

## 1.0 **ABSTRACT**

Non-point source pollutants from unconfirmed sources have the potential to adversely affect rivers and streams within the lower section of Upper Belle Fourche watershed within Crook County. Periodic exceedances of water quality standards for fecal coliform substantiate this concern. The potential impact of the increasing quantity of water that the watershed is being required transport due to coalbed methane development in the headwaters of the watershed is also of concern. The exceedance of fecal coliform standards can adversely impact contact recreation and consumptive use of water within the watershed and the specific impacts of water quantity and changes in the hydrological regime of the watershed are unclear at this time. Insufficient historical and inadequate current credible data exist to make accurate and defensible causal assumptions on a watershed basis.

To address these issues at a local level, the Board of Supervisors of the Crook County Natural Resource District (CCNRD) formed the Upper Belle Fourche Watershed Advisory Group comprised of local citizens concerned with the integrity of the natural resources found within their watershed. Maintaining community values and culture through science based land use planning on a watershed scale is also an objective of the group. Through a series of public meetings utilizing coordinated resource management principles, sufficient local input was gained to develop a grant proposal that was subsequently submitted to the Governors non-point task force and approved for funding.

Content for this sampling and analysis plan (SAP), the initial step in developing a local watershed management strategy, was developed through meetings with members of the Advisory Group and in coordination with the CCNRD Board and Staff. This SAP both address the local concerns and issues while meeting the Wyoming State legislative requirements (Enrolled Act 47) for credible data, as well as the Quality Assurance/Quality Control (QA/QC) requirements of the Wyoming Department of Environmental Quality (DEQ), Water Quality Division, and the United States Environmental Protection Agency (USEPA).

## 2.0 **BACKGROUND**

Currently there are two sections of the Upper Belle Fourche River, WYBF101202001-009-4 and WYBF101202001-004-4, listed as impaired on the WDEQ 303(d) list. The impairment listed is Fecal Coliform contamination. The standard as listed in WDEQ Water Quality Rules and Regulations Chapter 1 states: *During the recreation season, May 1 thorough September 30, fecal coliform concentrations shall not exceed geometric mean of 200 fecal coliform groups per 100 milliliters for any 30 day period based upon 5 samples obtained during separate 24 hour periods for any 30 day period, nor shall 10% of the samples exceed 400 groups per 100 milliliters during any 30 day period.*

USGS water quality sampling station #06428050, Belle Fourche River below Hulett, has collected water quality data for the period beginning in 1986 through 1996, including twenty-nine fecal coliform samples. Of those fecal samples, six exceeded the 400 groups/100 ml standard equaling a 20.6% exceedance rate. At USGS water quality sampling station #064286500, Belle Fourche River below Moorcroft, also lists data from the same period with a total of thirty-four fecal coliform samples. Of those samples, ten exceeded the 400 groups/100 ml standard equaling a 29.4% exceedance rate. Due to the exceedance, either a local watershed plan or a TMDL is required as it has been determined that these river reaches are not meeting or supporting their beneficial uses, full body and secondary contact recreation. This SAP is intended to serve as the basis for a local watershed plan.

Additionally, as a result of recent coalbed methane development, water discharges into tributaries of the Belle Fourche in Campbell County have altered the hydrological regime of the river. The impacts of this augmentation of natural flows to the fisheries in the Upper Belle Fourche watershed are not currently clearly understood. This is due in part because historical hydrological data have not been examined in order to develop a historical characterization of the watershed on a landscape scale for comparison to existing conditions in order to establish trends. This SAP will incorporate the historical characterization of the watershed to assist in developing an accurate assessment of current conditions and trends utilizing current credible data. That assessment will then serve as the basis for the development of best management practices to address the water quality issues within the watershed.

This SAP is supported by the Crook County Natural Resource District's Quality Assurance Project Plan found in Appendix *QAPP*, provides reference to a Quality Assurance/Quality Control plan, provides guidance for data management, and as a field guide for personnel who will be conducting the water quality monitoring activities for this project. Water quality data resulting from this study will meet the requirements of the State of Wyoming Enrolled Act 47, known as the Credible Data Bill. Water quality samples must be collected using the methods, procedures and/or protocols in the Natural Resources Conservation Service National Handbook of Water Quality Monitoring, May 1998, and the Wyoming Department of Environmental Quality, Water Quality Division, Watershed Program Manual of Standard Operating Procedures for Sample Collection and Analysis, August 1999, incorporated by reference in this SAP. Refer to Appendix *SOP* for Standard Operating Procedures relevant to this monitoring program).

### **3.0 PROJECT AREA DESCRIPTION**

Crook County has two distinct geographic regions. The Black Hills uplift which dominates the southeastern two-thirds of the county and the remaining one-third consisting of rolling hills and plains. The general geology varies from interbedded and eroded shales and sandstones along the Belle Fourche River to the limestone and intrusive igneous and metamorphic rocks in the Bearlodge Mountains. The watershed is dominated by alluvial and sedimentary formations including the Morrison Shale, Pierre Shale, Fox Hills Sandstone, and the Spearfish Siltstone. Elevation ranges from 3,125' where the Belle Fourche River leaves the county to 6,800' on the top of Warren Peak.

The Upper Belle Fourche Watershed begins in Campbell County near Gillette Wyoming and flows northeast into Crook County. The area of the watershed located in Crook County will be the area of focus of this study. Twenty-one percent of the total land area in Crook County is public. Public land management responsibility is distributed between the U.S. Forest Service (8.7%), State Lands (6.2%), Bureau of Land Management (4.8%), Bureau of Reclamation (.9%), with the remaining .1% shared by the National park Service/Cities/Wyoming Game & Fish/School District. Of the seventy-nine percent privately held land within the county, 1,297,225 is pastureland, 366,430 is woodland, 110,830 is dry farmed cropland and 6,085 irrigated cropland.

#### 4.0 **PURPOSE STATEMENT**

The following purpose statement was developed by the Belle Fourche Advisory Group.

**Non-point source pollutants from unknown sources are potentially impacting contact recreation and drinking water in rivers and streams within the lower section of Upper Belle Fourche watershed within Crook County as evidenced by periodic exceedance of water quality standards for fecal coliform. However incomplete historical, and inadequate current credible data exist to make accurate and defensible causal assumptions on a watershed basis.**

#### 5.0 **SAMPLE DESIGN**

The objectives of this monitoring plan are:

- 1) To assemble and analyze existing historical data for the Upper Belle Fourche watershed,
- 2) Conduct a watershed based water quality monitoring program utilizing reconnaissance methodology based upon physical, biological, and chemical data.
- 3) Identify water quality impairments affecting the beneficial uses of the lower section of the Upper Belle Fourche watershed,
- 4) Identify trends in water quality through the establishment of long-term monitoring sites within the Upper Belle Fourche watershed.
- 5) Utilize the data to develop Best Management Practices and to support science-based land and water use planning and decision-making.

#### 5.1 **SAMPLING PERSONNEL/TRAINING AND EXPERIENCE**

At the time of the development of this SAP, the technical staff required to implement this study have not yet been identified. However, personnel responsible for the implementation of this program should have the following *minimum* education and experience:

**Education** – Completion of Phases I – V, Watershed based Water Quality Program Planning Development and Implementation. Presented by the Wyoming Association of Conservation Districts, Wyoming Department of Environmental Quality, Wyoming Department of Agriculture, University of Wyoming, and the Natural Resources Conservation Service. Comparable education and training will be accepted in lieu of the training program.

**Experience** – Water quality sampling utilizing beneficial use reconnaissance and rapid bioassessment protocols. Group facilitation and plan development utilizing coordinated resource management or similar processes. Research and data analysis with emphasis on developing correlations between resource data and land use practices.

## 5.2 SAMPLING STATION/SITE LOCATION

The general areas for monitoring sites were established by the Upper Belle Fourche Advisory Committee. Identification of the specific locations of the monitoring reaches within each general area will be determined through coordination with landowners/land managers, and personnel experienced in water quality monitoring.

Table 1. Sampling Locations and ID Codes

<b>General Site Location/Descriptions/HUC/Ownership<sup>1</sup></b>	<b>Site ID Code</b>
Belle Fourche River @ Campbell/Crook County line/10120201-519 Upper Belle Fourche	BF1
Belle Fourche River @ Above the town of Moorcroft & below the confluence of Buffalo creek/10120201-519 Upper Belle Fourche	BF2
Belle Fourche River @ Below the town of Moorcroft & above the confluence of Donkey creek/10120201-519 Upper Belle Fourche/State of Wyoming	BF3
Belle Fourche River @ Above Keyhole Reservoir & below the confluence of Donkey creek/10120201-519 Upper Belle Fourche/Unknown	BF4
Belle Fourche River @ Below Keyhole Reservoir & above Inyan Kara creek/10120201-519 Upper Belle Fourche	BF5
Belle Fourche River @ Above Devils Tower National Monument & below Inyan Kara creek/10120201-519 Upper Belle Fourche	BF6
Belle Fourche River @ Below Devils Tower National Monument & above Barlow Canyon Road/10120201-519 Upper Belle Fourche	BF7
Belle Fourche River @ Above the Town of Hulett & below the confluence of Black Tail creek/10120201-519 Upper Belle Fourche/Unknown	BF8
Belle Fourche River @ Immediately downstream of the Town of Hulett/ 10120201-519 Upper Belle Fourche/Unknown	BF9
Belle Fourche River @ On the Wyoming/South Dakota state line/ 10120202-478 Lower Belle Fourche	BF10
Donkey Creek @ Campbell/Crook County line/ 10120201-519 Upper Belle Fourche	DC1
Donkey Creek @ Immediately upstream of it's confluence with the Belle Fourche River/10120201-519 Upper Belle Fourche/Unknown	DC2

***General site selection criteria included (but was not limited to):***

1. Inclusive of 303(d) listed stream segments.
2. Allow for identification and isolation of contaminants entering the Upper Belle Fourche in Crook County from upstream sources.
3. Isolate distinct land uses, sub-watersheds and confluences.
4. Provide for systematic elimination of non-contributing areas within the watershed, ultimately identifying areas contributing to the exceedance of WDEQ water quality standards.

***Specific monitoring reach selection criteria should include:***

<sup>1</sup> For general reference only. Specific ownerships will be determined when the specific monitoring reaches are identified.  
09/27/05

1. Year-round access.
2. Willing landowners and managers. Adequate rights of entry must be obtained to allow multi-year access to the entire study reach length. Study reach length defined as 20 times the maximum bankfull width.
3. A riffle, preferably 100 feet in length representative of other riffles within the study reach. If possible the riffle should have flow velocity of less than 3 feet per second and be less than eighteen inches in depth during low flow periods.
4. At least four pools within the study reach length.
5. Sighting as far as possible, while still meeting the study objectives, from bridges, dams and other man made structures within the floodplain.

## 5.2 SAMPLING FREQUENCY

Table 2. Sampling Schedules - Reconnaissance Phase

Station⇒ Date ↓	BF1	BF2	BF3	BF4	BF5	BF6	BF7	BF8	BF9	BF10	DC 1&2
4/1/01	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF
4/8/01	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF
4/15/01	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF
4/22/01	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF
4/29/01	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF
8/15/01	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF
10/1/01	BURP	BURP	BURP	BURP	BURP	BURP	BURP	BURP	BURP	BURP	BURP

**Legend**

IS – In-Situ Parameters, CF – Chemical Parameters include Fecal Coliform & E-coli, BURP = Biological and Physical Sampling

Table 2(a). Sampling Schedules - Trend Establishment Phase

Station⇒ Date ↓	BF1	BF2	BF3	BF4	BF5	BF6	BF7	BF8	BF9	BF10	DC1
4/1/01	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F
4/8/01	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF
4/15/01	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F
4/22/01	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF
4/29/01	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F	IS/F
8/15/01	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF	IS/CF
10/1/01	BURP	BURP	BURP	BURP	BURP	BURP	BURP	BURP	BURP	BURP	BURP

Legend: IS – In-Situ Parameters, F – Fecal Range Only, CF – Chemical Parameters including Fecal Range, BURP = Biological and Physical Sampling

A full range of chemical water quality parameters will be collected from the Belle Fourche River and Donkey Creek seven times throughout the first year. Biological and physical data will be collected one time in the fall. While all sites will be monitored each period during the first year reconnaissance

phase, some sites may be eliminated from the monitoring program upon analysis of first year data. In-situ (on-site) parameters will be measured with the YSI 600 Multi-probe and water samples will be collected using a DH-48 integrated sampler. Given this programs emphasis in fecal coliform and e-coli, the timing of sample collection should be set in order to meet criteria for fecal coliform sampling standards:

1. Five sample periods, within a thirty-day period but at least twenty-four hours apart to meet EPA protocol, during the spring runoff hydrograph. The April dates suggested in table 2 below are based upon an average spring runoff period and are for example only. The initiation of the actual spring thirty-day sampling period must be determined by existing snow pack and current climatological conditions.

The late summer low flow sampling period should occur when the recreational activity within the Upper Bell Fourche watershed is at its peak. However, if results from the fecal coliform and e-coli testing exceed standards then four more fecal coliform samples, within thirty days but at least twenty-four hours apart, must be taken to meet EPA protocol.

### **5.3 SAMPLING PARAMETERS & COLLECTION METHODS**

The conservation district will collect credible data containing physical, chemical, and biological parameters. To insure defensible and credible data, collection procedures for each parameter listed below will be completed according to established standard collection protocols. Each parameter's collection methodology is located in Appendix SOP.

#### **Physical parameters to be sampled:**

1. **BURP Monitoring:** Utilizing WDEQ field data sheets, the physical parameters consist or primary, secondary, and tertiary categories which examine the condition of the micro-habitat characteristics that directly and indirectly affect macroinvertebrates, as well as the adjacent terrestrial conditions
2. **Velocity:** Determining discharge is critical in assessing water quality. To establish the rate of discharge, velocity is measured at 60% total depth at sufficient intervals in a cross section of the stream to provide 20 – 25 readings.
3. **Temperature:** Stream water temperature affects growth, distribution and survival of aquatic organisms.
4. **Photo documentation:** Photos, preferably digital, will be taken in a panorama using cardinal directions beginning facing upstream and ending facing downstream. Visual records are necessary to support the qualitative aspects of the BURP.

#### **Chemical Parameters to be Sampled:**

Water Chemistry Sampling will follow standard sampling methodology outlined in Appendix SOP. Water samples will be integrated samples collected by moving the sampler vertically across the stream

channel at a depth of .60 of the total stream depth. All containers and lids will be rinsed three times in ambient water. Water samples used in collecting in-situ instantaneous measurements will be composited using a 1-2 gallon bucket and will consist of integrated samples. Refer to Parameters, Units, Analytical Methods, SOPs, Preservatives, Holding Times section of this SAP for the parameters and preservation methods. Parameters to be sampled are:

1. Specific Conductance: In general, the more dissolved material present in water, the higher the conductivity measurement. Dissolved materials are required to establish and maintain diverse macroinvertebrate communities. However, water with too high specific conductance can negatively affect aquatic organisms and water quality.
2. Dissolved Oxygen: Is the amount of free oxygen available to aquatic organisms and fish.
3. Nitrate and Nitrite as N: Indirect effects are stimulation of bacteria, including fecal coliform, periphyton, algae and instream macrophyte growth.
4. Ph: Is a standard measurement conducted for water quality.
5. Total Dissolved Solids: TDS is a measurement of the total substances dissolved in water and correlates with conductivity and salinity.
6. Total Phosphorus: Phosphorus is an essential element for plant growth and is considered one of the primary nutrients associated with non-point source pollution.
7. Total Suspended Solids: TSS in Wyoming streams is primarily due to suspended sediment. High TSS concentrations during low stream flow regimes results in sedimentation deposition to the streambed. A variety of adverse biological impacts are caused by sediment deposition.
8. Turbidity: A measure of the amount of light intercepted by a given volume of water due to the presence of suspended and dissolved matter and microscopic biota. Increasing the turbidity of the water decreases the amount of light that penetrates the water column. High levels of turbidity are harmful to aquatic life.
9. Sulfates: Sulfate is a naturally occurring constituent in Wyoming streams. However, artificial increases in levels of sulfate can occur due to introduction of water originating as a by-product during oil field production activity. Increases in sulfate concentration negatively impact benthic macroinvertebrates.

#### Biological Parameters to be Sampled:

##### Biological (Macroinvertebrate) Sampling:

Biological sampling methodology will be followed as outlined in Appendix SOP and will consist of a composite sampling from eight randomly selected sites within a riffle. Double Blind QA/QC sampling protocol will be used at every tenth sample site at a minimum. Parameters to be sampled include:

1. Macroinvertebrates: Macroinvertebrate sampling is a significant component of BURP. Evaluation of macroinvertebrate community structure serves as an indicator of long-term water quality and as a comparative criterion for chemical and physical parameter results.
2. Fecal Group: Consists of Total Coliform, E. Coli, and Fecal Coliform. Used as an indicator of the presence of intestinal material from warm-blooded animals. Because fecal coliform do not reproduce in water, the test can be used to define localized point source and non-point source pollution. Fecal DNA sampling was considered to assist in meeting this programs goals. The cost and the research based nature of the current methodology however made it prohibitive under the

fiscal capability of this project. The information from DNA sampling would benefit this investigation, if funding or partnership opportunities arise they should be actively pursued.

Table 3. Surface water quality chemical parameters to be sampled

Parameters	Units	Sample Volume	Preservative	Holding Time	Detection Limit	Measured	Sample Type
<b>Physical</b>							
Temperature	°F	N/A	N/A	N/A	N/A	YSI probe	Instantaneous
Velocity	ft <sup>3</sup> /sec	N/A	N/A	N/A	N/A	Global flow probe	Integrated
<b>Chemical</b>							
Conductance, Specific	mhos/cm	N/A	N/A	N/A	5 mhos/cm	YSI probe	Instantaneous
Dissolved Oxygen	mg/l	N/A	N/A	N/A	0.1 mg/L	YSI probe	Instantaneous
Nitrogen, Nitrate - Nitrite	mg/l	250 ml	Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> ) to pH<2	28 days	0.1 mg/l	lab analysis	Integrated
Ph	%H	N/A	N/A	N/A	0.1 of a pH unit	YSI probe	Instantaneous
Total Dissolved Solids	mg/l	200ml	Cool to 4° C	7 days	5 mg/l	lab analysis	Integrated
Total Phosphorous	mg/l	100 ml	Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> ) to Ph<2, cool to 4°C	28 days	0.1 mg/l	lab analysis	Integrated
Total Suspended Solids	mg/l	200 ml	Cool to 4°C	7 days	2 mg/l	lab analysis	Integrated
Turbidity	NTUs	100 ml	None	48 hours	0 NTU	lab analysis	Integrated
Sulfates	mg/l	50 ml	Cool to 4°C	28 days	10 mg/l	lab analysis	Integrated
<b>Biological</b>							
Fecal Group	mg/l	100 ml	Ice immediately, keep at or below 4°C	6 hours	variable	lab analysis	Integrated
Macroinvertebrates	N/A	N/A	Alcohol 90% or higher mixed with 6% formalin	N/A	N/A	lab analysis	Integrated

Table 4. Additional BURP Parameters

Parameters	Units	How Measured	Sample Type
Bank Vegetation Protection	N/A	Field Analysis	Qualitative
Bank Stability	N/A	Field Analysis	Qualitative
Bankfull Channel Shape	N/A	Field Analysis	Qualitative
Canopy Cover Over Stream	N/A	Field Analysis	Qualitative
Channelization/Alter	N/A	Field Analysis	Qualitative

Color, Odor, and Sheen	N/A	Field Analysis	Qualitative
Coordinates	lat./long	Garmin GPS Unit	N/A
Discharge	ft <sup>3</sup> /sec	Global probe & cross-section	Integrated
Embeddedness (silt covering) Rating	N/A	Field Analysis	Qualitative
Riffle Gradient	N/A	Field Analysis	Quantitative
Instream Cover for Fish	N/A	Field Analysis	Qualitative
Photo Points	N/A	Field Analysis	Quantitative
Pool/Riffle Ratio	N/A	Field Analysis	Qualitative
Predominant Soil Type	N/A	Field Analysis	Qualitative
Predominant Geology, Surficial	N/A	Field Analysis	Qualitative
Primary and Secondary Land Use	N/A	Field Analysis	Qualitative
Relative Abundance of Aquatic Biota	N/A	Field Analysis	Qualitative
Riparian Zone Width	N/A	Field Analysis	Qualitative
Rosgen Stream Channel Classification	N/A	Field Analysis	Qualitative
Site Sketch	N/A	N/A	Qualitative
Stream Substrate Composition	N/A	N/A	Qualitative
Width/Depth Ratio	N/A	Field Analysis	Quantitative

#### 5.4 SAMPLING METHODS/LABELING

##### Water Chemistry Sampling

Each sample will be labeled with a permanent, waterproof marking pen, such as a “Sharpie” on write-in-rain™ paper. The sample identification will be recorded on the bottle, on the Chain of Custody form, on the lab’s analytical report, and in the field logbook. At a minimum, sample labels must include:

1. Sampler’s initials as recorded in the field log book
2. Julian or consecutive day of the year followed by 00 for year 2000
3. The time, using a 24 hour clock (military time)
4. Sample ID code
5. Preservative used
6. Parameters to be tested (see Appendix SOP for approved abbreviations)

The sample ID location code is as shown in Table 1 of this SAP. For example BF1 is the location code for Belle Fourche sample site 1. Quality Control samples, such as blanks and duplicates will have the numerical identification for each in conjunction with the site identification.

##### Example Labels:

<b>Surface Water Sample</b>
Date: 12200 Time: 0940
Sample number: 1 of 3 (consecutive number as samples are taken)
Sampler: RLG
Sample ID #: BF1-122-00-RLG – TDS-01

Preservative: none
Parameter: Total Dissolved Solids

Explanation of Sample ID

Sample ID #: BF1-122-00-BG-S-01

- BF1 = Belle Fourche sample site 1 (site location from map)
- 122 = Julian Day
- 00 = year 2000
- RLG = Rik Lee Gay
- TDS = Total Dissolved Solids
- 01 = normal sample as opposed to a blank or duplicate sample

Quality Control Examples

Sample ID: BF1-122-00-RLG-TDS-02

- BF1 = Belle Fourche 1 (site location from map)
- 122 = Julian Day
- 00 = year 2000
- RLG = Rik Lee Gay
- TDS = Total Dissolved Solids
- 02 = Duplicate sample**
- 03 = Blank sample
- 04 = Spike sample

Sample ID: BF1-122-00-RLG-TDS-03

- BF1 = Belle Fourche 1 (site location from map)
- 122 = Julian Day
- 00 = year 2000
- RLG = Rik Lee Gay
- TDS = Total Dissolved Solids
- 02 = Duplicate sample
- 03 = Blank sample**
- 04 = Spike sample

The following table outlines quality control measures to follow for surface water sampling to ensure credible data collection (see Appendix QAQC for the Quality Control Measures methodology).

Table 5. Sample Quality Control

Parameter	QC Check	Frequency	Acceptable Range	Corrective Actions
Blanks	Contamination which might affect analytical results	1 per trip	Pass/Fail	Notify sampler and appropriate management; repeat blank with another bottle from same sampler and retest; find contamination source; Water Quality Specialist decides whether to accept or disallow data.
Chain of Custody Form	Laboratory Supervisor notes errors and omissions on sheet and in	Each group of samples shipped to the lab	No errors or omissions	Notify sampler and appropriate management; audit and train the field sampler; test results from samples which are sent to the laboratory

Sample Analysis Plan  
Upper Belle Fourche Watershed within Crook County, Wyoming

	laboratory database			without a Chain of Custody form are not suitable for use in legal actions
Chain of Custody Seal	Laboratory Supervisor records on Chain of Custody Form and in Laboratory database	Each container of samples shipped to the lab	No errors or omissions	Notify sampler and appropriate management; audit and train the field sampler; test results from samples which do not have a seal are not suitable for legal actions
Dissolved Oxygen	Written record of altitude; meter measures temperature and auto-calibrates	Site specific; before each use	Instrument specific; generally $\pm 0.1$ mg/l	Verify altitude; if still not correct return meter to YSI Incorporated for repair or replacement
Duplicates	Required	1 per trip per parameter OR 1 every 10 sample sites per trip per parameter	Required	Notify sampler and appropriate management if missing; audit and train field sampler. Water Quality Specialist decides whether to accept or disallow data.
Macroinvertebrate Sampling	Duplicate samples submitted as a blind test to contract laboratory	10% of all samples	90%	Audit and train field sampler and/or sample processing technician
pH	2 point meter check with pH 7 and 10 buffer standards supplied by Water Quality Division Laboratory	Once a day	$\pm 5\%$	Repeat field check; if still not correct return meter to YSI Incorporated for repair or replacement
Sample Preservation	Sample label and Chain of Custody agrees with parameter SOP; Laboratory Supervisor notes errors or omissions on Chain of Custody Form	All samples	No errors or omissions	Notify sampler and appropriate management; audit and train sampler; resample; data is flagged to indicate that it should not be entered in a database or used for decision making
Sample Labeling	Labels contain required information	All labels	No errors or omissions	Audit and train sampler
Temperature	Annual calibration against a thermometer traceable to an NBS thermometer	Annually	On the calibration mark	Repeat measurement with different thermometer; if not correct contact YSI Incorporated

The water quality technical staff will be responsible for understanding the Quality Assurance/Quality Control (QA/QC) Plan from each contract laboratory and for providing QA/QC guidance to all samplers. See Appendix QAQC for each laboratory's QA/QC plan.

## 6.0 HEALTH AND SAFETY

The samplers' personal safety must be the primary concern at all times and in all sampling situations. In any marginal or questionable situation, samplers are required to assume worst case conditions and use safety precautions and equipment appropriate to that situation. Samplers who encounter conditions which, in their best professional judgment, may exceed the protection of their safety equipment or may in any way represent a potential hazard to human health and safety should immediately leave the area and contact their supervisor.

During field sampling there must be a minimum of two sampling personnel present. Shoulder length gloves will be worn when sampling surface water. Samplers will thoroughly wash hands and arms with bacterial soap after sampling and before eating or drinking. If they are still in the field, antibacterial wipes will be used before eating or drinking. Never store or consume food or water near samples or sample containers, especially microbial samples. Samplers should be familiar with basic first aid and CPR.

Samplers are strongly recommended to carry a cell phone with them. Samplers will inform a supervisor when they leave for the field, where they will be sampling, and their time of return. The supervisor will activate the emergency action plan (detailed below) if the samplers have not returned to the office within the allotted time. To avoid worry and concern, samplers will call the office if they are running behind schedule.

**6.1 EMERGENCY ACTION PLAN**

A supervisor or personnel on duty will be notified of the departure time of each sampling trip, know the itinerary, persons involved, and estimated time of return. The contact person(s) will also know whom to contact to initiate rescue efforts. If samplers have not returned or reported on time, the supervisor or personnel on duty will contact the following:

1. Emergency Management Coordinator  
Veronica Canfield  
(307)283-2390

**7.0 LABORATORIES**

<u>Lab</u>	<u>Parameters</u>
WYOMING DEPARTMENT OF AGRICULTURE ANALYTICAL SERVICES 1174 Snowy Range Road Laramie, Wyoming 82070	Nitrogen, Nitrate – Nitrite Total Dissolved Solids Total Phosphorous Total Suspended Solids Turbidity Sulfates

Telephone: (307) 742-2984 E-mail: <a href="mailto:aslab@missc.state.wy.us">aslab@missc.state.wy.us</a> Internet: <a href="http://wyagric.state.wy/aslab/aslab.htm">http://wyagric.state.wy/aslab/aslab.htm</a>	
ENERGY LABORATORIES, INC. Casper, Wyoming toll free- (888) 235-0515 local- 235-0515 <a href="mailto:dewitt@energylab.com">dewitt@energylab.com</a>	Nitrogen, Nitrate – Nitrite Total Dissolved Solids Total Phosphorous Total Suspended Solids Turbidity Sulfates
INTERMOUNTAIN LABORATORIES, INC. 1701 Phillips Circle Gillette, WY 82718 Telephone (307) 682-8945	Fecal Range
AQUATIC BIOLOGY ASSOCIATES, INC. 3490 NW Deer Run Rd. Corvallis, OR 97330 Telephone: (541) 752-1568 E-mail: <a href="mailto:wisseman@aquaticbio.com">wisseman@aquaticbio.com</a>	Macroinvertebrates

Samples will be packed with ice packs in coolers and the cooler sealed with packing tape to be shipped best available method with Chain of Custody form. Coolers and sample bottles are obtained by contacting the lab of choice at least two weeks in advance of sampling date. Be sure to call the lab two days before shipping samples. To guarantee proper handling and analysis, do not collect & ship samples after Wednesday of any week.

Prior to being shipped, macroinvertebrate samples to be sent to the ABA Lab will first be drained of preservative and replaced with fresh preservative. Then placed in coolers supplied by ABA, sealed with packing tape and then shipped via UPS ground service with chain of custody form.

All contract labs will follow their Quality Assurance/Quality Control protocols as set forth in Appendix *QAQC*.

### **Laboratory Results and Data Archiving**

The originals of the lab results will be kept in the Crook County Natural Resource District office and copies will be stored Crook County Courthouse. If changes are made to the originals, the copies will be amended immediately. The Water Quality Specialist will be responsible for transferring specific paper records to an electronic format for statistical analysis.

One copy of the electronic records will be stored at the office and another back-up copy will be stored at the Crook County Courthouse. When changes are made to the office copy, the disks will be rotated and updated as soon as possible.

Table 6. Data Archiving

Record Type	Storage Location Original/Copy	Storage Length	Responsible Party
Calibration Logs	CCNRD / CCC	Indefinite	WQ Tech, District Manager
Chain of Custody	CCNRD / CCC	Indefinite	WQ Tech, District Manager
Field Log Book	CCNRD / CCC	Indefinite	WQ Tech, District Manager
Lab Results	CCNRD / CCC	Indefinite	WQ Tech, District Manager
Maps	CCNRD / CCC	Indefinite	WQ Tech, District Manager
Reports	CCNRD / CCC	Indefinite	WQ Tech, District Manager
SAP, QAPP, SOP	CCNRD / CCC	Indefinite	WQ Tech, District Manager
Spreadsheets	CCNRD / CCC	Indefinite	WQ Tech, District Manager
Database Management System	CCNRD / CCC	Indefinite	WQ Tech, District Manager

CCNRD – Crook County Natural Resource District

CCC – Crook County Courthouse

### 8.0 **REPORTS & SAMPLE ANALYSIS**

A consultant technically proficient in water quality monitoring will analyze all lab reports and field data. The technical consultant will be responsible for analyzing the data and prepare as necessary, monthly, quarterly, and annual reports. A final report to be submitted to the Crook County Natural Resource District Board of Supervisors and the Upper Belle Fourche Watershed Group will be prepared at the conclusion of this monitoring program.

All test results from contract laboratories will be delivered via email in Excel or Access spreadsheets. Excel and Access have the ability to produce charts and graphs and to perform statistical manipulation. Statistical manipulation will include the number of samples, mean, maximum, minimum, and the standard deviation.

### 9.0 **AMENDMENTS & MODIFICATIONS**

If problems arise with the sampling locations, number of samples per site, number/type of QC samples, sampling method/SOP, number of sites, database application program, or any other aspect of the SAP, it will be updated through modifications. Filing instructions will be included with each modification, which will most likely instruct the filer to place the modification in its relevant section. The modification will also include a notice of the amendment, which will be posted in the front of the SAP, before the title page. The most recent modification will be posted on top of former modifications. A log page, which will include modification number, date, general description of the modification, and the initials of the filer will be located in front of all the modifications. All sampling personnel in active status at the time of the modification will be verbally informed of the change(s).

## **10.0 ASSESSMENTS AND RESPONSE ACTIONS**

In order to identify any problems, the CCNRD will conduct a self-assessment with the Internal Review of Procedures using the relative quality assurance SOPs in the prescribed time frames. If a major problem exists, corrective action will be immediately taken and documented. In those situations where independent expertise is needed to assess a certain aspect of the project, the district will request technical assistance. The DEQ Project Officer may conduct any type of assessment at any time during the length of the project. This includes assessments of any contractor or sub-contractor performing sampling, analysis, or any other activity directly related to the program.

## **11.0 CHAIN OF CUSTODY**

Samples will be sealed and preserved appropriately for shipment (see Appendix SOP for Chain of Custody) and be accompanied by a Chain of Custody (COC) form.

1. It is mandatory to submit a completely filled out and signed COC form with the samples.
2. The lab receives the COC form and signs it.
3. The lab returns the completed COC form to the Crook County Natural Resource District.
4. The district files the original in the COC file and maintains it indefinitely. If there is a possible fire hazard or a need for space, the records will be transferred to the State Archives (see Appendix SOP for the Data Archiving).
5. A copy of the COC is provided to the WDEQ-WQD Watershed Program Sheridan office.

## **12.0 EQUIPMENT CALIBRATION AND MAINTENANCE**

The Water Quality Technician will be responsible for all equipment calibration and maintenance. All equipment will be calibrated according to the manufacturer's recommendations (see Appendix ECM for equipment calibration manuals). The original calibration log will be kept at the office to record calibrations completed, when, by whom, and dates of calibration solutions.

### **YSI 600 Multi-Parameter Water Quality Monitor/model# 600R – serial# 219733**

<b>Parameter</b>	<b>Units</b>	<b>Calibration</b>	<b>Schedule</b>	<b>Maintenance</b>	<b>Schedule</b>
Conductance, Specific	mhos/cm	Solution	Daily	Charge Battery	Monthly
Dissolved Oxygen	Mg/L	Barometer x 25.4	Daily	Charge Battery	Monthly
pH	%H	Buffer Solutions	Daily	Charge Battery	Monthly

		7/10			
Temperature	°F		Yearly	Charge Battery	Monthly

**Global Water Flow Probe**

Parameter	Units	Calibration	Schedule	Maintenance	Schedule
Velocity	ft <sup>3</sup> /sec	33.31 ft <sup>3</sup> /sec	Annually	Replace Battery	AS Needed

**Garmin GPS 12/model# 190-00143-10, serial# 36028819**

Parameter	Units	Calibration	Schedule	Maintenance	Schedule
Location	Lat./long coordinates	None	None	4 AA Batteries	Annually

**Surber Sampler Net Mesh 500um**

Parameter	Calibration	Schedule	Maintenance	Schedule
Macroinvertebrate	None	None	Physical Inspection	At Use

**Pentax IQ Zoom 105WR Date/serial# 2381991**

Parameter	Calibration	Schedule	Maintenance	Schedule
Photo Documentation	None	None	3 V Lithium Battery	As Needed

**13.0 FIELD LOG BOOKS**

Original field log books (see Appendix SOP for the Field Log Books methodology) will be kept at the office and copies of the pages will be kept at the Crook County Courthouse per the Data Archiving section of this SAP. The methodology to be followed is critical to ensure credible data. Key points are as follows:

The outside front cover must contain:

1. The samplers' printed names,
2. The from-to date periods covered by the log book (mm/dd/yy),
3. The sequential log book number.

The inside front cover must contain:

1. The signature identification of the samplers and all other persons who make entries in the logbook.
2. The samplers' chosen set of written initials must be shown.
  - a. These initials must be used for all entries in the logbook and for any sample labeling.
  - b. Any person making an entry must sign and initial the inside front cover of the logbook.

The log must have:

1. All pages sequentially numbered.
2. No pages removed.

All entries:

1. Must be made in permanent pen.
2. If pencil is used, the reason should be noted in the entry

All corrections:

1. Made with one line through the incorrect information, so that the original information can still be read.
2. The correct information is written in the next available space.
3. Corrections must be initialed and dated.
4. If an entire page is incorrect, one diagonal line is drawn through the entire page and the correct information is recorded in the next available space.

Procedure for change of personnel:

1. Samplers who resign or transfer must leave all logbooks.
2. Conservation District Board supervisors must verify that all logbooks are complete, numbered, accounted for and filed.

Data recorder:

1. If a field crew appoints one member as data recorder, all participants involved in the collection of that data must sign the inside front cover, show their chosen initials beneath their signature, and initial and date the field log book entries.

Additional data that should be recorded in the surface water field logbooks are as follows:

1. Date
2. Time
3. Site ID e.g. BF1
4. Parameters sampled
5. How blanks, spikes, and duplicates were identified
6. Any pertinent information not already considered

## 15.0 **FIELD DATA FORMS**

The BURP Monitoring sheets utilized the Wyoming Department of Environmental Quality will be used as data forms. Parameters analyzed in the field will be collected with the YSI multi-probe on the data logger *and* recorded in the field log book *on-site*. The information on the data logger will be downloaded at the office for analysis. Storage of this data is covered in the Data Archiving section of this SAP. All other data will be analyzed at the labs. The field logbooks will serve as data forms for any other pertinent information.

## 16.0 **DATA REVIEW AND VALIDATION**

Conservation district staff will be responsible for receiving the data sheets and field log books, checking for omissions in identification, decimal placement, dates, times, units reported, and comments. Water quality technical staff collecting data will be contacted immediately if there are data gaps or if scheduled sampling times were missed.

It is the water quality technical staff's responsibility to evaluate raw data generated by the contract laboratories for appropriate numeric reduction, data quality, and accuracy. All data will be reviewed and reported in units specified at the detection level of the analysis methods used. To reduce data point loss, data that is reported as "less than" detection level should be incorporated at a value of 1/2 the detection level. Once data is generated, it will be compiled in a database file. During this data transfer, the information will be reviewed and verified in accordance with data quality objectives.

Data generated in the laboratory will be validated by performance checks such as a duplicates, spikes, and blanks. Data will be reported in the units that have been designated to each parameter in the

Analytical Methods, Holding Times, Parameters, and Sample Collection Methods section tables. Scientific notation will be used and significant figures will correlate with detection levels. Both graphing and narrative conclusions will be used to describe the water quality results and trend variations.