

---

## LOWER GALLATIN TMDL PLANNING AREA SEDIMENT MONITORING

---

### *Sampling and Analysis Plan*

Project ID: M05-TMDL-02  
SAP ID: EM05SAP-03

#### **Prepared by:**

**MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY**  
Watershed Management Section, Water Quality Planning Bureau  
1520 East 6<sup>th</sup> Avenue  
Helena, MT 59620-0901

And

**PBS&J**  
3810 Valley Commons Drive, Suite 4  
Bozeman, MT 59718

#### **Approvals**

---

Lisa Kusnierz (TMDL Project Manager)

---

Date

---

Dean Yashan (TMDL Section Supervisor)

---

Date

---

Chris Shirley (Acting QA Officer)

---

Date

---

Jeff Dunn (Contractor – PBS&J)

---

Date

<b>1.0 Introduction and Background .....</b>	<b>1</b>
<b>2.0 Objectives and Design .....</b>	<b>3</b>
<b>3.0 Field Sampling Methods.....</b>	<b>6</b>
<b>4.0 Quality Assurance and Quality Control Requirements.....</b>	<b>6</b>
<b>5.0 Data Analysis, Record Keeping, and Reporting Requirements .....</b>	<b>9</b>
<b>6.0 Schedule for Completion .....</b>	<b>10</b>
<b>7.0 Project Team and Responsibilities .....</b>	<b>10</b>
<b>8.0 References.....</b>	<b>10</b>

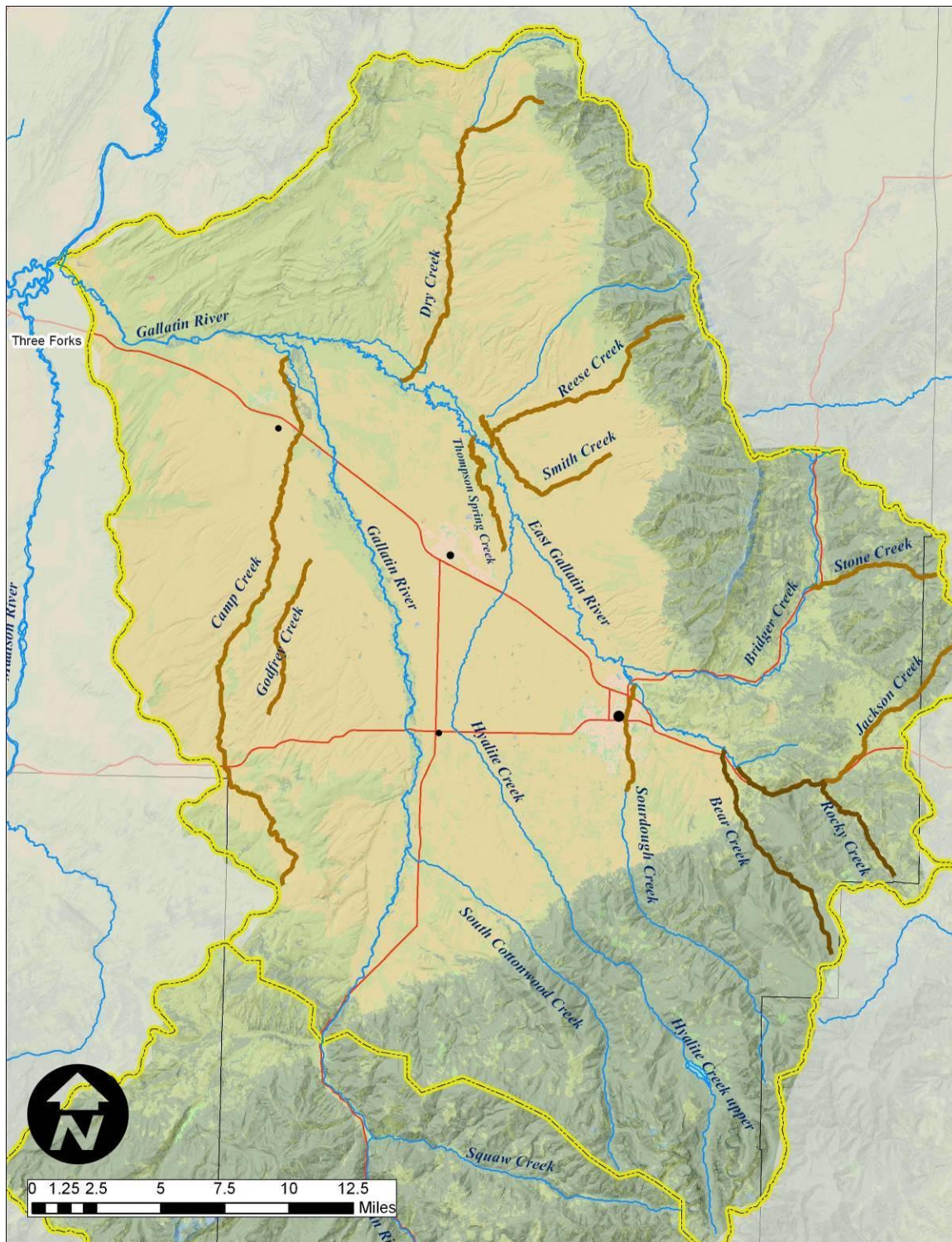
This document constitutes the Sampling and Analysis Plan (SAP) for the completion of sediment impairment determination, source assessment and loading estimates for the listed streams in the Lower Gallatin TMDL planning area (TPA).

## 1.0 Introduction and Background

The Lower Gallatin TPA encompasses an area of approximately 997 square miles in Gallatin County in southwestern Montana. The Lower Gallatin TPA includes the area of the Gallatin River watershed extending from the confluence with Spanish Creek at the north end of Gallatin Canyon, downstream to the confluence with the Madison River (**Figure 1**). The TPA is within the Gallatin fourth-level hydrologic unit code (HUC) of 10020008.

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, this list was referred to as the “303(d) list”, but is now named the “Integrated Report”. The Montana Water Quality Act further directs states to develop TMDLs for all water bodies appearing on the 303(d) list as impaired or threatened by “pollutants” (MCA 75-5-703).

Within the Lower Gallatin TPA, there are 11 water body segments listed on the 2006 303(d) List for sediment-related impairments (**Figure 1**). Two of the water bodies, Camp Creek and Godfrey Creek, are tributaries to the Gallatin River. The other nine water bodies are tributaries to the East Gallatin River, and they include Bear, Bozeman (a.k.a. Sourdough), Dry, Jackson, Reese, Rocky, Smith, Stone, and Thompson Springs creeks. South Cottonwood Creek, a tributary to the Gallatin River, is not listed for sediment but contains a DEQ reference site and is included within this SAP to provide reference data. The field methods conducted under this SAP are intended to assist DEQ in evaluating the impairment status of streams in the Lower Gallatin River TPA and for developing TMDLs where necessary.



**Figure 1. Sediment listed streams in the Lower Gallatin TPA.**

## 2.0 Objectives and Design

The objective of this sampling plan is to collect sediment and stream habitat data that will be used for the following:

- Verification of sediment impairment conditions on 303(d) listed tributaries in the Lower Gallatin TMDL Planning Area
- Quantification of sediment loads associated with specific land use categories in the Lower Gallatin TMDL Planning Area to assist in TMDL sediment load allocations

### *Study Design*

In order to meet the above objectives, substrate character and stream habitat conditions will be determined by extensive water quality sampling in the listed tributaries within the Lower Gallatin watershed. Longitudinal surveys that include pebble counts, grid toss, cross sections, pool data collection, riparian greenline surveys, and eroding bank information will be performed at each of the selected sample sites during August 2009.

Following procedures described in the document *Watershed Stratification Methodology for TMDL Sediment and Habitat Investigations* (DEQ 2008), listed stream reaches within the Lower Gallatin watershed were stratified by ecoregion, stream order, valley gradient, and channel confinement. An additional stratification was performed through the use of aerial photography in order to identify distinct riparian conditions and to note areas of apparent local impacts.

### *Selection of Candidate Assessment Reaches*

Candidate assessment reaches were selected in relatively low-gradient portions of the listed streams to facilitate the evaluation of sediment loading impacts. Other considerations in selecting candidate assessment reaches included representativeness of the candidate reaches to other reaches of the same slope, order, confinement and ecoregion, as well of ease of access. Within each candidate assessment reach, survey reaches ranging from 500, 1000, 1500, or 2000 feet will be established based on the bankfull width of the stream during the field assessment. Refer to the *Longitudinal Field Methods for the Assessment of TMDL Sediment and Habitat Impairments* (DEQ 2009) for additional details.

### *Selection of Limited Assessment Reaches*

Based on the distribution of reach types in higher gradient areas (i.e. >4%) that was determined via the stratification process, reaches were selected for a limited assessment. Although higher gradient reaches are typically areas of sediment transport, they may be sources of sediment. The limited assessment sites will only be evaluated for bank erosion and are referred to as “BEHI-only” sites. Data from the BEHI-only sites will be used to aid in the quantification of naturally occurring sediment from bank erosion in high gradient areas and sediment related to vary land use categories.

### Sampling Reaches

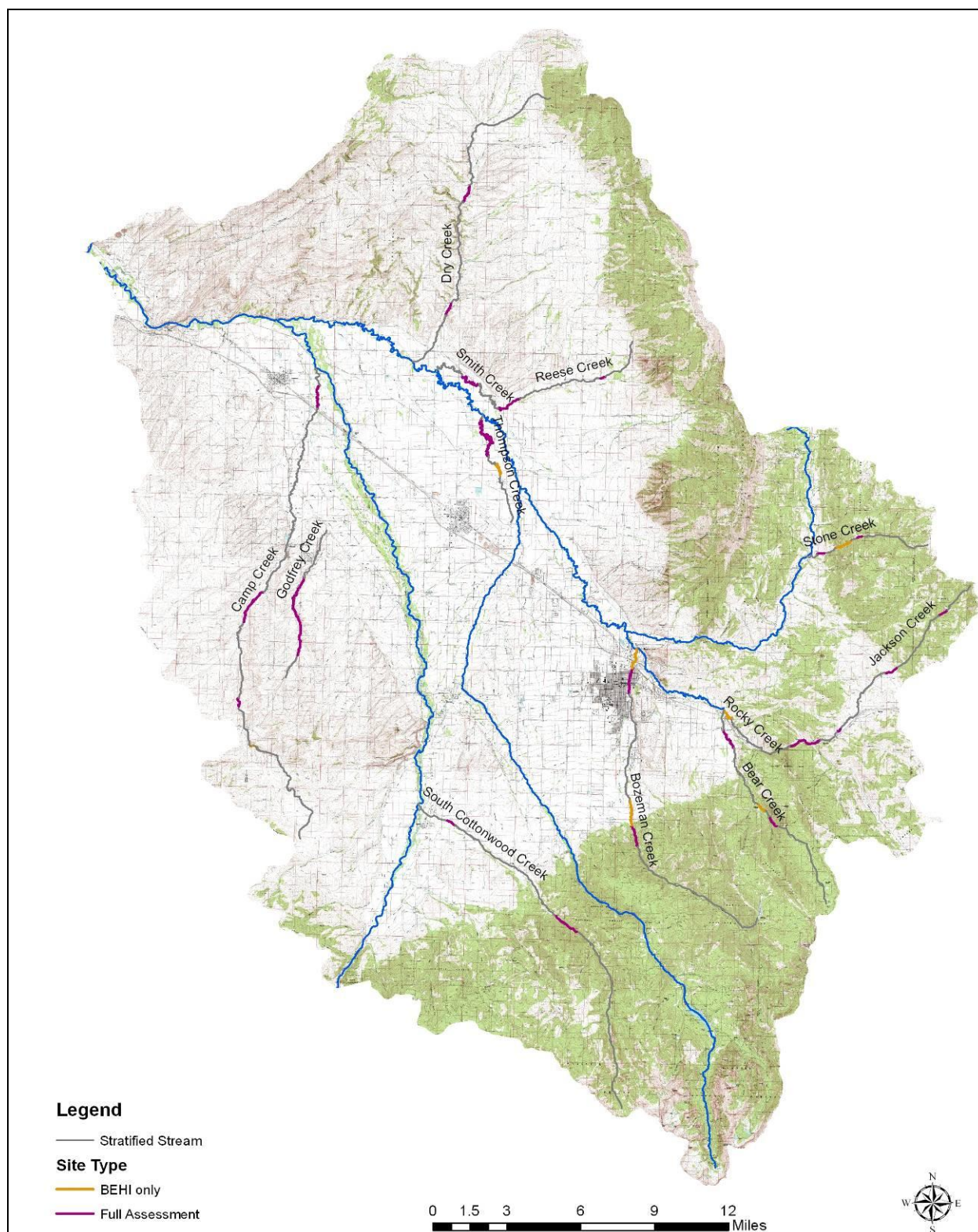
Thirty sediment sampling reaches spatially distributed throughout the study tributaries in the Lower Gallatin TPA were selected for inclusion in this project. Sampling reaches were chosen to include streams where data will assist with impairment determinations, as well as represent the range of landscape characteristics and land use/land cover influences existing in the watershed. Sampling reaches were identified based on the results of the stratification procedure, which incorporates stream order, valley confinement and slope, and ecoregion, and also an aerial analysis of the dominant land use/land cover adjacent to the stream (e.g. urban and residential areas, forest, logging, irrigation, grazing, row crops, and riparian area).

Based on the draft SAP, the representativeness of proposed and alternate sample sites and the riparian health conditions assigned during the stratification process were evaluated during a field reconnaissance trip to determine the final sample site list (**Table 1**) and to verify the riparian health classifications. The complete sediment and habitat assessment methodology is anticipated to be performed at 23 sample sites (including 2 reference sites) and a BEHI-only assessment will be performed at 7 sites (see **Table 1** and **Figure 2**).

**Table 1. All potential sediment assessment reaches in the Lower Gallatin TPA.**

<b>Stream</b>	<b>Full Assessment Reach</b>	<b>BEHI-only Reach</b>
Bear Creek	BEAR-18-01 BEAR 26-02	BEAR-20-01
Bozeman Creek	BOZE-14-01 BOZE-18-04	BOZE-15-01 BOZE-18-05
Camp Creek	CAMP-14-05 CAMP-14-12 CAMP-15-04	CAMP-13-02
Dry Creek	DRY-09-05 DRY-12-06	
Godfrey Creek	GOD-02-01 GOD-03-01	
Jackson Creek	JACK-04-01 JACK-10-02	
Reese Creek	REES-06-01 REES-15-06	
Rocky Creek	ROCK-02-01 ROCK-03-01	ROCK07-03
Smith Creek	SMIT-01-05	
S Cottonwood Creek	SCOT-25-02 (reference) SCOT-31-02 (reference)	
Stone Creek	STON-09-01 STON-13-02	STON11-02
Thompson Springs	THOM-02-03	THOM-01-04





**Figure 2. All potential sediment assessment reaches in the Lower Gallatin TPA.**

### 3.0 Field Sampling Methods

All monitoring and data collection will be done in accordance with the approach described in *Longitudinal Field Methods for the Assessment of TMDL Sediment and Habitat Impairments* (DEQ 2009) and *DEQ's Field Procedures Manual* (DEQ 2005). Because the approach for assessment of TMDL sediment and habitat impairments is evaluated annually, there may be some slight changes to the procedure. Any alterations will be determined by the DEQ TMDL project officer and will be discussed with all field crew members before field work begins.

### 4.0 Quality Assurance and Quality Control Requirements

Data quality objectives (DQOs) are the quantitative and qualitative criteria established for a sampling design in order to meet the project's objectives. Data Quality Indicators (DQIs) are quantitative criteria established for the data acquired within this design to assure it is of sufficient quality for its intended use.

#### DQOs

##### *Representativeness*

Representativeness refers to the extent to which measurements represent an environmental condition in time and space. This is a judgmental sampling design using the following rationale:

##### Spatial representation:

Sampling sites were chosen to represent the potential of landscape characteristics and land use/ land cover influences existing in the watershed to influence the stream substrate character, and stream morphology and habitat conditions. Final sampling sites are identified by both assessment of aerial images and field surveying to capture the variability in land use and watershed characteristics potentially contributing to sediment impairment issues in streams including: stream order, valley confinement and slope, ecoregion, and land use/land cover (e.g. urban and residential areas, forest, logging, irrigation, grazing, row crops, and riparian area).

**Table 2** shows the distribution of sampling reaches relative to the number of distinct reach types grouped by stream order, valley confinement and slope, and ecoregion. Although it is not indicated within Table 2, sampling reaches within each reach type also reflect an attempt to capture variability in land use/cover.

##### Temporal representation

This study is designed to document a stream's geometry, riparian condition, and substrate characteristics. It uses bankfull width and depth for many of its measures, which is based upon a 1.2 – 2.0 year return cycle.



### ***Comparability***

Comparability is the applicability of the project's data to the project's decision rule. The decision rules used for this project will be determined based on reference data for sediment and habitat conditions based upon regional data, internal data (no/limited human impact), and literature values.

### ***Completeness***

Completeness is a measure of the amount of data prescribed for assessment activities and the usable data actually collected, expressed as a percentage.

Completeness as % = (No. Valid Data Points or Samples / Total # Data Points or Samples) x 100

The overall project goal is 90% completeness. Sites lost due to inaccessibility will reduce the total number of sites in the equation but not the completeness goal. Data results qualified with R flags will count against completeness. Data with J flags will not affect completeness. If any listed stream has less than 50% of its planned sites sampled due to accessibility issues, the project conclusions will note this fact and account for the increased uncertainty in the TMDLs margin of safety.

## **DQIs**

### ***Precision***

Precision refers to the degree of agreement among repeated measurements of the same characteristic. DEQ has tested the reproducibility of the measurements employed in this design and found that the precision of repeat measurements is sufficient relative the total variance from cell to cell. The greatest source of result variance comes from the heterogeneity of a study site (due to natural/human disturbance variability) rather than systematic and random error of individual measurements. Therefore, DEQ feels that precision of measurements is controlled satisfactorily through training and adherence to the sampling protocols described in *Longitudinal Field Methods for the Assessment of TMDL Sediment and Habitat Impairments* (DEQ 2009)

### ***Sensitivity***

Sensitivity refers to the limit of a measurement to reliably detect a characteristic of a sample. Similar to precision, the sensitivity of measurements was tested during method development. No modifications to the measurement increments or units specified in *Longitudinal Field Methods for the Assessment of TMDL Sediment and Habitat Impairments* (DEQ 2009) are allowed without consent from the DEQ TMDL Project Officer.

**Table 2. Distribution of Assessment Reaches Relative to Stratified Reach Types.** The reach types are presented as Level III ecoregion (MR = Middle Rockies)-slope-stream order-confinement/Level IV ecoregion. Row shading indicates reach types grouped by all components except Level IV ecoregion. \* = BEHI-only

Reach Type	Number of Stratified Reaches	Number of Sampling Reaches
MR-0-1-U / W	4	1*
MR-0-2-U / G	4	1
MR-0-2-U / I	1	
MR-0-2-U / W	9	4 (including 1 BEHI site)
MR-0-3-C / W	2	
MR-0-3-U / G	1	
MR-0-3-U / W	12	9 (including 1 BEHI site)
MR-0-4-C / W	1	
MR-0-4-U / G	2	
MR-0-4-U / W	6	6 (including 1 BEHI site)
MR-2-1-U / G	2	
MR-2-1-U / I	1	
MR-2-1-U / W	2	
MR-2-2-C / G	2	1
MR-2-2-C / I	2	1
MR-2-2-U / G	8	
MR-2-2-U / I	4	1*
MR-2-2-U / W	7	2
MR-2-3-C / W	1	
MR-2-3-U / G	1	1
MR-2-3-U / W	5	1*
MR-2-4-U / G	1	
MR-2-4-U / W	1	
MR-4-1-C / G	1	
MR-4-1-C / I	3	1
MR-4-1-C / W	1	
MR-4-1-U / G	6	
MR-4-1-U / I	2	
MR-4-1-U / W	2	
MR-4-2-C / G	2	
MR-4-2-C / I	3	
MR-4-2-U / G	5	1*
MR-4-2-U / I	3	
MR-4-2-U / W	2	
MR-4-3-C / G	reference	
MR-4-3-U / W	1	
MR-10-1-C / G	1	
MR-10-1-C / I	2	
MR-10-1-U / G	6	
MR-10-1-U / W	1	
MR-10-2-U / W	1	
<b>Total</b>	<b>121</b>	<b>30 / 23</b>

### ***Bias***

Bias is directional error from the true value. In this context, it is an extension of the representativeness concept applied to an individual sample. Bias can occur either during site selection or measurement.

The stratification criteria used to assist with site selection in this study (DEQ 2008) is designed to reduce bias and identify sites that are representative of the natural (physical) influences of sediment loading, transport, and deposition in contrast to sites with non-natural (anthropogenic) influence. Because the stratification of a watershed is so key to controlling bias in the resulting data, all decisions made during the stratification process will be overseen by the DEQ TMDL Project Officer.

## **5.0 Data Analysis, Record Keeping, and Reporting Requirements**

A review of field data will be conducted following receipt of the field data package. All data collected as part of this SAP will be evaluated against the methods cited in **Section 4.0**. Data qualifiers (see below) should be assigned to data that does not appear to have followed these processes.

J - The associated numerical value is an extreme outlier to the dataset but the process appears to have been followed based on the supporting data and field notes. The use of a “J” qualifier allows the TMDL project officer to consider whether the value should be used outright, with caution, or censured from the dataset.

R – The associated numerical value is an extreme outlier to the dataset and the process appears NOT to have been followed based on the supporting data and field notes. The data are unusable; resampling and/or reanalysis are necessary if completeness goal is not met due to this data being rejected.

### ***Summary of Data Quality***

A summary discussion of data quality will be prepared following review of field documentation and data. The data quality analysis will summarize the QA/QC information from the field event, audit information, corrective actions taken (if any), and the overall results of sampling activities with respect to compliance with the provisions of this SAP. The primary focus of the data quality analysis will be an estimate of the effects any deviations from approved procedures may have on the project objectives or data uses.

Data generated during this project will be stored on field forms and in electronic spreadsheets and summary reports. Written field notes and forms will be processed by DEQ staff following QA/QC procedures to screen for data entry errors. All approved data will be input into an electronic spreadsheet format for future analysis purposes.

## **6.0 Schedule for Completion**

Field verification of sampling sites and riparian health classification is scheduled for late July 2009. Sampling is scheduled for late August 2009.

## **7.0 Project Team and Responsibilities**

Lisa Kusnierz – DEQ Project Officer  
Mark Bostrom – DEQ Quality Assurance Officer  
Steve Cook and Christina Staten – DEQ field crew  
Jeff Dunn – PBS&J Lead Scientist  
Lance Lehigh and Matt Johnson – PBS&J field crew  
Erich Weber – data entry (PBS&J)  
Zac Collins – GIS-related tasks for field assessments (PBS&J)

## **8.0 References**

- Montana Department of Environmental Quality (DEQ) 2008. Watershed Stratification Methodology for TMDL Sediment and Habitat Investigations. Montana Dept. of Environmental Quality.
- DEQ 2009. Longitudinal Field Methods for the Assessment of TMDL Sediment and Habitat Impairments. Montana Dept. of Environmental Quality.
- DEQ 2005. 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*  
<http://www.deq.state.mt.us/wqinfo/QAProgram/SOP%20WQPBWQM-020.pdf>