APPENDIX G – UNPAVED ROAD ASSESSMENT – BEAVERHEAD TPA

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G1.0 INTRODUCTION

An assessment of the road network within the Beaverhead TMDL Planning Area (TPA) was performed as part of the development of sediment TMDLs for 303(d) listed stream segments with sediment as a documented impairment. This assessment employed GIS, field data collection, and sediment modeling to assess sediment inputs from the unpaved road network. In addition, sediment inputs from failed culverts and the application of traction sand was also evaluated, along with an evaluation of fish passage at assessed crossings.

G1.1 SEDIMENT IMPAIRMENTS

The 2010 303(d) List includes the following stream segments for sediment / siltation impairment in the Beaverhead TPA: Spring Creek, Stone Creek, Blacktail Deer Creek, West Fork Blacktail Deer Creek, Clark Canyon Creek, Reservoir Creek, Taylor Creek, Dyce Creek, West Fork Dyce Creek, Scudder Creek, Steel Creek, Farlin Creek, French Creek, Rattlesnake Creek and the Beaverhead River.

G2.0 METHODS

Methods employed in this assessment are outlined in *Road Sediment Assessment & Modeling: Beaverhead TMDL Planning Area 303(d) Listed Tributary Streams – Road GIS Layers and Summary Statistics*, *July 30, 2010 (Montana Department of Environmental Quality, 2010a)* and *Road Sediment Assessment and Modeling Beaverhead TPA Sampling and Analysis Plan* (Montana Department of Environmental Quality, 2010b) and summarized below.

G2.1 SEDIMENT INPUTS FROM UNPAVED ROADS

Sediment inputs from unpaved roads were evaluated through a combination of GIS analysis, field data collection and computer modeling.

G2.1.1 GIS Analysis

Prior to field data collection, GIS data layers representing land ownership, road network, stream network, watersheds, and ecoregions were used to identify road crossings throughout the Beaverhead TPA. Land ownership data was divided into five categories: US Forest Service, US Bureau of Land Management, Montana Fish, Wildlife and Parks, Montana State Trust, and Private. The road network was derived from the State of Montana Base Map Service Center Transportation Framework Theme. The stream network was developed using the National Hydrography Dataset (NHD) mid-resolution (1:100,000) flowline layer. Flowlines were limited to streams/rivers and artificial paths; ditches and pipelines were not included. Watersheds were delineated on the basis of the 6th Hydrologic Unit Code layer and modified where necessary to delineate the subwatersheds of interest within the Beaverhead TPA. Landscapes were delineated according to EPA 2002 Level IV Ecoregions. These GIS layers were utilized to develop a database of stream crossings and parallel road segments that includes land ownership, road surface type, subwatershed, and ecoregion attributes in one attribute table. Through GIS analysis, 940 road crossings were identified within the Beaverhead TPA, 829 of which were identified as unpaved road crossings. Parallel road segments located within 150 feet of streams were also identified using GIS, totaling 177.30 miles, 171.27 of which were identified as unpaved road segments within 150 feet of a stream channel.

G2.1.2 Field Data Collection

A field assessment of unpaved roads was conducted by performing an inspection of road crossings and parallel road segments throughout the Beaverhead TPA in August of 2010.

G2.1.2.1 Crossing Assessment Sites

A total of 829 unpaved road crossings were identified in the Beaverhead TPA, 26 of which were assessed in the field. At each field assessed unpaved crossing, a series of measurements were performed to define road design, maintenance level, condition, culvert size, and sediment loading potential. Measurements included the length, gradient, and width of road contributing sediment from each side of a stream crossing. Additional information was collected describing road design, road surface type, soil type, rock content, traffic level, and the presence of any Best Management Practices (BMPs). Information collected at each crossing was used to estimate sediment loading with the WEPP:Road model.

G2.1.2.2 Parallel Road Segment Assessment Sites

A total of 171.27 miles of unpaved parallel road segments were identified in the Beaverhead TPA and seven sites were assessed. Unpaved parallel road segments were assessed as they were encountered in the field, with an attempt to locate assessment sites near selected unpaved road crossing assessment sites. At each unpaved parallel road segment assessment site, a series of measurements were performed to define road design, maintenance level, condition, and sediment loading potential. Measurements included the length, gradient, and width of road contributing sediment. Additional information was collected describing road design, road surface type, soil type, rock content, traffic level, and the presence of any BMPs. Information collected at each parallel road segment was used to estimate sediment loading with the WEPP:Road model.

G2.1.3 WEPP Modeling

Sediment loading from unpaved road crossings and parallel road segments was estimated using the WEPP:Road soil erosion model (http://forest.moscowfsl.wsu.edu/fswepp/). WEPP:Road is an interface to the Water Erosion Prediction Project (WEPP) model developed by the USDA Forest Service and other agencies, and is used to predict runoff, erosion, and sediment delivery from forest roads. The WEPP:Road model predicts sediment yields based on specific soil, climate, ground cover, and topographic conditions. Field data collected from each field assessed site provided the following input data necessary to run the WEPP:Road model:

- Road design: insloped, bare ditch; insloped, vegetated or rocked ditch; outsloped, rutted; outsloped unrutted
- Road surface: native, graveled, paved
- Traffic level: high, low, none
- Soil texture: clay loam, silt loam, sandy loam, loam
- Rock content
- Gradient, length and width of the road, fill and buffer
- Climate data
- Years to simulate

G2.1.4 Potential Culvert Failures

A coarse assessment for each culvert was preformed on-site in order to measure and identify characteristics of the culvert. Characteristics evaluated included structure type, diameter and dimensions, gradient, bankfull width, fill height/length/width, outlet invert, and streambed materials.

This information was then used to estimate potential sediment loads from a culvert failure. At each culvert assessed in the field, the flood frequencies for the 2, 5, 10, 25, 50, and 100-year events were determined based on the bankfull width upstream of the culvert using United State Geological Survey Southwest Montana Region regression equations (Parrett and Johnson, 2004). The Urban Drainage and Flood Control District (UDFCD) Sewer and Culvert Hydraulics Version 2.0 (http://www.udfcd.org/) spreadsheet model was then utilized to establish the flow capacity of each field assessed culvert. The amount of sediment contributed during a culvert failure was calculated based on the volume of road fill overlaying the culvert with the assumption that culvert failure would erode sediment to a width equal to the bankfull width of the channel upstream of the culvert. For this analysis, an estimated soil weight of 1.66 tons/yard^3 was utilized based on the maximum unit weight for dry well-graded subangular sand presented in Table 1:4 of *Introductory Soil Mechanics and Foundations: Geotechnical Engineering Forth Edition (Sowers, 1979)*.

G2.2 TRACTION SAND APPLICATION

The application of traction sand to paved roads during winter maintenance activities is a potential source of sediment to streams within the Beaverhead TPA. There are six major paved travel routes within the Beaverhead TPA include the following:

- Interstate 15
- State Highway 278
- State Highway 41
- State Highway 91
- Pioneer Mountains National Scenic Byway
- Blacktail Road

Out of these six major paved travel routes, winter maintenance is managed by the Montana Department of Transportation along Interstate 15, State Highway 278, State Highway 41, and State Highway 91, while the Beaverhead Roads Department is responsible for maintaining the Pioneer Mountains National Scenic Byway and Blacktail Road, along with the city streets in Dillon. There are a total of 111 paved crossings in the Beaverhead TPA per GIS mapping, with the vast majority located on the six identified major travel routes. Data pertaining to traction sand application rates along these travel routes was obtained from the Montana Department of Transportation and the Beaverhead Roads Department.

G2.3 FISH PASSAGE ANALYSIS

At each field assessed unpaved road crossing site, an evaluation of the culvert was performed, including measurements of structure type, structure diameter, structure gradient, bankfull width upstream of the culvert, fill height, fill length, fill width, outlet invert, and presence of streambed materials in the culvert. These measurements were used to determine if the culvert represented a fish passage barrier at various flow conditions based on the United States Forest Service Region 10 Fish Passage Evaluation Criteria as described in *A Summary of Technical Considerations to Minimize the Blockage of Fish at Culverts on National Forests in Alaska (U.S. Forest Service Alaska Region, 2002)*.

G3.0 RESULTS

The results of this assessment examining sediment loading from roads to streams within the Beaverhead TPA (**Figure G3-1**) are presented in the following sections. Results are presented by landownership

(**Figure G3-2**) and Level IV Ecoregion (**Figure 3-3**) for each of the 6th code subwatersheds (**Figure G3-4**) within the Beaverhead TPA.

G3.1 SEDIMENT INPUTS FROM UNPAVED ROADS

Sediment inputs from unpaved road crossings and parallel road segments were evaluated using the WEPP:Road model. The potential to reduce sediment loads from unpaved roads through the application of Best Management Practices (BMPs) was also assessed by reducing contributing road segment lengths to 100 feet. For unpaved road crossings, contributing road segment lengths exceeding 100 feet were reduced to 100 feet on either side of the crossing, while parallel road segment lengths greater than 100 were also reduced to 100 feet. In addition, sediment inputs from potential culvert failures were also evaluated.

G3.1.1 WEPP Model Input Parameters

Road condition data collected throughout the Beaverhead TPA in August of 2010 was input directly into the WEPP model following guidance outlined in *WEPP Interface for Predicting Forest Road Runoff, Erosion and Sediment Delivery Technical Documentation*, which is available on the Internet at http://forest.moscowfsl.wsu.edu/fswepp/docs/wepproaddoc.html. In addition to field collected data, the WEPP:Road model requires the selection of site-specific climate data to provide an estimate of mean annual precipitation. The WEPP:Road model contains 55 custom climate stations for Montana. Out of these 55 custom climate stations, three were selected in southwest Montana to represent the range of precipitation conditions in the Beaverhead TPA (**Table G3-1**). Precipitation in the Beaverhead TPA ranges from 9-10” to 42-46” annually based on data collected from 1971 to 2000 and compiled by the PRISM Group at Oregon State University (http://nris.mt.gov/nsdi/nris/precip71_00.html) (**Figure G3-5**). Road crossing assessments in the Beaverhead TPA were conducted at sites located in precipitation zones ranging from 10-11” to 26-30”. Mean annual sediment loads from unpaved road crossings and parallel road segments were estimated using field collected data and site-specific precipitation data in the WEPP:Road model.

Table G3-1. Precipitation Data Applied in the WEPP:Road Model.

Climate Station	Mean Precipitation (Inches)	PRISM Precipitation Zones (Inches)
Lima MT	11.21	9-10 to 13-14
Norris Madison PH MT	17.41	14-16 to 18-20
Mystic Lake	24.52	20-22 +

G3.1.2 Unpaved Road Crossings

Out of 829 unpaved road crossings delineated in GIS, a total of 26 were assessed in the field (**Figure G3-6**). From these 26 crossings, the estimated mean annual sediment load is 1.45 tons, with a mean annual sediment load of 0.056 tons contributed from each assessed unpaved road crossing (**Attachment G-1**). For extrapolation to the subwatershed scale, unpaved road crossings were grouped based on the Level IV Ecoregion, with the five mountain ecoregions grouped together as presented in **Table G3-2** and **Attachment G-2**. For the Beaverhead TPA, the estimated mean annual sediment load from unpaved road crossings is 45.14 tons (**Table G3-3**). Through the application of BMPs, it is estimated that this load can be reduced to 11.19 tons. A complete evaluation of sediment loads at the subwatershed scale is presented in **Attachment G-3**.

Table G3-2. Unpaved Road Crossing Mean Annual Sediment Loads for Level IV Ecoregions.

Level IV Ecoregion	Number of Sites Assessed	Mean Annual Load (Tons)	Mean Annual Load with BMPs (Tons)
Big Hole	2	0.004	0.003
Dry Intermontane Sagebrush Valleys	14	0.047	0.014
Dry Gneissic-Schistose-Volcanic Hills	6	0.059	0.016
Barren Mountains, Eastern Pioneer Sedimentary Mountains, Pioneer-Anaconda Ranges, Forested Beaverhead Mountains	4	0.106	0.013

Table G3-3. Unpaved Road Crossing Mean Annual Sediment Loads by Subwatershed.

Subwatershed	# of Crossings	Mean Annual Load (Tons)	Mean Annual Load with BMPs (Tons)
Beaverhead River	255	13.04	3.68
Blacktail Deer Creek	117	6.02	1.70
Clark Canyon Creek	3	0.18	0.05
Dyce Creek	11	0.87	0.15
East Fork Blacktail Deer Creek	42	3.46	0.57
Ermont Gulch	38	1.83	0.55
Farlin Creek	2	0.21	0.03
French Creek	8	0.79	0.10
Grasshopper Creek	156	7.60	1.65
Lower Rattlesnake Creek	16	0.76	0.23
Lower Stone Creek	5	0.24	0.07
Middle Fork Blacktail Deer Creek	8	0.46	0.12
Reservoir Creek	8	0.38	0.12
Scudder Creek	4	0.22	0.03
Spring Creek	40	2.08	0.57
Steel Creek	10	0.24	0.05
Taylor Creek	18	0.90	0.22
Upper Beaverhead River	16	0.94	0.26
Upper Rattlesnake Creek	23	1.44	0.32
Upper Stone Creek	15	0.84	0.24
West Fork Blacktail Deer Creek	31	2.40	0.44
West Fork Dyce Creek	3	0.26	0.04
BEAVERHEAD TPA	**829**	**45.14**	**11.19**

G3.1.3 Unpaved Parallel Road Segments

A total of seven unpaved parallel road segments were assessed in the field (**Figure G3-7**). From these seven unpaved parallel road segments, the estimated annual sediment load is 0.69 tons, with a mean annual sediment load of 0.099 tons contributed from each unpaved parallel road segment (**Table G3-4, Attachment G-4**). For extrapolation to the subwatershed scale, the mean annual sediment load per 100 feet was determined for the seven parallel road segments. In addition, contributing road segment lengths measured in the field were compared to GIS delineated lengths for the assessed parallel segments. Out of the seven field assessed parallel road segments, two did not correlate to parallel road segments in GIS, while erroneous GPS data from a third field assessed parallel road segment precluded correlation to a GIS delineated parallel road segment. For the remaining four parallel road segments, the contributing road length measured in the field averaged 7.2% of the overall road segment length

measured in GIS (**Table G3-5**). Based on this, the mean annual load per 100 feet was multiplied by 0.072 to account for the portion of the parallel road segment not contributing sediment to the stream (**Table G3-4**). Thus, for unpaved parallel road segments, 0.0023 tons per year was extrapolated to every 100 feet of unpaved road within 150 feet of the stream channel as delineated in GIS. For the Beaverhead TPA, the estimated mean annual sediment load from unpaved parallel road segments is 21.21 tons (**Table G3-6**). Through the application of BMPs, it is estimated that this load can be reduced to 8.41 tons. A complete evaluation of sediment loads at the sub-watershed based scale is presented in **Attachment G-5.**

Table G3-4. Unpaved Parallel Segment Mean Annual Sediment Loads.

Mean Annual Load (Tons)	Mean Annual Load with BMPs (Tons)	Mean Annual Load per 100 Feet (Tons)	Mean Annual Load per 100 Feet with BMPs (Tons)	Mean Annual Load per 100 Feet for 7.2% (Tons)	Mean Annual Load per 100 Feet for 7.2% with BMPs (Tons)
0.099	0.013	0.033	0.013	0.0023	0.0009

Table G3-5. Field Measured Lengths Compared to GIS Delineated Lengths for Parallel Segments.

Field Site ID	GIS Segment Length (Feet)	Field Contributing Length (Feet)	Field Contributing Length as a Percent of GIS Segment Length
P-1	1,964	261	13.3%
P-4	4,818	196	4.1%
P-7	8,299	200	2.4%
P-6	7,947	991	12.5%
TOTAL	**23,029**	**1,648**	**7.2%**

Table G3-6. Unpaved Parallel Road Segment Mean Annual Sediment Loads by Subwatershed.

Subwatershed	Parallel Segment Length (Miles)	Parallel Segment Length (Feet)	Mean Annual Load (Tons)	Mean Annual Load with BMPs (Tons)
Beaverhead River	49.02	258,808	6.07	2.41
Blacktail Deer Creek	27.98	147,723	3.46	1.37
Clark Canyon Creek	1.25	6,584	0.15	0.06
Dyce Creek	2.79	14,742	0.35	0.14
East Fork Blacktail Deer Creek	6.67	35,199	0.83	0.33
Ermont Gulch	7.09	37,451	0.88	0.35
Farlin Creek	1.50	7,936	0.19	0.07
French Creek	7.26	38,356	0.90	0.36
Grasshopper Creek	31.86	168,195	3.94	1.56
Lower Rattlesnake Creek	1.07	5,658	0.13	0.05
Lower Stone Creek	0.34	1,810	0.04	0.02
Middle Fork Blacktail Deer Creek	1.44	7,601	0.18	0.07
Reservoir Creek	1.06	5,613	0.13	0.05
Scudder Creek	1.47	7,770	0.18	0.07
Spring Creek	3.40	17,937	0.42	0.17
Steel Creek	3.78	19,959	0.47	0.19
Taylor Creek	1.26	6,635	0.16	0.06
Upper Beaverhead River	2.18	11,536	0.27	0.11
Upper Rattlesnake Creek	4.67	24,669	0.58	0.23
Upper Stone Creek	6.92	36,515	0.86	0.34
West Fork Blacktail Deer Creek	5.29	27,912	0.65	0.26
West Fork Dyce Creek	2.97	15,677	0.37	0.15
BEAVERHEAD TPA	**171.27**	**904,287**	**21.21**	**8.41**

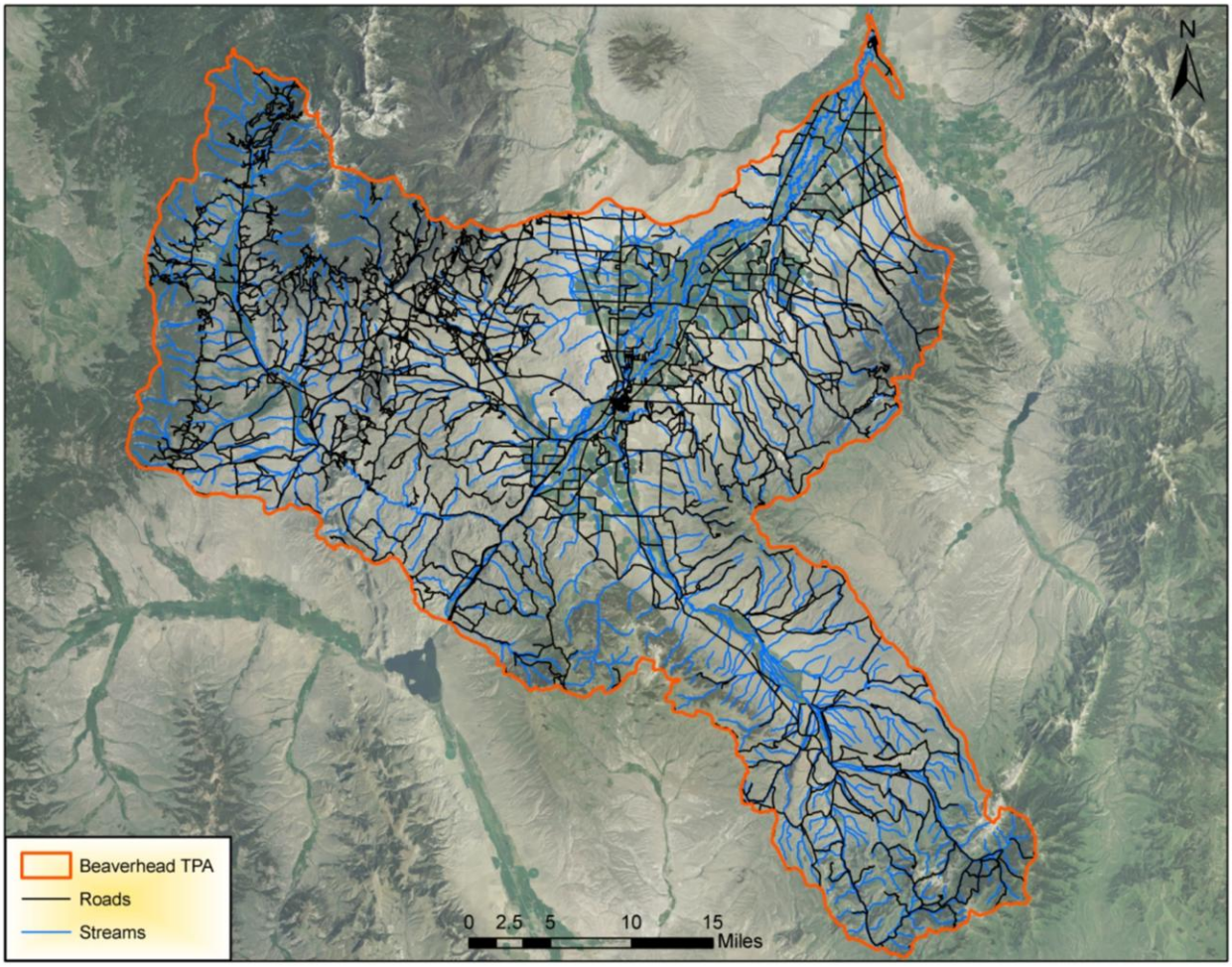

Figure G3-1. Road and Stream Networks in the Beaverhead TPA.

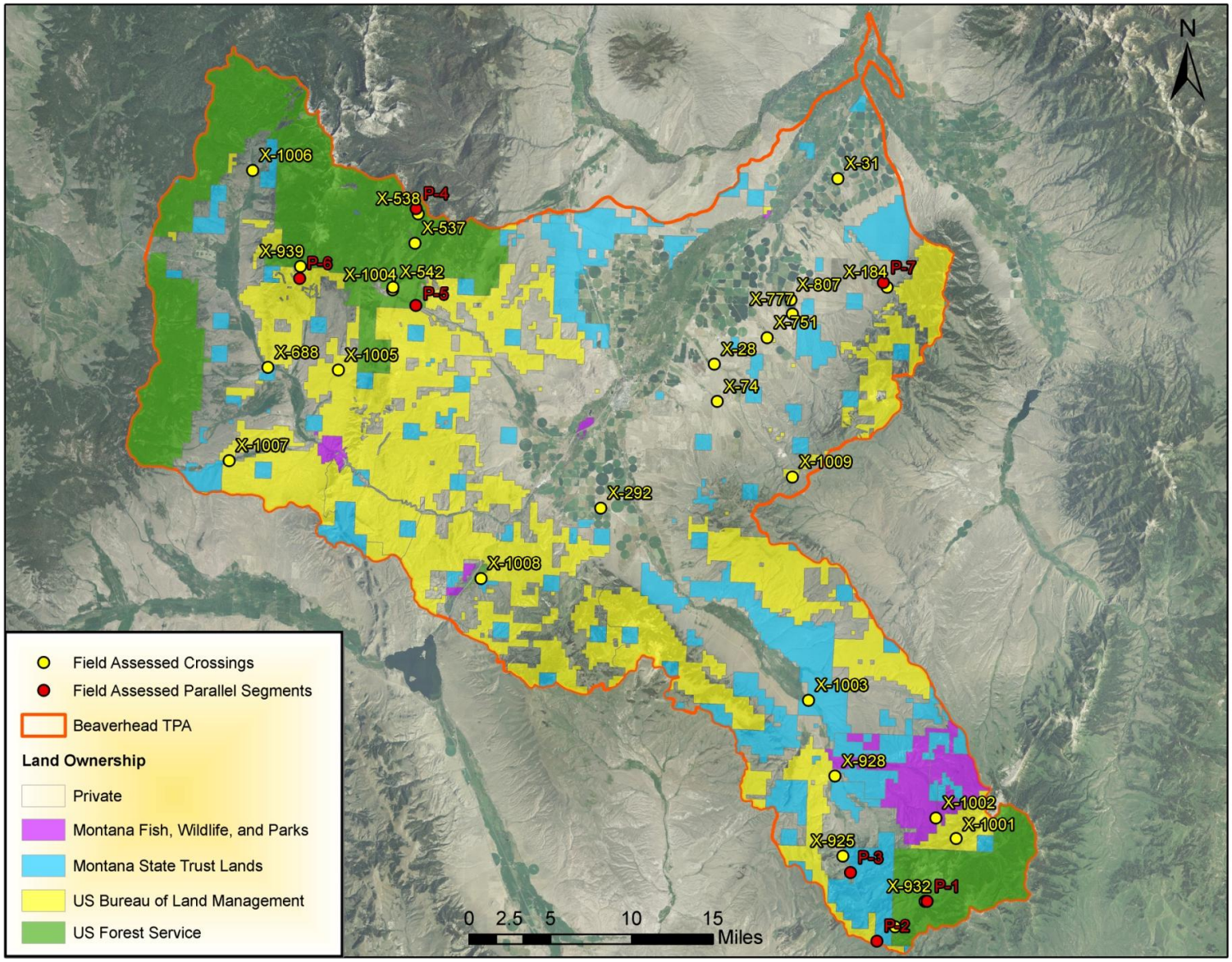

Figure G3-2. Landownership in the Beaverhead TPA.

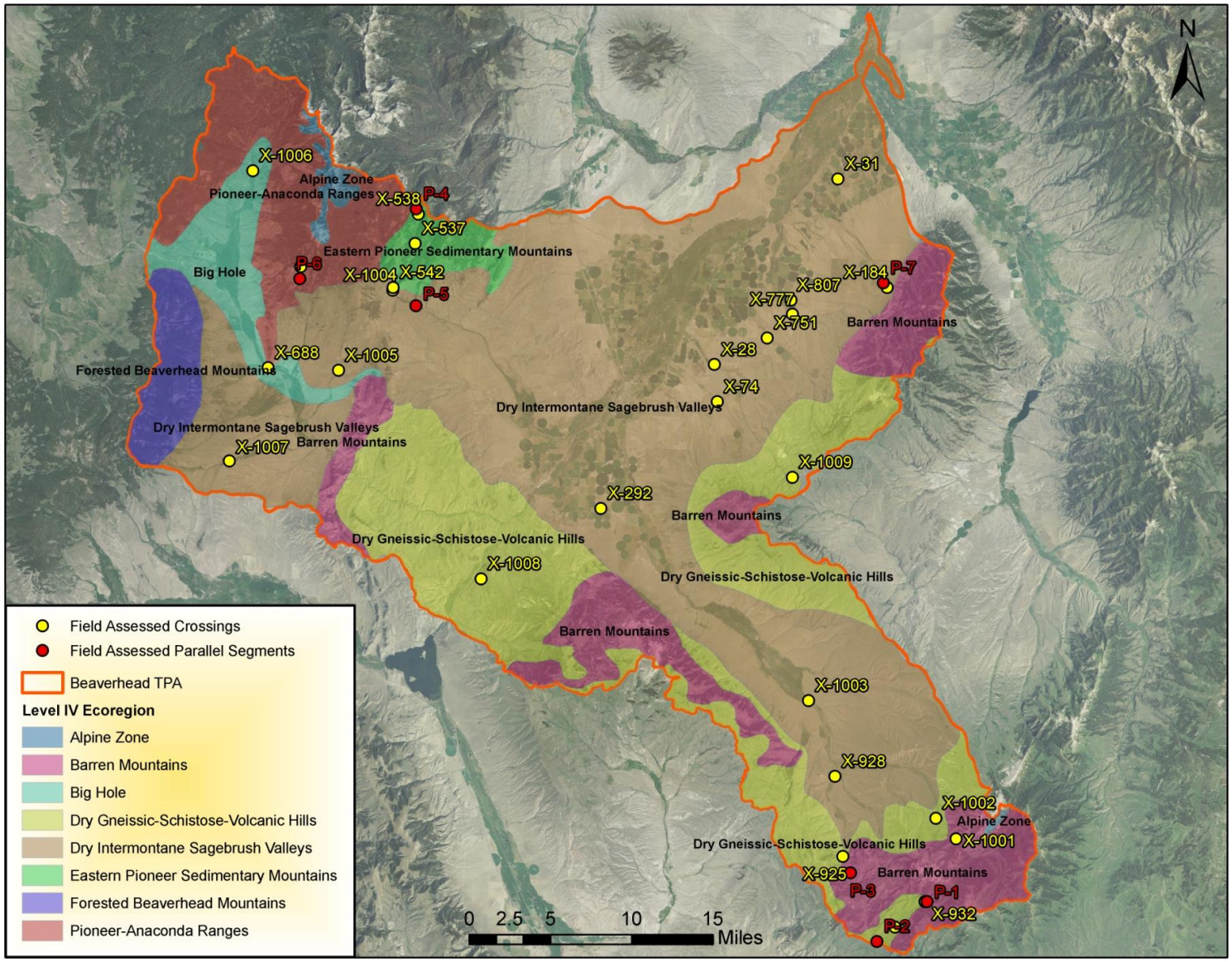

Figure G3-3. Level IV Ecoregions in the Beaverhead TPA.

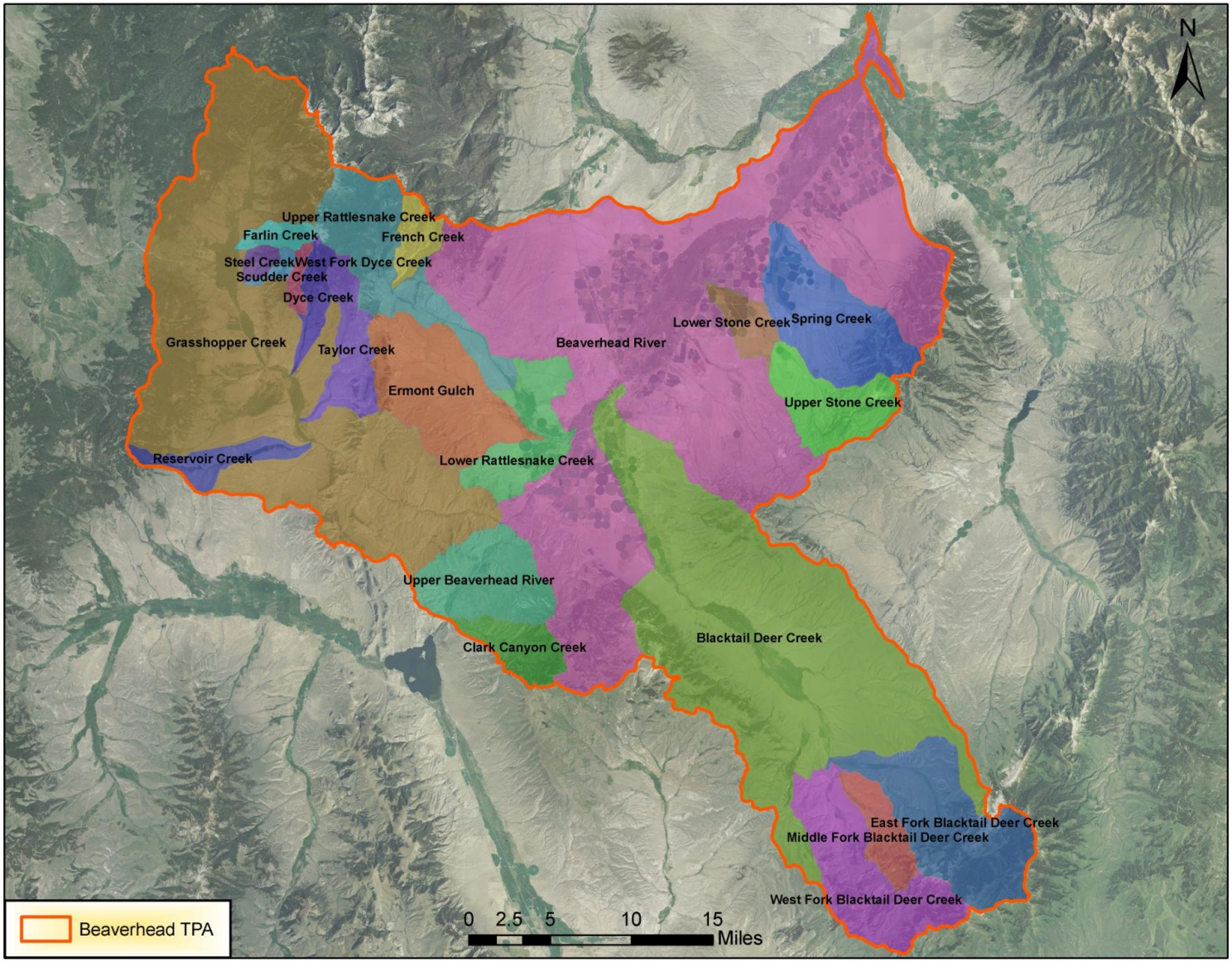

Figure G3-4. 6th Code Subwatersheds in the Beaverhead TPA.

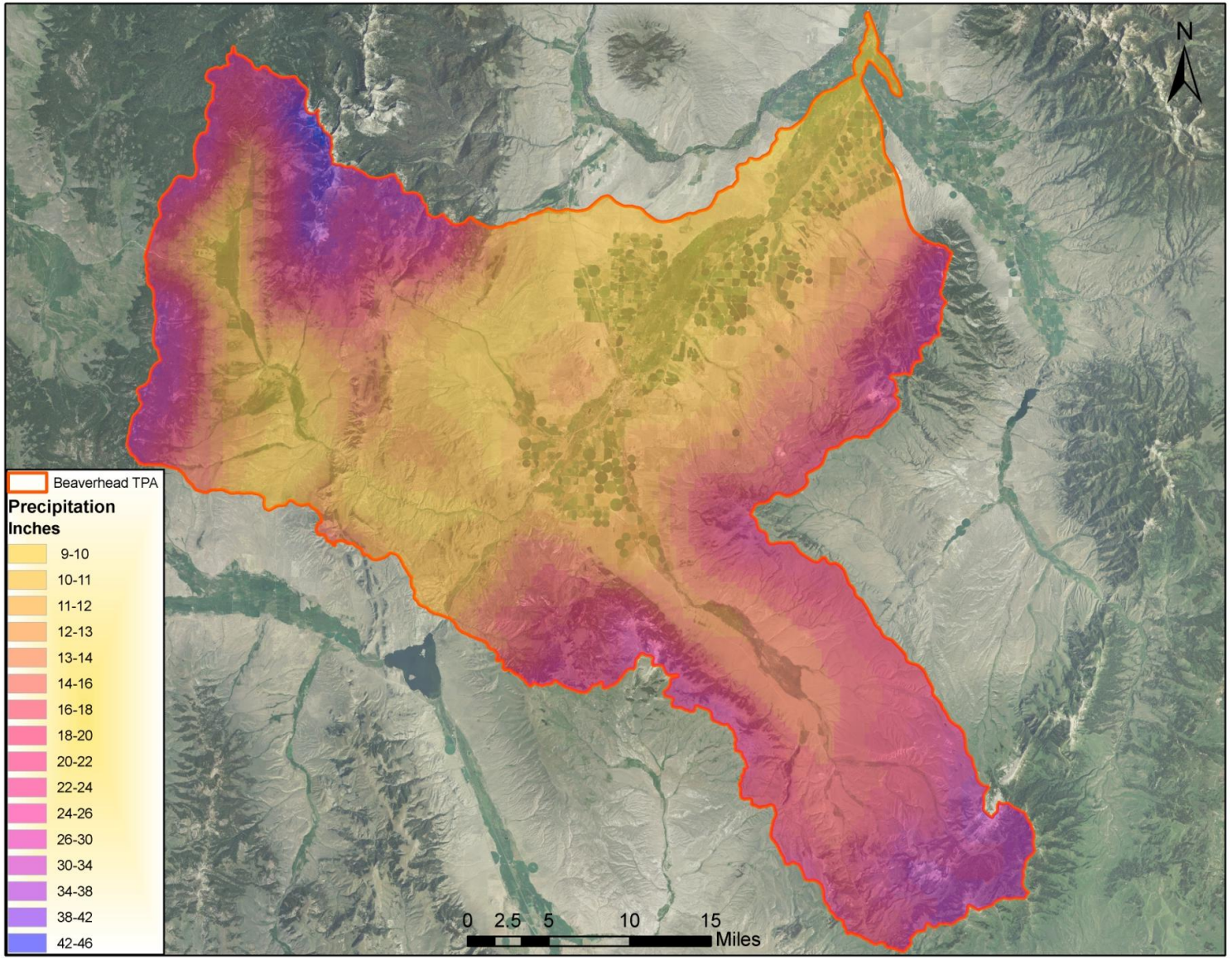

Figure G3-5. Precipitation Patterns in the Beaverhead TPA.

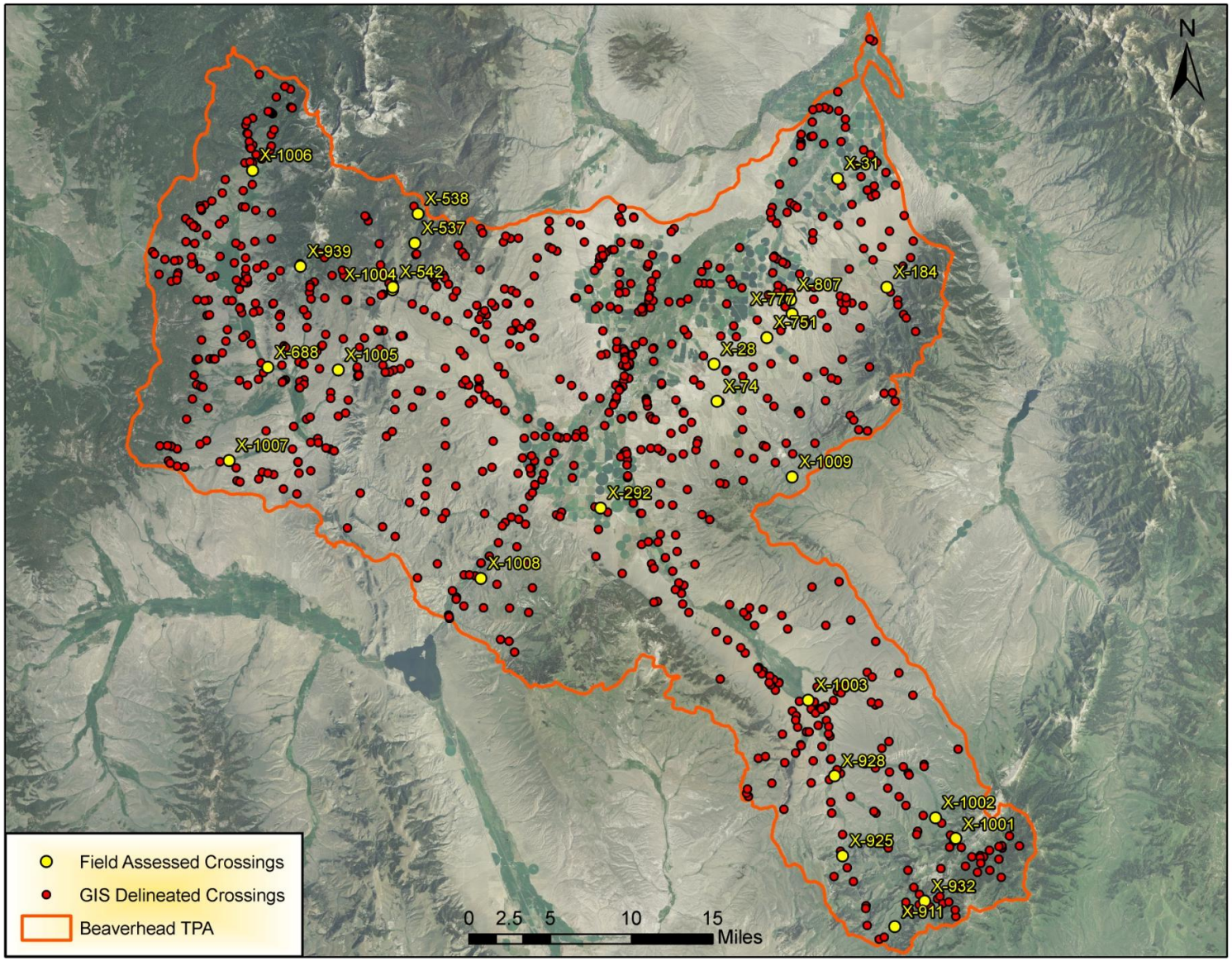

Figure G3-6. Unpaved Road Crossings in the Beaverhead TPA.

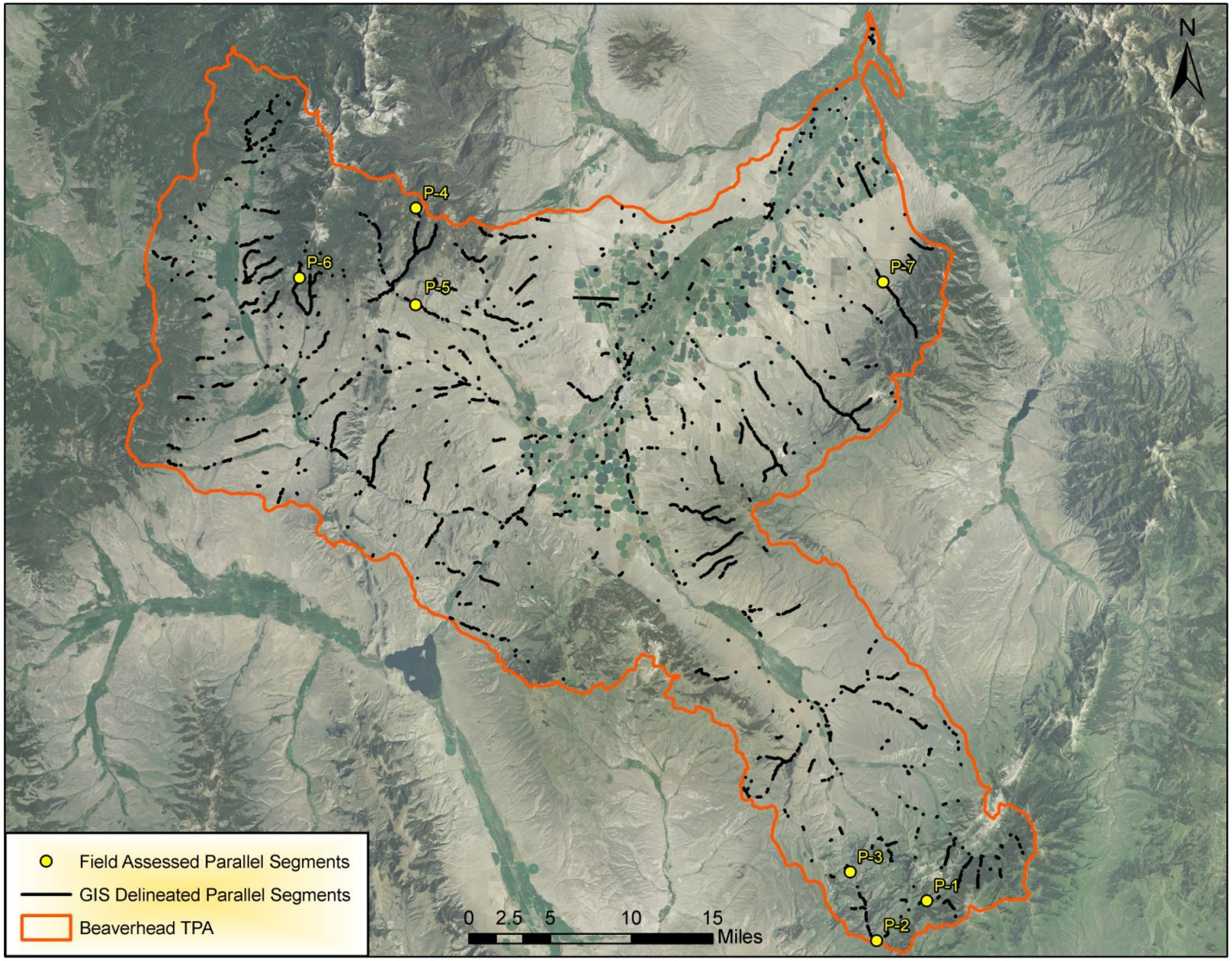

Figure G3-7. Unpaved Parallel Road Segments in the Beaverhead TPA.

G3.1.4 Potential Culvert Failures

Within the Beaverhead TPA, all 19 culverts assessed in the field are capable of passing the two-year flood event, while only two of these culverts (11%) pass a 100-year flood event (**Tables G3-7** and **G3-8**, **Attachment G-6**). Once a culvert's carrying capacity is exceeded, the potential for culvert failure increases, though the point at which a given culvert will fail remains uncertain. Hydraulic analysis of a culvert is extremely complex and potential sediment loads from the eroding fill as presented in **Table G3-7** are estimates assuming the entire height and length of road fill are eroded to a width equal to the bankfull width of the stream.

Table G3-7. Culvert Failure and Potential Sediment Load Evaluation.

Location ID	Q2	Q5	Q10	Q25	Q50	Q100	Estimated Maximum Culvert Capacity (cfs)	Potential Sediment Load if Culvert Fails (Tons)
X-932	7	21	35	62	88	123	102	117
X-911	2	7	13	25	38	55	22	15
X-925	57	120	175	264	341	435	68	92
X-928	139	255	348	490	608	746	401	362
X-1001	27	63	97	154	207	273	314	154
X-1002	1	3	6	13	20	31	13	4
X-292	14	36	58	96	134	181	47	37
X-538	10	28	46	79	111	152	94	37
X-542	14	36	58	96	134	181	108	46
X-1005	38	84	126	196	259	336	54	96
X-1006	38	84	126	196	259	336	243	181
X-1007	14	36	58	96	134	181	104	65
X-1008	22	53	83	134	182	242	208	137
X-31	5	15	25	46	67	95	47	184
X-777	10	28	46	79	111	152	64	58
X-751	38	84	126	196	259	336	180	903
X-28	7	21	35	62	88	123	96	35
X-74	3	9	17	32	47	68	106	235
X-1009	3	9	17	32	47	68	9	10

Grey cells indicate culvert fails to pass a given discharge

Table G3-8. Culvert Failure Summary.

Flood Frequency	Number of Culverts Passing	Number of Culverts Failing	Percent Passing	Percent Failing
Q2	19	0	100%	0%
Q5	16	3	84%	16%
Q10	15	4	79%	21%
Q25	11	8	58%	42%
Q50	5	14	26%	74%
Q100	2	17	11%	89%

If a culvert fails for a given event, the replacement culvert should address several issues. First, culverts typically cause changes in the upstream elevation and the new culvert should mitigate these effects to ensure that culvert placement does not negatively affect the surrounding habitat. Next, environmental considerations such as fish passage need to be accurately predicted. New three-sided culverts, where the bottom of the culvert is typically the natural channel bottom, allow better holding habitat and maintain a continuous stream channel bottom. The hydrology of the area should also be determined and directly related to the culvert design size for the given watershed. Following these principals will improve the stream system, increase fish habitat, and reduce potential sediment loads from failed culverts.

G3.2 TRACTION SAND APPLICATION

Montana Department of Transportation traction sand application rates based on the three year average (2009-2011) along State Highway 278, State Highway 41, State Highway 91, and Interstate 15 indicate State Highway 278 has the highest rate of application per plowed mile, while Interstate 15 has the lowest rate of application per plowed mile (**Table G3-9**, **Attachment G-7**). An average of 3,447 tons of traction sand are applied to these four travel routes annually, with application rates per plowed mile ranging from 0.11 tons along Interstate 15 to 0.20 tons along State Highway 278. Average annual traction sand application rates range from 149 tons along State Highway 91 to 1,703 tons along Interstate 15. No data was available from the Beaverhead Roads Department for traction sand application rates along the Pioneer Mountains Scenic Byway or Blacktail Road.

Table G3-9. Traction Sand Application Rates.

Travel Route	Management Responsibility	Length (miles)	Average Annual Traction Sand Application Rate (Tons)		Affected Stream Segments
			Travel Route	Per Plowed Mile	
State Highway 278	Montana Department of Transportation	13.9	998	0.20	Rattlesnake Creek from headwaters to mouth (Beaverhead R)
					Grasshopper Creek from headwaters to mouth (Beaverhead R)
State Highway 41	Montana Department of Transportation	27.6	598	0.17	Beaverhead River from Grasshopper Creek to mouth (Jefferson R)
					Stone Creek below confluence with unnamed creek in NE, S34, T6S, R7W
State Highway 91	Montana Department of Transportation	14.5	149	0.16	Beaverhead River from Grasshopper Creek to mouth (Jefferson R)
					Blacktail Deer Creek from headwaters to mouth (Beaverhead R)
Interstate 15	Montana Department of Transportation	30.3	1,703	0.11	Beaverhead River from Clark Canyon Res to Grasshopper Cr
					Beaverhead River from Grasshopper Creek to mouth (Jefferson R)
Pioneer Mountains National Scenic Byway	Beaverhead County Roads Department	16.5	Not available	Not available	Grasshopper Creek from headwaters to mouth (Beaverhead R)
Blacktail Road	Beaverhead County Roads Department	27.4*	Not available	Not available	Blacktail Deer Creek from headwaters to mouth (Beaverhead R)

* portion of Blacktail Road is gravel

G3.3 FISH PASSAGE ANALYSIS

Out of 26 road crossings assessed in the field, 19 had culverts, each of which was assessed as a potential fish passage barrier based on the United States Forest Service Region 10 Fish Passage Evaluation Criteria. This analysis utilizes site-specific information to evaluate fish passage at culverts, which are classified as “green”, “red”, or “grey” (**Table G3-10**). Culvert slope, the culvert span-to-bedwidth ratio, and the outlet perch are evaluated as potential limiting factors affecting fish passage. In the Beaverhead TPA, five of the culverts (26%) allowed fish passage, while 14 culverts (74%) were classified as fish passage barriers (**Attachment G-8**).

Table G3-10. Fish Passage Evaluation.

Fish Passage Evaluation Categories	Fish Passage Evaluation Criteria	Number of Culverts	Percentage of Total Culverts Assessed
Green[1]	conditions that have a high certainty of meeting juvenile fish passage at all desired stream flows	5	26%
Grey[2]	conditions that have a high certainty of not providing juvenile fish passage at all desired stream flows	0	0%
Red[3]	conditions are such that additional and more detailed analysis is required to determine their juvenile fish passage ability	14	74%

G4.0 DISCUSSION

In the Beaverhead TPA, sediment contributions from unpaved roads average 66.35 tons per year (**Table G4-1**). Through the application of BMPs, it is estimated that this sediment load can be reduced to 19.60 tons per year, which is a 70% reduction in sediment loads. This reduction is achieved by reducing contributing road lengths at unpaved road crossing to 100 feet from either side of the crossing and by reducing contributing road lengths along unpaved parallel road segments to 100 feet.

Table G4-1. Potential Reduction in Sediment Loads from Unpaved Roads through the Application of BMPs.

Subwatershed	Total Mean Annual Sediment Load from Unpaved Roads (Tons)	Total Mean Annual Sediment Load from Unpaved Road with BMPs (Tons)	Total Percent Reduction in Sediment Contributions from Unpaved Roads
Beaverhead River	19.11	6.09	68%
Blacktail Deer Creek	9.49	3.07	68%
Clark Canyon Creek	0.33	0.11	67%
Dyce Creek	1.22	0.29	77%
East Fork Blacktail Deer Creek	4.28	0.90	79%
Ermont Gulch	2.71	0.90	67%
Farlin Creek	0.40	0.10	75%
French Creek	1.69	0.46	73%
Grasshopper Creek	11.54	3.21	72%
Lower Rattlesnake Creek	0.89	0.28	68%
Lower Stone Creek	0.28	0.09	68%
Middle Fork Blacktail Deer Creek	0.64	0.19	71%
Reservoir Creek	0.51	0.17	67%
Scudder Creek	0.40	0.10	74%
Spring Creek	2.50	0.74	70%
Steel Creek	0.71	0.23	67%
Taylor Creek	1.05	0.28	73%
Upper Beaverhead River	1.21	0.37	70%
Upper Rattlesnake Creek	2.02	0.55	73%
Upper Stone Creek	1.69	0.58	66%
West Fork Blacktail Deer Creek	3.06	0.70	77%
West Fork Dyce Creek	0.63	0.19	70%
BEAVERHEAD TPA	**66.35**	**19.60**	**70%**

G5.0 REFERENCES

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ATTACHMENT G-1. UNPAVED ROAD CROSSING FIELD DATA AND WEPP MODELED SEDIMENT LOADS BEAVERHEAD TMDL PLANNING AREA

Waterbody	Location ID	Date	Latitude	Longitude	Level 4 Ecoregion	Estimated Mean Annual Precipitation (inches)	Soil Type	% Rock	Insloped/ Outsloped	Road Surface	Traffic Level	Years Modeled	Gradient CRL1 (%)	Length CRL1 (Feet)	Width CRL1 (Feet)	Gradient Fill (%)	Length Fill (Feet)	Gradient Buffer (%)	Length Buffer (Feet)	WEPP LOAD (lbs)	Gradient CRL1 (%)	Length CRL1 (Feet)	Width CRL1 (Feet)	Gradient Fill (%)	Length Fill (Feet)	Gradient Buffer (%)	Length Buffer (Feet)	WEPP LOAD (lbs)	MEAN ANNUAL LOAD (lbs)	MEAN ANNUAL LOAD with BMPs (lbs)
													L	L	L	L	L	L	L	L	R	R	R	R	R	R	R	R		
Bonita Fork	X-932	08/24/10	44.78053	-112.22952	DGSVH	24.52	Sand L	10	Insloped Veg/rock ditch	Native	Low	30	3.0	401	11	70	10	3	36	65.21	6.0	148	11	70	15	3	5	59.73	124.94	42.49
tributary to West Fork Blacktail Deer Creek	X-911	08/24/10	44.75685	-112.26570	DGSVH	24.52	Sand L	5	Outsloped Unrutted	Native	Low	30	0.5	5	12	36	5	36	5	0.70	8.0	239	12	36	5	36	5	60.69	61.39	26.09
West Fork Blacktail Deer Creek	X-925	08/24/10	44.81826	-112.33421	DGSVH	17.41	Sand L	10	Outsloped Unrutted	Native	Low	50	0.5	77	20	84	3	0.3	1	21.26	0.5	10	20	84	3	0.3	1	2.76	24.02	24.02
West Fork Blacktail Deer Creek	X-928	08/24/10	44.88919	-112.34758	DISV	17.41	Sand L	30	Outsloped Unrutted	Native	Low	50	0.5	5	20	58	10	0.3	1	1.99	0.5	5	20	58	10	0.3	1	1.99	3.98	3.98
Indian Creek	X-1001	08/24/10	44.83737	-112.19342	BM	24.52	Silt L	5	Outsloped Unrutted	Native	Low	30	0.5	36	9	84	10	84	5	2.64	4.0	99	9	84	15	0.3	1	10.07	12.71	12.71
tributary to East Fork Blacktail Deer Creek	X-1002	08/24/10	44.85511	-112.21970	DGSVH	24.52	Sand L	10	Outsloped Unrutted	Native	Low	30	1.0	40	15	58	3	1	1	6.52	5.0	125	15	58	3	1	1	27.97	34.49	28.89
Blacktail Deer Creek	X-1003	08/24/10	44.95570	-112.38423	DISV	17.41	Silt L	10	Insloped Veg/rock ditch	Native	Low	50	1.0	25	12	0.3	1	0.3	1	1.45	2.0	26	12	0.3	1	0.3	1	1.73	3.18	3.18
Sheep Creek	X-292	08/24/10	45.11956	-112.65396	DISV	11.21	Sand L	20	Outsloped Unrutted	Gravel	Low	50	0.5	21	23	150	2	0.3	1	2.24	0.5	19	23	150	2	0.3	1	2.03	4.27	4.27
French Creek	X-538	08/25/10	45.37448	-112.89925	EPSM	24.52	Sand L	10	Insloped Veg/rock ditch	Native	Low	30	9.0	162	10	100	7	0.3	1	74.75	3.0	5	10	84	7	0.3	1	0.48	75.23	41.67
French Creek	X-537	08/25/10	45.34817	-112.90182	EPSM	24.52	Loam	5	Outsloped Rutted	Native	Low	30	4.0	12	7	0.3	1	0.3	1	0.23	5.0	51	7	0.3	1	0.3	1	4.67	4.90	4.90
French Creek	X-542	08/25/10	45.30819	-112.92726	DISV	17.41	Sand L	5	Outsloped Unrutted	Native	Low	50	0.5	5	13	119	9	0.3	1	1.21	6.0	281	13	100	9	0.3	1	100.24	101.45	36.88
Rattlesnake Creek	X-1004	08/25/10	45.30591	-112.92741	DISV	17.41	Sand L	5	Outsloped Unrutted	Native	Low	50	7.0	123	20	70	10	18	12	50.15	0.5	39	17	58	4	27	3	9.62	59.77	50.39
Taylor Creek	X-1005	08/25/10	45.23233	-112.99125	DISV	11.21	Sand L	5	Outsloped Unrutted	Native	Low	50	3.0	140	14	100	8	0.3	1	7.90	0.5	5	14	100	8	0.3	1	0.23	8.13	5.87
West Fork Dyce Creek	X-939	08/25/10	45.32299	-113.04462	PAR	24.52	Sand L	20	Outsloped Rutted	Native	Low	30	15.0	616	8	0.3	1	0.3	1	749.34	2.0	51	8	0.3	1	0.3	1	3.98	753.32	41.70
Grasshopper Creek	X-688	08/25/10	45.23190	-113.08007	BH	11.21	Sand L	20	Outsloped Unrutted	Gravel	Low	50	-	-	-	-	-	-	-	0.00	4.0	156	19	0.3	1	0.3	1	12.30	12.30	7.89
Grasshopper Creek	X-1006	08/25/10	45.40641	-113.11069	BH	11.21	Sand L	10	Outsloped Unrutted	Gravel	Low	50	0.5	12	25	84	10	0.3	1	1.84	0.5	14	25	84	10	0.3	1	2.15	3.99	3.99
Reservoir Creek	X-1007	08/25/10	45.14744	-113.12333	DISV	11.21	Sand L	5	Outsloped Unrutted	Native	Low	50	4.0	208	11	47	14	0.3	1	8.70	-	-	-	-	-	-	-	0.00	8.70	4.18
tributary to Ashbaugh Creek	X-1008	08/26/10	45.05252	-112.80085	DGSVH	11.21	Silt L	20	Outsloped Rutted	Native	Low	50	9.0	783	11	0.3	1	18	73	315.70	-	-	-	-	-	-	-	0.00	315.70	1.29
Big Dry Gulch	X-31	08/26/10	45.42075	-112.37136	DISV	11.21	Sand L	20	Outsloped Unrutted	Gravel	High	50	6.0	273	36	70	17	0.3	1	279.12	0.5	5	36	70	17	0.3	1	2.68	281.80	104.92
tributary to McHennesy Creek	X-184	08/26/10	45.32575	-112.30422	DISV	17.41	Sand L	20	Outsloped Rutted	Native	Low	50	6.0	47	9	0.3	1	0.3	1	7.00	7.0	18	9	0.3	1	0.3	1	1.60	8.60	8.60
un-named	X-807	08/26/10	45.31134	-112.42515	DISV	11.21	Sand L	10	Outsloped Unrutted	Gravel	Low	50	1.0	187	14	0.3	1	0.3	1	5.61	4.0	106	14	0.3	1	0.3	1	4.89	10.50	7.61
Spring Creek	X-777	08/26/10	45.29870	-112.42234	DISV	11.21	Sand L	5	Outsloped Unrutted	Native	Low	50	2.0	60	12	47	9	0.3	1	1.95	6.5	5	12	47	9	0.3	1	0.29	2.24	2.24
Stone Creek	X-751	08/26/10	45.27695	-112.45329	DISV	11.21	Sand L	10	Outsloped Unrutted	Gravel	High	50	3.0	249	40	47	20	0.3	1	185.27	0.5	10	40	47	20	0.3	1	5.64	190.91	80.04
Carter Creek	X-28	08/26/10	45.25144	-112.51839	DISV	11.21	Sand L	10	Outsloped Unrutted	Native	Low	50	6.0	482	15	36	10	0.3	1	35.75	6.0	250	15	36	10	0.3	1	18.54	54.29	14.84
un-named	X-74	08/26/10	45.21842	-112.51294	DISV	11.21	Sand L	30	Outsloped Unrutted	Gravel	High	50	6.0	769	25	150	25	0.3	1	584.73	0.5	5	25	27	29	0.3	1	1.38	586.11	77.42
un-named	X-1009	08/26/10	45.15380	-112.41488	DGSVH	17.41	Silt L	5	Outsloped Unrutted	Native	Low	50	5.0	224	21	47	7	47	1	134.09	2.0	30	21	47	7	47	1	12.20	146.29	72.06

Waterbody	Location ID	Date	Segment 1 Installed BMPs		Segment 1 Potential BMPs		Road Crossing and BMP Notes/Comments
			L	R	L	R	
Bonita Fork	X-932	08/24/10	none	slash filter	waterbars	sediment pond	-
tributary to West Fork Blacktail Deer Creek	X-911	08/24/10	water bar above contributing segment	-	-	-	Brook trout in pool below culvert, puddling from RR
West Fork Blacktail Deer Creek	X-925	08/24/10	-	-	re-vegetation	re-vegetation	Berm located along upstream end
West Fork Blacktail Deer Creek	X-928	08/24/10	none	none	re-vegetation	re-vegetation	relatively flat crossing
Indian Creek	X-1001	08/24/10	none	none	N/A	waterbar	small puddles at crossing
tributary to East Fork Blacktail Deer Creek	X-1002	08/24/10	none	none	waterbar	waterbar	grassy/willow veg existing buffer
Blacktail Deer Creek	X-1003	08/24/10	none	none	bridge replacement	bridge replacement	wooden bridge allows sediment into stream, tracked auto bridge
Sheep Creek	X-292	08/24/10	none	none	re-vegetation	re-vegetation	perhaps replace with longer culvert
French Creek	X-538	08/25/10	rolling dip	-	slash filter, improve dip u/s	-	rolling dip at upstream end is headcutting and should be improved. Effectively capture flow
French Creek	X-537	08/25/10	none	none	add culvert	add culvert	add bottomless arch culvert
French Creek	X-542	08/25/10	none	none	-	waterbars	small gullies observed in both "tracks"
Rattlesnake Creek	X-1004	08/25/10	none	none	manage cutslope, sediment pond	re-vegetation, slash filter	cutslope/hillslope load could be captured w/ditch and pond
Taylor Creek	X-1005	08/25/10	none	none	waterbars	none	road wash directly on top of culvert, add slash filter
West Fork Dyce Creek	X-939	08/25/10	rolling dip	none	improve rolling dips	waterbar	rolling dips are not effective
Grasshopper Creek	X-688	08/25/10	-	none	-	barriers along bridge	erosion down road with direct inputs from bridge deck
Grasshopper Creek	X-1006	08/25/10	none	none	re-vegetation	re-vegetation	short contributing distances directly on top of culvert
Reservoir Creek	X-1007	08/25/10	-	-	waterbars	-	drains from River L past culvert and into stream
tributary to Ashbaugh Creek	X-1008	08/26/10	none	-	waterbars, rolling dips	-	majority of contribution from left rut, right flows past crossing.
Big Dry Gulch	X-31	08/26/10	none	none	sediment basin	-	430 ft from the top of the hill to ditch along west side of road from River Left, assessed from ditch to diversion, ditch is sediment buffer
tributary to McHennesy Creek	X-184	08/26/10	none	none	bridge/culvert	bridge/culvert	stream ford
un-named	X-807	08/26/10	none	none	waterbars	waterbars	stream ford w/obvious fine sediment accumulation
Spring Creek	X-777	08/26/10	none	none	waterbars	none	
Stone Creek	X-751	08/26/10	BMP-sediment basin at top	none	additional sediment basin	re-vegetation	small stream along N (d/s) side of road, flows in ditch mostly
Carter Creek	X-28	08/26/10	none	none	waterbars/sediment ponds	waterbars/sediment ponds	
un-named	X-74	08/26/10	-	-	sediment traps, re-veg	sediment traps, re-veg	road surface "very hard", clear sides of erosion in roadside ditches
un-named	X-1009	08/26/10	none	none	waterbars	none	obvious flow observed

ATTACHMENT G-2. UNPAVED ROAD CROSSING ECOREGION ANALYSIS BEAVERHEAD TMDL PLANNING AREA

Location ID	Level IV Ecoregion	Level IV Ecoregion	Number of Sites Assessed	MEAN ANNUAL LOAD (tons)	MEAN ANNUAL LOAD with BMPs (tons)	Percent Reduction
X-688	BH	Big Hole		0.006	0.004	36%
X-1006	BH	Big Hole		0.002	0.002	0%
		Big Hole	2	0.004	0.003	27%
X-928	DISV	Dry Intermontane Sagebrush Valleys		0.002	0.002	0%
X-1003	DISV	Dry Intermontane Sagebrush Valleys		0.002	0.002	0%
X-292	DISV	Dry Intermontane Sagebrush Valleys		0.002	0.002	0%
X-542	DISV	Dry Intermontane Sagebrush Valleys		0.051	0.018	64%
X-1004	DISV	Dry Intermontane Sagebrush Valleys		0.030	0.025	16%
X-1005	DISV	Dry Intermontane Sagebrush Valleys		0.004	0.003	28%
X-1007	DISV	Dry Intermontane Sagebrush Valleys		0.004	0.002	52%
X-31	DISV	Dry Intermontane Sagebrush Valleys		0.141	0.052	63%
X-184	DISV	Dry Intermontane Sagebrush Valleys		0.004	0.004	0%
X-807	DISV	Dry Intermontane Sagebrush Valleys		0.005	0.004	28%
X-777	DISV	Dry Intermontane Sagebrush Valleys		0.001	0.001	0%
X-751	DISV	Dry Intermontane Sagebrush Valleys		0.095	0.040	58%
X-28	DISV	Dry Intermontane Sagebrush Valleys		0.027	0.007	73%
X-74	DISV	Dry Intermontane Sagebrush Valleys		0.293	0.039	87%
		Dry Intermontane Sagebrush Valleys	14	0.047	0.014	69%
X-932	DGSVH	Dry Gneissic-Schistose-Volcanic Hills		0.062	0.021	66%
X-911	DGSVH	Dry Gneissic-Schistose-Volcanic Hills		0.031	0.013	58%
X-925	DGSVH	Dry Gneissic-Schistose-Volcanic Hills		0.012	0.012	0%
X-1002	DGSVH	Dry Gneissic-Schistose-Volcanic Hills		0.017	0.014	16%
X-1008	DGSVH	Dry Gneissic-Schistose-Volcanic Hills		0.158	0.001	100%
X-1009	DGSVH	Dry Gneissic-Schistose-Volcanic Hills		0.073	0.036	51%
		Dry Gneissic-Schistose-Volcanic Hills	6	0.059	0.016	72%
X-1001	BM	Barren Mountains		0.006	0.006	0%
X-538	EPSM	Eastern Pioneer Sedimentary Mountains		0.038	0.021	45%
X-537	EPSM	Eastern Pioneer Sedimentary Mountains		0.002	0.002	0%
X-939	PAR	Pioneer-Anaconda Ranges		0.377	0.021	94%
		Barren Mountains, Eastern Pioneer Sedimentary Mountains, Pioneer-Anaconda Ranges, Forested Beaverhead Mountains	4	0.106	0.013	88%

ATTACHMENT G-3. UNPAVED ROAD CROSSING SUBWATERSHED SEDIMENT LOADS BEAVERHEAD TMDL PLANNING AREA

Subwatershed	Owner Name	Level IV Ecoregion	MEAN ANNUAL LOAD per CROSSING (tons)	MEAN ANNUAL LOAD per CROSSING with BMPs (tons)	# of Crossings	MEAN ANNUAL LOAD (tons)	MEAN ANNUAL LOAD with BMPs (tons)	Percent Reduction
Beaverhead River	Montana State Trust Lands	Dry Intermontane Sagebrush Valleys	0.047	0.014	31	1.466	0.448	69%
					31	1.466	0.448	69%
Beaverhead River	Private Land	Barren Mountains	0.106	0.013	7	0.740	0.088	88%
Beaverhead River	Private Land	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	14	0.825	0.227	72%
Beaverhead River	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	176	8.322	2.542	69%
Beaverhead River	Private Land	Eastern Pioneer Sedimentary Mountains	0.106	0.013	1	0.106	0.013	88%
					198	9.993	2.870	71%
Beaverhead River	US Bureau of Land Management	Dry Intermontane Sagebrush Valleys	0.047	0.014	18	0.851	0.260	69%
					18	0.851	0.260	69%
Beaverhead River	US Forest Service	Dry Intermontane Sagebrush Valleys	0.047	0.014	2	0.095	0.029	69%
Beaverhead River	US Forest Service	Eastern Pioneer Sedimentary Mountains	0.106	0.013	6	0.635	0.076	88%
					8	0.729	0.105	86%
Beaverhead River					**255**	**13.039**	**3.683**	**72%**
Blacktail Deer Creek	Montana State Trust Lands	Barren Mountains	0.106	0.013	1	0.106	0.013	88%
Blacktail Deer Creek	Montana State Trust Lands	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	3	0.177	0.049	72%
Blacktail Deer Creek	Montana State Trust Lands	Dry Intermontane Sagebrush Valleys	0.047	0.014	33	1.560	0.477	69%
					37	1.843	0.538	71%
Blacktail Deer Creek	Private Land	Barren Mountains	0.106	0.013	5	0.529	0.063	88%
Blacktail Deer Creek	Private Land	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	6	0.353	0.097	72%
Blacktail Deer Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	63	2.979	0.910	69%
					74	3.861	1.070	72%
Blacktail Deer Creek	US Bureau of Land Management	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	3	0.177	0.049	72%
Blacktail Deer Creek	US Bureau of Land Management	Dry Intermontane Sagebrush Valleys	0.047	0.014	3	0.142	0.043	69%
					6	0.319	0.092	71%
Blacktail Deer Creek					**117**	**6.022**	**1.700**	**72%**
Clark Canyon Creek	Private Land	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	2	0.118	0.032	72%
					2	0.118	0.032	72%
Clark Canyon Creek	US Bureau of Land Management	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	1	0.059	0.016	72%
					1	0.059	0.016	72%
Clark Canyon Creek					**3**	**0.177**	**0.049**	**72%**
Dyce Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	3	0.142	0.043	69%
Dyce Creek	Private Land	Pioneer-Anaconda Ranges	0.106	0.013	2	0.212	0.025	88%
					5	0.353	0.069	81%
Dyce Creek	US Bureau of Land Management	Dry Intermontane Sagebrush Valleys	0.047	0.014	2	0.095	0.029	69%
Dyce Creek	US Bureau of Land Management	Pioneer-Anaconda Ranges	0.106	0.013	2	0.212	0.025	88%
					4	0.306	0.054	82%
Dyce Creek	US Forest Service	Pioneer-Anaconda Ranges	0.106	0.013	2	0.212	0.025	88%
					2	0.212	0.025	88%
Dyce Creek					**11**	**0.871**	**0.148**	**83%**
East Fork Blacktail Deer Creek	Montana Fish, Wildlife, and Parks	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	6	0.353	0.097	72%
East Fork Blacktail Deer Creek	Montana Fish, Wildlife, and Parks	Dry Intermontane Sagebrush Valleys	0.047	0.014	11	0.520	0.159	69%
					17	0.874	0.256	71%
East Fork Blacktail Deer Creek	Montana State Trust Lands	Barren Mountains	0.106	0.013	1	0.106	0.013	88%
East Fork Blacktail Deer Creek	Montana State Trust Lands	Dry Intermontane Sagebrush Valleys	0.047	0.014	1	0.047	0.014	69%
					2	0.153	0.027	82%
East Fork Blacktail Deer Creek	US Bureau of Land Management	Barren Mountains	0.106	0.013	5	0.529	0.063	88%
					5	0.529	0.063	88%
East Fork Blacktail Deer Creek	US Forest Service	Barren Mountains	0.106	0.013	18	1.904	0.227	88%
					18	1.904	0.227	88%
East Fork Blacktail Deer Creek					**42**	**3.459**	**0.574**	**83%**
Ermont Gulch	Montana State Trust Lands	Dry Intermontane Sagebrush Valleys	0.047	0.014	3	0.142	0.043	69%
					3	0.142	0.043	69%
Ermont Gulch	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	19	0.898	0.274	69%
					19	0.898	0.274	69%
Ermont Gulch	US Bureau of Land Management	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	3	0.177	0.049	72%
Ermont Gulch	US Bureau of Land Management	Dry Intermontane Sagebrush Valleys	0.047	0.014	11	0.520	0.159	69%
					14	0.697	0.208	70%
Ermont Gulch	US Forest Service	Dry Intermontane Sagebrush Valleys	0.047	0.014	2	0.095	0.029	69%
					2	0.095	0.029	69%
Ermont Gulch					**38**	**1.832**	**0.554**	**70%**
Farlin Creek	Private Land	Pioneer-Anaconda Ranges	0.106	0.013	1	0.106	0.013	88%
					1	0.106	0.013	88%
Farlin Creek	US Bureau of Land Management	Pioneer-Anaconda Ranges	0.106	0.013	1	0.106	0.013	88%
					1	0.106	0.013	88%
Farlin Creek					**2**	**0.212**	**0.025**	**88%**
French Creek	US Forest Service	Dry Intermontane Sagebrush Valleys	0.047	0.014	1	0.047	0.014	69%
					1	0.047	0.014	69%
French Creek	US Forest Service	Eastern Pioneer Sedimentary Mountains	0.106	0.013	7	0.740	0.088	88%
					7	0.740	0.088	88%
French Creek					**8**	**0.788**	**0.103**	**87%**
Grasshopper Creek	Montana Fish, Wildlife, and Parks	Dry Intermontane Sagebrush Valleys	0.047	0.014	3	0.142	0.043	69%
					3	0.142	0.043	69%
Grasshopper Creek	Montana State Trust Lands	Barren Mountains	0.106	0.013	1	0.106	0.013	88%
Grasshopper Creek	Montana State Trust Lands	Big Hole	0.004	0.003	10	0.041	0.030	27%
Grasshopper Creek	Montana State Trust Lands	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	1	0.059	0.016	72%
Grasshopper Creek	Montana State Trust Lands	Dry Intermontane Sagebrush Valleys	0.047	0.014	7	0.331	0.101	69%
Grasshopper Creek	Montana State Trust Lands	Forested Beaverhead Mountains	0.106	0.013	2	0.212	0.025	88%
Grasshopper Creek	Montana State Trust Lands	Pioneer-Anaconda Ranges	0.106	0.013	1	0.106	0.013	88%
					22	0.854	0.198	77%
Grasshopper Creek	Private Land	Big Hole	0.004	0.003	35	0.143	0.104	27%
Grasshopper Creek	Private Land	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	6	0.353	0.097	72%
Grasshopper Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	21	0.993	0.303	69%
Grasshopper Creek	Private Land	Pioneer-Anaconda Ranges	0.106	0.013	6	0.635	0.076	88%
					68	2.124	0.580	73%
Grasshopper Creek	US Bureau of Land Management	Big Hole	0.004	0.003	3	0.012	0.009	27%
Grasshopper Creek	US Bureau of Land Management	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	8	0.471	0.130	72%
Grasshopper Creek	US Bureau of Land Management	Dry Intermontane Sagebrush Valleys	0.047	0.014	21	0.993	0.303	69%
Grasshopper Creek	US Bureau of Land Management	Pioneer-Anaconda Ranges	0.106	0.013	2	0.212	0.025	88%
					34	1.688	0.467	72%
Grasshopper Creek	US Forest Service	Big Hole	0.004	0.003	1	0.004	0.003	27%
Grasshopper Creek	US Forest Service	Dry Intermontane Sagebrush Valleys	0.047	0.014	3	0.142	0.043	69%
Grasshopper Creek	US Forest Service	Forested Beaverhead Mountains	0.106	0.013	16	1.692	0.202	88%
Grasshopper Creek	US Forest Service	Pioneer-Anaconda Ranges	0.106	0.013	9	0.952	0.114	88%
					29	2.790	0.362	87%
Grasshopper Creek					**156**	**7.597**	**1.651**	**78%**

Subwatershed	Owner Name	Level IV Ecoregion	MEAN ANNUAL LOAD per CROSSING (tons)	MEAN ANNUAL LOAD per CROSSING with BMPs (tons)	# of Crossings	MEAN ANNUAL LOAD (tons)	MEAN ANNUAL LOAD with BMPs (tons)	Percent Reduction
Lower Rattlesnake Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	16	0.757	0.231	69%
					16	0.757	0.231	69%
Lower Rattlesnake Creek					**16**	**0.757**	**0.231**	**69%**
Lower Stone Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	5	0.236	0.072	69%
					5	0.236	0.072	69%
Lower Stone Creek					**5**	**0.236**	**0.072**	**69%**
Middle Fork Blacktail Deer Creek	Montana State Trust Lands	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	2	0.118	0.032	72%
Middle Fork Blacktail Deer Creek	Montana State Trust Lands	Dry Intermontane Sagebrush Valleys	0.047	0.014	1	0.047	0.014	69%
					3	0.165	0.047	72%
Middle Fork Blacktail Deer Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	4	0.189	0.058	69%
					4	0.189	0.058	69%
Middle Fork Blacktail Deer Creek	US Forest Service	Barren Mountains	0.106	0.013	1	0.106	0.013	88%
					1	0.106	0.013	88%
Middle Fork Blacktail Deer Creek					**8**	**0.460**	**0.117**	**74%**
Reservoir Creek	Montana State Trust Lands	Dry Intermontane Sagebrush Valleys	0.047	0.014	1	0.047	0.014	69%
					1	0.047	0.014	69%
Reservoir Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	4	0.189	0.058	69%
					4	0.189	0.058	69%
Reservoir Creek	US Bureau of Land Management	Dry Intermontane Sagebrush Valleys	0.047	0.014	1	0.047	0.014	69%
					1	0.047	0.014	69%
Reservoir Creek	US Forest Service	Dry Intermontane Sagebrush Valleys	0.047	0.014	2	0.095	0.029	69%
					2	0.095	0.029	69%
Reservoir Creek					**8**	**0.378**	**0.116**	**69%**
Scudder Creek	Montana State Trust Lands	Pioneer-Anaconda Ranges	0.106	0.013	1	0.106	0.013	88%
					1	0.106	0.013	88%
Scudder Creek	Private Land	Big Hole	0.004	0.003	2	0.008	0.006	27%
					2	0.008	0.006	27%
Scudder Creek	US Bureau of Land Management	Pioneer-Anaconda Ranges	0.106	0.013	1	0.106	0.013	88%
					1	0.106	0.013	88%
Scudder Creek					**4**	**0.220**	**0.031**	**86%**
Spring Creek	Montana State Trust Lands	Dry Intermontane Sagebrush Valleys	0.047	0.014	3	0.142	0.043	69%
					3	0.142	0.043	69%
Spring Creek	Private Land	Barren Mountains	0.106	0.013	2	0.212	0.025	88%
Spring Creek	Private Land	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	1	0.059	0.016	72%
Spring Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	33	1.560	0.477	69%
					36	1.831	0.518	72%
Spring Creek	US Bureau of Land Management	Barren Mountains	0.106	0.013	1	0.106	0.013	88%
					1	0.106	0.013	88%
Spring Creek					**40**	**2.078**	**0.574**	**72%**
Steel Creek	Private Land	Big Hole	0.004	0.003	8	0.033	0.024	27%
Steel Creek	Private Land	Pioneer-Anaconda Ranges	0.106	0.013	1	0.106	0.013	88%
					9	0.138	0.036	74%
Steel Creek	US Forest Service	Pioneer-Anaconda Ranges	0.106	0.013	1	0.106	0.013	88%
					1	0.106	0.013	88%
Steel Creek					**10**	**0.244**	**0.049**	**80%**
Taylor Creek	Montana State Trust Lands	Big Hole	0.004	0.003	2	0.008	0.006	27%
Taylor Creek	Montana State Trust Lands	Dry Intermontane Sagebrush Valleys	0.047	0.014	2	0.095	0.029	69%
					4	0.103	0.035	66%
Taylor Creek	Private Land	Big Hole	0.004	0.003	1	0.004	0.003	27%
Taylor Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	3	0.142	0.043	69%
					4	0.146	0.046	68%
Taylor Creek	US Bureau of Land Management	Dry Intermontane Sagebrush Valleys	0.047	0.014	2	0.095	0.029	69%
Taylor Creek	US Bureau of Land Management	Pioneer-Anaconda Ranges	0.106	0.013	2	0.212	0.025	88%
					4	0.306	0.054	82%
Taylor Creek	US Forest Service	Dry Intermontane Sagebrush Valleys	0.047	0.014	5	0.236	0.072	69%
Taylor Creek	US Forest Service	Pioneer-Anaconda Ranges	0.106	0.013	1	0.106	0.013	88%
					6	0.342	0.085	75%
Taylor Creek					**18**	**0.897**	**0.220**	**75%**
Upper Beaverhead River	Montana Fish, Wildlife, and Parks	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	3	0.177	0.049	72%
					3	0.177	0.049	72%
Upper Beaverhead River	Montana State Trust Lands	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	1	0.059	0.016	72%
					1	0.059	0.016	72%
Upper Beaverhead River	Private Land	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	5	0.295	0.081	72%
					5	0.295	0.081	72%
Upper Beaverhead River	US Bureau of Land Management	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	7	0.412	0.114	72%
					7	0.412	0.114	72%
Upper Beaverhead River					**16**	**0.942**	**0.260**	**72%**
Upper Rattlesnake Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	10	0.473	0.144	69%
					10	0.473	0.144	69%
Upper Rattlesnake Creek	US Bureau of Land Management	Dry Intermontane Sagebrush Valleys	0.047	0.014	1	0.047	0.014	69%
					1	0.047	0.014	69%
Upper Rattlesnake Creek	US Forest Service	Dry Intermontane Sagebrush Valleys	0.047	0.014	6	0.284	0.087	69%
Upper Rattlesnake Creek	US Forest Service	Eastern Pioneer Sedimentary Mountains	0.106	0.013	2	0.212	0.025	88%
Upper Rattlesnake Creek	US Forest Service	Pioneer-Anaconda Ranges	0.106	0.013	4	0.423	0.050	88%
					12	0.918	0.162	82%
Upper Rattlesnake Creek					**23**	**1.438**	**0.321**	**78%**
Upper Stone Creek	Montana State Trust Lands	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	3	0.177	0.049	72%
					3	0.177	0.049	72%
Upper Stone Creek	Private Land	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	5	0.295	0.081	72%
Upper Stone Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	4	0.189	0.058	69%
					9	0.484	0.139	71%
Upper Stone Creek	US Bureau of Land Management	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	3	0.177	0.049	72%
					3	0.177	0.049	72%
Upper Stone Creek					**15**	**0.837**	**0.236**	**72%**
West Fork Blacktail Deer Creek	Montana State Trust Lands	Barren Mountains	0.106	0.013	4	0.423	0.050	88%
West Fork Blacktail Deer Creek	Montana State Trust Lands	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	2	0.118	0.032	72%
					6	0.541	0.083	85%
West Fork Blacktail Deer Creek	Private Land	Barren Mountains	0.106	0.013	2	0.212	0.025	88%
West Fork Blacktail Deer Creek	Private Land	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	2	0.118	0.032	72%
West Fork Blacktail Deer Creek	Private Land	Dry Intermontane Sagebrush Valleys	0.047	0.014	6	0.284	0.087	69%
					10	0.613	0.144	76%
West Fork Blacktail Deer Creek	US Bureau of Land Management	Dry Intermontane Sagebrush Valleys	0.047	0.014	1	0.047	0.014	69%
					1	0.047	0.014	69%
West Fork Blacktail Deer Creek	US Forest Service	Barren Mountains	0.106	0.013	8	0.846	0.101	88%
West Fork Blacktail Deer Creek	US Forest Service	Dry Gneissic-Schistose-Volcanic Hills	0.059	0.016	6	0.353	0.097	72%
					14	1.200	0.198	83%
West Fork Blacktail Deer Creek					**31**	**2.401**	**0.440**	**82%**
West Fork Dyce Creek	US Bureau of Land Management	Dry Intermontane Sagebrush Valleys	0.047	0.014	1	0.047	0.014	69%
					1	0.047	0.014	69%
West Fork Dyce Creek	US Forest Service	Pioneer-Anaconda Ranges	0.106	0.013	2	0.212	0.025	88%
					2	0.212	0.025	88%
West Fork Dyce Creek					**3**	**0.259**	**0.040**	**85%**
BEAVERHEAD TPA					**829**	**45.144**	**11.194**	**75%**

ATTACHMENT G-4. UNPAVED PARALLEL ROAD SEGMENT FIELD DATA AND WEPP MODELED SEDIMENT LOADS BEAVERHEAD TMDL PLANNING AREA

Waterbody	Location ID	Date	Upstream		Downstream		Level IV Ecoregion	Estimated Mean Annual Precipitation (inches)	Soil Type	% Rock	Insloped/ Outsloped	Road Surface	Traffic Level	Years Modeled	Gradient (%)	Length (Feet)	Length with BMPs (Feet)	Width (Feet)	Gradient Fill (%)	Length Fill (Feet)	Gradient Buffer (%)	Length Buffer (Feet)	MEAN ANNUAL LOAD (lbs)	MEAN ANNUAL LOAD (lbs) with BMPs
			Latitude	Longitude	Latitude	Longitude																		
Bonita Fork	P-1	08/24/10	44.78064	-112.22701	44.78070	-112.22796	BM	24.52	Sand L	10	Insloped Veg/rock ditch	Native	Low	30	7.0	261	100	12	70	10	2	30	63.09	10.63
West Fork Blacktail Deer Creek	P-2	08/24/10	44.74370	-112.28789	44.74378	-112.28883	DGSVH	24.52	Sand L	30	Outsloped Unrutted	Native	Low	30	6.0	264	100	21	47	8	0.3	1	115.33	43.68
West Fork Blacktail Deer Creek	P-3	08/24/10	44.80396	-112.32388	44.80372	-112.32373	BM	17.41	Sand L	30	Outsloped Unrutted	Native	Low	50	1.0	98	98	19	70	15	0.3	1	53.02	53.02
French Creek	P-4	08/25/10	45.37941	-112.90262	45.37899	-112.90211	EPSM	24.52	Sand L	10	Outsloped Unrutted	Native	Low	30	9.0	196	100	9	100	20	9	5	51.56	26.31
Rattlesnake Creek	P-5	08/25/10					DISV	11.21	Sand L	10	Outsloped Unrutted	Native	Low	50	3.0	116	100	17	36	5	0.3	1	6.8	5.86
West Fork Dyce Creek	P-6	08/25/10	45.31491	-113.04537	45.31232	-113.04511	PAR	24.52	Sand L	20	Outsloped Rutted	Native	Low	30	10.0	991	100	12	84	5	9	20	1075.21	30.82
McHennesy Creek	P-7	08/26/10	45.32963	-112.30913	45.33008	-112.30961	DISV	17.41	Sand L	20	Outsloped Unrutted	Native	Low	50	4.0	200	100	8	84	3	0.3	1	19.86	9.93

Waterbody	Location ID	Date	Installed BMPs	Potential BMPs	Parallel Segement Notes/Comments
Bonita Fork	P-1	08/24/10	vegetated ditch	waterbars	culvert discharge at toe of slope, flows through wetland vegetation
West Fork Blacktail Deer Creek	P-2	08/24/10	trench along inside of road	slash filters	meandering channel at road bend with distinct input point
West Fork Blacktail Deer Creek	P-3	08/24/10	berm of graded gravel	revegetation along river right bank	channel abuts road occasionally, portion flows into culvert, portion directly into channel
French Creek	P-4	08/25/10	waterbars, rolling dips, vegetated buffer	waterbars	steep slope, gullies on road observed
Rattlesnake Creek	P-5	08/25/10	slash filters, blade berms	additional slash filters	slash filters in several places
West Fork Dyce Creek	P-6	08/25/10	none	rolling dips, waterbars	parallel to small stream, steep road, rutted with rocks
McHennesy Creek	P-7	08/26/10	none	waterbars	grassed median

ATTACHMENT G-5. UNPAVED PARALLEL ROAD SEGMENT SUBWATERSHED SEDIMENT LOADS BEAVERHEAD TMDL PLANNING AREA

Subwatershed	Owner Name	Parallel Segment Length (Miles)	Parallel Segment Length (Feet)	MEAN ANNUAL LOAD per 100 Feet for 7.2% (tons)	MEAN ANNUAL LOAD per 100 Feet for 7.2% with BMPs (tons)	MEAN ANNUAL LOAD (tons)	MEAN ANNUAL LOAD with BMPs (tons)	Percent Reduction
Beaverhead River	US Bureau of Land Management	4.25	22445	0.0023	0.0009	0.526	0.209	60%
Beaverhead River	US Forest Service	3.00	15842	0.0023	0.0009	0.372	0.147	60%
Beaverhead River	Montana State Trust Lands	2.72	14354	0.0023	0.0009	0.337	0.133	60%
Beaverhead River	Montana Fish, Wildlife, and Parks	0.37	1941	0.0023	0.0009	0.046	0.018	60%
Beaverhead River	Montana Department of Transportation	0.02	106	0.0023	0.0009	0.002	0.001	60%
Beaverhead River	Private Land	38.66	204121	0.0023	0.0009	4.787	1.898	60%
Beaverhead River		49.02	258808			6.069	2.406	60%
Blacktail Deer Creek	US Bureau of Land Management	8.46	44675	0.0023	0.0009	1.048	0.415	60%
Blacktail Deer Creek	Montana State Trust Lands	4.03	21304	0.0023	0.0009	0.500	0.198	60%
Blacktail Deer Creek	Montana Fish, Wildlife, and Parks	0.18	936	0.0023	0.0009	0.022	0.009	60%
Blacktail Deer Creek	Private Land	15.30	80809	0.0023	0.0009	1.895	0.751	60%
Blacktail Deer Creek		27.98	147723			3.464	1.373	60%
Clark Canyon Creek	US Bureau of Land Management	0.21	1111	0.0023	0.0009	0.026	0.010	60%
Clark Canyon Creek	Montana State Trust Lands	0.03	161	0.0023	0.0009	0.004	0.001	60%
Clark Canyon Creek	Private Land	1.01	5311	0.0023	0.0009	0.125	0.049	60%
Clark Canyon Creek		1.25	6584			0.154	0.061	60%
Dyce Creek	US Bureau of Land Management	1.98	10439	0.0023	0.0009	0.245	0.097	60%
Dyce Creek	US Forest Service	0.09	492	0.0023	0.0009	0.012	0.005	60%
Dyce Creek	Private Land	0.72	3811	0.0023	0.0009	0.089	0.035	60%
Dyce Creek		2.79	14742			0.346	0.137	60%
East Fork Blacktail Deer Creek	US Bureau of Land Management	0.44	2314	0.0023	0.0009	0.054	0.022	60%
East Fork Blacktail Deer Creek	US Forest Service	5.09	26871	0.0023	0.0009	0.630	0.250	60%
East Fork Blacktail Deer Creek	Montana State Trust Lands	0.42	2196	0.0023	0.0009	0.051	0.020	60%
East Fork Blacktail Deer Creek	Montana Fish, Wildlife, and Parks	0.72	3819	0.0023	0.0009	0.090	0.035	60%
East Fork Blacktail Deer Creek		6.67	35199			0.825	0.327	60%
Ermont Gulch	US Bureau of Land Management	2.15	11366	0.0023	0.0009	0.267	0.106	60%
Ermont Gulch	US Forest Service	0.49	2564	0.0023	0.0009	0.060	0.024	60%
Ermont Gulch	Montana State Trust Lands	0.83	4405	0.0023	0.0009	0.103	0.041	60%
Ermont Gulch	Private Land	3.62	19117	0.0023	0.0009	0.448	0.178	60%
Ermont Gulch		7.09	37451			0.878	0.348	60%
Farlin Creek	US Bureau of Land Management	0.40	2097	0.0023	0.0009	0.049	0.019	60%
Farlin Creek	US Forest Service	0.03	133	0.0023	0.0009	0.003	0.001	60%
Farlin Creek	Private Land	1.08	5705	0.0023	0.0009	0.134	0.053	60%
Farlin Creek		1.50	7936			0.186	0.074	60%
French Creek	US Forest Service	7.26	38356	0.0023	0.0009	0.899	0.357	60%
French Creek		7.26	38356			0.899	0.357	60%
Grasshopper Creek	US Bureau of Land Management	12.55	66276	0.0023	0.0009	1.554	0.616	60%
Grasshopper Creek	US Forest Service	4.09	21605	0.0023	0.0009	0.507	0.201	60%
Grasshopper Creek	Montana State Trust Lands	1.15	6074	0.0023	0.0009	0.142	0.056	60%
Grasshopper Creek	Montana Fish, Wildlife, and Parks	1.66	8773	0.0023	0.0009	0.206	0.082	60%
Grasshopper Creek	Private Land	12.40	65466	0.0023	0.0009	1.535	0.609	60%
Grasshopper Creek		31.86	168195			3.944	1.564	60%
Lower Rattlesnake Creek	Private Land	1.07	5658	0.0023	0.0009	0.133	0.053	60%
Lower Rattlesnake Creek		1.07	5658			0.133	0.053	60%
Lower Stone Creek	Private Land	0.34	1810	0.0023	0.0009	0.042	0.017	60%
Lower Stone Creek		0.34	1810			0.042	0.017	60%
Middle Fork Blacktail Deer Creek	US Forest Service	0.01	66	0.0023	0.0009	0.002	0.001	60%
Middle Fork Blacktail Deer Creek	Montana State Trust Lands	1.13	5942	0.0023	0.0009	0.139	0.055	60%
Middle Fork Blacktail Deer Creek	Private Land	0.30	1593	0.0023	0.0009	0.037	0.015	60%
Middle Fork Blacktail Deer Creek		1.44	7601			0.178	0.071	60%
Reservoir Creek	US Bureau of Land Management	0.13	707	0.0023	0.0009	0.017	0.007	60%
Reservoir Creek	US Forest Service	0.20	1074	0.0023	0.0009	0.025	0.010	60%
Reservoir Creek	Montana State Trust Lands	0.40	2110	0.0023	0.0009	0.049	0.020	60%
Reservoir Creek	Private Land	0.33	1721	0.0023	0.0009	0.040	0.016	60%
Reservoir Creek		1.06	5613			0.132	0.052	60%
Scudder Creek	US Bureau of Land Management	0.22	1140	0.0023	0.0009	0.027	0.011	60%
Scudder Creek	Montana State Trust Lands	0.58	3070	0.0023	0.0009	0.072	0.029	60%
Scudder Creek	Private Land	0.67	3560	0.0023	0.0009	0.083	0.033	60%
Scudder Creek		1.47	7770			0.182	0.072	60%
Spring Creek	US Bureau of Land Management	0.18	955	0.0023	0.0009	0.022	0.009	60%
Spring Creek	Montana State Trust Lands	0.03	158	0.0023	0.0009	0.004	0.001	60%
Spring Creek	Private Land	3.19	16824	0.0023	0.0009	0.395	0.156	60%
Spring Creek		3.40	17937			0.421	0.167	60%
Steel Creek	US Bureau of Land Management	0.31	1658	0.0023	0.0009	0.039	0.015	60%
Steel Creek	US Forest Service	0.65	3431	0.0023	0.0009	0.080	0.032	60%
Steel Creek	Private Land	2.82	14870	0.0023	0.0009	0.349	0.138	60%
Steel Creek		3.78	19959			0.468	0.186	60%
Taylor Creek	US Bureau of Land Management	0.88	4620	0.0023	0.0009	0.108	0.043	60%
Taylor Creek	US Forest Service	0.14	747	0.0023	0.0009	0.018	0.007	60%
Taylor Creek	Montana State Trust Lands	0.05	256	0.0023	0.0009	0.006	0.002	60%
Taylor Creek	Private Land	0.19	1011	0.0023	0.0009	0.024	0.009	60%
Taylor Creek		1.26	6635			0.156	0.062	60%
Upper Beaverhead River	US Bureau of Land Management	0.55	2913	0.0023	0.0009	0.068	0.027	60%
Upper Beaverhead River	Montana State Trust Lands	0.82	4331	0.0023	0.0009	0.102	0.040	60%
Upper Beaverhead River	Montana Fish, Wildlife, and Parks	0.06	308	0.0023	0.0009	0.007	0.003	60%
Upper Beaverhead River	Private Land	0.75	3984	0.0023	0.0009	0.093	0.037	60%
Upper Beaverhead River		2.18	11536			0.271	0.107	60%
Upper Rattlesnake Creek	US Bureau of Land Management	0.04	234	0.0023	0.0009	0.005	0.002	60%
Upper Rattlesnake Creek	US Forest Service	2.83	14924	0.0023	0.0009	0.350	0.139	60%
Upper Rattlesnake Creek	Private Land	1.80	9511	0.0023	0.0009	0.223	0.088	60%
Upper Rattlesnake Creek		4.67	24669			0.578	0.229	60%
Upper Stone Creek	US Bureau of Land Management	2.15	11329	0.0023	0.0009	0.266	0.105	60%
Upper Stone Creek	Montana State Trust Lands	0.13	689	0.0023	0.0009	0.016	0.006	60%
Upper Stone Creek	Private Land	4.64	24497	0.0023	0.0009	0.574	0.228	60%
Upper Stone Creek		6.92	36515			0.856	0.339	60%
West Fork Blacktail Deer Creek	US Bureau of Land Management	0.44	2299	0.0023	0.0009	0.054	0.021	60%
West Fork Blacktail Deer Creek	US Forest Service	2.02	10661	0.0023	0.0009	0.250	0.099	60%
West Fork Blacktail Deer Creek	Montana State Trust Lands	1.96	10343	0.0023	0.0009	0.243	0.096	60%
West Fork Blacktail Deer Creek	Montana Fish, Wildlife, and Parks	0.10	532	0.0023	0.0009	0.012	0.005	60%
West Fork Blacktail Deer Creek	Private Land	0.77	4077	0.0023	0.0009	0.096	0.038	60%
West Fork Blacktail Deer Creek		5.29	27912			0.655	0.259	60%
West Fork Dyce Creek	US Bureau of Land Management	2.75	14539	0.0023	0.0009	0.341	0.135	60%
West Fork Dyce Creek	US Forest Service	0.22	1138	0.0023	0.0009	0.027	0.011	60%
West Fork Dyce Creek		2.97	15677			0.368	0.146	60%
BEAVERHEAD TPA		**171.27**	**904287**			**21.206**	**8.407**	**60%**

ATTACHMENT G-6. CULVERT FAILURE ANALYSIS BEAVERHEAD TMDL PLANNING AREA

Location ID	Structure Type	Culvert Dimensions	Culvert Slope	Bankfull Width	Q2	Q5	Q10	Q25	Q50	Q100	Estimated Maximum Capacity at Cross Section	Headwater Hieght (Fill Hieght)	Field Measured Fill Width	Modeled Fill Width*	Fill Length	Fill Volume*	Fill Volume*	Potential Sediment Load if Culvert Fails*
		(ft)	(%)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft^3)	(CY)	(tons)
X-932	Round CMP	3	4	5	7	21	35	62	88	123	102	10	66	5	38	1900	70	117
X-911	Round CMP	2	1	2.5	2	7	13	25	38	55	22	4	22	2.5	24	240	9	15
X-925	Round CMP	5	0.5	15	57	120	175	264	341	435	68	4	29	15	25	1500	56	92
X-928	Squash CMP	9 span 6 rise	1	24	139	255	348	490	608	746	401	7	25	24	35	5880	218	362
X-1001	Squash CMP	6 span 4 rise	3	10	27	63	97	154	207	273	314	10	51	10	25	2500	93	154
X-1002	Round CMP	2	2	1.5	1	3	6	13	20	31	13	2	11	1.5	24	72	3	4
X-292	Round CMP	4	1	7	14	36	58	96	134	181	47	3	21	7	29	609	23	37
X-538	Round CMP	4	3	6	10	28	46	79	111	152	94	5	18	6	20	600	22	37
X-542	Round CMP	4	2	7	14	36	58	96	134	181	108	6	41	7	18	756	28	46
X-1005	Round CMP	3	1	12	38	84	126	196	259	336	54	5	20	12	26	1560	58	96
X-1006	Round CMP	10	1	12	38	84	126	196	259	336	243	7	42	12	35	2940	109	181
X-1007	Round CMP	4	1	7	14	36	58	96	134	181	104	6	31	7	25	1050	39	65
X-1008	Round CMP	5	3	9	22	53	83	134	182	242	208	8	22	9	31	2232	83	137
X-31	Round CMP	2	3	4	5	15	25	46	67	95	47	15	427	4	50	3000	111	184
X-777	Round CMP	3	1	6	10	28	46	79	111	152	64	6	30	6	26	936	35	58
X-751	Round CMP	4	4	12	38	84	126	196	259	336	180	12	289	12	102	14688	544	903
X-28	Round CMP	4	2	5	7	21	35	62	88	123	96	5	76	5	23	575	21	35
X-74	Round CMP	3	3	3	3	9	17	32	47	68	106	15	270	3	85	3825	142	235
X-1009	Round CMP	1.5	4	3	3	9	17	32	47	68	9	2	25	3	28	168	6	10
*Assuming a fill width equal to the bankfull width																		
culvert fails to pass discharge																		

ATTACHMENT G-7. MONTANA DEPARTMENT OF TRANSPORTATION TRACTION SAND APPLICATION RATES 2009-2011 BEAVERHEAD TMDL PLANNING AREA

TRAVEL ROUTE	TRAVEL ROUTE DESCRIPTION	TRAVEL ROUTE LENGTH (MILES)	YEAR	YARDS OF SAND	MILES PLOWED	RATE = LBS PER PLOWED MILE	TONS PER PLOWED MILE	TONS OF SAND
State Highway 278	**Mile Marker 0 - 13.9**	**13.9**	2009	745	5,492	407	0.20	1,118
			2010	472	3,341	424	0.21	708
			2011	778	6,500	359	0.18	1,167
			3 YEAR AVERAGE	**665.0**	**5,111**	**390**	**0.20**	**998**
State Highway 41	**Mile Marker 0 -27.6**	**27.6**	2009	400	3,672	327	0.16	600
			2010	348	3,029	345	0.17	522
			2011	448	3,999	336	0.17	672
			3 YEAR AVERAGE	**398.7**	**3,567**	**335**	**0.17**	**598**
State Highway 91	**This is two MDT routes:**	**14.5**	2009	59	724	244	0.12	89
	Mile Marker 0 - 3.5 (S-222)		2010	85	656	389	0.19	128
	Mile Marker 0 -11 (X-81001)		2011	153	1,438	319	0.16	230
			3 YEAR AVERAGE	**99.0**	**939**	**316**	**0.16**	**149**
Interstate 15	**Mile Marker 44.7 - 75**	**30.3**	2009	1140	17,123	200	0.10	1,710
			2010	955	11,825	242	0.12	1,433
			2011	1311	17,898	220	0.11	1,967
			3 YEAR AVERAGE	**1135.3**	**15,615**	**218**	**0.11**	**1,703**
							TOTAL	**3,447**

RATE OF SAND PER PLOWED MILE IS BASED ON AN AVERAGE WEIGHT OF 3000 LBS. PER YARD

All of the years are MDT fiscal years (July 1st - June 30th)

ATTACHMENT G-8. FISH PASSAGE ASSESSMENT BEAVERHEAD TMDL PLANNING AREA

Location ID	Structure Type	Evaluation Method	Culvert Dimensions (ft)	Width (ft)	Culvert Slope (%)	Bankfull Width (ft)	Culvert/ Bankfull Ratio	Outlet Perch (inches)	Final Classification (# of failures)
X-932	Round CMP	3	3	3	4[3]	**5**	0.60[2]	9.6[3]	2[3]
X-911	Round CMP	3	2	2	1[2]	**2.5**	0.80[1]	0[1]	0[1]
X-925	Round CMP	4	5	5	0.5[2]	**15**	0.33[3]	0[1]	1[3]
X-928	Squash CMP	4	9 span 6 rise	9	1[2]	**24**	0.38[3]	0[1]	1[3]
X-1001	Squash CMP	4	6 span 4 rise	6	3[3]	**10**	0.60[2]	27.6[3]	2[3]
X-1002	Round CMP	3	2	2	2[3]	**1.5**	1.33[1]	3.6[2]	1[3]
X-292	Round CMP	3	4	4	1[2]	**7**	0.57[2]	0[1]	0[1]
X-538	Round CMP	3	4	4	3[3]	**6**	0.67[2]	6[3]	2[3]
X-542	Round CMP	3	4	4	2[3]	**7**	0.57[2]	0[1]	1[3]
X-1005	Round CMP	3	3	3	1[2]	**12**	0.25[3]	0[1]	1[3]
X-1006	Round CMP	4	10	10	1[2]	**12**	0.83[1]	0[1]	0[1]
X-1007	Round CMP	3	4	4	1[2]	**7**	0.57[2]	0[1]	0[1]
X-1008	Round CMP	4	5	5	3[3]	**9**	0.56[2]	0[1]	1[3]
X-31	Round CMP	3	2	2	3[3]	**4**	0.50[2]	0[1]	1[3]
X-777	Round CMP	3	3	3	1[2]	**6**	0.50[2]	0[1]	0[1]
X-751	Round CMP	3	4	4	4[3]	**12**	0.33[3]	26.4[3]	3[3]
X-28	Round CMP	3	4	4	2[3]	**5**	0.80[1]	0[1]	1[3]
X-74	Round CMP	3	3	3	3[3]	**3**	1.00[1]	36[3]	2[3]
X-1009	Round CMP	3	1.5	1.5	4[3]	**3**	0.50[2]	0[1]	1[3]

Note: Evaluation Method based on Table:1 Fish Passage Evaluation Criteria located in *A Summary of Techincal Considerations to Minimize the Blockage of Fish at Culverts on the National Forests of Alaska*

1 conditions that have a high certainty of meeting juvenile fish passage at all desired stream flows

2 conditions are such that additional and more detailed analysis is required to determine their juvenile fish passage ability

3 conditions that have a high certainty of <u>not</u> providing juvenile fish passage at all desired stream flows