fish Hatchery Road (D1)		Dalton Ditch- Robertson Road (D2)		Dalton Ditch- Cottage Grove (D3)		Dalton Ditch- Upper Ponderosa (D4)		Dalton Ditch- Lower Ponderosa (D5)	
Date	Time	Result ¹	Time	Result ¹	Time	Result ¹	Time	Result ¹	Time	Result ¹	Time	Result ^{1,2}	Time	Result ^{1,2}
7/18/05	9:23	29	8:52	96							9:07	411	9:11	135
7/25/05	10:01	12	9:12	308							10:15	2420	10:18	2420
8/4/05	10:16	4	9:13	921							10:37	1733	10:33	387
8/10/05	9:26	18	8:31	517							9:43	2420	9:41	1733
8/15/05	8:55	2	8:01	276							8:17	2420	8:15	2420
Geometric mean		9		329								1587		881
7/21/08	9:07	23	9:42	28							9:24	36	9:29	39
7/31/08	10:04	23	10:45	29							10:22	96	10:31	1203
8/4/08	10:24	18	11:13	272							10:45	45	11:00	57
8/7/08	9:25	19	10:54	147							10:15	51	10:27	45
8/18/08	13:45	11	14:02	102							13:23	79	13:26	112
Geometric mean		18		80								57		106
7/13/09	13:50	41	14:12	194							13:30	1553	13:32	770
7/20/09	8:54	31	8:30	38							9:40	770	9:43	453
7/27/09	10:50	19	11:15	24							10:27	2420	10:33	1553
7/30/09	8:01	28	7:40	45							8:47	1414	8:50	687
8/5/09	14:32	3	14:55	16							14:11	1986	14:16	1120
Geometric mean		18		42								1520		839
8/10/10			11:09	47	10:58	156	10:54	52	10:50	116	10:36	70	10:22	70
8/12/10			9:40	46	9:07	579	9:12	40	9:17	488	9:22	461	9:25	387
8/16/10			9:59	26	9:37	66	9:41	68	9:46	687	9:51	548	9:52	649
8/24/10			14:53	57	14:27	10	14:31	62	14:35	261	14:43	547	14:45	285
8/26/10			8:33	102	8:11	12	8:17	194	8:20	2420	8:26	1414	8:28	1553
Geometric mean				50		59		70		476		424		379

¹ Colony forming units per 100 mL of sample, most probable number, ²Result of 2420 substituted for most probable number of >2419.6. Actual count may have been greater.

Table 3. Quality control sample results for North Piney Creek and Dalton Ditch.

Date	Time	Replicate 1 result	Replicate 2 result	Replicate RPD	Blank Time	Blank result
7/18/05	941	11	8.4	25.9	825	<1
7/18/05	852	96	88.4	8.1		
7/25/05	915	236	410.6	54.0	845	<1
7/25/05	1018	2420	2420	0.0		
8/4/05	931	58	63.1	9.1	840	<1
8/4/05	1016	4	8.6	70.9		
8/10/05	842	80	167	70.7	810	<1
8/10/05	831	517	290.9	56.0		
8/15/05	812	33	35.5	7.3	730	<1
8/15/05	822	42	48.1	13.1		
7/21/08	830	4	4.1	0.0	1215	<1
7/21/08	924	36	41.1	12.1		
7/31/08	1022	96	86	10.9	1115	<1
7/31/08	955	105	112.1	6.5		
8/4/08	950	11	20.1	59.4	1310	<1
8/4/08	1036	45	31.7	34.2		
8/7/08	1015	51	70.8	32.1	1123	<1
8/7/08	910	26	24.6	4.0		
8/18/08	1317	25	25.9	5.1	1500	<1
8/18/08	1345	11	6.3	52.6		
7/13/09	1255	<1	2	200.0	1542	<1
7/13/09	1412	194	143.9	29.4		
7/20/09	835	41	35.4	13.9	1024	<1
7/20/09	838	55	54.1	2.2		
7/27/09	1033	1553	1203.3	25.4	1157	<1
7/27/09	1014	51	36.4	33.8		
7/30/09	843	13	7.2	58.8	925	<1
7/30/09	749	16	9.7	49.0		
8/5/09	1403	8	5.2	36.2	1525	<1
8/5/09	1416	1120	1299.7	14.9		
8/10/10					1132	<1
8/12/10	940	46	37	21.7	1030	<1
8/16/10	941	68	66	3.0	1032	<1
8/24/10	1435	261	325	21.8	1533	<1
8/26/10	811	12	16	28.6	836	<1

REFERENCES

WDEQ. 2000. Quality Assurance Project Plan (QAPP) for Beneficial Use Reconnaissance Project (BURP) Water Quality Monitoring. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming.

WDEQ. 2007a. Water Quality Rules and Regulations, Chapter 1, Wyoming Surface Water Quality Standards. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming.

WDEQ. 2007b. Wyoming's method for determining water quality condition of surface waters and TMDL prioritization. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming.

WDEQ. 2011. Manual of Standard Operating Procedures for Sample Collection and Analysis. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming.