

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



**Bitter Creek and Killpecker Creek  
2011 Bacteria and Chloride Spring Sampling  
Results Summary Report**

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## **Executive Summary**

Sampling in the Bitter Creek watershed for E. coli bacteria and chloride was undertaken in the spring of 2011 by EDE Consultants under the direction of the Sweetwater County Conservation District (SWCCD) and the Bitter/Killpecker Creek Watershed Assessment Group (BKWAG). Additional assistance was provided by the Wyoming Department of Environmental Quality (WDEQ) in terms of choosing sampling sites and the installation of flow monitoring equipment. Sampling benefited from the higher than average snow pack conditions seen in the spring of 2011 having samples collected during both high and relatively normal stream flow conditions.

E. coli bacteria samples were collected as 5 day geomeans from five locations that had previously been sampled during the project. All results were within historical ranges seen at these locations. The two rural sites upstream of Rock Springs had sample results giving geomean calculations below the primary contact E. coli bacteria criterion of 126 col/100ml. The three sites influenced by urban development had sample result geomean calculations exceeding this criterion. A set of E. coli samples was able to be collected from Salt Wells Creek for the first time during the project due to higher than normal flow conditions. All bacteria samples collected from Salt Wells Creek were at or below the primary contact bacteria criterion.

Chloride sampling was conducted during the relatively high flows seen at the end of May 2011. Samples were collected from seven locations that had previously been sampled during the project, five of which were also used for bacteria sampling. The two additional sites were located on Killpecker Creek with the intention of collecting a more robust set of quality/flow data for this significant tributary of Bitter Creek. All of the chloride concentrations recorded during the higher than normal stream flow conditions were within historical ranges at the sites. All seven sets of results were near or at the lowest results seen at their respective sites during the project. In addition, Salt Wells Creek was able to be sampled for chloride for the first time during the project and displayed chloride levels far below the chronic chloride criterion.

With help from Mike Wachtendonk of the WDEQ seven water level data loggers and two barometric pressure loggers were installed at the sampling locations in Bitter and Killpecker Creeks. Data from these loggers will be used by the WDEQ with the sample results to calculate Total Maximum Daily Loads (TMDLs) for both E. coli bacteria and chloride for the impaired reaches of Bitter and Killpecker Creeks.

## **Project Goals**

The Sweetwater County Conservation District (SWCCD) and Bitter/Killpecker Watershed Assessment Group (BKWAG) project goals for Spring water quality and quantity sampling in Bitter and Killpecker Creeks in 2011, were established during the March 10<sup>th</sup>, 2011 BKWAG meeting in Rock Springs. Sampling goals have shifted from the identification of stream reach areas having high concentrations of E. coli and chloride (this is thought to be suitably defined for the near term), to maintaining legacy quality observation sites and collecting quality data paired to stream flow (quantity) at select sites. The quality and flow data will be used to aid the Wyoming Department of Environmental Quality (WDEQ) in calculating pollutant loads for development of Total Maximum Daily Load (TMDL) standards for both E. coli and chloride. Sampling sites have been selected with WDEQ input.

For 2011 the SWCCD and BKWAG decided to proceed with collecting 5 day geomean samples for bacteria in order to maintain consistency with past sampling rounds, and because of the high degree of variability common to bacteria sampling (results can change widely from day to day). It was also thought that if samples obtained in Killpecker Creek continued the 2009-2010 trend of E. coli concentrations meeting WDEQ standards it may be a candidate for delisting, making the 5 day geomean calculations essential (WDEQ methodology requires 5-day geomeans). E. coli and chloride (along with other additional basic inorganic quality parameters) samples were planned to be collected at a limited number of key sites in the watershed with opportunistic single day grab samples collected during high flow events as possible. In addition, water level data loggers were to be installed at these key locations in the watershed to collect continuous depth information for use in determining site flows based on surveyed site channel ratings. All former significant stream sampling sites where project samples have been collected since 2004 were planned to receive a site visit to photo document the presence or absence of flow and general site conditions.

## **Work Completed**

E. coli samples were collected at four "legacy" sites consisting of BC-2 downstream of Rock Springs, KC-1 on Killpecker Creek just before its confluence with Bitter Creek, BC-4 on Bitter Creek just upstream of the confluence with Killpecker Creek and BC-6 at Point of Rocks at the upstream end of the WDEQ 303d listed impairment reach of Bitter Creek. Site BC-10, just downstream of the significant head cut 10 miles east of Rock Springs was selected in addition to these four sites to help document apparent ephemeral flow conditions in Bitter Creek between Point of Rocks and Rock Springs.

A significant opportunity arose from the late spring and elevated snow melt runoff in 2011 which resulted in Salt Wells Creek flowing at site SWC-1 for the first time since project monitoring began in 2004. Significant flow occurred in this tributary to Bitter Creek and samples were collected at the same time as the legacy sites. No other

opportunistic *E. coli* samples have been collected at this point in the 2011 sampling season.

*E. coli* samples for the 5 day geomean were originally collected 5/31/11 thru 6/2/11 and 6/15/11 and 6/16/11. Unfortunately the lab began analysis of some of the samples on 5/31/11 thru 6/2/11 after the 6 hour holding time had expired. As a result the following samples are out of compliance:

- BC-2 - the sample on 6/2/11 exceeded the holding time by 10 minutes
- BC-4 - the sample on 5/31/11 exceeded the holding time by 40 minutes and the sample on 6/2/11 exceeded the holding time by 30 minutes
- BC-6 - the samples on 5/31/11 and 6/2/11 exceeded the holding time by 130 minutes, the sample on 6/1/11 exceeded the holding time by 10 minutes
- BC-10 - the samples on 5/31/11 and 6/2/11 exceeded the holding time by 110 minutes
- KC-1 - the sample on 5/31/11 exceeded the holding time by 60 minutes and the sample on 6/2/11 exceeded the holding time by 50 minutes
- SWC-1 - the samples on 5/31/11 and 6/2/11 exceeded the holding time by 80 minutes

To correct this error, the lab offered to redo two sampling rounds free of charge. Travel costs for the extra sampling were defrayed by combining the trip with other EDE project work in the Rock Springs area. Unfortunately Salt Wells Creek dried up between collection of the 6th and 7th samples resulting in an inadequate number of samples in compliance to calculate a true WDEQ 5 day geomean result.

In terms of the larger project goals, the *E. coli* samples collected that are in compliance will be usable for calculating daily loads, and the SWC-1 samples will provide significant insight into any contribution of Salt Wells Creek to the Bitter Creek *E. coli* impairment.

Inorganic (chloride and other basic parameters) samples were also collected at the same four legacy sites as for *E. coli* plus BC-10 with two additional samples collected in the Killpecker Creek watershed. Site KC-5 at the Yellowstone Road bridge and site KC-2 at the Hwy 191 bridge near Reliance were selected in Killpecker Creek with input from the WDEQ to assess chloride loading within the reach of Killpecker Creek that displays perennial flow. The high stream flows seen in late May and early June allowed the collection of chloride samples during a relatively high flow event for the project to date. In addition, inorganic sampling was conducted at SWC-1 in Salt Wells Creek. This was the first chloride sample collected from this tributary during the project. No other opportunistic chloride samples have been collected at this point in the 2011 sampling season.

The four legacy sites (BC-2, BC-4, BC-6 and KC-1) plus site BC-10 and site KC-2 were selected as the locations for installation of the water level data loggers. Two additional barometric pressure data loggers were installed (to enable proper calculations of water levels) at the SWCCD office in Rock Springs and at site DM-1 near Point of

Rocks. The loggers were installed on 5/26/11 and 5/27/11 at all sites and will be visited by both WDEQ and EDE during the year to collect data at appropriate intervals. The collected data will then be paired to the dates when sampling was conducted at the sites to establish quality-flow relationships (loading).

Site visits that include photo documentation and a brief description of stream flow conditions were conducted in May/June of 2011 at 31 sites including BC-2, BC-3, BC-3a, BC-4, BC-5, BC-6, BC-7, BC-8, BC-9, BC-10, BC-11, BC-12, BC-13, BC-14, BC-15, BCS-3, BCS-4, DHC-1, DM-1, KC-1, KC-2, KC-3, KC-4, KC-5, KC-6, KCS-3, KCS-4, KCS-5, LBC-1, SWC-1 and TM-1. As of this time the site visit for BC-1 near the mouth of the Green River is not able to be completed until appropriate access arrangements are made.

## **Data Analysis/Conclusions**

### E. coli bacteria

E. coli sampling in the spring of 2011 occurred during a combination of both high flow (snow melt) and relatively normal spring flows. The sample results for the legacy sites are within the historical ranges seen throughout the study. The three urban sites (BC-2, BC-4 and KC-1) all had E. coli 5-day geomean concentrations in exceedance of the primary contact E. coli criterion of 126 col/100ml. The three rural sites sampled (BC-6, BC-10 and SWC-1) had 5-day geomean concentrations below the E. coli criterion.

The spring 2011 E. coli sampling results continue to support the bacteria impairment of Bitter Creek from the Green River to Rock Springs. E. coli concentrations for the extended impairment of Bitter Creek at BC-6 fall just below the primary contact criterion, however, one of the 5 results used to calculate the geomean exceeds the EPA holding time of 6 hours by 10 minutes. The impairment of Killpecker Creek for E. coli continues to be supported by the spring 2011 bacteria geomean of 517.72 col/100ml. This significantly reverses the trend seen over the past two years at KC-1 which had shown E. coli levels drop from 87.06 col/100ml to 3.98 col/100ml.

Given the necessity of re-sampling due to laboratory error, some interesting observations arose. Sites BC-6 and BC-10, located in more rural settings, had sample results giving higher geomeans when the earlier, high flow event results were included in the calculations. Sites BC-2, BC-4 and KC-1, within and downstream of Rock Springs, all exhibited lower geomean calculations when the higher flow sample results were included. However it should be noted that both sets of calculations for sites BC-2, BC-4 and KC-1 exceeded the primary contact bacteria criterion.

In the case of site BC-6 at Point of Rocks, the 5 day geomean containing 3 out-of-compliance results from high flows in late May and early June is 172.5 col/100ml. The geomean for BC-6 containing two results from the lower flows at the end of June (and one earlier result that is just 10 minutes out of compliance) is 118.2 col/100ml, just under the primary contact criterion. Similarly, the geomean is higher for site BC-10 if

one includes the earlier, high flow event results although the overall difference is very small (11.7 col/100ml vs. 1.45 col/100ml) and both results are far below the primary contact criterion. The only other geomean developed for site BC-10 was in the spring of 2009 with a calculation of 896.33 col/100ml. The extremes noted in the course of just two spring samples at BC-10 highlight the variability common to E. coli calculations during the project in the watershed. Site SWC-1 was sampled for the first time during the project and showed similar characteristics between high and low flow calculations. Lower bacteria numbers were noted during higher flows in late May and early June. Higher bacteria numbers were noted in lower flows at the end of June. Unfortunately dry conditions at the end of June prevented collection of a full 5 samples for calculating a geomean.

Please refer to the table labeled Table 1 - 2004 - 2011 Sampling E. coli Results for the full list of E. coli geomean calculations.

### Chloride

Chloride sampling results at site BC-2 continue to support the chloride impairment of Bitter Creek from the Green River to Rock Springs, although site BC-4 had results below the chronic chloride criterion. Site BC-10 continues to support the extended chloride impairment from Rock Springs to Point of Rocks, while site BC-6 sample results at the upper end of this reach were below the chronic chloride criterion. Chloride levels at all sites sampled including BC-2, BC-4, BC-6, BC-10, KC-1, KC-2 and KC-5 are in the lower range of the historical project data. This may suggest that high flow events associated with spring snow melt in the headwaters and tributaries do not necessarily contribute to higher chloride loading in this watershed.

Sites KC-1, KC-5 and KC-2 on Killpecker Creek offer an example. Sampling on May 31<sup>st</sup> showed that all three KC sites were running with elevated flows with turbidity too high for the turbidimeter to record. Significant rainfall in the Rock Springs area had occurred on the days leading up to sampling these sites. Site KC-1 exhibited much higher turbidity and flow, based on visual observation, than both KC-5 and KC-2 which are further upstream. Further observation revealed that a significant amount of flow was entering Killpecker Creek downstream of Site KC-5 via the tributary called KCS-3 which receives spring flows directly from snow melt off White Mountain above North Rock Springs. This significant input of snow melt and turbidity resulted in a chloride result of 640 mg/l, the second lowest of 11 samples recorded at site KC-1 during the entire study, and thousands of mg/l below any recent sampling. The chloride measurement for KC-5 was 260 mg/l, the lowest of four samples collected at this site. The chloride measurement at site KC-2 was 140 mg/l, the 5th lowest of nine samples. Again all three Killpecker Creek samples from the spring of 2011 were collected during a high runoff event with significant sediment loads and all showed relatively low amounts of chloride for this watershed.

Salt Wells Creek was also sampled for chloride on May 31<sup>st</sup>. This was the first chloride sample collected from this tributary during the study. Initial observations based on the lab result of 43 mg/l of chloride and the ephemeral flow regime would indicate

that this tributary is likely not a large potential contributor of chloride to the Bitter Creek watershed.

Please refer to the table labeled Table 2 - 2004 - 2011 Sampling Chloride Results for the full list of chloride results.

Table 1 - 2004 - 2011 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	Spring 2011	
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		118.20	172.51
BC-12									54.89	726.17				
BC-10									896.33				1.45	** 11.73
SWC-1													*15.87	** 5.25
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		517.72	** 194.88
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	549.31	**399.34
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	219.39	**131.46
BC-1	26.03	705.98	194.22	681.71										

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

\* geomean includes one value that is out of compliance (BC-6 is only 10 minutes over the 6 hour holding time)

\*\* geomean includes two values that are out of compliance - over the 6 hour holding time

\*\*\* geomean includes three values that are out of compliance - over the 6 hour holding time

Table 2 - 2004 - 2011 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	May 2011
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 Spring														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		150
BC-12											770	810			
BC-11											54				
BC-10											1700				280
SWC-1															43
BC-5	68	660		240	630	220				480	590				
DHC1		160													
BC-4	67	730		150	300	580				690			1000		110
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			140
KCS-2							3300	2400		3100					
KCS-1							1500								
KC-5											4400	3800	3400		260
KC-4											5500	4700			
KCS-8									7.4						
KCS-7									8.1						
KCS-3							28000	31000	11400	22000	17000	16100			
KCS-10										21000					
KCS-4							33000	37000	16000	22000	29000	29200			
KCS-9										30000					
KCS-6									54000						
KCS-5							2500	7000							
KC-RStrib1											170	160			
KC-1	600	4000	4800	2200	2900	7000					8800	11600	8300	4400	640
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	510
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