APPENDIX B - LOWER CLARK FORK TRIBUTARIES TMDL PLANNING AREA SEDIMENT MONITORING REPORT

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B1.0 INTRODUCTION

The Lower Clark Fork Tributaries Total Maximum Daily Load Planning Area ([TMDL] LCFT-TPA) is located entirely in Sanders County in northwestern Montana and includes the entire Lower Clark Fork River fourth level HUC watershed (**Figure B1-1**). The TPA addresses six tributary watersheds to the Lower Clark Fork River. Four tributaries are included on the 2006 State of Montana's 303(d) List for sediment impacts and habitat limitations (**Table B1-1**). Elk Creek TMDLs were completed in 1998 but is included in this investigation for monitoring and review. Swamp Creek was included to gather data for assessment purposes and potential TMDL development.

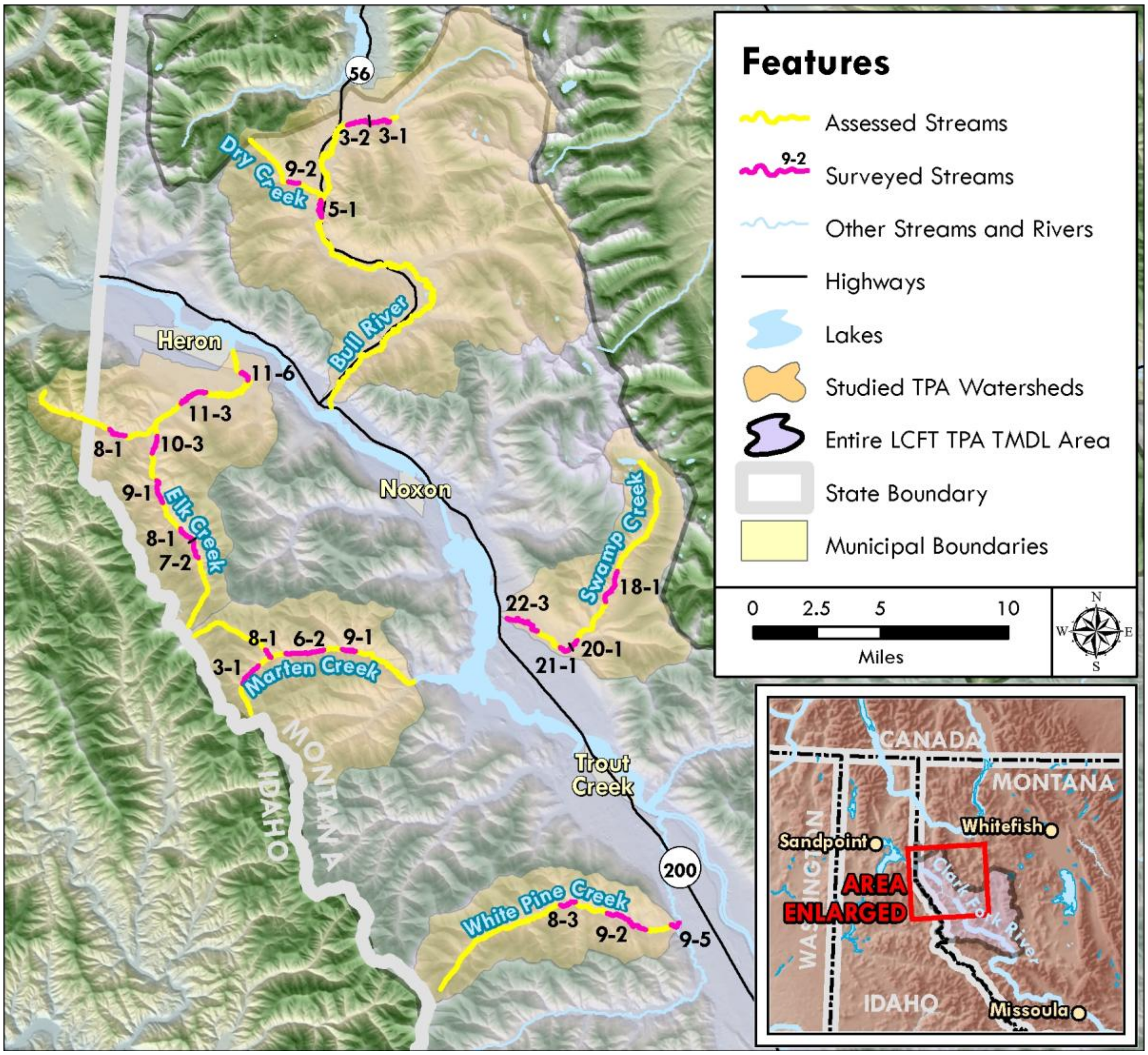

Figure B1-1. The project area vicinity map for the LCFT-TPA.

Table B1-1. Tributaries in the LCFT-TPA, stream class, impairment source description, and impairment cause.

Stream Name	Class	Source Description	Cause
BULL RIVER from the North Fork to the mouth (Cabinet Gorge Reservoir)	B-1	Silviculture Activities, Streambank Mod/destabilization	Sedimentation/Siltation, Physical substrate habitat alterations
DRY CREEK	B-1	Forest Roads (Road Construction and Use)	Sedimentation/Siltation
ELK CREEK from headwaters to mouth (Cabinet Gorge Res.)	B-1	Top of Form Grazing in Riparian or Shoreline Zones, Habitat Modification - other than Hydromodification Bottom of Form	Sedimentation/Siltation
MARTIN CREEK from headwaters to the mouth (Noxon Reservoir)	B-1	Forest Roads (Road Construction and Use, Silviculture Activities, Streambank Mod/Destabilization	Other habitat alterations, Siltation
SWAMP CREEK	A-1	N/A	N/A
Top of Form WHITE PINE CREEK, headwaters to the mouth (Beaver Creek) Bottom of Form	B-1	Forest Roads (Road Construction and Use), Grazing in Riparian or Shoreline Zones, Natural Sources, Silviculture Harvesting, Streambank Mod/Destabilization, Watershed Runoff Following Forest Fire	Top of Form Alteration in stream-side or littoral vegetative covers, Sedimentation/Siltation, Temperature/Water

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. This list is referred to as the “303(d) List”, and is included within Montana’s biennial 305(b) “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).

In 2008, Montana Department of Environmental Quality (MT MDEQ) initiated an effort to collect data to support the development of TMDLs and TMDL related investigation for the six tributaries in the LCFT-TPA listed above. The data collection effort involved assessing sediment and habitat conditions as these conditions influence aquatic life beneficial uses. River Design Group, Inc. (RDG), was contracted by MT MDEQ to assist in the implementation of stream stratification, sampling design, ground surveys, and sediment and habitat analyses.

The stream stratification method is intended to develop water body characterizations that can be applied across watersheds, accounting for localized ecological variations. The stratification enables comparison between observed and expected values for sediment and habitat parameters, quantifying the effects of anthropogenic influences. Stratification for the LCFT-TPA streams began by dividing the water bodies into reaches and sub-reaches. These divisions were based on aerial photo interpretation, landscape conditions, and land-use factors. This preliminary work was completed in summer 2008.

Following the initial stratification, representative sub-reaches were chosen by MT MDEQ for data collection. Following a two day sampling reach verification reconnaissance July 22-23, 2008, RDG and

MT MDEQ personnel completed site surveys from September 22 to October 2, 2008. RDG and MT MDEQ personnel visited the selected sub-reaches and recorded bank erosion sites, vegetation, and channel characteristics data. These data were analyzed in November and December 2008, resulting in full descriptions of sediment and habitat conditions for all of the surveyed reaches.

B2.0 Aerial Assessment Reach Stratification

B2.1 Methods

An aerial assessment of streams in the LCFT-TPA was conducted using ArcGIS (ESRI 2008) and 2005 color aerial imagery. Other relevant geographic data layers were acquired from the U.S. Geological Survey (USGS), the U.S. Environmental Protection Agency (USEPA) and the Montana State National Resource Information System (MT NRIS) database. Additional layers include the following data sets.

- Ecoregion (USEPA)
- Scanned and Rectified Topographic Maps, 1:24,000 (USGS)
- National Hydrography Dataset Lakes and Streams (USGS)
- 2005 National Aerial Image Program (NAIP – NRIS)

GIS data layers were used to stratify streams into reaches based on landscape and land-use factors. The stream reach stratification methodology applied in this study is described in *Watershed Stratification Methodology for TMDL Sediment and Habitat Investigations* (MDEQ 2008a), with additional background information provided in *White Paper: A Watershed Stratification Approach for TMDL Sediment and Habitat Impairment Verification* (MDEQ 2008b).

The reach stratification methodology involves delineating a water body stream segment into stream reaches and sub-reaches. This process was completed for the following sediment-listed stream segments in the LCFT-TPA:

- Elk Creek
- Bull River
- Dry Creek
- White Pine Creek
- Martin Creek
- Swamp Creek

B2.2 Stream Reaches

Water body segments are generally delineated by a water use class designated by the State of Montana, e.g. A-1, B-3, C-3 (Administrative Rules of Montana Title 17 Chapter 30, Sub-Chapter 6). Although a water body segment is the smallest unit for which an impairment determination is made, the stratification approach described in this document initially stratifies individual water body segments into discrete assessment reaches that are delineated by distinct variability in landscape controls such as Strahler stream order, valley slope, and valley confinement. The reason for this is that the inherent differences in landscape controls between stream reaches often prevents a direct comparison from being made between the geomorphic attributes of one stream reach to another.

By initially stratifying water body segments into stream reaches having similar geomorphic landscape controls, it is feasible to make comparisons between similar reaches in regards to observed versus expected channel morphology. Likewise, when land use is used as an additional stratification (e.g. grazed vs. non-grazed sub-reaches), sediment and habitat parameters for impaired stream reaches can be more readily compared to reference reaches that meet the same geomorphic stratification criteria.

The aerial photograph reach stratification methodology involves dividing a stream segment into distinct reaches based on four landscape factors:

- Level IV ecoregion
- Valley gradient
- Strahler stream order
- Valley confinement

B2.2.1 Sub-reaches

Once stream reaches have been classified by the four criteria identified in **Section B2.1**, reaches are further divided based on the surrounding vegetation and land-use characteristics as observed in the 2005 color aerial imagery using ArcGIS. The result is a series of stream reaches and sub-reaches delineated by landscape and land-use factors. Stream reaches with similar landscape factors can then be compared based on the character of surrounding land-use practices.

B2.3 Reach Types

Each individual combination of the four stream reach factors will be referred to as a “reach type” in this report.

Reach Type - Unique combination of Ecoregion, gradient, Strahler stream order, and confinement

Note that the Northern Rockies Level III Ecoregion contains six Level IV Ecoregions in the LCFT-TPA:

- Purcell-Cabinet-North Bitterroot Mountains (15q)
- Clark Fork Valley and Mountains (15k)
- Coeur D’Alene Metasedimentary Zone (15o)
- Grave Creek Range – Nine Mile Divide (15a)
- High Northern Rockies (15h)
- Salish Mountains (15l)

For the reach type analysis, the Northern Rockies Level III Ecoregion was assigned to all reaches. Possible reach type combinations based on the Level III Ecoregion identified in the LCFT-TPA are presented in **Table B2-1**.

Table B2-1. Possible Level III Ecoregion, Valley Gradient, Strahler Stream Order, and Confinement Combinations.

Ecoregion III	Valley Gradient	Strahler Stream Order	Confinement
Northern Rockies	> 10 %	1	Unconfined
	4 - 10 %	2	Confined
	2 - < 4 %	3	
	< 2 %	4	

Reach types were described using the following naming convention:

Level III Ecoregion – Valley Gradient – Strahler Stream Order – Confinement

The following identifiers were applied for each of the four factors:

Level III Ecoregion:
- NR = Northern Rockies

Valley Gradient:
- 0 = 0-<2%
- 2 = 2-<4%
- 4 = 4-10%
- 10 = >10%

Strahler Stream Order:
- 1 = first order
- 2 = second order
- 3 = third order
- 4 = fourth order

Confinement:
- U = unconfined
- C = confined

Thus, a stream reach identified as NR-0-3-U is a low gradient (0-<2%), 3rd order, unconfined stream in the Northern Rockies Level III Ecoregion. Reach type combinations are presented in **Table B2-2** and the sampled reaches in the project area are presented in **Table B2-3**. A map of the classified stream reaches is included in **Figure B2-1**.

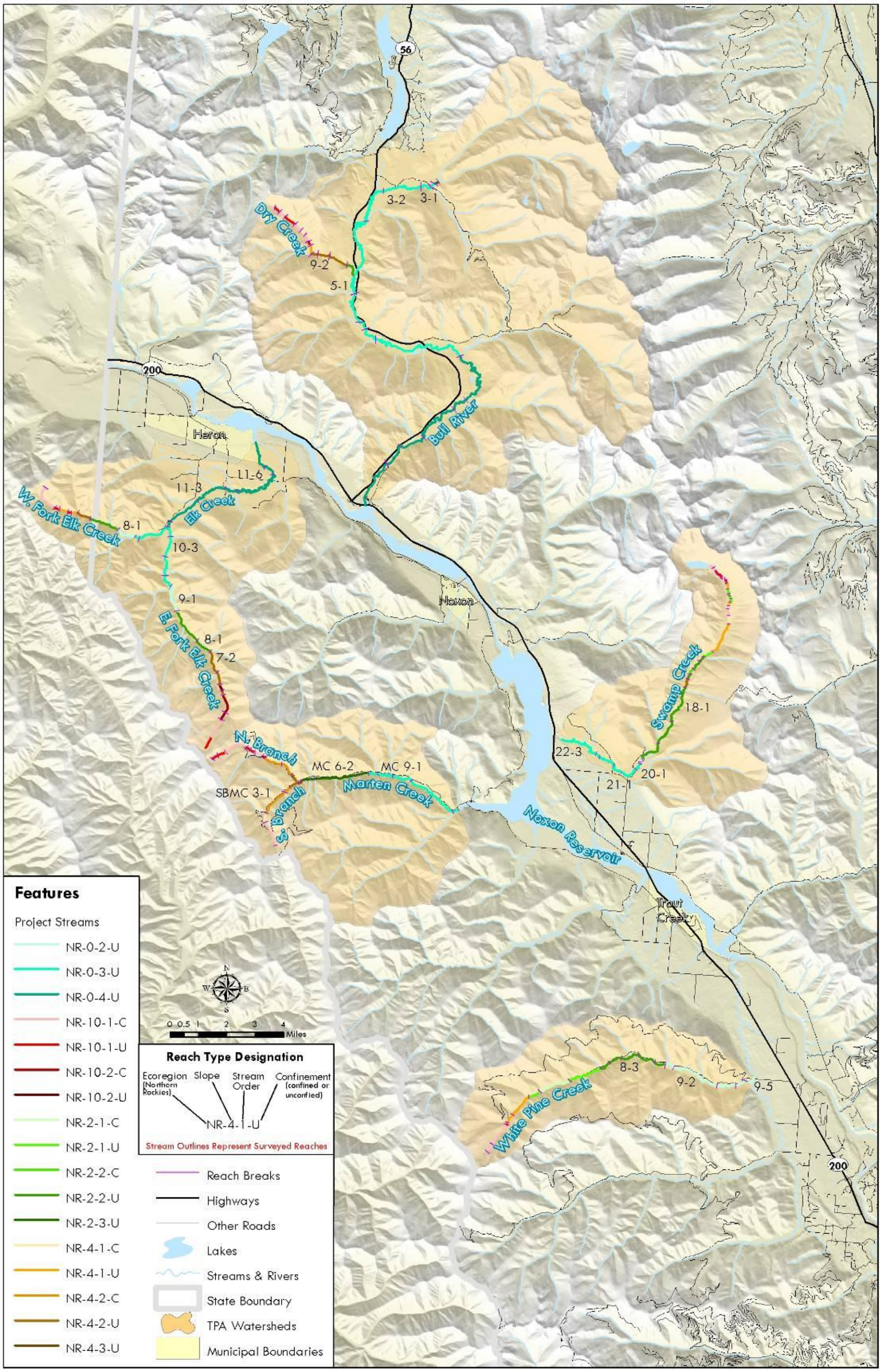

Figure B2-1. The reach type designation map for the LCFT-TPA.

Table B2-2. Identified Level III Ecoregion, Valley Gradient, Strahler Stream Order and Confinement Combinations.

Level III Ecoregion	Valley Gradient	Strahler Stream Order	Confine-ment	Reach Type	Level IV Ecosystem	Number of Reaches	Number of Monitoring Sites
Northern Rockies	0 - <2%	2	U	NR-0-2-U	15k,o,q	9	4
		3	U	NR-0-3-U	15k,o,q	28	8
		4	U	NR-0-4-U	15o,h	13	2
	2% - 4%	1	U	NR-2-1-U	15k,q	8	0
		1	C	NR-2-1-C	15k	1	0
		2	U	NR-2-2-U	15k,o,q	16	3
		2	C	NR-2-2-C	15q	1	0
		3	U	NR-2-3-U	15k,o,q	4	1
	4% - 10%	1	U	NR-4-1-U	15k,o,q	12	0
		1	C	NR-4-1-C	15o,q	4	0
		2	U	NR-4-2-U	15k,o,q	14	3
		2	C	NR-4-2-C	15o	4	1
		3	U	NR-4-3-U	15h	1	0
	>10%	1	U	NR-10-1-U	15k,o,q,h	30	0
		1	C	NR-10-1-C	k,o,q,h	15	0
		2	U	NR-10-2-U	15k,o	4	0
		2	C	NR-10-2-C	15k,o	3	0

Table B2-3. Sampled reaches in project area sorted by reach type

Level III Ecoregion	Reach Type	Reach ID	Number Sampled
Northern Rockies	NR-0-2-U	WFELK 8-1,EFELK 9-1,WHP 9-2,WHP 9-5	4
	NR-0-3-U	BULL 3-2, BULL 3-3, BULL 5-1, EFELK 10-3, MC 9-1, SWP 20-1, SWP 21-1, SWP 22-3	8
	NR-0-4-U	ELK 11-3, ELK 11-6	2
	NR-2-2-U	EFELK 8-1, SWP 18-1, WHP 8-3	3
	NR-2-3-U	MC 6-2	1
	NR-4-2-U	DRY 9-2, EFELK 7-2,NBMC 8-1	3
	NR-4-2-C	SBMC 3-1	1

B3.0 SEDIMENT AND HABITAT DATASET REVIEW

B3.1 FIELD METHODOLOGY

The following sections include descriptions for the various field methodologies that were employed for the stream assessments. The methods follow standard MDEQ protocols for sediment and habitat assessment, as presented in the document, *Longitudinal Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (MDEQ 2008a). All field forms used in the study are standard forms used by MDEQ for sediment and habitat assessments. On-site training in field methodologies and field forms was conducted by MDEQ for the entire assessment team during the first two days of the assessment period. For most survey sites, a minimum of 5 team members were present, which were always divided into 3 teams, referred to as the "Greenline," "Substrate," and "Cross-Section" teams in this section. The teams worked independently moving upstream through the survey site and in a pre-established order so as to create the least possible in-stream disturbance.

B3.1.1 Survey Site Delineation

Stream survey sites were delineated beginning at riffle crests at the downstream ends of reaches. Survey sites were measured upstream at pre-determined lengths based on the bankfull width at the selected downstream riffle. Survey lengths of 500 ft were used for bankfull widths less than 10 ft; survey lengths of 1,000 ft were used for bankfull widths between 10 ft and 50 ft; survey lengths of 1,500 ft were used for bankfull widths between 50 ft and 60 ft; and survey lengths of 2,000 ft were used for bankfull widths greater than 60 ft. Each survey site was divided into 5 equally sized study cells. For each site, the field team leader identified the appropriate downstream riffle crest to begin a reach. Where no riffles were present or the stream was dry, the field team leader identified the appropriate starting point.

The GPS location of the downstream end of the survey site was recorded on the **Sediment and Habitat Assessment Site Information Form**.

Digital photographs were taken at both upstream and downstream ends of the survey site, looking both upstream and downstream. Photo numbers and a brief description were recorded in the **Photo Log**.

B3.1.2 Field Determination of Bankfull

All members of the field crew (except for the "Greenline" team member) participated in determining the bankfull elevation prior to breaking into their respective teams. Indicators that were used to estimate the bankfull channel elevation included scour lines, changes in vegetation types, tops of point bars, changes in slope, changes in particle size and distribution, stained rocks and inundation features. Multiple locations and indicators were examined, and bankfull elevation estimates and their corresponding indicators were recorded in the **Bankfull Elevation and Slope Assessment Field Form** by the field team leader. Final determination of the appropriate bankfull elevation was determined by the team leader, and informed by the team experience and notes from the field form.

B3.1.3 Channel Cross-sections

The "Cross-Section team" was composed of two members of the assessment crew, who also performed riffle grid tosses (**Section B3.1.4.4**), pebble counts (**Section B3.1.4.6**), and riffle stability index (**Section**

B3.1.4.7). Channel cross-section measurements were performed at the first riffle in each cell using a line level and a measuring rod and recorded in the **Channel Cross-section Field Form**.

Cross-sections were conducted in each cell containing a riffle feature. In the case that riffles were present in only 1 or 2 cells, but those cells contained multiple riffles, additional cross-sections were performed at the most downstream unmeasured riffle, such that a minimum of three cross-sections were conducted. If only 1 or 2 riffles were present in the entire reach, they were measured. In no cases of this assessment was the stream devoid of riffles.

To begin, the Cross-Section team placed a bank pin at the pre-determined bankfull elevation (using bankfull indicators as guides) on the right and left banks. A measuring tape was strung perpendicular to the stream channel at the most "well-defined" portion of the riffle and tied to the bank pins.

Where mid-channel bars or other features or crossings were present in the channel which prevented a "clean" line across the channel, protocol provided in Section 2.3 of the *Longitudinal Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* document were followed (MDEQ 2008a).

Depth measurements at bankfull were collected to a tenth of a foot across the channel at regular intervals. These intervals varied depending on channel width, following protocol in item 15, Section 2.3 of the *Longitudinal Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (MDEQ 2008a). The thalweg depth was recorded at the deepest point of the channel independent of the regularly spaced intervals.

From the recorded data, the following were calculated for each cross-section:

Mean depth = sum of depth measurements / number of depth measurements (excluding the RBF and LBF measurements, unless they were greater than zero, such as when there is a vertical bank)

Cross-sectional area = bankfull width x mean bankfull depth
Width/depth ratio = bankfull width / mean bankfull depth

Entrenchment ratio = floodprone width / bankfull width.

In the case that cross-sectional areas determined from different cross-sections varied greatly, a cross-section was re-strung and measured again. In some cases, major alterations in stream features caused these discrepancies, which were noted in the field form.

The floodprone elevation was determined by multiplying the maximum depth value by 2. The floodprone width was then determined by stringing a tape from the bankfull channel margin on both right and left banks until the tape (pulled tight and "flat") touched ground at the floodprone elevation. The total floodprone width was calculated by adding the bankfull channel width to the distances on either end of the channel to the floodprone elevation. When dense vegetation or other features prevented a direct line of tape from being strung, best professional judgment was used to determine the floodprone width.

GPS coordinates for each cross-section were recorded. Photos were taken upstream and downstream of the cross section from the middle of the channel. A photo was also taken across the channel, showing the tape across the stream.

B3.1.4 Channel Bed Morphology

A variety of channel bed morphology features was measured and recorded by the "Substrate" team, which usually consisted of two team members, and included the field team leader. The length of the survey site occupied by pools and riffles was identified and recorded in the **Pools, Riffles and Large Woody Debris Field Form.** Beginning from the downstream end of the survey site, the upstream and downstream stations of "dominant" riffle and pool stream features were recorded. Features were considered "dominant" when occupying over 50% of the stream width. Pools and riffles were measured from head crest or riffle crest, respectively, until the end of that feature (defined as the tail crest for pools).

Runs and glides were not recorded in the field form. Stream features were identified per standard field method criteria (MDEQ 2008a).

B3.1.4.1 Residual Pool Depth

At all pools encountered, a residual pool depth measurement was taken. Backwater pools were not measured. Measured pools were recorded at each station (distance in feet) of occurrence, beginning at the downstream end (station 0) of the survey site. The depth of the pool tail crest (MDEQ 2008a) at its deepest point was measured. No pool tail crest depth was recorded for dammed pools (see **B3.1.4.2**).

The maximum depth of each pool was also recorded. In the case of dry channels, readings were taken from channel bed surface to bankfull height.

B3.1.4.2 Pool Habitat Quality

Qualitative assessments of each pool feature were undertaken and recorded in the **Pools, Riffles and Large Woody Debris Field Form** as follows:

1. Pool types were determined to be either Scour **(S)** or Dammed **(D)**.

2. Pool size was relative to bankfull channel width was recorded as Small **(S)**, Medium **(M)**, or Large **(L)**. Small pools were defined as those <1/3 of the bankfull channel; medium pools were >1/3 and <2/3 of the bankfull channel; and large pools were determined to be those >2/3 of the bankfull channel or >20 feet wide.

3. Pool formative features were recorded as either Lateral Scours **(LS)**, Plunge **(P)**, Boulder **(B)**, or Woody Debris **(W)**.

4. The primary pool cover type was recorded using the following codes:
   V = Overhanging Vegetation
   D = Depth
   U = Undercut
   B = Boulder
   W = Woody Debris
   N = No apparent cover

5. When undercut banks were present, their depths were measured to a tenth of a foot by inserting a measuring rod horizontally into the undercut bank.

B3.1.4.3 Fine Sediment in Pool Tail-outs
A measurement of the percent of fine sediment in pool tail-outs was taken using the grid toss method at the first and second scour pool of each cell. Grid toss readings were focused in those pool tail-out gravels that appeared to be suitable or potentially suitable for trout spawning.

Measurements were taken within the "arc" just upstream of the pool tail crest, following the methodology in Section 2.8 of *Longitudinal Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (MDEQ 2008a). Three measurements were taken across the channel with specific attention given to measurements in gravels determined to be of appropriate size for salmonid spawning. The potential for spawning was recorded as Yes **(Y)**, No **(N)**, or Unclear **(?)** at each measurement site.

B3.1.4.4 Grid Toss - Fine Sediment in Riffles
Using the same grid toss method as used in pools by the Substrate team (**Section B3.1.4.3**), measurements of fine sediment in riffles were recorded by the Cross-Section team. Grid tosses were performed in the same general location but before the pebble counts (**Section B3.1.4.6**) and to avoid disturbances to fine sediments. These measurements were recorded in the **Riffle Pebble Count Field Form.**

B3.1.4.5 Woody Debris Quantification
The amount of large woody debris (LWD) was recorded by the Substrate team along the entire assessment reach in the **Pools, Riffles and Large Woody Debris Field Form**. Large pieces of woody debris located within the bankfull channel and which were relatively stable as to influence the channel form were counted as either single, aggregate or willow bunch. Further description of these categories is provided in Section 2.10 of *Longitudinal Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (MDEQ 2008a).

B3.1.4.6 Riffle Pebble Count
One Wolman pebble count (Wolman 1954) was performed by the Cross-Section team at the first riffle encountered in cells 1, 3 and 5 as the team progressed upstream, providing a minimum of 300 particle sizes measured within each assessment reach. These data was recorded in the **Riffle Pebble Count Field Form**. Particle sizes were measured along their intermediate length axis (*b-axis*) and results were grouped into size categories. The team progressed from bankfull to bankfull using the "heel to toe" method, measuring particle size at the tip of the boot at each step. More specific details of the pebble count methodology and protocol followed in cases where riffles were not encountered in the designated cells can be found in Section 2.11 of *Longitudinal Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (MDEQ 2008a).

B3.1.4.7 Riffle Stability Index
In streams that had developed point bars, a riffle stability index was performed to determine the average size of the largest recently deposited particle. This information was recorded in the **Riffle Pebble Count Field Form**.

For streams in which gravel bars were present, a total of 3 stability index measurements were conducted, which consisted of intermediate axis (*b-axis*) measurements of 15 particles determined to be among the largest size group to be recently deposited and which occur on over 10% of the point bar. During post-field data processing, the riffle stability index was calculated as the geometric mean of the survey site dataset.

B3.1.5 Riparian Greenline Assessment

After the entire survey length was strung by the Greenline team member, an assessment of riparian vegetation cover was performed. The greenline, which is located at approximately the bankfull channel margin, was walked by the Greenline team member, who noted the general vegetation community type of the groundcover, understory and overstory on both banks. Vegetation types were recorded at 10-foot intervals and were entered in the **Riparian Greenline Field Form**.

The ground cover vegetation (<1.5 feet tall) was described using the following categories:

- **W** = Wetland vegetation, such as sedges and rushes
- **G** = Grasses or forbs, rose, snowberry (vegetation lacking binding root structure)
- **B** = Bare/disturbed ground
- **R** = Rock, when a large cobble or bolder is encountered
- **RR** = Riprap

The understory (1.5 to 15 feet tall) and overstory (>15 feet tall) vegetation were described using the following categories:

- **C** = Coniferous
- **D** = Deciduous, riparian shrubs and trees with sufficient rooting mass and depth to provide protection to the streambanks
- **M** = mixed coniferous and deciduous

At 50-foot intervals, a riparian buffer width was estimated on either side of the bank. This width corresponded to the belt of vegetation buffering the stream from adjacent land uses. Upon conclusion of the greenline measurements, the total numbers of each type of vegetation were tallied.

B3.1.6 Streambank Erosion Assessment

An assessment of all actively/visually eroding and slowly eroding/undercut/vegetated streambanks was conducted along each survey site. This assessment consisted of the Bank Erosion Hazard Index (BEHI; see **Section B4.0**) and Near Bank Stress estimation which are used to quantify sediment loads from bank erosion. All streambank measurements were recorded in the **Streambank Erosion Field Form** and **Additional Streambank Erosion Measurements Form.** Further information related to the streambank erosion assessment methodology and results is included in **Section B4.0**.

B3.1.7 Water Surface Slope

Three water surface slope measurements were estimated using a clinometer and recorded in the **Elevation & Water Surface Slope Field Form** at each survey site. Two crew members, usually part of the Cross-Section team stood at the water's surface in a riffle or similar stream feature and at a distance from each other with a direct line-of-site.

B3.1.8 Field Notes

At the completion of data collection at each survey site, field notes were collected by the field leader with inputs from the entire field team. The following four categories contributed to field notes, which served to provide an overall context for the condition of the stream channel relative to surrounding and historical uses:

- Description of human impacts and their severity
- Description of stream channel conditions
- Description of streambank erosion conditions
- Description of riparian vegetation conditions

B3.1.9 Quality Assurance/Control

Two days of on-site training were held to familiarize the entire crew with all the field forms and procedures. The field team leader and most experienced crew members led the separate teams during these first two days. At the conclusion of the first day's training, all field forms were reviewed for completeness and accuracy.

To ensure the highest quality data collection, several protocols were followed at every site visit. Equipment checks were done every morning and field maps were reviewed with drivers before approaching the site. Field forms were distributed and double-checked before teams left the vehicles to the survey sites. Any questions that arose from field teams were brought to the attention of the field team leader until doubts and questions were resolved to the leader's satisfaction.

Summaries of data for selected parameters follows in **Section B3.2** and **Section B4**. Full field data results are included in **Tables B5-1** through **B5-7** in **Section B5**.

B3.2 Sampling Parameter Descriptions and Summaries by Reach Type

The following sections present a definition of the sampling parameters that were used to evaluate stream conditions for each surveyed reach. Graphs and data tables follow the sampling parameter descriptions. The box plots represent the 25th, 50th (median), and 75th percentile values. The whiskers include the maximum value and minimum values measured.

B3.2.1 Width/Depth Ratio

The channel width/depth ratio is defined as the channel width at bankfull height divided by the mean bankfull depth (Rosgen 1996). Bankfull is a concept used by hydrologists to define a regularly occurring channel-forming high flow. One of the first generally accepted definitions of bankfull was provided by Dunne and Leopold (1978):

> ***"The bankfull stage corresponds to the discharge at which channel maintenance is the most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphologic characteristics of channels."***

The channel width/depth ratio is one of several standard measurements used to classify stream channels (Rosgen 1996), making it a useful variable for comparing conditions on reaches within the same stream type. A comparison of observed and expected width/depth ratio is a useful indicator of channel over-widening and aggradation, which are often linked to excess streambank erosion or acute or chronic erosion from sources upstream of the study reach. Channels that are over-widened often are associated with excess sediment deposition and streambank erosion, contain shallower, warmer water, and provide fewer deepwater habitat refugia for fish.

Width/depth data can be compared to guideline threshold values from previous studies to indicate if width/depth ratios observed on reaches in the LCFT-TPA are greater than those expected for minimally impacted channels. Results exceeding the guideline values may indicate over-widening. A general threshold value for width/depth ratio is 23 for Rosgen B type channels and 30 for C channels. These values represent an average of target values used in previous TMDL assessments in northwest Montana.

The width/depth ratios by reach type are presented in **Figure B3-1**. The summary data are also presented in **Table B3-1**.

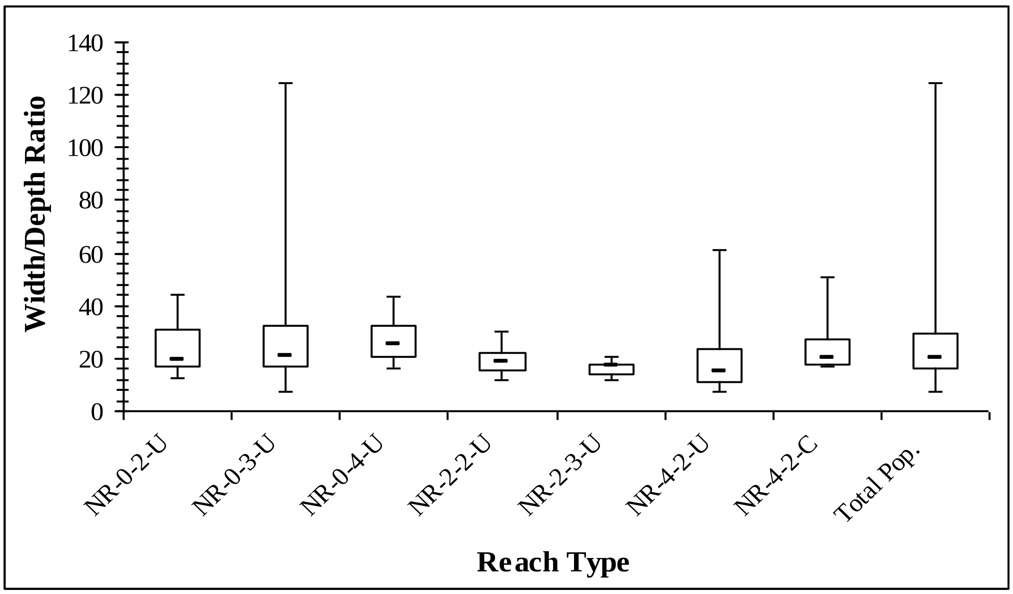

Figure B3-1. Width/Depth Ratio segregated by reach type.

Table B3-1. Summary of Width/Depth ratio statistics by reach type

Statistical Parameter	Reach Type							
	NR-0-2-U	NR-0-3-U	NR-0-4-U	NR-2-2-U	NR-2-3-U	NR-4-2-U	NR-4-2-C	Total Population
# Reaches Sampled	4	8	2	3	1	3	1	22
Sample Size	20	40	10	19	5	15	5	114
Minimum	12.3	7.4	15.9	11.5	11.5	7.3	17.3	7.3
25th percentile	16.6	17.0	20.7	15.1	13.9	10.8	17.6	16.0
Median	19.2	20.6	24.7	18.5	17.1	14.9	20.2	20.1
75th percentile	30.8	32.8	32.4	21.9	17.7	23.8	27.6	29.3
Maximum	44.0	124.8	43.3	30.3	20.9	61.1	50.5	124.8

B3.2.2 Entrenchment Ratio

Stream entrenchment ratio is equal to the floodprone width divided by the bankfull width (Rosgen 1996). Entrenchment ratio is used to help determine if a stream shows departure from its natural stream type. It is an indicator of stream incision, and therefore indicates how easily a stream can access its floodplain. Streams are often incised due to detrimental land management or may be naturally incised due to landscape characteristics. A stream that is overly entrenched generally is more prone to streambank erosion due to greater energy exerted on the banks during flood events. Greater scouring energy in incised channels results in higher sediment loads derived from eroding banks. If the stream is not actively degrading (down-cutting), the sources of human caused incision may be historical in nature and may not currently be present, although sediment loading may continue to occur. The entrenchment ratio is an important measure of channel condition as it relates to sediment loading and habitat condition, due to the long-lasting impacts of incision and the large potential for sediment loading in incised channels.

An expected entrenchment ratio for reaches classified as B channels falls within the range of 1.4-2.2, although an entrenchment ratio as low as 1.2 and as high as 2.4 is not outside the realm of expected channel dimensions. C channels, including Cb channels, generally have entrenchment ratios of greater than 2.2 (Rosgen 1996).

The entrenchment ratios by reach type are presented in **Figure B3-2**. The summary data are also presented in **Table B3-2**.

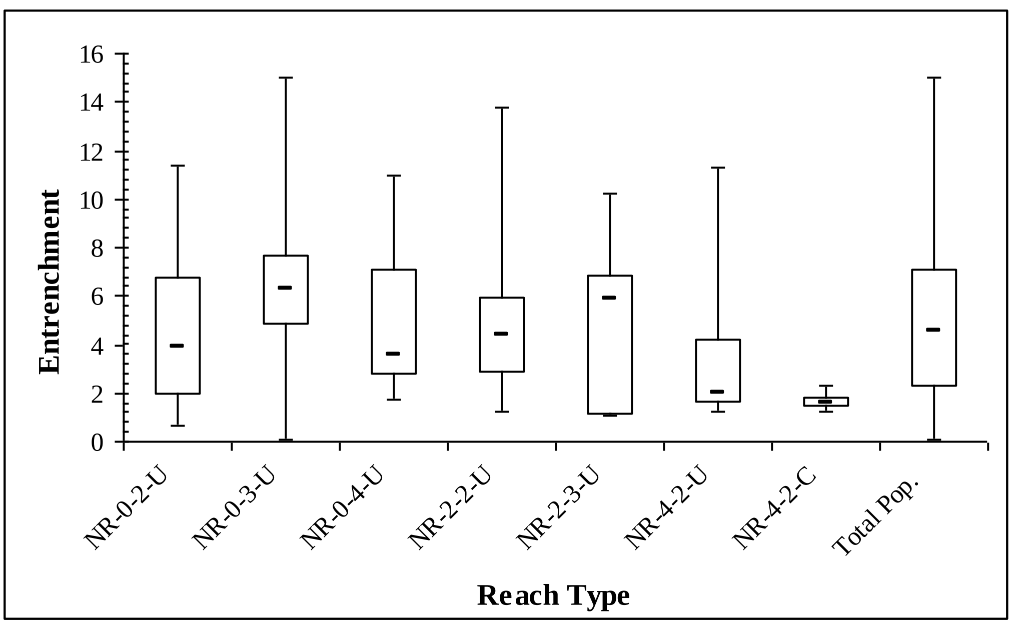

Figure B3-2. Entrenchment Ratio segregated by reach type.

Table B3-2. Summary of Entrenchment ratio statistics by reach type

Statistical Parameter	Reach Type							
	NR-0-2-U	NR-0-3-U	NR-0-4-U	NR-2-2-U	NR-2-3-U	NR-4-2-U	NR-4-2-C	Total Population
# Reaches Sampled	4	8	2	3	1	3	1	22
Sample Size	20	40	10	19	5	15	5	114
Minimum	0.7	0.1	1.8	1.2	1.1	1.3	1.2	0.1
25th percentile	2.0	4.9	2.8	2.9	1.2	1.6	1.5	2.3
Median	3.9	6.2	3.6	4.4	5.9	2.0	1.6	4.5
75th percentile	6.7	7.6	7.1	6.0	6.8	4.2	1.8	7.1
Maximum	11.4	15.0	11.0	13.8	10.2	11.3	2.3	15.0

B3.2.3 Greenline Inventory: Percent Understory Shrub Cover

Riparian shrub cover is one of the most important influences on streambank stability. Removal of riparian shrub cover can dramatically increase streambank erosion and increase channel width/depth ratios. Shrubs stabilize streambanks by holding soil and armoring lower banks with their roots, and reduce scouring energy of water by slowing flows with their branches.

Good riparian shrub cover is also important for fish habitat. Riparian shrubs provide shade, reducing solar inputs and increase in water temperature. The dense network of fibrous roots of riparian shrubs allows streambanks to remain intact while water scours the lowest portion of streambanks, creating important fish habitat in the form of overhanging banks and lateral scour pools. Overhanging branches of riparian shrubs provide important cover for aquatic species. In addition, riparian shrubs provide critical inputs of food for fish and their feed species. Terrestrial insects falling from riparian shrubs provide one main food source for fish. Organic inputs from shrubs, such as leaves and small twigs, provide food for aquatic macroinvertebrates, which are an important food source for fish.

Targets for streambank shrub cover and resulting streambank stability generally fall within the range of 75% to 85%, based on previous studies in Montana and Canada. Study reaches with lower than 75% shrub cover may be prone to excessive streambank erosion or have excessive streambank instability. It is important to keep in mind that understory shrub cover from study reaches may be low due to dense overstory canopy cover and competition from overstory canopy species, as in spruce-dominated reaches on smaller streams.

The greenline understory shrub cover percentages by reach type are presented in **Figure B3-3**. The summary data are also presented in **Table B3-3**.

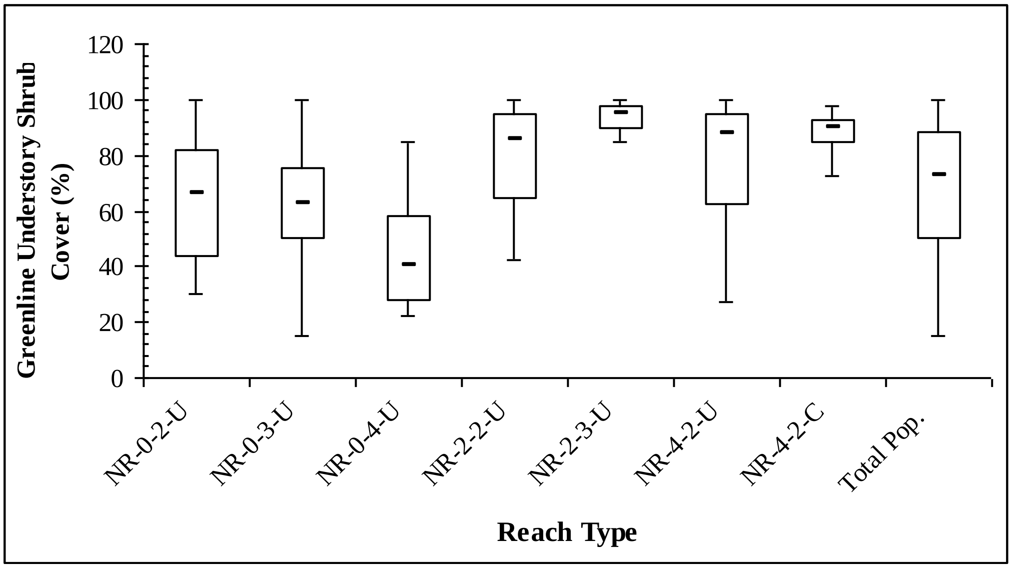

Figure B3-3. Greenline Understory Shrub Cover (%) segregated by reach type.

Table B3-3. Summary of Greenline Understory Shrub Cover statistics by reach type

Statistical Parameter	Reach Type							
	NR-0-2-U	NR-0-3-U	NR-0-4-U	NR-2-2-U	NR-2-3-U	NR-4-2-U	NR-4-2-C	Total Population
# Reaches Sampled	4	8	2	3	1	3	1	22
Sample Size	20	40	10	15	5	15	5	110
Minimum	30.0	15.0	22.5	42.5	85.0	27.5	72.5	15.0
25th percentile	43.8	50.0	28.1	64.5	90.0	62.5	85.0	50.6
Median	66.3	62.5	40.0	85.7	95.0	87.5	90.0	72.5
75th percentile	81.9	75.6	58.1	95.0	97.5	95.0	92.5	88.3
Maximum	100.0	100.0	85.0	100.0	100.0	100.0	97.5	100.0

B3.2.4 Greenline Inventory: Percent Bare Ground

Percent bare ground is an important indicator of erosion potential, as well as an indicator of land management influences on riparian habitat. Bare ground was noted in the greenline inventory in cases where recent ground disturbance was observed, leaving bare soil exposed. Bare ground is often caused by trampling from livestock or wildlife, fallen trees, recent bank failure, new sediment deposits from overland or overbank flow, or severe disturbance in the riparian area, such as from past mining, road-building, or fire. Ground cover on streambanks is important to prevent sediment recruitment to stream channels. Sediment can wash in from unprotected areas due to snowmelt, storm runoff, or flooding. Bare areas are also much more susceptible to erosion from hoof shear. Most stream reaches have a small amount of naturally-occurring bare ground. As conditions are highly variable, this measurement is most useful when compared to reference values from best available conditions within the study area or literature values.

Natural levels of bare ground can vary according to the riparian site type or habitat type, and by the landscape setting of the stream reach. For the purposes of this assessment, a general guideline value of greater than or equal to 10% bare ground is assigned to indicate a potential reduced riparian habitat quality or lowered filtering capacity.

Due to the large number of zero values, a box plot was not completed for the greenline bare ground percentage variable. The tabular data are presented in **Table B3-4**.

Table B3-4. Summary of Greenline Bare Ground statistics by reach type

Statistical Parameter	Reach Type							
	NR-0-2-U	NR-0-3-U	NR-0-4-U	NR-2-2-U	NR-2-3-U	NR-4-2-U	NR-4-2-C	Total Population
# Reaches Sampled	4	8	2	3	1	3	1	22
Sample Size	20	40	10	15	5	15	5	110
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25th percentile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Median	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75th percentile	0.0	0.0	7.5	0.0	0.0	0.0	0.0	0.0
Maximum	10.0	22.5	20.0	0.0	0.0	0.0	0.0	22.5

B3.2.5 Riffle Pebble Count: Substrate Fines (<2 mm)

Percent surface fine sediment provides a good measure of the siltation occurring in a river system and serves as an indicator of stream bottom aquatic habitat. Although it is difficult to correlate percent surface fines with loading in mass per time directly, the Clean Water Act allows “other applicable measures” for the development of TMDL water quality restoration plans. Percent surface fines have been used successfully in other TMDLs in western Montana addressing sediment related to stream bottom deposits, siltation, and aquatic life uses. Surface fine sediment measured in the Wolman (1954) pebble count is one indicator of aquatic habitat condition and can indicate excessive sediment loading. The Wolman pebble count method provides a survey of the particle distribution of the entire channel width, allowing investigators to calculate a percentage of the surface substrate (as frequency of occurrence) composed of fine sediment.

Studies have shown that increased substrate fine materials less than 2 mm can adversely affect embryo development success by limiting the amount of oxygen needed for development (Meehan 1991). As well, the TMDL for the Flathead Headwaters cites recent work completed in the Boise National Forest in Idaho, which showed a strong correlation between the health of macroinvertebrate communities and percent surface fines defined as all particles less than two millimeters.

Other studies in western Montana have set a threshold value for percent fine substrate (<2 mm) at 15% to 20%. The guideline values used in these studies were based on best available conditions and empirical equations developed by Weaver and Fraley (1991). Surface fine sediment is difficult to measure with a great degree of precision using the Wolman pebble count method. To be conservative, any of the study reaches displaying greater than 15% fine sediment <2 mm diameter in riffles may indicate an impact to fisheries or aquatic life.

The pebble count measurements for particles <2 mm by reach type are presented in **Figure B3-4**. The summary data are also presented in **Table B3-5**.

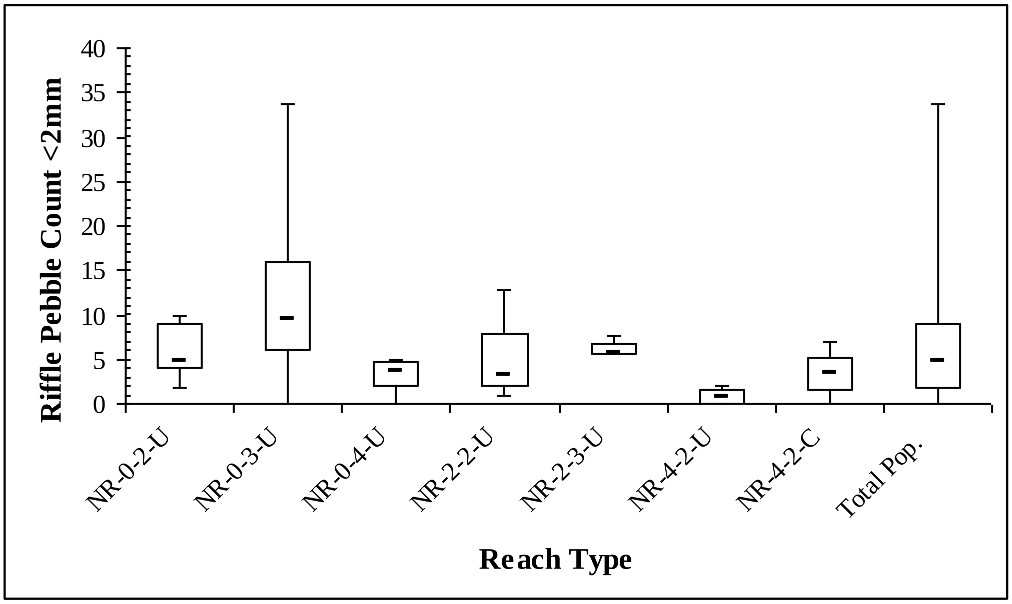

Figure B3-4. Riffle Pebble Count <2 mm by reach type.

Table B3-5. Summary of Riffle Pebble Count (<2 mm) statistics by reach type

Statistical Parameter	Reach Type							
	NR-0-2-U	NR-0-3-U	NR-0-4-U	NR-2-2-U	NR-2-3-U	NR-4-2-U	NR-4-2-C	Total Population
# Reaches Sampled	4	8	2	3	1	3	1	22
Sample Size	12	24	6	9	3	9	3	66
Minimum	1.8	0.0	0.0	0.9	5.6	0.0	0.0	0.0
25th percentile	4.1	6.1	2.0	1.9	5.6	0.0	1.7	1.8
Median	4.8	9.4	3.6	3.1	5.6	0.8	3.3	4.8
75th percentile	9.0	15.9	4.7	7.8	6.6	1.5	5.1	9.0
Maximum	10.0	33.6	5.0	12.7	7.6	1.9	7.0	33.6

B3.2.6 Riffle Pebble Count: Substrate Fines (<6 mm)

As with surface fine sediment smaller than 2 mm diameter, an accumulation of surface fine sediment less than 6 mm diameter may indicate excess sedimentation. The size distribution of substrate material in the streambed is also indicative of habitat quality for salmonid spawning and incubation. Excess surface fine substrate may have detrimental impacts on aquatic habitat by cementing spawning gravels, thus reducing their accessibility, preventing flushing of toxins in egg beds, reducing oxygen and nutrient delivery to eggs and embryos, and impairing emergence of fry (Meehan 1991). Weaver and Fraley (1991) observed a significant inverse relationship between the percentage of material less than 6.35 mm and the emergence success of westslope cutthroat trout and bull trout.

Previous assessments in western Montana specify a wide range of target values for fine sediment less than 6 mm in diameter. Values vary by stream type and specific sampling method. For this assessment a guideline threshold value for fine sediment <6 mm in riffles is 20%, which represents an average value of the guideline values used in previous studies.

The pebble count measurements for particles <6 mm by reach type are presented in **Figure B3-5**. The summary data are also presented in **Table B3-6**.

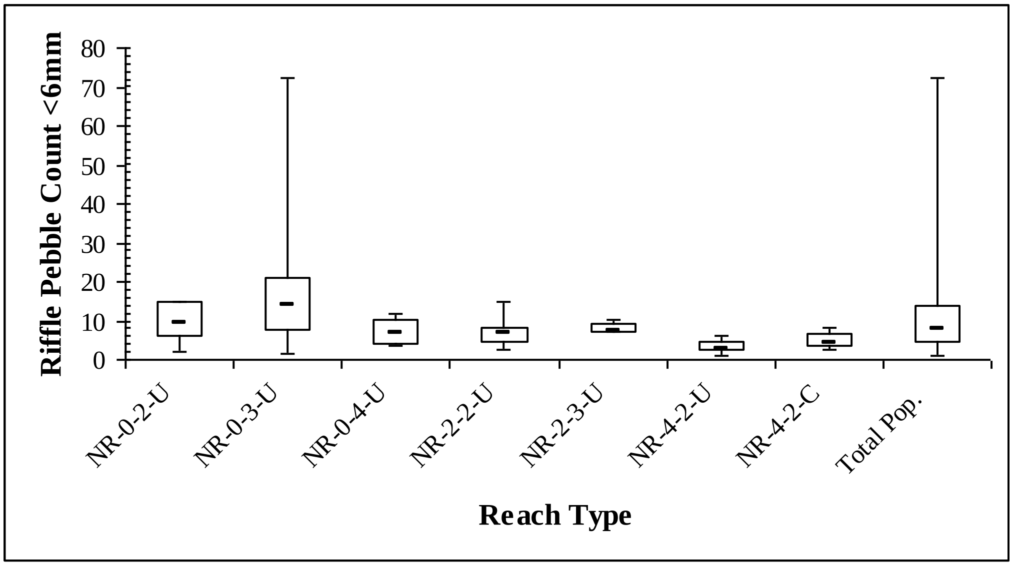

Figure B3-5. Riffle Pebble count <6 mm by reach type.

Table B3-6. Summary of Riffle Pebble Count <6 mm statistics by reach type

Statistical Parameter	Reach Type							
	NR-0-2-U	NR-0-3-U	NR-0-4-U	NR-2-2-U	NR-2-3-U	NR-4-2-U	NR-4-2-C	Total Population
# Reaches Sampled	4	8	2	3	1	3	1	22
Sample Size	12	24	6	9	3	9	3	66
Minimum	1.8	1.7	3.6	2.7	7.1	0.9	2.8	0.9
25th percentile	6.4	7.9	4.1	4.8	7.4	2.3	3.5	4.6
Median	9.0	13.8	6.5	6.7	7.1	2.7	4.2	7.7
75th percentile	14.6	21.0	10.4	8.3	9.0	4.8	6.7	13.9
Maximum	15.1	72.4	12.0	14.7	10.4	6.3	8.0	72.4

B3.2.7 Riffle Grid Toss: Substrate Fines (<6 mm)

The wire grid toss is a standard procedure frequently used in aquatic habitat assessment. This method provides a more precise (repeatable) measurement of surface fine sediment than the broader survey approach of the Wolman pebble count. This measurement does not cover the entire channel width, as in the Wolman pebble count, but rather provides a more thorough measurement of surface fines in a subsample of the cross-section.

Previous assessments in western Montana specify a wide range of target values for fine sediment less than 6 mm in diameter. Values vary by stream type and specific sampling method. For this assessment a guideline threshold value for fine sediment <6 mm in riffles is 20%, which represents an average value of the guideline values used in previous studies.

The pool tailout grid toss results for particles <6 mm are presented in **Figure B3-6** and **Table B3-7**.

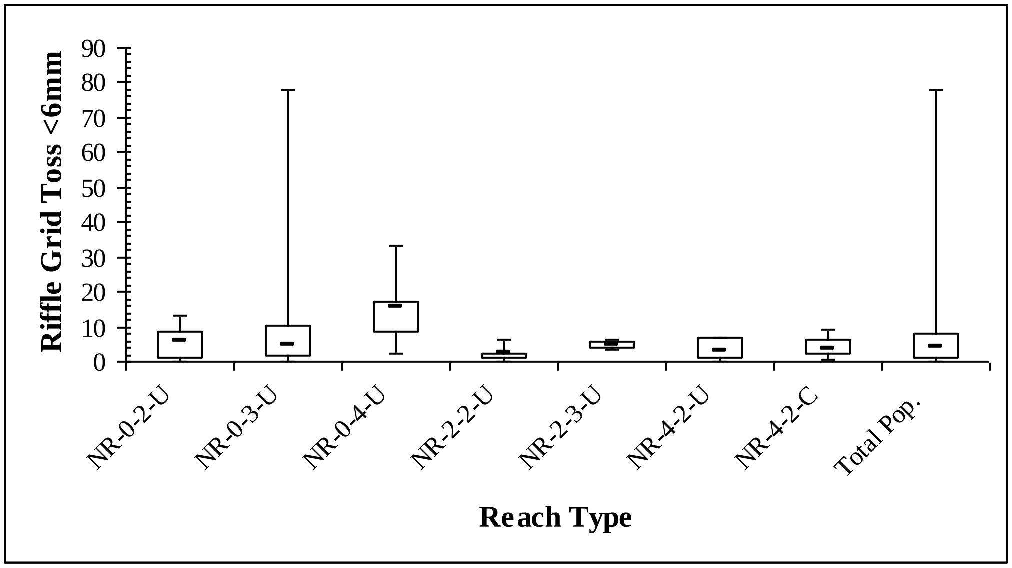

Figure B3-6. Riffle Grid Toss <6 mm by reach type.

Table B3-7. Summary of Riffle Grid Toss <6 mm statistics by reach type

Statistical Parameter	Reach Type							
	NR-0-2-U	NR-0-3-U	NR-0-4-U	NR-2-2-U	NR-2-3-U	NR-4-2-U	NR-4-2-C	Total Population
# Reaches Sampled	4	8	2	3	1	3	1	22
Sample Size	12	24	6	9	3	9	3	66
Minimum	0.0	0.0	2.0	0.0	3.4	0.0	0.7	0.0
25th percentile	1.0	1.6	8.8	1.0	4.1	1.4	2.0	1.4
Median	5.6	4.8	15.3	2.0	4.8	2.7	3.4	4.1
75th percentile	8.8	10.2	17.2	2.0	5.6	6.8	6.5	8.2
Maximum	12.9	78.2	33.3	6.1	6.4	6.8	9.0	78.2

B3.2.8 Pool Residual Depth (Reach mean value)

Residual pool depth, defined as the difference between pool maximum depth and crest depth, is a discharge-independent measure of pool depth and an indicator of the quality of pool habitat. Deep pools are important resting and hiding habitat for fish, and provide refugia during temperature extremes and high flow periods. Pool residual depth is also an indirect measurement of sediment inputs to listed streams. An increase in sediment loading would be expected to cause pools to fill, thus decreasing residual pool depth over time.

Previous assessments in western Montana specify target values for pool residual depth ranging from 1.5 ft to an average of 3 ft. Few individual pool depths exceeded 3 feet in the assessment reaches in this study, even in minimally impacted reaches, and most reaches had an average residual pool depth of less than 1.5 ft. Due to the stream sizes for most of the streams in the LCFT-TPA, a guideline value of 1.5 ft for mean residual pool depth appears to be the more suitable metric when examining these results.

The mean residual pool depths for the reach types are presented in **Figure B3-7** and **Table B3-8**.

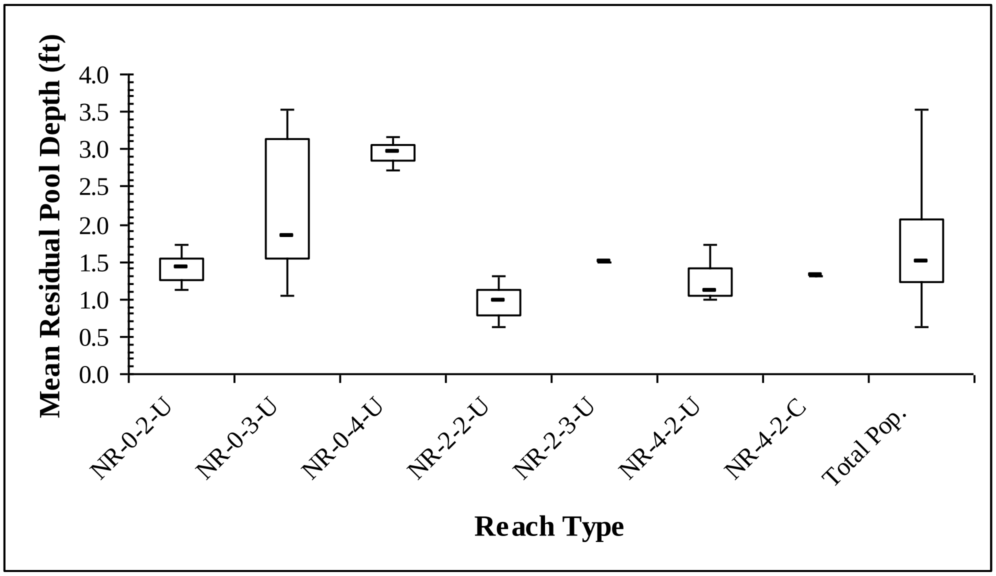

Figure B3-7. Mean Residual Pool Depth by reach type.

Table B3-8. Summary of Mean Residual Pool Depth statistics by reach type

Statistical Parameter	Reach Type							
	NR-0-2-U	**NR-0-3-U**	**NR-0-4-U**	**NR-2-2-U**	**NR-2-3-U**	**NR-4-2-U**	**NR-4-2-C**	**Total Population**
# Reaches Sampled	4	8	2	3	1	3	1	22
Sample Size	4	8	2	3	1	3	1	22
Minimum	1.1	1.0	2.7	0.6	1.5	1.0	1.3	0.6
25th percentile	1.3	1.6	2.8	0.8	1.5	1.1	1.3	1.2
Median	1.4	1.8	2.9	1.0	1.5	1.1	1.3	1.5
75th percentile	1.6	3.1	3.1	1.1	1.5	1.4	1.3	2.1
Maximum	1.7	3.5	3.2	1.3	1.5	1.7	1.3	3.5

3.2.9 Pool Frequency

Pool frequency is a measure of the availability of pool habitat to provide rearing habitat, cover, and refugia for salmonids. Pool frequency is related to channel complexity, availability of stable obstacles, and sediment supply. Excessive erosion and sediment deposition can reduce pool frequency by filling in smaller pools. Pool frequency can also be affected adversely by riparian habitat degradation resulting in a reduced supply of large woody debris or scouring from stable root masses in streambanks.

Previous assessments from western Montana have specified pool frequency target values that vary according to channel wetted width, and in some cases by stream order and Rosgen type. The average wetted width on assessed stream reaches in the LCFT-TPA was approximately 25 ft. A target value of 47 pools per mile, or approximately 9 pools per 1,000 feet, was used in previous studies for reaches with a specified wetted width of 25 ft. Although wetted widths differ among the assessed reaches in the LCFT-TPA, reaches with a pool frequency much below 9 pools/1,000 ft may have reduced aquatic habitat quality.

The pool frequencies per 1,000 ft for the reach types are presented in **Figure B3-8** and **Table B3-9**.

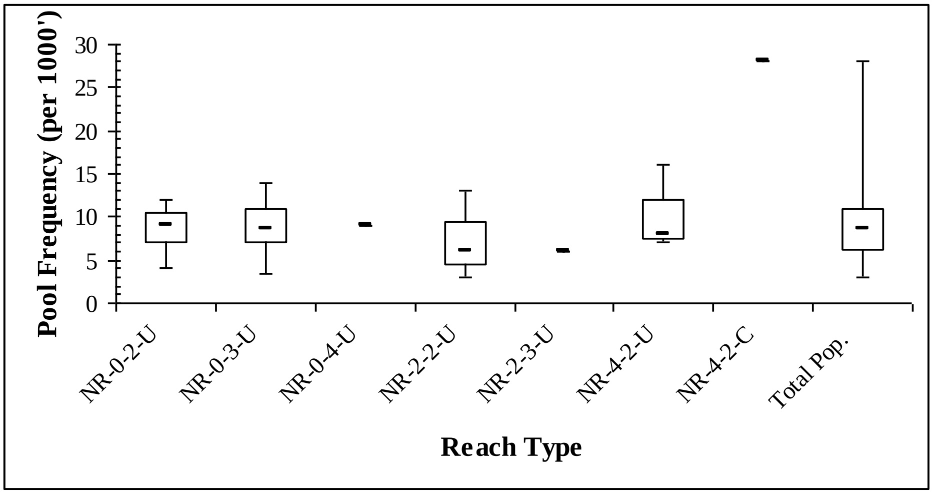

Figure B3-8. Pool Frequency (per 1,000 ft) by reach type.

Table B3-9. Summary of Pool Frequency statistics by reach type

Statistical Parameter	Reach Type							
	NR-0-2-U	**NR-0-3-U**	**NR-0-4-U**	**NR-2-2-U**	**NR-2-3-U**	**NR-4-2-U**	**NR-4-2-C**	**Total Population**
# Reaches Sampled	4	8	2	3	1	3	1	22
Sample Size	4	8	2	3	1	3	1	22
Minimum	4.0	3.3	9.0	3.0	6.0	7.0	28.0	3.0
25th percentile	7.0	7.0	9.0	4.5	6.0	7.5	28.0	6.3
Median	9.0	8.5	9.0	6.0	6.0	8.0	28.0	8.5
75th percentile	10.5	11.0	9.0	9.5	6.0	12.0	28.0	11.0
Maximum	12.0	14.0	9.0	13.0	6.0	16.0	28.0	28.0

B3.2.10 Large Woody Debris Frequency

Large woody debris (LWD) is a critical component of high-quality salmonid habitat, providing habitat complexity, quality pool habitat, cover, and long-term nutrient inputs. LWD also constitutes a primary influence on stream function, including sediment and organic material transport, channel form, bar formation and stabilization, and flow dynamics (Bilby and Ward 1989). LWD frequency can be measured and compared to reference reaches or literature values to determine more or less LWD is present than would be expected under optimal conditions. Too high or too low an LWD frequency may indicate riparian habitat impairment or upstream influences on habitat quality.

Target values for LWD span a broad range of values, even for streams of similar size. A guideline value of approximately 150 pieces of LWD per mile, or approximately 28 pieces of LWD per 1,000 ft, represents an average of target values from other studies with similar average reach width. Results for LWD should be interpreted with caution, as the guideline value for this parameter is tied to a high degree of variability due to land use, vegetative community, soils, among other factors.

The LWD frequency per 1,000 ft for the reach types are presented in **Figure B3-9** and **Table B3-10**.

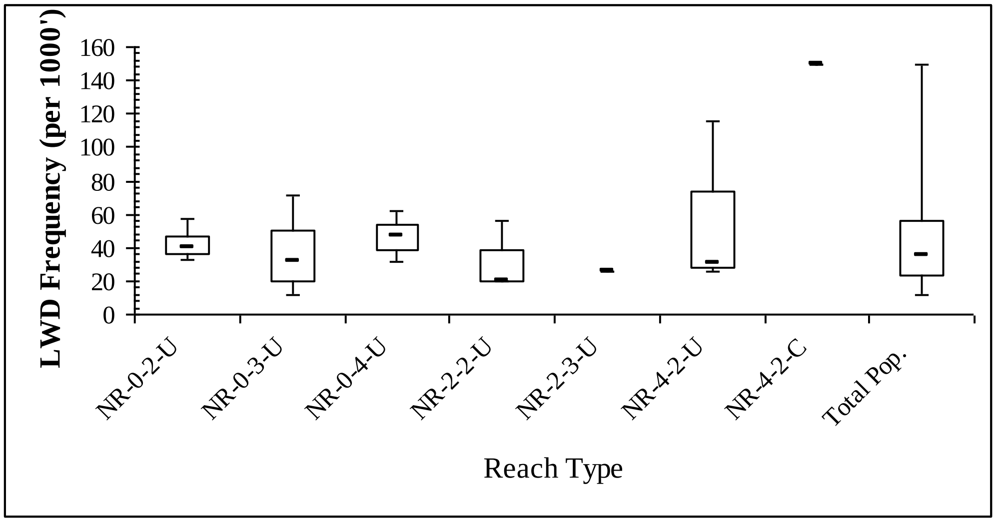

Figure B3-9. LWD Frequency (per 1,000 ft) by reach type.

Table B3-10. Summary of LWD frequency by reach type

Statistical Parameter	Reach Type							
	NR-0-2-U	NR-0-3-U	NR-0-4-U	NR-2-2-U	NR-2-3-U	NR-4-2-U	NR-4-2-C	Total Population
# Reaches Sampled	4	8	2	3	1	3	1	22
Sample Size	4	8	2	3	1	3	1	22
Minimum	33.0	11.3	31.0	20.0	26.0	26.0	149.0	11.3
25th percentile	36.0	19.8	38.8	20.0	26.0	28.0	149.0	23.0
Median	40.0	31.0	46.5	20.0	26.0	30.0	149.0	35.0
75th percentile	46.5	50.0	54.3	38.0	26.0	73.0	149.0	56.0
Maximum	57.0	71.0	62.0	56.0	26.0	116.0	149.0	149.0

Figure B3-10 presents the data for all of the measured variables for all of the reach types.

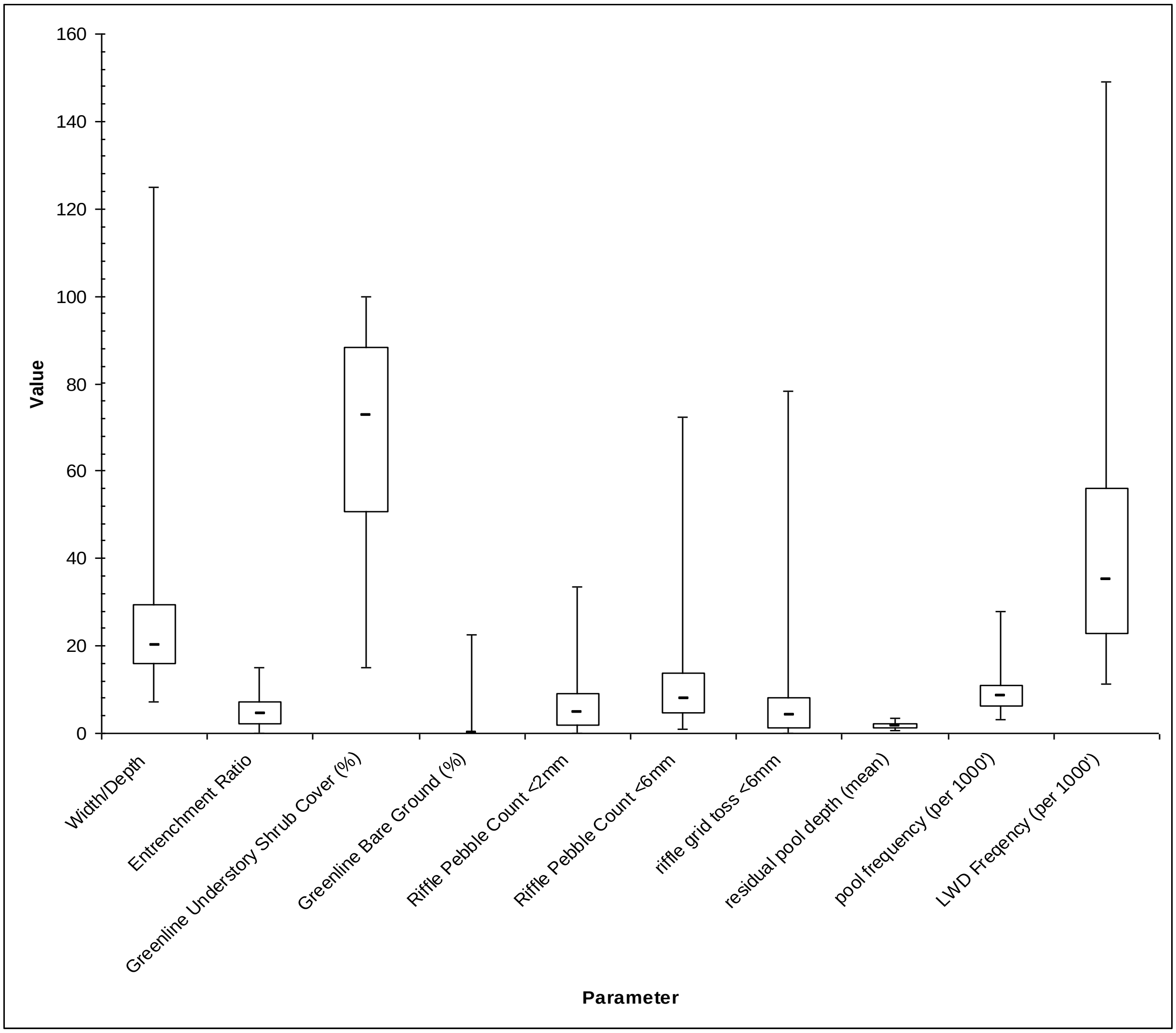

Figure B3-10. The measured variables by reach type.

B3.3 Sampled Reaches Field Descriptions

The following sections provide brief descriptions for each reach. Descriptions are provided for the type and degree of human impacts, stream channel conditions, streambank erosion properties, and the composition of the riparian vegetation community.

B3.3.1 Bull River Reach 3-3

Description of Human Impacts and Severity

Human impacts related to clearing/conversion of riparian vegetation (woody shrub community conversion to reed canarygrass). Streambanks mostly stable with some sloughing of upper bank.

Description of Stream Channel Conditions

Stable C5 channel morphology with plane bed, dune-ripple bedforms. Channel bed sediment is mostly sand/silt with some small gravel content.

Description of Streambank Erosion Conditions

Stable silt-clay streambank content, very cohesive bank materials, low bank erodibility potential.

Description of Riparian Vegetation Conditions
Reed canarygrass dominates the riparian zone with willow and red osier dogwood forming narrow bands adjacent to streambanks.

B3.3.2 Bull River Reach 3-2

Description of Human Impacts and Severity
Riparian zone likely logged prior to ~circa 1990 wildfire. This reach was historically used for log drives when western red cedars were logged. No current active human impacts. Private residences upstream and downstream of survey reach.

Description of Stream Channel Conditions
C4 channel type with pool-riffle morphology with side channel development. Mid-channel and transverse bars present alluding to high sediment (coarse) supply from North Fork and South Fork Bull River. This is a transitional reach between the upper watershed transport reaches which are typically B stream types, and downstream depositional E stream type reaches. Abundant sediment deposits occur downstream of the surveyed reach, the gradient is lower, plus sinuosity and bed material fines are higher. The bankfull channel cross-section width is 30 ft to 90 ft (avg 50 ft).

Description of Streambank Erosion Conditions
Moderate bank erosion occurring along areas prone to high NBS, mainly streambanks on outside meanders with poor vegetation and rooting conditions. Streambanks are comprised of sandy, gravelly unconsolidated materials.

Description of Riparian Vegetation Conditions
The understory is dominated by alder, willow, and grass/forbs. The shrub community is recovering from ~1990s stand replacement wildfire. The entire riparian zone was affected by partial to full stand replacement (mixed severity burn). Burned cedar and spruce trees/stumps present. Overstory consists of patchy conifers with spruce and cedars along the channel margin. A shrub community dominated by Drummond and Bebb's willow is establishing on gravel deposits.

B3.3.3 Bull River Reach 5-1

Description of Human Impacts and Severity
The riparian zone may have been historically affected by agricultural operations, but is currently subject to only natural influences.

Description of Stream Channel Conditions
Slow-moving water and a C5 stream type channel morphology characterize this reach. Low gradient riffles and few, long pools are present in the reach.

Description of Streambank Erosion Conditions
Vegetative mats composing the streambanks are moderately undercut, with the underlying fine materials eroded. In numerous locations, vegetated blocks have slumped into the channel, exposed to further decomposition. Sparse cedars and shrubs line the banks with low to moderate percent cover.

Description of Riparian Vegetation Conditions

Riparian vegetation consists primarily of reed canary grass with scattered cedars and understory shrubs. Minimal overstory is present.

B3.3.4 Dry Creek Reach 9-2

Description of Human Impacts and Severity

This reach and the channel corridor are subject to major debris torrents in addition to active channel headcuts and avulsions. The processes influencing this reach are considered natural and originally dictated by the alluvial fan that forms the bed geomorphic surface. Natural influences are observed on similar adjacent streams including Star and Napoleon Gulches. There is evidence of historical logging practices such as an abandoned road along the North side of the valley that was relocated mid-slope due to chronic road failures.

Description of Stream Channel Conditions

Channel headcuts and avulsions are common, with the channel incised through the debris fan deposits. Fresh coarse sediment lag deposits are present (up to 4' diameter material), though the channel was dry at the time of the survey. Large Woody Debris loading to the channel forms localized gradient increases and knickpoints in the channel profile. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen B3.

Description of Streambank Erosion Conditions

Erosion conditions vary throughout the reach, but are generally characterized by high to extreme bank erodibility conditions, shallow rooting depth and high bank-to-height ratios.

Description of Riparian Vegetation Conditions

Conifer species dominate, and large LWD jams are prevalent, fromed by frequent channel shifts. The shallow rooting depth offers low or minimal bank protection.

B3.3.5 West Fork Elk Creek Reach 8-1

Description of Human Impacts and Severity

Evidence of historical logging includes cedar stumps throughout the reach. However, stream channel and riparian zone appear to be relatively stable. Logging may have been limited and there is no sign of recent activity.

Description of Stream Channel Conditions

The stream is intermittent. Deep pools and runs, with smaller sections of riffle throughout. Large diameter wood interspersed along stream channel helping to create pools and redirect flow. Small material gravel dominant at pool crests and depositional sections of stream with large size cobble (90-128 mm) frequent in stream bottom. Some embeddedness of larger cobble from finer material. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C3.

Description of Streambank Erosion Conditions

There is limited bank erosion. Bank erosion is natural where it occurs. Most bank erosion occurring near cedar stumps, roots, trunks or large woody debris knick points. Deep, curving bends – pool forming – also result in limited erosion at corners.

Description of Riparian Vegetation Conditions
Some large cedars throughout and small woody shrubs/vegetation in understory. Stumps are visible but mixed age class in cedar composition with interspersed deciduous trees. Good vegetation cover for the shaded, cedar sections of the reach. Cedars and conifers are sparsely distributed.

B3.3.6 East Fork Elk Creek Reach 9-1

Description of Human Impacts and Severity
Minimal evidence of human impacts near the stream however barbed wire was found along streambanks and within the channel suggesting previous fencing possibly for livestock. Gabion basket was also found in the streambank on Reach 2.

Description of Stream Channel Conditions
Long riffles and few pools, with pools typically influenced by LWD. Although topographic maps indicate a channel slope of <2%, the actual channel slope is 2-4%, exhibiting B4 stream type conditions. Based on the valley morphology, floodplain and vegetation characteristics, the probable historical stream type was likely a Rosgen B3. Large bedload suggests the reach is aggrading. The stream bed is elevated with deep channels along the edge of stream bottom. A shifting thalweg and channel bars forming midstream in some areas near LWD or upstream of bends.

Description of Streambank Erosion Conditions
Some areas of sand and small fines dominated substrate, easily eroding where channel shape shifts due to LWD or bends however not much bank erosion witnessed outside of these erosive soil type areas.

Description of Riparian Vegetation Conditions
Conifer-dominated forest although size class is uniform indicating past disturbance. Good riparian buffer width although vegetation density and diversity are average.

B3.3.7 East Fork Elk Creek Reach 8-1

Description of Human Impacts and Severity
Similar to EFELK 7-2, there is very little evidence of human impacts in the reach. Limited logging occurred a number of years ago about 3 miles upstream, but no evidence in the study reach. A forest fire approximately 20 years ago affected the vegetation community.

Description of Stream Channel Conditions
Large cobble substrate and long runs characterized the B stream reach. The few pools typically occur at meanders. There is a limited amount of in-channel coarse LWD possibly reflecting riparian age class and past disturbance regimes. Pools lack complexity and cover and are not well developed. Few pools are greater than 1/3 bankfull width. The substrate is dominated by coarse particles, limited sorting, and the channel bed is well armored. The stream is intermittent in the survey reach. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen B4.

Description of Streambank Erosion Conditions
Naturally occurring eroding banks, very limited in size and frequency are usually at outside meanders. Streambanks are armored with large cobble. One large eroding hillslope with stable toe is eroding about 8 ft up the bank. Channel intercepts flood lag deposits possibly deposited during the 1964 flood. Mature

cottonwoods buried up to 3 ft by sediment. Source of material to channel (natural), primarily heterogeneous mixture of sediment size classes.

Description of Riparian Vegetation Conditions
Diverse riparian zone dominated by conifer with some interspersed deciduous trees. No disturbance to understory or mid-story vegetation. There is moderate rooting density along streambanks. There are relatively young age classes, 12-16" DBH max diameter on floodplain. Large wood is limited in survey reach, low pool and large wood frequency. There is limited large wood recruitment potential and high stream energy (average slope 3-4%).

B3.3.8 East Fork Elk Creek Reach 7-2

Description of Human Impacts and Severity
Minimal human impacts though there is some logging (2.5-3 mi) upstream. Logged area is small, not much noticeable logging effect.

Description of Stream Channel Conditions
East Fork Elk Creek in Reach 7-2 is primarily a B stream type with A stream type and D stream type inclusions. Intermittent channel conditions appear to be due to sediment. Low wood frequency with marginal quality pools. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen B3a.

Description of Streambank Erosion Conditions
The armored channel exhibits minimal erosion.

Description of Riparian Vegetation Conditions
The riparian zone is characterized by a grass/forb, shrub understory with an overstory of conifers and patchy cottonwoods. Riparian condition looks good with stable vegetation and multiple age classes.

B3.3.9 East Fork Elk Creek Reach 10-3

Description of Human Impacts and Severity
Historically, valley bottoms similar to EFELK 10-3 in the Lower Clark Fork tributaries were dominated by western red cedar. Channel and floodplain instability is due to vegetation changes from cedar to alder. Other vegetation changes include shifts from stable cedar to reed canarygrass. Agricultural practices and livestock grazing have also affected vegetation conditions. The current landowner fences livestock from the stream and maintains a buffer, but woody vegetation is sparse and relatively ineffective for bank stabilization.

Description of Stream Channel Conditions
Bedload material very mobile (smaller cobbles dominate) with abundant fines in pool bottoms and slow areas. Moderately deep pools and riffles characterize the channel morphology. There is limited trout habitat with habitat mainly provided by pools formed by alders slumping from eroding banks. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C4.

Description of Streambank Erosion Conditions
Streambanks are actively eroding. Some streambank stabilization projects have been installed including 2 engineered log jams and 1 rip-rap bank. High stream energy at meanders and streambank instability

due to riparian vegetation dominated by reed canarygrass and alder rather than historical vegetation that likely included denser species such as willow and dogwood. Bedload deposits influence the channel morphology at meanders. Large wood redirects flow into streambanks which is also affecting stability. Limited root density and sandy soils in some places also affect bank stability.

Description of Riparian Vegetation Conditions
The riparian zone includes reed canarygrass and alder. There are minimal woody species and virtually no conifers. There is a narrow riparian buffer.

B3.3.10 Elk Creek Reach 11-3

Description of Human Impacts and Severity
Historically, valley bottoms like this were dominated by western red cedar. Channel and floodplain instability is due to vegetation changes from cedar to alder. Other vegetation changes include shifts from stable cedar to reed canary grass via human influence of agricultural practices and livestock grazing. The current landowner fences livestock from the stream and maintains a buffer, but woody vegetation is sparse and relatively ineffective for bank stabilization. Some hay fields adjacent to stream but appear to be having limited impact.

Description of Stream Channel Conditions
Small cobble substrate dominates the mobile stream bed. Glacial Lake Missoula bed deposits visible in some areas. Deep pools are located through some meanders. Riffles are uncommon and the channel appears to be relatively unstable. Mid-channel bars and long depositional benches occur throughout the aggrading reach. Channel substrate and depositional bar substrate are of similar size class indicating very mobile, shifting materials. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C4 or C5.

Description of Streambank Erosion Conditions
Large, long sandy streambanks are unstable due to lack of good riparian vegetation. Local haying but does not seem to be affecting the streambanks themselves. Minimal riparian vegetation remains.

Description of Riparian Vegetation Conditions
There is limited riparian vegetation in the reach. Some deciduous species, but mainly alders with a reed canarygrass understory. Slight buffer between stream and hayfields averages 5 ft. Cattle appear to be excluded from the channel. River right (opposite streambank from the hayfield) has more established riparian vegetation, but again limited in vegetation quality and diversity.

B3.3.11 Elk Creek Reach 11-6

Description of Human Impacts and Severity
Some residences and horses located near the stream, but livestock fenced from channel. At the upper end of the reach the left floodplain and streabank is mowed down and chairs and table are present. Channel over-widening appears to be mainly from channel mobility and the confluence of two channel threads. Past grazing and other land uses may have also affected channel stability.

Description of Stream Channel Conditions
The stream has a pool-riffle morphology, with the bed coarsening in a downstream direction. Riffles underdeveloped with long glide features associated with pools. Floodplain riparian vegetation primarily

consists of grass/forb, reed canarygrass, and pole-sized alders. The outside streambanks are characterized by a low and middle terrace. Streambank heights are approximately 2 ft to 3 ft above the bankfull stage. Lateral scour pool associated with large wood, mature alders, or the channel morphology. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C4.

Description of Streambank Erosion Conditions
Alternating pool-riffle sequences associated with an inset floodplain surface and bracketing low and middle terraces that are prone to erosion on outside meander sequences. The 1997 flood appears to have affected the channel morphology. The channel generally downcut into the valley fill by as much as 2 ft relative to the low terrace which is the abandoned floodplain surface. The channel has limited meander belt width and is actively expanding the floodplain through erosion and accretion. Streambanks are generally comprised of fine gravel and lacustrine silt and clays. The rooting depth is relatively shallow and knapweed dominates several droughty terraces. Streambanks have high erosion potential.

Description of Riparian Vegetation Conditions
Knapweed occupies drier terraces adjacent to the stream. The understory vegetation, from 5 ft to 15 ft in height, is comprised of mature and decadent alder. No overstory canopy exists with the exception of mature alders. Streambank vegetation is comprised of alder which replaced the historical western red cedar cover type. The cedar were most likely logged in the early 1900s similar to practices in other tributaries. Vegetation conversion is due primarily to disturbance that is causing channel instability and increased sediment loading to the channel. Despite these conditions, the channel is primarily single threaded with deep pools at outside meanders and constrictions. Pools generally lack cover and complexity and depth. Undercut streambanks provide the primary cover. The channel bed sediment distribution is bi-modal with coarse gravel surface material and high embeddedness with interstitial fines in the sub-surface bed material.

B3.3.12 White Pine Creek Reach 9-2

Description of Human Impacts and Severity
Most impacts are related to historical logging, past grazing, agriculture and on-going road maintenance. Large stumps suggest historical canopy and past logging practices. Extensive knapweed inhabits drier floodplain surfaces.

Description of Stream Channel Conditions
The channel is dynamic with an abundant sediment load. Shallow pools are located where the stream interacts with large wood and alder bunches. There is considerable sediment recruitment from eroding streambanks. Most depositional features are colonized by vegetation. Meander cut-offs, floodplain scrolls, and extensive depositional bars suggest active channel processes. The channel profile includes pools, long glides and abrupt riffles. Algae is common throughout channel suggesting high nutrient levels. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C4.

Description of Streambank Erosion Conditions
Considerable streambank erosion contributes sediment ranging from silts to medium cobble. Most erosion is occurring on outside streambanks with extreme bank heights. Alders provide some streambank stability but most eroding banks are dominated by grasses and knapweed.

Description of Riparian Vegetation Conditions
The vegetation community is characterized by an alder overstory with an understory including grasses, knapweed, and willows. Other shrubs include alder which are regenerating throughout the site. Sedges are common on depositional features parallel to channel. Areas of significant weed infestation include knapweed, oxeye daisy, purple loosestrife, and Canada thistle.

B3.3.13 White Pine Creek Reach 9-5

Description of Human Impacts and Severity
There is a recent subdivision on surrounding uplands. Riparian vegetation has been mowed. A newer bridge and low water ford have introduced fine sediment to the stream. Equipment was used to manipulate the channel potentially resulting in an active avulsion. Tractor tracks are apparent on the floodplain.

Description of Stream Channel Conditions
The entrenched channel has a relatively low sinuosity planform characterized by short riffles and long pools and glides. Some large wood and numerous alder thickets promote channel scour and pool diversity. Fine to medium gravels predominate the channel bed material. Fine sediment and flocculant cover the channel bed in most slow water areas. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C4.

Description of Streambank Erosion Conditions
Bank erosion is relatively common at outside streambanks due to excessive bank heights. Reed canary grass colonizes failed streambank blocks. Point bars are largely colonized by reed canarygrass. Alders located on the floodplain as well as on the streambanks to the entrenched bankfull channel. A few other shrubs include spirea.

Description of Riparian Vegetation Conditions
Alder dominate the overstory and reed canarygrass dominates the understory. Vegetation is mowed to the top of bank. Alders shade >50% of the channel. No overstory canopy exists above the alders. Reed canarygrass is displacing sedges and rushes from low depositional areas.

B3.3.14 White Pine Creek Reach 8-3

Description of Human Impacts and Severity
No obvious impacts in the reach though the channel intersects the road at the top and bottom of WPC 8-3.

Description of Stream Channel Conditions
There are multiple channels and substantial bedload in the intermittent reach. The reach resembles fan morphology with poor habitat conditions and limited pools. Large wood present but infrequently influences channel morphology. Most of the large wood is in the form of single pieces with a few aggregates. White Pine Creek Reach 8-3 currently exhibits a Rosgen D3 channel morphology. Based on the valley morphology, floodplain, and vegetation characteristics, the probable historical stream type was likely a Rosgen C3.

Description of Streambank Erosion Conditions
Most streambanks exhibit erosion. BEHI was completed on both channels. There is considerable sediment, generally coarser substrate, generated within the reach from streambank and floodplain erosion. Large material is mobilized by larger flood events. Lag deposits vegetated by multi-age vegetation depending on age and disturbance regime of deposit.

Description of Riparian Vegetation Conditions
The riparian zone is characterized by a multi-species canopy of fir and cottonwood. Same species comprise the midstory and understory. There are limited shrubs, mainly small conifers. Shrubs include cottonwood, Rocky Mountain maple, mock orange, dogwood, ribes, and spirea. Noxious weed located on depositional features include knapweed and purple loosestrife.

B3.3.15 Swamp Creek Reach 18-1

Description of Human Impacts and Severity
No identifiable human impacts other than signs of livestock grazing.

Description of Stream Channel Conditions
The plane bed channel is characterized by riffle-step morphology. Shallow pocket pools are typically located in channel margins. The channel bed material is comprised of coarse material and minimal gravels. The reach is a migratory corridor with no spawning habitat due to the sizeable bed material and high stream energy. Beavers are active on the floodplain and influence the vegetation community. Dynamic channel in the upstream portion of the reach with floodplain overflow channels, coarse alluvium deposits and LWD. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C3b.

Description of Streambank Erosion Conditions
Minimal streambank erosion due to coarse bed and streambank material. Some erosion of floodplain areas due to flood channel scour.

Description of Riparian Vegetation Conditions
The riparian community is dense and diverse. Overstory species include cottonwood, cedar, aspen, and spruce. Understory species include willows, dogwood, alder, and snowberry. Beaver influence riparian vegetation especially along the channel and broader floodplain areas.

B3.3.16 Swamp Creek Reach 20-1

Description of Human Impacts and Severity
Grazing impacts include hoof shear and streambanks, vegetation disturbance and removal, and nutrient and sediment loading. There is a bridge at the downstream end of the survey reach.

Description of Stream Channel Conditions
The channel is dynamic with considerable bedload and instability. Large wood and alder thickets promote channel scour and provide habitat diversity. Beaver play an important role influencing channel morphology, sediment storage, water storage and the vegetation community. Grazing may be furthering the system's susceptibility to periodic disturbance. There is considerable off-channel habitat. Swamp Creek Reach 20-1 currently exhibits a Rosgen D4 channel morphology. Based on the valley morphology, floodplain, and vegetation characteristics, the probable historical stream type was likely a Rosgen C4.

Description of Streambank Erosion Conditions
Considerable bank erosion in reach is contributing sediment to the channel. Most eroding banks are less than 3 ft high. Glacial Lake Missoula deposits are contributing fine silts to stream. Most fine sediment is in the lower portion of the reach, especially downstream of a floodplain channel that joins the creek in Cell 1.

Description of Riparian Vegetation Conditions
There is a diffuse overstory with infrequent spruce, larch and cedar. The shrub understory and mid-story are dominated by spirea and alder, respectively. The vegetation community looks to be highly influenced by past and present beaver activity. A lack of a more complete overstory may be due to high water table related to beaver activity.

B3.3.17 Swamp Creek Reach 21-1

Description of Human Impacts and Severity
Obvious human impacts in the reach include bank rip-rap and grazing. One house is located in the reach. It also appears that the USFS portion of the reach is grazed. Bank erosion is common.

Description of Stream Channel Conditions
The channel morphology was characterized by long pools/glides and short riffles. Alder clumps and large wood influence pool scour and habitat. The channel appears to be over-widened through much of the reach due to grazing impacts. The upstream end of the reach has two channels. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C4.

Description of Streambank Erosion Conditions
Bank erosion is common in the reach. Accelerated erosion is related to livestock grazing, hoof shear, and vegetation removal. The most severe erosion was due to bank toe failure and bank slumping.

Description of Riparian Vegetation Conditions
Riparian vegetation was characterized by an alder overstory and grass understory. Additional shrubs found in the USFS section included spirea, willows, and dogwood. Knapweed and mullein were located on depositional bars.

B3.3.18 Swamp Creek Reach 22-3

Description of Human Impacts and Severity
The uplands were previously logged. The most severe human influence is irrigation withdrawal. The stream was nearly dry in SWP 22-3. Numerous fish were stranded in the remaining pools. The downstream end of the reach may be influenced by reservoir operations.

Description of Stream Channel Conditions
The channel is bedrock controlled through the reach. Bedrock is either exposed at the channel surface or is covered by a thin veneer of sediment ranging from sand to boulders. The channel is relatively homogeneous with few moderate to large pools. A narrow floodplain separates the channel from adjacent hillslopes. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C4 or F4.

Description of Streambank Erosion Conditions
Erosion is moderate in the reach. Bedrock limits erosion in the upper portion of the reach. Failing reed canarygrass-dominated banks are fairly common. However, a good riparian shrub community limits the extent of lateral bank retreat.

Description of Riparian Vegetation Conditions
Vegetation conditions are relatively diverse with a dense shrub layer and moderate canopy. Reed canarygrass is common throughout the reach.

B3.3.19 Marten Creek Reach 6-2

Description of Human Impacts and Severity
No obvious human impacts. Large wood influences channel morphology and deposition. Bedorck forms much of the southern channel margin.

Description of Stream Channel Conditions
Downstream end of reach has intermittent conditions partially caused by sediment wedge. Large downstream jam is influencing sediment wedge. Water emerges upstream and downstream of the intermittent reach. Steeper reaches have coarser bed material including boulders that are unlikely to move except in uncommon flood events. Short meandering sections are influenced by large wood and have substantial mobile bedload deposits. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C3b.

Description of Streambank Erosion Conditions
In the lower reach, there is a bedrock outcrop on the southern bank. There is minimal bank erosion on the north bank. Bank erosion occurs on most streambanks lacking bedrock. Eroding banks are commonly 3 ft to 4 ft high.

Description of Riparian Vegetation Conditions
The overstory includes cottonwood, alder, fir, larch and cedar. The understory includes dogwood, mulberry, Rocky Mountain maple, snowberry, and thimbleberry. There is no apparent logging in the riparian zone. Large trees recruit to channel. Cedars are more common in the upper half of reach. Mature cottonwoods relatively common.

B3.3.20 Marten Creek Reach 9-1

Description of Human Impacts and Severity
No human impacts were identified.

Description of Stream Channel Conditions
The stream is dynamic with expansive alluvial deposits. Loose sediment suggests a mobile bed with limited larger material and LWD for channel stability. Channel changes may be relatively frequent based on overflow channels, moderately fresh deposition, and bank erosion. The habitat is generally homogeneous with limited pools and long riffles. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen C3.

Description of Streambank Erosion Conditions
Bank erosion is pervasive with most outside banks affected by scour. Flood-deposited coarse material is colonized by shrubs. Most of these surfaces are not stable enough to resist erosion. Eroding banks range from 2 ft to 4 ft in height.

Description of Riparian Vegetation Conditions
The canopy is less contiguous compared to upstream reaches. Cottonwoods are the primary overstory species with infrequent conifers. Understory species include snowberry, dogwood, Rocky Mountain maple, tansy, and cottonwoods. Flood deposits are colonized by pioneer species. The greater stable floodplain supports a dense understory.

B3.3.21 North Branch Marten Creek Reach 8-1

Description of Human Impacts and Severity
There is evidence of past logging activities within the channel migration zone. There is moderate potential for large wood recruitment. The stream interacts with USFS road hillslope in Cell 5 (~100 ft right bank). The fillslope is stable with grasses/shrubs. There is low sediment delivery potential.

Description of Stream Channel Conditions
The channel is characterized as having a plane bed, riffle/step (forced) pool morphology. The bed material is very coarse with gravel deposited in low energy interstitial areas between boulders. There is limited pool development and depths due to armored bed and lack of coarse large wood. The channel is classified as a Rosgen B3a type with steeper, more confined B2 inclusions.

Description of Streambank Erosion Conditions
Streambanks are generally stable with some discrete point sources located along meander outcurves and constrictions. Source areas are armored with large cobble-boulder sediment (low-mod BEHI ratings). Overall, there is low supply from eroding streambanks.

Description of Riparian Vegetation Conditions
The overstory is dominated by conifers and deciduous trees. There is evidence of past harvest activities within the stream migration zone. Mid-story conifers with Rocky Mountain maple, alder, dogwood and thimbleberry ground cover (grass/forbs).

B3.3.22 South Branch Marten Creek Reach 3-1

Description of Human Impacts and Severity
There does not appear to be any human impacts in the reach other than a fire. The riparian zone is intact with no signs of logging.

Description of Stream Channel Conditions
There is a considerable amount of wood in the reach, influencing channel morphology and habitat. Series of log steps store sediment and provide upstream deposition and downstream scour. Based on the valley morphology, floodplain, substrate and vegetation conditions, the existing stream type and probable historical stream type would be classified as a Rosgen B4a.

Description of Streambank Erosion Conditions
Dense vegetation, and rocky hillslope and bank materials result in minimal to moderate bank erosion.

Description of Riparian Vegetation Conditions
There is a multi-story riparian zone with a mature conifer canopy. The overstory is dominated by hemlock. The riparian understory includes alder, devils club, and Rocky Mountain maple. There is substantial large wood recruitment to the channel.

B3.4 GRAPHICAL PARAMETER SUMMARIES BY REACH

The following section provides graphs for stream channel and riparian zone metrics measured in each of the reaches described in **Section B3.5**.

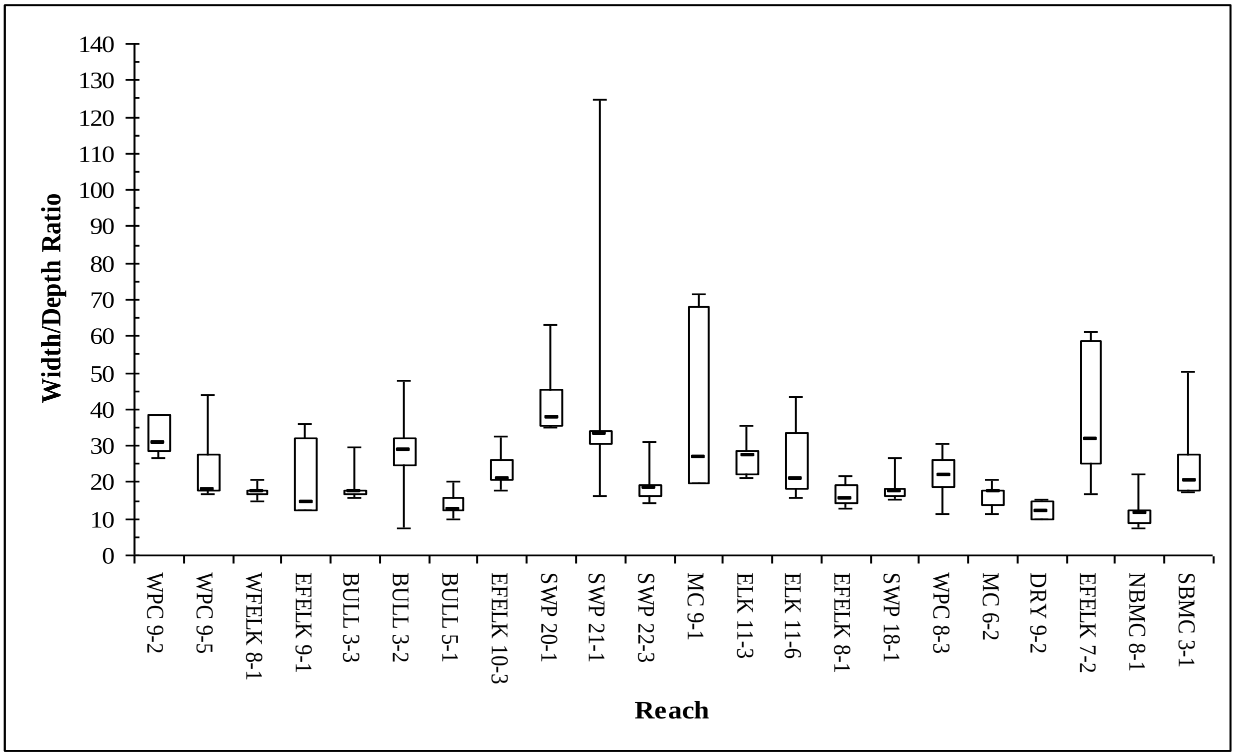

Figure B3-11. Width/Depth Ratio by reach.

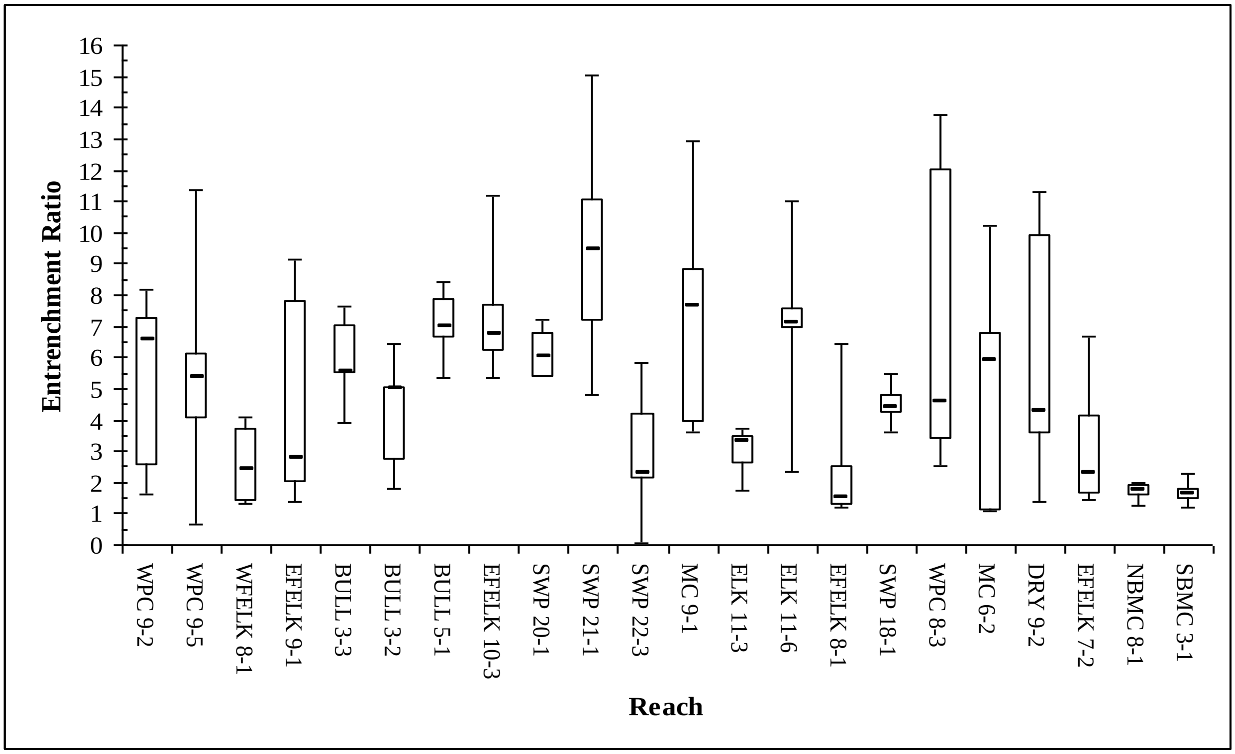

Figure B3-12. Entrenchment Ratio by reach.

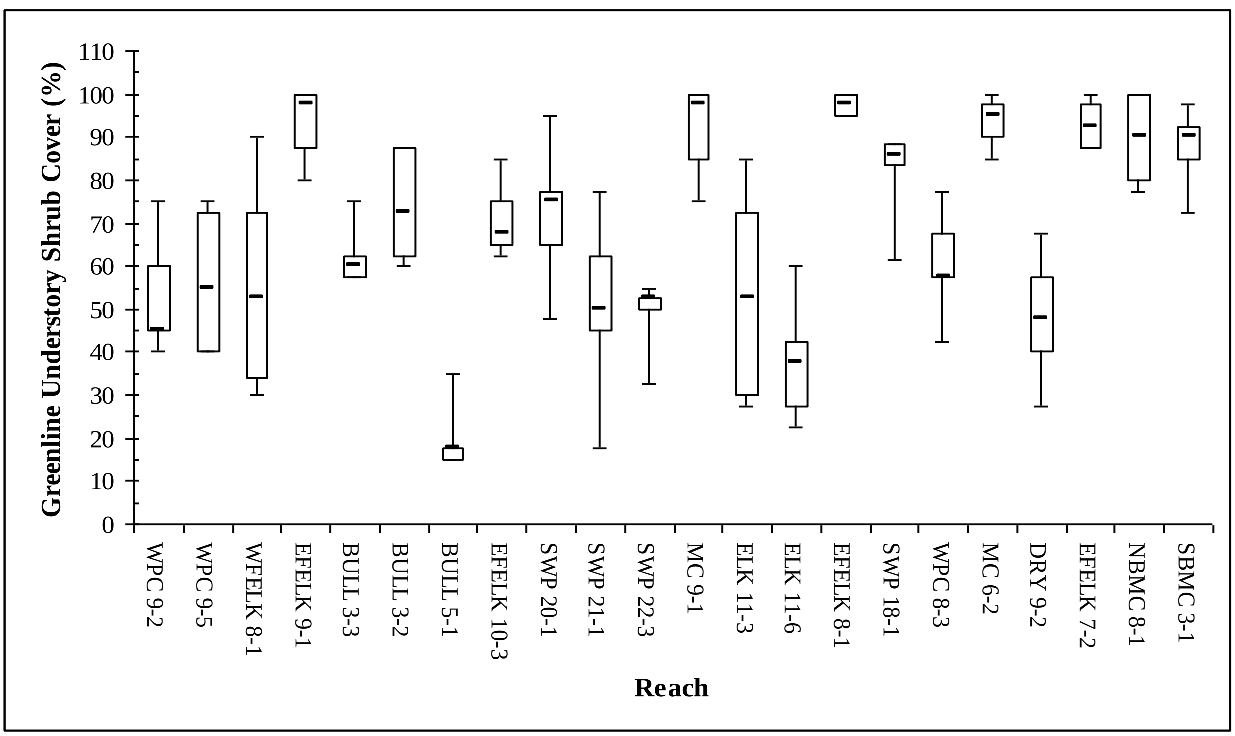

Figure B3-13. Greenline Understory Shrub Cover (%) by reach.

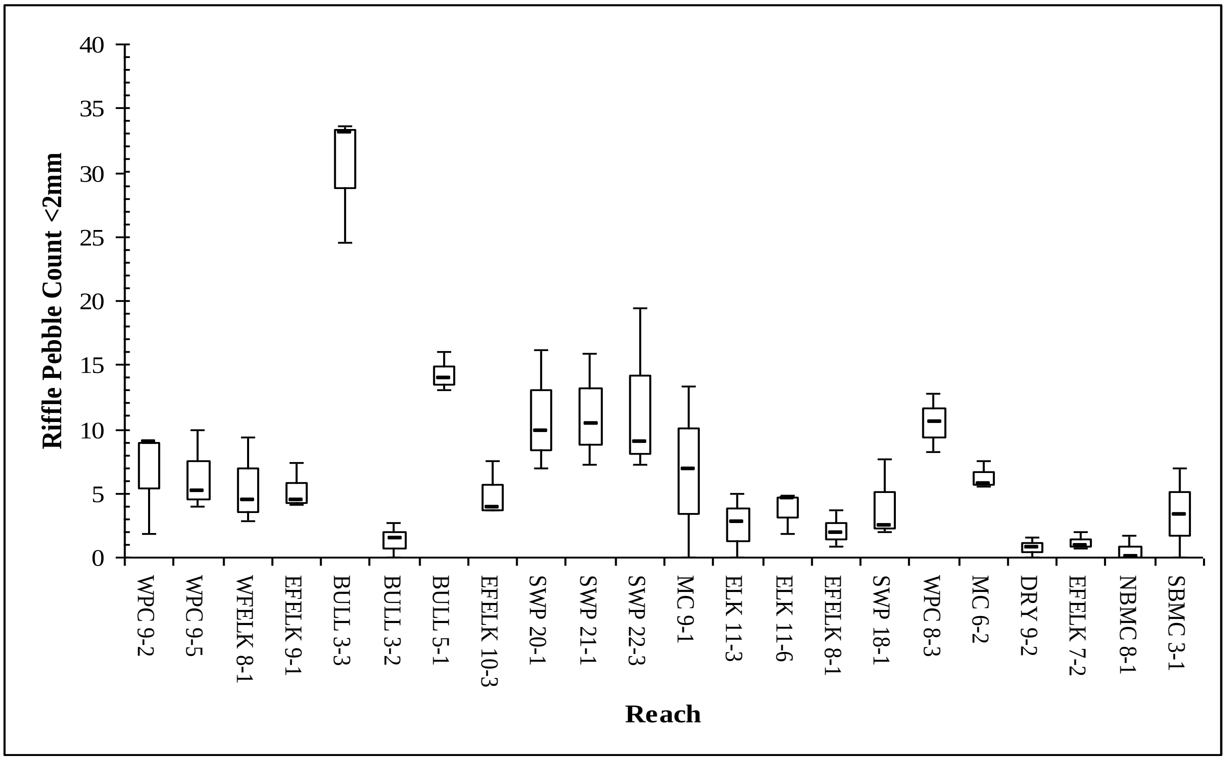

Figure B3-14. Riffle Pebble Count <2 mm by reach.

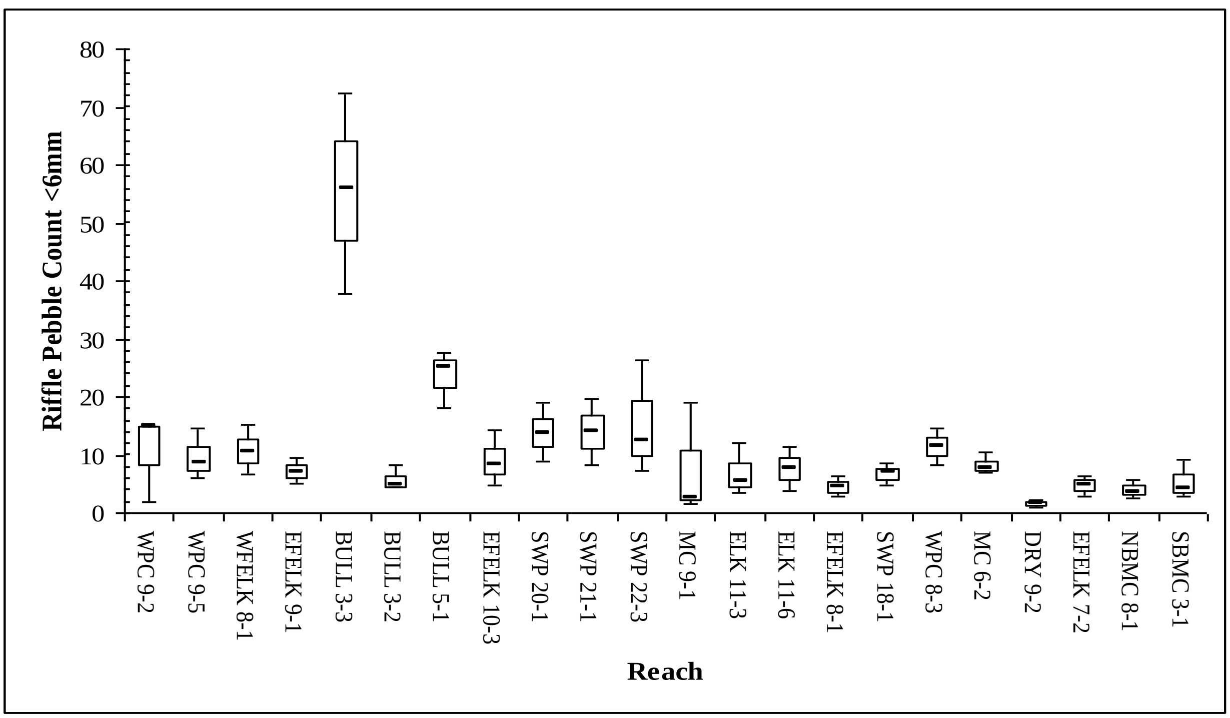

Figure B3-15. Riffle Pebble Count <6 mm by reach.

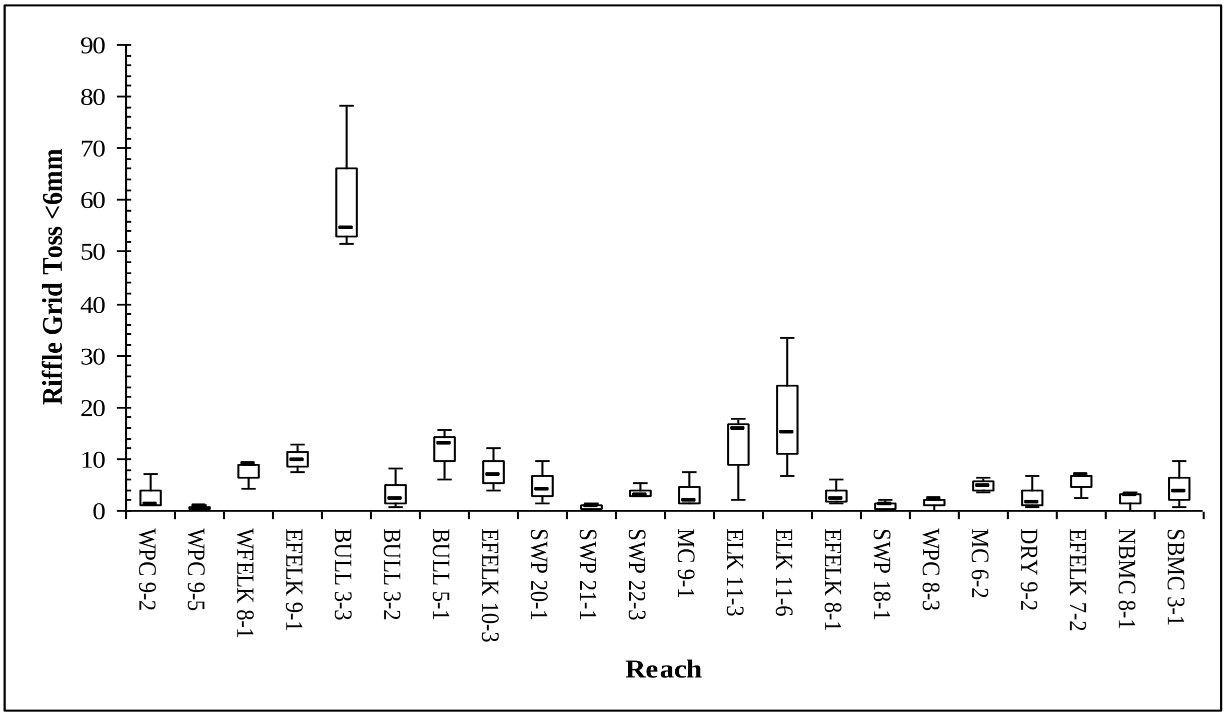

Figure B3-16. Riffle Grid Toss <6 mm by reach.

B4.0 STREAMBANK EROSION SOURCE ASSESSMENT

B4.1 OVERVIEW

For each monitoring reach selected in the aerial photo assessment, measurements were collected to calculate the Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS), in accordance with the Watershed Assessment of River Stability and Sediment Supply guidelines (Rosgen 2006). These measurements were used in conjunction with streambank length and erosion source notes to determine sediment loads per 1,000 feet of channel within each surveyed reach.

The BEHI procedure integrates multiple factors which have a direct impact on streambank stability, including the following parameters.

- Ratio of streambank height to bankfull stage.
- Ratio of riparian vegetation rooting depth to streambank height.
- Degree of rooting density.
- Composition of streambank materials.
- Streambank angle.
- Bank material stratigraphy.
- Bank surface protection afforded by woody debris and vegetation.

The BEHI index incorporates these seven variables into a numerical reach score that is used to rank streambank erosion potential on a scale ranging from very low to extreme (**Table B4-1**). For the LCFT-TPA sites, several bank sites within each reach were evaluated for streambank integrity. The number of sites evaluated within each reach was based upon the variability of streambank conditions within the reach. Selected sites provided a representative sample of streambank conditions throughout the reach.

Table B4-1. BEHI score and rating matrix (Rosgen 1996).

Parameter		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height Ratio	Value	1.0 – 1.1	1.11 – 1.19	1.2 – 1.5	1.6 – 2.0	2.1 – 2.8	> 2.8
	Index	1.0 – 1.9	2.0 – 3.9	4.0 – 5.9	6.0 – 7.9	8.0 – 9.0	10
Root Depth Ratio	Value	1.0 – 0.9	0.89 – 0.5	0.49 – 0.3	0.29 – 0.15	0.14 – 0.05	<0.05
	Index	1.0 – 1.9	2.0 – 3.9	4.0 – 5.9	6.0 – 7.9	8.0 – 9.0	10
Weighted Root Density	Value	100 – 80	79 – 55	54 – 30	29 – 15	14 – 5	<5
	Index	1.0 – 1.9	2.0 – 3.9	4.0 – 5.9	6.0 – 7.9	8.0 – 9.0	10
Bank Angle	Value	0 – 20	21 – 60	61 – 80	81 – 90	91 – 119	>119
	Index	1.0 – 1.9	2.0 – 3.9	4.0 – 5.9	6.0 – 7.9	8.0 – 9.0	10
Surface Protection	Value	100 – 80	79 – 55	54 – 30	29 – 15	14 – 10	<10
	Index	1.0 – 1.9	2.0 – 3.9	4.0 – 5.9	6.0 – 7.9	8.0 – 9.0	10

After evaluating the core bank integrity parameters described above, bank material composition factors are considered. Depending upon bank materials, BEHI score are adjusted up or down (Rosgen 1996). Banks comprised of bedrock, boulders and cobble had very low erosion potential. Banks composed of cobble and/or gravel with a high fraction of sand had increased erosion potential. Stratified banks containing layers of unstable material also displayed greater erosion potential. After adjusting the core BEHI score for bank material composition factors, a final BEHI score and rating is derived (**Table B4-2**).

Table B4-2. BEHI score and rating following bank materials adjustment.

Rating	Very Low	Low	Moderate	High	Very High	Extreme
Score	5-9.5	10-19.5	20-29.5	30-39.5	40-45	46-50

B4.2 Field Measurement of BEHI

Within each sub-reach, eroding streambanks were identified and supporting BEHI measurements recorded. Measurements were completed for the following metrics:

- Bank condition including actively eroding, slowly eroding, undercut, or vegetated banks
- Bank height
- Bankfull height
- Root depth
- Root density
- Bank angle
- Surface protection
- Material adjustments
- Bankfull mean depth
- Near bank maximum depth
- Stationing
- Mean height
- Bank composition (size classes)
- Hoof shear presence
- Sources of streambank instability (percentage)

In addition to these measurements, photos were taken facing each streambank from a location perpendicular and a location upstream of the streambank. Photos were labeled according to the streambank site and position of the photograph.

B4.3 Index Calculations

To calculate the BEHI rating for each eroding streambank, the following parameters were used:

- Bank height/bankfull height
- Root depth/bank height
- Weighted root density
- Bank density
- Surface protection

Each parameter is matched to a corresponding index value, derived from statistical relations for sedimentary/metamorphic geologic substrata (Rosgen 1996; 2001a). Index values are summarized to create an overall BEHI rating number, which is then converted into a categorical rating (Very Low, Low, Moderate, High, Very High or Extreme).

To calculate the NBS rating for each bank, the following relationship is used:

NBS = Near Bank Maximum Bankfull Depth (ft) / Bankfull Mean Depth (ft)

As with the BEHI ratings, the resulting NBS value corresponds to a categorical rating.

B4.4 Retreat Rate

The BEHI and NBS categorical ratings were matched to derive the average retreat rate of each streambank (ft/yr) (**Table B4-3**).

Table B4-3. BEHI and Near Bank Stress categories and rate of streambank retreat (ft/yr).

BEHI	Near Bank Stress					
	Very Low	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Very Low	NA	NA	NA	NA	NA	NA
Low	0.02	0.04	0.07	0.16	0.32	0.67
Moderate	0.09	0.15	0.25	0.42	0.70	1.16
High-Very High	0.17	0.25	0.38	0.58	0.87	1.32
Extreme	0.16	0.42	1.07	2.75	7.03	17.97

B4.5 Bank Erosion Sediment Loading

The mass eroded (tons/yr) from each streambank is calculated using the following equation:

Mass eroded = Streambank Length (ft)* Mean Streambank Height (ft) * Retreat Rate (ft/yr)

Mass eroded per each streambank is then filtered into two categories (actively eroding versus slowly eroding, undercut, or vegetated banks).

B4.6 BEHI Results

The following sections provide the BEHI results by reach categories. Each reach category has two accompanying data tables.

B4.6.1 Bull River Reach 3-3

Streambanks in Bull River Reach 3-3 were stable. The silt-clay bank material is cohesive and resistant to scour. Vegetation conditions range from drier grasses to dense reed canarygrass and shrubs. Vegetated streambanks overhang the stream and provide debris inputs. Typical reach photographs are included in **Figure B4-1**. BEHI results for Reach 3-3 are included in **Table B4-4** and **Table B4-5**.

Figure B4-1. Typical streambank conditions in Bull River Reach 3-3.

Table B4-4. BEHI statistics for Bull River Reach 3-3.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
BULL 3-3	9/25/08	Active	35.6	661	22.0	104.3	69.5
BULL 3-3	9/25/08	Slow	36.6	93	3.1	5.5	3.7
BULL 3-3	9/25/08	Total		754	25.1	109.8	73.2

Table B4-5. BEHI statistics for Bull River Reach 3-3.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
BULL 3-3	9/25/08	Active	5.9	0.0	0.0	0.0	0.0	0.0	94.1	0.0
BULL 3-3	9/25/08	Slow	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
BULL 3-3	9/25/08	Total	5.6	0.0	0.0	0.0	0.0	0.0	94.4	0.0

B4.6.2 Bull River Reach 3-2

There was moderate bank erosion occurring along areas prone to high NBS. Streambanks on outside meanders with poor vegetation and rooting conditions typically experienced the greatest erosion. Streambanks are comprised of sandy, gravelly unconsolidated materials. Eroded blocks vegetated by reed canarygrass, grass, and shrubs were located throughout the reach. **Figure B4-2** includes typical bank erosion conditions in the reach. Summary data for Bull River Reach 3-2 are presented in **Table B4-6** and **Table B4-7**.

Figure B4-2. Typical eroding bank conditions in Bull River Reach 3-2.

Table B4-6. BEHI statistics for Bull River Reach 3-2.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
BULL 3-2	9/25/08	Actively	36.9	84	4.2	11.7	11.7
BULL 3-2	9/25/08	Slowly	27.8	152	7.6	8.9	8.9
BULL 3-2	9/25/08	Total		236	11.8	20.6	20.6

Table B4-7. BEHI statistics for Bull River Reach 3-2.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
BULL 3-2	9/25/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	70.0	30.0
BULL 3-2	9/25/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	97.2	2.8
BULL 3-2	9/25/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	81.7	18.3

B4.6.3 Bull River Reach 5-1

The streambanks are primarily composed of sands and other fine materials, overlain by reed canarygrass, shrubs and scattered cedar roots. Vegetative cover is extensive throughout the reach, but the root mats are undercut and slumping on several banks. Bank structure may have been historically influenced by agriculture, but erosion is currently attributed to natural causes. **Figure B4-3** includes typical bank erosion conditions in the reach. Summary data for Bull River Reach 5-1 are presented in **Table B4-8** and **Table B4-9**.

Figure B4-3. Typical eroding bank conditions in Bull River Reach 5-1.

Table B4-8. BEHI statistics for Bull River Reach 5-1.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
BULL 5-1	9/25/08	Actively	32.3	280	9.3	16.2	10.8
BULL 5-1	9/25/08	Slowly	27.5	423	14.1	27.1	18.0
BULL 5-1	9/25/08	Total		703	23.4	43.2	28.8

Table B4-9. BEHI statistics for Bull River Reach 5-1.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
BULL 5-1	9/25/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
BULL 5-1	9/25/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	97.9	2.1
BULL 5-1	9/25/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	98.7	1.3

B4.6.4 Dry Creek Reach 9-2

Coarse cobbles and boulders form the streambank material in this reach, covered with a mat of forest roots and associated understory shrubs. The high bank height ratios and shallow rooting depths form the basis for erodability, further increased by historical silviculture activity. High near-bank stress ratings on all banks are moderated by the coarse bank material and vegetative cover. **Figure B4-4** includes typical bank erosion conditions in the reach. Summary data for Dry Creek Reach 9-2 are presented in **Table B4-10** and **Table B4-11**.

Figure B4-4. Typical eroding bank conditions in Dry Creek Reach 9-2.

Table B4-10. BEHI statistics for Dry Creek Reach 9-2.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
DRY 9-2	9/26/08	Actively	13.8	126	6.3	4.3	4.3
DRY 9-2	9/26/08	Slowly	16.9	208	10.4	8.1	8.1
DRY 9-2	9/26/08	Total		334	16.7	12.4	12.4

Table B4-11. BEHI statistics for Dry Creek Reach 9-2.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
DRY 9-2	9/26/08	Actively	0.0	0.0	0.0	0.0	40.0	0.0	60.0	0.0
DRY 9-2	9/26/08	Slowly	0.0	0.0	0.0	0.0	40.0	0.0	60.0	0.0
DRY 9-2	9/26/08	Total	0.0	0.0	0.0	0.0	40.0	0.0	60.0	0.0

B4.6.5 West Fork Elk Creek Reach 8-1

Limited bank erosion in this reach is related to natural influences. Bank erosion occurs primarily near cedar stumps, roots, trunks or large woody debris knick points. Deep, curving bends also result in limited erosion at corners. **Figure B4-5** includes typical bank erosion conditions in the reach. Summary data for West Fork Elk Creek Reach 8-1 are presented in **Table B4-12** and **Table B4-13**.

Figure B4-5. Typical eroding bank conditions in West Fork Elk Creek Reach 8-1.

Table B4-12. BEHI statistics for West Fork Elk Creek Reach 8-1.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
WFELK 8-1	9/23/08	Actively	12.7	130	6.5	5.9	5.9
WFELK 8-1	9/23/08	Slowly	0.0	0	0.0	0.0	0.0
WFELK 8-1	9/23/08	Total		130	6.5	5.9	5.9

Table B4-13. BEHI statistics for West Fork Elk Creek Reach 8-1.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
WFELK 8-1	9/23/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
WFELK 8-1	9/23/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WFELK 8-1	9/23/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0

B4.6.6 East Fork Elk Creek Reach 9-1

Areas of sand and small fines dominate the substrate; locations where the channel shape shifts due to LWD or bends are responsible for the erosion of these materials. However, not much bank erosion was found outside of these erodible areas. Extensive vegetation cover is successfully mitigating erosion and providing cover. **Figure B4-6** includes typical bank erosion conditions in the reach. Summary data for East Fork Elk Creek Reach 9-1 are presented in **Table B4-14** and **Table B4-15**.

Figure B4-6. Typical eroding bank conditions in East Fork Elk Creek Reach 9-1.

Table B4-14. BEHI statistics for East Fork Elk Creek Reach 9-1.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
EFELK 9-1	9/23/08	Actively	32.4	102	5.1	4.0	4.0
EFELK 9-1	9/23/08	Slowly	28.5	57	2.9	1.9	1.9
EFELK 9-1	9/23/08	Total		159	8.0	5.9	5.9

Table B4-15. BEHI statistics for East Fork Elk Creek Reach 9-1.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
EFELK 9-1	9/23/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	84.8	15.2
EFELK 9-1	9/23/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
EFELK 9-1	9/23/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	89.7	10.3

B4.6.7 East Fork Elk Creek Reach 8-1

Naturally occurring eroding banks, very limited in size and frequency are usually at outside meanders. The streambanks are armored with large cobble, with a mat of shrub and tree cover on top. One large eroding hillslope with a stable toe is eroding about 8 ft up the bank. The channel intercepts flood lag deposits possibly deposited during the 1964 flood. Mature cottonwoods are buried up to 3 ft by sediment. A homogeneous mixture of sediment size classes is the primary source of material to the channel (natural). **Figure B4-7** includes typical bank erosion conditions in the reach. Summary data for East Fork Elk Creek Reach 8-1 are presented in **Table B4-16** and **Table B4-17**.

Figure B4-7. Typical eroding bank conditions in East Fork Elk Creek Reach 8-1.

Table B4-16. BEHI statistics for East Fork Elk Creek Reach 8-1.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
EFELK 8-1	9/22/08	Actively	23.6	104	5.2	3.2	3.2
EFELK 8-1	9/22/08	Slowly	32.2	112	5.6	8.4	8.4
EFELK 8-1	9/22/08	Total		216	10.8	11.6	11.6

Table B4-17. BEHI statistics for East Fork Elk Creek Reach 8-1.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
EFELK 8-1	9/22/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
EFELK 8-1	9/22/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
EFELK 8-1	9/22/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0

B4.6.8 East Fork Elk Creek Reach 7-2

The armored channel exhibits minimal erosion, all of which is attributable to natural causes. Vegetation extends to the channel margin, completely covering the mixed sizes of material that comprise the streambank. **Figure B4-8** includes typical bank erosion conditions in the reach. Summary data for East Fork Elk Creek Reach 7-2 are presented in **Table B4-18** and **Table B4-19**.

Figure B4-8. Typical eroding bank conditions in East Fork Elk Creek Reach 7-2.

Table B4-18. BEHI statistics for East Fork Elk Creek Reach 7-2.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
EFELK 7-2	9/22/08	Actively	31.8	49	2.5	1.9	1.9
EFELK 7-2	9/22/08	Slowly	22.1	41	2.1	1.2	1.2
EFELK 7-2	9/22/08	Total		90	4.5	3.1	3.1

Table B4-19. BEHI statistics for East Fork Elk Creek Reach 7-2.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
EFELK 7-2	9/22/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
EFELK 7-2	9/22/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
EFELK 7-2	9/22/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0

B4.6.9 East Fork Elk Creek Reach 10-3

Most streambanks in this reach are actively eroding. Some streambank stabilization projects have been installed including 2 engineered log jams and 1 rip-rap bank. High stream energy and bedload deposits occur at meanders, influencing channel morphology. The riparian vegetation is dominated by reed canarygrass and alder rather than historically dense species such as willow and dogwood, resulting in streambank instability. Large wood redirects flow into streambanks which is also affecting stability. Limited root density and sandy soils in some places also affect bank stability. **Figure B4-9** includes typical bank erosion conditions in the reach. Summary data for East Fork Elk Creek Reach 10-3 are presented in **Table B4-20** and **Table B4-21**.

Figure B4-9. Typical eroding bank conditions in East Fork Elk Creek Reach 10-3.

Table B4-20. BEHI statistics for East Fork Elk Creek Reach 10-3.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
EFELK 10-3	9/24/08	Actively	38.8	66	3.3	2.6	2.6
EFELK 10-3	9/24/08	Slowly	27.0	88	4.4	1.7	1.7
EFELK 10-3	9/24/08	Total		154	7.7	4.3	4.3

Table B4-21. BEHI statistics for East Fork Elk Creek Reach 10-3.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
EFELK 10-3	9/24/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	70.0	30.0
EFELK 10-3	9/24/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	79.9	20.1
EFELK 10-3	9/24/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	74.0	26.0

B4.6.10 Elk Creek Reach 11-3

Large, long sandy streambanks are unstable due to lack of good riparian vegetation. Local haying occurs in this reach but does not seem to be affecting the streambanks themselves. Minimal riparian vegetation remains on eroding banks aside from reed canarygrass and small patches of alder. **Figure B4-10** includes typical bank erosion conditions in the reach. Summary data for Elk Creek Reach 11-3 are presented in **Table B4-22** and **Table B4-23**.

Figure B4-10. Typical eroding bank conditions in Elk Creek Reach 11-3.

Table B4-22. BEHI statistics for Elk Creek Reach 11-3.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
ELK 11-3	9/24/08	Actively	40.6	130	6.5	6.8	6.8
ELK 11-3	9/24/08	Slowly	37.7	142	7.1	9.2	9.2
ELK 11-3	9/24/08	Total		272	13.6	16.0	16.0

Table B4-23. BEHI statistics for Elk Creek Reach 11-3.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
ELK 11-3	9/24/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	70.0	30.0
ELK 11-3	9/24/08	Slowly	0.0	9.3	0.0	0.0	0.0	0.0	61.2	29.5
ELK 11-3	9/24/08	Total	0.0	5.3	0.0	0.0	0.0	0.0	65.0	29.7

B4.6.11 Elk Creek Reach 11-6

Alternating pool-riffle sequences are associated with an inset floodplain surface and bracketing low and middle terraces that are prone to erosion on outside meander sequences. The 1997 flood appears to have affected the channel morphology. The channel generally down-cut into the valley fill by as much as 2 ft relative to the low terrace which is the abandoned floodplain surface. The channel has limited meander belt width and is actively expanding the floodplain through erosion and accretion. Streambanks are generally comprised of fine gravel and lacustrine silt and clays. The rooting depth is relatively shallow and knapweed dominates several droughty terraces. Streambanks have high erosion potential. **Figure B4-11** includes typical bank erosion conditions in the reach. Summary data for Elk Creek Reach 11-6 are presented in **Table B4-24** and **Table B4-25**.

Figure B4-11. Typical eroding bank conditions in Elk Creek Reach 11-6.

Table B4-24. BEHI statistics for Elk Creek Reach 11-6.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
ELK 11-6	9/24/08	Actively	33.9	372	18.6	19.9	19.9
ELK 11-6	9/24/08	Slowly	0.0	0	0.0	0.0	0.0
ELK 11-6	9/24/08	Total		372	18.6	19.9	19.9

Table B4-25. BEHI statistics for Elk Creek Reach 11-6.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
ELK 11-6	9/24/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	70.0	30.0
ELK 11-6	9/24/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ELK 11-6	9/24/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	70.0	30.0

B4.6.12 White Pine Creek Reach 9-2

Considerable streambank erosion contributes sediment ranging from silts to medium cobble. Most erosion is occurring on outside streambanks with extreme bank heights. Alders provide some streambank stability but most eroding banks are dominated by grasses and knapweed. Inside banks are characterized by point bar deposits and sparse vegetative cover. Reaches upstream and downstream are influenced by a forest road, active evulsions and shifting channel braids. **Figure B4-12** includes typical bank erosion conditions in the reach. Summary data for White Pine Creek Reach 9-2 are presented in **Table B4-26** and **Table B4-27**.

Figure B4-12. Typical eroding bank conditions in White Pine Creek Reach 9-2.

Table B4-26. BEHI statistics for White Pine Creek Reach 9-2.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
WPC 9-2	10/1/08	Actively	37.3	711	35.6	42.6	42.6
WPC 9-2	10/1/08	Slowly	0.0	0	0.0	0.0	0.0
WPC 9-2	10/1/08	Total		711	35.6	42.6	42.6

Table B4-27. BEHI statistics for White Pine Creek Reach 9-2.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
WPC 9-2	10/1/08	Actively	0.0	0.5	0.0	0.0	0.0	0.0	99.5	0.0
WPC 9-2	10/1/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WPC 9-2	10/1/08	Total	0.0	0.5	0.0	0.0	0.0	0.0	99.5	0.0

B4.6.13 White Pine Creek Reach 9-5

Bank erosion is relatively common at outside streambanks due to excessive bank heights. Reed canary grass colonizes failed streambank blocks. Point bars are largely colonized by reed canarygrass. Alders are located on the floodplain as well as on the streambanks of the entrenched bankfull channel. A few other shrubs are present in the reach, including spirea. The streambank has been anthropogenically altered (bulldozed and graded) on river-left near the downstream end of the reach. Haying is a dominant influence on river-left, which extends from the floodplain to the channel margin. **Figure B4-13** includes typical bank erosion conditions in the reach. Summary data for White Pine Creek Reach 9-5 are presented in **Table B4-28** and **Table B4-29**.

Figure B4-13. Typical eroding bank conditions in White Pine Creek Reach 9-5.

Table B4-28. BEHI statistics for White Pine Creek Reach 9-5.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
WPC 9-5	10/1/08	Actively	35.9	215	10.8	9.5	9.5
WPC 9-5	10/1/08	Slowly	29.2	169	8.5	4.5	4.5
WPC 9-5	10/1/08	Total		384	19.2	14.1	14.1

Table B4-29. BEHI statistics for White Pine Creek Reach 9-5.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
WPC 9-5	10/1/08	Actively	0.0	1.1	91.8	0.0	0.0	0.0	7.1	0.0
WPC 9-5	10/1/08	Slowly	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
WPC 9-5	10/1/08	Total	0.0	0.8	94.4	0.0	0.0	0.0	4.8	0.0

B4.6.14 White Pine Creek Reach 8-3

Most streambanks in the reach exhibit erosion. There is considerable sediment, generally coarser substrate, generated within the reach from streambank and floodplain erosion. Large material is mobilized by larger flood events. Lag deposits are vegetated by multi-age vegetation depending on age and disturbance regime of deposit. Multiple braided channels show evidence of scouring during floods then subsequent abandonment. **Figure B4-14** includes typical bank erosion conditions in the reach. Summary data for White Pine Creek Reach 8-3 are presented in **Table B4-30** and **Table B4-31**.

Figure B4-14. Typical eroding bank conditions in White Pine Creek Reach 8-3.

Table B4-30. BEHI statistics for White Pine Creek Reach 8-3.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
WPC 8-3	10/1/08	Actively	19.0	747	37.4	11.4	11.4
WPC 8-3	10/1/08	Slowly	31.3	74	3.7	2.1	2.1
WPC 8-3	10/1/08	Total		821	41.1	13.5	13.5

Table B4-31. BEHI statistics for White Pine Creek Reach 8-3.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
WPC 8-3	10/1/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
WPC 8-3	10/1/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
WPC 8-3	10/1/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0

B4.6.15 Swamp Creek Reach 18-1

Minimal streambank erosion is present due to coarse bed and streambank material. Some erosion of floodplain areas has occurred as a result of flood channel scour. Dense shrub cover including willow communities and forest understory anchors most of the streambanks while scattered cedar groves provide additional root cover. **Figure B4-15** includes typical bank erosion conditions in the reach. Summary data for Swamp Creek Reach 18-1 are presented in **Table B4-32** and **Table B4-33**.

Figure B4-15. Typical eroding bank conditions in Swamp Creek Reach 18-1.

Table B4-32. BEHI statistics for Swamp Creek Reach 18-1.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
SWP 18-1	10/1/08	Actively	21.2	118	5.9	4.0	4.0
SWP 18-1	10/1/08	Slowly	18.6	55	2.8	0.3	0.3
SWP 18-1	10/1/08	Total		173	8.7	4.2	4.2

Table B4-33. BEHI statistics for Swamp Creek Reach 18-1.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
SWP 18-1	10/1/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
SWP 18-1	10/1/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
SWP 18-1	10/1/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0

B4.6.16 Swamp Creek Reach 20-1

Considerable bank erosion in this reach is contributing sediment to the channel. Most eroding banks are less than 3 ft high. Glacial Lake Missoula deposits are contributing fine silts to the stream. Most of the fine sediment is in the lower portion of the reach, especially downstream of a floodplain channel that joins the creek in Cell 1. Grazing has significantly contributed to stream erosion throughout the reach, as shown by cropped grass and hoof shear. The channel appears to be actively shifting in the upstream cells, with relict point-bars, lack of vegetative cover and abandoned channels. **Figure B4-16** includes typical bank erosion conditions in the reach. Summary data for Swamp Creek Reach 20-1 are presented in **Table B4-34** and **Table B4-35**.


Figure B4-16. Typical eroding bank conditions in Swamp Creek Reach 20-1.

Table B4-34. BEHI statistics for Swamp Creek Reach 20-1.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
SWP 20-1	9/30/08	Actively	34.0	245	12.3	17.1	17.1
SWP 20-1	9/30/08	Slowly	34.8	38	1.9	1.0	1.0
SWP 20-1	9/30/08	Total		283	14.2	18.1	18.1

Table B4-35. BEHI statistics for Swamp Creek Reach 20-1.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
SWP 20-1	9/30/08	Actively	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
SWP 20-1	9/30/08	Slowly	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
SWP 20-1	9/30/08	Total	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0

B4.6.17 Swamp Creek Reach 21-1

Bank erosion is common in the reach. Accelerated erosion is related to livestock grazing, hoof shear, and vegetation removal. The most severe erosion was due to bank toe failure and bank slumping. **Figure B4-17** includes typical bank erosion conditions in the reach. Summary data for Swamp Creek Reach 21-1 are presented in **Table B4-36** and **Table B4-37**.

Figure B4-17. Typical eroding bank conditions in Swamp Creek Reach 21-1.

Table B4-36. BEHI statistics for Swamp Creek Reach 21-1.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
SWP 21-1	10/2/08	Actively	35.4	311	15.6	12.4	12.4
SWP 21-1	10/2/08	Slowly	23.6	216	10.8	3.1	3.1
SWP 21-1	10/2/08	Total		527	26.4	15.5	15.5

Table B4-37. BEHI statistics for Swamp Creek Reach 21-1.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
SWP 21-1	10/2/08	Actively	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
SWP 21-1	10/2/08	Slowly	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
SWP 21-1	10/2/08	Total	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0

B4.6.18 Swamp Creek Reach 22-3

Erosion is moderate in the reach. Bedrock limits erosion in the upper portion of the reach. Failing reed canarygrass-dominated banks are fairly common. However, a good riparian shrub community limits the extent of lateral bank retreat. **Figure B4-18** includes typical bank erosion conditions in the reach. Summary data for Swamp Creek Reach 22-3 are presented in **Table B4-38** and **Table B4-39**.

Figure B4-18. Typical eroding bank conditions in Swamp Creek Reach 22-3.

Table B4-38. BEHI statistics for Swamp Creek Reach 22-3.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
SWP 22-3	10/2/08	Actively	27.5	200	10.0	4.8	4.8
SWP 22-3	10/2/08	Slowly	31.0	380	19.0	10.1	10.1
SWP 22-3	10/2/08	Total		580	29.0	14.8	14.8

Table B4-39. BEHI statistics for Swamp Creek Reach 22-3.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
SWP 22-3	10/2/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	89.3	10.7
SWP 22-3	10/2/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
SWP 22-3	10/2/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	96.6	3.4

B4.6.19 Marten Creek Reach 6-2

In the lower reach, there is a bedrock outcrop on the southern bank. There is minimal bank erosion on the north bank. Bank erosion occurs on most streambanks lacking bedrock. Eroding banks are commonly 3 ft to 4 ft high. **Figure B4-19** includes typical bank erosion conditions in the reach. Summary data for Marten Creek Reach 6-2 are presented in **Table B4-40** and **Table B4-41**.

Figure B4-19. Typical eroding bank conditions in Marten Creek Reach 6-2.

Table B4-40. BEHI statistics for Marten Creek Reach 6-2.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
MC 6-2	9/30/08	Actively	28.1	324	16.2	33.5	33.5
MC 6-2	9/30/08	Slowly	26.8	134	6.7	6.8	6.8
MC 6-2	9/30/08	Total		458	22.9	40.2	40.2

Table B4-41. BEHI statistics for Marten Creek Reach 6-2.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
MC 6-2	9/30/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
MC 6-2	9/30/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
MC 6-2	9/30/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0

B4.6.20 Marten Creek Reach 9-1

Bank erosion is pervasive with most outside banks affected by scour. Flood-deposited coarse material is colonized by shrubs and weeds. Most of these surfaces are not stable enough to resist erosion. Eroding banks range from 2 ft to 4 ft in height. **Figure B4-20** includes typical bank erosion conditions in the reach. Summary data for Marten Creek Reach 9-1 are presented in **Table B4-42** and **Table B4-43**.

Figure B4-20. Typical eroding bank conditions in Marten Creek Reach 9-1.

Table B4-42. BEHI statistics for Marten Creek Reach 9-1.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
MC 9-1	9/30/08	Actively	25.9	265	13.3	8.1	8.1
MC 9-1	9/30/08	Slowly	36.4	96	4.8	3.7	3.7
MC 9-1	9/30/08	Total		361	18.1	11.9	11.9

Table B4-43. BEHI statistics for Marten Creek Reach 9-1.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
MC 9-1	9/30/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
MC 9-1	9/30/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
MC 9-1	9/30/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0

B4.6.21 North Branch Marten Creek Reach 8-1

Streambanks are generally stable with some discrete point sources located along meander outcurves and constrictions. Source areas are armored with large cobble-boulder sediment (low-mod BEHI ratings). Overall, there is low supply from eroding streambanks, and high vegetative cover prevents erosion of the thin forest topsoil. **Figure B4-21** includes typical bank erosion conditions in the reach. Summary data for North Branch Marten Creek Reach 8-1 are presented in **Table B4-44** and **Table B4-45**.

Figure B4-21. Typical eroding bank conditions in North Branch Marten Creek 8-1.

Table B4-44. BEHI statistics for North Branch Marten Creek 8-1.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
NBMC 8-1	9/29/08	Actively	27.6	367	18.4	33.2	33.2
NBMC 8-1	9/29/08	Slowly	35.9	48	2.4	1.9	1.9
NBMC 8-1	9/29/08	Total		415	20.8	35.1	35.1

Table B4-45. BEHI statistics for North Branch Marten Creek 8-1.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
NBMC 8-1	9/29/08	Actively	7.2	0.0	0.0	0.0	0.0	0.0	91.8	0.9
NBMC 8-1	9/29/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
NBMC 8-1	9/29/08	Total	6.8	0.0	0.0	0.0	0.0	0.0	92.3	0.9

B4.6.22 South Branch Marten Creek Reach 3-1

Dense vegetation, a rocky hillslope and coarse bank materials result in minimal to moderate bank erosion. Numerous LWD and boulder deposits dissipate energy and prevent further scouring. **Figure B4-21** includes typical bank erosion conditions in the reach. Summary data for South Branch Marten Creek Reach 3-1 are presented in **Table B4-46** and **Table B4-47**.

Figure B4-22. Typical eroding bank conditions in South Branch Marten Creek 3-1.

Table B4-46. BEHI statistics for South Branch Marten Creek 3-1.

Reach ID	Date	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	% of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)
SBMC 3-1	9/29/08	Actively	32.7	170	8.5	6.1	6.1
SBMC 3-1	9/29/08	Slowly	29.3	71	3.6	1.4	1.4
SBMC 3-1	9/29/08	Total		241	12.1	7.5	7.5

Table B4-47. BEHI statistics for South Branch Marten Creek 3-1.

Reach ID	Date	Erosion Rate	Trans-portation Load (%)	Riparian Grazing Load (%)	Crop-land Load (%)	Mining Load (%)	Silviculture Load (%)	Irrigation Load (%)	Natural Load (%)	"Other Load" (%)
SBMC 3-1	9/29/08	Actively	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
SBMC 3-1	9/29/08	Slowly	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
SBMC 3-1	9/29/08	Total	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0

B4.7 Data Summary

The following data summary tables are organized by stream reach category. The tables present the reach sediment load by category (actively eroding or slowly eroding) and the dominant influence (anthropogenic or natural). If <75% of the bank erosion-influenced load was attributed to natural sources, the load is considered to be anthropogenically-influenced.

Table B4-48. Summarized BEHI sediment loads for reaches categorized as NR-0-2-U.

	Reach Sediment Load per 1000 ft			Dominant Influence	
Reach ID	**Actively Eroding**	**Slowly Eroding**	**Total**	**Anthropogenic**	**Natural**
WPC 9-2	42.6	0	42.6		X
WPC 9-5	9.5	4.5	14.1	X	
WFELK 8-1	5.9	0.0	5.9		X
EFELK 9-1	4.0	1.9	5.9		X
Reach Category Avg Load	**15.5**	**1.6**	**17.1**	**14.1**	**18.1**

Table B4-49. Summarized BEHI sediment loads for reaches categorized as NR-0-3-U.

	Reach Sediment Load per 1000 ft			Dominant Influence	
Reach ID	**Actively Eroding**	**Slowly Eroding**	**Total**	**Anthropogenic**	**Natural**
BULL 3-2	69.5	3.7	73.2		X
BULL 3-3	11.7	8.9	20.6		X
BULL 5-1	10.8	18.0	28.8		X
EFELK 10-3	2.6	1.7	4.3	X	
SWP 20-1	17.1	1.0	18.1	X	
SWP 21-1	12.4	3.1	15.5	X	
SWP 22-3	4.8	10.1	14.8		X
MC 9-1	8.1	3.7	11.9		X
Reach Category Avg Load	**17.1**	**6.3**	**23.4**	**12.6**	**29.9**

Table B4-50. Summarized BEHI sediment loads for reaches categorized as NR-0-4-U.

	Reach Sediment Load per 1000 ft			Dominant Influence	
Reach ID	**Actively Eroding**	**Slowly Eroding**	**Total**	**Anthropogenic**	**Natural**
ELK 11-3	6.8	9.2	16.0	X	
ELK 11-6	19.9	0.0	19.9	X	
Reach Category Avg Load	**13.4**	**4.6**	**17.9**	**17.9**	**NA**

Table B4-51. Summarized BEHI sediment loads for reaches categorized as NR-2-2-U.

	Reach Sediment Load per 1000 ft			Dominant Influence	
Reach ID	**Actively Eroding**	**Slowly Eroding**	**Total**	**Anthropogenic**	**Natural**
EFELK 8-1	3.2	8.4	11.6		X
SWP 18-1	4.0	0.3	4.2		X
WPC 8-3	11.4	2.1	13.5		X
Reach Category Avg Load	**6.2**	**3.6**	**9.8**	**NA**	**9.8**

Table B4-52. Summarized BEHI sediment loads for reaches categorized as NR-2-3-U.

	Reach Sediment Load per 1000 ft			Dominant Influence	
Reach ID	**Actively Eroding**	**Slowly Eroding**	**Total**	**Anthropogenic**	**Natural**
MC 6-2	33.5	6.8	40.2		X
Reach Category Avg Load	**33.5**	**6.8**	**40.2**		**40.2**

Table B4-53. Summarized BEHI sediment loads for reaches categorized as NR-4-2-U.

	Reach Sediment Load per 1000 ft			Dominant Influence	
Reach ID	**Actively Eroding**	**Slowly Eroding**	**Total**	**Anthropogenic**	**Natural**
DRY 9-2	4.3	8.1	12.4	X	
EFELK 7-2	1.9	1.2	3.1		X
NBMC 8-1	33.2	1.9	35.1		X
Reach Category Avg Load	**13.1**	**3.8**	**16.9**	**12.4**	**19.1**

Table B4-54. Summarized BEHI sediment loads for reaches categorized as NR-4-2-C.

	Reach Sediment Load per 1000 ft			Dominant Influence	
Reach ID	**Actively Eroding**	**Slowly Eroding**	**Total**	**Anthropogenic**	**Natural**
SBMC 3-1	6.1	1.4	7.5		X
Reach Category Avg Load	**6.1**	**1.4**	**7.5**		**7.5**

Table B4-55. Summarized BEHI sediment loads for all reaches.

	Reach Sediment Load per 1000 ft		
	Actively Eroding	**Slowly Eroding**	**Total**
Average Load	14.7	4.4	19.1
Predominantly Anthropogenic Average Load	10.4	3.9	14.3
Predominantly Natural Average Load	16.7	4.6	21.3

B5.0 Complete Data Tables

Table B5-1 Site Information

Reach ID	Estimated Potential Stream Type	Site	Date	Downstream End Latitude	Downstream End Longitude	Upstream End Latitude	Upstream End Longitude	Site Length (Feet)	Field Slope (Percent)	GIS Calculated Sinuosity
BULL 3-3	3b	1	9/25/08	48.18290	-115.85980	48.18475	-115.85946	1500	?	1.789417
BULL 3-2	3b	1	9/25/08	48.19190	-115.84073	48.19204	-115.83732	1000	1.2	1.290334
BULL 5-1	3d	1	9/25/08	48.13637	-115.86691	48.13881	-115.86826	1500	0 - .5	1.732135
DRY 9-2	2a	1	9/26/208	48.15430	-115.89391	48.15471	-115.89761	1000	5.5	1.044950
WFELK 8-1	2a	1	9/23/08	48.00419	-116.02782	48.00587	-116.02992	1000	1.9	1.170213
EFELK 9-1	2a	1	9/23/08	47.97232	-115.98622	47.97091	-115.98434	1000	2.3	1.176851
EFELK 8-1	2a	1	9/22/08	47.95076	-115.96153	47.94947	-115.95863	1000	3.4	1.093058
EFELK 7-2	2a	1	9/22/08	47.94256	-115.95217	47.94104	-115.95013	1000	4.4	1.088247
EFELK 10-3	3a	1	9/24/08	47.99864	-115.99221	47.99651	-115.9929	1000	1.0	1.100009
ELK 11-3	4a	1	9/24/08	48.02867	-115.96578	48.02722	-115.96811	1000	0.7	1.369215
ELK 11-6	4a	1	9/24/08	48.04345	-115.92021	48.0423	-115.91806	1000	0.7	1.389891
WPC 8-3	2a	1	10/1/08	47.76049	-115.60864	47.75895	-115.6115	1000	2.0	1.172609
WPC 9-2	2a	1	10/1/08	47.75223	-115.56216	47.75319	-115.56422	1000	1.0	1.188126
WPC 9-5	2a	1	10/1/08	47.75103	-115.51971	47.75079	-115.52259	1000	1.0	1.427827
SWP 18-1	2a	1	10/1/08	47.93712	-115.59932	47.93837	-115.59659	1000	2.3	1.143045
SWP 20-1	3a	1	9/30/08	47.90531	-115.62559	47.90669	-115.62405	1000	1.0	1.352212
SWP 21-1	3a	1	10/2/08	47.90189	-115.63107	47.90313	-115.62935	1000	1.0	1.496653
SWP 22-3	3a	1	10/2/08	47.91557	-115.66788	47.91636	-115.665	1000	1.1	1.393954
MC 6-2	3a	1	9/30/08	47.89019	-115.84001	47.88897	-115.8438	1000	2.0	1.019166
MC 9-1	3b	1	9/30/08	47.89231	-115.81169	47.89249	-115.81456	1000	1.8	1.285985
NBMC 8-1	2a	1	9/29/08	47.88479	-115.87954	47.88665	-115.88225	1000	5.3	1.048189
SBMC 3-1	2a	1	9/29/08	47.87459	-115.89573	47.87291	-115.89808	1000	7.5	1.040067

Values represent actual field results except in the following circumstances:
GIS calculated sinuosity measured in GIS using upstream and downstream coordinates and reach length

Table B5-2. Channel Cross Section Data

Reach ID	Site	Date	Cell	Latitude	Longitude	Feature	Bankfull Channel Width	Cross-Sectional Area	Bankfull Mean Depth	Width / Depth Ratio	Maximum Depth	Floodprone Width	Entrenchment Ratio	Notes
BULL 3-3	1	9/25/08	1	48.18290	-115.85980	pool	60.0	228.0	3.8	15.8	4.6	460	7.7	
BULL 3-3	1	9/25/08	2	48.18329	-115.86098	pool	51.0	154.7	3.0	16.8	3.8	283	5.5	
BULL 3-3	1	9/25/08	3	48.18363	-115.86068	pool	59.4	206.1	3.5	17.1	4.7	419	7.1	
BULL 3-3	1	9/25/08	4	48.18368	-115.85998	pool	76.0	196.8	2.6	29.3	2.9	296	3.9	
BULL 3-3	1	9/25/08	5	48.18420	-115.85949	pool	59.9	204.7	3.4	17.5	4.2	330	5.5	
BULL 3-2	1	9/25/08	1	48.19190	-115.84073	riffle	53.0	97.8	1.8	28.7	2.8	148	2.8	
BULL 3-2	1	9/25/08	2	48.19231	-115.84019	riffle	49.0	75.7	1.5	31.8	3.3	249	5.1	
BULL 3-2	1	9/25/08	3	48.19229	-115.83961	riffle	64.5	87.4	1.4	47.8	2.2	415	6.4	
BULL 3-2	1	9/25/08	4	48.19209	-115.83876	riffle	50.7	105.1	2.1	24.5	3.1	254	5.0	
BULL 3-2	1	9/25/08	5	48.19221	-115.83775	riffle	90.5	110.9	12.3	7.4	2.7	166	1.8	
BULL 5-1	1	9/25/08	1	48.13637	-115.86691	riffle	64.0	329.4	5.2	12.4	6.5	344	5.4	
BULL 5-1	1	9/25/08	2	48.13739	-115.86773	pool/ riffle	58.0	273.6	4.7	12.3	6.0	458	7.9	
BULL 5-1	1	9/25/08	3	48.13785	-115.86835	pool/ riffle	54.0	302.7	5.6	9.6	7.6	454	8.4	
BULL 5-1	1	9/25/08	4	48.13801	-115.86802	riffle	67.0	282.0	4.2	16.0	6.2	467	7.0	
BULL 5-1	1	9/25/08	5	48.1388	-115.8683	riffle	70.4	246.9	3.5	20.1	5.0	470	6.7	
DRY 9-2	1	9/26/08	1	48.15430	-115.89391	riffle	46.0	142.1	3.1	14.9	4.4	166	3.6	
DRY 9-2	1	9/26/08	2	48.15429	-115.89503	riffle	42.5	120.1	2.8	15.0	4.2	183	4.3	
DRY 9-2	1	9/26/08	3	48.15450	-115.89556	riffle	30.3	91.2	3.0	10.1	4.3	300	9.9	
DRY 9-2	1	9/26/08	4	48.15439	-115.89646	riffle	30.0	89.9	3.0	10.0	4.5	340	11.3	
DRY 9-2	1	9/26/08	5	48.15471	-115.89761	riffle	31.0	79.6	2.6	12.1	3.6	42	1.4	
WFELK 8-1	1	9/23/08	1	48.00425	-116.02784	riffle	22.6	24.0	1.1	20.5	1.9	33	1.4	
WFELK 8-1	1	9/23/08	2	48.00437	-116.02854	riffle	20.0	22.5	1.1	17.9	1.6	75	3.8	
WFELK 8-1	1	9/23/08	3	48.00497	-116.02902	riffle	16.5	18.5	1.1	14.7	1.6	68	4.1	
WFELK 8-1	1	9/23/08	4	48.00545	-116.02971	riffle	25.2	36.8	1.5	17.3	2.0	61	2.4	
WFELK 8-1	1	9/23/08	5	48.00587	-116.02992	riffle	17.0	17.3	1.0	16.7	1.6	23	1.3	
EFELK 9-1	1	9/23/08	1	47.97232	-115.98622	riffle	22.8	36.4	1.6	14.3	2.3	178	7.8	dry channel

Table B5-2. Channel Cross Section Data

Reach ID	Site	Date	Cell	Latitude	Longitude	Feature	Bankfull Channel Width	Cross-Sectional Area	Bankfull Mean Depth	Width / Depth Ratio	Maximum Depth	Floodprone Width	Entrenchment Ratio	Notes
EFELK 9-1	1	9/23/08	2	47.97201	-115.98585	riffle	39.0	42.5	1.1	35.8	1.9	357	9.2	dry channel
EFELK 9-1	1	9/23/08	3	47.97127	-115.98491	riffle	23.8	45.5	1.9	12.5	2.4	66	2.8	dry channel
EFELK 9-1	1	9/23/08	4	47.97158	-115.98494	riffle	22.1	39.5	1.8	12.3	2.2	30	1.4	dry channel
EFELK 9-1	1	9/23/08	5	47.97091	-115.98434	riffle	30.0	27.8	0.9	32.3	1.7	62	2.1	dry channel
EFELK 8-1	1	9/22/08	1	47.95076	-115.96153	riffle	29.4	44.9	1.5	19.3	2.2	75	2.5	
EFELK 8-1	1	9/22/08	2	47.95053	-115.96086	riffle	22.4	35.0	1.6	14.4	2.3	34	1.5	
EFELK 8-1	1	9/22/08	3	47.95017	-115.96044	riffle	21.1	30.2	1.4	15.1	2.3	26	1.2	
EFELK 8-1	1	9/22/08	4	47.94986	-115.95985	riffle	21.4	36.4	1.7	12.6	2.4	28	1.3	
EFELK 8-1	1	9/22/08	5	47.94961	-115.95880	riffle	29.7	40.8	1.4	21.7	2.2	192	6.5	
EFELK 7-2	1	9/22/08	1	47.94215	-115.95219	riffle	19.4	22.5	1.2	16.7	1.9	129	6.7	dry channel
EFELK 7-2	1	9/22/08	2	47.94188	-115.95166	riffle	29.0	33.4	1.2	25.2	1.6	121	4.2	dry channel
EFELK 7-2	1	9/22/08	3	47.94172	-115.95139	riffle	20.7	13.4	0.7	31.8	1.3	35	1.7	dry channel
EFELK 7-2	1	9/22/08	4	47.94137	-115.95064	riffle	34.8	20.6	0.6	58.9	1.6	50	1.4	
EFELK 7-2	1	9/22/08	5	47.94104	-115.95013	TOR to TOR	39.1	25.0	0.6	61.1	1.8	90	2.3	
EFELK 10-3	1	9/24/08	1	47.99864	-115.99221	riffle	38.3	71.6	1.9	20.5	2.4	428	11.2	
EFELK 10-3	1	9/24/08	2	47.99809	-115.99217	riffle	44.0	59.4	1.4	32.6	1.9	339	7.7	
EFELK 10-3	1	9/24/08	3	47.99752	-115.99237	riffle	28.8	46.6	1.6	17.8	2.0	154	5.3	
EFELK 10-3	1	9/24/08	4	47.99726	-115.99260	riffle	35.6	61.5	1.7	20.6	2.3	241	6.8	
EFELK 10-3	1	9/24/08	5	47.99690	-115.99306	riffle	37.0	52.0	1.4	26.2	1.8	231	6.2	
ELK 11-3	1	9/24/08	1	48.02867	-115.96578	riffle	47.9	64.9	1.4	35.5	2.1	159	3.3	
ELK 11-3	1	9/24/08	2	48.02868	-115.96649	riffle	36.5	59.8	1.6	22.3	2.8	127	3.5	
ELK 11-3	1	9/24/08	3	48.02830	-115.96709	riffle	48.0	85.3	1.8	27.1	3.0	178	3.7	
ELK 11-3	1	9/24/08	4	48.02775	-115.96717	riffle/ pool	42.0	84.0	2.0	21.0	2.8	74	1.8	
ELK 11-3	1	9/24/08	5	48.02751	-115.96781	riffle	44.5	68.9	1.6	28.7	2.3	119	2.7	
ELK 11-6	1	9/24/08	1	48.04345	-115.92021	pool (twg to	45.8	63.7	1.4	33.7	2.0	326	7.1	

Table B5-2. Channel Cross Section Data

Reach ID	Site	Date	Cell	Latitude	Longitude	Feature	Bankfull Channel Width	Cross-Sectional Area	Bankfull Mean Depth	Width / Depth Ratio	Maximum Depth	Floodprone Width	Entrenchment Ratio	Notes
						twg - mxd)								
ELK 11-6	1	9/24/08	2	48.04290	-115.92019	riffle	33.5	61.4	1.8	18.3	2.9	234	7.0	
ELK 11-6	1	9/24/08	3	48.04291	-115.91926	riffle	28.0	49.3	1.8	15.9	2.4	308	11.0	
ELK 11-6	1	9/24/08	4	48.04279	-115.91886	riffle	29.3	41.5	1.4	20.6	2.3	222	7.6	
ELK 11-6	1	9/24/08	5	48.04230	-115.91806	Twg (maxd to maxd)	60.2	83.6	1.4	43.3	2.1	143	2.4	
WPC 8-3	1	10/1/08	1	47.75965	-115.61098	riffle	54.0	96.3	1.8	30.3	2.8	245	4.5	
WPC 8-3	1	10/1/08	2 (RL)	47.75937	-115.61128	riffle	38.0	55.5	1.5	26.0	2.2	120	3.2	
WPC 8-3	1	10/1/08	2 (RR)	47.76001	-115.60983	riffle	26.4	30.8	1.2	22.0	1.7	120	4.5	
WPC 8-3	1	10/1/08	3 (RL)	47.75992	-115.61072	riffle	21.5	40.1	1.9	11.5	2.4	296	13.8	
WPC 8-3	1	10/1/08	3 (RR)	47.75992	-115.61072	riffle	24.6	32.7	1.3	18.5	1.7	296	12.0	
WPC 8-3	1	10/1/08	4 (RL)	47.75965	-115.61098	riffle	20.0	29.0	1.5	13.8	2.1	268	13.4	
WPC 8-3	1	10/1/08	4 (RR)	47.75965	-115.61098	riffle	22.6	24.5	1.1	20.9	1.9	268	11.8	
WPC 8-3	1	10/1/08	5	47.75937	-115.61128	riffle	26.0	31.0	1.2	21.8	1.9	89	3.4	
WPC 8-3	1	10/1/08	5 (RR)	47.75913	-115.61119	riffle	35.0	45.5	1.3	26.9	1.7	89	2.5	
WPC 9-2	1	10/1/08	1	47.75223	-115.56216	riffle	32.5	39.9	1.2	26.6	1.6	238	7.3	
WPC 9-2	1	10/1/08	2	47.75235	-115.56273	riffle	40.3	42.4	1.1	38.4	1.6	65	1.6	
WPC 9-2	1	10/1/08	3	47.75235	-115.56273	riffle	40.3	32.4	1.1	38.4	1.6	105	2.6	
WPC 9-2	1	10/1/08	4	47.75294	-115.56353	riffle	36.7	44.5	1.2	30.3	1.9	240	6.5	
WPC 9-2	1	10/1/08	5	47.75273	-115.56319	riffle	30.4	32.5	1.1	28.4	1.6	248	8.2	
WPC 9-5	1	10/1/08	1	47.75103	-115.51971	riffle	38.1	52.4	1.4	27.8	2.0	25	0.7	
WPC 9-5	1	10/1/08	2	47.75042	-115.51991	pool	51.5	60.7	1.2	44.0	2.0	210	4.1	
WPC 9-5	1	10/1/08	3	47.75037	-115.52094	riffle	30.8	57.3	1.9	16.6	2.5	350	11.4	
WPC 9-5	1	10/1/08	4	47.75041	-115.52145	riffle	31.7	56.1	1.8	17.9	2.3	170	5.4	
WPC 9-5	1	10/1/08	5	47.75078	-115.52244	riffle	36.6	76.3	2.1	17.6	2.4	225	6.1	

Table B5-2. Channel Cross Section Data

Reach ID	Site	Date	Cell	Latitude	Longitude	Feature	Bankfull Channel Width	Cross-Sectional Area	Bankfull Mean Depth	Width / Depth Ratio	Maximum Depth	Floodprone Width	Entrenchment Ratio	Notes
SWP 18-1	1	10/2/08	1	47.93712	-115.59932	riffle	30.0	54.9	1.8	16.4	3.0	145	4.8	
SWP 18-1	1	10/2/08	2	47.93739	-115.59792	riffle	36.9	51.5	1.4	26.4	2.1	157	4.3	
SWP 18-1	1	10/2/08	3	47.93728	-115.59750	riffle	33.5	63.7	1.9	18.0	3.3	184	5.5	
SWP 18-1	1	10/2/08	4	47.93751	-115.59771	riffle	28.2	46.0	1.6	17.3	2.7	123	4.4	
SWP 18-1	1	10/2/08	5	47.93837	-115.59659	riffle	25.5	43.1	1.7	15.2	2.2	92	3.6	
SWP 20-1	1	9/30/08	1	47.90566	-115.62511	riffle	51.4	75.7	1.5	35.0	2.2	371	7.2	
SWP 20-1	1	9/30/08	2	47.90592	-115.62478	riffle	49.0	38.1	0.8	63.0	1.9	264	5.4	divided channel
SWP 20-1	1	9/30/08	3	no riffle - braided channel (see photos 373 & 374)										no riffle - braided channel - no good place to get slope
SWP 20-1	1	9/30/08	4	47.90598	-115.62401	riffle	47.6	57.1	1.2	39.7	1.5	258	5.4	
SWP 20-1	1	9/30/08	5	47.90634	-115.62401	riffle	42.7	51.4	1.2	35.6	1.6	284	6.7	
SWP 21-1	1	10/2/08	1	47.90189	-115.63107	riffle	47.5	68.7	1.4	33.0	2.4	448	9.4	
SWP 21-1	1	10/2/08	2	47.90191	-115.62992	riffle	28.5	49.3	1.7	16.5	2.4	429	15.0	
SWP 21-1	1	10/2/08	3	47.90212	-115.62946	riffle	70.9	40.3	0.6	124.8	2.0	341	4.8	
SWP 21-1	1	10/2/08	4	47.90253	-115.62930	riffle/ pool	37.7	46.5	1.2	30.7	2.1	418	11.1	very marginal riffle/slow moving water
SWP 21-1	1	10/2/08	5	47.90289	-115.62929	riffle/ pool	40.3	48.0	1.2	33.9	1.2	290	7.2	greater depths include side pool measurements
SWP 22-3	1	10/2/08	1	47.91571	-115.66749	riffle	40.5	116.0	2.9	14.1	3.6	171	4.2	
SWP 22-3	1	10/2/08	2	47.91596	-115.66708	riffle	35.0	75.1	2.1	16.3	2.8	205	5.9	
SWP 22-3	1	10/2/08	3	47.91632	-115.66658	riffle	38.2	79.3	2.1	18.4	2.7	88	2.3	
SWP 22-3	1	10/2/08	4	47.91658	-115.66617	riffle	38.9	49.4	1.3	30.9	1.9	84	2.2	

Table B5-2. Channel Cross Section Data

Reach ID	Site	Date	Cell	Latitude	Longitude	Feature	Bankfull Channel Width	Cross-Sectional Area	Bankfull Mean Depth	Width / Depth Ratio	Maximum Depth	Floodprone Width	Entrenchment Ratio	Notes
SWP 22-3	1	10/2/08	5	47.91668	-115.66507	riffle	914.0	1.5	47.9	19.1	73.9	82	0.1	
MC 6-2	1	9/30/08	1	47.89019	-115.84001	riffle	35.8	61.5	1.7	20.9	2.4	244	6.8	
MC 6-2	1	9/30/08	2	47.88995	-115.84078	riffle	30.4	52.4	1.7	17.7	2.2	33	1.1	
MC 6-2	1	9/30/08	3	47.88984	-115.84148	riffle	32.6	76.6	2.4	13.9	3.1	192	5.9	
MC 6-2	1	9/30/08	4	47.88963	-115.84235	riffle	29.6	51.5	1.7	17.1	2.4	35	1.2	
MC 6-2	1	9/30/08	5	47.88897	-115.84380	riffle	25.0	54.3	2.2	11.5	2.6	255	10.2	
MC 9-1	1	9/30/08	1	47.89231	-115.81169	riffle	41.7	66.3	1.6	26.4	2.3	167	4.0	
MC 9-1	1	9/30/08	2	47.89244	-115.81255	riffle	73.9	80.6	1.16/ 1.02	67.8	2.1	269	3.6	divided channel
MC 9-1	1	9/30/08	3	47.89202	-115.81318	riffle	35.0	61.8	1.8	19.9	2.1	310	8.9	
MC 9-1	1	9/30/08	4	47.89211	-155.81344	riffle	33.5	57.6	1.7	19.5	2.4	434	12.9	
MC 9-1	1	9/30/08	5	47.89244	-115.81417	riffle	60.4	51.2	0.8	71.3	1.6	460	7.6	
NBMC 8-1	1	10/1/08	1	47.88472	-115.88026	riffle	30.6	41.9	1.4	22.3	1.9	53	1.7	
NBMC 8-1	1	10/1/08	2	47.88522	-115.88061	riffle	20.1	34.9	1.7	11.6	2.2	40	2.0	
NBMC 8-1	1	10/1/08	3	47.88581	-115.88103	riffle	21.2	36.3	1.7	12.4	2.0	27	1.3	
NBMC 8-1	1	10/1/08	4	47.88602	-115.88192	riffle	17.0	39.8	2.3	7.3	39.8	33	1.9	
NBMC 8-1	1	10/1/08	5	47.8866	-115.8823	riffle	18.0	36.3	2.0	9.0	2.5	29	1.6	
SBMC 3-1	1	9/29/08	1	47.87455	-115.89579	riffle	23.8	27.8	1.2	20.2	1.7	36	1.5	Lat/Long from GIS
SBMC 3-1	1	9/29/08	2	47.87411	-115.89632	riffle	26.5	26.5	1.0	27.6	2.3	61	2.3	Lat/Long from GIS
SBMC 3-1	1	9/29/08	3	47.87371	-115.89678	riffle	53.0	55.7	1.1	50.5	1.9	64	1.2	Lat/Long from GIS
SBMC 3-1	1	9/29/08	4	47.87350	-115.89703	riffle	31.5	56.5	1.8	17.6	2.6	58	1.8	Lat/Long from GIS
SBMC 3-1	1	9/29/08	5	47.87334	-115.89748	riffle	22.2	28.6	1.3	17.3	1.7	36	1.6	Lat/Long from GIS

Table B5-3. Riffle Substrate Data

Reach ID	Site	Date	Cell	Riffle Pebble Count D50	Riffle Pebble Count Percent <2mm	Riffle Pebble Count Percent <6mm	Riffle Grid Toss Percent <6mm	Riffle Stability Index
BULL 3-3	1	9/25/08	1	7.2	25	38	78	NA
BULL 3-3	1	9/25/08	3	2.8	34	72	52	NA
BULL 3-3	1	9/25/08	5	5	33	56	54	NA
BULL 3-2	1	9/25/08	1	66	3	5	8	94
BULL 3-2	1	9/25/08	3	68	1	5	1	NA
BULL 3-2	1	9/25/08	5	46	0	8	2	97
BULL 5-1	1	9/25/08	1	16	16	25	13	NA
BULL 5-1	1	9/25/08	3	30	14	18	6	NA
BULL 5-1	1	9/25/08	5	12	13	28	16	NA
DRY 9-2	1	9/26/08	1	167	1	2	7	NA
DRY 9-2	1	9/26/08	3	119	2	2	1	NA
DRY 9-2	1	9/26/08	5	145	0	1	1	NA
WFELK 8-1	1	9/23/08	1	49	3	7	9	NA
WFELK 8-1	1	9/23/08	3	44	9	15	4	NA
WFELK 8-1	1	9/23/08	5	59	4	11	9	NA
EFELK 9-1	1	9/23/08	1	49	4	7	7	NA
EFELK 9-1	1	9/23/08	3	40	7	9	10	NA
EFELK 9-1	1	9/23/08	5	51	4	5	13	NA
EFELK 8-1	1	9/22/08	1	91	2	5	2	NA
EFELK 8-1	1	9/22/08	3	100	4	6	1	NA
EFELK 8-1	1	9/22/08	5	94	1	3	6	NA
EFELK 7-2	1	9/22/08	1	87	1	3	7	NA
EFELK 7-2	1	9/22/08	3	93	1	6	3	NA
EFELK 7-2	1	9/22/08	5	59	2	5	7	NA
EFELK 10-3	1	9/22/08	1	43	4	5	7	96
EFELK 10-3	1	9/22/08	3	31	8	14	12	96
EFELK 10-3	1	9/22/08	5	47	4	8	4	94
ELK 11-3	1	9/24/08	1	25	5	12	16	99
ELK 11-3	1	9/24/08	3	25	0	5	18	99
ELK 11-3	1	9/24/08	5	36	3	4	2	89
ELK 11-6	1	9/24/08	1	33	5	8	15	83
ELK 11-6	1	9/24/08	3	33	2	4	33	94

Table B5-3. Riffle Substrate Data

Reach ID	Site	Date	Cell	Riffle Pebble Count D50	Riffle Pebble Count Percent <2mm	Riffle Pebble Count Percent <6mm	Riffle Grid Toss Percent <6mm	Riffle Stability Index
ELK 11-6	1	9/24/08	5	45	5	11	7	NA
WPC 8-3	1	10/1/08	1	69.6	13	15	0	NA
WPC 8-3	1	10/1/08	3	94 (RL); 64 (RR)	1.39 (RL); 8 (RR)	5.56 (RL); 8 (RR)	2	NA
WPC 8-3	1	10/1/08	5	62 (RL)	8	8	2	NA
WPC 9-2	1	10/1/08	1	72	2	2	1	74
WPC 9-2	1	10/1/08	3	39	9	15	1	95
WPC 9-2	1	10/1/08	5	41	9	15	7	NA
WPC 9-5	1	10/1/08	1	35	4	6	1	97
WPC 9-5	1	10/1/08	3	20	10	15	0	NA
WPC 9-5	1	10/1/08	5	43.7	5	9	1	NA
SWP 18-1	1	10/1/08	1	84	2	5	2	NA
SWP 18-1	1	10/1/08	3	100	8	9	0	NA
SWP 18-1	1	10/1/08	5	76	2	7	?	NA
SWP 20-1	1	9/30/08	1	30	10	14	10	NA
SWP 20-1	1	9/30/08	3	42	7	9	1	NA
SWP 20-1	1	9/30/08	5	33	16	19	4	NA
SWP 21-1	1	10/2/08	1	36	10	14	0	NA
SWP 21-1	1	10/2/08	3	45	16	20	1	NA
SWP 21-1	1	10/2/08	5	36	7	8	1	NA
SWP 22-3	1	10/2/08	1	18	20	27	5	NA
SWP 22-3	1	10/2/08	3	44	9	12	3	NA
SWP 22-3	1	10/2/08	5	38	7	7	3	NA
MC 6-2	1	9/30/08	1	50	6	7	5	NA
MC 6-2	1	9/30/08	3	95	6	8	3	NA
MC 6-2	1	9/30/08	5	44	8	10	6	NA
MC 9-1	1	9/30/08	1	35	13	19	7	93
MC 9-1	1	9/30/08	3	78	7	2	2	87
MC 9-1	1	9/30/08	5	76	0	3	1	NA
NBMC 8-1	1	9/29/08	1	73	0	4	3	NA
NBMC 8-1	1	9/29/08	3	100	0	2	0	NA
NBMC 8-1	1	9/29/08	5	62	2	6	3	NA
SBMC 3-1	1	9/29/08	1	44	0	3	10	NA
SBMC 3-1	1	9/29/08	3	49	7	9	1	NA

Table B5-3. Riffle Substrate Data

Reach ID	Site	Date	Cell	Riffle Pebble Count D50	Riffle Pebble Count Percent <2mm	Riffle Pebble Count Percent <6mm	Riffle Grid Toss Percent <6mm	Riffle Stability Index
SBMC 3-1	1	9/29/08	5	50	3	4	3	NA

Values represent actual field results except in the following circumstances:
RSI is calculated based on the geometric mean of the sample and the cumulative particle size distribution of the nearest riffle pebble count

Table B5-4. Pool and Large Woody Debris Data

Reach ID	Site	Date	Cell	Mean Residual Pool Depth	Number of Pools per 500 Feet	Number of Individual Pieces of LWD per 500 Feet	Number of LWD Aggregates per 500 Feet	Total Number of LWD per 500 Feet	Number of Pools per 1000 Feet	Number of Individual Pieces of LWD per 1000 Feet	Number of LWD Aggregates per 1000 Feet	Total Number of LWD per 1000 Feet
BULL 3-3	1	9/25/08	1-5	3.5	2	2.3	0.5	5.7	4	5	1	11
BULL 3-2	1	9/25/08	1-5	2.8	4	4.5	1.0	9.5	8	9	2	19
BULL 5-1	1	9/25/08	1-5	3.5	1.6	7.3	1.0	11.0	3	15	2	22
DRY 9-2	1	9/26/08	1-5	1.7	4	11.5	6.5	58.0	8	23	13	116
WFELK 8-1	1	9/23/08	1-5	1.3	5	11.5	2.5	21.5	10	23	5	43
EFELK 9-1	1	9/23/08	1-5	1.1	2	4.5	2.5	18.5	4	9	5	37
EFELK 8-1	1	9/22/08	1-5	1.3	1.5	8.5	0.5	10.0	3	17	1	20
EFELK 7-2	1	9/22/08	1-5	1.1	3.5	4.5	3.0	13.0	7	9	6	26
EFELK 10-3	1	9/22/08	1-5	1.0	4.5	19.0	2.0	28.0	9	38	4	56
ELK 11-3	1	9/24/08	1-5	2.7	4.5	8.5	4.0	31.0	9	17	8	62
ELK 11-6	1	9/24/08	1-5	3.2	4.5	4.5	3.0	15.5	9	9	6	31
WPC 8-3	1	10/1/08	1-5	1 (dry bed)	3.0	21.0	0.5	22.0	6	42	1	56
WPC 9-2	1	10/1/08	1-5	1.5	6.0	3.5	2.5	15.0	12	7	5	33
WPC 9-5	1	10/1/08	1-5	1.7	4.0	12.0	5.0	22.0	8	24	10	57
SWP 18-1	1	10/1/08	1-5	0.6	6.5	5.5	1.0	8.5	13	11	2	20
SWP 20-1	1	9/30/08	1-5	1.7	7.0	4.5	2.0	18.5	14	9	4	71
SWP 21-1	1	10/2/08	1-5	1.8	5.5	4.0	4.0	15.0	11	8	8	48
SWP 22-3	1	10/2/08	1-5	1.33 (dry bed)	5.5	9.5	2.0	11.5	11	19	4	40
MC 6-2	1	9/30/08	1-5	1.5	3.0	11.0	2.5	11.5	6	22	5	26
MC 9-1	1	9/30/08	1-5	1.4	4.0	4.5	1.0	7.5	8	9	2	20

Table B5-4. Pool and Large Woody Debris Data

Reach ID	Site	Date	Cell	Mean Residual Pool Depth	Number of Pools per 500 Feet	Number of Individual Pieces of LWD per 500 Feet	Number of LWD Aggregates per 500 Feet	Total Number of LWD per 500 Feet	Number of Pools per 1000 Feet	Number of Individual Pieces of LWD per 1000 Feet	Number of LWD Aggregates per 1000 Feet	Total Number of LWD per 1000 Feet
NBMC 8-1	1	9/29/08	1-5	1.0	8.0	4.0	3.0	14.5	16	8	6	30
SBMC 3-1	1	9/29/08	1-5	1.3	14.0	22.5	8.5	74.5	28	45	17	149

Table B5-5. Fine Sediment in Pool Tail-outs

Reach ID	Site	Date	Cell	Pool Grid Toss Percent <6mm
WPC 9-2	1	10/1/08	1	4
WPC 9-2	1	10/1/08	1	5
WPC 9-2	1	10/1/08	2	8
WPC 9-2	1	10/1/08	2	0
WPC 9-2	1	10/1/08	3	10
WPC 9-2	1	10/1/08	3	12
WPC 9-2	1	10/1/08	4	16
WPC 9-2	1	10/1/08	4	20
WPC 9-5	1	10/1/08	1	10
WPC 9-5	1	10/1/08	1	38
WPC 9-5	1	10/1/08	2	7
WPC 9-5	1	10/1/08	2	4
WPC 9-5	1	10/1/08	4	6
WPC 9-5	1	10/1/08	5	26
WPC 9-5	1	10/1/08	5	31
WPC 8-3	1	10/1/08	1	1
WPC 8-3	1	10/1/08	2	3
WPC 8-3	1	10/1/08	2	10
WPC 8-3	1	10/1/08	4	3
WPC 8-3	1	10/1/08	5	?
WPC 8-3	1	10/1/08	5	4
SWP 18-1	1	10/1/08	1	0
SWP 18-1	1	10/1/08	1	0
SWP 18-1	1	10/1/08	1	0
SWP 18-1	1	10/1/08	3	0
SWP 18-1	1	10/1/08	3	0
SWP 18-1	1	10/1/08	4	11
SWP 18-1	1	10/1/08	4	0
SWP 18-1	1	10/1/08	4	0
SWP 18-1	1	10/1/08	5	0
SWP 18-1	1	10/1/08	5	0
SWP 21-1	1	10/2/08	1	12
SWP 21-1	1	10/2/08	1	1
SWP 21-1	1	10/2/08	3	2
SWP 21-1	1	10/2/08	3	10
SWP 21-1	1	10/2/08	4	6
SWP 21-1	1	10/2/08	4	15
SWP 21-1	1	10/2/08	5	5
SWP 20-1	1	9/30/08	1	71
SWP 20-1	1	9/30/08	1	12
SWP 20-1	1	9/30/08	2	8
SWP 20-1	1	9/30/08	2	1
BULL 3-3	1	9/25/08	2	8
BULL 3-3	1	9/25/08	2	32
BULL 3-3	1	9/25/08	4	37
BULL 3-3	1	9/25/08	4	6

Table B5-5. Fine Sediment in Pool Tail-outs

Reach ID	Site	Date	Cell	Pool Grid Toss Percent <6mm
BULL 3-3	1	9/25/08	5	0
BULL 3-2	1	9/25/08	1	0
BULL 3-2	1	9/25/08	2	10
BULL 3-2	1	9/25/08	3	3
BULL 3-2	1	9/25/08	4	5
BULL 3-2	1	9/25/08	4	7
BULL 3-2	1	9/25/08	5	9
BULL 3-2	1	9/25/08	5	5
BULL 5-1	1	9/25/08	1	51
BULL 5-1	1	9/25/08	3	13
BULL 5-1	1	9/25/08	4	14
DRY 9-2	1	9/26/08	1	0
DRY 9-2	1	9/26/08	2	0
DRY 9-2	1	9/26/08	2	0
DRY 9-2	1	9/26/08	3	0
DRY 9-2	1	9/26/08	3	0
DRY 9-2	1	9/26/08	4	8
DRY 9-2	1	9/26/08	5	8
WFELK 8-1	1	9/23/08	1	16
WFELK 8-1	1	9/23/08	2	11
WFELK 8-1	1	9/23/08	2	5
WFELK 8-1	1	9/23/08	3	18
WFELK 8-1	1	9/23/08	4	8
WFELK 8-1	1	9/23/08	4	18
WFELK 8-1	1	9/23/08	5	13
WFELK 8-1	1	9/23/08	5	27
EFELK 9-1	1	9/23/08	1	14
EFELK 9-1	1	9/23/08	2	10
EFELK 9-1	1	9/23/08	4	27
EFELK 8-1	1	9/22/08	1	22
EFELK 8-1	1	9/22/08	4	24
EFELK 7-2	1	9/22/08	1	40
EFELK 7-2	1	9/22/08	1	13
EFELK 7-2	1	9/22/08	5	21
EFELK 10-3	1	9/22/08	1	13
EFELK 10-3	1	9/22/08	1	13
EFELK 10-3	1	9/22/08	2	5
EFELK 10-3	1	9/22/08	2	5
EFELK 10-3	1	9/22/08	3	10
EFELK 10-3	1	9/22/08	4	16
EFELK 10-3	1	9/22/08	5	3
ELK 11-3	1	9/24/08	1	3
ELK 11-3	1	9/24/08	2	4
ELK 11-3	1	9/24/08	2	5
ELK 11-3	1	9/24/08	3	6
ELK 11-3	1	9/24/08	3	6
ELK 11-3	1	9/24/08	4	29

Table B5-5. Fine Sediment in Pool Tail-outs

Reach ID	Site	Date	Cell	Pool Grid Toss Percent <6mm
ELK 11-3	1	9/24/08	4	3
ELK 11-3	1	9/24/08	5	3
ELK 11-6	1	9/24/08	1	1
ELK 11-6	1	9/24/08	1	4
ELK 11-6	1	9/24/08	2	1
ELK 11-6	1	9/24/08	2	6
ELK 11-6	1	9/24/08	3	2
ELK 11-6	1	9/24/08	3	7
ELK 11-6	1	9/24/08	4	7
ELK 11-6	1	9/24/08	4	4
ELK 11-6	1	9/24/08	5	2
WPC 8-3	1	10/1/08	1	1
WPC 8-3	1	10/1/08	2	3
WPC 8-3	1	10/1/08	2	10
WPC 8-3	1	10/1/08	4	3
WPC 8-3	1	10/1/08	5	?
WPC 8-3	1	10/1/08	5	4
WPC 9-2	1	10/1/08	1	4
WPC 9-2	1	10/1/08	1	5
WPC 9-2	1	10/1/08	2	8
WPC 9-2	1	10/1/08	2	0
WPC 9-2	1	10/1/08	3	10
WPC 9-2	1	10/1/08	3	12
WPC 9-2	1	10/1/08	4	16
WPC 9-2	1	10/1/08	4	20
WPC 9-5	1	10/1/08	1	10
WPC 9-5	1	10/1/08	1	38
WPC 9-5	1	10/1/08	2	7
WPC 9-5	1	10/1/08	2	4
WPC 9-5	1	10/1/08	4	6
WPC 9-5	1	10/1/08	5	26
WPC 9-5	1	10/1/08	5	31
SWP 18-1	1	10/1/08	1	0
SWP 18-1	1	10/1/08	1	0
SWP 18-1	1	10/1/08	1	0
SWP 18-1	1	10/1/08	3	0
SWP 18-1	1	10/1/08	3	0
SWP 18-1	1	10/1/08	4	11
SWP 18-1	1	10/1/08	4	0
SWP 18-1	1	10/1/08	4	0
SWP 18-1	1	10/1/08	5	0
SWP 18-1	1	10/1/08	5	0
SWP 20-1	1	9/30/08	1	71
SWP 20-1	1	9/30/08	1	12
SWP 20-1	1	9/30/08	2	8
SWP 20-1	1	9/30/08	2	1
SWP 20-1	1	9/30/08	3	0

Table B5-5. Fine Sediment in Pool Tail-outs

Reach ID	Site	Date	Cell	Pool Grid Toss Percent <6mm
SWP 20-1	1	9/30/08	3	18
SWP 20-1	1	9/30/08	4	11
SWP 20-1	1	9/30/08	4	3
SWP 20-1	1	9/30/08	5	4
SWP 21-1	1	10/2/08	1	12
SWP 21-1	1	10/2/08	1	1
SWP 21-1	1	10/2/08	3	2
SWP 21-1	1	10/2/08	3	10
SWP 21-1	1	10/2/08	4	6
SWP 21-1	1	10/2/08	4	15
SWP 21-1	1	10/2/08	5	5
SWP 22-3	1	10/2/08	1	4
SWP 22-3	1	10/2/08	2	6
SWP 22-3	1	10/2/08	2	21
SWP 22-3	1	10/2/08	3	10
SWP 22-3	1	10/2/08	3	23
SWP 22-3	1	10/2/08	4	17
SWP 22-3	1	10/2/08	4	5
SWP 22-3	1	10/2/08	5	9
SWP 22-3	1	10/2/08	5	0
MC 6-2	1	9/30/08	2	15
MC 6-2	1	9/30/08	3	5
MC 6-2	1	9/30/08	4	10.96
MC 6-2	1	9/30/08	5	7
MC 6-2	1	9/30/08	5	8
MC 9-1	1	9/30/08	1	10
MC 9-1	1	9/30/08	2	3
MC 9-1	1	9/30/08	2	0
MC 9-1	1	9/30/08	3	20
MC 9-1	1	9/30/08	3	0
MC 9-1	1	9/30/08	4	37
MC 9-1	1	9/30/08	4	0
MC 9-1	1	9/30/08	5	0
NBMC 8-1	1	9/29/08	1	2
NBMC 8-1	1	9/29/08	1	3
NBMC 8-1	1	9/29/08	2	0
NBMC 8-1	1	9/29/08	2	4
NBMC 8-1	1	9/29/08	3	0
NBMC 8-1	1	9/29/08	3	2
NBMC 8-1	1	9/29/08	4	0
NBMC 8-1	1	9/29/08	4	0
NBMC 8-1	1	9/29/08	5	1
NBMC 8-1	1	9/29/08	5	3
SBMC 3-1	1	9/29/08	1	8
SBMC 3-1	1	9/29/08	1	3
SBMC 3-1	1	9/29/08	2	6
SBMC 3-1	1	9/29/08	2	5

Table B5-5. Fine Sediment in Pool Tail-outs

Reach ID	Site	Date	Cell	Pool Grid Toss Percent <6mm
SBMC 3-1	1	9/29/08	3	16
SBMC 3-1	1	9/29/08	3	30
SBMC 3-1	1	9/29/08	4	0
SBMC 3-1	1	9/29/08	5	9
SBMC 3-1	1	9/29/08	5	3

Pool grid toss percent fines <6mm is the average of 3 grid tosses

Table B5-6. Riparian Greenline Data

Reach ID	Site	Date	Cell	Percent Understory Shrub Cover	Percent Bare/ Disturbed Ground	Percent Riprap	Percent Overstory Canopy Cover	Right Bank Mean Riparian Zone Width	Left Bank Mean Riparian Zone Width
BULL 3-3	1	9/25/08	1	75	3	0	18	19	>100
BULL 3-3	1	9/25/08	2	63	20	0	3	75	>100
BULL 3-3	1	9/25/08	3	58	23	0	0	>100	>100
BULL 3-3	1	9/25/08	4	60	23	0	13	>100	>100
BULL 3-3	1	9/25/08	5	58	13	0	0	>100	>100
BULL 3-2	1	9/25/08	1	73	0	0	38	27.5	>100
BULL 3-2	1	9/25/08	2	60	0	0	15	81.25	>100
BULL 3-2	1	9/25/08	3	63	0	0	28	>100	>100
BULL 3-2	1	9/25/08	4	88	0	0	20	>100	>100
BULL 3-2	1	9/25/08	5	88	0	0	60	>100	>100
BULL 5-1	1	9/25/08	1	18	0	0	8	>100	>100
BULL 5-1	1	9/25/08	2	35	0	0	28	>100	>100
BULL 5-1	1	9/25/08	3	18	0	0	3	>100	>100
BULL 5-1	1	9/25/08	4	15	0	0	0	>100	>100
BULL 5-1	1	9/25/08	5	15	0	0	0	>100	>100
DRY 9-2	1	9/26/08	1	68	0	0	85	>100	35
DRY 9-2	1	9/26/08	2	40	0	0	78	>100	>100
DRY 9-2	1	9/26/08	3	28	0	0	78	>100	>100
DRY 9-2	1	9/26/08	4	48	0	0	88	>100	>100
DRY 9-2	1	9/26/08	5	58	0	0	83	>100	>100
WFELK 8-1	1	9/23/08	1	90	0	0	95	>100	>100
WFELK 8-1	1	9/23/08	2	30	0	0	68	>100	>100
WFELK 8-1	1	9/23/08	3	53	0	0	55	>100	>100
WFELK 8-1	1	9/23/08	4	73	0	0	63	>100	>100
WFELK 8-1	1	9/23/08	5	34	0	0	73	>100	>100
EFELK 9-1	1	9/23/08	1	100	0	0	45	>100	>100
EFELK 9-1	1	9/23/08	2	80	0	0	28	>100	>100
EFELK 9-1	1	9/23/08	3	88	0	0	75	>100	>100
EFELK 9-1	1	9/23/08	4	100	0	0	40	>100	>100

Table B5-6. Riparian Greenline Data

Reach ID	Site	Date	Cell	Percent Understory Shrub Cover	Percent Bare/ Disturbed Ground	Percent Riprap	Percent Overstory Canopy Cover	Right Bank Mean Riparian Zone Width	Left Bank Mean Riparian Zone Width
EFELK 9-1	1	9/23/08	5	98	0	0	38	>100	>100
EFELK 8-1	1	9/22/08	1	98	0	0	63	>100	>100
EFELK 8-1	1	9/22/08	2	95	0	0	35	>100	>100
EFELK 8-1	1	9/22/08	3	100	0	0	58	>100	18.75
EFELK 8-1	1	9/22/08	4	100	0	0	75	>100	17.5
EFELK 8-1	1	9/22/08	5	95	0	0	70	>100	60
EFELK 7-2	1	9/22/08	1	88	0	0	58	>100	51.25
EFELK 7-2	1	9/22/08	2	88	0	0	50	>100	>100
EFELK 7-2	1	9/22/08	3	100	0	0	60	?	?
EFELK 7-2	1	9/22/08	4	98	0	0	45	?	?
EFELK 7-2	1	9/22/08	5	93	0	0	63	>100	>100
EFELK 10-3	1	9/22/08	1	75	0	0	35	33	41
EFELK 10-3	1	9/22/08	2	85	0	0	33	45	55
EFELK 10-3	1	9/22/08	3	65	0	0	25	33	83
EFELK 10-3	1	9/22/08	4	63	0	0	33	35	22
EFELK 10-3	1	9/22/08	5	68	0	0	8	24	28
ELK 11-3	1	9/24/08	1	28	0	0	8	>100	35
ELK 11-3	1	9/24/08	2	30	8	0	8	>100	20
ELK 11-3	1	9/24/08	3	73	0	0	30	>100	25
ELK 11-3	1	9/24/08	4	85	0	0	35	>100	29
ELK 11-3	1	9/24/08	5	53	8	0	23	>100	13
ELK 11-6	1	9/24/08	1	43	0	0	3	>100	>100
ELK 11-6	1	9/24/08	2	23	8	23	3	>100	>100
ELK 11-6	1	9/24/08	3	38	0	0	13	>100	>100
ELK 11-6	1	9/24/08	4	60	0	0	45	>100	>100
ELK 11-6	1	9/24/08	5	28	20	0	23	10	>100
WPC 8-3	1	10/1/08	1	43	0	0	25	>100	90
WPC 8-3	1	10/1/08	2	58	0	0	15	95	60
WPC 8-3	1	10/1/08	3	78	0	0	20	>100	35
WPC 8-3	1	10/1/08	4	68	0	0	20	65	19

Table B5-6. Riparian Greenline Data

Reach ID	Site	Date	Cell	Percent Understory Shrub Cover	Percent Bare/ Disturbed Ground	Percent Riprap	Percent Overstory Canopy Cover	Right Bank Mean Riparian Zone Width	Left Bank Mean Riparian Zone Width
WPC 8-3	1	10/1/08	5	58	0	0	53	60	>100
WPC 9-2	1	10/1/08	1	75	0	0	3	>100	>100
WPC 9-2	1	10/1/08	2	45	0	0	5	>100	>100
WPC 9-2	1	10/1/08	3	60	0	0	3	>100	>100
WPC 9-2	1	10/1/08	4	45	0	0	5	>100	>100
WPC 9-2	1	10/1/08	5	40	0	0	0	>100	>100
WPC 9-5	1	10/1/08	1	40	10	0	10	>100	>100
WPC 9-5	1	10/1/08	2	40	10	0	10	>100	>100
WPC 9-5	1	10/1/08	3	73	0	0	55	>100	>100
WPC 9-5	1	10/1/08	4	55	0	0	23	>100	>100
WPC 9-5	1	10/1/08	5	75	8	0	33	>100	>100
SWP 18-1	1	10/1/08	1	62	0	0	15	>100	>100
SWP 18-1	1	10/1/08	2	89	0	0	27	>100	85
SWP 18-1	1	10/1/08	3	86	0	0	32	>100	76
SWP 18-1	1	10/1/08	4	89	0	0	50	>100	35
SWP 18-1	1	10/1/08	5	83	0	0	63	>100	>100
SWP 20-1	1	9/30/08	1	78	0	0	13	>100	>100
SWP 20-1	1	9/30/08	2	65	0	0	8	>100	>100
SWP 20-1	1	9/30/08	3	48	0	0	8	>100	>100
SWP 20-1	1	9/30/08	4	75	0	0	13	>100	>100
SWP 20-1	1	9/30/08	5	95	0	0	20	>100	>100
SWP 21-1	1	10/2/08	1	78	0	0	30	>100	>100
SWP 21-1	1	10/2/08	2	63	0	0	18	>100	>100
SWP 21-1	1	10/2/08	3	45	0	0	13	>100	>100
SWP 21-1	1	10/2/08	4	18	0	5	0	>100	>100
SWP 21-1	1	10/2/08	5	50	0	0	8	>100	>100
SWP 22-3	1	10/2/08	1	53	0	0	23	>100	67.5
SWP 22-3	1	10/2/08	2	55	0	0	10	>100	>100
SWP 22-3	1	10/2/08	3	53	0	0	5	41.25	>100
SWP 22-3	1	10/2/08	4	33	0	0	13	5	>100

Table B5-6. Riparian Greenline Data

Reach ID	Site	Date	Cell	Percent Understory Shrub Cover	Percent Bare/ Disturbed Ground	Percent Riprap	Percent Overstory Canopy Cover	Right Bank Mean Riparian Zone Width	Left Bank Mean Riparian Zone Width
SWP 22-3	1	10/2/08	5	50	0	0	18	62.5	>100
MC 6-2	1	9/30/08	1	100	0	0	50	20	>100
MC 6-2	1	9/30/08	2	95	0	0	60	18	>100
MC 6-2	1	9/30/08	3	90	0	0	65	19	>100
MC 6-2	1	9/30/08	4	98	0	0	60	15	>100
MC 6-2	1	9/30/08	5	85	0	0	58	56	>100
MC 9-1	1	9/30/08	1	85	0	0	10	>100	>100
MC 9-1	1	9/30/08	2	100	0	0	10	>100	>100
MC 9-1	1	9/30/08	3	75	0	0	25	88	>100
MC 9-1	1	9/30/08	4	100	0	0	25	90	>100
MC 9-1	1	9/30/08	5	98	0	0	18	>100	>100
NBMC 8-1	1	9/29/08	1	100	0	0	38	58	>100
NBMC 8-1	1	9/29/08	2	100	0	0	40	50	>100
NBMC 8-1	1	9/29/08	3	90	0	0	38	>100	>100
NBMC 8-1	1	9/29/08	4	78	0	3	45	40	>100
NBMC 8-1	1	9/29/08	5	80	0	18	28	55	>100
SBMC 3-1	1	9/29/08	1	98	0	0	75	15	50
SBMC 3-1	1	9/29/08	2	90	0	0	68	15	50
SBMC 3-1	1	9/29/08	3	93	0	0	58	15	50
SBMC 3-1	1	9/29/08	4	73	0	0	63	15	50
SBMC 3-1	1	9/29/08	5	85	0	0	50	15	50

All greenline measurements are averaged by cell

Table B5-7. Bank Erosion Hazard Index (BEHI) Data

Stream	Ecoregion	Reach ID	Reach Type	Bankfull Width	Estimated Potential Stream Type	Site	Date	Cell	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	Percent of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)	Reach Transporation Load (Tons/Year)	Transporation Load (Percent)	Reach Riparian Grazing Load (Tons/Year)	Riparian Grazing Load (Percent)	Reach Cropland Load (Tons/Year)	Cropland Load (Percent)	Reach Mining Load (Tons/Year)	Mining Load (Percent)	Reach Silviculture Load (Tons/Year)	Silviculture Load (Percent)	Reach Irrigation Load (Tons/Year)	Irrigation Load (Percent)	Reach Natural Load (Tons/Year)	Natural Load (Percent)	Reach "Other" Load (Tons/Year)	"Other" Load (Percent)
Bull	15q	BULL 3-2	3-U-0	61.5	3b	1	9/25/08	1-5	Actively/ Visually Eroding	36.9	84	4.2	11.7	11.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82.1	70.0	35.2	30.0
Bull	15q	BULL 3-2	3-U-0	61.5	3b	1	9/25/08	1-5	Slowly Eroding/ Undercut/ Vegetated	27.8	152	7.6	8.9	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	93.8	0.2	6.2
Bull	15q	BULL 3-2	3-U-0	61.5	3b	1	9/25/08	1-5	Total		236	11.8	20.6	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.9	70.8	35.4	29.2
Bull	15q	BULL 3-3	3-U-0	61.3	3b	1	9/25/08	1-5	Actively/ Visually Eroding	35.6	661	22.0	104.3	69.5	6.2	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.1	94.1	0.0	0.0
Bull	15q	BULL 3-3	3-U-0	61.3	3b	1	9/25/08	1-5	Slowly Eroding/ Undercut/ Vegetated	36.6	93	3.1	5.5	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2	100.0	0.0	0.0
Bull	15q	BULL 3-3	3-U-0	61.3	3b	1	9/25/08	1-5	Total		754	25.1	109.8	73.2	6.2	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	111.3	94.8	0.0	0.0
Bull	15q	BULL 5-1	3-U-0	62.7	3d	1	9/25/08	1-5	Actively/ Visually Eroding	32.3	280	9.3	16.2	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3	100.0	0.0	0.0
Bull	15q	BULL 5-1	3-U-0	62.7	3d	1	9/25/08	1-5	Slowly Eroding/ Undercut/ Vegetated	27.5	423	14.1	27.1	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.6	98.7	0.3	1.3
Bull	15q	BULL 5-1	3-U-0	62.7	3d	1	9/25/08	1-5	Total		703	23.4	43.2	28.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.9	99.1	0.3	0.9
Dry	15q	DRY 9-2	2-U-0	36	2a	1	9/26/08	1-5	Actively/ Visually Eroding	13.2	126	6.3	4.3	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	40.0	0.0	0.0	2.6	60.0	0.0	0.0
Dry	15q	DRY 9-2	2-U-0	36	2a	1	9/26/08	1-5	Slowly Eroding/ Undercut/ Vegetated	15.7	208	10.4	8.1	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	40.0	0.0	0.0	4.9	60.0	0.0	0.0
Dry	15q	DRY 9-2	2-U-0	36	2a	1	9/26/08	1-5	Total		334	16.7	12.4	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	40.0	0.0	0.0	7.4	60.0	0.0	0.0
Elk	15k	EFELK 10-3	3-U-0	36.7	3a	1	9/24/08	1-5	Total		154	7.7	5.9	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	72.9	1.6	27.1
Elk	15k	EFELK 10-3	3-U-0	36.7	3a	1	9/24/08	1-5	Actively/ Visually Eroding	37.8	20	1.0	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	70.0	0.2	30.0
Elk	15k	EFELK 10-3	3-U-0	36.7	3a	1	9/24/08	1-5	Slowly Eroding/ Undercut/ Vegetated	31.7	134	6.7	5.2	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	73.3	1.4	26.7
Elk	15k	EFELK 7-2	2-U-4	28.5	2a	1	9/22/08	1-5	Total		90	4.5	3.1	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	100.0	0.0	0.0
Elk	15k	EFELK 7-2	2-U-4	28.5	2a	1	9/22/08	1-5	Actively/ Visually Eroding	31.8	49	2.5	1.9	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	100.0	0.0	0.0
Elk	15k	EFELK 7-2	2-U-4	28.5	2a	1	9/22/08	1-5	Slowly Eroding/ Undercut/ Vegetated	22.1	41	2.1	1.2	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	100.0	0.0	0.0

Table B5-7. Bank Erosion Hazard Index (BEHI) Data

Stream	Ecoregion	Reach ID	Reach Type	Bankfull Width	Estimated Potential Stream Type	Site	Date	Cell	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	Percent of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)	Reach Transporation Load (Tons/Year)	Transporation Load (Percent)	Reach Riparian Grazing Load (Tons/Year)	Riparian Grazing Load (Percent)	Reach Cropland Load (Tons/Year)	Cropland Load (Percent)	Reach Mining Load (Tons/Year)	Mining Load (Percent)	Reach Silviculture Load (Tons/Year)	Silviculture Load (Percent)	Reach Irrigation Load (Tons/Year)	Irrigation Load (Percent)	Reach Natural Load (Tons/Year)	Natural Load (Percent)	Reach "Other" Load (Tons/Year)	"Other" Load (Percent)
Elk	15k	EFELK 8-1	2-U-2	24.8	2a	1	9/22/08	1-5	Total		216	10.8	9.9	9.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.9	100.0	0.0	0.0
Elk	15k	EFELK 8-1	2-U-2	24.8	2a	1	9/22/08	1-5	Actively/ Visually Eroding	23.6	104	5.2	5.4	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	100.0	0.0	0.0
Elk	15k	EFELK 8-1	2-U-2	24.8	2a	1	9/22/08	1-5	Slowly Eroding/ Undercut/ Vegetated	32.7	112	5.6	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	100.0	0.0	0.0
Elk	15k	EFELK 9-1	2-U-0	27.5	2a	1	9/23/08	1-5	Total		159	8.0	6.4	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	90.5	0.6	9.5
Elk	15k	EFELK 9-1	2-U-0	27.5	2a	1	9/23/08	1-5	Actively/ Visually Eroding	32.4	102	5.1	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	86.6	0.6	13.4
Elk	15k	EFELK 9-1	2-U-0	27.5	2a	1	9/23/08	1-5	Slowly Eroding/ Undercut/ Vegetated	28.4	57	2.9	1.9	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	100.0	0.0	0.0
Elk	15k	ELK 11-3	4-U-0	43.8	4a	1	9/24/08	1-5	Actively/ Visually Eroding	40.6	130	6.5	6.8	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	70.0	2.1	30.0
Elk	15k	ELK 11-3	4-U-0	43.8	4a	1	9/24/08	1-5	Slowly Eroding/ Undercut/ Vegetated	37.2	142	7.1	9.8	9.8	0.0	0.0	1.0	9.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	62.3	2.8	28.9
Elk	15k	ELK 11-3	4-U-0	43.8	4a	1	9/24/08	1-5	Total		272	13.6	16.6	16.6	0.0	0.0	1.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.9	65.5	4.9	29.4
Elk	15k	ELK 11-6	4-U-0	39.4	4a	1	9/24/08	1-5	Actively/ Visually Eroding	33.9	372	18.6	19.9	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9	70.0	6.0	30.0
Elk	15k	ELK 11-6	4-U-0	39.4	4a	1	9/24/08	1-5	Slowly Eroding/ Undercut/ Vegetated	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Elk	15k	ELK 11-6	4-U-0	39.4	4a	1	9/24/08	1-5	Total		372	18.6	19.9	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9	70.0	6.0	30.0
Marten	15o	MC 6-2	3-U-2	30.7	3a	1	9/30/08	1-5	Total		458	22.9	40.2	40.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.2	100.0	0.0	0.0
Marten	15o	MC 6-2	3-U-2	30.7	3a	1	9/30/08	1-5	Actively/ Visually Eroding	28.1	324	16.2	33.5	33.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.5	100.0	0.0	0.0
Marten	15o	MC 6-2	3-U-2	30.7	3a	1	9/30/08	1-5	Slowly Eroding/ Undercut/ Vegetated	26.8	134	6.7	6.8	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8	100.0	0.0	0.0
Marten	15k	MC 9-1	3-U-0	48.9	3b	1	9/30/08	1-5	Total		361	18.1	11.9	11.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.9	100.0	0.0	0.0
Marten	15k	MC 9-1	3-U-0	48.9	3b	1	9/30/08	1-5	Actively/ Visually Eroding	25.4	265	13.3	8.1	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.1	100.0	0.0	0.0
Marten	15k	MC 9-1	3-U-0	48.9	3b	1	9/30/08	1-5	Slowly Eroding/ Undercut/ Vegetated	36.4	96	4.8	3.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	100.0	0.0	0.0
Marten	15o	NBMC 8-1	2-U-4	21.4	2a	1	9/29/08	1-5	Total		415	20.8	35.1	35.1	2.4	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.4	92.3	0.3	0.9

Table B5-7. Bank Erosion Hazard Index (BEHI) Data

Stream	Ecoregion	Reach ID	Reach Type	Bankfull Width	Estimated Potential Stream Type	Site	Date	Cell	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	Percent of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)	Reach Transporation Load (Tons/Year)	Transporation Load (Percent)	Reach Riparian Grazing Load (Tons/Year)	Riparian Grazing Load (Percent)	Reach Cropland Load (Tons/Year)	Cropland Load (Percent)	Reach Mining Load (Tons/Year)	Mining Load (Percent)	Reach Silviculture Load (Tons/Year)	Silviculture Load (Percent)	Reach Irrigation Load (Tons/Year)	Irrigation Load (Percent)	Reach Natural Load (Tons/Year)	Natural Load (Percent)	Reach "Other" Load (Tons/Year)	"Other" Load (Percent)
Marten	15o	NBMC 8-1	2-U-4	21.4	2a	1	9/29/08	1-5	Actively/ Visually Eroding	27.6	367	18.4	33.2	33.2	2.4	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5	91.8	0.3	0.9
Marten	15o	NBMC 8-1	2-U-4	21.4	2a	1	9/29/08	1-5	Slowly Eroding/ Undercut/ Vegetated	35.9	48	2.4	1.9	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	100.0	0.0	0.0
Marten	15o	SBMC 3-1	2-C-4	31.4	2a	1	9/29/08	1-5	Total		241	12.1	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	100.0	0.0	0.0
Marten	15o	SBMC 3-1	2-C-4	31.4	2a	1	9/29/08	1-5	Actively/ Visually Eroding	32.7	170	8.5	6.1	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	100.0	0.0	0.0
Marten	15o	SBMC 3-1	2-C-4	31.4	2a	1	9/29/08	1-5	Slowly Eroding/ Undercut/ Vegetated	29.3	71	3.6	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	100.0	0.0	0.0
Swamp	15q	SWP 18-1	2-U-2	33.5	2a	1	10/1/08	1-5	Actively/ Visually Eroding	21.2	118	5.9	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	100.0	0.0	0.0
Swamp	15q	SWP 18-1	2-U-2	33.5	2a	1	10/1/08	1-5	Slowly Eroding/ Undercut/ Vegetated	18.6	55	2.8	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	100.0	0.0	0.0
Swamp	15q	SWP 18-1	2-U-2	33.5	2a	1	10/1/08	1-5	Total		173	8.7	4.2	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	100.0	0.0	0.0
Swamp	15q	SWP 20-1	3-U-0	47.7	3a	1	9/30/08	1-5	Actively/ Visually Eroding	34.0	245	12.3	17.1	17.1	0.0	0.0	17.1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Swamp	15q	SWP 20-1	3-U-0	47.7	3a	1	9/30/08	1-5	Slowly Eroding/ Undercut/ Vegetated	29.3	38	1.9	0.6	0.6	0.0	0.0	0.6	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Swamp	15q	SWP 20-1	3-U-0	47.7	3a	1	9/30/08	1-5	Total		283	14.2	17.7	17.7	0.0	0.0	17.7	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Swamp	15k	SWP 21-1	3-U-0	45	3a	0	10/2/08	1-5	Total		527	26.4	14.6	14.6	0.0	0.0	14.6	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Swamp	15k	SWP 21-1	3-U-0	45	3a	1	10/2/08	1-5	Actively/ Visually Eroding	34.2	311	15.6	12.4	12.4	0.0	0.0	12.4	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Swamp	15k	SWP 21-1	3-U-0	45	3a	0	10/2/08	1-5	Slowly Eroding/ Undercut/ Vegetated	21.9	216	10.8	2.2	2.2	0.0	0.0	2.2	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Swamp	15q	SWP 22-3	3-U-0	40.1	3a	1	10/2/08	1-5	Actively/ Visually Eroding	26.2	200	10.0	4.6	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	88.9	0.5	11.1
Swamp	15q	SWP 22-3	3-U-0	40.1	3a	1	10/2/08	1-5	Slowly Eroding/ Undercut/ Vegetated	30.1	380	19.0	9.7	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.7	100.0	0.0	0.0
Swamp	15q	SWP 22-3	3-U-0	40.1	3a	1	10/2/08	1-5	Total		580	29.0	14.3	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.7	96.4	0.5	3.6
Elk	15o	WFELK 8-1	2-U-0	20.3	2a	1	9/23/08	1-5	Actively/ Visually Eroding	13.6	130	6.5	6.1	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	100.0	0.0	0.0

Table B5-7. Bank Erosion Hazard Index (BEHI) Data

Stream	Ecoregion	Reach ID	Reach Type	Bankfull Width	Estimated Potential Stream Type	Site	Date	Cell	Erosion Rate	Mean BEHI Score	Length of Eroding Bank (Feet)	Percent of Reach with Eroding Bank	Reach Sediment Load (Tons/Year)	Total Sediment Load per 1000 Feet (Tons/Year)	Reach Transporation Load (Tons/Year)	Transporation Load (Percent)	Reach Riparian Grazing Load (Tons/Year)	Riparian Grazing Load (Percent)	Reach Cropland Load (Tons/Year)	Cropland Load (Percent)	Reach Mining Load (Tons/Year)	Mining Load (Percent)	Reach Silviculture Load (Tons/Year)	Silviculture Load (Percent)	Reach Irrigation Load (Tons/Year)	Irrigation Load (Percent)	Reach Natural Load (Tons/Year)	Natural Load (Percent)	Reach "Other" Load (Tons/Year)	"Other" Load (Percent)
Elk	15o	WFELK 8-1	2-U-0	20.3	2a	1	9/23/08	1-5	Slowly Eroding/ Undercut/ Vegetated	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Elk	15o	WFELK 8-1	2-U-0	20.3	2a	1	9/23/08	1-5	Total		130	6.5	6.1	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	100.0	0.0	0.0
White Pine	15k	WPC 8-3	2-U-2	31.9	2a	1	10/1/08	1-5	Total		821	41.1	13.5	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5	100.0	0.0	0.0
White Pine	15k	WPC 8-3	2-U-2	31.9	2a	1	10/1/08	1-5	Actively/ Visually Eroding	17.9	747	37.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	100.0	0.0	0.0
White Pine	15k	WPC 8-3	2-U-2	31.9	2a	1	10/1/08	1-5	Slowly Eroding/ Undercut/ Vegetated	31.3	74	3.7	2.1	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	100.0	0.0	0.0
White Pine	15k	WPC 9-2	2-U-0	35.3	2a	1	10/1/08	1-5	Total		711	35.6	42.6	42.6	0.0	0.0	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.4	99.5	0.0	0.0
White Pine	15k	WPC 9-2	2-U-0	35.3	2a	1	10/1/08	1-5	Actively/ Visually Eroding	37.3	711	35.6	42.6	42.6	0.0	0.0	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.4	99.5	0.0	0.0
White Pine	15k	WPC 9-2	2-U-0	35.3	2a	1	10/1/08	1-5	Slowly Eroding/ Undercut/ Vegetated	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White Pine	15k	WPC 9-5	2-U-0	37.7	2a	1	10/1/08	1-5	Total		384	19.2	14.9	14.9	0.0	0.0	0.1	0.7	14.1	94.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7	4.5	0.0	0.0
White Pine	15k	WPC 9-5	2-U-0	37.7	2a	1	10/1/08	1-5	Actively/ Visually Eroding	35.5	215	10.8	9.5	9.5	0.0	0.0	0.1	1.1	8.8	91.8	0.0	0.0	0.0	0.0	0.0	0.0	0.7	7.1	0.0	0.0
White Pine	15k	WPC 9-5	2-U-0	37.7	2a	1	10/1/08	1-5	Slowly Eroding/ Undercut/ Vegetated	31.5	169	8.5	5.3	5.3	0.0	0.0	0.0	0.0	5.3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

B6.0 REFERENCES

Bilby, R. and J.W. Ward. 1989. Changes in characteristics and function of woody debris with increasing size of streams in western Washington. Transactions of the American Fisheries Society 118:368-378.

Dunne, T. and L.B. Leopold. 1978. Water in Environmental Planning. W.H. Freeman and Company, New York.

Meehan, W.R., ed. 1991. Influences of forest and rangeland management on salmonid fishes and their habitats. Special Publication 19. American Fisheries Society, Bethesda, MD. 751 p.

Montana Department of Environmental Quality (MDEQ). 2008a. Longitudinal Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments.

Montana Department of Environmental Quality (MDEQ). 2008b. Watershed Stratification Methodology for TMDL Sediment and Habitat Investigations.

Rosgen, D. L. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

Weaver, T. and J. Fraley. 1991. Fisheries Habitat and Fish Populations, Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program - Final Report. Flathead Basin Commission,Kalispell, MT. pp. 53- 68.

Wolman, M.G. 1954. A method of sampling coarse river-bed material: Trans. Am. Geophys. Union, v. 35, p. 951-956.