# ATTACHMENT 1 - ROAD SEDIMENT ASSESSMENT & MODELING

# ROAD SEDIMENT ASSESSMENT & MODELING LOWER CLARK FORK RIVER TPA

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# 1.0 INTRODUCTION

This report presents a sediment and culvert assessment of the unpaved road network within six watersheds of the Lower Clark Fork River TMDL Planning Area (TPA). This assessment was performed as part of the development of sediment TMDLs for 303(d) listed stream segments with sediment as a documented impairment. Roads located near stream channels can impact stream function through degradation of riparian vegetation, channel encroachment, and sediment loading. The degree of impact is determined by a number of factors, including road type, construction specifications, drainage, soil type, topography, precipitation, and the use of Best Management Practices (BMPs). Through a combination of GIS analysis, field assessment, and computer modeling, estimated sediment loads were developed for unpaved road crossings and parallel segments. Existing road conditions were modeled and future road conditions were estimated after the application of sediment reducing Best Management Practices (BMPs). Existing culverts were also assessed for fish passage.

The 2008 303(d) List includes the following stream segments for sediment / siltation impairment: Bull River, Dry Creek, Marten Creek and White Pine Creek. Elk Creek, which had a TMDL completed in 1997, and Swamp Creek were also included in analysis for this report. **Table A-1** includes a summary of sediment impaired stream segments.

# 2.0 DATA COLLECTION

The Lower Clark Fork Unpaved Road Sediment assessment consisted of three primary tasks: 1.) GIS Layer development and summary statistics, 2.) field assessment and sediment modeling, and 3.) sediment load calculations and load reduction allocations for sediment listed watersheds. Additional information on assessment techniques is available in prior reporting for this project: *Task 1. Road GIS Layers and Summary Statistics* (MDEQ 2009), and *Task 2. Sampling and Analysis Plan* (MDEQ 2009).

## 2.1 Spatial Analysis

Using road layers provided by the Kootenai National Forest (KNF), crossings and parallel segments in the road network were identified and classified relative to $6^{th}$ code subwatershed (with the separation of Dry Creek from Upper Bull River), land ownership, soil erosion hazard class and road type (**Tables A-2a through A-2d**). A random subset of 50 unpaved crossing sites was generated for field assessment based on the proportion of total crossings within each watershed and by land ownership. Some sites were relocated prior to the field effort to focus on road crossings accessible by vehicle. The goal of the field effort was to characterize at least 40 road crossings and up to 10 parallel segments.

Parallel road segments were identified as areas where roads encroach upon the stream channel, and total road lengths within 100-foot stream buffer zones were generated. There is a total of 23.65 miles of unpaved parallel road segments within 100 feet of stream channels.

## 2.2 Field Data Collection

A total of 43 unpaved crossings and 19 parallel segments were evaluated in the field (**Figures 2, 3, 4, and 5, Attachment B, D, and E**). The following crossings were evaluated in each watershed: two crossings in Swamp Creek, one crossing in Dry Creek, seven crossings in White Pine Creek, ten crossings in Marten Creek, eleven crossings in Elk Creek and twelve crossings in the Bull River watershed.

In the field, parallel segments were selected based on best professional judgment while traveling roads on which specific crossings were selected for evaluation. When a parallel reach was encountered, the reach was divided into smaller segments and assessed at pre-selected intervals to eliminate sample bias. Parallel segments were evaluated in the Marten Creek, White Pine Creek and Elk Creek watersheds.

## 2.3 Sediment Assessment Methodology

The road sediment assessment was conducted using the WEPP:Road forest road erosion prediction model (http://forest.moscowfsl.wsu.edu/fswepp/). WEPP:Road is an interface to the Water Erosion Prediction Project (WEPP) model (Flanagan and Livingston, 1995), developed by the USDA Forest Service and other agencies, and is used to predict runoff, erosion, and sediment delivery from forest roads. The model predicts sediment yields based on specific soil, climate, ground cover, and topographic conditions. Specifically, the following model input data was collected in the field: soil type, percent rock, road surface, road design, traffic level, and specific road topographic values (road grade, road length, road width, fill grade, fill length, buffer grade, and buffer length). In addition, supplemental data was collected on vegetation condition of the buffer, evidence of erosion from the road system, and potential for fish passage failure.

The six watersheds encompass a wide range of annual precipitation: Precipitation quantity ranges from 26 to 100 inches per year with an average value of 47.5 inches and a median value of 46 inches. The sites assessed in the field ranged in elevation from 2340 feet to 5108 feet. The weather stations within the TMDL planning area are Trout Creek 2 W, Montana (248379, 30.32 inches annual precipitation; 2490 feet elevation) and Trout Creek Ranger Stn, Montana, (248380, 28.54 inches annual precipitation; 2360 feet elevation). Due to the lack of representative long-term precipitation stations in the Lower Clark Fork TPA, one station from outside the geographic area was selected to model the higher elevation sites (>3,500 feet). The selected station, Burke 2 ENE, Idaho (101272), contained similar climate and elevation conditions as those encountered in the Lower Clark Fork (48.9 inches annual precipitation; 4090 feet elevation). The Troy 18N, Montana (248395) station was used to model the lower elevation sites below 3,500 feet in elevation (35.60 inches annual precipitation; 2720 feet elevation). The Troy 18N site was chosen over the Trout Creek stations because the increased elevation better represented the sites assessed in the field (elevations are listed in **Attachment D**). Thirty year simulations were run for each unpaved road crossing segment since the quantity of precipitation exceeded 500 millimeters (19.69 inches) for all listed watersheds.

Some road conditions encountered in the field are not accurately represented in the WEPP:Road design options; as a result, some adjustments were made to the model to more appropriately represent these types of roads. **Attachment C** contains a description of model or site condition adjustments, as recommended by the model author or by best professional judgment. **Attachment C** includes a table with specific adjustments per site name and custom climate parameters.

## 2.4 Field Adjustments

Field conditions required that a number of sites be moved to different locations due to lack of access (landowner permission, road condition, or accessibility by vehicle). In the Task 2. Sampling and Analysis Plan, fifty stream crossing field sites were identified with the intent that at least forty stream crossings and up to ten parallel sites would be assessed in the field. The resulting forty-three (43) assessment sites were selected in the field as shown on **Table A-3** and on **Figures 2 through 5**.

## 2.5 Mean Sediment Loads from Field Assessed Sites – Stream Crossings

Field assessment data and WEPP:Road modeling results were used to develop sediment loads based on various watershed criteria. A standard statistical breakdown of loads from the unpaved road network across all six watersheds was generated for each ownership class using the applicable dataset of field assessed crossing sites. Mean load and contributing length, median load, maximum and minimum loads, and $25^{th}$ and $75^{th}$ percentile loads were calculated for unpaved road crossings within each watershed and ownership type that was the basis of the field assessment. A statistical summary of sediment loads for field assessed sites are included in **Table 2-1**.

**Table 2-1. Sediment Load Summary for Field Assessed Crossings by Ownership**

| Statistical Parameter | Federal | Federal (USFS Roadless Area) | State | Private | Sum |
|---|---|---|---|---|---|
| Total Number of Crossings | 293 | 7 | 5 | 80 | 385 |
| Number of Sites (n) | 39 | 0 | 1 | 3 | 43 |
| Mean Contributing Length (ft) | 274.4 | N/A | 121.0 | 419.3 | |
| Mean Load (tons/year) | 0.14 | N/A | 0.02 | 0.23 | |
| Median Load (tons/year) | 0.02 | N/A | 0.02 | 0.15 | |
| Maximum Load (tons/year) | 1.49 | N/A | 0.02 | 0.49 | |
| Minimum Load (tons/year) | 0.00 | N/A | 0.02 | 0.04 | |
| 25th Percentile (tons/year) | 0.01 | N/A | 0.02 | 0.10 | |
| 75th Percentile (tons/year) | 0.10 | N/A | 0.02 | 0.32 | |

The sediment load summaries from ownership categories with greater than one site (Federal and Private) show significant differences between minimum and maximum load values, as well as between mean and median values. These data suggest that a small number of high sediment load crossing sites impact the average values.

For the purposes of estimating the sediment load from each road crossing in the Lower Clark Fork TPA, the average of all field sites by ownership category assumes that the random subset of crossings assessed as part of this study is representative of the road crossing conditions in each of the six watersheds. Due to accessibility issues, unpaved privately-owned road crossings were not assessed in the Bull River and White Pine Creek watersheds, and a privately-owned crossing was not randomly chosen in the Sampling and Analysis Plan for the Marten Creek watershed. The average result from stream crossings on privately owned land in the Swamp Creek and Elk Creek watersheds was used to represent the sediment load on private land.

The single crossing evaluated in Dry Creek contributed the most significant sediment load (1.49 tons/year) of the assessed sites due to its road length (700 feet) and high road gradient (15%). The method of averaging all federally-owned sites assumes that the fifteen crossings in Dry Creek are not contributing sediment at the same magnitude as the single assessed site. Additional investigation may be warranted in this watershed since the sediment load from the single crossing is much greater than the average annual sediment load. Craig Neesvig, District Hydrogeologist for the Cabinet Ranger District, stated that an assessment of the Federal roads is currently underway by the Watershed Council in the Dry Creek watershed. Mr. Neesvig attributed the sediment listing in Dry Creek due to its flashy nature and due to logging of large diameter cedar trees.

The random selection of sites as described in *Task 2. Sampling and Analysis Plan* (MDEQ 2009) did not select any of the Federal – Roadless crossings. Although the Roadless designation and remoteness would intuit a smaller average sediment load, site evaluation was not performed to support this theory. Without available data, the average sediment loads for Federal sites will be used for the seven crossings in the Federal – USFS Roadless Areas.

Mean sediment loads were also calculated and classified based on Kooteni National Forest (KNF) road classification and are compared to results from the Yakk River TPA. Road classifications are numerically categorized (1 – Impassable to Motorized Vehicles, 2 – Restricted / Legally Gated Admin Use, 3 – Barriered / Legally No Admin Use, and 4 – Open During Bear Season). The Yaak River TPA Unpaved Road Assessment has many similarities to this report: the field-assessment focused on listed watersheds only, the WEPP:Road model with the same climate stations was utilized, and both sites are located in the KNF. The similar order of magnitude of WEPP:Road results from the Class 2 and 4 roads suggests that the unpaved road condition may have been accurately characterized with a limited number of samples. Results are shown in **Table 2-2**.

**Table 2-2. Mean Sediment Loads by KNF Road Classification**

| KNF Road Classification (IGBC) Lower Clark Fork River TPA | Number of Sites Assessed | Mean Contributing Length (ft) | Mean Sediment Load (tons/yr) |
|---|---|---|---|
| 1 – Impassible to Motorized Vehicles | 0 | N/A | N/A |
| 2 – Restricted/Legally Gated Admin Use | 8 | 180 | 0.01 |
| 3 – Barriered/Legally No Admin Use | 0 | N/A | N/A |
| 4 – Open During Bear Season | 35 | 304 | 0.15 |
| **KNF Road Classification (IGBC) Yaak River TPA** | **Number of Sites Assessed** | **Mean Contributing Length (ft)** | **Mean Sediment Load (tons/yr)** |
| 1 – Impassible to Motorized Vehicles | 4 | 170 | 0.001 |
| 2 – Restricted/Legally Gated Admin Use | 15 | 268 | 0.06 |
| 3 – Barriered/Legally No Admin Use | 10 | 207 | 0.11 |
| 4 – Open During Bear Season | 18 | 451 | 0.60 |

## 2.6 Mean Sediment Loads from Field Assessed Sites – Parallel Segments

Mean sediment loads were calculated for parallel road segments in White Pine Creek watershed, Marten Creek watershed and Elk Creek watershed. Only two segments in Marten Creek were assessed on privately-owned land (MC-PP-05 and MC-PP-05). There was no observable or modeled difference between the private and Federal segments as shown in **Attachment D**. The parallel segments in Elk Creek were measured every 550 feet. It was noted that BMPs were in place every 300 to 400 feet along the road. Thus the average sediment load may be best characterized with the road length decreased to 400 feet (**Attachment E**) rather than at the road length of 550 feet as listed on the field worksheet. A summary of modeling results from field assessed sites is located in **Attachments D and E** and **Table 2-3**.

**Table 2-3. Sediment Load Summary from Unpaved Field Assessed Parallel Sites**

| Statistical Parameter | White Pine Creek | Marten Creek | Elk Creek |
|---|---|---|---|
| Number of Segments (n) | 5 | 6 | 8 |
| Mean Contributing Length (ft) | 573.3 | 843.5 | 300.9[A] |
| Mean Road Gradient (%) | 6.8 | 2.3 | 7.1 |
| Mean Buffer Length (ft) | 103.7 | 110.8 | 28.2 |
| Mean Buffer Gradient (%)[B] | 0.7 | 0.9 | 29.3 |
| Mean Load (tons/year/mile) | 0.095 | 0.002 | 2.10 |
| Median Load (tons/year/mile) | 0.00 | 0.00 | 2.44 |
| Maximum Load (tons/mile/ year) | 0.414 | 0.010 | 3.85 |
| Minimum Load (tons/year/mile) | 0.00 | 0.00 | 0.00 |

[A]Road Lengths for ELF-FS-06 (4 segments) were decreased to 400 feet due to existing BMPs.

[B]A minimum value of 0.3 % was used for buffer gradients that could not be measured in the field.

These results indicate that sediment load per mile per year is dependent on road length and gradient and the buffer length and gradient. The sediment load did not appear to be dependent on ownership management of the parallel segments based on the Marten Creek segments.

## 2.7 Paved Parallel Roads

As shown in **Figure 6**, few of the parallel roads are paved. Winter maintenance of the roads is divided between county and state responsibility. The Sanders County Road Department, District 3 applies traction sand to the paved, graveled and native surfaced roads near Trout Creek, Noxon and Heron (Elk Creek Watershed) due to regular use and steep gradients of the roads. The traction sand, of glacier deposit origin, is taken from the White Pine Creek or Elk Creek watershed; the coarser material is used on gravel roads in the summer. The quantity of sand applied to the roads was estimated as 10 cubic yards for 85 lane miles (42.5 road miles, **0.28 tons/mile**). The Sanders County Road Department usually plows and re-applies traction sand every day (depending on snowfall) for four to five months in the winter. This would equate to **28 tons/mile/year** assuming a five day workweek, for five months. The Noxon Section, Montana Department of Transportation (MDT) estimates that 10 cubic yards of sand was applied to 15 miles of road along the Bull River (**0.83 tons/mile**); however MDT has discontinued the use of sand in favor of using salt. Conversions were calculated with an assumed bulk density of 1.25 tons per cubic yard.

The Blackfoot Headwaters TPA Unpaved Road assessment assumed a delivery rate of 5% for roads within 100 feet and 10% for roads within 200 feet of surface water. Per the report, a comparison with a study in Vail Pass, Colorado suggested that as much as 30% of traction sand was delivered to the nearby surface water. Per **Figure 6**, discussions with the State and County Road Departments, and the Vail Pass, Colorado study, traction sand may be delivered to surface waters within the Elk River watershed.

# 3.0 UNPAVED ROAD NETWORK LOAD ANALYSIS-

The annual mean sediment loads from field assessed sites for unpaved road crossings and parallel segments were extrapolated to the six specific watersheds: Bull River, Dry Creek, Elk Creek, Marten Creek, White Pine Creek and Swamp Creek. Results indicate that the greatest sediment is produced from Federally-owned roads due to the sheer quantity of Federal roads; however the sediment load per crossing was greater on private land.

Sediment load results were also compared to the USDA NRCS Soil Hazard Classification and the results from this study did not appear to correlate with hazard class, which is likely due to the greater sensitivity of the WEPP:road model to road length for specific high-load crossings in the Lower Clark Fork TPA rather than to the variables of the USDA NRCS rating system (soil erosion factor K, slope, and content of rock fragments).

A fish passage evaluation was completed for field-assessed culverts using the criteria listed in Table 1 of the document *A Summary of Technical Considerations to Minimize the Blockage of Fish at Culverts on National Forests in Alaska* (USFS, September 27, 2002). Few culverts passed the fish passage evaluation due to steep culvert gradients and minimal constriction ratios.

## 3.1 Sediment Load from Road Crossings - Extrapolation to Watershed Scale

The road network was classified by major landowner within each watershed, as various entities and administrative controls direct operation and maintenance of the road network. Three major landowner classifications were developed: Federal lands, State of Montana, and private landowners. Mean sediment loads from field assessed sites were used to extrapolate existing loads for each ownership class in each listed watershed. Extrapolation of these results to the remainder of road crossings assumes that the random subset of crossings assessed as part of this study is representative of the each of the six watersheds.

The total extrapolated annual sediment load for each listed watershed from Unpaved Road Crossing is shown in **Table 3-1**. Detailed sediment loads for road crossings classified by ownership within each subwatershed are included in **Table A-4**.

**Table 3-1. Extrapolated Sediment Load Summary from Unpaved Road Crossings – Existing Conditions**

| Sub Watershed | Total Number of Crossings | Total Number of Assessed Crossings | Total Sediment Load (t/y) |
|---|---|---|---|
| Bull River | 111 | 12 | 16.65 |
| Dry Creek | 17 | 1 | 2.38 |
| Elk Creek | 98 | 11 | 17.86 |
| Marten Creek | 82 | 10 | 11.66 |
| Swamp Creek | 15 | 1 | 2.91 |
| White Pine Creek | 62 | 7 | 9.04 |

Road crossing extrapolation results showed that the Elk Creek (17.86 tons/year) and the Bull River (16.65 tons/year) contained the two highest sediment loads from unpaved road crossings. In the six watersheds, the majority of sediment load is generated from crossings on Federal land (42.0 tons/year, 300 crossings), followed by private land (18.4 tons/year, 80 crossings), and State land (0.1 tons/year, 5 crossings).

## 3.2 Sediment Load from Parallel Segments - Extrapolation to Watershed Scale

Mean sediment loads per mile per year were calculated for parallel road segments in White Pine Creek watershed, Marten Creek watershed and Elk Creek watershed as stated in **Section 2.6**. The annual sediment load from each parallel segment was normalized to a per mile sediment load (**Table 2-3**); the normalized results were averaged to represent the six watersheds (**Table 3-2**). Extrapolation of these results to the remainder of parallel segments assumes that the random subset of parallel segments assessed as part of this study is representative of the larger watershed. The results in **Section 2.6** show the dependence of the sediment load on road and buffer characteristics.

**Table 3-2. Sediment Load Extrapolation From Unpaved Parallel Segments by HUC/303(d) Subwatershed – Existing Conditions**

| Watershed | Unpaved Roads w/in 100 ft of Stream (Mi) | Average Sediment Load per mile (t/y/mile) | Total Sediment Load (t/y) |
|---|---|---|---|
| Elk Creek[A] | 6.78 | 0.843 | 5.72 |
| Marten Creek | 4.91 | 0.843 | 4.14 |
| White Pine Creek | 4.12 | 0.843 | 3.47 |
| Bull River (without Dry Creek) | 6.06 | 0.843 | 5.11 |
| Dry Creek | 0.79 | 0.843 | 0.67 |
| Swamp Creek | 0.99 | 0.843 | 0.83 |
| [A]Elk Creek parallel segments had existing BMPs every 300 to 400 feet. The modeled results from WEPP: Road with the contributing length reduced to every 400 feet were utilized in the report and in this table. | | | |

## 3.3 Sediment Load from Road Crossings – USDA / NRCS Soil Hazard Classification

Soil types were downloaded from USDA – NRCS Soil Web Survey as a possible tool to predict where problem culverts may occur. Within the Soil Data Mart tool provided from USDA-NRCS, there is a Hazard of Erosion and Suitability for Roads on Forestland category from which the hazard of erosion on roads and trails is detailed for each soil type. The soils in the Lower Clark Fork TPA include a range of slight, moderate, and severe hazard classifications and the rating system is based on the soil erosion factor K, slope, and content of rock fragments of each soil component. Many of the road crossings were assessed on the same soil unit (e.g. four crossings were assessed on USDA NRCS soil map unit 112, severe hazard classification, Eutric Glossoboralfs, lacustrine terraces).

WEPP:Road sediment load results were compared to the specific soil identified in the USDA NRC soil survey. The average annual sediment load results were highest in the slight and moderate Soil Hazard Classifications. The results were compared to the WEPP:Roads input for traffic level, gravel surface addition, fillslope gradient, rock content, road length (**Figure 7**) and road gradient. Road gradient and rock fragment (of the native road surface) varied within a single soil type. The results from this study did not appear to correlate with hazard class, which is likely due to the greater sensitivity of the WEPP:road model to road length for the specific high-load crossings in the Lower Clark Fork TPA rather than to road gradient or to rock content per the USDA NRCS rating system.

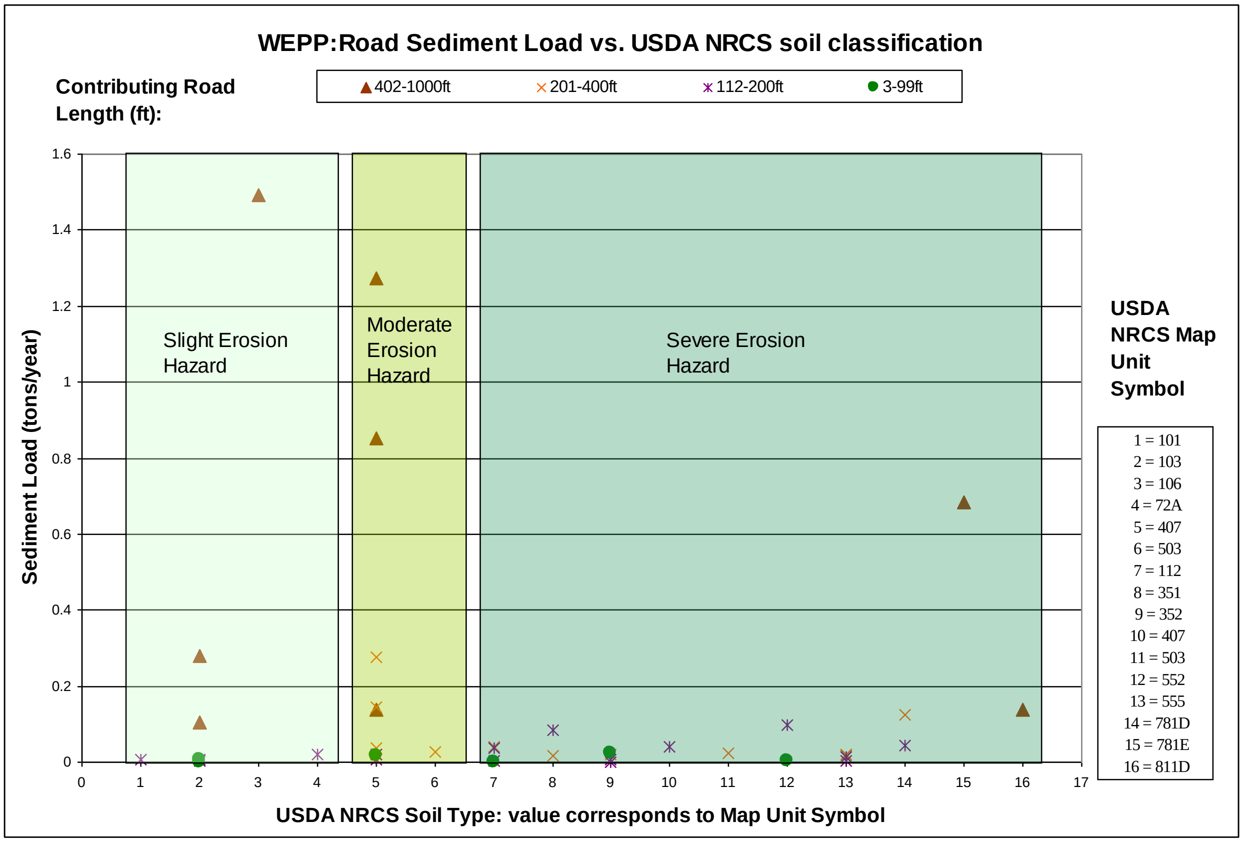


**Figure 7. WEPP:Road Sediment Results for each USDA NRCS Soil Unit**

## 3.4 Culvert Assessment – Fish Passage

Culverts were analyzed for their ability to allow for fish passage. Of the 43 field assessed road crossing sites, field sites with bridges, along with any sites where any of the required screening data could not be accurately collected were removed from the dataset. After removing these sites from the dataset, thirty five (35) culverts were determined to be suitable for fish passage assessment.

Measurements were collected at each field assessed crossing site, and these values were used to determine if culverts represented fish passage barriers at various flow conditions. The fish passage evaluation was completed using the criteria listed in Table 1 of the document *A Summary of Technical Considerations to Minimize the Blockage of Fish at Culverts on National Forests in Alaska* (USFS, September 27, 2002). The analysis uses site-specific information to classify culverts as green (passing all life stages of salmonids), red (partial or total barrier to salmonids), or grey (needs additional analysis). Indicators used in the classification are the ratio of the culvert width to bankfull width (constriction ratio), culvert slope, and outlet drop, with large (>48-inches) and small (<48-inches) culvert groups evaluated differently. Failure of any one of the three indicators results in a red classification. Using the Alaska fish passage analysis, 33 of 35 culverts (94%) were classified as partial or total fish barriers, and 2 of 35 (6%) were classified as needing additional evaluation. None of the field assessed culverts were classified as capable of passing fish at all flows and life stages (**Table 3-3**). The predominant cause for preventing fish passage was steep gradient across the culvert and minimal constriction ratios.

**Table 3-3. Fish Passage Analysis for Selected Culverts Using Alaska Region Criteria**

| Culvert Classification or Indicator | Definition of Indicator | Number of Culverts | Percentage of Total Culverts Assessed (n = 35) |
|---|---|---|---|
| **Green** | High certainty of meeting juvenile fish passage at all flows | 0 | 0% |
| **Grey** | Additional and more detailed analysis is required to determine juvenile fish passage ability | 2 | 6% |
| **Red** | High certainty of not providing juvenile fish passage at all desired stream flows | 33 | 94% |

The eight crossings that could not be assessed for fish passage were due to the lack of a culvert (4 crossings: cattle guard, bridge, concrete pads, overland flow), bankfull width was not defined on a vegetated drainage swale (1 culvert) and the perch height of the culvert outlet was not recorded (3 culverts) due to the inability to see the outlet (steep gradients from 12 – 26%). The Montana Fish Wildlife & Parks (MFWP), GIS Layer *Fish Species Distribution – Streams* indicates that fish are present at only seven of the 43 stream crossing sites. GIS Metadata was updated 1999 – 2009 and notes that the absence of species on the GIS layer is not evidence of absence of fish in a stream. One of the seven crossings was not assessed for fish passage due to the presence of concrete pads; discussion of the remaining six sites are highlighted in a brown color in the comments section of **Table A-5.** Only 19 of the 35 culverts had visual stream flow during the visit. The flow was visually estimated and ranged from 0.2 cfs to 6 cfs. In addition to the six actively flowing and fish-bearing streams identified by MFWP, the 13 road crossings with active water flow are highlighted in yellow in the comments column in **Table A-5.**

# 4.0 APPLICATION OF BEST MANAGEMENT PRACTICES

Sediment impacts are widespread throughout the Lower Clark Fork River TMDL Planning Area, and sediment loading from the unpaved road network is one of several sources within the watershed. Application of Best Management Practices (BMPs) on the unpaved road network will result in a decrease in sediment loading to streams. BMP sediment reduction was evaluated based on a reduction in contributing road length.

The selected scenario for estimating sediment load reductions was calculated by assuming a uniform reduction in contributing road length to 200-feet for each unpaved crossing. Due to the extent of the unpaved road network and the resulting inability to assess it in its entirety, generalized assumptions are necessary for modeling the effects of BMPs. Restoration efforts would need to consider site-specific BMPs that, on average, would likely be represented by the modeling assumptions. Other management issues that will impact BMP scenarios are the ability to perform restoration work within the different land ownership categories.

## 4.1 Contributing Road Length Reduction Scenario

A contributing road length reduction scenario for road crossings was selected assuming a total road length reduction to 200 feet (100-feet on each road for a crossing with two contributing roads). On crossing locations in excess of this length reduction scenario, road lengths were reduced to the corresponding post-BMP scenario of 200-feet. No changes were made to crossing locations where the contributing road length was less than the 200-foot BMP reduction scenario. The 200-foot BMP scenario was evaluated using the WEPP:Road model, so potential sediment load reductions could be estimated. The results are shown in **Attachment E**. Average annual reduced mean sediment loads were then extrapolated to the entire watershed in the same manner in which the existing sediment loads were calculated. Estimated summary load reductions by watershed are show in **Table 4-1**. Detailed calculations are shown in **Table A-6.**

**Table 4-1. Extrapolated Sediment Load Summary from Unpaved Road Crossings – Road Length Reduction**

| Watershed | Total Number of Sites | Existing Conditions - Total Sediment Load (t/y) | BMP Conditions - Total Sediment Load (t/y) | Load Reduction % |
|---|---|---|---|---|
| Bull River | 111 | 16.65 | 4.91 | 71% |
| Dry Creek | 17 | 2.38 | 0.68 | 71% |
| Elk Creek | 98 | 17.86 | 5.30 | 70% |
| Marten Creek | 82 | 11.66 | 3.34 | 71% |
| Swamp Creek | 15 | 2.91 | 0.87 | 70% |
| White Pine Creek | 62 | 9.04 | 2.60 | 71% |

Total sediment load from road crossings would be approximately 70%, assuming all sites were fully BMP’d.

Parallel segments were modeled with a road length reduction to 400 feet (**Attachment E**). The presence of BMPs was noted in the Elk Creek watershed and WEPP:Road results from Attachment D were utilized for watershed extrapolation in **Table 3-2**. Further extrapolation is possible through a uniform road length reduction of Marten Creek (0.003 tons/mile/year) and White Pine Creek (0.072 tons/mile/year) segments. This would result in an average normalized sediment yield of 0.797 tons/year/mile across all parallel segments assessed in the field with contributing road lengths less than 400 feet.

## 4.2 Assessment of Existing BMPs

As an alternative to or in combination with reductions in contributing road length, other potential BMPs are available that would reduce sediment loading from the unpaved road network. Road sediment reduction strategies such as the installation of full structural BMPs at existing road crossings (drive through dips, culvert drains, settling basins, silt fence, etc), road surface improvement, reduction in road traffic levels (seasonal or permanent road closures), and timely road maintenance to reduce surface rutting are all BMPs that would lead to reduced sediment loading from the road network.

The presence of BMPs was noted for each of the field-assessed stream crossing sites. Of the 43 sites, 25 had at least one of the following: graveled surface, water bar, culvert drain, or drive through dip. Sample sizes for each category are included in the legend on the graph. Results are shown in **Figure 8**.

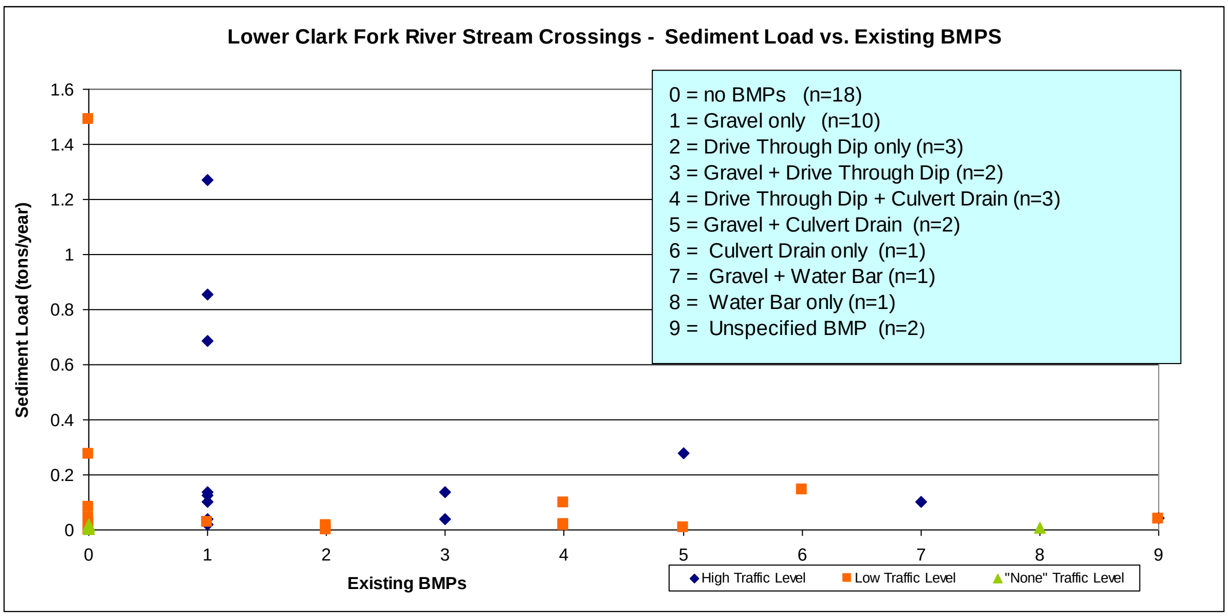


**Figure 8. WEPP:Road Sediment Results for each BMP Category**

The sediment yield for each crossing was impacted by the road surface (gravel or native) and the traffic level (high, low or none) in the WEPP model. Conclusions from Figure 8 are preliminary due to the small sample sizes; however it appears that the minimized traffic reduces sediment yield regardless of the presence of BMPs (with the exception of the Dry Creek crossing which had a significant road length (700 feet) and road gradient (15%). The presence of gravel did not appear to decrease sediment yield; however this may be due more to traffic level than to the presence of gravel, as noted in the comparison of the following categories: 0&1, 2&3, and 5&6. Drive-through dips, culvert drains and water bars appeared to be equally effective for the Lower Clark Fork River assessed crossings. WEPP software does not allow for specific modeling of BMPs and the results may not completely indicate effectiveness.

# 5.0 QUALITY ASSURANCE / QUALITY CONTROL RESULTS

## 5.1 Representativeness

Representativeness refers to the extent to which measurements represent an environmental condition in time and space. Spatial representation was achieved through the Lower Clark Fork Roads field assessment. Fifty sites were randomly selected through GIS based on watershed and ownership categories with the intent that at least forty sites would be assessed. A total of 43 road crossings were assessed in the field. Spatial representation is shown in **Table A-3**. Adequate coverage of Federal and State ownership was achieved in the six watersheds. Only three crossings were assessed on privately owned land out of a total of 80 crossings. The average sediment yield for crossings on private land may warrant additional research.

All forty-three field sites were located on Kootenai National Forest Road Classes: 2 – Restricted / Legally Gated Admin Use, and 4 – Open During Bear Season. Class 1 and 3 roads were not assessed with this report.

The single crossing evaluated in Dry Creek contributed the most significant sediment load (1.49 tons/year) of the assessed sites due to the road length (700 feet) and high road gradient (15%). Additional investigation may be warranted in this watershed since the annual sediment load is much greater than the average annual sediment load on Federal property.

Temporal variations were not accounted for in this study, as the field data collected at road crossing locations does not change during the year.

## 5.2 Comparability

Comparability is the applicability of the project's data to the WEPP:Road model input data. The WEPP:Road model includes a high and low data value for each input parameter. Field data was compared to the model input range and those sites with data outside these ranges were flagged for additional evaluation through the review of photographs, field comments, personal communication and other field data. No sites were determined to be unacceptable for use in the model. A review of comparability of field data is shown in **Table A-7**.

## 5.3 Completeness

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

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

The overall project goal is 90% completeness. A total of 43 sites were assessed in the field. As documented in **Table A-7**, and **Attachment C,** all sites were deemed valid through data adjustments based on comments, phone conversations with the field crew and through analysis of photographs for input into the WEPP:Road model. This equates to a completeness of 100%.

# 6.0 REFERENCES

MDEQ 2007. Unpaved Road Sediment Assessment Yaak River TMDL Planning Area, October 2007, Prepared by Water & Environmental Technologies, PC. Prepared for Montana Department of Environmental Quality, Water Quality Planning Bureau, Helena, Montana.

MDEQ 2009. Task 1. Road GIS & Summary Statistics, Lower Clark Fork River TPA. Prepared by Water & Environmental Technologies, PC. Prepared for Montana Department of Environmental Quality, Water Quality Planning Bureau, Helena, Montana.

MDEQ 2009. Task 2. Sampling and Analysis Plan, Lower Clark Fork River TPA. Prepared by Water & Environmental Technologies, PC. Prepared for Montana Department of Environmental Quality, Water Quality Planning Bureau, Helena, Montana.

Inland Native Fish Strategy, Environmental Assessment. 1995. Decision notice and finding of no significant impact. U.S. Department of Agriculture, Forest Service, Intermountain, Northern, and Pacific Northwest Regions.

USDA Forest Service 1999. FS WEPP - Forest Service Interfaces for the Water Erosion Prediction Project Computer Model. Rocky Mountain Research Station and San Dimas Technology and Development Center.

Elliott, William J, PE, PhD, Team Leader, Rocky Mountain Research Station, Moscow, ID - personal communication.

**Traction Sand References:**

Kuhn, Don, Sanders County Road Department, District 3– personal communication, 406-827-3691

Nelson, Bill, Montana Department of Transportation, Noxon Section- personal communication, 406-847-2650.

Traction Sand Material Safety Data Sheet, 2006, http://lanemt.com/msds.htm, last assessed March, 11, 2009.

# FIGURES

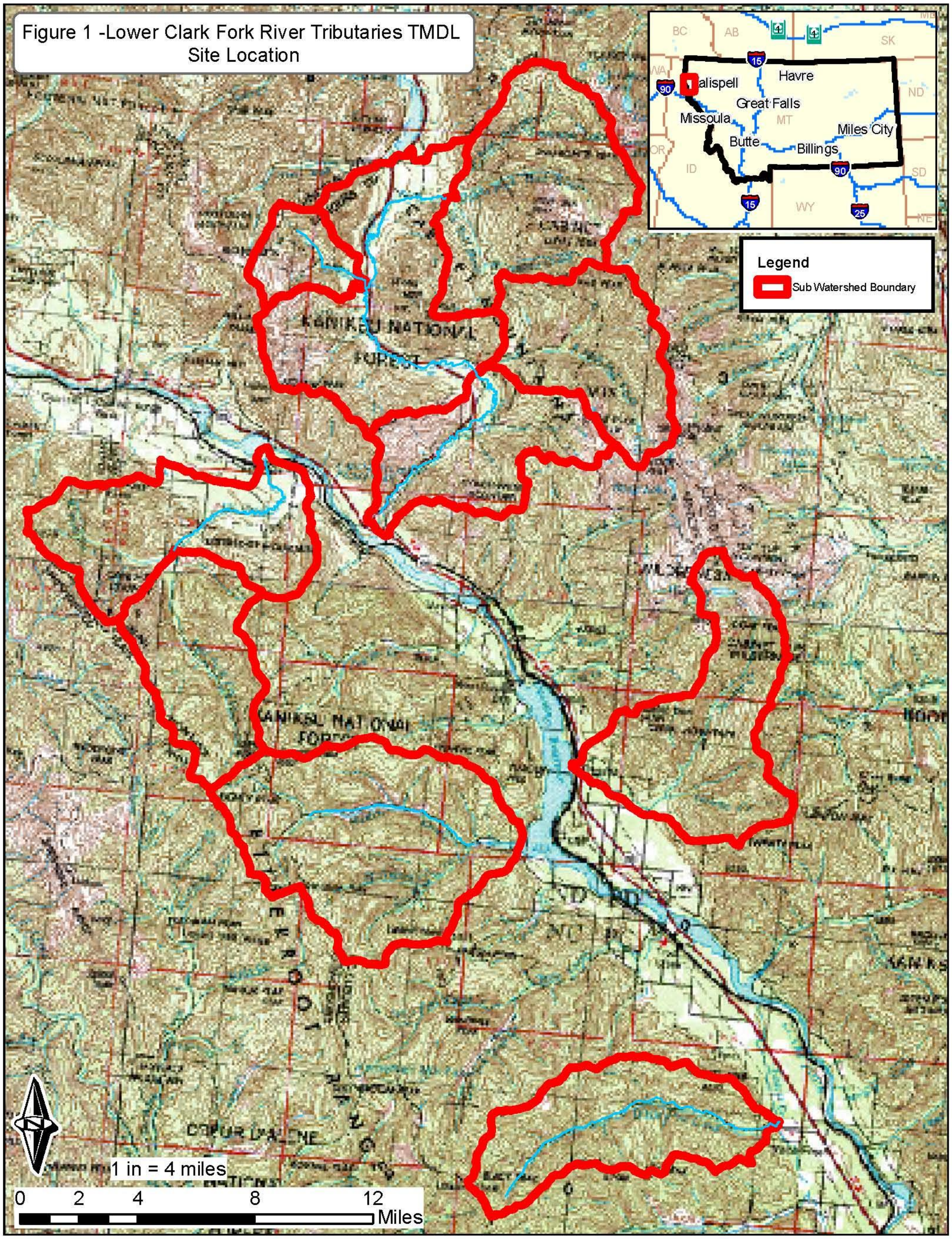
Figure 1 -Lower Clark Fork River Tributaries TMDL
Site Location
Legend
Sub Watershed Boundary
Kalispell
Havre
Great Falls
Missoula
MT
Butte
Billings
Miles City
BC
AB
SK
WA
ND
OR
ID
WY
SD
NE
1 in = 4 miles
0 2 4 8 12
Miles

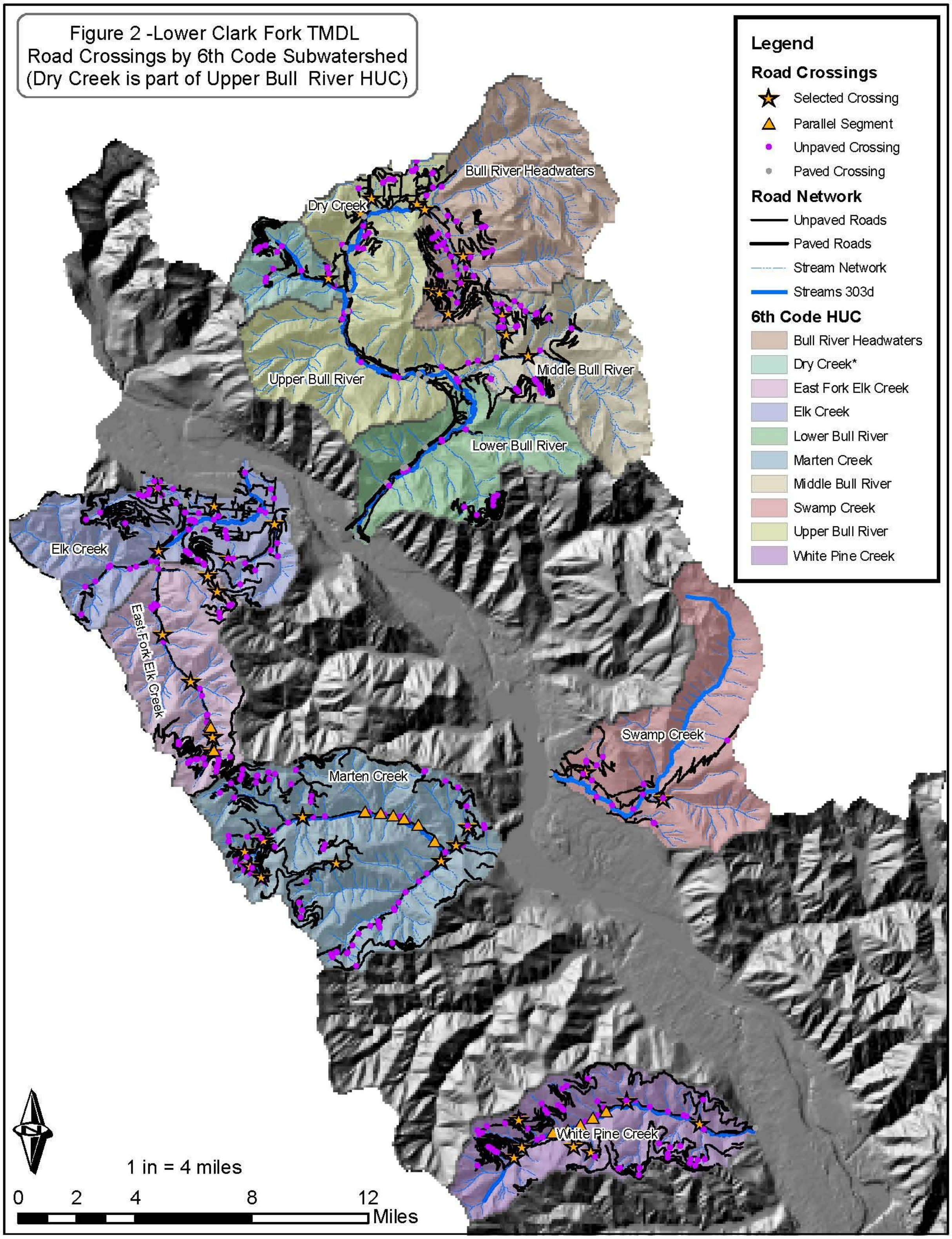
Figure 2 -Lower Clark Fork TMDL
Road Crossings by 6th Code Subwatershed
(Dry Creek is part of Upper Bull River HUC)
Legend
Road Crossings
Selected Crossing
Parallel Segment
Unpaved Crossing
Paved Crossing
Road Network
Unpaved Roads
Paved Roads
Stream Network
Streams 303d
6th Code HUC
Bull River Headwaters
Dry Creek*
East Fork Elk Creek
Elk Creek
Lower Bull River
Marten Creek
Middle Bull River
Swamp Creek
Upper Bull River
White Pine Creek
Bull River Headwaters
Dry Creek
Upper Bull River
Middle Bull River
Lower Bull River
Elk Creek
East Fork Elk Creek
Swamp Creek
Marten Creek
White Pine Creek
N
1 in = 4 miles
0 2 4 8 12
Miles

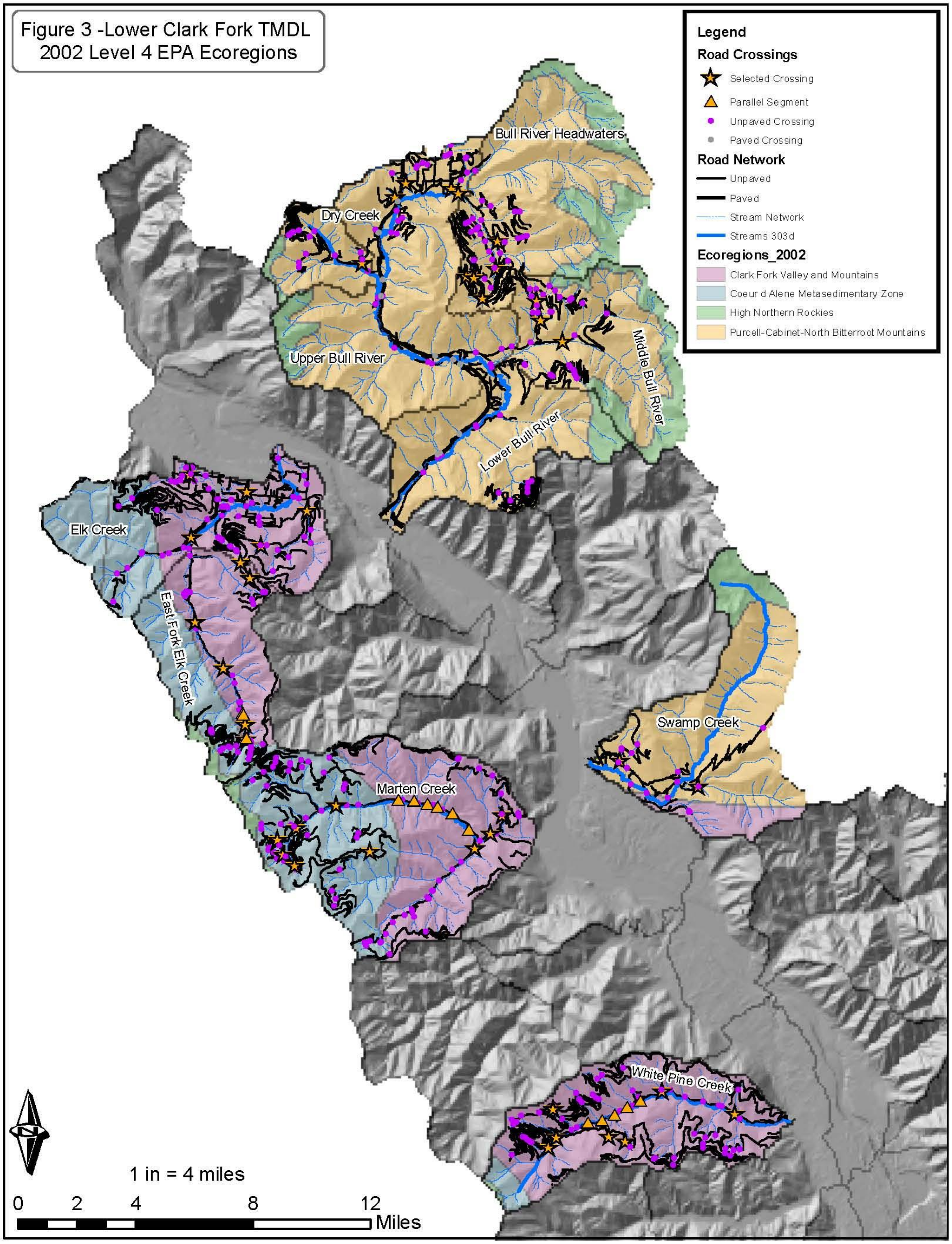
Figure 3 -Lower Clark Fork TMDL
2002 Level 4 EPA Ecoregions
Legend
Road Crossings
Selected Crossing
Parallel Segment
Unpaved Crossing
Paved Crossing
Road Network
Unpaved
Paved
Stream Network
Streams 303d
Ecoregions_2002
Clark Fork Valley and Mountains
Coeur d Alene Metasedimentary Zone
High Northern Rockies
Purcell-Cabinet-North Bitterroot Mountains
Bull River Headwaters
Dry Creek
Upper Bull River
Middle Bull River
Lower Bull River
Elk Creek
East Fork Elk Creek
Marten Creek
Swamp Creek
White Pine Creek
1 in = 4 miles
0 2 4 8 12
Miles

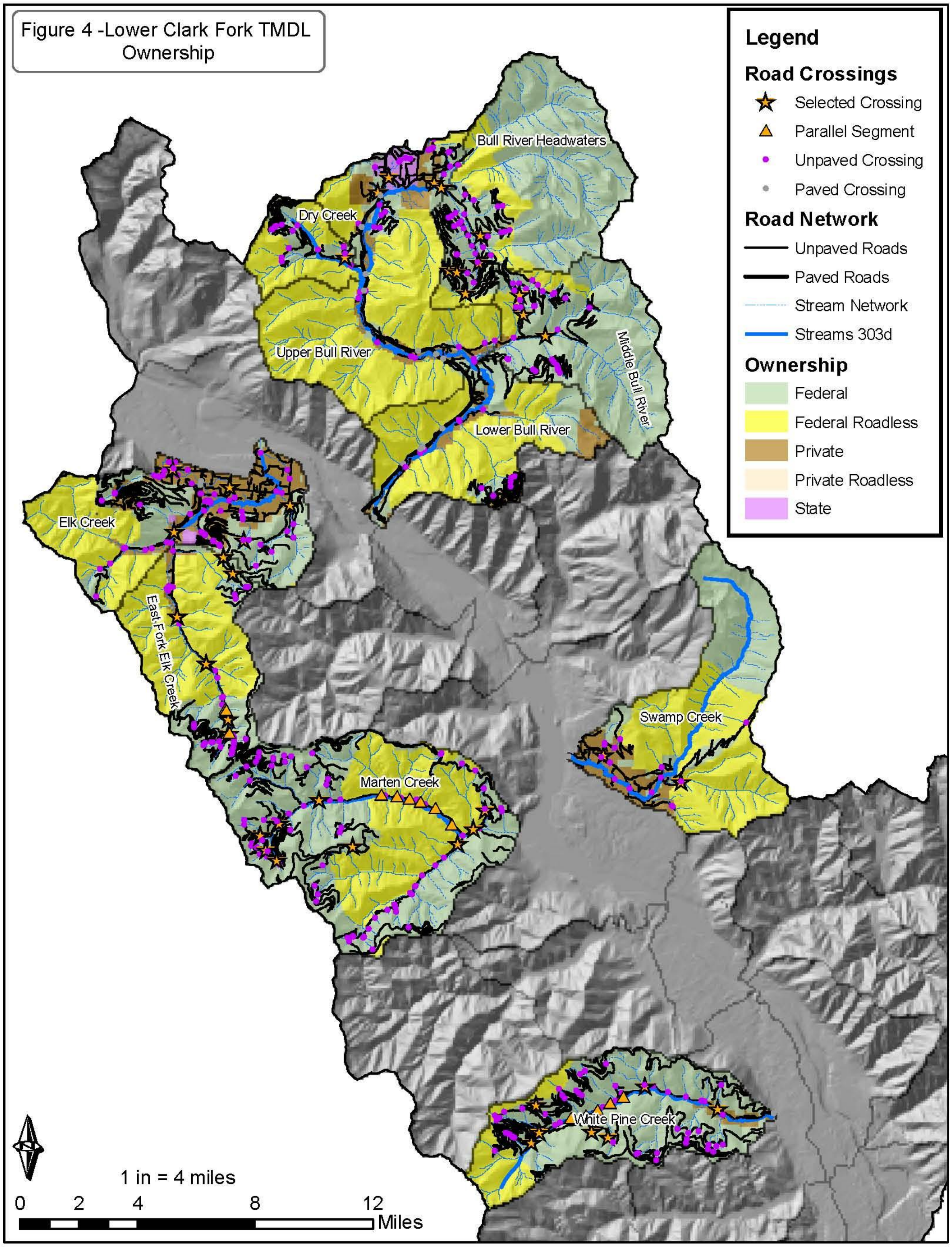
Figure 4 -Lower Clark Fork TMDL
Ownership
Legend
Road Crossings
Selected Crossing
Parallel Segment
Unpaved Crossing
Paved Crossing
Road Network
Unpaved Roads
Paved Roads
Stream Network
Streams 303d
Ownership
Federal
Federal Roadless
Private
Private Roadless
State
Bull River Headwaters
Dry Creek
Upper Bull River
Middle Bull River
Lower Bull River
Elk Creek
East Fork Elk Creek
Swamp Creek
Marten Creek
White Pine Creek
1 in = 4 miles
0
2
4
8
12
Miles

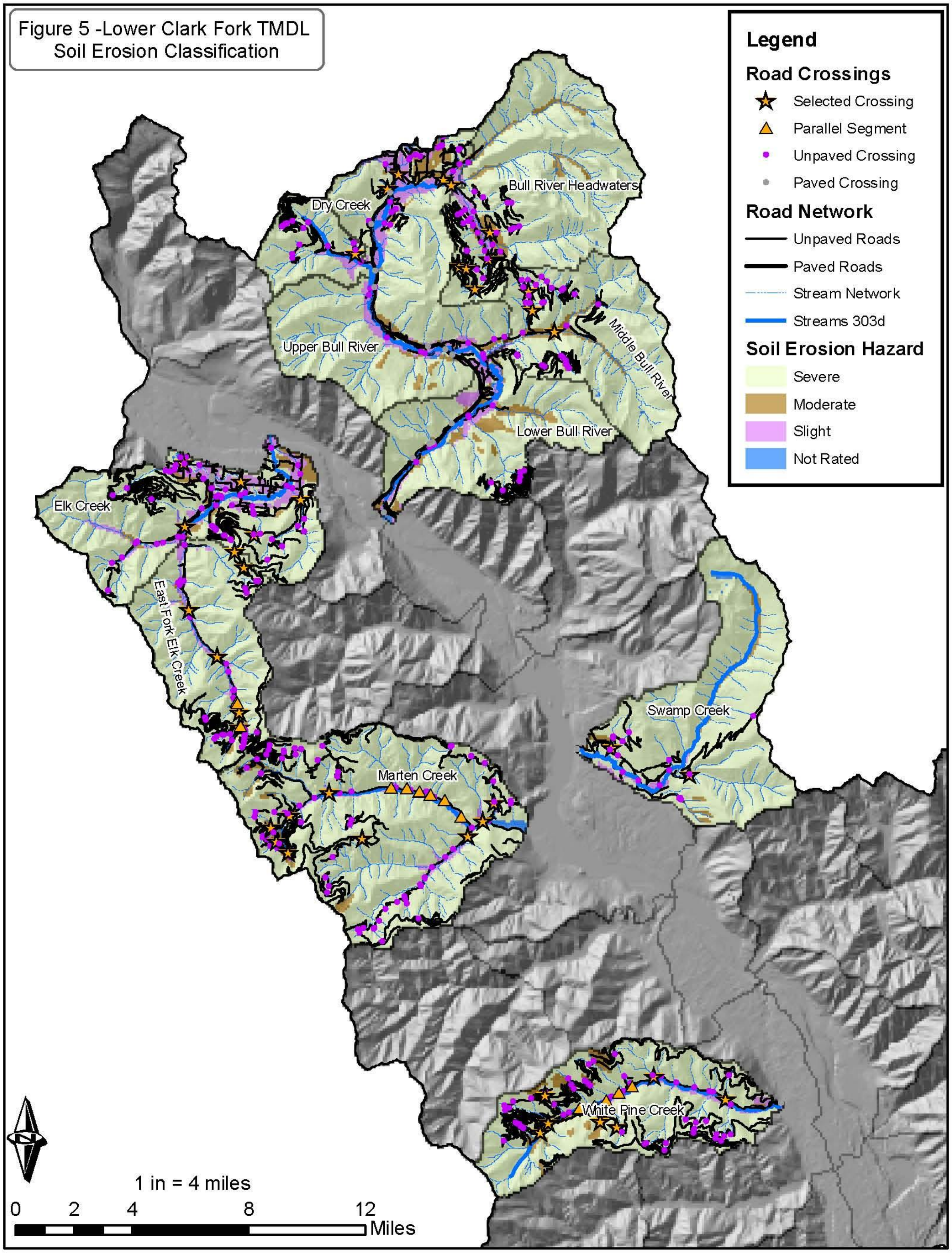
Figure 5 -Lower Clark Fork TMDL
Soil Erosion Classification
Legend
Road Crossings
Selected Crossing
Parallel Segment
Unpaved Crossing
Paved Crossing
Road Network
Unpaved Roads
Paved Roads
Stream Network
Streams 303d
Soil Erosion Hazard
Severe
Moderate
Slight
Not Rated
Bull River Headwaters
Dry Creek
Upper Bull River
Middle Bull River
Lower Bull River
Elk Creek
East Fork Elk Creek
Swamp Creek
Marten Creek
White Pine Creek
1 in = 4 miles
0 2 4 8 12
Miles

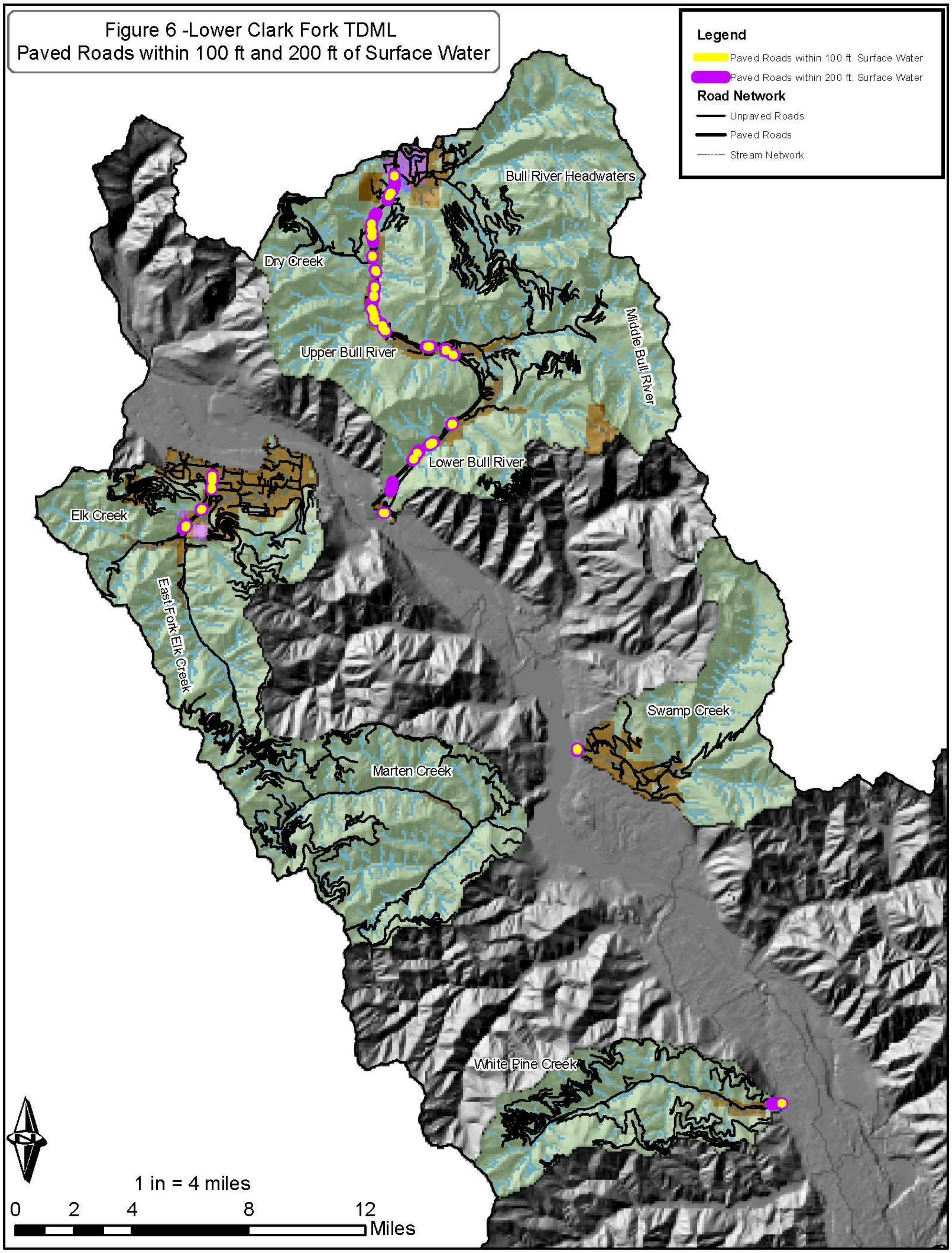
Figure 6 -Lower Clark Fork TDML
Paved Roads within 100 ft and 200 ft of Surface Water
Legend
Paved Roads within 100 ft. Surface Water
Paved Roads within 200 ft. Surface Water
Road Network
Unpaved Roads
Paved Roads
Stream Network
Bull River Headwaters
Dry Creek
Upper Bull River
Middle Bull River
Lower Bull River
Elk Creek
East Fork Elk Creek
Swamp Creek
Marten Creek
White Pine Creek
1 in = 4 miles
0
2
4
8
12
Miles

# ATTACHMENT A

## Attached Tables

**Table A-1. Sediment Listed Stream Segments – Lower Clark Fork River TPA**

| **Waterbody** MT76N003_() | **Stream Length (mi)** | **Most Recent 303(d) Listing** | **Impairment Listing** | **Probable Causes** |
|---|---|---|---|---|
| Bull River (040) | 24.7 | 2008 | Sediment/Siltation, Physical substrate habitat alterations | ▪ Silviculture Activities<br>▪ Streambank Modifications / destabilization |
| Dry Creek (180) | 3.5 | 2008 | Sediment/Siltation | ▪ Forest Roads (Road Construction and Use) |
| Marten Creek (090) | 6.7 | 2008 | Sediment/Siltation, Physical substrate habitat alterations | ▪ Forest Roads (Road Construction and Use)<br>▪ Silviculture Activities<br>▪ Streambank Modifications / destabilization |
| White Pine Creek (120) | 11.9 | 2008 | Sediment/Siltation Alteration in stream-side or littoral vegetative covers | ▪ Forest Roads (Road Construction and Use)<br>▪ Grazing in Riparian or Shoreline Zones<br>▪ Natural Sources<br>▪ Silviculture<br>▪ Streambank Modifications/destabilization<br>▪ Watershed Runoff following Forest Fire |
| Elk Creek (060) | 8.1 | 2006 | Sediment/Siltation | ▪ Grazing in Riparian or Shoreline Zones<br>▪ Habitat Modification – other than Hydromodification |
| Swamp Creek (160) | 13.9 | 2006 | Sediment/Siltation | ▪ Insufficient data to assess |

**Table A-2. Road Summary by Subwatershed, Land Ownership, USDA NRCS Soil Erosion Hazard Classification and Road Type**

**Table. A-2a. Lower Clark Fork Tributaries 303(d) Listed Streams Road Summary by 6th Code Subwatershed (USGS HUC 12)**

| 6th Code Subwatershed (USGS HUC 12) | Area ($Mi^2$) | Stream Miles (Mi) | Unpaved Crossings | Unpaved Crossing Density (Crossing / $Mi^2$) | Paved Crossings | Total Crossings | Total Road Length (Mi) | Total Road Density ($Mi/Mi^2$) | % of Total Roads which are unpaved | Total Unpaved Road Length w/in 100 ft Streams (Mi) | Total Unpaved Road Density w/in 100 ft of Streams ($Mi/Mi^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bull River Headwaters | 43.10 | 97.85 | 35 | 0.81 | 0 | 35 | 51.40 | 1.19 | 100% | 1.12 | 0.03 |
| Lower Bull River | 41.57 | 68.48 | 13 | 0.31 | 5 | 18 | 44.96 | 1.08 | 81.2% | 1.04 | 0.02 |
| Middle Bull River | 28.65 | 61.97 | 30 | 1.05 | 0 | 30 | 43.14 | 1.51 | 100% | 1.83 | 0.06 |
| Upper Bull River (without Dry Creek) | 76.34 | 148.09 | 33 | 0.43 | 7 | 40 | 53.07 | 0.70 | 81.3% | 2.08 | 0.03 |
| Dry Creek | 14.13 | 31.68 | 17 | 1.20 | 0 | 17 | 26.36 | 1.86 | 100% | 0.79 | 0.06 |
| Bull River Watershed | 203.79 | 408.07 | 128 | 0.63 | 12 | 140 | 218.93 | 1.07 | 91.6% | 6.86 | 0.03 |
| East Fork Elk Creek | 41.82 | 84.02 | 39 | 0.93 | 0 | 39 | 49.17 | 1.18 | 100% | 3.23 | 0.08 |
| Elk Creek | 42.54 | 76.00 | 59 | 1.39 | 5 | 64 | 113.29 | 2.66 | 97.0% | 3.55 | 0.08 |
| Elk Creek Watershed | 84.36 | 160.02 | 98 | 1.16 | 5 | 103 | 162.46 | 1.93 | 97.9% | 6.78 | 0.08 |
| Marten Creek | 71.06 | 143.52 | 82 | 1.15 | 0 | 82 | 133.99 | 1.89 | 100% | 4.91 | 0.07 |
| Swamp Creek | 54.67 | 98.21 | 15 | 0.27 | 1 | 16 | 31.24 | 0.57 | 99.5% | 0.99 | 0.02 |
| White Pine Creek | 36.19 | 70.90 | 62 | 1.71 | 1 | 63 | 117.98 | 3.26 | 99.7% | 4.12 | 0.11 |

**Table A-2b. Road Summary by Land Ownership**

| Sub Watershed | Land Ownership | Area ($Mi^2$) | Stream Miles (Mi) | Unpaved Crossings | Unpaved Crossing Density (Crossing / $Mi^2$) | Paved Crossings | Total Crossings | Total Road Length (Mi) | Total Road Density ($Mi/Mi^2$) | % of Total Roads which are unpaved | Total Unpaved Road Length w/in 100 ft Streams (Mi) | Total Unpaved Road Density w/in 100 ft of Streams ($Mi/Mi^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bull River - Headwaters<br>Lower Bull River<br>Middle Bull River<br>Upper Bull River | Federal | 122.75 | 249.62 | 85 | 0.69 | 1 | 86 | 141.22 | 1.15 | 96% | 4.07 | 0.03 |
| | Federal-Roadless | 55.98 | 93.12 | 2 | 0.04 | 0 | 2 | 1.24 | 0.02 | 90% | 0.23 | 0.00 |
| | Private - Roadless | 0.09 | 0.08 | 0 | 0.00 | 0 | 0 | 0.43 | 4.75 | 7% | 0.00 | 0.00 |
| | Private | 9.25 | 29.86 | 19 | 2.05 | 11 | 30 | 41.38 | 4.47 | 71% | 1.13 | 0.12 |
| | State | 1.60 | 3.70 | 5 | 3.13 | 0 | 5 | 8.31 | 5.20 | 93% | 0.62 | 0.39 |
| | Total | 189.67 | 376.38 | 111 | 0.59 | 12 | 123 | 192.57 | 1.02 | 90% | 6.06 | 0.03 |
| Dry Creek | Federal | 8.47 | 18.87 | 15 | 1.77 | 0 | 15 | 25.87 | 3.05 | 100% | 0.77 | 0.09 |
| | Federal-Roadless | 5.66 | 12.51 | 2 | 0.35 | 0 | 2 | 0.49 | 0.09 | 100% | 0.03 | 0.00 |
| | Private - Roadless | 0.00 | 0.00 | 0 | 0.00 | 0 | 0 | 0.00 | 0.00 | N/A | 0.00 | 0.00 |
| | Private | 0.01 | 0.29 | 0 | 0.00 | 0 | 0 | 0.00 | 0.00 | N/A | 0.00 | 0.00 |
| | State | 0.00 | 0.00 | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | Total | 14.13 | 31.67 | 17 | 1.20 | 0 | 17 | 26.36 | 1.86 | 100% | 0.79 | 0.06 |
| East Fork Elk Creek<br>Elk Creek | Federal | 46.14 | 81.18 | 52 | 1.13 | 1 | 53 | 95.97 | 2.08 | 100% | 3.93 | 0.09 |
| | Federal-Roadless | 26.68 | 47.62 | 0 | 0.00 | 0 | 0 | 1.36 | 0.05 | 100% | 0.04 | 0.00 |
| | Private - Roadless | 0.02 | 0.04 | 0 | 0.00 | 0 | 0 | 0.00 | 0.00 | N/A | 0.00 | 0.00 |
| | Private | 11.21 | 31.18 | 46 | 4.10 | 4 | 50 | 65.12 | 5.81 | 95% | 2.80 | 0.25 |
| | State | 0.32 | 0.00 | 0 | 0.00 | 0 | 0 | 0.00 | N/A | N/A | 0.00 | 0.00 |
| | Total | 84.36 | 160.02 | 98 | 1.16 | 5 | 103 | 162.46 | 1.93 | 98% | 6.78 | 0.08 |
| Marten Creek | Federal | 51.58 | 103.20 | 79 | 1.53 | 0 | 79 | 131.07 | 2.54 | 100% | 4.77 | 0.09 |
| | Federal-Roadless | 19.26 | 38.72 | 1 | 0.05 | 0 | 1 | 1.63 | 0.08 | 100% | 0.03 | 0.00 |
| | Private - Roadless | 0.00 | 0.00 | 0 | 0.00 | 0 | 0 | 0.00 | 0.00 | N/A | 0.00 | 0.00 |
| | Private | 0.21 | 1.60 | 2 | 9.39 | 0 | 2 | 1.30 | 6.09 | 100% | 0.10 | 0.48 |
| | State | 0.00 | 0.00 | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | Total | 71.06 | 143.52 | 82 | 1.15 | 0 | 82 | 133.99 | 1.89 | 100% | 4.91 | 0.07 |
| Swamp Creek | Federal | 31.34 | 52.64 | 6 | 0.19 | 0 | 6 | 12.03 | 0.38 | 100% | 0.29 | 0.01 |
| | Federal-Roadless | 18.87 | 36.68 | 0 | 0.00 | 0 | 0 | 0.34 | 0.02 | 100% | 0.00 | 0.00 |
| | Private - Roadless | 0.01 | 0.01 | 0 | 0.00 | 0 | 0 | 0.00 | 0.00 | N/A | 0.00 | 0.00 |
| | Private | 4.45 | 8.88 | 9 | 2.02 | 1 | 10 | 18.87 | 4.24 | 99% | 0.70 | 0.16 |
| | State | 0.00 | 0.00 | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | Total | 54.67 | 98.21 | 15 | 0.27 | 1 | 16 | 31.24 | 0.57 | 99% | 0.99 | 0.02 |
| White Pine Creek | Federal | 30.21 | 57.62 | 56 | 1.85 | 0 | 56 | 113.82 | 3.77 | 100% | 3.92 | 0.13 |
| | Federal-Roadless | 5.00 | 9.23 | 2 | 0.40 | 0 | 2 | 0.76 | 0.15 | 100% | 0.04 | 0.01 |
| | Private - Roadless | 0.00 | 0.00 | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | Private | 0.99 | 4.05 | 4 | 4.06 | 1 | 5 | 3.41 | 3.46 | 91% | 0.16 | 0.16 |
| | State | 0.00 | 0.00 | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | Total | 36.19 | 70.90 | 62 | 1.71 | 1 | 63 | 117.98 | 3.26 | 100% | 4.12 | 0.11 |

**Table A-2c. Road Summary by USDA – NRCS Soil Erosion Hazard Classification**

| Sub Watershed | Soil Hazard Classification | Area ($Mi^2$) | Stream Miles (Mi) | Unpaved Crossings | Unpaved Crossing Density (Crossing / $Mi^2$) | Paved Crossings | Total Crossings | Total Road Length (Mi) | Total Road Density ($Mi/Mi^2$) | % of Total Roads which are unpaved | Total Unpaved Road Length w/in 100 ft Streams (Mi) | Total Unpaved Road Density w/in 100 ft of Streams ($Mi/Mi^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bull River Headwaters Lower Bull River Middle Bull River Upper Bull River | Moderate | 11.20 | 37.79 | 26 | 2.32 | 2 | 28 | 33.98 | 3.03 | 84.9% | 1.12 | 0.10 |
| | Severe | 168.91 | 287.69 | 61 | 0.36 | 2 | 63 | 130.11 | 0.77 | 96.2% | 3.26 | 0.02 |
| | Slight | 9.32 | 48.89 | 24 | 2.57 | 7 | 31 | 28.45 | 3.05 | 71.1% | 1.68 | 0.18 |
| | Not Rated | 0.23 | 2.01 | 0 | 0.00 | 1 | 1 | 0.03 | 0.15 | 48.1% | 0.00 | 0.00 |
| | Total | 189.67 | 376.39 | 111 | 0.59 | 12 | 123 | 192.57 | 1.02 | 90.5% | 6.06 | 0.03 |
| Dry Creek | Moderate | 0.00 | 0.00 | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | Severe | 13.16 | 25.78 | 14 | 1.06 | 0 | 14 | 23.63 | 1.80 | 100% | 0.60 | 0.05 |
| | Slight | 0.97 | 5.90 | 3 | 3.08 | 0 | 3 | 2.72 | 2.79 | 100% | 0.19 | 0.19 |
| | Not Rated | 0.00 | 0.00 | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | Total | 14.13 | 31.68 | 17 | 1.20 | 0 | 17 | 26.36 | 1.86 | 100% | 0.79 | 0.06 |
| East Fork Elk Creek Elk Creek | Moderate | 1.92 | 5.36 | 11 | 5.72 | 0 | 11 | 9.00 | 4.68 | 100% | 0.96 | 0.50 |
| | Severe | 76.45 | 119.57 | 58 | 0.76 | 3 | 61 | 129.51 | 1.69 | 98.6% | 4.07 | 0.05 |
| | Slight | 5.89 | 34.24 | 29 | 4.92 | 2 | 31 | 23.95 | 4.07 | 93.3% | 1.75 | 0.30 |
| | Not Rated | 0.10 | 0.85 | 0 | 0.00 | 0 | 0 | 0.00 | 0.03 | 100% | 0.00 | 0.00 |
| | Total | 84.36 | 160.02 | 98 | 1.16 | 5 | 103 | 162.46 | 1.93 | 97.9% | 6.78 | 0.08 |
| Marten Creek | Moderate | 1.50 | 8.12 | 11 | 7.32 | 0 | 11 | 9.89 | 6.58 | 100% | 0.84 | 0.56 |
| | Severe | 67.11 | 112.98 | 52 | 0.77 | 0 | 52 | 113.57 | 1.69 | 100% | 2.71 | 0.04 |
| | Slight | 2.10 | 20.38 | 18 | 8.56 | 0 | 18 | 10.40 | 4.95 | 100% | 1.32 | 0.63 |
| | Not Rated | 0.35 | 2.03 | 1 | 2.89 | 0 | 1 | 0.14 | 0.39 | 100% | 0.04 | 0.11 |
| | Total | 71.06 | 143.52 | 82 | 1.15 | 0 | 82 | 133.99 | 1.89 | 100% | 4.91 | 0.07 |
| Swamp Creek | Moderate | 2.09 | 12.57 | 0 | 0.00 | 0 | 0 | 0.99 | 0.47 | 100% | 0.00 | 0.00 |
| | Severe | 51.67 | 80.53 | 12 | 0.23 | 0 | 12 | 28.91 | 0.56 | 99.6% | 0.92 | 0.02 |
| | Slight | 0.69 | 3.91 | 3 | 4.32 | 0 | 3 | 1.28 | 1.85 | 100% | 0.07 | 0.10 |
| | Not Rated | 0.21 | 1.20 | 0 | 0.00 | 1 | 1 | 0.05 | 0.22 | 0% | 0.00 | 0.00 |
| | Total | 54.67 | 98.21 | 15 | 0.27 | 1 | 16 | 31.24 | 0.57 | 99.5% | 0.99 | 0.02 |
| White Pine Creek | Moderate | 2.51 | 6.43 | 8 | 3.18 | 0 | 8 | 9.23 | 3.67 | 100% | 1.19 | 0.47 |
| | Severe | 32.38 | 52.24 | 43 | 1.33 | 0 | 43 | 103.21 | 3.19 | 100% | 1.90 | 0.06 |
| | Slight | 1.30 | 12.23 | 11 | 8.49 | 1 | 12 | 5.54 | 4.28 | 94.6% | 1.03 | 0.80 |
| | Not Rated | 0.00 | 0.00 | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | Total | 36.19 | 70.90 | 62 | 1.71 | 1 | 63 | 117.98 | 3.26 | 99.7% | 4.12 | 0.11 |

**Table A-2d. Road Summary by Road Type**

| Sub Watershed | Road Type | Area (Mi$^2$ | Stream Miles (Mi) | Unpaved Crossings | Unpaved Crossing Density (Crossing / Mi$^2$) | Paved Crossings | Total Crossings | Total Road Length (Mi) | Total Road Density (Mi/Mi$^2$) | % of Total Roads which are unpaved | Total Unpaved Road Length w/in 100 ft Streams (Mi) | Total Unpaved Road Density w/in 100 ft of Streams (Mi/Mi$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bull River Headwaters Lower Bull River Middle Bull River Upper Bull River | 1 - Impassable to motorized vehicles | N/A | N/A | 39 | N/A | 0 | 39 | 65.34 | N/A | 100% | 1.86 | N/A |
| | 2 - Restricted / Legally gated admin use | N/A | N/A | 12 | N/A | 0 | 12 | 22.16 | N/A | 100% | 0.83 | N/A |
| | 3 - Barriered / legally no admin use | N/A | N/A | 15 | N/A | 0 | 15 | 24.84 | N/A | 100% | 0.69 | N/A |
| | 4 - Open during bear season | N/A | N/A | 45 | N/A | 12 | 57 | 80.24 | N/A | 77.1% | 2.68 | N/A |
| | Total | 189.67 | 376.39 | 111 | 0.59 | 12 | 123 | 192.57 | 1.02 | 90.5% | 6.06 | 0.032 |
| Dry Creek | 1 - Impassable to motorized vehicles | N/A | N/A | 13 | N/A | 0 | 13 | 21.46 | N/A | 100% | 0.52 | N/A |
| | 2 - Restricted / Legally gated admin use | N/A | N/A | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | 3 - Barriered / legally no admin use | N/A | N/A | 1 | N/A | 0 | 1 | 2.81 | N/A | 100% | 0.04 | N/A |
| | 4 - Open during bear season | N/A | N/A | 3 | N/A | 0 | 3 | 2.08 | N/A | 100% | 0.23 | N/A |
| | Total | 14.13 | 31.68 | 17 | 1.20 | 0 | 17 | 26.36 | 1.86 | 100% | 0.79 | 0.056 |
| East Fork Elk Creek Elk Creek | 1 - Impassable to motorized vehicles | N/A | N/A | 15 | N/A | 0 | 15 | 27.70 | N/A | 100% | 0.90 | N/A |
| | 2 - Restricted / Legally gated admin use | N/A | N/A | 11 | N/A | 0 | 11 | 27.44 | N/A | 100% | 0.53 | N/A |
| | 3 - Barriered / legally no admin use | N/A | N/A | 3 | N/A | 0 | 3 | 9.06 | N/A | 100% | 0.26 | N/A |
| | 4 - Open during bear season | N/A | N/A | 69 | N/A | 5 | 74 | 98.26 | N/A | 96.6% | 5.09 | N/A |
| | Total | 84.36 | 160.02 | 98 | 1.16 | 5 | 103 | 162.46 | 1.93 | 97.9% | 6.78 | 0.080 |
| Marten Creek | 1 - Impassable to motorized vehicles | N/A | N/A | 26 | N/A | 0 | 26 | 62.07 | N/A | 100% | 1.78 | N/A |
| | 2 - Restricted / Legally gated admin use | N/A | N/A | 21 | N/A | 0 | 21 | 23.73 | N/A | 100% | 1.35 | N/A |
| | 3 - Barriered / legally no admin use | N/A | N/A | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | 4 - Open during bear season | N/A | N/A | 35 | N/A | 0 | 35 | 48.19 | N/A | 100% | 1.78 | N/A |
| | Total | 71.06 | 143.52 | 82 | 1.15 | 0 | 82 | 133.99 | 1.89 | 100% | 4.91 | 0.069 |
| Swamp Creek | 1 - Impassable to motorized vehicles | N/A | N/A | 0 | N/A | 0 | 0 | 0.39 | N/A | 100% | 0.00 | N/A |
| | 2 - Restricted / Legally gated admin use | N/A | N/A | 1 | N/A | 0 | 1 | 6.61 | N/A | 100% | 0.02 | N/A |
| | 3 - Barriered / legally no admin use | N/A | N/A | 0 | N/A | 0 | 0 | 0.00 | N/A | N/A | 0.00 | N/A |
| | 4 - Open during bear season | N/A | N/A | 14 | N/A | 1 | 15 | 24.24 | N/A | 99.3% | 0.97 | N/A |
| | Total | 54.67 | 98.21 | 15 | 0.27 | 1 | 16 | 31.24 | 0.57 | 99.5% | 0.99 | 0.018 |
| White Pine Creek | 1 - Impassable to motorized vehicles | N/A | N/A | 19 | N/A | 0 | 19 | 53.44 | N/A | 100% | 0.76 | N/A |
| | 2 - Restricted / Legally gated admin use | N/A | N/A | 19 | N/A | 0 | 19 | 26.19 | N/A | 100% | 0.77 | N/A |
| | 3 - Barriered / legally no admin use | N/A | N/A | 0 | N/A | 0 | 0 | 1.39 | N/A | 100% | 0.00 | N/A |
| | 4 - Open during bear season | N/A | N/A | 24 | N/A | 1 | 25 | 36.96 | N/A | 98.9% | 2.59 | N/A |
| | Total | 36.19 | 70.90 | 62 | 1.71 | 1 | 63 | 117.98 | 3.26 | 99.7% | 4.12 | 0.114 |

**Table A-3. Proposed Field Sites and Actual Assessed Field Sites**

| Sub Watershed | Land Ownership | Number of Field Sites Randomly Selected | Number of Assessed Sites |
|---|---|---|---|
| Bull River - Headwaters<br>Lower Bull River<br>Middle Bull River<br>Upper Bull River | Federal | 11 | 11 |
| | Federal-Roadless | 0 | 0 |
| | Private - Roadless | 0 | 0 |
| | Private | 2 | 0 |
| | State | 1 | 1 |
| | Total | 14 | 12 |
| Dry Creek | Federal | 2 | 1 |
| | Federal-Roadless | 0 | 0 |
| | Private - Roadless | 0 | 0 |
| | Private | 0 | 0 |
| | State | 0 | 0 |
| | Total | 2 | 1 |
| East Fork Elk Creek<br>Elk Creek | Federal | 7 | 9 |
| | Federal-Roadless | 0 | 0 |
| | Private - Roadless | 0 | 0 |
| | Private | 6 | 2 |
| | State | 0 | 0 |
| | Total | 13 | 11 |
| Marten Creek | Federal | 11 | 10 |
| | Federal-Roadless | 0 | 0 |
| | Private - Roadless | 0 | 0 |
| | Private | 0 | 0 |
| | State | 0 | 0 |
| | Total | 11 | 10 |
| Swamp Creek | Federal | 1 | 1 |
| | Federal-Roadless | 0 | 0 |
| | Private - Roadless | 0 | 0 |
| | Private | 1 | 1 |
| | State | 0 | 0 |
| | Total | 2 | 2 |
| White Pine Creek | Federal | 7 | 7 |
| | Federal-Roadless | 0 | 0 |
| | Private - Roadless | 0 | 0 |
| | Private | 1 | 0 |
| | State | 0 | 0 |
| | Total | 8 | 7 |

| Soil Erosion Hazard Classification | Number of Field Sites Randomly Selected | Number of Assessed Sites |
|---|---|---|
| Moderate | 11 | 11 |
| Severe | 25 | 22 |
| Slight | 14 | 10 |
| Not Rated | 0 | 0 |

| Road Type Classification | Number of Field Sites Randomly Selected | Number of Assessed Sites |
|---|---|---|
| 1 - Impassable to motorized vehicles | 8 | 0 |
| 2 - Restricted / Legally gated admin use | 9 | 8 |
| 3 - Barriered / legally no admin use | 1 | 0 |
| 4 - Open during bear season | 32 | 35 |

**Table A-4. Detailed Extrapolated Sediment Load From Unpaved Road Crossings by HUC/303(d) Subwatershed – Existing Conditions**

| Sub Watershed | Land Ownership | Unpaved Crossings | Field Assessed Crossings | Average Sediment Load (t/y) | Total Sediment Load (t/y) |
|---|---|---|---|---|---|
| Bull River -Headwaters<br>Lower Bull River<br><br>Middle Bull River<br>Upper Bull River | Federal | 85 | 11 | 0.14 | 11.90 |
| | Federal-Roadless | 2 | 0 | 0.14 | 0.28 |
| | Private | 19 | 0 | 0.23 | 4.37 |
| | State | 5 | 1 | 0.02 | 0.10 |
| | Total | 111 | 12 | N/A | 16.65 |
| Dry Creek | Federal | 15 | 1 | 0.14 | 2.10 |
| | Federal-Roadless | 2 | 0 | 0.14 | 0.28 |
| | Private | 0 | 0 | 0.23 | 0 |
| | State | 0 | 0 | 0.02 | 0 |
| | Total | 17 | 1 | N/A | 2.38 |
| East Fork Elk Creek<br>Elk Creek | Federal | 52 | 9 | 0.14 | 7.28 |
| | Federal-Roadless | 0 | 0 | 0.14 | 0 |
| | Private | 46 | 2 | 0.23 | 10.58 |
| | State | 0 | 0 | 0.02 | 0 |
| | Total | 98 | 11 | N/A | 17.86 |
| Marten Creek | Federal | 79 | 10 | 0.14 | 11.06 |
| | Federal-Roadless | 1 | 0 | 0.14 | 0.14 |
| | Private | 2 | 0 | 0.23 | 0.46 |
| | State | 0 | 0 | 0.02 | 0 |
| | Total | 82 | 10 | N/A | 11.66 |
| Swamp Creek | Federal | 6 | 0 | 0.14 | 0.84 |
| | Federal-Roadless | 0 | 0 | 0.14 | 0 |
| | Private | 9 | 1 | 0.23 | 2.07 |
| | State | 0 | 0 | 0.02 | 0 |
| | Total | 15 | 1 | N/A | 2.91 |
| White Pine Creek | Federal | 56 | 7 | 0.14 | 7.84 |
| | Federal-Roadless | 2 | 0 | 0.14 | 0.28 |
| | Private | 4 | 0 | 0.23 | 0.92 |
| | State | 0 | 0 | 0.02 | 0 |
| | Total | 62 | 7 | N/A | 9.04 |

**Table A-5. Fish Passage Analysis for Selected Road Crossings Using Alaska Region Criteria**

| Location ID | Structure Type | Structure Diameter or Dimensions (ft) | Width | Culvert Slope | Bf in Riffle Above Culvert (ft) | Culvert/ BF ratio | Perch | Streambed Materials in Culvert | Final Classification | Notes/Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| **Fish passage evaluation criteria: Circular CMP 48" span and smaller** | | | | | | | | | | |
| BRH-FS-10 | Steel | 1.5 | 1.5 | 4 | 13 | 0.12 | 0 | No | RED | Culvert extensions on downstream side- water chute- note pic 1785 |
| MC-FS-25 | Steel | 1.5 | 1.5 | 7 | 3 | 0.50 | 0 | Yes | RED | Seasonal flows, no flow currently |
| WPC-FS-35 | Steel | 1.5 | 1.5 | 2 | 13 | 0.12 | 0 | No | RED | small wetland area above culvert, flow 0.5 cfs |
| UBR-FS-06 | Steel | 2 | 2 | 2 | 20 | 0.10 | 0 | Yes | RED | Good flow sed contribution at downstream end. |
| BRH-FS-09 | Steel | 2 | 2 | 3 | 12 | 0.17 | 0 | No | RED | Culvert offset 3ft to main entry flow 2-3 cfs |
| BRH-FS-11 | Steel | 2 | 2 | 3 | 5 | 0.40 | 20 | No | RED | Several channels above culvert, 1 cfs. Well vegetated- giant cedar grove |
| MC-FS-16 | Steel | 2 | 2 | 6 | 12 | 0.17 | 1.5 | No | RED | No Flow, seasonal |
| WPC-FS-29 | Steel | 2 | 2 | 25 | 4 | 0.50 | 1 | No | RED | Flow; seasonal dry |
| WPC-FS-32 | Steel | 2 | 2 | 4 | 14 | 0.14 | 72 | No | RED | Trickle: 0.25-0.50 cfs/ heavy veg/ particially blockade debris |
| EC-P-36 | Steel | 2 | 2 | 1 | 10 | 0.20 | 0 | No | RED | Potholes at crossing, erosion both fill areas, trickle flow. |
| UBR-FS-05 | Steel | 2.5 | 2.5 | 2 | 17 | 0.15 | 6 | No | RED | Major contributions at fill areas from road. |
| MC-FS-23 | Steel | 2.5 | 2.5 | 2 | 10 | 0.25 | 0 | No | RED | No flow, seasonal high amount of debris - upstream area and veg. |
| UBR-S-04 | Steel | 3 | 3 | 1 | 18 | 0.17 | 0 | Yes | RED | drains between two wetlands, low vel flow |
| BRH-FS-12 | Steel | 3 | 3 | 5 | 18 | 0.17 | 24 | No | RED | - |
| MBR-FS-15 | Steel | 3 | 3 | 4 | 14 | 0.21 | 3 | - | RED | Pond 2.5 ft deep, downstream |
| MC-FS-17 | Steel | 3 | 3 | 3 | 24 | 0.13 | 0 | No | RED | 1-2 cfs |
| MC-FS-19 | Steel | 3 | 3 | 5 | 11 | 0.27 | 5 | No | RED | 1-2 cfs, rocked up and downstream, recently installed culvert |
| MC-FS-21 | Steel | 3 | 3 | 5 | 10 | 0.30 | 3 | No | RED | Recently Installed, no veg on fill, erosion present, 2-3 cfs. |
| MC-FS-22 | Steel | 3 | 3 | 2 | 14 | 0.21 | 2.5 | No | RED | Well rocked upstream, 1-2 cfs, some erosion downstream on fill |
| MC-FS-24 | 2-Stl | 3 | 3 | 1 | 20 | 0.15 | 0 | No | RED | 1-has flow, 3-4 cfs |
| EC-FS-28 | Steel | 3 | 3 | 30 | 8 | 0.38 | 0 | No | RED | 0.5 - 1 cfs |
| WPC-FS-33 | Steel | 3 | 3 | 6 | 12 | 0.25 | 96 | No | RED | 1-2 cfs, rocked around culvert, heavy veg. |
| EC-FS-37 | Steel | 3 | 3 | 2 | 12 | 0.25 | 2 | No | RED | No flow, seasonal, pond below outlet. |
| EC-FS-41 | Steel | 3 | 3 | 5 | 10 | 0.30 | 0 | Yes | RED | No flow, but evidence of good flow during run off |
| WPC-FS-30 | Steel | 3 X 4 | 4 | 2 | 13 | 0.31 | 6 | No | RED | Flow 1-2 cfs / culvert at 20-30 degree angle to flow entry |
| WPC-FS-34 | Steel | 3 x 4 squashed | 4 | 1 | 14 | 0.29 | 0 | Yes | RED | No flow, seasonal , no apparent erosion or flow problems |
| **Fish passage evaluation criteria: Circular CMP greater than 48" and less than 100% substrate cover** | | | | | | | | | | |
| MC-FS-20 | Steel | 5 | 5 | 2 | 18 | 0.28 | 4 | No | RED | 5-6 cfs, Ditch culvert delivers to downstream fill |
| BRH-FS-08 | Steel | 5 | 5 | 5 | 10 | 0.50 | 12 | No | RED | Not much sediment input, lots of rocks at each end. |
| BRH-FS-13 | Steel | 3X5 | 5 | 8 | 13 | 0.38 | 8.4 | No | RED | Large culvert, 3-5 cfs, pull over upper end culvert |
| WPC-FS-31 | Concrete | 4 X 11 | 11 | 1 | 18 | 0.61 | 0 | Yes | GREY | Fill length width bridge dimensions, debris and sediment on bridge top. |
| ECFC-FS-43 | Steel | 4 | 4 | 8 | 17 | 0.24 | 12 | No | RED | 5-10 cfs, ruts and standing water on road. |
| EFEC-FS-42 | Steel | 3 X 4.5 | 4.5 | 7 | 8 | 0.56 | 0 | No | RED | Culvert diagonal to road. |
| ED-P-40 | Steel | 5 | 5 | 2 | 10 | 0.50 | 0 | Yes | GREY | No flow, very fine sediment in the bottom of culvert |
| EFEC-FS-39 | Steel | 5 | 5 | 2 | 8 | 0.63 | 24 | No | RED | No flow, large cobbles a small boulder in streambed |
| EFEC-FS-38 | Steel | 5 | 5 | 5 | 12 | 0.42 | 12 | No | RED | 5-10 cfs, E. Fork Elk Creek |
| Legend: | | High certainty of not providing juvenile fish passage | | High certainty of providing juvenile fish passage | | Additional and more detailed analysis is required | | Field notes indicate flowing water at crossing | | Montana Fish Wildlife & Parks, GIS Layer *Fish Species Distribution – Streams* indicates fish present. Metadata updated 1999 – 2009 and absence of species on the GIS layer is not evidence of absence in a stream. |

**Table A-6. Detailed Extrapolated Sediment Load from Unpaved Road Crossings by HUC/303(d) Subwatershed – Road Length Reduction**

| Sub Watershed | Land Ownership | Unpaved Crossings | Field Assessed Crossings | Average Sediment Load (t/y) | Total Sediment Load (t/y) |
|---|---|---|---|---|---|
| Bull River -Headwaters<br>Lower Bull River<br><br>Middle Bull River<br>Upper Bull River | Federal | 85 | 11 | 0.04 | 3.40 |
| | Federal-Roadless | 2 | 0 | 0.04 | 0.08 |
| | Private | 19 | 0 | 0.07 | 1.33 |
| | State | 5 | 1 | 0.02 | 0.10 |
| | Total | 111 | 12 | N/A | 4.91 |
| Dry Creek | Federal | 15 | 1 | 0.04 | 0.60 |
| | Federal-Roadless | 2 | 0 | 0.04 | 0.08 |
| | Private | 0 | 0 | 0.07 | 0 |
| | State | 0 | 0 | 0.02 | 0 |
| | Total | 17 | 1 | N/A | 0.68 |
| East Fork Elk Creek<br>Elk Creek | Federal | 52 | 9 | 0.04 | 2.08 |
| | Federal-Roadless | 0 | 0 | 0.04 | 0 |
| | Private | 46 | 2 | 0.07 | 3.22 |
| | State | 0 | 0 | 0.02 | 0 |
| | Total | 98 | 11 | N/A | 5.30 |
| Marten Creek | Federal | 79 | 10 | 0.04 | 3.16 |
| | Federal-Roadless | 1 | 0 | 0.04 | 0.04 |
| | Private | 2 | 0 | 0.07 | 0.14 |
| | State | 0 | 0 | 0.02 | 0 |
| | Total | 82 | 10 | N/A | 3.34 |
| Swamp Creek | Federal | 6 | 0 | 0.04 | 0.24 |
| | Federal-Roadless | 0 | 0 | 0.04 | 0 |
| | Private | 9 | 1 | 0.07 | 0.63 |
| | State | 0 | 0 | 0.02 | 0 |
| | Total | 15 | 1 | N/A | 0.87 |
| White Pine Creek | Federal | 56 | 7 | 0.04 | 2.24 |
| | Federal-Roadless | 2 | 0 | 0.04 | 0.08 |
| | Private | 4 | 0 | 0.07 | 0.28 |
| | State | 0 | 0 | 0.02 | 0 |
| | Total | 62 | 7 | N/A | 2.60 |

**Table A-7. Comparability of Field Data to WEPP:Road Parameters**

| WEPP:Road Variable | Road gradient (%) | Road length (ft) | Road width (ft) | Fill gradient (%) | Fill length (ft) | Buff gradient (%) | Buff length (ft) | Rock content (%) |
|---|---|---|---|---|---|---|---|---|
| Minimum Value | 0.3% | 3 ft | 1 ft | 0.3% | 1 ft | 0.3% | 1 ft | 0% |
| Maximum Value | 40% | 1000 ft | 300 ft | 150% | 1000 ft | 100% | 1000 ft | 100% |
| Measured Range from the Field Data | 1 – 15 % | 3 ft – 2 miles | 8 – 28 ft | 3 – 150 % | 3 – 116 ft | 0.3 – 65% | 20 – 160 ft | 20 – 80% |
| Non-compliant values | UBR-FS-07 (N/A) | UBR-FS-07 (N/A)<br>MC-FS-25 (N/A)<br>WPC-FS-30 (1000+)<br>WPC-FS-31 (1000+)<br>WPC-PP-01 (1000+)<br>WPC-PP-05 (1000+)<br>MC-PP-# (0.5 miles) | UBR-FS-07 (N/A)<br>WPC-PP-05 (-) | Multiple entries (-) | Multiple entries (-) | Multiple entries (-) | Multiple entries (-)<br>Multiple entries (150+) | Multiple entries (-) |
| Action Taken | Assumptions listed in Attachment C. | Assumptions listed in Attachment C. | Assumptions listed in Attachment C. | Minimum values entered for (-) entries. | Minimum values entered for (-) entries. | Minimum values entered for (-) entries. | Minimum values entered for (-) entries.<br>150 ft entered for 150+ | Assumptions listed in Attachment C. |

# ATTACHMENT B

## Field Assessment Site Location Data

**Field Assessment Site Location Information**

| SITEID | X | Y | Z | SITEID | X | Y | Z |
|---|---|---|---|---|---|---|---|
| BRH-FS-08 | -115.7840 | 48.1719 | 2930.5 | MC-FS-25 | -115.7645 | 47.8725 | 2398.3 |
| BRH-FS-09 | -115.7833 | 48.1586 | 3004.7 | SCr-FS-01 | -115.6050 | 47.9117 | 2700.1 |
| BRH-FS-10 | -115.8046 | 48.1534 | 4372.4 | SCr-P-02 | -115.6636 | 47.9217 | 2552.5 |
| BRH-FS-11 | -115.7989 | 48.1529 | 3911.2 | UBR-FS-05 | -115.8621 | 48.1893 | 2526.6 |
| BRH-FS-12 | -115.7913 | 48.1431 | 3704.5 | UBR-FS-06 | -115.8211 | 48.1960 | 2432.3 |
| DC-FS-03 | -115.8823 | 48.1557 | 2482.8 | UBR-FS-07 | -115.8152 | 48.1938 | 2443.5 |
| EC-FS-28 | -115.9393 | 48.0128 | 3492.5 | UBR-S-04 | -115.8549 | 48.1969 | 2342.8 |
| EC-FS-37 | -115.9909 | 48.0141 | 2388.5 | WPC-FS-29 | -115.6923 | 47.7474 | 4908.1 |
| EC-FS-41 | -115.9072 | 48.0321 | 2394.4 | WPC-FS-30 | -115.6935 | 47.7285 | 3559.7 |
| EC-P-36 | -115.9959 | 48.0451 | 2493.4 | WPC-FS-31 | -115.6884 | 47.7338 | 3474.4 |
| EC-P-40 | -115.9527 | 48.0386 | 2348.5 | WPC-FS-32 | -115.6379 | 47.7344 | 4222.4 |
| EFEC-FS-26 | -115.9451 | 47.9964 | 4400.1 | WPC-FS-33 | -115.6505 | 47.7364 | 4015.8 |
| EFEC-FS-27 | -115.9532 | 48.0039 | 4235.6 | WPC-FS-34 | -115.6139 | 47.7607 | 2818.2 |
| EFEC-FS-38 | -115.9399 | 47.9245 | 3559.7 | WPC-FS-35 | -115.5596 | 47.7523 | 2549.2 |
| EFEC-FS-39 | -115.9592 | 47.9510 | 2837.9 | Parallel Sites | | | |
| EFEC-FS-42 | -115.9830 | 47.9729 | 2614.8 | ELK-FS-06 | -115.9385 | 47.9176 | 3914.0 |
| EFEC-FS-43 | -115.9390 | 47.9170 | 3937.0 | ELK-FS-07 | -115.9420 | 47.9287 | 3379.3 |
| MBR-FS-13 | -115.7517 | 48.1442 | 3433.9 | ELK-FS-08 | -115.9429 | 47.9294 | 3343.2 |
| MBR-FS-14 | -115.7478 | 48.1349 | 3137.6 | MC-PP-01 | -115.8238 | 47.8932 | 2641.1 |
| MBR-FS-15 | -115.7303 | 48.1254 | 2738.2 | MC-PP-02 | -115.8123 | 47.8933 | 2591.9 |
| MC-FS-16 | -115.8414 | 47.8671 | 5108.3 | MC-PP-03 | -115.8025 | 47.8924 | 2555.8 |
| MC-FS-17 | -115.8956 | 47.8572 | 3982.9 | MC-PP-04 | -115.7944 | 47.8912 | 2506.6 |
| MC-FS-18 | -115.9044 | 47.8619 | 3950.1 | MC-PP-05 | -115.7835 | 47.8888 | 2477.0 |
| MC-FS-19 | -115.9096 | 47.8679 | 3871.4 | MC-PP-06 | -115.7704 | 47.8813 | 2404.9 |
| MC-FS-20 | -115.9094 | 47.8690 | 3825.5 | WPC-PP-01 | -115.6666 | 47.7420 | 3264.4 |
| MC-FS-21 | -115.8963 | 47.8755 | 3425.2 | WPC-PP-02 | -115.6561 | 47.7437 | 3192.3 |
| MC-FS-22 | -115.8687 | 47.8884 | 2916.7 | WPC-PP-03 | -115.6475 | 47.7468 | 3070.9 |
| MC-FS-23 | -115.7468 | 47.8900 | 2565.6 | WPC-PP-04 | -115.6386 | 47.7511 | 2992.1 |
| MC-FS-24 | -115.7544 | 47.8806 | 2339.2 | WPC-PP-05 | -115.6294 | 47.7547 | 2900.3 |

# ATTACHMENT C

## WEPP: Road Model Adjustments and Custom Climates

**WEPP: Road Model Adjustments**

Heavily vegetated road conditions are not properly represented in the standard WEPP:Road assumption. As a result, William J. Elliott, author of the model, was consulted to determine how best to represent these roads within the confines of the model.

There are three traffic scenarios available in the model. For roads where vegetation has grown up on the edges, the no traffic scenario is most appropriate as this scenario grows a limited amount of vegetation on the road. It uses the same plant growth for the road that the high traffic used for the fillslope. The following table explains the model assumptions for the three traffic scenarios:

| Traffic | High | Low | None |
|---|---|---|---|
| Erodibility | 100% | 25% | 25% |
| Hydraulic Conductivity | 100% | 100% | 100% |
| Vegetation on Road Surface | 0 | 0 | 50% |
| Vegetation on fill | 50% | 50% | 100% Forested |
| Buffer | Forested | Forested | Forested |

Based on conversations with Dr. Elliott, it was not appropriate to use the forest buffer to describe the road as the hydraulic conductivity of the soil would be too high. However, the hydraulic conductivity of the fillslope would be reasonable to use to describe the road surface for a fully forested scenario. This means, for the fully vegetated/forested road surface scenario, minimize the road segment length, put the remainder of the road surface length and gradient into the fillslope box, and minimize the buffer length and gradient at stream crossings.

**Parallel Road Adjustments**

The WEPP:Road model has a maximum contributing road length of 1000-feet. According to Dr. Elliott, it is rare that the contributing road length ever exceeds this distance. As a result, any field assessed parallel road segment in excess of this distance was reduced to 1000-feet for modeling purposes.

**Road Crossing Model Adjustments**

Some road crossing locations had contributing road length on each side of the crossing, and road conditions were significantly different on each side. In these situations, each road segment was modeled separately and the two segments were then summed to get the total sediment load for the crossing. Also, some crossing locations were located at the convergence of two or more roads, with all roads contributing to sediment load at the crossing. In these cases, road segments were modeled separately and then summed to get the total sediment load for the crossing.

**Rock Content**

The rock percentage was not determined for road crossings that had a gravel over-layer. Rock fragments by volume is specified in the Appendix 1: Soil Parameters (Elliot et al, 1999). The values for graveled loam (65%) and graveled sand (65%) were input into the WEPP model.

| Site Name | Road Design | Model Adjustments | Site Name | Road Design | Model Adjustments |
|---|---|---|---|---|---|
| BRH-FS-08 | IV | Rock Fragment added per WEPP Appendix 1. | MC-FS-19 | OU | |
| BRH-FS-09 | OR | Rock Fragment added per WEPP Appendix 1. | MC-FS-20 | OR | |
| BRH-FS-10 | OR | | MC-FS-21 | OR | |
| BRH-FS-10 | OR | | MC-FS-22 | OU | Rock Fragment added per WEPP Appendix 1. |
| BRH-FS-11 | IV | | MC-FS-23 | OU | Rock Fragment added per WEPP Appendix 1. |
| BRH-FS-11 | OU | | MC-FS-24 | OU | Rock Fragment added per WEPP Appendix 1. |
| BRH-FS-12 | OU | | MC-FS-25 | OU | Road modeled as IV with minimum width and length per comments. |
| DC-FS-03 | OR | Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. | MC-PP-01 | OU | Limited road length to 1000 ft. Rock Fragment added per WEPP Appendix 1. |
| ECFC-FS-43 | IV | Assumed 8 ft of the 11 ft ditch width contributed to ruts | MC-PP-02 | IV | Limited road length to 1000 ft. Rock Fragment added per WEPP Appendix 1. |
| EC-FS-28 | IV | | MC-PP-03 | OR | Limited road length to 1000 ft. Rock Fragment added per WEPP Appendix 1. |
| EC-FS-37 | OU | Rock Fragment added per WEPP Appendix 1. | MC-PP-04 | IV | Limited road length to 1000 ft. Rock Fragment added per WEPP Appendix 1. |
| EC-FS-41 | IV | Rock Fragment added per WEPP Appendix 1. | MC-PP-05 | OR | Limited road length to 1000 ft. Rock Fragment added per WEPP Appendix 1. |
| EC-P-36 | IV | Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. | MC-PP-06 | OU | Limited road length to 1000 ft. Rock Fragment added per WEPP Appendix 1. |
| EC-P-40 | OU | Insloped, unrutted modeled as insloped, bare. Rock Fragment added per WEPP Appendix 1. | SCR-FS-01 | IB | |
| EC-P-40 | OU | Rock Fragment added per WEPP Appendix 1. | SCR-FS-01 | OU | Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. |
| EFEC-FS-26 | OU | | SCR-P-02 | OU | Rock Fragment added per WEPP Appendix 1. |
| EFEC-FS-27 | OU | | UBR- FS- 05 | OU | Rock Fragment added per WEPP Appendix 1. |
| EFEC-FS-27 | OR | | UBR-FS-05 | OR | Rock Fragment added per WEPP Appendix 1. |
| EFEC-FS-38 | OU | Assumed 8 ft of the 11 ft ditch width contributed to ruts | UBR-FS-06 | OU | Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. |
| EFEC-FS-39 | OU | | UBR-FS-07 | IV | Road modeled as IV with minimum width and length per comments. Assumed silt loam. |
| EFEC-FS-42 | IV | | UBR-FS-07 | OU | Road modeled with minimum width and length per comments. Assumed silt loam. |
| Road Design options: OU = Outslope unrutted road, OR = Outslope rutted road, IV = Inslope road with vegetated or rocked ditch, IB = Inslope road with bare ditch | | | | | |

| Site Name | Road Design | Model Adjustments | Site Name | Road Design | Model Adjustments |
|---|---|---|---|---|---|
| ELK-FS-06 | OU | Limited road length to 1000 ft., Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. | UBR-S-04 | OU | Rock Fragment added per WEPP Appendix 1. |
| ELK-FS-06 | OU | Limited road length to 1000 ft., Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. | WPC-FS-29 | IV | |
| ELK-FS-06 | OU | Limited road length to 1000 ft., Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. | WPC-FS-30 | OU | Limited road length to 1000 ft., Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. Rock Fragment added per WEPP Appendix 1. |
| ELK-FS-06 | OU | Limited road length to 1000 ft., Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. | WPC-FS-31 | IV | Limited road length to 1000 ft., Crowned road modeled as OR per WEPP Guidance. Rock Fragment added per WEPP Appenidx 1. |
| ELK-FS-06 | OU | Limited road length to 1000 ft., Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. | WPC-FS-32 | OU | |
| ELK-FS-07 | OU | Insloped, rutted modeled as outsloped, rutted per WEPP Guidance. | WPC-FS-32 | OU | |
| ELK-FS-08 | OU | | WPC-FS-33 | IV | |
| MBR-FS-13 | OU | | WPC-FS-33 | OU | |
| MBR-FS-14 | IV | | WPC-FS-34 | OU | Rock Fragment added per WEPP Appendix 1. |
| MBR-FS-14 | IV | | WPC-FS-35 | OR | Rock Fragment added per WEPP Appendix 1. |
| MBR-FS-15 | OU | Rock Fragment added per WEPP Appendix 1. | WPC-PP-01 | OR | Limited road length to 1000 ft. Rock Fragment added per WEPP Appendix 1. |
| MBR-FS-15 | IV | Rock Fragment added per WEPP Appendix 1. | WPC-PP-02 | OR | Rock Fragment added per WEPP Appendix 1. |
| MC-FS-16 | IV | | WPC-PP-02 | OR | Rock Fragment added per WEPP Appendix 1. |
| MC-FS-16 | OR | | WPC-PP-03 | OR | Rock Fragment added per WEPP Appendix 1. |
| MC-FS-17 | OR | | WPC-PP-04 | OR | Added road surface and rock fragment for gravel road. |
| MC-FS-18 | OR | | WPC-PP-05 | OU | Limited road length to 1000 ft. Road modeled with minimum width and length per comments. Rock Fragment added per WEPP Appendix 1. |
| MC-FS-18 | OR | | | | |
| Road Design options: OU = Outslope unrutted road, OR = Outslope rutted road, IV = Inslope road with vegetated or rocked ditch, IB = Inslope road with bare ditch | | | | | |

# Custom Climates:

| Troy 18N + | |
|---|---|
| Modified by Rock:Clime on September 27, 2009 from TROUT CREEK RS MT 248380 0 | |
| T MAX 30.20 38.00 46.10 56.50 66.90 74.10 81.70 82.40 71.20 55.40 38.40 30.20 deg F | |
| T MIN 16.10 20.00 24.40 29.70 36.60 43.10 46.20 45.70 38.90 31.80 25.80 18.60 deg F | |
| MEANP 4.34 2.88 2.74 2.33 2.55 2.62 1.44 1.52 2.20 2.93 5.25 4.79 in | |
| # WET 14.00 9.94 10.97 10.14 12.13 11.89 8.00 8.02 10.00 10.85 15.00 15.97 | |
| silt loam soil | 30 year run |
| Average annual precipitation 36 in | |

| Burke + | |
|---|---|
| Modified by Rock:Clime on September 27, 2009 from TROUT CREEK RS MT 248380 0 | |
| T MAX 28.70 34.30 39.00 47.70 57.70 65.60 76.30 74.10 65.50 52.00 37.30 30.90 deg F | |
| T MIN 15.90 19.50 21.60 27.50 32.90 39.00 44.20 43.20 38.60 32.20 24.70 19.10 deg F | |
| MEANP 6.56 5.41 4.89 3.02 2.98 3.33 1.19 1.42 2.52 4.35 5.91 6.12 in | |
| # WET 19.89 15.92 15.77 12.09 12.96 11.89 5.93 7.11 7.89 12.08 16.90 18.00 | |
| sandy loam soil | 30 year run |
| Average annual precipitation 47 in | |

# ATTACHMENT D

# WEPP: Road Modeling Results for Field Assessed Sites

**WEPP: Road Modeling Results for Field Assessed Crossings**

| Comment | Elevation | Soil | Years | Design | Surface, traffic | Road grad (%) | Road length (ft) | Road width (ft) | Fill grad (%) | Fill length (ft) | Buff grad (%) | Buff length (ft) | Rock cont (%) | Average annual rain runoff (in) | Average annual snow runoff (in) | Average annual sediment leaving road (lb/yr) | Average annual sediment leaving buffer (lb/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **State Ownership** | | | | | | | | | | | | | | | | | |
| UBR-S-04 | 2342.75 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 1 | 121 | 20 | 150 | 5 | 0.3 | 1 | 65 | 0.3 | 0.1 | 28 | 38 |
| **Private Ownership** | | | | | | | | | | | | | | | | | |
| EC-P-40 | 2348.49 | Sandy Loam | 30 | Insloped, bare ditch | graveled high | 8 | 254 | 31 | 100 | 11 | 0.3 | 1 | 65 | 0.5 | 0.1 | 817 | Summed |
| EC-P-40 | 2348.49 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 9 | 440 | 18 | 40 | 9 | 0.3 | 1 | 65 | 0.3 | 0 | 380 | 975 |
| EC-P-36 | 2493.44 | Sandy Loam | 30 | Outsloped, rutted | native low | 9 | 162 | 15.5 | 85 | 3 | 0.3 | 1 | 35 | 0.6 | 0.4 | 107 | 87 |
| SCR-P-02 | 2552.49 | Sandy Loam | 30 | Outsloped, rutted | native high | 4 | 402 | 16 | 75 | 7.5 | 0.3 | 1 | 65 | 0.4 | 0.1 | 303 | 301 |
| **Private Ownership** | | | | | | | **419.3** | | | | | | | | | **Mean** | **0.23** |
| | | | | | | | | | | | | | | **25th** | **0.097** | **Median** | **0.15** |
| | | | | | | | | | | | | | | **75th** | **0.32** | **Maximum** | **0.49** |
| | | | | | | | | | | | | | | | | **Minimum** | **0.04** |
| **Federal Ownership** | | | | | | | | | | | | | | | | | |
| MC-FS-24 | 2339.24 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 2 | 122 | 27 | 150 | 8 | 0.3 | 1 | 65 | 0.4 | 0.1 | 49 | 77 |
| EC-FS-37 | 2388.45 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 6 | 288 | 19.5 | 95 | 7 | 0.3 | 1 | 65 | 0.5 | 0.1 | 279 | 250 |
| EC-FS-41 | 2394.37 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 2 | 396 | 22 | 45 | 12 | 0.3 | 1 | 0 | 0.1 | 0 | 261 | 84 |
| MC-FS-25 | 2398.29 | Silt Loam | 30 | Insloped, vegetated or rocked ditch | native none | 9 | 3 | 1 | 10 | 6 | 0.3 | 1 | 50 | 0.1 | 0 | 0 | 0 |
| UBR-FS-06 | 2432.25 | Sandy Loam | 30 | Outsloped, rutted | native low | 1 | 64 | 16.5 | 95 | 7 | 0.3 | 1 | 45 | 0.5 | 0.2 | 10 | 14 |
| UBR-FS-07 | 2443.52 | Silt Loam | 30 | Insloped, vegetated or rocked ditch | native low | 1 | 3 | 1 | 85 | 12 | 0.3 | 1 | 80 | 0.1 | 0 | 0 | Summed |
| UBR-FS-07 | 2443.52 | Silt Loam | 30 | Insloped, vegetated or rocked ditch | native low | 1 | 3 | 1 | 85 | 12 | 0.3 | 1 | 80 | 0.1 | 0 | 0 | 0 |
| DC-FS-03 | 2482.84 | Sandy Loam | 30 | Outsloped, rutted | native low | 15 | 700 | 12.5 | 90 | 7 | 0.3 | 1 | 60 | 1.4 | 0.8 | 3,188 | 2982 |
| UBR- FS- 05 | 2526.56 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 5 | 98 | 16 | 55 | 18 | 0.3 | 1 | 65 | 0.2 | 0 | 41 | Summed |
| UBR-FS-05 | 2526.56 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 5 | 215 | 15 | 0.3 | 1 | 0.3 | 1 | 65 | 0.2 | 0 | 83 | 42 |
| WPC-FS-35 | 2549.21 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled low | 2 | 281 | 17 | 50 | 13 | 0.3 | 1 | 65 | 0.3 | 0.1 | 58 | 51 |
| MC-FS-23 | 2565.62 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 6 | 511 | 21 | 105 | 8 | 0.3 | 1 | 65 | 0.3 | 0 | 341 | 206 |
| EFEC-FS-42 | 2614.83 | Sandy Loam | 30 | Outsloped, unrutted | native low | 2 | 123 | 12 | 55 | 20 | 0.3 | 1 | 70 | 0.2 | 0 | 23 | 9 |
| SCR-FS-01 | 2700.13 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled low | 3 | 65 | 8 | 0.3 | 1 | 0.3 | 1 | 50 | 0.3 | 0 | 4 | Summed |
| SCR-FS-01 | 2700.13 | Sandy Loam | 30 | Outsloped, rutted | native low | 5 | 90 | 9 | 0.3 | 1 | 0.3 | 1 | 45 | 0.6 | 0.4 | 15 | 10 |
| MBR-FS-15 | 2738.19 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 3 | 130 | 14 | 50 | 116 | 0.3 | 1 | 65 | 0.2 | 0 | 124 | Summed |
| MBR-FS-15 | 2738.19 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 5 | 300 | 10 | 50 | 116 | 0.3 | 1 | 65 | 0.1 | 0 | 76 | 275 |
| WPC-FS-34 | 2818.24 | Sandy Loam | 30 | Outsloped, unrutted | graveled low | 4 | 177 | 17 | 60 | 10 | 0.3 | 1 | 65 | 0.2 | 0 | 36 | 16 |
| EFEC-FS-39 | 2837.93 | Sandy Loam | 30 | Outsloped, unrutted | native low | 4 | 160 | 14 | 40 | 13 | 0.3 | 1 | 60 | 0.3 | 0.1 | 43 | 16 |
| MC-FS-22 | 2916.67 | Silt Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 5 | 661 | 21 | 75 | 13 | 0.3 | 1 | 65 | 0.3 | 0.1 | 609 | 558 |
| BRH-FS-08 | 2930.54 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 9 | 230 | 14 | 60 | 13 | 0.3 | 1 | 65 | 0.2 | 0 | 139 | 75 |

| Comment | Elevation | Soil | Years | Design | Surface, traffic | Road grad (%) | Road length (ft) | Road width (ft) | Fill grad (%) | Fill length (ft) | Buff grad (%) | Buff length (ft) | Rock cont (%) | Average annual rain runoff (in) | Average annual snow runoff (in) | Average annual sediment leaving road (lb/yr) | Average annual sediment leaving buffer (lb/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BRH-FS-09 | 3004.7 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 4 | 440 | 20 | 30 | 12 | 0.3 | 1 | 65 | 0.4 | 0.1 | 193 | 207 |
| MBR-FS-14 | 3137.58 | Silt Loam | 30 | Outsloped, unrutted | native low | 4 | 22 | 12 | 0.3 | 1 | 0.3 | 1 | 55 | 0.7 | 0.9 | 5 | Summed |
| MBR-FS-14 | 3137.58 | Silt Loam | 30 | Outsloped, unrutted | native low | 5 | 111 | 12 | 0.3 | 1 | 0.3 | 1 | 55 | 0.8 | 1.1 | 25 | 3 |
| MC-FS-21 | 3425.2 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | native low | 7 | 112 | 19.5 | 80 | 32 | 0.3 | 1 | 70 | 0.6 | 0.2 | 248 | 194 |
| MBR-FS-13 | 3433.89 | Silt Loam | 30 | Outsloped, rutted | native low | 5 | 82 | 16 | 85 | 15 | 0.3 | 1 | 25 | 0.6 | 0.8 | 75 | 47 |
| WPC-FS-31 | 3474.41 | Silt Loam | 30 | Outsloped, rutted | graveled high | 6 | 1000 | 17 | 95 | 6 | 0.3 | 1 | 65 | 0.3 | 0.1 | 1,831 | 1706 |
| EC-FS-28 | 3492.46 | Sandy Loam | 30 | Outsloped, rutted | native none | 6 | 99 | 6 | 80 | 41 | 0.3 | 1 | 55 | 0.4 | 0.1 | 17 | 10 |
| EFEC-FS-38 | 3559.71 | Sandy Loam | 30 | Outsloped, rutted | native low | 8 | 132 | 8 | 90 | 20 | 0.3 | 1 | 80 | 1 | 0.5 | 95 | 81 |
| WPC-FS-30 | 3559.71 | Sandy Loam | 30 | Outsloped, rutted | graveled high | 6 | 1000 | 19.5 | 75 | 10 | 0.3 | 1 | 65 | 0.6 | 0.2 | 2,642 | 2544 |
| BRH-FS-12 | 3704.48 | Sandy Loam | 30 | Outsloped, unrutted | native low | 3 | 156 | 10 | 70 | 14 | 0.3 | 1 | 65 | 0.3 | 0.1 | 32 | 14 |
| MC-FS-20 | 3825.46 | Sandy Loam | 30 | Outsloped, unrutted | native low | 5 | 138 | 18 | 85 | 17 | 0.3 | 1 | 80 | 0.5 | 0.2 | 59 | 41 |
| MC-FS-19 | 3871.39 | Sandy Loam | 30 | Outsloped, unrutted | native low | 6 | 98 | 16 | 68 | 29 | 0.3 | 1 | 80 | 0.4 | 0.1 | 41 | 33 |
| BRH-FS-11 | 3911.23 | Sandy Loam | 30 | Outsloped, unrutted | native low | 2 | 150 | 12 | 85 | 11 | 0.3 | 1 | 60 | 0.3 | 0.1 | 34 | Summed |
| BRH-FS-11 | 3911.23 | Sandy Loam | 30 | Outsloped, unrutted | native low | 4 | 82 | 16 | 85 | 11 | 0.3 | 1 | 60 | 0.5 | 0.2 | 31 | 31 |
| MC-FS-18 | 3950.13 | Sandy Loam | 30 | Outsloped, unrutted | native low | 9 | 156 | 21 | 110 | 36 | 0.3 | 1 | 80 | 0.5 | 0.2 | 137 | Summed |
| MC-FS-18 | 3950.13 | Sandy Loam | 30 | Outsloped, unrutted | native low | 5 | 216 | 19 | 110 | 36 | 0.3 | 1 | 80 | 0.4 | 0.1 | 98 | 289 |
| MC-FS-17 | 3982.94 | Sandy Loam | 30 | Outsloped, unrutted | native low | 5 | 158 | 18 | 110 | 9 | 0.3 | 1 | 60 | 0.6 | 0.2 | 68 | 43 |
| WPC-FS-33 | 4015.75 | Silt Loam | 30 | Outsloped, unrutted | native none | 8 | 78 | 11.5 | 85 | 32 | 0.3 | 1 | 20 | 0.2 | 0.1 | 28 | Summed |
| WPC-FS-33 | 4015.75 | Silt Loam | 30 | Outsloped, unrutted | native none | 8 | 68 | 11.5 | 85 | 32 | 0.3 | 1 | 20 | 0.2 | 0.1 | 24 | 12 |
| WPC-FS-32 | 4222.44 | Silt Loam | 30 | Outsloped, unrutted | native none | 3 | 70 | 10 | 60 | 13 | 0.3 | 1 | 45 | 0.3 | 0.2 | 14 | Summed |
| WPC-FS-32 | 4222.44 | Silt Loam | 30 | Outsloped, unrutted | native none | 5 | 97 | 10 | 60 | 13 | 0.3 | 1 | 45 | 0.4 | 0.2 | 22 | 6 |
| EFEC-FS-27 | 4235.56 | Silt Loam | 30 | Outsloped, rutted | native none | 5 | 166 | 6 | 115 | 34 | 0.3 | 1 | 45 | 1.1 | 3 | 47 | Summed |
| EFEC-FS-27 | 4235.56 | Silt Loam | 30 | Outsloped, rutted | native none | 3 | 119 | 6 | 115 | 34 | 0.3 | 1 | 45 | 0.9 | 2 | 16 | 40 |
| BRH-FS-10 | 4372.35 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | native low | 7 | 170 | 16 | 65 | 15 | 0.3 | 1 | 60 | 1.1 | 0.6 | 193 | Summed |
| BRH-FS-10 | 4372.35 | Sandy Loam | 30 | Outsloped, unrutted | native low | 7 | 30 | 12 | 65 | 15 | 0.3 | 1 | 60 | 0.5 | 0.2 | 10 | 167 |
| EFEC-FS-26 | 4400.12 | Silt Loam | 30 | Outsloped, rutted | native none | 4 | 197 | 5.5 | 110 | 32 | 0.3 | 1 | 20 | 0.7 | 2.7 | 41 | 26 |
| WPC-FS-29 | 4908.14 | Silt Loam | 30 | Outsloped, unrutted | native low | 5 | 201 | 11 | 80 | 37 | 0.3 | 1 | 55 | 0.4 | 0.2 | 42 | 47 |
| MC-FS-16 | 5108.27 | Silt Loam | 30 | Outsloped, unrutted | native none | 5 | 161 | 14.5 | 70 | 21 | 0.3 | 1 | 70 | 0.5 | 0.3 | 50 | Summed |
| MC-FS-16 | 5108.27 | Silt Loam | 30 | Outsloped, unrutted | native none | 7 | 182 | 14.5 | 70 | 21 | 0.3 | 1 | 70 | 0.6 | 0.5 | 71 | 32 |
| ECFC-FS-43 | 5192 | Sandy Loam | 30 | Outsloped, rutted | native low | 9 | 390 | 10 | 90 | 12 | 0.3 | 1 | 60 | 1.2 | 0.6 | 620 | 552 |
| **Federal Results** | | | | | | | **274.4** | | | | | | | | | **Mean** | **0.14** |
| | | | | | | | | | | | | | | **25th** | **0.008** | **Median** | **0.02** |
| | | | | | | | | | | | | | | **75th** | **0.10** | **Maximum** | **1.49** |
| | | | | | | | | | | | | | | | | **Minimum** | **0.00** |

**WEPP: Road Modeling Results for Field Assessed Parallel Segments**

| Comment | Elevation | Soil | Years | Design | Surface, traffic | Road grad (%) | Road length (ft) | Road width (ft) | Fill grad (%) | Fill length (ft) | Buff grad (%) | Buff length (ft) | Rock cont (%) | Average annual rain runoff (in) | Average annual snow runoff (in) | Average annual sediment leaving road (lb/yr) | Average annual sediment leaving buffer (lb/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Elk Creek Parallel Segments** | | | | | | | | | | | | | | | | | |
| ELK-FS-06 | 3914.04 | Sandy Loam | 30 | Outsloped, rutted | native low | 8 | 550 | 12 | 0.3 | 1 | 65 | 20 | 70 | 0.6 | 0.4 | 1,013 | 613 |
| ELK-FS-06 | 3914.04 | Sandy Loam | 30 | Outsloped, rutted | native low | 6 | 550 | 13 | 0.3 | 1 | 25 | 30 | 70 | 0.5 | 0.3 | 1,496 | 725 |
| ELK-FS-06 | 3914.04 | Sandy Loam | 30 | Outsloped, rutted | native low | 8 | 550 | 13 | 0.3 | 1 | 35 | 60 | 70 | 0.6 | 0.4 | 1,251 | 694 |
| ELK-FS-06 | 3914.04 | Sandy Loam | 30 | Outsloped, rutted | native low | 7 | 550 | 13 | 0.3 | 1 | 30 | 40 | 70 | 0.8 | 0.6 | 1,388 | 928 |
| ELK-FS-06 | 3937.01 | Sandy Loam | 30 | Outsloped, rutted | native low | 8 | 550 | 12 | 0.3 | 1 | 30 | 20 | 70 | 0.8 | 0.6 | 1,403 | 1,058 |
| ELK-FS-07 | 3379.27 | Sandy Loam | 30 | Outsloped, rutted | native low | 7 | 80 | 13 | 0.3 | 1 | 20 | 20 | 60 | 0.1 | 0 | 33 | 8 |
| ELK-FS-08 | 3343.18 | Sandy Loam | 30 | Outsloped, unrutted | native low | 6 | 26 | 10 | 0.3 | 1 | 0.3 | 7.5 | 80 | 0 | 0 | 5 | 0 |
| | | | | | | | | | | | Mean | 28.2 | | | | **Mean** | **0.29** |
| **Elk Creek Parallel Segments** Results | | | | | | | | | | | Median | 20 | | **25th** | **0.15** | **Median** | **0.35** |
| | | | | | | | | | | | | | | **75th** | **0.41** | **Maximum** | **0.49** |
| | | | | | | | | | | | | | | | | **Minimum** | **0.00** |
| **Marten Creek Parallel Segments** | | | | | | | | | | | | | | | | | |
| MC-PP-01 | 2641.08 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 2 | 1000 | 23 | 0.3 | 1 | 1 | 80 | 65 | 0 | 0 | 146 | 10 |
| MC-PP-02 | 2591.86 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 3 | 1000 | 23 | 3 | 5 | 1 | 150 | 65 | 0 | 0 | 542 | 0 |
| MC-PP-03 | 2555.77 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 3 | 1000 | 20 | 0.3 | 3 | 0.3 | 150 | 65 | 0 | 0 | 467 | 0 |
| MC-PP-04 | 2506.56 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 1 | 1000 | 23 | 6 | 4 | 1 | 75 | 65 | 0 | 0 | 75 | 5 |
| MC-PP-05 | 2477.03 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 1 | 1000 | 23 | 4 | 10 | 1 | 150 | 65 | 0 | 0 | 481 | 0 |
| MC-PP-06 | 2404.86 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 4 | 61 | 23 | 8 | 11 | 1 | 60 | 65 | 0 | 0 | 38 | 0 |
| | | | | | | | | | | | Mean | 110.8 | | | | **Mean** | **0.001** |
| **Marten Creek Parallel Segments** Results | | | | | | | | | | | Median | 115 | | **25th** | **0.000** | **Median** | **0.000** |
| | | | | | | | | | | | | | | **75th** | **0.002** | **Maximum** | **0.04** |
| | | | | | | | | | | | | | | | | **Minimum** | **0.00** |
| **White Pine Creek Parallel Segments** | | | | | | | | | | | | | | | | | |
| WPC-PP-01 | 3264.44 | Sandy Loam | 30 | Outsloped, unrutted | graveled low | 5 | 1000 | 19 | 60 | 23 | 0.3 | 1 | 65 | 0.2 | 0 | 230 | 157 |
| WPC-PP-02 | 3192.26 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled low | 9 | 210 | 23 | 50 | 7 | 0.3 | 150 | 65 | 0 | 0 | 145 | Summed |
| WPC-PP-02 | 3192.26 | Sandy Loam | 30 | Outsloped, unrutted | graveled low | 9 | 210 | 20 | 50 | 7 | 0.3 | 150 | 65 | 0 | 0 | 85 | 0 |
| WPC-PP-03 | 3070.87 | Sandy Loam | 30 | Outsloped, unrutted | graveled low | 5 | 293 | 22 | 55 | 18 | 1 | 41 | 65 | 0 | 0 | 78 | 0 |
| WPC-PP-04 | 2992.13 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled low | 5 | 727 | 25.5 | 70 | 20 | 1 | 120 | 65 | 0 | 0 | 476 | 16 |
| WPC-PP-05 | 2900.26 | Sandy Loam | 30 | Outsloped, unrutted | graveled low | 8 | 1000 | 1 | 0.3 | 1 | 1 | 160 | 65 | 0 | 0 | 14 | 0 |
| | | | | | | | | | | | Mean | 103.7 | | | | **Mean** | **0.02** |
| **White Pine Creek Parallel Segments** Results | | | | | | | | | | | Median | 135 | | **0.000** | **0.000** | **0.000** | **0.00** |
| | | | | | | | | | | | | | | **75th** | **0.01** | **0.01** | **0.01** |
| | | | | | | | | | | | | | | | | **Minimum** | **0.00** |

Shaded cells in the Road length column represent two upstream sections of the culvert. These cells were summed prior to calculating the average road length for each crossing within a watershed.

Shaded cells in the last column were summed either because the road was crowned and was modeled as two widths (inslope and outslope portion) or because of the two contributing upstream road sections.

# ATTACHMENT E

## WEPP: Road Modeling Results for Field Assessed Sites with Road Length Reductions

**WEPP: Road Modeling Results for Field Assessed Crossings: 200 feet maximum length**

| Comment | Elevation | Soil | Years | Design | Surface, traffic | Road grad (%) | Road length (ft) | Road width (ft) | Fill grad (%) | Fill length (ft) | Buff grad (%) | Buff length (ft) | Rock cont (%) | Average annual rain runoff (in) | Average annual snow runoff (in) | Average annual sediment leaving road (lb/yr) | Average annual sediment leaving buffer (lb/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **State Ownership** | | | | | | | | | | | | | | | | | |
| UBR-S-04 | 2342.75 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 1 | 121 | 20 | 150 | 5 | 0.3 | 1 | 65 | 0.3 | 0.1 | 28 | 38 |
| **Private Ownership** | | | | | | | | | | | | | | | | | |
| EC-P-40 | 2348.49 | Sandy Loam | 30 | Insloped, bare ditch | graveled high | 8 | 100 | 31 | 100 | 11 | 0.3 | 1 | 65 | 0.4 | 0 | 221 | Summed |
| EC-P-40 | 2348.49 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 9 | 100 | 18 | 40 | 9 | 0.3 | 1 | 65 | 0.3 | 0 | 86 | 230 |
| EC-P-36 | 2493.44 | Sandy Loam | 30 | Outsloped, rutted | native low | 9 | 162 | 15.5 | 85 | 3 | 0.3 | 1 | 35 | 0.6 | 0.4 | 107 | 87 |
| SCR-P-02 | 2552.49 | Sandy Loam | 30 | Outsloped, rutted | native high | 4 | 200 | 16 | 75 | 7.5 | 0.3 | 1 | 65 | 0.4 | 0.1 | 135 | 120 |
| **Private Ownership** | | | | | | | | | | | | | | | | **Mean** | **0.07** |
| | | | | | | | | | | | | | | **25th** | **0.052** | **Median** | **0.06** |
| | | | | | | | | | | | | | | **75th** | **0.09** | **Maximum** | **0.12** |
| | | | | | | | | | | | | | | | | **Minimum** | **0.04** |
| **Federal Ownership** | | | | | | | | | | | | | | | | | |
| MC-FS-24 | 2339.24 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 2 | 122 | 27 | 150 | 8 | 0.3 | 1 | 65 | 0.4 | 0.1 | 49 | 77 |
| EC-FS-37 | 2388.45 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 6 | 200 | 19.5 | 95 | 7 | 0.3 | 1 | 65 | 0.5 | 0.1 | 171 | 148 |
| EC-FS-41 | 2394.37 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 2 | 200 | 22 | 45 | 12 | 0.3 | 1 | 0 | 0.1 | 0 | 132 | 43 |
| MC-FS-25 | 2398.29 | Silt Loam | 30 | Insloped, vegetated or rocked ditch | native none | 9 | 3 | 1 | 10 | 6 | 0.3 | 1 | 50 | 0.1 | 0 | 0 | 0 |
| UBR-FS-06 | 2432.25 | Sandy Loam | 30 | Outsloped, rutted | native low | 1 | 64 | 16.5 | 95 | 7 | 0.3 | 1 | 45 | 0.5 | 0.2 | 10 | 14 |
| UBR-FS-07 | 2443.52 | Silt Loam | 30 | Insloped, vegetated or rocked ditch | native low | 1 | 3 | 1 | 85 | 12 | 0.3 | 1 | 80 | 0.1 | 0 | 0 | Summed |
| UBR-FS-07 | 2443.52 | Silt Loam | 30 | Insloped, vegetated or rocked ditch | native low | 1 | 3 | 1 | 85 | 12 | 0.3 | 1 | 80 | 0.1 | 0 | 0 | 0 |
| DC-FS-03 | 2482.84 | Sandy Loam | 30 | Outsloped, rutted | native low | 15 | 200 | 12.5 | 90 | 7 | 0.3 | 1 | 60 | 1.2 | 0.6 | 382 | 317 |
| UBR- FS- 05 | 2526.56 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 5 | 98 | 16 | 55 | 18 | 0.3 | 1 | 65 | 0.2 | 0 | 41 | Summed |
| UBR-FS-05 | 2526.56 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 5 | 102 | 15 | 0.3 | 1 | 0.3 | 1 | 65 | 0.2 | 0 | 39 | 30 |
| WPC-FS-35 | 2549.21 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled low | 2 | 200 | 17 | 50 | 13 | 0.3 | 1 | 65 | 0.3 | 0.1 | 46 | 40 |
| MC-FS-23 | 2565.62 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 6 | 200 | 21 | 105 | 8 | 0.3 | 1 | 65 | 0.3 | 0 | 133 | 81 |
| EFEC-FS-42 | 2614.83 | Sandy Loam | 30 | Outsloped, unrutted | native low | 2 | 123 | 12 | 55 | 20 | 0.3 | 1 | 70 | 0.2 | 0 | 23 | 9 |
| SCR-FS-01 | 2700.13 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled low | 3 | 65 | 8 | 0.3 | 1 | 0.3 | 1 | 50 | 0.3 | 0 | 4 | Summed |
| SCR-FS-01 | 2700.13 | Sandy Loam | 30 | Outsloped, rutted | native low | 5 | 90 | 9 | 0.3 | 1 | 0.3 | 1 | 45 | 0.6 | 0.4 | 15 | 10 |
| MBR-FS-15 | 2738.19 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 3 | 100 | 14 | 50 | 116 | 0.3 | 1 | 65 | 0.2 | 0 | 92 | Summed |
| MBR-FS-15 | 2738.19 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 5 | 100 | 10 | 50 | 116 | 0.3 | 1 | 65 | 0.1 | 0 | 25 | 136 |
| WPC-FS-34 | 2818.24 | Sandy Loam | 30 | Outsloped, unrutted | graveled low | 4 | 177 | 17 | 60 | 10 | 0.3 | 1 | 65 | 0.2 | 0 | 36 | 16 |
| EFEC-FS-39 | 2837.93 | Sandy Loam | 30 | Outsloped, unrutted | native low | 4 | 160 | 14 | 40 | 13 | 0.3 | 1 | 60 | 0.3 | 0.1 | 43 | 16 |
| MC-FS-22 | 2916.67 | Silt Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 5 | 200 | 21 | 75 | 13 | 0.3 | 1 | 65 | 0.3 | 0.1 | 162 | 144 |

| Comment | Elevation | Soil | Years | Design | Surface, traffic | Road grad (%) | Road length (ft) | Road width (ft) | Fill grad (%) | Fill length (ft) | Buff grad (%) | Buff length (ft) | Rock cont (%) | Average annual rain runoff (in) | Average annual snow runoff (in) | Average annual sediment leaving road (lb/yr) | Average annual sediment leaving buffer (lb/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BRH-FS-08 | 2930.54 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 9 | 200 | 14 | 60 | 13 | 0.3 | 1 | 65 | 0.2 | 0 | 121 | 65 |
| BRH-FS-09 | 3004.7 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 4 | 200 | 20 | 30 | 12 | 0.3 | 1 | 65 | 0.4 | 0.1 | 80 | 82 |
| MBR-FS-14 | 3137.58 | Silt Loam | 30 | Outsloped, unrutted | native low | 4 | 22 | 12 | 0.3 | 1 | 0.3 | 1 | 55 | 0.7 | 0.9 | 5 | Summed |
| MBR-FS-14 | 3137.58 | Silt Loam | 30 | Outsloped, unrutted | native low | 5 | 111 | 12 | 0.3 | 1 | 0.3 | 1 | 55 | 0.8 | 1.1 | 25 | 3 |
| MC-FS-21 | 3425.2 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | native low | 7 | 112 | 19.5 | 80 | 32 | 0.3 | 1 | 70 | 0.6 | 0.2 | 248 | 194 |
| MBR-FS-13 | 3433.89 | Silt Loam | 30 | Outsloped, rutted | native low | 5 | 82 | 16 | 85 | 15 | 0.3 | 1 | 25 | 0.6 | 0.8 | 75 | 47 |
| WPC-FS-31 | 3474.41 | Silt Loam | 30 | Outsloped, rutted | graveled high | 6 | 200 | 17 | 95 | 6 | 0.3 | 1 | 65 | 0.4 | 0.1 | 214 | 185 |
| EC-FS-28 | 3492.46 | Sandy Loam | 30 | Outsloped, rutted | native none | 6 | 99 | 6 | 80 | 41 | 0.3 | 1 | 55 | 0.4 | 0.1 | 17 | 10 |
| EFEC-FS-38 | 3559.71 | Sandy Loam | 30 | Outsloped, rutted | native low | 8 | 132 | 8 | 90 | 20 | 0.3 | 1 | 80 | 1 | 0.5 | 95 | 81 |
| WPC-FS-30 | 3559.71 | Sandy Loam | 30 | Outsloped, rutted | graveled high | 6 | 200 | 19.5 | 75 | 10 | 0.3 | 1 | 65 | 0.6 | 0.2 | 297 | 286 |
| BRH-FS-12 | 3704.48 | Sandy Loam | 30 | Outsloped, unrutted | native low | 3 | 156 | 10 | 70 | 14 | 0.3 | 1 | 65 | 0.3 | 0.1 | 32 | 14 |
| MC-FS-20 | 3825.46 | Sandy Loam | 30 | Outsloped, unrutted | native low | 5 | 138 | 18 | 85 | 17 | 0.3 | 1 | 80 | 0.5 | 0.2 | 59 | 41 |
| MC-FS-19 | 3871.39 | Sandy Loam | 30 | Outsloped, unrutted | native low | 6 | 98 | 16 | 68 | 29 | 0.3 | 1 | 80 | 0.4 | 0.1 | 41 | 33 |
| BRH-FS-11 | 3911.23 | Sandy Loam | 30 | Outsloped, unrutted | native low | 2 | 118 | 12 | 85 | 11 | 0.3 | 1 | 60 | 0.3 | 0.1 | 27 | Summed |
| BRH-FS-11 | 3911.23 | Sandy Loam | 30 | Outsloped, unrutted | native low | 4 | 82 | 16 | 85 | 11 | 0.3 | 1 | 60 | 0.5 | 0.2 | 31 | 28 |
| MC-FS-18 | 3950.13 | Sandy Loam | 30 | Outsloped, unrutted | native low | 9 | 100 | 21 | 110 | 36 | 0.3 | 1 | 80 | 0.5 | 0.2 | 88 | Summed |
| MC-FS-18 | 3950.13 | Sandy Loam | 30 | Outsloped, unrutted | native low | 5 | 100 | 19 | 110 | 36 | 0.3 | 1 | 80 | 0.4 | 0.1 | 45 | 162 |
| MC-FS-17 | 3982.94 | Sandy Loam | 30 | Outsloped, unrutted | native low | 5 | 158 | 18 | 110 | 9 | 0.3 | 1 | 60 | 0.6 | 0.2 | 68 | 43 |
| WPC-FS-33 | 4015.75 | Silt Loam | 30 | Outsloped, unrutted | native none | 8 | 78 | 11.5 | 85 | 32 | 0.3 | 1 | 20 | 0.2 | 0.1 | 28 | Summed |
| WPC-FS-33 | 4015.75 | Silt Loam | 30 | Outsloped, unrutted | native none | 8 | 68 | 11.5 | 85 | 32 | 0.3 | 1 | 20 | 0.2 | 0.1 | 24 | 12 |
| WPC-FS-32 | 4222.44 | Silt Loam | 30 | Outsloped, unrutted | native none | 3 | 70 | 10 | 60 | 13 | 0.3 | 1 | 45 | 0.3 | 0.2 | 14 | Summed |
| WPC-FS-32 | 4222.44 | Silt Loam | 30 | Outsloped, unrutted | native none | 5 | 97 | 10 | 60 | 13 | 0.3 | 1 | 45 | 0.4 | 0.2 | 22 | 6 |
| EFEC-FS-27 | 4235.56 | Silt Loam | 30 | Outsloped, rutted | native none | 5 | 100 | 6 | 115 | 34 | 0.3 | 1 | 45 | 0.8 | 1.6 | 19 | Summed |
| EFEC-FS-27 | 4235.56 | Silt Loam | 30 | Outsloped, rutted | native none | 3 | 100 | 6 | 115 | 34 | 0.3 | 1 | 45 | 0.8 | 1.6 | 13 | 18 |
| BRH-FS-10 | 4372.35 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | native low | 7 | 170 | 16 | 65 | 15 | 0.3 | 1 | 60 | 1.1 | 0.6 | 193 | Summed |
| BRH-FS-10 | 4372.35 | Sandy Loam | 30 | Outsloped, unrutted | native low | 7 | 30 | 12 | 65 | 15 | 0.3 | 1 | 60 | 0.5 | 0.2 | 10 | 167 |
| EFEC-FS-26 | 4400.12 | Silt Loam | 30 | Outsloped, rutted | native none | 4 | 197 | 5.5 | 110 | 32 | 0.3 | 1 | 20 | 0.7 | 2.7 | 41 | 26 |
| WPC-FS-29 | 4908.14 | Silt Loam | 30 | Outsloped, unrutted | native low | 5 | 200 | 11 | 80 | 37 | 0.3 | 1 | 55 | 0.4 | 0.2 | 42 | 47 |
| MC-FS-16 | 5108.27 | Silt Loam | 30 | Outsloped, unrutted | native none | 5 | 100 | 14.5 | 70 | 21 | 0.3 | 1 | 70 | 0.5 | 0.3 | 31 | Summed |
| MC-FS-16 | 5108.27 | Silt Loam | 30 | Outsloped, unrutted | native none | 7 | 100 | 14.5 | 70 | 21 | 0.3 | 1 | 70 | 0.6 | 0.5 | 39 | 19 |
| ECFC-FS-43 | 5192 | Sandy Loam | 30 | Outsloped, rutted | native low | 9 | 200 | 10 | 90 | 12 | 0.3 | 1 | 60 | 1.1 | 0.5 | 211 | 180 |
| **Federal Results** | | | | | | | | | | | | | | | | **Mean** | **0.04** |
| | | | | | | | | | | | | | | **25th** | **0.008** | **Median** | **0.02** |
| | | | | | | | | | | | | | | **75th** | **0.05** | **Maximum** | **0.16** |
| | | | | | | | | | | | | | | | | **Minimum** | **0.00** |

**WEPP: Road Modeling Results for Field Assessed Parallel Segments: 400 feet maximum length**

| Comment | Elevation | Soil | Years | Design | Surface, traffic | Road grad (%) | Road length (ft) | Road width (ft) | Fill grad (%) | Fill length (ft) | Buff grad (%) | Buff length (ft) | Rock cont (%) | Average annual rain runoff (in) | Average annual snow runoff (in) | Average annual sediment leaving road (lb/yr) | Average annual sediment leaving buffer (lb/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Elk Creek Parallel Segments** | | | | | | | | | | | | | | | | | |
| ELK-FS-06 | 3914.04 | Sandy Loam | 30 | Outsloped, rutted | native low | 8 | 400 | 13 | 0.3 | 1 | 25 | 30 | 70 | 0.6 | 0.3 | 577 | 330 |
| ELK-FS-06 | 3914.04 | Sandy Loam | 30 | Outsloped, rutted | native low | 6 | 400 | 13 | 0.3 | 1 | 35 | 60 | 70 | 0.5 | 0.2 | 856 | 394 |
| ELK-FS-06 | 3914.04 | Sandy Loam | 30 | Outsloped, rutted | native low | 8 | 400 | 13 | 0.3 | 1 | 30 | 40 | 70 | 0.5 | 0.3 | 715 | 370 |
| ELK-FS-06 | 3914.04 | Sandy Loam | 30 | Outsloped, rutted | native low | 7 | 400 | 12 | 0.3 | 1 | 30 | 20 | 70 | 0.8 | 0.5 | 816 | 508 |
| ELK-FS-06 | 3937.01 | Sandy Loam | 30 | Outsloped, rutted | native low | 8 | 400 | 12 | 0.3 | 1 | 65 | 20 | 70 | 0.8 | 0.5 | 811 | 584 |
| ELK-FS-07 | 3379.27 | Sandy Loam | 30 | Outsloped, rutted | native low | 7 | 80 | 13 | 0.3 | 1 | 20 | 20 | 60 | 0.1 | 0 | 33 | 8 |
| ELK-FS-08 | 3343.18 | Sandy Loam | 30 | Outsloped, unrutted | native low | 6 | 26 | 10 | 0.3 | 1 | 0.3 | 7.5 | 80 | 0 | 0 | 5 | 0 |
| **Elk Creek Parallel Segments** Results | | | | | | | | | | | Mean | 28.2 | | | | **Mean** | **0.16** |
| | | | | | | | | | | | Median | 20 | | **25th** | **0.085** | **Median** | **0.19** |
| | | | | | | | | | | | | | | **75th** | **0.23** | **Maximum** | **0.49** |
| | | | | | | | | | | | | | | | | **Minimum** | **0.00** |
| **Marten Creek Parallel Segments** | | | | | | | | | | | | | | | | | |
| MC-PP-01 | 2641.08 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 2 | 400 | 23 | 0.3 | 1 | 1 | 80 | 65 | 0 | 0 | 89 | 2 |
| MC-PP-02 | 2591.86 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 3 | 400 | 23 | 3 | 5 | 1 | 150 | 65 | 0 | 0 | 217 | 0 |
| MC-PP-03 | 2555.77 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 3 | 400 | 20 | 0.3 | 3 | 0.3 | 150 | 65 | 0 | 0 | 187 | 0 |
| MC-PP-04 | 2506.56 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled high | 1 | 400 | 23 | 6 | 4 | 1 | 75 | 65 | 0 | 0 | 64 | 1 |
| MC-PP-05 | 2477.03 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 1 | 400 | 23 | 4 | 10 | 1 | 150 | 65 | 0 | 0 | 192 | 0 |
| MC-PP-06 | 2404.86 | Sandy Loam | 30 | Outsloped, unrutted | graveled high | 4 | 61 | 23 | 8 | 11 | 1 | 60 | 65 | 0 | 0 | 38 | 0 |
| **Marten Creek Parallel Segments** Results | | | | | | | | | | | Mean | 110.8 | | | | **Mean** | **0.000** |
| | | | | | | | | | | | Median | 115 | | **25th** | **0.000** | **Median** | **0.000** |
| | | | | | | | | | | | | | | **75th** | **0.002** | **Maximum** | **0.04** |
| | | | | | | | | | | | | | | | | **Minimum** | **0.00** |
| **White Pine Creek Parallel Segments** | | | | | | | | | | | | | | | | | |
| WPC-PP-01 | 3264.44 | Sandy Loam | 30 | Outsloped, unrutted | graveled low | 5 | 400 | 19 | 60 | 23 | 0.3 | 1 | 65 | 0.2 | 0 | 230 | 63 |
| WPC-PP-02 | 3192.26 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled low | 9 | 210 | 23 | 50 | 7 | 0.3 | 150 | 65 | 0 | 0 | 145 | Summed |
| WPC-PP-02 | 3192.26 | Sandy Loam | 30 | Outsloped, unrutted | graveled low | 9 | 210 | 20 | 50 | 7 | 0.3 | 150 | 65 | 0 | 0 | 85 | 0 |
| WPC-PP-03 | 3070.87 | Sandy Loam | 30 | Outsloped, unrutted | graveled low | 5 | 293 | 22 | 55 | 18 | 1 | 41 | 65 | 0 | 0 | 78 | 0 |
| WPC-PP-04 | 2992.13 | Sandy Loam | 30 | Insloped, vegetated or rocked ditch | graveled low | 5 | 400 | 25.5 | 70 | 20 | 1 | 120 | 65 | 0 | 0 | 476 | 2 |
| WPC-PP-05 | 2900.26 | Sandy Loam | 30 | Outsloped, unrutted | graveled low | 8 | 400 | 1 | 0.3 | 1 | 1 | 160 | 65 | 0 | 0 | 14 | 0 |
| **White Pine Creek Parallel Segments** Results | | | | | | | | | | | Mean | 103.7 | | | | **Mean** | **0.01** |
| | | | | | | | | | | | Median | 135 | | **0.000** | **0.000** | **0.000** | **0.00** |
| | | | | | | | | | | | | | | **75th** | **0.01** | **0.01** | **0.01** |
| | | | | | | | | | | | | | | | | **Minimum** | **0.00** |

Shaded cells in the Road length column represent two upstream sections of the culvert. These cells were summed prior to calculating the average road length for each crossing within a watershed.
Shaded cells in the last column were summed either because the road was crowned and was modeled as two widths (inslope and outslope portion) or because of the two contributing upstream road sections.