

# MEMORANDUM

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**TO: Kerri Sabey, Uinta County Conservation District**

**FROM: Beth Kelly, WWC**

**DATE: April 20, 2009**

**SUBJECT: 2007 – 2008 Stream Water Quality Data Analysis**

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Between 2007 and 2008 the Uinta County Conservation District (the District) monitored stream water quality and quantity on the Bear River and Blacks Fork/Smiths Fork Rivers. The data was mailed to WWC for entry and analysis. The following summarizes the QA/QC evaluation and data analysis results. In addition, some recommendations are included.

## **QA/QC Evaluation**

### Blacks Fork/Smiths Fork

Overall, the data collected on the Blacks Fork/Smiths Fork Rivers by the District was found to be very good quality and credible. WWC evaluated the precision and found that all field parameters and bacteria met the District's duplicate objective of 10%. Additionally, the District collected one field blank per trip. Following a thorough review of the data, WWC found that 24 consecutive pH readings in May 2007 read near the same value and 12 turbidity measurements read negative results. In the field notes on May 7, 2007, the District noted that they did not believe the probe was working correctly. Therefore, the data anomalies were removed from the statistical analysis. An evaluation of data accuracy found that all parameters, except turbidity met the data quality objectives (DQOs). The majority (77%) of the relative percent difference (RPD) statistics were derived from turbidity measurements of less than 10 NTU.

A comparison of field measurements to laboratory analysis was completed to ensure credible data. Strong positive linear relationships were apparent between TSS and turbidity and TDS and EC, with a correlation coefficient of 0.97 and 0.98, respectively.

A review of the holding times and sample preservation was also completed to ensure the bacteria results are accurate. The review found that all holding times were less than 6 hours for all bacteria samples and less than 24 hours for inorganic samples. A review of the sample preservation techniques (i.e., cooler temperatures) demonstrated that the preservation requirement of 4 °C was consistently met. On August 20, 2007 the cooler temperature was reported as 5 °C and two additional days, May 15, 2007 and September 27, 2007, did not report cooler temperatures. Although these isolated events of improper preservation or lack of documentation occurred it does not appear that bacteria concentrations were affected. Bacteria concentrations during these events were comparable to previous and subsequent measurements.

## Bear River

The QA/QC review of the Bear River data also confirmed excellent collection technique by the District. Overall 16% of the samples collected were duplicate samples and field blanks were collected each trip. A review of the laboratory data confirmed that all analyses were completed within the holding time requirements listed in the Bear River Sampling and Analysis Plan (SAP).

## **Data Analysis Summary**

The data analysis review completed by WWC utilized several different types of analysis techniques including trend, temporal, regression, and basic site comparison. A summary of the key findings on both the Blacks Fork/Smiths Fork Rivers and Bear River are presented below. Temporal plots of *E. coli* in the Blacks Fork/Smiths Fork Rivers are included with this report.

## Blacks Fork

- At the confluence of the Blacks Fork and Threemile Creek the water type transitions from that of a mountain stream (calcium/sodium bicarbonate) to that typical of a prairie stream (calcium sulfate).
- Total dissolved solids (TDS) concentrations increased from upstream to downstream. The upstream sites (BF-10, BF-8, and BF-7) measured TDS concentrations between 56 and 840 mg/L with an average of 173 mg/L. TDS results measured on Threemile Creek (TM-1) averaged 2,045 mg/L for 4 samples. These TDS concentrations potentially influenced the downstream water quality. The TDS at the three downstream sites (BF-5, BF-4, and BF-3) averaged 1,620 mg/L.
- All temperature and pH field measurements met the WDEQ aquatic life criteria. However, four dissolved oxygen (DO) measurements were below the aquatic life standard of 5 mg/L. The exceedances were all measured at site BF-3 during the fall sampling seasons.
- Threemile Creek discharge rates measured between 2.17 and 9.50 cfs and averaged 5.14 cfs.
- The maximum discharge rate measured on the Blacks Fork was 117.7 cfs at site BF-8 on May 16, 2007. Overall the average measured discharge rates during the spring seasons were similar (2007 = 28.9 cfs, 2008 = 32.9 cfs). While the fall average discharge rates varied dramatically (2007 = 6.1 cfs, 2008 = 19.8 cfs). Potential explanations for the fall variation may be due to seasonal temperatures and increased irrigation demands.
- During all sampling seasons, *E. coli* geometric means were below the WDEQ standard of 126 cfu/100 mL at the upstream sites (BF-10 and BF-8).
- A decrease in bacteria at all sites was found during the fall 2008 sampling, with only two sites exceeding the WDEQ standard.
- No apparent correlations were observed between *E. coli* and stream temperature or discharge rates.
- Turbidity and *E. coli* demonstrated moderate positive correlation during the Spring 2007 and Fall 2008 sampling seasons. On the Blacks Fork River in Spring 2007 the correlation coefficient equaled 0.53. During the Fall 2008

sampling season the Blacks Fork and Smiths Fork rivers had a correlation coefficient of 0.69.

- 25 of the 140 samples collected on Blacks Fork River and Threemile Creek exceeded the single sample *E. coli* standard of 410 cfu/100 mL. Seventeen of these exceedances were measured at sites BF-7, BF-5, and BF-4, while five exceedances were measured on Threemile Creek.

### Smiths Fork

- The water type of the Smiths Fork changed at site SF3. Upstream the water was calcium bicarbonate, while downstream the water type transitioned to sodium bicarbonate.
- Similar to the Blacks Fork, inorganic constituent concentrations in the Smiths Fork increased from upstream to downstream. The amount of change varied, however, the greatest evolutions were observed for sodium, TSS, chloride and sulfate.
- Turbidity also increased from upstream to downstream with the highest measurement of 2,554 NTU measured at SF1 on May 7, 2007.
- Stream temperature and DO measurements met WDEQ's aquatic life criteria standards. Three pH measurements exceeded the standard of 9.0, all of which occurred during the fall sampling seasons.
- With the exception of fall 2007, site SF-5 measured the lowest bacteria concentrations during the four sampling seasons.
- Turbidity and *E. coli* demonstrated a strong positive relationship during the fall 2008 sampling season. The correlation coefficient equaled 0.96 for 5 samples, suggesting that bacteria may be attached to sediment particles.
- The single sample *E. coli* standard of 410 cfu/100 mL was exceeded in 31% of the samples collected. All sites exceeded the limit at least three times, while site SF-4 exceeded the limit nine times.

### Bear River

The Bear River in Southwestern Wyoming has been listed by the Wyoming Department of Environmental Quality (WDEQ) as impaired for sediment between Woodruff Narrows Reservoir and Sulphur Creek. The listing was a result of water chemistry, biological, and physical data collected by WDEQ in the late 1990's. The monitoring results reported silt covering increased downstream of Sulphur Creek, while habitat scores decreased primarily due to "sediment in the sample riffles and pools, bank stability conditions, and disruptive pressures adjacent to the channel" (WDEQ<sup>1</sup>). Additionally, the macroinvertebrate and biological assessment confirmed that core metrics change from clean-water taxa and functional feeding group upstream to functional feeding groups that are sediment tolerant and respond to nutrient enrichment downstream.

As a result of this listing the District monitored five sites on Bear River, two sites on Sulphur Creek, and one site on LaChapelle Creek, a tributary to Sulphur Creek. The following review details data trends and correlations, however because the listing is

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<sup>1</sup> Wyoming Department of Environmental Quality, 2001, "Beneficial Use Reconnaissance Monitoring Report and Assessment Report – Bear River," Cheyenne, Wyoming.

based on substrate sediment and habitat it is impossible to numerically compare the 2007 and 2008 monitoring results to regulatory standards (as no quantitative criteria have been established for a sediment listing).

- The water type of Bear River and Sulphur Creek is calcium bicarbonate, which is typical of mountain streams. LaChapelle Creek exhibited similar concentrations of calcium, magnesium, and sodium cations while bicarbonate was the dominate anion.
- Field measurements, including stream temperature, DO, and pH were compared to aquatic life standards and found to meet all standards.
- Nutrient (nitrite, nitrate, total phosphate) concentrations were measured at all sites and the majority of results were found to be at the detection limits. Total phosphate concentrations were found to vary from the detection limit to 0.16 mg/L, while the maximum nitrate concentration measured was 0.09 mg/L at BR-1 on June 5, 2007. The WDEQ standards for nitrite and nitrate are 1 mg/L and 10 mg/L, respectively. While no regulatory standards exist for total phosphate.
- Throughout the monitoring project temperature, conductivity, TDS, and chloride increased upstream to downstream on the Bear River.
- The water quality on Sulphur Creek did not vary significantly between sites SC-2 and SC-1, while discharge rates increased from upstream to downstream. In comparison to Bear River, Sulphur Creek measured higher concentrations of key constituents including conductivity, chloride, and TDS. Box and whisker plots, included with this report, portray how concentrations in LaChapelle Creek and Sulphur Creek affect the Bear River. Upstream of the confluence with the Bear River site BR-4 measured an average conductivity of 187.6  $\mu\text{S}/\text{cm}$ , however, following the confluence site BR-3 measured an average conductivity of 226.9  $\mu\text{S}/\text{cm}$ . The increase in conductivity may also be attributed to other influences based on the distance between these sites.
- A moderate positive linear relationship between TSS and turbidity was apparent (Pearson's R-value of 0.69). No additional relationships were observed between turbidity and discharge rates or turbidity and EC.
- Overall turbidity was low, with the highest levels measured in Spring 2007 ranging from 22 to 155 NTU.
- Discharge rates on the Bear River were measured a total of 8 times during the fall seasons. Spring flow measurements could not be done because the water levels were too high and the current was too swift. The measured discharge rates varied from 29 cfs to 86.8 cfs during the fall sampling.

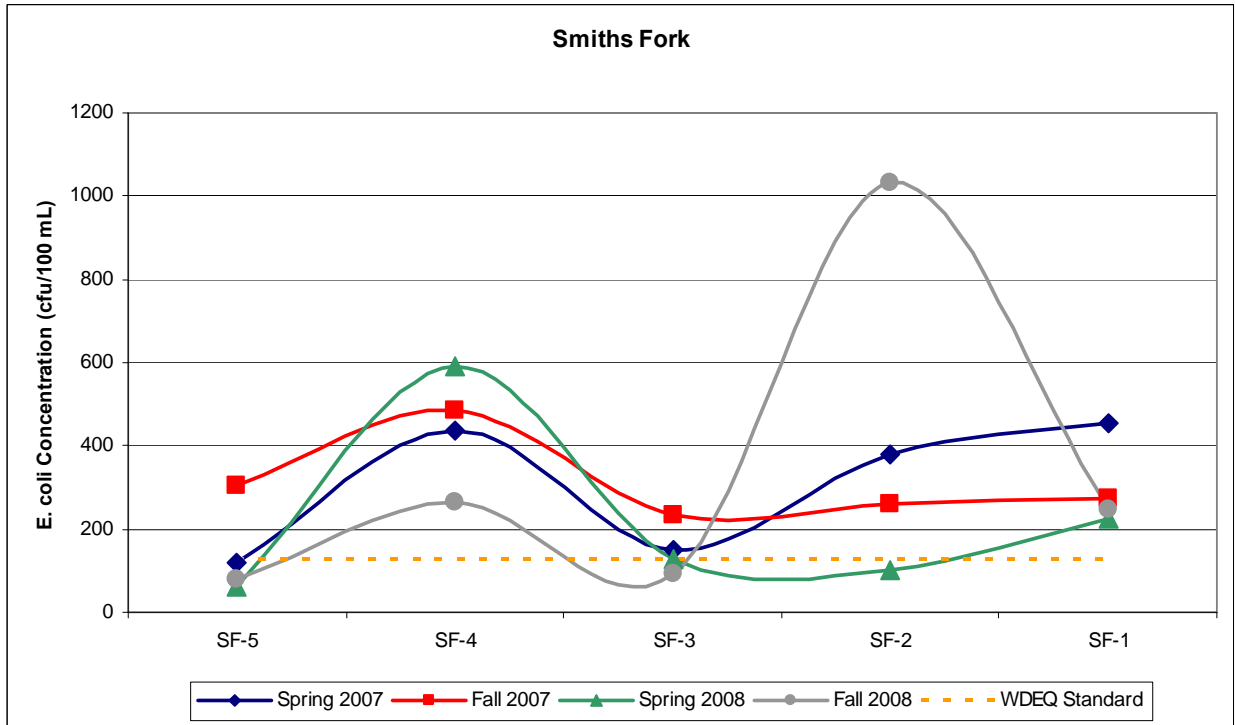
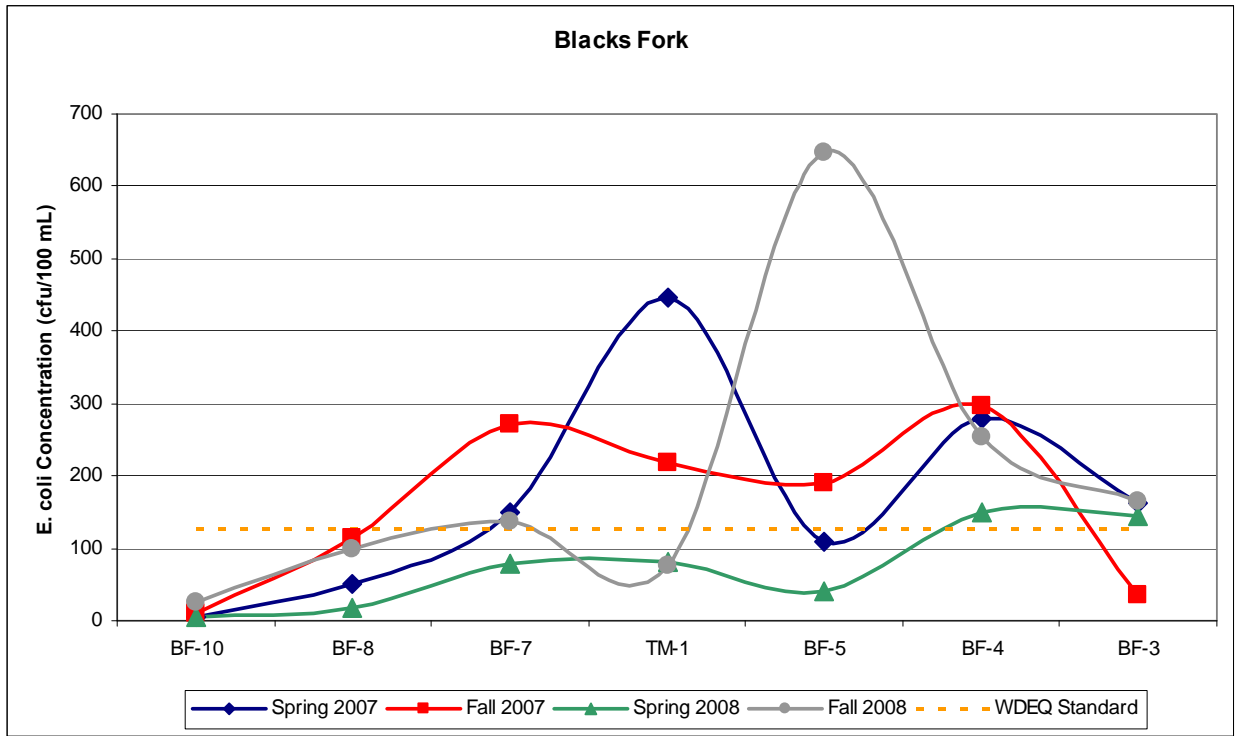
### Recommendations

The following observations and recommendations are derived from WWC's general review of the data.

- The District personnel should be commended for exemplary monitoring techniques and persistent approach to stream health improvements.

- Ensure that the bacteria sample cooler temperature remains below 4 °C and that the temperature is recorded on the Total Coliform and *Escherichia coli* Analysis Log.
- The turbidity significant digits varied throughout the monitoring data. Verify that the probe is accurate to 3 decimal places.
- While collecting inorganic samples it might be worthwhile to collect bacteria samples on the Blacks Fork and Smiths Fork. Inorganic chemistry and nutrient concentrations when compared to pathogen levels may delineate potential sources.
- Continue implementation of BMP's on the Blacks Fork and Smiths Fork Rivers to target faulty or aged septic systems and poorly located animal feeding operations. Additionally, continue to implement BMPs on the Smiths Fork to address the 303(d) listing for habitat. The previous work completed on the East and West Forks of Smiths Fork has been designated by WDEQ as a success.
- According to Richard Thorp, WDEQ, a stream listed for sediment impairment is very difficult to delist. BMP implementation is comparable to those conducted by UCCD on the East and West Forks of Smiths Fork including fencing off streams, replanting vegetation, bank stabilization and installation of sediment detention basins.
- In March 11, 2009 and March 24, 2009 phone conversations with Don Newton, WDEQ, it was stated that Bear River TMDL implementation is scheduled to begin this year, while the Blacks Fork and Smiths Fork Rivers are anticipated to begin in 2010. TMDL's for the Bear River will be based on a holistic approach because sediment is so ambiguous. Don Newton stated that the WDEQ is open to working with the District on future monitoring plans and BMP implementation on the Bear River.

## Blacks Fork/Smiths Fork Temporal Plots



### Bear River Box and Whisker Plots

