APPENDIX F – UNPAVED ROAD SEDIMENT ASSESSMENT

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F1.0 INTRODUCTION

This appendix presents a sediment assessment of the unpaved road network within the Red Rock TMDL Planning Area (TPA). This assessment was performed based on GIS analysis and extrapolation from previous field sampling and modeling of sediment run-off of similar unpaved roads in the Madison TMDL Planning Area by DEQ (DEQ 2020). The resulting extrapolated values for Selway subwatershed were cross-checked with estimates of sediment run-off from unpaved roads in the Selway subwatershed by the USFS, to evaluate that values estimated by DEQ approximated those made in the field. The Madison TMDL Planning area is located adjacent to the Red Rock TMDL Planning area and is assumed to have unpaved roads of similar condition as in the Red Rock TPA. The Selway watershed is a subwatershed within the Red Rock TPA that is listed as impaired for sediment, and the USFS conducted a thorough assessment of sediment from unpaved roads in this subwatershed 2018. Potential future conditions were estimated after the application of sediment- reducing Best Management Practices (BMPs). These also were based on extrapolated values from unpaved roads of similar type in the Madison TPA if BMPs were applied.

F2.0 DATA COLLECTION

F2.1 SPATIAL ANALYSIS

The unpaved road sediment assessment was primarily a GIS analysis. Unpaved roads were determined from the Montana Roads Web Map Service, and verified using aerial photography layers in ArcPro mapping software. DEQ staff used ArcPro to locate each unpaved crossing (e.g., bridges, culverts, fords) and stream-adjacent stretch of road within 100-feet of streams (called "parallel road segment") that could contribute sediment to impaired stream segments Red Rock TPA. Unpaved road crossings were identified as locations where the unpaved roads layer intersected the National Hydrography Dataset (NHD) stream layer. Parallel road segments were identified by placing a 150-foot buffer around the NHD stream layer, and selecting sections of the unpaved roads layer that intersected this buffer. A total of 874 unpaved gravel road crossings and 265 miles of gravel unpaved parallel road segments were identified within the sediment-impaired watersheds of the Red Rock TPA. Parallel road segments that overlapped with crossings were only counted as crossings to avoid double-counting.

F3.0 SEDIMENT LOADING EXTRAPOLATION

F3.1 SEDIMENT LOADING RATES FROM MADISON TMDL

The amount of sediment contributing from each of these crossings and parallel road segments was based on estimates of contributed sediment for different elevation and ownership categories as determined previously for the adjacent Madison TPA as part of the Madison Sediment Temperature TMDLS and Water Quality Improvement Plan, with the assumption that the Red Rock TMDL Planning area has similar road conditions.

As part of that analysis for the Madison TPA, a total of 25 unpaved road crossings and 16 parallel road segments totally approximately 4 miles were selected as representative and evaluated in the field in 2015. The following information was collected at road crossings and parallel road segments: soil type,

percent rock, road surface, road design, traffic level, and road topographic values (road grade, road length, road width, fill grade, fill length, buffer grade, and buffer length). The WEPP model (Flanagan and Livingston 1995) produced an estimate of sediment leaving the crossings and parallel road segments given these characteristics, and resulting contributing length of road to the stream. To estimate the sediment reduction at sampled cross sections if BMP's were implemented, the original field data was used in the WEPP model, but the length of road contributing sediment was shortened to 200 feet.

Finally, the average sediment yield per crossing and miles of parallel road segment was estimated for each ownership/elevation category. Those crossings or parallel road segments in the "public" category were those within areas owned by federal or state agencies, while those in the "private" category were ranches or other lands owned by private citizens. Ownership categories were similarly estimated using ArcPro mapping software. "High" elevation crossings or parallel road segments were selected as those > 6300 feet while low-elevation crossings or parallel road segments were those at elevations < 6300 feet. The average sediment yield for each crossing was estimated by dividing the total sediment yield across sampled cross-sections by the number of cross-sections. The average sediment yield per mile of parallel road segment was similarly estimated by dividing the total sediment yield from sampled parallel road segments by the length of parallel road segments in each of these ownership-elevation categories.

F3.2 SEDIMENT LOADING RATES FROM USFS-SELWAY SUBWATERSHED

In 2019, the USFS conducted a thorough assessment of sediment entering streams which primarily included the Selway subwatershed (Personal Communication, Kevin Weiner, 4/5/21). As part of this assessment, segments of road contributing sediment to streams in the subwatershed were identified and sampled for the same characteristics as was used by DEQ in the assessment completed for the Madison TPA. Also similar to the Madison TPA, a WEPP modeling approach was used to estimate the amount of sediment entering Selway Creek and its tributaries. These areas significantly overlapped with crossings and parallel roads segments identified by DEQ in the GIS analysis. However, the DEQ method identified some additional crossings not identified by USFS. To compare results between methods, the portions of road that were evaluated in both surveys were identified using GIS. The total length of segments that overlapped was 3.09 miles, and the total volume of sediment runoff from these segments was 1.93 tons, for an average loading of 0.62 tons/stream mile/year according to the USFS surveys.

F3.3 SEDIMENT LOADING RATES-RED ROCK TPA ADJUSTMENT

The average loading for segments for sampled segments in the Selway subwatershed, (which is in public ownership in high elevations) by USFS was 0.62 tons/stream mile/year. Comparatively, the average loading from public, high elevation segments sampled in the Madison TPA estimated by DEQ was 0.84 tons/year. Approximately 24% less sediment entered public, high elevation segments using the extrapolation by DEQ compared to that estimated from the USFS field surveys. It was assumed that these differences extended to other ownership/elevation categories. Therefore, the values used for the Madison TMDLS were reduced by 24% in the estimation of the loading from roads in the Red Rock TPA for each ownership/elevation category (**Table F-1**).

Table F-1. Summary of sediment leaving the buffer at parallel road segments and road crossings from the Madison assessment and the adjusted values (multiply X 0.76 to get 24%) applied to the Red Rock watershed.

Category	Avg. Sediment Per Mile-Madison (Tons/Yr)	Avg. Sediment Per Mile- Red Rock TPA (Tons/Yr)	Avg. Sediment per Crossing - Madison (Tons/Yr)	Avg. Sediment Per Crossing- Red Rock TPA (Tons/Yr)
Public, high elevation	0.835	0.635	0.272	0.207
Public, low elevation	2.818	2.142	0.038	0.029
Private, high* elevation	NA	0.635	NA	0.207
Private, low elevation	0.932	0.708	0.136	0.103

*because no private, high elevation crossings or parallel road segments were surveyed, the values at public, high elevation crossings or parallel road segments was used.

F4.0 SUBWATERSHED LOADING ESTIMATES

F4.1 LOADS FROM CROSSINGS

The estimated load from crossings was determined for each subwatershed by multiplying the number of crossings for each ownership/elevation category by the tons/year of load estimated for that category according to **Table F-1 (Table F-2)**.

Table F-2. Estimated number of crossings, and loadings for each ownership/elevation type for each subwatershed evaluated for sediment in the Red Rock TPA.

Subwatershed	Private Low Elevation (No.)	Private High Elevation (No.)	Public Low Elevation (No.)	Public High Elevation (No.)	Private Low Elevation (No. X 0.103 tons/yr)	Private High Elevation (No. X 0.207 tons/yr)	Public Low Elevation (No. X 0.029 tons/yr)	Public High Elevation (No.X 0.207 tons/yr)	Total
Bean	0	1	0	1	0.00	0.21	0.00	0.21	0.41
Big Sheep Creek	5	54	2	129	0.52	11.18	0.15	26.70	38.54
Muddy Creek	0	9	0	38	0.00	1.86	0.00	7.87	9.73
Big Sheep Creek main	5	8	2	27	0.52	1.66	0.15	5.59	7.91
Nicholia Creek/upper	0	37	0	64	0.00	7.66	0.00	13.25	20.91
Corral Creek	0	1	0	0	0.00	0.21	0.00	0.00	0.21
East Fork Clover Creek	0	1	0	0	0.00	0.21	0.00	0.00	0.21
Fish Creek	0	0	0	5	0.00	0.00	0.00	1.04	1.04
Horse Prairie Creek	77	134	27	226	7.93	27.74	0.78	46.78	83.24
Horse Prairie Creek main	41	72	17	98	4.22	14.90	0.49	20.29	39.91
Medicine Lodge Creek	34	48	10	81	3.50	9.94	0.29	16.77	30.50
Selway Creek	0	1	0	24	0.00	0.21	0.00	4.97	5.18
Trail Creek	2	13	0	23	0.21	2.69	0.00	4.76	7.66
Jones Creek	0	2	0	0	0.00	0.41	0.00	0.00	0.41
Long Creek	0	9	0	12	0.00	1.86	0.00	2.48	4.35
Medicine Lodge Creek	34	48	10	81	3.50	9.94	0.29	16.77	30.50

Table F-2. Estimated number of crossings, and loadings for each ownership/elevation type for each subwatershed evaluated for sediment in the Red Rock TPA.

	Private		Public		Private		Public		
Subwatershed	Low Elevation *(No.)*	High Elevation *(No.)*	Low Elevation *(No.)*	High Elevation *(No.)*	Low Elevation *(No. X 0.103 tons/yr)*	High Elevation *(No. X 0.207 tons/yr)*	Low Elevation *(No. X 0.029 tons/yr)*	High Elevation *(No.X 0.207 tons/yr)*	Total
Muddy Creek	0	9	0	38	0.00	1.86	0.00	7.87	9.73
O' Dell Creek	0	9	0	24	0.00	1.86	0.00	4.97	6.83
Peet Creek	0	5	0	4	0.00	1.04	0.00	0.83	1.86
Price Creek	0	0	0	9	0.00	0.00	0.00	1.86	1.86
Red Rock Creek	0	12	0	8	0.00	2.48	0.00	1.66	4.14
Red Rock Creek main	0	11	0	8	0.00	2.28	0.00	1.66	3.93
Corral Creek	0	1	0	0	0.00	0.21	0.00	0.00	0.21
Sage Creek	8	61	5	42	0.82	12.63	0.15	8.69	22.29
Selway Creek	0	1	0	24	0.00	0.21	0.00	4.97	5.18
Tom Creek	0	0	0	2	0.00	0.00	0.00	0.41	0.41
Trail Creek	2	13	0	23	0.21	2.69	0.00	4.76	7.66

F4.2 LOADS FROM PARALLEL ROAD SEGMENTS

The estimated load from parallel road segments was determined for each subwatershed by multiplying the number of parallel road segments for each ownership/elevation category by the tons/year of loading estimated for that category according to **Table F-1 (Table F-3)**.

Table F-3. Estimated length of parallel road segments, and loadings for each ownership/elevation type for each subwatershed evaluated for sediment in the Red Rock TPA.

	Private		Public		Private		Public		
Subwatershed	**Low Elevation (Miles)**	**High Elevation (Miles)**	**Low Elevation (Miles)**	**High Elevation (Miles)**	**Low Elevation** (*Miles * 0.708 Tons/Yr*)	**High Elevation** (*Miles * 0.635 Tons/Yr*)	**Low Elevation** (*Miles * 2.142 Tons/Yr*)	**High Elevation** (*Miles * 0.635 Tons/Yr*)	**Total (Tons/Yr)**
Bean	0.00	0.37	0.00	0.21	0.00	0.23	0.00	0.13	0.37
Big Sheep Creek	0.11	6.44	0.10	18.07	0.08	4.09	0.21	11.47	15.86
Muddy Creek	0.00	2.50	0.00	6.25	0.00	1.59	0.00	3.97	5.56
Big Sheep Creek main	0.10	1.54	0.09	5.59	0.07	0.98	0.19	3.55	4.79
Nicholia Creek/upper	0.01	2.40	0.01	6.23	0.01	1.52	0.02	3.96	5.51
Corral Creek	0.00	0.09	0.00	0.00	0.00	0.06	0.00	0.00	0.06
East Fork Clover Creek	0.00	0.11	0.00	0.00	0.00	0.07	0.00	0.00	0.07
Fish Creek	0.00	0.00	0.00	1.43	0.00	0.00	0.00	0.91	0.91
Horse Prairie Creek	3.23	14.41	3.20	34.57	2.29	9.15	6.85	21.95	40.24
Horse Prairie Creek main	1.25	8.27	2.47	15.03	0.89	5.25	5.29	9.54	20.97
Medicine Lodge Creek	1.98	3.97	0.73	13.55	1.40	2.52	1.56	8.60	14.09
Selway Creek	0.00	0.00	0.00	3.43	0.00	0.00	0.00	2.18	2.18
Trail Creek	0.00	2.17	0.00	2.56	0.00	1.38	0.00	1.63	3.00
Jones Creek	0.00	0.40	0.00	0.00	0.00	0.25	0.00	0.00	0.25
Long Creek	0.00	0.35	0.00	1.80	0.00	0.22	0.00	1.14	1.37
Medicine Lodge Creek	1.98	3.97	0.73	13.55	1.40	2.52	1.56	8.60	14.09
Muddy Creek	0.00	2.51	0.00	6.25	0.00	1.59	0.00	3.97	5.56
Odell Creek	0.00	0.31	0.00	0.96	0.00	0.20	0.00	0.61	0.81
Peet Creek	0.00	0.55	0.00	0.48	0.00	0.35	0.00	0.30	0.65
Price Creek	0.00	0.08	0.00	0.41	0.00	0.05	0.00	0.26	0.31
Red Rock Creek	0.00	0.83	0.00	0.70	0.00	0.53	0.00	0.44	0.97
Red Rock Creek main	0.00	0.74	0.00	0.70	0.00	0.47	0.00	0.44	0.91

Table F-3. Estimated length of parallel road segments, and loadings for each ownership/elevation type for each subwatershed evaluated for sediment in the Red Rock TPA.

Subwatershed	Private Low Elevation (Miles)	Private High Elevation (Miles)	Public Low Elevation (Miles)	Public High Elevation (Miles)	Private Low Elevation (*Miles * 0.708 Tons/Yr*)	Private High Elevation (*Miles * 0.635 Tons/Yr*)	Public Low Elevation (*Miles * 2.142 Tons/Yr*)	Public High Elevation (*Miles * 0.635 Tons/Yr*)	Total (Tons/Yr)
Corral Creek	0.00	0.09	0.00	0.00	0.00	0.06	0.00	0.00	0.06
Sage Creek	0.53	2.95	0.28	7.77	0.38	1.87	0.60	4.93	7.78
Selway Creek	0.00	0.18	0.00	3.43	0.00	0.11	0.00	2.18	2.29
Tom Creek	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.04	0.04
Trail Creek	0.00	2.17	0.00	2.56	0.00	1.38	0.00	1.63	3.00

F5.0 BEST MANAGEMENT PRACTICES-ADJUSTED LOADINGS

For the Madison Sediment TMDLs (DEQ, 2020), The WEPP model (Flanagan and Livingston 1995) produced an estimate of sediment leaving the crossings and parallel road segments at each field-sampled location given the characteristics and resulting contributing length. To estimate the sediment reduction at sampled cross sections if BMP's were implemented, the original field data was used in the WEPP model, but the length of road contributing sediment was shortened to 200 feet. The average values produced in this modeling effort were applied to the crossings and parallel road segments in the Red Rock TPA, assuming that the range of condition of roads is similar in both the Madison TPA and Red Rock TPA. They were not adjusted for the lower estimated loading rates in the Red Rock TPA versus the Madison TPA, given that these values represent attainable conditions if BMPs were applied, and not current conditions. It was assumed that the attainable condition once BMPs are applied is similar between study areas.

Table F-4. Loading estimates before and after applying Best Management Practices, which were used in development of the Red Rock TMDLs.

Category	Avg. Sediment Per Mile of Parallel Road Segment- (Tons/Yr)	Avg. Sediment Per Mile of Parallel Road Segment with BMPs (Tons/Yr)	Avg. Sediment Per Crossing (Tons/Yr)	Avg. Sediment Per Crossing with BMPs (Tons/Yr)
Public, high elevation	0.635	0.544	0.207	0.063
Public, low elevation	2.142	2.02	0.029	0.017
Private, high elevation*	0.635	0.544	0.207	0.063
Private, low elevation	0.708	0.546	0.103	0.093

* Average values from public, high elevation sites were used, since no private, high elevation sites were sampled

F5.1 BMP-ADJUSTED LOADS: CROSSINGS

The estimated load at crossings was determined for each subwatershed by multiplying the number of crossings for each ownership/elevation category by the tons/year of loads estimated for that category if BMPs were implemented, according to **Table F-4 (Table F-5)**.

Table F-5. Estimated number of crossings, and loadings for each ownership/elevation type for each subwatershed evaluated for sediment in the Red Rock TPA after BMP-adjusted values were applied.

Subwatershed	Private		Public		Private		Public		Total (Tons/Yr)
	Low Elevation	High Elevation	Low Elevation	High Elevation	Low Elevation (No. X 0.093)	High Elevation (No.X 0.063)	Low Elevation No. X 0.017)	High Elevation (No. X 0.063)	
Bean	0	1	0	1	0.0	0.1	0.0	0.1	0.1
Big Sheep Creek	5	54	2	129	0.5	3.4	0.0	8.1	11.5
Muddy Creek	0	9	0	38	0.0	0.6	0.0	2.4	3.0
Big Sheep Creek Main	5	8	2	27	0.5	0.5	0.0	1.7	2.7
Nicholia Creek/ upper	0	37	0	64	0.0	2.3	0.0	4.0	6.4
Corral Creek	0	1	0	0	0.0	0.1	0.0	0.0	0.1
East Fork Clover Creek	0	1	0	0	0.0	0.1	0.0	0.0	0.1
Fish Creek	0	0	0	5	0.0	0.0	0.0	0.3	0.3
Horse Prairie Creek	77	134	27	226	6.9	8.08	0.54	13.63	29.2
Horse Prairie Creek main	41	72	17	98	3.7	4.3	0.3	5.9	14.2
Medicine Lodge Creek	34	48	10	81	3.1	2.9	0.2	4.9	11.0
Selway Creek	0	1	0	24	0.0	0.1	0.0	1.4	1.5
Trail Creek	2	13	0	23	0.19	0.82	0.00	1.45	2.5
Jones Creek	0	2	0	0	0.0	0.1	0.0	0.0	0.1
Long Creek	0	9	0	12	0.0	0.5	0.0	0.7	1.3
Medicine Lodge Creek	34	48	10	81	3.1	2.9	0.2	4.9	11.0
Muddy Creek	0	9	0	38	0.0	0.5	0.0	2.3	2.8
O' Dell Creek	0	9	0	24	0.0	0.5	0.0	1.4	2.0

Table F-5. Estimated number of crossings, and loadings for each ownership/elevation type for each subwatershed evaluated for sediment in the Red Rock TPA after BMP-adjusted values were applied.

Subwatershed	Private		Public		Private		Public		Total (Tons/Yr)
	Low Elevation	High Elevation	Low Elevation	High Elevation	Low Elevation *(No. X 0.093)*	High Elevation *(No.X 0.063)*	Low Elevation *No. X 0.017)*	High Elevation *(No. X 0.063)*	
Peet Creek	0	5	0	4	0.0	0.3	0.0	0.2	0.5
Price Creek	0	0	0	9	0.0	0.0	0.0	0.5	0.5
Red Rock Creek	0	12	0	8	0.0	0.7	0.0	0.5	1.2
Red Rock Creek main	0	11	0	8	0.0	0.7	0.0	0.5	1.1
Corral Creek	0	1	0	0	0.0	0.1	0.0	0.0	0.1
Sage Creek	8	61	5	42	0.7	3.7	0.1	2.5	7.0
Selway Creek	0	1	0	24	0.00	0.06	0.00	1.44	1.50
Tom Creek	0	0	0	2	0.00	0.00	0.00	0.12	0.12
Trail Creek	2	13	0	23	0.19	0.82	0.00	1.45	2.45

F5.2 BMP-ADJUSTED LOADS-PARALLEL ROAD SEGMENTS

The estimated load at parallel road segments was determined for each subwatershed by multiplying the number of miles for each ownership/elevation category by the tons/year of load estimated for that category according to **Table F-4 (Table F-6)**.

Table F-6. Estimated length of parallel road segments, and loadings for each ownership/elevation type for each subwatershed evaluated for sediment in the Red Rock TPA after BMP-adjusted values were applied.

Subwatershed	Private Low Elevation	Private High Elevation	Public Low Elevation	Public High Elevation	Private Low Elevation (Miles X 0.546 Tons/Yr)	Private High Elevation (Miles X 0.544 Tons/Yr)	Public Low Elevation (Miles X 2.02 Tons/Yr)	Public High Elevation (Miles X 5.44 Tons/Yr)	Total (Tons/Yr)
Bean	0.00	0.37	0.00	0.21	0.00	0.20	0.00	0.11	0.32
Big Sheep Creek	0.11	6.44	0.10	18.07	0.06	3.50	0.20	9.83	13.60
Muddy Creek	0.00	2.50	0.00	6.25	0.00	1.36	0.00	3.40	4.76
Big Sheep Creek Main	0.10	1.54	0.09	5.59	0.05	0.84	0.18	3.04	4.12
Nicholia Creek/Upper	0.01	2.40	0.01	6.23	0.01	1.31	0.02	3.39	4.72
Corral Creek	0.00	0.09	0.00	0.00	0.00	0.05	0.00	0.00	0.05
East Fork Clover Creek	0.00	0.11	0.00	0.00	0.00	0.06	0.00	0.00	0.06
Fish Creek	0.00	0.00	0.00	1.43	0.00	0.00	0.00	0.78	0.78
Horse Prairie Creek	3.23	14.41	3.20	34.57	1.76	7.84	6.46	18.81	34.87
Horse Prairie Creek main	1.25	8.27	2.47	15.03	0.68	4.50	4.99	8.18	18.35
Medicine Lodge Creek	1.98	3.97	0.73	13.55	1.08	2.16	1.47	7.37	12.09
Selway Creek	0.00	0.00	0.00	3.43	0.00	0.00	0.00	1.87	1.87
Trail Creek	0.00	2.17	0.00	2.56	0.00	1.18	0.00	1.39	2.57
Jones Creek	0.00	0.40	0.00	0.00	0.00	0.22	0.00	0.00	0.22
Long Creek	0.00	0.35	0.00	1.80	0.00	0.19	0.00	0.98	1.17
Medicine Lodge Creek	1.98	3.97	0.73	13.55	1.08	2.16	1.47	7.37	12.09
Muddy Creek	0.00	2.51	0.00	6.25	0.00	1.37	0.00	3.40	4.77
O' Dell Creek	0.00	0.31	0.00	0.96	0.00	0.17	0.00	0.52	0.69
Peet Creek	0.00	0.55	0.00	0.48	0.00	0.30	0.00	0.26	0.56

Table F-6. Estimated length of parallel road segments, and loadings for each ownership/elevation type for each subwatershed evaluated for sediment in the Red Rock TPA after BMP-adjusted values were applied.

Subwatershed	Private		Public		Private		Public		Total (Tons/Yr)
	Low Elevation	High Elevation	Low Elevation	High Elevation	Low Elevation *(Miles X 0.546 Tons/Yr)*	High Elevation *(Miles X 0.544 Tons/Yr)*	Low Elevation *(Miles X 2.02 Tons/Yr)*	High Elevation *(Miles X 5.44 Tons/Yr)*	
Price Creek	0.00	0.08	0.00	0.41	0.00	0.04	0.00	0.22	0.27
Red Rock Creek	0.00	0.83	0.00	0.70	0.00	0.45	0.00	0.38	0.83
Red Rock Creek main	0.00	0.74	0.00	0.70	0.00	0.40	0.00	0.38	0.78
Corral Creek	0.00	0.09	0.00	0.00	0.00	0.05	0.00	0.00	0.05
Sage Creek	0.53	2.95	0.28	7.77	0.29	1.60	0.57	4.23	6.69
Selway Creek	0.00	0.18	0.00	3.43	0.00	0.10	0.00	1.87	1.96
Tom Creek	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.03	0.03
Trail Creek	0.00	2.17	0.00	2.56	0.00	1.18	0.00	1.39	2.57

F6.0 CALCULATION OF PERCENT REDUCTIONS WITH BMPS

To determine total estimated loading from unpaved roads before and after BMPs for each subwatershed, the loading from crossings and parallel road segments was summed. The estimated percent reduction was estimated as: (Total Loading-Total Loading with BMPs)/Total Loading X 100. The potential tons reduced per stream mile was estimated as (Total Loading-Total Loading with BMPs)/stream miles, with the total stream miles estimated as the total length of streams in the NHD stream layer (**Table F-7**). The final estimates of percent reductions for Big Sheep Creek, Horse Prairie Creek, and Red Rock Creek include those of both the mainstem and assessed subwatersheds.

Table F-7. Estimated reduction in sediment loads from unpaved roads with BMPs implemented, as potential tons of sediment reduced per stream mile.

Subwatershed	Loading-Crossings (Tons/Yr)	Loading (Parallel Road Segments (Tons/Yr)	Total Loading (Tons/Yr)	Loading with BMPs-Crossings (Tons/Yr)	Loading with BMPs-Parallel Road Segments (Tons/Yr)	Total Loading with BMPs (Tons/Yr)	% Reduct-ion	Total Stream Miles	Potential Tons Reduced Per Stream Mile
Bean	0.41	0.37	0.78	0.1	0.32	0.42	46	8.6	0.042
Big Sheep Creek	38.45	15.86	54.40	12	13.6	25.60	53	298.0	0.097
Corral Creek	0.21	0.06	0.27	0.1	0.05	0.15	44	4.4	0.027
East Fork Clover Creek	0.21	0.07	0.28	0.1	0.06	0.16	43	7.7	0.016
Fish Creek	1.04	0.91	1.95	0.3	0.78	1.08	45	8.8	0.099
Horse Prairie Creek	83.24	40.24	123.48	29.2	34.87	64.07	48	897.3	0.066
Jones Creek	0.41	0.25	0.66	0.1	0.22	0.32	52	10.4	0.033
Long Creek	4.35	1.37	5.72	1.3	1.17	2.47	57	59.9	0.054
Medicine Lodge Creek	30.50	14.09	44.59	11	12.09	23.09	48	250.5	0.086
Muddy Creek	9.70	5.56	15.26	2.8	4.77	7.57	50	64.6	0.119
O'Dell Creek	6.80	0.81	7.61	2	0.69	2.69	65	53.3	0.092
Peet Creek	1.86	0.65	2.51	0.5	0.56	1.06	58	25.6	0.057
Price Creek	1.86	0.31	2.17	0.5	0.27	0.77	65	19.3	0.073
Red Rock Creek	4.14	0.97	5.11	1.2	0.83	2.03	60	69.5	0.044
Sage Creek	22.29	7.78	30.07	7	6.69	13.69	54	278.1	0.059
Selway Creek	5.18	2.29	7.47	1.5	1.96	3.46	54	37.7	0.106
Tom Creek	0.41	0.04	0.45	0.12	0.03	0.15	67	16.7	0.018
Trail Creek	7.66	3.00	10.66	2.45	2.57	5.03	53	63.1	0.065

F7.0 REFERENCES

Flanagan, D. C. and S. J. Livingston. 1995. USDA-Water Erosion Prediction Project User Summary. NSERL Report No. 11, National Soil Erosion Research Lab, USDA, West Lafayette IN, 139 pp.

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