## JACK CREEK WATER QUALITY MONITORING PROJECT

## SAMPLING AND ANALYSIS PLAN

### Prepared for the Montana Department of Environmental Quality

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### Prepared by:

Sunni Heikes-Knapton Madison Watershed Coordinator PO Box 606 Ennis, MT 59729

Adam Sigler MSU Extension Water Quality P. O. Box 173120 Bozeman, MT 59717-3120

#### **Approvals:**

Robert Ray (Watershed Protection Section Supervisor
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Date

Mindy McCart	thy (QA	Officer)
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Date

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## Introduction

This document constitutes the Sampling and Analysis Plan (SAP) for the completion of nutrient and sediment assessments for Jack Creek, a tributary of the Madison River located in Madison County Montana (Figure 1).

Jack Creek is a mountain stream watershed system located within the Madison Range east of Ennis, Montana. Encompassing waters from Lee Metcalf Wilderness, Cedar Creek Wilderness and Moonlight Basin Ski Resort, Jack Creek originates in high elevation alpine environments and flows through developed and undeveloped areas, rangeland, pasture and cropland as it makes its way to the Madison River.



Figure 1: Jack Creek map and sampling locations.

The Jack Creek watershed is unique in its variety of land types and land uses in a relatively compact area, making for an ideal opportunity to examine the consequences of land management on water resources. The headwaters of Jack Creek flow from multiple sources including the Lee Metcalf Wilderness Area, the Cedar Creek Wilderness and Moonlight Basin Ski Resort. Conditions in these wilderness areas remain relatively static while Moonlight Basin moves forward with plans for environmentally responsible ski, golf and residential development. Moving down in elevation, Jack Creek drains the landscape of the Jack Creek Preserve, which serves as an outdoor classroom for teaching conservation and protection of wildlife and its habitat. Jack Creek then flows through an active agricultural landscape where stock grazing and irrigated hay production dominate the land use.

Historic conditions also influenced the decision to include Jack Creek in a monitoring program. Jack Creek is included on Montana's 303(d) list for sedimentation/siltation, indicating water quality which is impaired or threatened by an excess particle load. Under Montana law, an impaired water body is defined as a water body for which sufficient and credible data indicates non-compliance with applicable water quality standards (MCA 75-5-103). Section 303 of the Federal Clean Water Act requires states to submit a list of impaired water bodies or stream segments to the U.S. Environmental Protection Agency (EPA) every two years. Prior to 2004, the EPA and DEQ referred to this list as the 303(d) list. Since 2004, the EPA requested that states combine the 303(d) list with the 305(b) report containing an assessment of Montana's water quality and its water quality programs. This new combined 303(d)/305(b) report is referred to as the Integrated Water Quality Report. Continued monitoring on Jack Creek would provide useful data for decision making regarding the present impaired status.

Additional factors also contribute to the value of examining conditions of Jack Creek. Throughout the area, climatic effects range from regions of significant snowpack to dry landscapes used primarily for grazing. Many other factors are similarly diverse including hydrology, geology, upland vegetation, topography, and population densities. Finally, Jack Creek is easily accessible to local residents and the Ennis School District, which serves the communities of Ennis, Cameron, Virginia City, and McAllister.

Present day conditions of Jack Creek indicate a system significantly influenced by high flow periods, with some indications of nutrient and sediment loading related to land use practices. Historic high flows have resulted in areas of channel instability, resulting in site specific incidences of degradation. Signs of degradation have been noted at both the middle and lower portions of Jack Creek, indicated by highly unstable and eroding banks (Figure 2, Figure 3). The consequences of bank instability can result in unnatural contributions of sediment to Jack Creek. Sediment contributions likely associated with roads are also a concern, and are periodically noted for Jack Creek (Figure 4)

Nutrient and sediment levels are of particular concern for the Jack Creek project. Excess nutrients can cause nuisance algae to proliferate and affect beneficial uses such as recreation and aquatic life. Excess sediment can cause impairment of instream habitat for macroinvertebrate and fisheries production. Waters of Montana are protected from excessive nutrient concentrations by narrative standards. Draft numeric standards were released in 2008 but have not been adopted yet. Sources of nutrients and TSS in Jack Creek include agricultural fertilizers, wildlife, livestock and pet waste, and sedimentation due to adjacent roads, bank erosion and land use practices.



Figure 2: Failing bank stabilization structure, Campground site.



Figure 3: Heavily eroded bank, South Side Road Site.



Figure 4: Localized sediment contribution at Madison site linked to precipitation caused surface run off.

## **Project Objectives**

The parameters for this project were selected based on the listing of Jack Creek for sediment impairment on the 303d list and based on interest in assessment of potential impacts from new development and existing land use on nutrient loading. Partners in the project are invested not only because of the opportunities to support youth and adult education opportunities, but also to examine the consequences of land use on water quality and quantity in Jack Creek. Annual data collections provide illustration of the effectiveness, or limitations, of best management practices implemented to reduce impacts.

Historic water quality data for Jack Creek provides evidence of similar parameters being examined in previous data collection events. The assessment record for Jack Creek available in the MT DEQ Clean Water Act Information Center lists three sources of data for major nutrients on Jack Creek. One of the three (Storet/MT View) indicates exceedances for total N and total P target levels in the past. Ranges of pH, dissolved oxygen and conductivity are also provided in the same data source. Chronic dewatering was also included as an impairment in the lower reaches of Jack Creek.

While the project seeks to address specific concerns identified for Jack Creek, it also includes a community driven approach. In the initial planning, a collaborative partnership between developers, private landowners, local conservation groups, university researchers and a school district was formed based on the shared belief of "giving back to the community". Partners wanted to develop a volunteer water monitoring project along Jack Creek for multiple reasons. The objectives of the Jack Creek project are as follows:

- Monitor the physical, chemical and biological conditions of Jack Creek to establish a baseline dataset
- Track spatial and temporal trends in water quality and quantity of Jack Creek
- Create an opportunity for communication between data collectors and project partners and partner landowners to address issues immediately as they arise
- Provide opportunities for community members to participate in monitoring events, as part of the newly formed volunteer monitoring team.
- Introduce students to practical/applicable side of math and science through experiential learning while gathering useful water quality and quantity data

The following is a list of draft hypothesis that may be tested based on the data collected in 2011. This list is a preliminary list created in the spring of 2011 and will be evaluated during the 2011 report writing process to determine 1) are these actually the questions we are interested in asking 2) are we collecting the data necessary to answer these questions?

1) What are the TSS concentrations and amount of bedded fine sediments at the monitoring stations during 2011 and do they vary among stations?

2) What are the nutrient concentrations at the Jack Creek monitoring stations during 2011, and do they vary spatially and/or temporally?

3) What are the flows at the Jack Creek monitoring stations during 2011?

4) What are the relative amount s of algae growth among the Jack Creek monitoring stations during 2011, i.e. are there apparent spatial or temporal differences?

Through the collection of water quality data, the project will provide the following products or opportunities:

- Annual report containing data from current year with comparisons to data collected in previous years. Baseline conditions will be established by noting any extremes or incidences of exceedences of state standards.
- Report will contain discussion on trends between and within stations and between and within years. This will provide opportunities to outreach to landowners that may be influencing water quality conditions at specific sites.
- Summary of preliminary findings of the Jack Creek project and the other streams included in the Madison Stream Team project will be presented to the general public following the field season 2011.
- Members of the Madison Stream Team will be included in regular monitoring days on Jack Creek, to build confidence in sampling techniques and to compare conditions on Jack Creek to their assigned streams.
- Students from local classes will be invited to participate in education events on Jack Creek, focused on the causes and consequences of water quality impairments and the proper methods for collecting water quality data.

### Project Design

Seven sites will be sampled throughout the length of Jack Creek, as described in Table 1. The sites were chosen based on upstream and surrounding land uses, channel morphology, and ease of access, as described in Table 2. Moonlight Creek, which drains an undeveloped area, is considered a reference reach for the upper portion of Jack Creek which has headwaters in the Moonlight development area. At this point, no reference stream has been identified for the lower portion of Jack Creek after it enters the Madison Valley.

Table 1. Jack creek sampling sites and information					
Site ID	Site Name	Lat/Long	Site Description	Parameters	
JC-JCR	Jack Creek Ranch	45°22'30.64" 111°41' 37.74"	Less than 1 mile upstream from confluence with Madison River	Full Suite	
JC-CY	Canyon	45°21'23.40" 111°35' 07.34"	Directly upstream from former USGS gaging station.	Full Suite	
JC-CG	Campground	45°20'47.84" 111°31' 45.02"	Directly upstream from end of public access section of Jack Creek Road.	Full Suite	

#### Table 1: Jack Creek sampling sites and information

Site ID	Site Name	Lat/Long	Site Description	Parameters
JC-SSR	South Side Road	45°19'52.08" 111°28' 33.03"	Downstream of resort development area.	Full Suite
JC-MC	Moonlight Creek	45°19'52.23" 111°25' 35.93"	Reference site located above Jack Creek road.	Full Suite
JC-MR	Madison Road	45°18'38.81" 111°25' 48.73"	Located within resort development area, off of golf course access road.	Full Suite
JC-LC	Lone Creek	45°18'47.52" 111°26' 15.60"	Located within resort development area, directly below base of chairlift.	Flow only

Table 2: Jack Creek sampling site selection rational

Site ID	Site Name	Land Type	Potential Impairments	Rational for site selection
JC-JCR	Jack Creek Ranch	Agricultural	Livestock	Examine effect of lower watershed land uses and spatial trends throughout upper portions of watershed.
JC-CY	Canyon	Forested	Road sediments	Examine effect of road, compare data with historic flow data from USGS gaging station.
JC-CG	Campground	Forested	Failing bank structures	Examine condition of stream above county road and below resort development areas.
JC-SSR	South Side Road	Forested	Headcut, eroding banks	Directly below resort development area, accessible by South Side Road.
JC-MC	Moonlight Creek	Forested	Reference	Tributary with no present anthropogenic activities in basin, considered headwaters system, accessible by Jack Creek Road.
JC-MR	Madison Road	Forested	Resort Development	Area of ongoing development and road use. Accessible by Madison Road.
JC-LC	Lone Creek	Forested	Resort Development	Area of ongoing development, area likely to have most effect from groundwater well installation.

The 2011 sampling schedule is detailed in Table 3. Data collections days span the length of the sampling season April-October, in order to monitor conditions on multiple periods of the hydrograph. Initial sampling will occur during April 2011, likely to be the rising limb of the hydrograph. The May or June events will likely capture near peak flows, with the July event likely on the descending limb of the hydrograph. August, September and October sampling events will likely capture base flows. Regular data collection events will be open to members of the Madison Stream Team, indicated below as MST. Three education events are also scheduled, to allow student and other youth groups the opportunity to learn about the reasons and approaches for water quality data collection.

Although data collection days have been separated from youth education days, both types of events will include collection of some of the target parameters. The separation of data collection and education events will benefit the data collection days by providing sufficient time to visit all 7 sites. Foremost in importance, the separation provides a more rigorous approach to teaching on education days, allowing sufficient time to present the concepts of water quality monitoring and to allow the student groups to fully understand the concepts presented. Students participating in education days will still measure the same parameters, with equipment that encourages better understanding of the process, such as field meters or Hach kits.

Date	Event Type	Flow	Field	TSS and	Pebble	Rock
			Parameters	Nutrients for	Count	Chlorophyll
			and	Lab Analysis		Pictures
			Turbidity	-		
April	Data, install	Х	Х			
	rods					
May	Data, MST	Х	X			
May	Education	Х	X			
June	Data	Х	X	Х		
July	Data, MST	Х	X	Х		X
August	Data, MST	Х	Х	X		X
August	Education	Х	Х			
September	Data, MST	Х	Х	X	Х	X
September	Education	Х	Х			
October	Data, pull	Х	X	X		
	rods					

Table 3: Sampling information for 2011 field season

Field Parameters: Temperature, pH, Dissolved Oxygen and Specific Conductivity

Instantaneous discharge (flow) will be measured for each site on each visit so that nutrient loads can be calculated. TruTrack stage recorders will also be deployed and rating curves constructed to facilitate continuous discharge calculations over the course of the season. Collection of field parameters is basic operating procedure when other water quality data is collected and will provide context for interpreting basic stream conditions and other data. Flow is the only parameter collected at the Lone Creek Ranch sample site.

Nutrients (Nitrate/Nitrite, Total Phosphorous) and TSS will be collected and submitted to a lab for analysis at all sites except Lone Creek Ranch (see Table 1) for June-October sampling events (total of 6 x 5 = 30 field sample sets plus 5 blank and 5 dup = 40 total sample sets to the lab). Nutrient concentration data will be evaluated against MT DEQ draft numeric nutrient standards for exceedance of standards. In addition, rocks photographed during the growing season will be visually assessed for extent of algae/chlorophyll presence to qualitatively assess presence of a nuisance algae problem. Quality control samples will be collected and sent to the analytical lab along with field samples at a rate greater than 10%.

Total suspended solids data has been collected since project inception and data collection will continue in 2011 through submission of samples to the DEQ contracted analytical lab. A relationship between TSS and turbidity will be assessed in 2011 and the utility of further TSS data collection in the future will be assessed. Turbidity measurement using secchi tubes is very effective for education because it provides immediate results in comprehendible units. Secchi tube measurements are quantitative but have limited resolution and are more prone to observer variability than are measurements with a turbidity meter. Turbidity measurements with a Hach meter will be collected in 2011 if a meter becomes available. Pebble count data will be collected at each site during the September sample event. Pebble count data will be assessed as a potential supplement to or replacement for TSS data.

Jack Creek data collected in 2011 will be summarized in graphs to facilitate easy comparison to applicable standards presented in Circular DEQ-7 and ARM 17.30.623 and MT DEQ draft nutrient criteria (MTDEQ 2008). Jack Creek is classified as a B1 stream within the Middle Rockies level III Ecoregion. Water quality data along with pebble count and chlorophyll photographs will facilitate discussion of future data collection priorities.

## **Project Team Responsibilities**

The project manager will be the Madison Watershed Coordinator, Sunni Heikes-Knapton. Responsibilities of the project manager include pre-season meeting, data collection, data analysis, report composition and presentation, coordinating educational events, and storage/maintenance/calibration of equipment. The project manager will have a field technician who will assist during the data collection and educational days. The field technician for 2011 is Kristina Whitlow, who has assisted with the project since 2008. The project administration will be completed by the Madison Conservation District, which will include the accounting and financial management of the project. The project team responsibilities are provided in Table 4.

The project partners, who include members of the Moonlight Basin Corporate Office, the Jack Creek Preserve Foundation, the Madison River Foundation, and the Madison Conservation District will participate as financial contributors and will provide volunteer assistance, when possible. Melissa Newman, high school science teacher, will participate with science club members on education days. Science club members will provide assistance teaching younger students and will have the opportunity to present the project at local conservation events.

Members of the Madison Stream Team, a newly formed volunteer monitoring group, completed their first level 2 training on June 15 and 16, 2010. This training was presented by Montana State University Extension Water Quality staff. A second level 2 training is planned for June 29<sup>th</sup> and 30<sup>th</sup> 2011 for the stream team and a level 3 training will be offered to those interested.

In 2011, Madison Stream Team members will be invited to participate in data collection days on Jack Creek to develop confidence in sampling methods and approaches, and to provide a comparison to the other streams that they regularly monitor.

Name/Title	Project Responsibilities	Contact information				
Sunni Heikes-Knapton;	Project Manager: Data Collection,	PO Box 606				
Madison Watershed	analysis, report composition,	Ennis, MT 59729				
Coordinator	coordination of educational events,	406.682.3181				
	equipment maintenance	mwc@3rivers.net				
Kristina Whitlow; Field	Assist Project Manager	Ennis, MT 59729				
Technician		406.360.5606				
		k2whitlow@yahoo.com				

Table 4: Project team members and responsibilities for 2011 Jack Creek project.

Name/Title	Project Responsibilities	Contact information
Janet Endecott; Madison	Financial Management, invoice	PO Box 606
Conservation District	payment	Ennis, MT 59729
Supervisor		406.682.7289
		madisoncd@3rivers.net
Melissa Newman; High	Education organizer	PO Box 517
School Science Teacher		Ennis, MT 59729
		406.682.4237
		mnewman@ennisschools.org

# Field Sampling Methods, Sample Handling Procedures

A Site Visit Form (Appendix A) will be completed for each site visit, for all parameters sampled. Sampling will be done in accordance with the MDEQ's Field Procedures Manual (DEQ, 2005). Pictures will be taken during the initial sampling event at each site to document the general site environment and site conditions. Site photos will be retaken for subsequent sampling events only if the conditions at the site change. Photos will be taken during the months of July, August and September of 10 randomly selected rocks from each site to qualitatively assess the amount of chlorophyll present. All pictures will be documented, with picture number, date/time, stream name, sample site ID, and directional reference recorded. The GPS coordinate system datum will be NAD 1983 State Plane Montana, in decimal degrees to at least the fourth decimal. GPS data will be verified for accuracy upon data entry by referencing aerial imagery in mapping software. Field activities will be documented by following the site visit form (Appendix A).

Parameter	Meter	Measurement Range	Resolution	Accuracy
temperature	Hanna HI	0.0 to 60.0° C	0.1 °C	± 0.5 °C
	98129			
рН	Hanna HI	0.00 to 14.00	0.01 pH	±0.01
	98129			
EC	Hanna HI	0 to 3999 μS/cm	1 μS/cm	±2% f.s.
	98129			
DO	YSI 550 A	0.0-20.0 mg/l	0.01 mg/l	±0.3 mg/L or 2% of
				reading, whichever is
				greater

#### Table 5: Field meter specifications for target parameters

### Water Sample Collection for Laboratory Analysis

Three grab samples (non-depth integrated) will be collected for the analysis of TSS and nutrients, using acid washed, polyethylene bottles provided by the testing laboratory. Table 6 details the parameters that will be analyzed within each grab sample, the associated bottle size, and preservative to be added in the field. Total phosphorus and nitrate are analyzed from the same bottle.

Parameter	Preferred	Alternate	Req. Report	Holding	Bottle	Preservative
	Method	Method	Limit ug/L	Time Days		
Total	EPA 160.2	A2540 D	4000	7	1000 ml	≤6oC
Suspended					HDPE	
Solids (TSS)						
Total	A 4500-N C	A4500-N B	50	30	250ml	≤6oC
Persulfate					HDPE	
Nitrogen						
(TPN)						
Nitrate-	EPA 353.2	A4500-NO3 F	10	28	500ml	H2SO4, ≤6oC
Nitrite as N					HDPE	
Total	EPA 365.1	A4500-P F	5	28	500ml	H2SO4, ≤6oC
Phosphorus					HDPE	
as P						

Table 6: Collection, storage and analytical methods for water quality parameters

Bottles shall be rinsed three times with stream water prior to sampling. Samples will be collected in a well-mixed portion of each stream, or, if the stream has ceased flowing (intermittent), the sample will be collected at the surface in a pool without disturbing the sediments. During sampling, the sample bottle opening should face upstream and should be drawn through the water column once, carefully avoiding disturbance of bottom sediments.

Quality control (QC) samples consisting of blanks and duplicates will be collected on each of the five sampling days that samples are collected for lab analysis. A field blank is prepared by transporting laboratory-grade deionized (DI) water to the field and pouring it into sample containers provided by the lab. The blank will be prepared at the same time that the samples are collected from the stream. A duplicate sample is a second stream sample collected at the same time in the same way that the regular stream sample is collected. Duplicate and blank samples will be collected at the same location for each event but the site they are collected at will rotate through the sample sites for subsequent sample events. Duplicate and blank samples are labeled according to the labeling protocol below which does not identify which sample is which to the lab so they are considered blind samples. Blank and duplicate samples are handled and delivered to the lab in the same manner that regular samples are handled.

Sample labels should be filled out with Company (Madison Conservation District), the date, the time and the sample ID. The sample ID is very important and includes the year, the month, the day, the site ID and a letter indicating they type of sample (regular, blank or duplicate).

Sample ID = Year-Month-Day-SiteID-Sample Type Letter

- A = Regular Sample
- B = Duplicate Sample
- C = Blank Sample

Sample ID Examples:

A regular sample collected at the Jack Creek Ranch on May 23<sup>rd</sup>, 2011 would be labeled: 11-05-23-JC-JCR-A

A duplicate at the same place and time as above:

11-05-23-JC-JCR-B

A blank at the same place and time as above:

11-05-23-JC-JCR-C

A regular sample collected at Moonlight Creek on August 3<sup>rd</sup>, 2011 would be labeled: 11-08-03-JC-MC-A

## Flow (Discharge) Measurement

Stream discharge data will be collected at all water quality monitoring sites using a Global Flow Probe current velocity meter and standard USGS area-velocity method in accordance with MDEQ's Field Procedures Manual (DEQ, 2005a). TruTrack capacitance rods will be inserted into installed stilling wells during the initial site visit, and programmed to record hourly water height (mm), water temperature (C), and air temperature (C). Upon each subsequent site visit, data will be downloaded to laptop computer equipped with Omnilog Software and saved as a Microsoft Excel file with site name, date, and time of download. Measured flow and recorded height will be used to create a stage/discharge relationship for sample year 2011. At Patrick Lizon's suggestion, stage data for periods with air temperatures less than freezing will be evaluated and data may be qualified based on DEQ observations that stage data accuracy decreases in this temperatures range.

## Field Parameter and Turbidity Measurement

Field parameters (water temperature, pH, EC) will be measured with a Hanna HI 98129 combo meter. Dissolved oxygen will be collected with a YSI 550A meter. The Hanna and YSI meters will be calibrated at the beginning of the sampling day according to specifications in the operations manual. Calibration solutions will have expiration dates checked prior to calibration, and only unexpired solutions will be used.

Turbidity measurements will be completed using secchi tubes by collecting a water sample from the middle of the water column in the middle of the channel. With the tube filled to the zero line and the sampler's back to the sun, the secchi disk is lowered on a string until the secchi pattern is no longer discernable by sampler. The depth of the secchi disk below the water line in the tube is the turbidity measurement with units of centemeters. Three readings will be completed and averaged.

Pebble counts will be conducted in accordance with MDEQ's Field Procedures Manual (DEQ, 2005a). Field form for pebble count data is found in Appendix A.

## Sample Handling and Laboratory Analytical Procedures

Immediately following grab-sample collection, samples will be put on ice. Sample handling procedures will follow DEQ standard operating procedures as defined in DEQ guidance, Sampling and Water Quality Assessment of Streams and Rivers in Montana, 2005: Quality Assurance Project Plan (DEQ, 2005b). The MT DEQ contract analytical lab chain of custody forms will be used to document and track all samples collected during the project. Chain of custody forms will be completed for each set of samples submitted to the laboratory. Nutrient and TSS samples will be shipped via UPS to Pace Labs in Billings for analysis. Table 6 details the holding time, collection container, preservative, storage temperature, analytical method, and required reporting limit for each analyte.

## **Quality Assurance and Quality Control Requirements**

In order for water quality data to be useful, it needs to be an accurate representation of conditions in the waterbody at the time the samples were collected. This requires proper sample handling and processing and then assessment of data to ensure quality. Data quality objectives (DQOs) state the required quality of data for the intended use and data quality indicators (DQIs) are the specific criteria that data are assessed by to determine quality. Definitions and a list of DQIs are included in the glossary. These indicators are assessed by collecting quality control (QC) samples and then performing quality assurance (QA) checks on those samples.

QC samples are blank, duplicate and spike samples collected or created in the lab and/or the field for evaluation of quality indicators. Once the lab results are returned for the QC samples, QA is the process of assessing the data through use of indicators to determine data quality.

### Data Quality Objectives

Efforts have been made to produce a **spatially representative** dataset by selecting seven sites spread over different land uses ranging from the top of the watershed down toward the confluence with the Madison. See Table 2 for a description of the rational for site selection. Sample collection has also been distributed across the hydrograph to capture a **temporal representation** of the differences in discharge and water quality at different points on the hydrograph. See Table 3 for the schedule of sample events.

Provisions are in place to ensure **sensitivity** of data collected to differences in stream water quality and **comparability** of data collected to other datasets. These provisions include the collection of grab samples and field QC for submission to a certified laboratory and assessment of QC data relative to data quality indicators. Data that does not meet quality criteria will be qualified appropriately in the annual report and during the MT EQIUS submission process.

In order to ensure the highest degree of data **completeness** possible, the Project Manager will fill out datasheets and review them before leaving a site. In the situation that Madison Stream Team members are participating as data collectors, Project Manager will review the data sheet prior to leaving the site to reduce the occurrence of empty data fields. The overall project goal is 90% completeness. Sites lost due to inaccessibility will reduce the total number of sites and will not be considered as part of the 10% acceptable loss under the completeness goal.

### **Data Quality Indicators**

Quality assurance and quality control (QAQC) can be broken down into a field and a laboratory component. The field component consists of collection of blank and duplicate samples and comparison of data to criteria. The laboratory component consists of assessment of data for blanks as well as a variety of duplicate and spiked samples analyzed by the lab. Blank samples should ideally yield results indicating "no detection" of the analyte in questions. Duplicate samples should ideally produce identical results and analysis of spiked samples should recover exactly the amount of analyte added. Methods are not perfect however, so the criteria outlined in the following two sections are used to assess if data is of acceptable quality.

### **Quality Assurance for Field Quality Control Samples**

Field quality control samples are typically collected for 10% of all samples collected, this means 1 in 10 samples. One set of field QC samples will be collected for each trip which will result in greater than a 10% QC (there are 6 sites where chemistry samples will be collected). Each set of field QC samples will include a blank and a duplicate for each analyte being sampled for. Accuracy for field QC samples will be assessed by ensuring that blank samples return values less than the data quality indicator criteria specified in (Table 7). If a blank sample returns a result greater than the threshold, all data for that parameter from that sample batch of samples may need to be qualified. The exception is that data with a value greater than 10 times the detected value in the blank does not need to be qualified. Precision for field QC samples will be assessed by ensuring that relative percent difference (RPD) between duplicates is less than 25%. RPD is calculated using the equation below. In addition to these accuracy/precision checks, it will be necessary to check that all samples were processed within their specified hold times.

### RPD as % = ((D1 – D2)/((D1 + D2)/2)) x 100

Where:

D1 is first replicate result D2 is second replicate result

Parameter	Field Blank	Field Duplicate
TSS	< 1 mg/L	< 25% RPD
Total Persulfate	<0.1 mg/L	< 25% RPD
Nitrogen		
Nitrate-Nitrite as N	<0.01 mg/L	< 25% RPD
Total Phosphorus as P	<0.005 mg/L	< 25% RPD

#### Table 7: Data quality indicator criteria for field QC samples

### **Quality Assurance for Lab Quality Control Samples**

Certified laboratories run QC samples for at least 10% of their sample volume. Integrity of laboratory data will be determined by comparing results for laboratory QC samples to the data quality indicator criteria in Table 8. Reports with lab QC results and data quality indicator calculations should be provided by the lab with each set of sample results. Each of the quality indicator criteria in Table 8 must be checked for each analyte for each batch of samples submitted to the lab. This process is easier if a matrix is used to systematically check the numbers. Both a completed and a blank example matrix for this purpose are provided in the Appendix E.

Parameter	Method	Method Blanks	Lab Duplicates (RPD)	Lab Control LCS/LFB (percent recovery)	Matrix Spike/ Matrix Spike Dup (percent recovery)
TSS	EPA 160.2 or	4			
	2540D	< 1  mg/L	< 10% RPD	75%-120%	NA
Total Persulfate	A4500-N C or	<0.1 mg/L			
Nitrogen	A4500-N B		< 10% RPD	90%-110%	90%-110%
Nitrate-Nitrite	A353.2 or	<0.01 mg/L			
as N	A4500-NO3 F		< 10% RPD	90%-110%	90%-110%
Total Phosphorus as P	EPA 365.1 or	< 0.005			
	4500-P F	mg/L	< 10% RPD	90%-110%	90%-110%

 Table 8: Data quality indicator criteria for lab QC samples

### Qualifying Data that fails data quality criteria

If any of the data quality objectives for field or laboratory QC samples fail the criteria above, all data for that analyte for that sample batch must be qualified accordingly. Note that a blank which exceeds the threshold does not automatically mean all data for that sample batch must be qualified. Sample results with values greater than 10 times the detected value in the blank do not need to be qualified. A narrative in the annual sampling report should outline what data was qualified and for what reason. The data will also need to be qualified during the process of uploading to MT EQUIS using the appropriate qualifier codes. A list of data qualifier codes is provided in the appendix.

### Training

Members of the Madison Stream Team received a level II training in June 2010. Team members will receive a second level II training in June 29 and 30 of 2011 and those who are interested will be offered a level III training which builds on the level II training.

## Data Analysis, Record Keeping and Reporting Requirements

Copies of laboratory analytical reports and electronic data deliverable spreadsheets will be provided by the DEQ contract analytical laboratory to both the Madison Watershed Coordinator and to DEQ. Coordinator will review the laboratory data to ensure lab results are within reporting limits (including the laboratory QA/QC samples) prior to data entry into the MT Volunteer Water Quality Database Repository housed at the MT Watercourse and later into MT eWQX. A review of field and analytical data will be conducted following receipt of the laboratory data package that includes all items on the QC Checklist in Appendix A. Data qualifiers provided in Appendix D will be assigned to data in both hardcopy and electronic form that does not meet these target quality control criteria.

Data generated during this project will be stored on field forms and in laboratory reports obtained from the laboratories. Site Visit and Chain of Custody forms will be properly completed for all samples. Written field notes, field forms, and digital photos will be processed by field staff following QA/QC procedures to screen for data entry errors. Data from all sampling events will be entered into eWQX.

The parameters for data analyses were selected based on the listing of Jack Creek for sediment impairment on the 303d list and based on interest in assessment of potential impacts from new development and existing land use on nutrients. Partners in the project are interested in examining the consequences of land use on water quality and quantity in Jack Creek. The analyses of this data (and priori data) will provide illustrations for assessing the effectiveness, or limitations, of current best management practices.

The data analysis objectives are to:

- Display the physical, chemical and biological conditions of Jack Creek toward establishing a baseline stream segment dataset.
- Compare spatial and temporal trends in water quality and quantity of Jack Creek through a stream condition summary report including data from current year with comparisons to data collected in previous years. Baseline conditions will be noted, including any extremes or incidences of exceedences of state standards.
- The Jack Creek data collected in 2011 will be summarized in graphs to facilitate easy comparison to applicable standards. Nutrient concentration data will be evaluated against MT DEQ draft numeric nutrient standards for exceedance of standards and will be graphically plotted from upstream to downstream. The intention will be that, over time, ongoing examinations of seasonal variations in nutrient concentrations could provide insights into nutrient sources.
- The summary report will discuss trends between and within stations and between and within years. This summary report will provide opportunities to outreach to landowners who may be influencing water quality conditions at specific sites.

Analysis of the outreach and education objectives will include:

- Present a preliminary summary of the Jack Creek project data and other streams in the Madison Stream Team project to the general public following the 2011 field season.
- Including Madison Stream Team members in regular monitoring days on Jack Creek, to build confidence in sampling techniques and to compare conditions on Jack Creek to their assigned streams.
- Inviting students from local classes to participate in education events on Jack Creek, focused on the causes and consequences of water quality impairments and the proper methods for collecting water quality data.

## References

DEQ 2005a. Water Quality Planning Bureau Field Procedures Manual for Water Quality Assessment Monitoring. Montana Dept. of Environmental Quality, WQPBWQM-020, revision 2. April 21, 2005. Available at

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- DEQ, 2005b. Quality Assurance Project Plan (QAPP) Sampling and Water Quality Assessment of Streams and Rivers in Montana, 2005. Available at <u>http://www.deq.state.mt.us/wqinfo/QAProgram/WQPBQAP-02.pdf</u>.
- DEQ, 2006. Circular DEQ-7, Montana Numeric Water Quality Standards, 2006. Available at

http://www.cedarcreekengineering.com/customers/carolina/Avon/Reports/Mo ntana/GW%20-%20CompiledDEQ-7.pdf

- MT DEQ. 2008. Scientific and Technical Basis of the Numeric Nutrient Criteria for Montana's Wadeable Streams and Rivers. Michael Suplee, Ph.D. - Montana Department of Environmental Quality; Vicki Watson, Ph.D. – University of Montana; Arun Varghese and Josh Cleland – ICF International. Available on the web at: <u>http://deq.mt.gov/wqinfo/standards/PDF/WhitePaper\_FNL3\_Nov12-08.pdf</u> [verified June 5, 2010].Appendix A: Site Visit Form and QC Checklist
- MT DEQ. 2011. MT DEQ. Clean Water Act Information Center, Jack Creek Water Quality Assessment. <u>http://cwaic.mt.gov/wqrep/2010/assmtrec/MT41F004\_050.pdf</u> URL confirmed: 5/10/2011

Appendix A: Site Visit Forms, QC Checklist

## Jack Creek Site Visit Form

Date:		Time:		Team I	am Member(s): Sta										ation ID: JC							
Waterbo	dy:					Site Descr	ription:					County: Madison, MT										
HUC:			Latitu	de:				_		Longitu	de:				(Record in decimal degrees)							
Elevation (m): GPS Datum: NAD83								Lat/Long Verified? By:														
SAMPLE	S COLLEC	TED:		SA	MPLE I	D (format =	2digit MO 2	digit YR	Stat	tionID Lett	er example:	0711JC-	JCR-A)	W	Water Sample Collection Info: Grab Sample							
Analysis	Request	ed:		Sample	e ID:		Sample ID:	-			Sample ID:			w	ater Sa	ample Pi	reservation	Info: (Circle	Below)			
Total S	Suspende	d Sediment												Н	NO <sub>3</sub>	H <sub>2</sub> SO	4 HCL	None				
Nitrog	en, Nitrat	te + Nitrite												Н	NO <sub>3</sub>	H <sub>2</sub> SO	₄ HCL	None				
Total I	Phosphor	us												Н	NO <sub>3</sub>	H <sub>2</sub> SO	₄ HCL	None				
Stream I	ield Mea	surements	:					Cu	ırre	nt Weath	ner (Circle (	One):		Site	Visit	Comm	ents:					
Water T	emperatu	ire:		Air T	empera	ature:		Cl	oud	Cover:												
pH:				Turb	idity:	Reading 1:		<5	5%	5 - 25%	25 -75%	75 -	100%									
Specific	Conductiv	vity:		Read	ling 2:	Readir	ng 3:	Pr	Precipitation:													
Dissolve	d Oxygen	:		Aver	age of	3 readings	5:	No	None Light Moderate Heavy													
Turbidity	/: (Visual)	Clear	Sligh	nt 🗌	Turbi	d 🗌 Op	aque 🗌	Pa	ast P	Precipitat	ion (last 24	hours	):									
Flow Me	thod: Me	eter 📃 🛛 Flo	at 🗌	Gage [				No	one	Light	Modera	ate	Heavy	'								
TruTrack	Downloa	ad: 🗌						Phote	Photographs: Digital 🦳 Film 🗌 Chlorophyll photo (10 rc								to (10 roo	:ks):				
Flow Me	asuremen	t	Chanr	nel Wid	th:	ft						-					-		-			
Station	Distance	Depth	Velocit	ty Sta	ation	Distance	Depth	Veloci	ity	Station	Distance	Dept	י ו	Velocity	Sta	ition	Distance	Depth	Velocity			
1				6						11					16							
2				7						12					17							
3				8						13					18							
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5					)					15					20				l			
Chemist	ry Lab Inf	ormation:																				
Lab Sam	ples Subr	mitted to:	TBD			Account	#: N/A			Date Sub	mitted:			And	alytica	al Servi	ices Quot	e ID #:				
Invoice A	Address:	Madison	Conse	rvatior	n Distri	ct, PO Box	606, Ennis	5 MT 59	9729	9				EDI	$\Sigma$	Forma	at: MDEQ	eWQX				
Contact	Name &	Phone: Sur	nni Heil	kes-Kn	apton,	Madison V	Natershed	Coord	linat	tor, 406.6	582.3181 o	r 406.5	70.41	93								
Relinquis	hed By:				Shippe	d By (circle	one): FEDE	X UP	PS	FORM	REVIEWED	& CHEC	KED B	Y:								
Date/Tim	e:				Date/T	me:																

Jack Creek Sampling and Analysis Plan

#### Site Visit Form Instructions

#### (Modified from MDEQ Site Visit Form 2/2007 Revision) – REV04-2010

v. JC-ML

vi. JC-MAD

vii. JC-LC

- 1. **Date/Time**: Enter the date and time of the station visit.
- 2. Team Member(s): Enter the first and last name(s) of the individuals conducting field activities.
- 3. Waterbody: Enter the name of the waterbody such as "Gallatin River".
- 4. Location: Description of sample location (ie, "upstream of bridge on Forest Service Rd 100".
- 5. **Station ID**: Also known as the "**Site ID**". Enter the appropriate ID for the station:
  - i. JC-JCR
  - ii. JC-CY
  - iii. JC-CMP
  - iv. JC-SSR
- 6. **Visit #**: Enter "1" if this is a new station.
- 7. **HUC**: Enter the fifth code (10 digit) HUC (Hydrologic Unit Code) the station falls within:
  - i. Jack Creek = 1002000710
- 8. County: Enter "Madison".
- 9. Lat/Long: Latitude and Longitudes should be obtained in decimal degrees using a GPS unit reading NAD83. If a lat/long is obtained by another method, the datum and method must be recorded in the Site Visit Comments.
- 10. Lat/Long Verified: Latitudes and Longitudes should be verified <u>immediately</u> upon return from the field. Verify by plotting on a paper map or using a mapping website. Once the lat/long has been verified check the Verified box and enter initials after "By".
  - Do not make minor adjustments to measured values during verification; they are assumed to be correct within the limitations of the measurement system.
  - Gross errors should be corrected: 1) Draw single line through the erroneous value(s) and initial. Don't erase original reading. 2) Write corrected value in the comment field along with the method and datum used to derive the corrected value.
- 11. Elevation: Record and circle GPS datum used. If elevation is obtained by another method, the datum and method must be recorded in the Site Visit Comments.
- 12. Samples Collected: Check the box next to each activity that is collected during the station visit.
- 13. **Sample ID**: Write the Sample ID (i.e. 0710JC-JCRA) for all samples collected. The first 4 digits are the month (ie 07) and the year (ie 10), followed by the Station ID (ie JC-JCR), followed by a letter (ie, A, B, C) to distinguish sample from blanks and duplicates. Note in Site Visit Comments which sample IDs are "field blanks" and "duplicates".
- 14. Sample Collection Procedure: Circle the appropriate Sample Collection Procedure ID.
- 15. Analysis Requested: For each chemistry sample, circle the preservative used. (See Table 4 Collection, Storage, and Analytical methods, SAP).
- 16. Field Measurements: Record field measurements in spaces provided.
- 17. Field Assessments: Check the boxes next to each type of field assessment completed.
- 18. Site Visit Comments: Record general comments about the station visit, samples, and field measurements.
- 19. Current Weather Conditions: Circle appropriate one.
- 20. Chemistry Lab Information: If chemistry lab samples were taken, complete this section.
  - Date Submitted: Record date the samples were sent to the laboratory.
  - Relinquished By: Sign and date the form when delivering samples for shipment.
  - Shipped By: Enter name of shipper (UPS or FedEx) and date the form at delivery of samplers for shipment.
  - 21. Form Checked By: <u>Before</u> leaving the site, field form MUST be reviewed for completeness and accuracy by the Field Leader and signed.

		PEBB	LE COUNT (SI	JBSTRATE (	COMF	POSITIC	N) DATA	SHEET		-			
Date:			Project	ID: MST	Tri	ip ID: Ⅳ	IST2011	Station ID: MST					
Stream Name:							Station	Description:					
Team Member(s):													
Organization:		MST	Volunteer Moni	toring Progra	m			Equipment Used: Gravelometer					
				PEBBLE (	COUN	IT							
NOTE: You must sa	mple for a minimum	of 100 s	substrate piec	es.									
Row ID	Particle Category		Size (mm)	Riffle Count		(Other)	) Count	Character	istic Group: PE	BL-CNT			
								Sum	% of Total	Cumulative Total			
1	Silt / Clav		<1						0	0.00%			
2	Sand		1 - 2						0	0.00%			
3	Very Fine		> 2 - 4						0	0.00%			
4	Fine		> 4 - 5.7			1			0	0.00%			
5	Fine	> 5.7 - 8					0	0.00%					
6	Medium	L.S.	> 8 - 11.3						0	0.00%			
7	Medium	A R	> 11.3 - 16						0	0.00%			
8	Coarse	SR/	> 16 - 22.6						0	0.00%			
9	Coarse	0	> 22.6 - 32						0	0.00%			
10	Very Coarse		> 32 - 45						0	0.00%			
11	Very Coarse		> 45 - 64						0	0.00%			
12	Small	ES	> 64 - 90						0	0.00%			
13	Small	3LE	> 90 - 128						0	0.00%			
14	Large	BB	> 128 - 180						0	0.00%			
15	Large	U N	> 180 - 256						0	0.00%			
16	Small	S	> 256 - 362						0	0.00%			
17	Small	ER	> 362 - 512						0	0.00%			
18	Medium	2	> 512 - 1024						0	0.00%			
19	Large	0	> 1024 - 2048						0	0.00%			
20	Bedrock	ñ	> 2048						0	0.00%			
21	Total # Samples				0		0		0 0.00%				
MST Modified 6/2/2011													

#### **Quality Control Checklist**

- Condition of samples upon receipt
- \_\_\_\_Cooler/sample temperature
- Proper collection containers
- \_\_\_\_All containers intact
- \_\_\_\_Sample pH of acidified samples <2
- \_\_\_\_All field documentation complete. If incomplete areas cannot be completed, document the issue.
- \_\_\_\_Holding times met
- \_\_\_\_Field duplicates collected at the proper frequency (specified in SAP)
- \_\_\_\_Field blanks collected at the proper frequency (specified in SAP)
- \_\_\_\_All sample IDs match those provided in the SAP. Field duplicates are clearly marked on samples and noted as such in lab results.
- \_\_\_\_Analyses carried out as described within the SAP (e.g. analytical methods, photo documentation, field protocols)
- \_\_\_\_Reporting detection limit met the project-required detection limit
- \_\_\_\_All blanks were less than the project-required detection limit
- \_\_\_\_If any blanks exceeded the project-required detection limit, associated data is flagged
- \_\_\_\_Laboratory blanks/duplicates/matrix spikes/lab control samples were analyzed at a minimum 10% frequency
- \_\_\_\_Laboratory blanks/duplicates/matrix spikes/lab control samples were all within the required control limits defined within the SAP
- Project DQOs and DQIs were met (as described in SAP)
- \_\_\_\_\_Summary of results of QC analysis, issues encountered, and how issues were addressed (corrective action)
- \_\_\_\_Completed QC checklist before MT-eWQX upload



#### CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

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Require	ed Client Information:	Required	, Proje	ct infon	mation:					Invoi	ice Ini	ortte	tion:												Page	c		of	
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						Address:							□ NPDES □ GR						GR	OUND WATER DRINKING WATER									
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Jack Creek Sampling and Analysis Plan

# Appendix B: QA/QC Terms

**Accuracy.** A data quality indicator, accuracy is the extent of agreement between an observed value (sampling result) and the accepted, or true, value of the parameter being measured. High accuracy can be defined as a combination of high precision and low bias.

**Analyte.** Within a medium, such as water, an analyte is a property or substance to be measured. Examples of analytes would include pH, dissolved oxygen, bacteria, and heavy metals.

*Bias.* Often used as a data quality indicator, bias is the degree of systematic error present in the assessment or analysis process. When bias is present, the sampling result value will differ from the accepted, or true, value of the parameter being assessed.

**Blind sample.** A type of sample used for quality control purposes, a blind sample is a sample submitted to an analyst without their knowledge of its identity or composition. Blind samples are used to test the analyst's or laboratory's expertise in performing the sample analysis.

*Comparability.* A data quality indicator, comparability is the degree to which different methods, data sets, and/or decisions agree or are similar.

**Completeness.** A data quality indicator that is generally expressed as a percentage, completeness is the amount of valid data obtained compared to the amount of data planned.

**Data users.** The group(s) that will be applying the data results for some purpose. Data users can include the monitors themselves as well as government agencies, schools, universities, businesses, watershed organizations, and community groups.

**Data quality indicators (DQIs).** DQIs are attributes of samples that allow for assessment of data quality. These include precision, accuracy, bias, sensitivity, comparability, representativeness and completeness.

**Data quality objectives (DQOs).** Data quality objectives are quantitative and qualitative statements describing the degree of the data's acceptability or utility to the data user(s). They include data quality indicators (DQIs) such as accuracy, precision, representativeness, comparability, and completeness. DQOs specify the quality of the data needed in order to meet the monitoring project's goals. The planning process for ensuring environmental data are of the type, quality, and quantity needed for decision making is called the **DQO process.** 

**Detection limit.** Applied to both methods and equipment, detection limits are the lowest concentration of a target analyte that a given method or piece of equipment can reliably ascertain and report as greater than zero.

**Duplicate sample.** Used for quality control purposes, duplicate samples are two samples taken at the same time from, and representative of, the same site that are carried through all assessment and analytical procedures in an identical manner. Duplicate samples are used to measure natural variability as well as the precision of a method, monitor, and/or analyst. More than two duplicate samples are referred to as *replicate samples*.

*Environmental sample.* An environmental sample is a specimen of any material collected from an environmental source, such as water or macroinvertebrates collected from a stream, lake, or estuary.

**Equipment or rinsate blank.** Used for quality control purposes, equipment or rinsate blanks are types of field blanks used to check specifically for carryover contamination from reuse of the same sampling equipment (see *field blank*).

**Field blank.** Used for quality control purposes, a field blank is a "clean" sample (e.g., distilled water) that is otherwise treated the same as other samples taken from the field. Field blanks are submitted to the analyst along with all other samples and are used to detect any contaminants that may be introduced during sample collection, storage, analysis, and transport.

*Instrument detection limit.* The instrument detection limit is the lowest concentration of a given substance or analyte that can be reliably detected by analytical equipment or instruments (see *detection limit*).

*Matrix.* A matrix is a specific type of medium, such as surface water or sediment, in which the analyte of interest may be contained.

*Measurement Range.* The measurement range is the extent of reliable readings of an instrument or measuring device, as specified by the manufacturer.

*Method detection limit (MDL).* The MDL is the lowest concentration of a given substance or analyte that can be reliably detected by an analytical procedure (see *detection limit*).

**Precision.** A data quality indicator, precision measures the level of agreement or variability among a set of repeated measurements, obtained under similar conditions. Relative percent difference (RPD) is an example of a way to calculate precision by looking at the difference between results for two duplicate samples.

*Protocols.* Protocols are detailed, written, standardized procedures for field and/or laboratory operations.

**Quality assurance (QA).** QA is the process of ensuring quality in data collection including: developing a plan, using established procedures, documenting field activities, implementing planned activities, assessing and improving the data collection process and assessing data quality by evaluating field and lab quality control (QC) samples.

**Quality assurance project plan (QAPP).** A QAPP is a formal written document describing the detailed *quality control* procedures that will be used to achieve a specific project's data quality requirements. This is an overarching document that might cover a number of smaller projects a group is working on. A QAPP may have a number of sample analysis plans (SAPs) that operate underneath it.

**Quality control (QC).** QC samples are the blank, duplicate and spike samples that are collected in the field and/or created in the lab for analysis to ensure the integrity of samples and the quality of the data produced by the lab.

**Relative percent difference (RPD).** RPD is an alternative to standard deviation, expressed as a percentage and used to determine precision when only two measurement values are available. Calculated with the following formula: RPD as  $\% = ((D1 - D2)/((D1 + D2)/2)) \times 100$ 

Where: D1 is first replicate result D2 is second replicate result

Replicate samples. See duplicate samples.

**Representativeness.** A data quality indicator, representativeness is the degree to which data accurately and precisely portray the actual or true environmental condition measured.

*Sample analysis plan (SAP).* A SAP is a document outlining objectives, data collection schedule, methods and data quality assurance measures for a project.

**Sensitivity.** Related to *detection limits*, sensitivity refers to the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. The more sensitive a method is, the better able it is to detect lower concentrations of a variable.

**Spiked samples.** Used for quality control purposes, a spiked sample is a sample to which a known concentration of the target analyte has been added. When analyzed, the difference between an environmental sample and the analyte's concentration in a spiked sample should be equivalent to the amount added to the spiked sample.

*Split sample.* Used for quality control purposes, a split sample is one that has been equally divided into two or more subsamples. Splits are submitted to different analysts or laboratories and are used to measure the precision of the analytical methods.

**Standard reference materials (SRM).** An SRM is a certified material or substance with an established, known and accepted value for the analyte or property of interest. Employed in the determination of bias, SRMs are used as a gauge to correctly calibrate instruments or assess measurement methods. SRMs are produced by the U. S. National Institute of Standards and Technology (NIST) and characterized for absolute content independent of any analytical method.

**Standard operating procedures (SOPs).** An SOP is a written document detailing the prescribed and established methods used for performing project operations, analyses, or actions.

**True value.** In the determination of accuracy, observed measurement values are often compared to true, or standard, values. A true value is one that has been sufficiently well established to be used for the calibration of instruments, evaluation of assessment methods or the assignment of values to materials.

<b>Appendix C:</b>	Data	qualifiers and	descriptions.
		744111010 4114	

Result Qualifier	Result Qualifier Description
В	Detection in field and/or trip blank
D	Reporting limit (RL) increased due to sample matrix interference (sample dilution)
Н	EPA Holding Time Exceeded
J	Estimated: The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
R	Rejected: The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.
U	Not Detected: The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.
UJ	Not Detected/Estimated: The analyte was not detected at a level greater than or equal to the adjusted CRQL or the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

# Appendix D: Example QAQC matrix

Below is an example of a matrix for use in addressing whether all data quality criteria are met for each analyte for each batch of samples. A blank electronic table is provided on the following page for use as a template for Jack Creek.



					???Sample	Event Date???	,			
		TSS	5	TN		NO3		ТР		
		Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value	
1	Method	EPA 160.2		A4500 N-C		E353.2		E365.1		
2	Method Blank	<1 mg/L		<0.1 mg/L		<0.01 mg/L		<0.005 mg/L		
3	Lab Control	75-120%		90-110%		90-110%		90-110%		
4	Lab Fortified Blank	NA		90-110%		90-110%		90-110%		
5	Sample Dup	<10%		<10%		<10%		<10%		
6	Matrix Spike	NA		90-110%		90-110%		90-110%		
7	Matrix Spike Dup	NA		90-110%		90-110%		90-110%		
8	Field Blank	<1 mg/L		<0.1 mg/L	<0.1 mg/L			<0.005 mg/L		
9	Field Dup	Field Dup <25%		<25%		25%		25%		

# Jack Creek QC Check