

**Bitter Creek and Killpecker Creek Watershed Management Plan
And Implementation Project**



**Bitter Creek and Killpecker Creek
Fall 2010 Bacteria and Chloride Sampling
Results Summary Report**

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1.0 Executive Summary

EDE Consultants conducted bacteria and chloride sampling for the Sweetwater County Conservation District (SWCCD) along portions of Bitter Creek and Killpecker Creek and their tributaries during spring and fall 2010. A portion of Bitter Creek is listed as impaired for both chloride and E. coli, and a portion of Killpecker Creek is listed as impaired for E. coli on Wyoming's 303d list of waters requiring Total Maximum Daily Loads (TMDLs).

Sampling begun in 2004, and continued through 2009, was conducted to confirm the impairment and evaluate areas contributing to exceedences of the chloride and E. coli bacteria standards in Bitter and Killpecker Creeks. In 2010 the scope of the sampling was greatly reduced pending development of a (TMDL) by the Wyoming Department of Environmental Quality (WDEQ) for both chloride and bacteria in these drainages. Bacteria sampling was shifted to tracking E. coli at four "legacy" sites without further investigation of possible sources. Chloride sampling was also scaled back but continued to measure chloride concentrations in two areas that are potential source areas contributing to chloride exceedences. Killpecker Creek was sampled for chloride along Elk St. in Rocks Springs, south of Yellowstone Rd. Bitter Creek and Ten Mile Draw were sampled for chloride in the vicinity of Point of Rocks, Wy., where Deadman Wash, Ten Mile Draw and Bitter Creek converge.

Results of sampling completed during 2010 are summarized in this report, and reviewed in context with 2004 through 2009 sampling. Fall 2010 sampling was limited by low water levels in the watershed. Sampling for all of 2010 suggests:

- The 2008 extended Wyoming Department of Environmental Quality 303d impairment listing for chloride from Rock Springs to Point of Rocks is supported.
- Chloride concentrations in Bitter Creek are elevated at, and just upstream of Point of Rocks as well as in Ten Mile Draw and Deadman Wash pointing to chloride inputs in this vicinity.
- Native soils in and along Bitter Creek just upstream of Point of Rocks and the lower reaches of Ten Mile Draw and Deadman Wash

potentially contribute to increased chloride concentrations seen within Bitter Creek in this reach.

- Ground water inputs from an artesian well and soil samples in the headwater area of Ten Mile Draw do not appear to be significant contributors to chloride levels in this drainage.
- Chloride concentrations within Killpecker Creek continue to show a significant increase between the Yellowstone Road crossing and the confluence with Bitter Creek downstream. This reach is currently experiencing significant road and infrastructure construction in the area just downstream of Yellowstone Road.
- 2010 E. coli sampling at the 4 legacy sites does not by itself support the extended impairment for E. coli between Rock Springs and Point of Rocks on Bitter Creek or the lower reaches of Killpecker Creek. However, historic sample data in these reaches does support the impairment.
- 2010 E. coli concentrations in Bitter Creek downstream of the City of Rock Springs, are less than observed in 2004, 2005 or 2009. Overall water quality in this reach continues to support the impaired listing.
- 2010 E. coli concentrations in Killpecker Creek just upstream of the Bitter Creek confluence were the lowest recorded during the sampling project to date. Sampling was not conducted this year at the Highway 191 road crossing near Reliance, WY.

2.0 Introduction and Background

This report provides an update of ongoing chloride and E. coli bacteria monitoring under the Bitter Creek and Killpecker Creek Watershed Management Plan and Implementation Project, for the Sweetwater County Conservation District (SWCCD). This report is presented as a final sampling summary for 2010 monitoring, and supplements previous monitoring review documents prepared for the Bitter and Killpecker Creek studies (EDE 2006-1, EDE 2006-2, EDE 2009-1, EDE 2009-2).

Sampling for this project is being done to address Wyoming Department of Environmental Quality (WDEQ) 303d chloride and bacteria impairment listings on Bitter and Killpecker Creeks. The 303d list is an account of impaired waters in Wyoming requiring computation of Total Maximum Daily Load (TMDL) developed by WDEQ in accordance with Environmental Protection Agency (EPA) standards and requirements set forth in the Clean Water Act of 1972. The SWCCD sampling program allows:

- Confirmation of the accuracy of the 303d listings.
- Evaluation of what may be causing the impairment(s).
- Assessment of whether best management practices (BMPs) may be implemented to improve water quality.

During 2008 the WDEQ revised the extent of the impaired listing for chloride and bacteria on Bitter Creek within the 303d list, increasing the length of listed reaches. The Bitter Creek chloride and bacteria 303d impairment was previously listed from the confluence of Bitter Creek with the Green River through the City of Rock Springs, WY. The 2008 revision extended this impaired zone to include Bitter Creek from the City of Rock Springs, WY to Point of Rocks, WY. Killpecker Creek is listed as impaired for bacteria only, from Bitter Creek upstream to Reliance, WY.

The 2010 sampling program was reduced in scope due to the pending development of TMDLs for both chloride and E. coli by the WDEQ in 2012. 2004 through 2010 monitoring locations are presented on Plate 1. 2010 sampling and objectives included:

- 1) Chloride surface water samples were collected in Ten Mile Draw, Deadman Wash and Bitter Creek just upstream of the Deadman Wash confluence to identify potential source areas of chloride contributing to elevated concentrations previously observed in Bitter Creek at site BC-6.
- 2) Chloride surface water samples were collected on Killpecker Creek between Yellowstone Road and the confluence with Bitter Creek. The intent was to observe potential contributions to elevated chloride concentrations from ongoing road and bridge construction in this area.
- 3) Soil samples were collected in the Ten Mile Draw area in order to identify potential sources of chloride contributing to the Bitter Creek 303d impairment to Point of Rocks.
- 4) E. coli samples were collected at four "legacy sites" to serve as reference points for future monitoring that will be conducted as part of the WDEQ's TMDL for E. coli bacteria in both the Killpecker and Bitter Creek drainages.

EDE Consultants (EDE) conducted 2010 bacteria and chloride sampling within surface waters of Bitter Creek, Killpecker Creek, and their tributaries for the SWCCD during May, June, September and October 2010. Soils sampling within the Ten Mile Draw drainage near Point of Rocks was conducted during May and September 2010.

2010 sampling results are summarized in this report along with discussion of the results in relation to the impairment listings, the sampling objectives listed above, and EPA standards. Both Bitter and Killpecker Creeks have been classified by the WDEQ as recreational waters. EPA E. coli bacteria standards are based on anticipated levels of recreation designated; 1) primary contact (ingestion or full body immersion) or; 2) secondary contact (incidental or accidental exposure not resulting in ingestion or immersion). The primary contact standard for E. coli applies from May 1 through September 30. For the remainder of the year all Wyoming waters are protected for secondary contact recreation.

- The primary contact standard for E. coli is exceeded when the geometric mean of not less than five samples taken not less than

twenty-four hours apart in a period of not more than thirty days, is greater than 126 organisms per 100 mL.

- The secondary contact standard for *E. coli* is exceeded when the geometric mean of not less than five samples taken not less than twenty-four hours apart in a period of not more than thirty days, is greater than 630 organisms per 100 mL.

The chloride criterion applies to Class 1, 2AB, 2B, and 2C waters only. WDEQ classifies Bitter and Killpecker Creeks as 2C and 3B respectively. Although Killpecker Creek samples have shown high chloride concentration, as a 3B classified stream, Killpecker Creek *is not* listed as impaired for chloride. Previous sampling implicates Killpecker Creek as a major contributor of chloride to Bitter Creek (2C), which *is* listed as impaired for chloride. The chloride standards consist of a chronic and an acute standard.

- The acute standard for chloride is exceeded when the one hour average concentration exceeds 860 mg/L more than once every three years on average.
- The chronic standard for chloride is exceeded when the four day average concentration exceeds 230 mg/L more than once every three years on average.

3.0 2010 Chloride Sampling and Soils Sampling

Chloride (inorganic) sampling from 2004 through 2005 was conducted at 15 sites along Bitter and Killpecker Creeks (Plate 1, EDE 2006-1, EDE 2006-2). Ten potential chloride source sites were established along Killpecker Creek, north of I-80 and south of Yellowstone Road, and sampled in 2006, 2007, and 2008 (EDE 2009). 19 sites were sampled for chloride in spring 2009 along Bitter and Killpecker Creeks and their tributaries to refine evaluation of potential chloride sources observed from the 2004-2008 sample analysis. Chloride sampling was significantly reduced in 2010 to 11 sites. Chloride sampling sites for the 2004-2010 Watershed Assessment Project are shown on Plate 1.

Chloride concentrations in samples collected at the Bitter and Killpecker Creek sites from 2004 through 2010 are presented in Table 1. 2004-2010 Bitter and Killpecker Creek comprehensive sampling results are presented on Figure 1 for context of the data collected at all sites to date. 2004-2010 Upper Bitter Creek chloride sample results, and 2004-2010 Killpecker Creek chloride sample results, are presented on Figures 2 and 3 respectively.

Spring 2010 chloride water sampling revisited 2 existing sites on Killpecker Creek and 5 existing sites on Bitter Creek. Additionally 3 new sites in the Deadman Wash and Ten Mile Draw tributaries near Point of Rocks were also monitored (Plate 1). Fall 2010 conditions were typically dry and only two stream locations had sufficient water for sampling in September of 2010. In addition, an artesian well flowing directly into the Ten Mile Draw channel was sampled in early October 2010. Chloride monitoring goals and results based on spring and fall 2010 sampling analysis are summarized below:

1) *Confirm the 2008 Bitter Creek 303d impairment reach to Point of Rocks.*

Spring 2010 chloride sampling results continue to support the 2008 303d impairment extension to Point of Rocks based on chloride concentrations greater than the chronic criteria standard (Table 1), observed at two sites in this reach. These results, in conjunction with previous results from 2004-2009, further validate the impairment listing. These sites (BC-4 and BC-6) were dry in fall 2010.

Table 1 – 2004-2010 Bitter and Killpecker Creek Chloride Sampling Results

2004 - 2010 Sampling Chloride Results (Upstream to Downstream)

Sites	Mar 2004	Apr 2004	Aug 2004	Sep 2004	May 2005	Sep 2005	Jun 2006	Sep 2007	Jun 2008	Nov 2008	May 2009	Sep 2009	May 2010	Sep 2010
BC-7	4	23		37	29	41				16				
BC-15											4.4	26		
BC-14											7.5	21		
BC-13											14			
BCS-6												46		
BCS-5												96		
BC-17													320	
BLM														7.5
TM-2													640	
TM-1	340	200		200	190	290				230	180		490	
DM-1	47	85		190	130	200				49			160	
DM-2													360	
BC-6	43	140		510	270	740				130	600	590	380	
BC-12											770	810		
BC-11											54			
BC-10											1700			
SWC-1														
BC-5	68	660		240	630	220				480	590			
DHC1		160												
BC-4	67	730		150	300	580				690			1000	
BT Well											92	91		
MH Well											150	160		
KC-3	98	440			390									
KC-7											64			
KC-2	130	240	80	310	390	26					170	37		
KCS-2							3300	2400		3100				
KCS-1							1500							
KC-5											4400	3800	3400	
KC-4											5500	4700		
KCS-8									7.4					
KCS-7									8.1					
KCS-3							2800	3100	1140	2200	1700	1610		
KCS-10										2100				
KCS-4							3300	3700	1600	2200	2900	2920		
KCS-9										3000				
KCS-6									5400					
KCS-5							2500	7000						
KC-RStrib1											170	160		
KC-1	600	4000	4800	2200	2900	7000					8800	1160	8300	4400
BC-3A		1200			990	2000								
BC-3	200	2000		1100	1900	2100				1800				
LBC-1	710	1300			680									
BC-2	260	1500		820	1700	1800							1800	1500
BC-1	420	1300		670	1600	1600								

blue = exceedance of chronic chloride criteria = 230 mg/L

red = exceedance of acute chloride criteria = 860 mg/L

Figure 2 - 2004-2010 Upper Bitter Creek Chloride Sampling Results

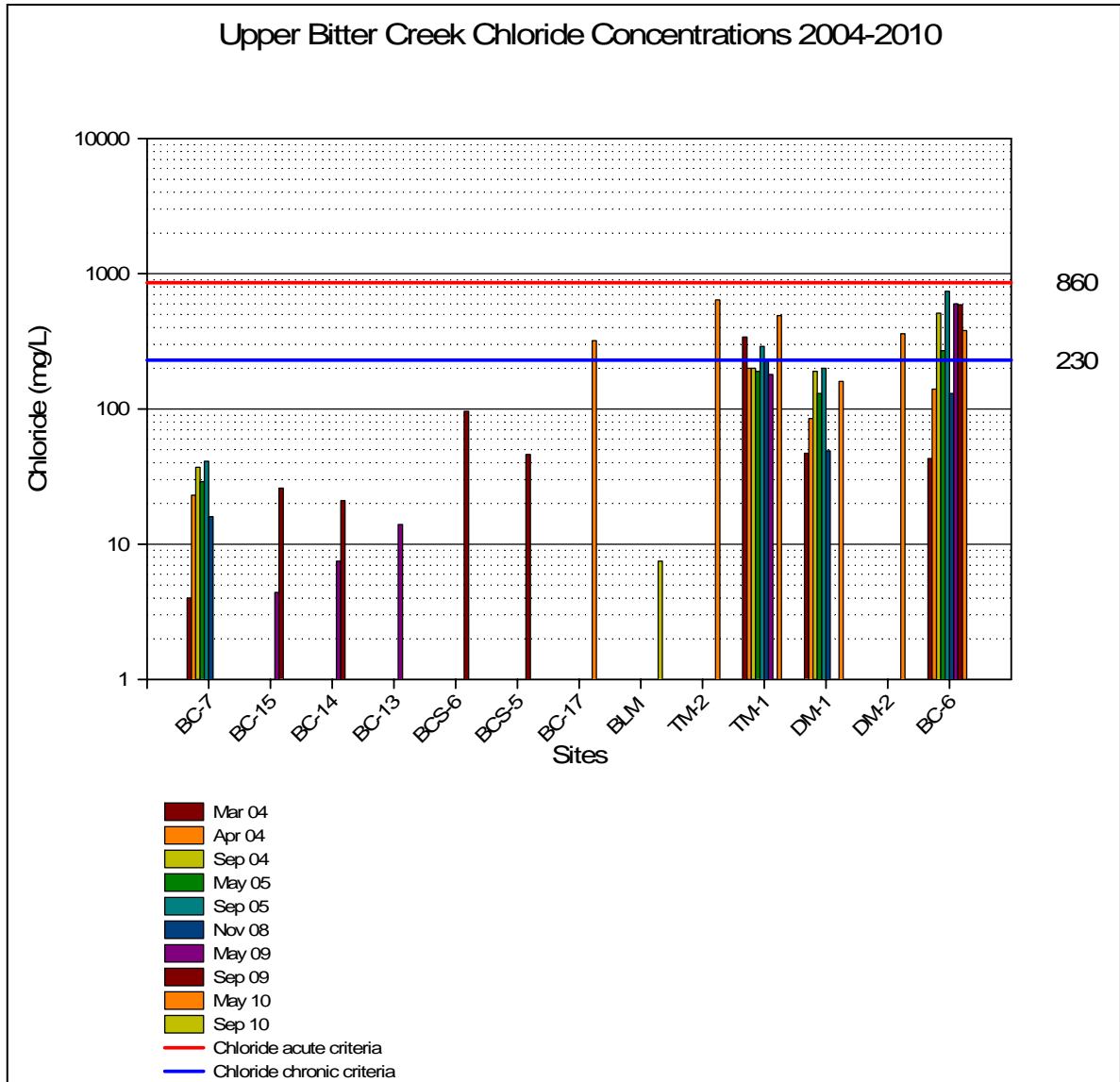
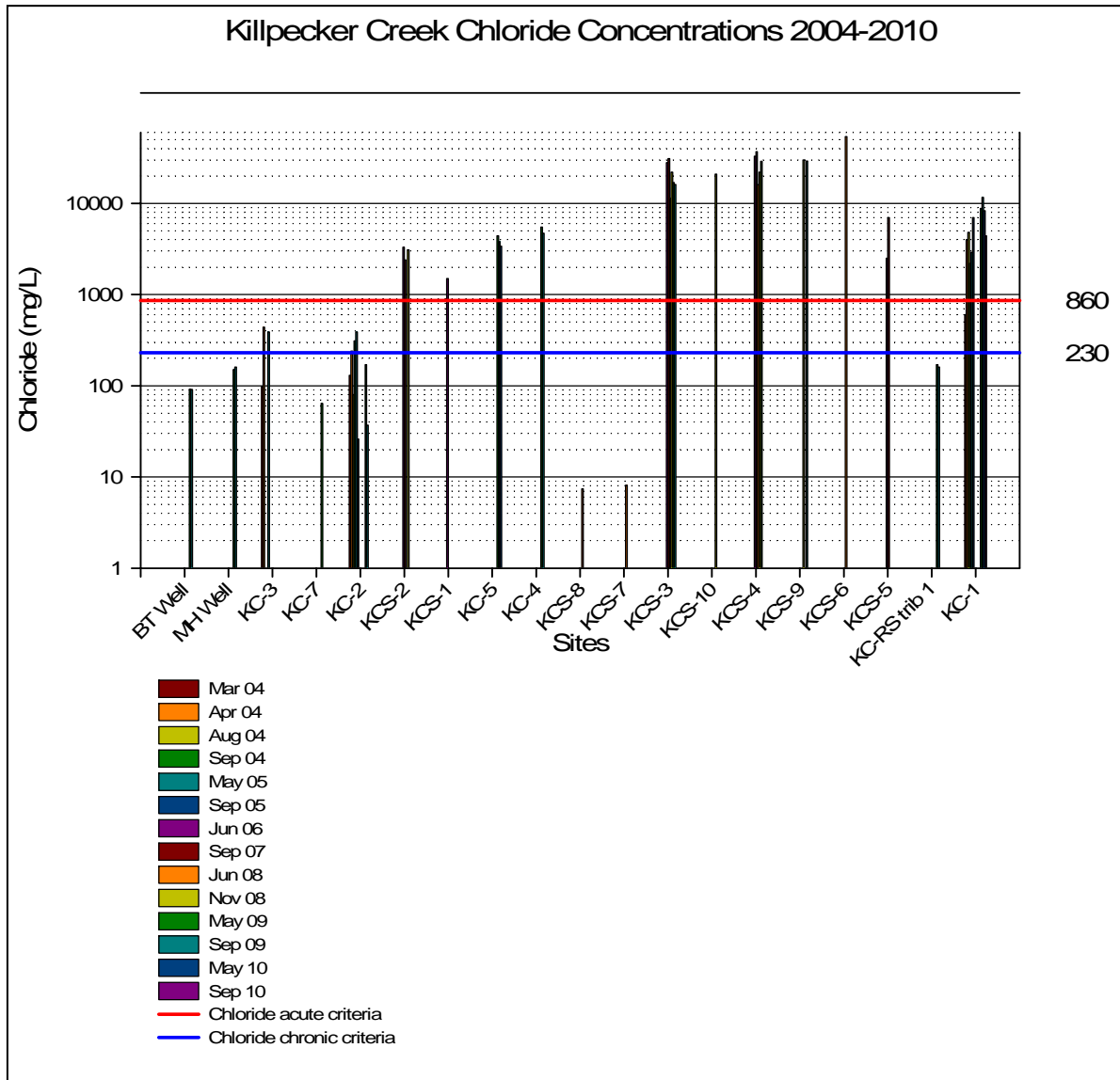


Figure 3 - 2004-2010 Killpecker Creek Chloride Sampling Results



- 2) *Identify potential source areas of chloride contributing to elevated concentrations observed in Bitter Creek at site BC-6.*

The spring 2010 chloride sampling results indicate that chloride sources are present in the vicinity of Point of Rocks (Table 1, Plate1). Previous sampling showed a large chloride increase between BC-13 and BC-6 at Point of Rocks. Site BC-17 shows that some of the increase occurs in Bitter Creek itself for an undetermined distance upstream of the confluence with Deadman Wash. 2009 sampling indicates minimal levels of chloride approximately 1.5 miles upstream at site BC-13. Further sampling in Ten Mile Draw (sites TM-1 and TM-2) shows that significant amounts of chloride are present *when stream flow occurs*. This appears to be diluted by flow from Deadman Wash as these two tributaries converge. However, the combined flow does contribute significant amounts of chloride to Bitter Creek just upstream of site BC-6 at Point of Rocks. This further refinement of sampling at the upper end of the impairment suggests that the alluvial areas in the immediate vicinity of Point of Rocks are a likely contributor to the marked increase in chloride that is observed at site BC-6.

Sampling upstream in Ten Mile Draw was undertaken in fall 2010 but limited (due to dry conditions) to an artesian well on BLM land upstream of Bridger Coal Company and 4 soils samples. This well (Site BLM Spring) flows directly into the stream channel but does not contribute enough to cause perennial stream flow. Water samples indicate very low chloride levels compared to downstream samples at sites TM-2 and TM-1 near Point of Rocks. Soils adjacent to this well (within 50') do show elevated chloride levels although not as high as soils in the alluvial plain near Point of Rocks. Soil samples farther from the spring and farther up the stream channel show minimal levels of chloride. Sampling results from two surface water stations upstream and downstream of the mine property operated by Bridger Coal Company (roughly halfway between the BLM Spring and Point of Rocks) suggest that the chloride inputs begin upstream of mining activity adjacent to Ten Mile Draw (an undisturbed drainage on the mine). Lab reports for two

shallow alluvial wells in Ten Mile Draw at the *upstream boundary* of the mining permit indicate elevated levels of chloride present in shallow groundwater. Nearby groundwater wells in deeper strata show much lower levels of chloride than the shallow alluvial wells. Additional soils and stream samples may be beneficial in determining the specific reach of Ten Mile Draw upstream of Bridger Coal Company where chloride levels begin to significantly increase.

It is noteworthy to remember that flows within the main stem of Bitter Creek and its tributaries in the vicinity of Point of Rocks are ephemeral in nature and do not constitute a year round contribution to the extended impairment reach of Bitter Creek.

3) *Refine/confirm the source area identified on lower Killpecker Creek during 2006-2008.*

Spring 2010 chloride samples taken at sites KC-5 and KC-1 confirm the source area identified in 2004-2008 sampling north of I-80 and south of Yellowstone Road (Table 1, Figure 3, Plate 1). The spring 2010 sample results seen at site KC-5 indicate that this source area may continue some distance north of Yellowstone Road at site KC-5 but south of site KC-2 (Table 1). Fall 2010 sampling was only possible at the downstream site (KC-1) due to dry conditions. Sample results showed a return at site KC-1 to chloride levels last seen in 2004. The magnitude of the chloride concentrations at these lower Killpecker Creek basin sites is much greater than it is within the upper Killpecker Creek basin. This, in conjunction with the perennial nature of the stream in this area, indicates that the *principal* reach of Killpecker Creek *consistently* contributing to elevated chloride within Bitter Creek is located in this area downstream of site KC-2. In addition, significant, ongoing road and infrastructure construction is occurring in the stream reach south of Yellowstone Rd. It is unclear as to what specific impacts this construction will have as it disturbs the various small tributaries entering Killpecker Creek. At present, downstream chloride levels are higher than upstream chloride levels.

However, both up and downstream chloride contributions are lower than had been observed in 2009 sampling.

12 soils samples were collected from 2006 through 2008 within the potential chloride source area along Killpecker Creek between I-80 and Yellowstone Road. Spring 2009 chloride soils sampling was conducted to build on 2006-2008 sampling, and better define potential areas where soils may be contributing to elevated chloride concentrations observed within both Bitter and Killpecker Creeks. In spring 2009, 7 soils samples were collected along Bitter Creek upstream of Rock Springs, and 4 soils samples were collected along Killpecker Creek upstream of KC-2. In 2010 eight soil samples were collected. Seven were taken to look at chloride levels along Ten Mile Draw and one was taken near Bitter Creek site BC-17. 2006-2010 soils sample results are shown in Table 2, site locations are shown on Plate 1.

Spring 2010 soils sample chloride concentrations were mostly very high with results similar to those seen along lower Killpecker Creek (Table 2). Three samples were collected in the alluvial fan material through which Ten Mile Draw enters Deadman Wash. TMSS-1 which displayed the highest chloride concentration recorded in the seven year study was furthest upstream near stream sample site TM-2. TMSS-2 was halfway between stream sites TM-2 and TM-1 and measured almost exactly half the amount of chloride. TMSS-3 was collected near the existing TM-1 stream site and showed negligible amounts of chloride. These three soil samples in the Ten Mile Draw drainage were collected on the bench running adjacent to the south side of the stream channel. A fourth soil sample was collected on the bench on the south side of the Bitter Creek channel adjacent to stream sample site BC-17. The fourth sample also displayed high levels of chloride similar to those seen in the Ten Mile Draw and the lower Killpecker Creek drainage. It is unclear *exactly* where elevated chloride levels begin in Bitter Creek proper upstream of Point of Rocks. However, stream samples 1.5 miles upstream of Point of Rocks show extremely low levels of chloride as do the rest of the headwaters of Bitter Creek. Soil sample TMSS-4 was collected at the bluff several hundred yards southwest of TM-2 and TMSS-1 to explore the potential contributions of the parent

rock material in the vicinity. Additional soil sampling in fall 2010 was conducted near the BLM Spring site in the headwaters of the Ten Mile Draw drainage. Soils adjacent to the artesian well (site TMSS-5) showed elevated levels of chloride while soils from a nearby bluff and upstream of the spring (sites TMSS-6 and TMSS-7) had very low chloride levels.

The soils data collected in 2010 suggests that areas near Point of Rocks contain soils high in chloride which may contribute to elevated chloride levels during run-off events and seasonal flows from both Bitter Creek and surrounding tributaries. It would also appear that chloride levels begin to increase downstream of the BLM Spring site but upstream of mining operations at Bridger Coal Company in Ten Mile Draw. The ephemeral nature of these streams would result in chloride contributions to Bitter Creek only during portions of the year when flow exists.

Table 2 – 2006–2010 Bitter and Killpecker Creek Chloride Soils Sampling Results

Chloride from Soils Samples 2006-2010		
Sample ID	Sample Date	Chloride PE meq/L
KC Soil - 1	6/15/2006	420.00
KC Soil -2	6/15/2006	534.00
KC Soil -3	6/15/2006	530.00
KC Soil -4	6/15/2006	155.00
KC Soil -5	6/15/2006	417.00
KCSS-6	9/6/2007	341.00
KCSS-7	9/6/2007	203.00
KCSS-8	9/6/2007	125.00
KCSS-9	6/10/2008	0.15
KCSS-10	6/10/2008	3.05
KCSS-11	6/10/2008	0.18
KCSS-12	6/10/2008	2.74
BCSS-1	5/29/2009	12.20
BCSS-2	5/29/2009	35.80
BCSS-3	5/29/2009	5.13
BCSS-4	5/29/2009	17.10
BCSS-5	5/29/2009	0.12
BCSS-6	5/11/2009	1.17
KCSS-13	5/13/2009	0.31
KCSS-14	5/13/2009	1.68
KCSS-15	5/13/2009	371.00
LCSS-1	5/13/2009	0.37
NBBSS-1	5/29/2009	5.23
BCSS-7-01	9/23/2009	0.09
BCSS-7-02	9/23/2009	0.05
BCSS-8	9/23/2009	13.00
BCSS-9	9/23/2009	0.23
BCSS-10	9/23/2009	1.36
BCSS-11	9/17/2009	21.20
BCSS-12	9/17/2009	14.50
BCSS-13	9/17/2009	19.20
BCSS-14	9/17/2009	10.40
BCSS-15	9/17/2009	0.14
BCSS-16	9/17/2009	0.13
BCSS-17	5/25/2010	421.00
TMSS-1	5/26/2010	679.00
TMSS-2	5/26/2010	341.00
TMSS-3	5/26/2010	3.62
TMSS-4	9/14/2010	0.09
TMSS-5	9/14/2010	61.80
TMSS-6	9/14/2010	0.13
TMSS-7	9/14/2010	0.06

soils showing elevated chloride levels

4.0 2010 Bacteria Sampling

Bacteria sampling from 2004 through 2005 was conducted at 15 sites along Bitter and Killpecker Creeks (Plate 1, EDE 2006-1, EDE 2006-2). 6 potential source sites (4 discharging to Bitter Creek, and 2 groundwater wells) were established along Bitter Creek within the City of Rock Springs and sampled in 2006, 2007, and 2008 (EDE 2009). Spring 2009 E-coli sampling was conducted at 7 of the original (2004-2005) Bitter and Killpecker Creek sites and at 9 new Bitter and Killpecker Creek sites. Sampling at an additional 4 sites was attempted for E. coli to broaden the evaluation, but these sites were dry during the sampling round (these include historic sites SWC-1 and KC-3). For 2010 E. coli sampling throughout both drainages was reduced to four "legacy sites". Samples from sites near Point of Rocks, upstream of the Bitter/Killpecker Creek confluence in Rock Springs, lower Killpecker Creek in Rock Springs and in Bitter Creek downstream of Rock Springs are intended to act as reference measurements as the WDEQ seeks to implement a TMDL for E. coli on both Bitter and Killpecker Creeks.

E. coli geomean concentration sample results collected at the Bitter and Killpecker Creek sites from 2004 through 2010 are presented in Table 3. 2004-2010 Bitter and Killpecker Creek comprehensive E-coli geomean concentration sample results are presented on Figure 4 for context of the data collected at all sites to date. 2004-2010 legacy site E. coli geomean concentration sample results are presented on Figure 5 and Killpecker Creek geomean concentration sample results are shown on Figure 6. Site locations are presented on Plate 1.

2010 E. coli sampling monitoring goals and interim results based on spring 2010 sampling analysis are summarized below:

- 1) *Monitor E. coli levels at 4 legacy sites spread over the 3 impaired reaches of Bitter and Killpecker Creeks to serve as reference points for upcoming TMDL development.*

The E. coli concentrations sampled during the 2010 sampling round do not initially support the impairment listings for Killpecker Creek or the

extended impairment on Bitter Creek. All four legacy sites were sampled in May and June of 2010. However, viable samples could only be collected at two locations in September of 2010 due to dry conditions. Samples were collected at the upper end of the extended Bitter Creek impairment at Point of Rocks (site BC-6), immediately upstream of the Bitter/Killpecker Creek confluence in Rock Springs (site BC-4), at the lower end of Killpecker Creek in Rock Springs (site KC-1) and downstream of Rock Springs (site BC-2). The furthest downstream site (BC-2) showed 5 day geometric mean E. coli concentrations of 150.53 col/100ml in May and June and 52.18 col/100ml in September indicating that this lower reach of Bitter Creek continues to exceed the full contact recreation limit of 126 col/100ml. Meanwhile, the KC-1 site has shown 4 consecutive decreases in E. coli concentration, all below the level of the more stringent full contact recreation criterion. In fact the latest measurement from September 2010 is the lowest on record at this location. This gives rise to some cautious optimism that improvements along Killpecker Creek are having positive effects on overall E. coli contributions to Bitter Creek within the Rocks Springs City limits. The much less robust number of bacteria samples collected in 2010 limits the ability to speak to the effectiveness of BMPs in stream reaches that were of specific concern in previous sampling such as Killpecker creek near Reliance and Bitter Creek as it enters the east side of Rock Springs.

Table 3 – 2004-2010 Bitter and Killpecker Creek E. coli Sampling Results

2004 - 2010 Sampling E. coli Bacteria Results (Upstream to Downstream)

Sites	Spring 2004	Fall 2004	Spring 2005	Fall 2005	Spring 2006	Fall 2007	Spring 2008	Fall 2008	Spring 2009	Fall 2009	Spring 2010	Fall 2010
BC-7	2.61	132.54	99.81	1033.13								
TM-1	77.25	33.59	56.70	963.14								
DM-1	7.63		37.81	98.50								
BC-6	3.59	1.82	27.74	266.80					212.75	54.33	85.44	
BC-12									54.89	726.17		
BC-10									896.33			
SWC-1												
BC-5	5.72		28.80	406.00					4.24			
BC-9									49.28			
BC-SYN 4										3030.00		
BC-SYN 3										2370.00		
BC-8									2031.78	1747.67		
BC-SYN 2									0.50			
DHC1	1.00	377.77										
BC-SYN 1									63			
BC-4	14.49	351.74	42.62	1324.25					2410.67	749.49	75.88	
KC-3	1.58		92.52									
KC-6									6382.19	601.65		
KC-2	66.09	889.42	297.37	3109.38					5703.00	1669.13		
KC-RStrib 1									1.66	19.97		
KC-1	45.68	727.12	399.21	424.76					87.06	70.44	17.91	3.98
BCW-1					0.50	0.50	1.21	0.50				
BCS-4					179.81	31.26	28.22	79.34				
BCS-3					0.50	0.50	1.86	2.47				
BCW-2					0.91	0.50	1.21	3.78				
BC-16									320.52	314.10		
BCS-2					0.50	0.50	6.14	0.50				
BC-3A	3.59	2.71	123.76	1774.69								
BC-3	61.68	169.86	269.83	2324.92					136.52	570.28		
BCS-1					1.05	5.24	0.50	0.50				
BC-RStrib2										0.5		
BC-Syn5/trib1										22400.00		
LBC-1	65.21		2.46									
BC-2	26.04	224.85	243.58	1163.32					82.16	219.39	150.53	52.18
BC-1	26.03	705.98	194.22	681.71								

red = exceedance of primary contact E.coli bacteria criterion = 126 col/100ml May - Sept

Figure 4 - 2004-2010 Bitter and Killpecker Creek E. coli Sampling Results

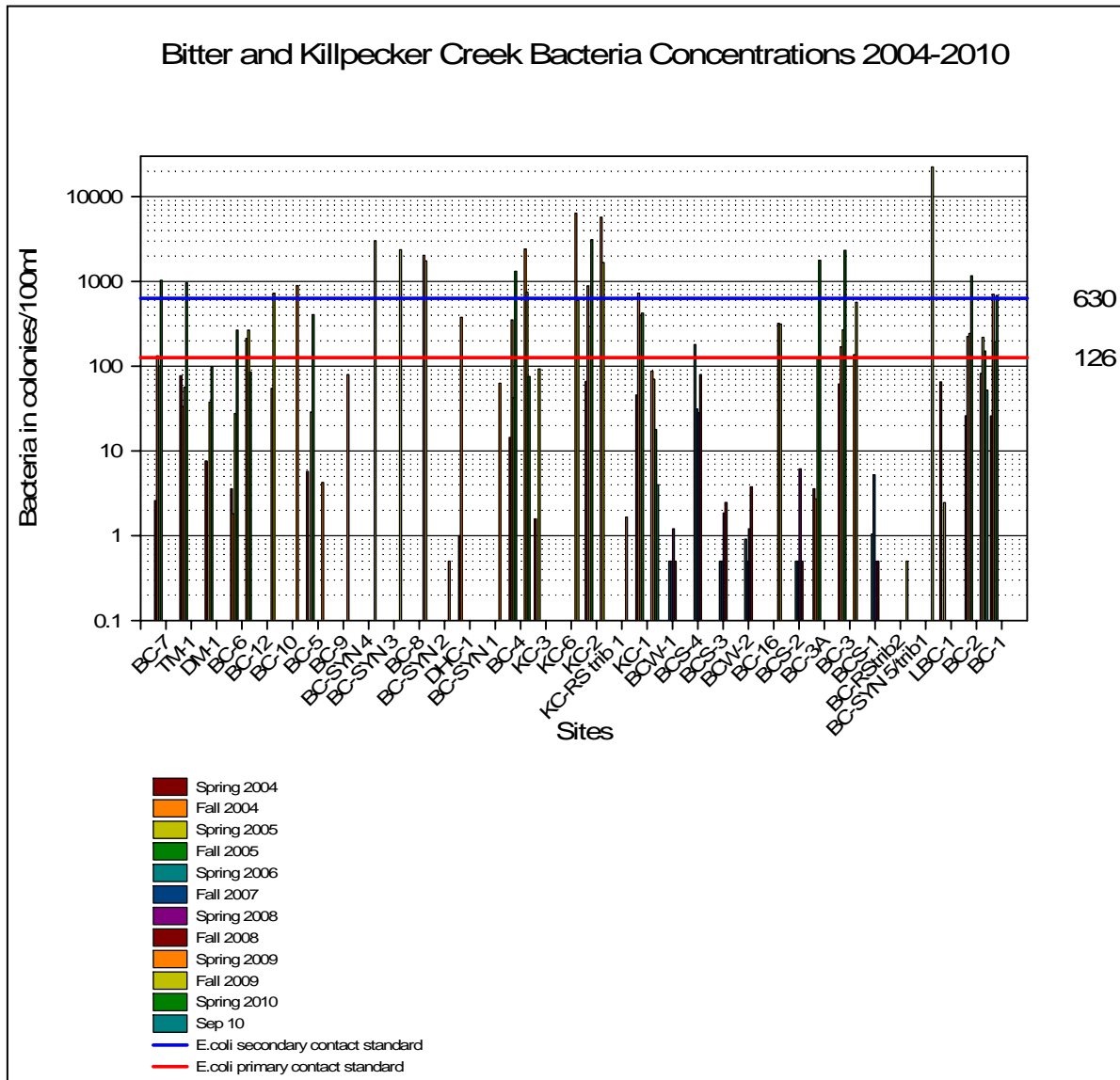


Figure 5 - 2004-2010 Legacy Site E. coli Sampling Results

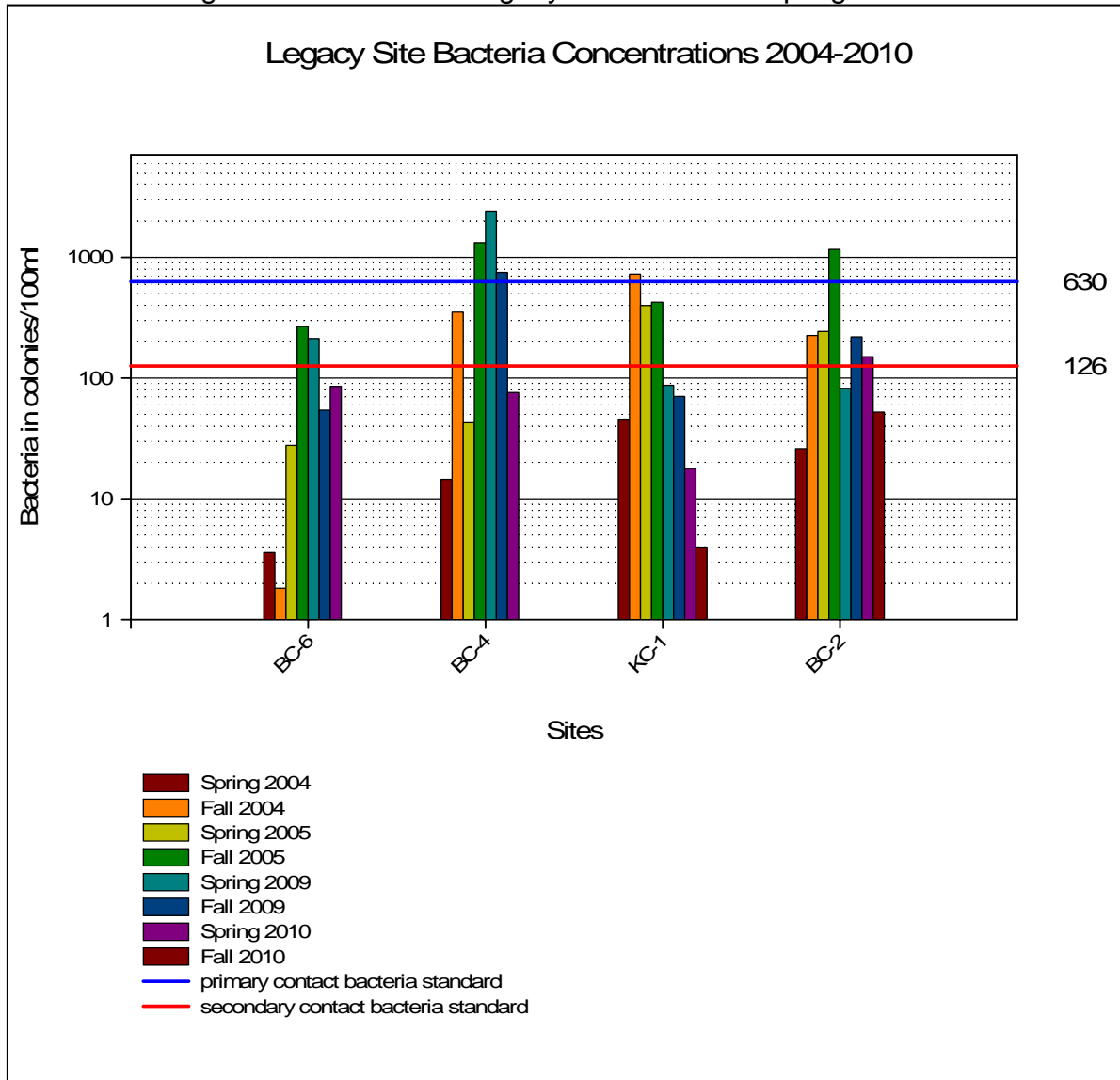
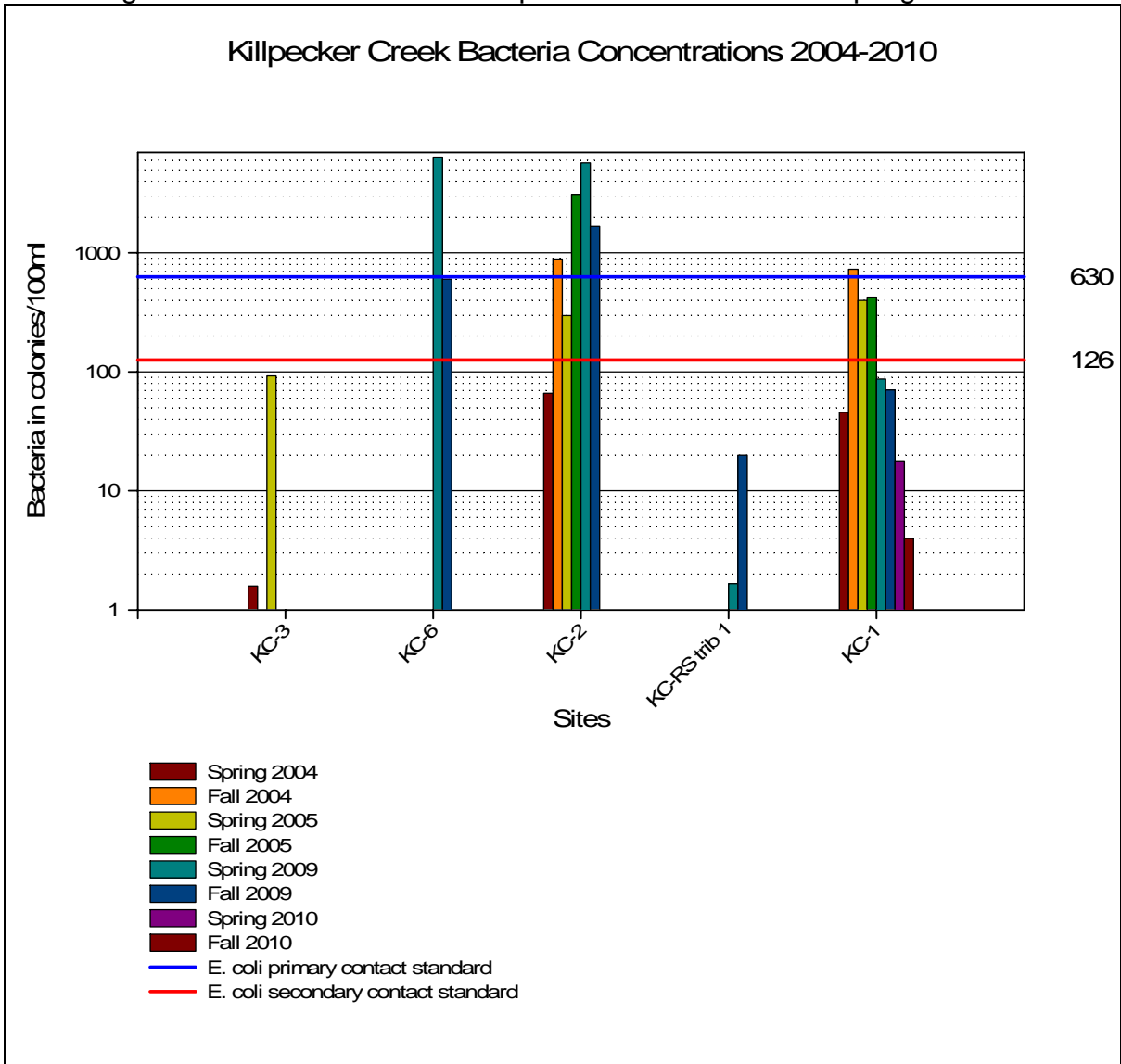


Figure 6 - 2004-2010 Lower Killpecker Creek E. coli Sampling Results



5.0 Summary and Conclusions

2010 sampling was conducted to monitor the extent and potential sources for the extended Bitter Creek chloride impairment near Point of Rocks and to monitor four "legacy sites" for the Bitter and Killpecker Creek E.coli impairment listings on the WDEQ 303d list. Conclusions that can be drawn from the 2010 sampling are:

- 2010 chloride sampling supports the initial and extended 303d impairment listings from Rock Springs to Point of Rocks.
- A potential source area for elevated chloride concentrations in Bitter Creek occurs upstream of site BC-6 and downstream of site BC-13 including the Ten Mile Draw tributary near Point of Rocks.
- Native soils in and along Bitter Creek and Ten Mile Draw upstream of site BC-6 and downstream of BC-13 may be contributing to increased chloride concentrations seen within Bitter Creek in this reach. Soils sampling as well as surface and groundwater quality reports from Bridger Coal Company indicate that potential chloride contributions from Ten Mile Draw begin at an unknown point upstream of Bridger Cola Company's mining operations but downstream of the BLM Spring located near the headwater area of this tributary to Bitter Creek.
- The ephemeral nature (noted during the 2004-2010 sampling) of Bitter Creek upstream of Point of Rocks as well as the Ten Mile Draw and Deadman Wash tributaries that enter Bitter Creek at Point of Rocks allows only for intermittent contributions from these areas to the extended chloride impairment of Bitter Creek.
- The primary source of elevated chloride concentrations within Killpecker Creek appears to be downstream of site KC-2. A noteworthy portion of that source is native soils upstream of I-80, downstream of Yellowstone Road, and west of Killpecker Creek. It is unclear what, if any, impact ongoing road and infrastructure construction in the area has on chloride levels in this reach of Killpecker Creek. 2010 chloride

concentrations were lower than those seen in 2009 but higher than those recorded in 2004-2005 before significant construction began.

- Spring 2010 E. coli concentrations within Bitter Creek at Point of Rocks (site BC-6) and within the City of Rock Springs at site BC-4 are lower than the 126 col/100ml criteria that would confirm the impairment. Fall measurements were not possible at either of these locations due to dry conditions and stagnant pools at the sampling sites. However, water quality downstream of Rock Springs at site BC-2 continues to support the impaired listing on the lower portion of Bitter Creek. The 2010 E. coli concentrations in Killpecker Creek at site KC-1 were the lowest observed during the entire project and were well below the impairment criteria. Four consecutive samples have been below 126 col/100ml with each new sample having a concentration reduced from the previous one.
- The discharge to Killpecker Creek at site KC-6 near Reliance was not sampled in 2010. The City and County have been notified of the high E. coli concentrations observed there in 2009. No further sampling was conducted at this site by the SWCCD as per the reduced sampling plan decided on for 2010.

Continued monitoring of the four E. coli legacy sites, to collect inorganic stream samples and further exploratory chloride soils sampling may be warranted at the discretion of the SWCCD. Continued 5 day geomean monitoring of the E. coli legacy sites would allow the SWCCD to maintain a series of reference points at key locations in the watershed for minimal cost. However, conversation with WY DEQ personnel (Don Newton) calls that approach into question from a methodological standpoint as a 5 day geomean sampling plan is required only if a stream is a candidate for listing or de-listing on the 303d List of Impaired Waters. Single sample or bi-yearly sampling may accomplish the reference goals desired by the SWCCD. Further inorganics and soil sampling in 2011 may contribute to the accuracy of the chloride TMDL being developed by the WY DEQ. However, the SWCCD needs to

determine what level of involvement they want in the collection of data towards this end. At present the WY DEQ is scheduled to begin work on assigning TMDLs for E. coli impairment on Bitter Creek and Killpecker Creek and for chloride impairment on Bitter Creek at some point in 2012. These questions must be addressed before monitoring goals for the Watershed Assessment can be set for 2011.

6.0 References

EDE Consultants, "Bitter and Killpecker Creeks Watershed Study 319 (h) Grant Project Report 2004-2005 Monitoring Period", 23 N. Scott St. Suite 27, Sheridan, WY 82801, June 2006 (EDE 2006-1).

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EDE Consultants, "Bitter Creek and Killpecker Creek 2009 Bacteria and Chloride Sampling Results Comprehensive Report", 23 N. Scott St. Suite 27, Sheridan, WY 82801, February 5th, 2010 (EDE 2010).

Wyoming Department of Environmental Quality, Water Quality Division, "Wyoming's Draft 2008 305 (b) Integrated State Water Quality Assessment Report and Draft 2008 303(d) List of Waters Requiring TMDLs", 2008.

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Plate 1 – 2010 Monitoring Site Locations