

ROAD SEDIMENT ASSESSMENT & MODELING: KOOTENAI-FISHER TMDL PLANNING AREA ROAD GIS LAYERS & SUMMARY STATISTICS

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ATTACHMENTS

Attachment A Road Summary Statistics

1.0 INTRODUCTION

An assessment of the road network within the Kootenai-Fisher TMDL Planning Area (TPA) will be performed as part of the development of sediment TMDLs for 303(d) listed stream segments with sediment as a documented impairment. This report details the various GIS layers and existing datasets used in the road assessment, as well as road summary statistics throughout the Kootenai-Fisher TPA. This assessment will be used to support sediment source modeling using the USDA Agricultural Research Service's WEPP model.

The Kootenai-Fisher TPA encompasses an area of approximately 2,511 square miles in Lincoln and Flathead counties in northwestern Montana. The Kootenai-Fisher TPA includes both the Kootenai TPA (1,667 square miles) and the Fisher TPA (844 square miles). The Kootenai TPA encompasses the majority of the Upper Kootenai River HUC8 (17010104), while the Fisher TPA aligns with the Fisher River HUC8 (17010101). Within the Kootenai-Fisher TPA, there are six water body segments listed on the 2010 303(d) List for sediment-related impairments (**Table 1**). Bristow Creek, Libby Creek, Lake Creek and Quartz Creek are listed as impaired due to sediment in the Kootenai TPA, while Wolf Creek and Raven Creek are listed as impaired due to sediment in the Fisher TPA.

Table 1. Waterbody segments that will be addressed during the road assessment.

TPA	List ID	Waterbody Description
Kootenai/Fisher	MT76C001_020	WOLF CREEK, headwaters to mouth (Fisher River)
Kootenai/Fisher	MT76C001_030	RAVEN CREEK, headwaters to mouth (Pleasant Valley Fisher River)
Kootenai/Fisher	MT76D002_110	BRISTOW CREEK, the headwaters to mouth at Lake Koocanusa
Kootenai/Fisher	MT76D002_062	LIBBY CREEK, from the highway 2 bridge to mouth (Kootenai River)
Kootenai/Fisher	MT76D002_070	LAKE CREEK, Bull Lake outlet to mouth (Kootenai River)
Kootenai/Fisher	MT76D002_090	QUARTZ CREEK, headwaters to confluence with the Kootenai River

2.0 GIS ROAD SEDIMENT ASSESSMENT SUMMARY

This section provides a description of the various GIS layers and sources for data that were used in the road sediment assessment study.

2.1 LAND OWNERSHIP

Data on land ownership was obtained from NRIS, which maps public land ownership at a scale of 1:100,000. Ownership was divided into seven categories: US Forest Service, US Bureau of Land Management, US Fish and Wildlife Service, Montana Fish, Wildlife and Parks, Montana State Trust Lands, Private, and Unknown, though no roads intersected US Bureau of Land Management or US Fish and Wildlife Service managed lands in the Kootenai-Fisher TPA.

2.2 ROAD LAYERS

The roads layer is primarily derived from the Travel Routes for Region 1 geodatabase developed by the US Forest Service and available from the Northern Region Geospatial Library (<http://www.fs.fed.us/r1/gis/>), supplemented with the Lincoln County Roads dataset. The State of Montana Base Map Service Center Transportation Framework Theme was initially considered, but was

not utilized since the data are not uniform and road surface type information is commonly lacking. The US Forest Service Travel Routes for Region 1 database contains a significant amount of road surface type information, and was found to be just as complete of an inventory of road locations, particularly in areas with a mix of federally and privately managed lands. Road data in the US Forest Service Travel Routes for Region 1 database was sometimes lacking in areas of urban and rural residential development. When this was the case, specific roads were selected from the Lincoln County roads dataset, which also contained road surface type information, and merged with the US Forest Service data to build a complete dataset. Road surface types were assigned a “DEQ Class” of 1, 2, 3, or 4 based on surface type attribute information contained in the various road datasets as presented in **Table 2**.

Table 2. Road surface type attributes.

DEQ Class	DEQ Class Description	Road Database Attributes
1	Paved	Paved, Asphalt, Bituminous Surface Treatment, Paved/NonHighway
2	Gravel	Crushed Aggregate or Gravel, Gravel, Graded, Bladed
3	Native	Native Material
4	Unknown	assigned when surface type information lacking

2.3 STREAM AND WATERSHED LAYERS

Stream layers were developed using the National Hydrography Dataset (NHD) 1:24,000 high-resolution flowline layer. Flowlines were limited to streams/rivers and artificial paths; ditches and pipelines were not included. Artificial paths are required as larger waterbodies are digitized as polygons (waterbody areas), and the NHD flowline layer uses an artificial path to connect flowlines through these areas.

Watersheds were delineated on the basis of the USGS 6th Hydrologic Unit Code (HUC12) layer and modified where necessary to delineate the subwatersheds of interest (**Table 3** and **Figure 1**). Delineated subwatersheds include the Upper Lake Creek HUC12, which was split into areas draining upstream (above) and downstream (below) the Bull Lake outlet, along with the Raven Creek subwatershed, which was created using the ‘Delineate Watershed’ tool in GIS and a 30-meter DEM.

Table 2. Subwatersheds for sediment listed stream segments in the Kootenai-Fisher TPA.

Hu_10_Name	Hu_12_Name	Subwatershed_ID
Bristow Creek-Rainy Creek	Bristow Creek	Bristow Creek
Flower Creek-Quartz Creek	Quartz Creek	Quartz Creek
Lake Creek	Keeler Creek	Keeler Creek
	Lower Lake Creek	Lower Lake Creek
	Ross Creek	Ross Creek
	Stanley Creek	Stanley Creek
	Upper Lake Creek	Upper Lake Creek_above Bull Lake
	Upper Lake Creek	Upper Lake Creek_below Bull Lake
Libby Creek	Big Cherry Creek	Big Cherry Creek
	Granite Creek	Granite Creek
	Lower Libby Creek	Lower Libby Creek
	Swamp Creek-Cowell Creek	Swamp Creek-Cowell Creek
	Upper Libby Creek	Upper Libby Creek
Wolf Creek	Dry Fork Creek	Dry Fork Creek
	Little Wolf Creek	Little Wolf Creek
	Lower Wolf Creek	Lower Wolf Creek
	Middle Wolf Creek	Middle Wolf Creek
	Upper Wolf Creek	Upper Wolf Creek
	Weigel Creek	Weigel Creek
Pleasant Valley Fisher River	Pleasant Valley Fisher River-Loon Lake	Raven Creek_sub6code

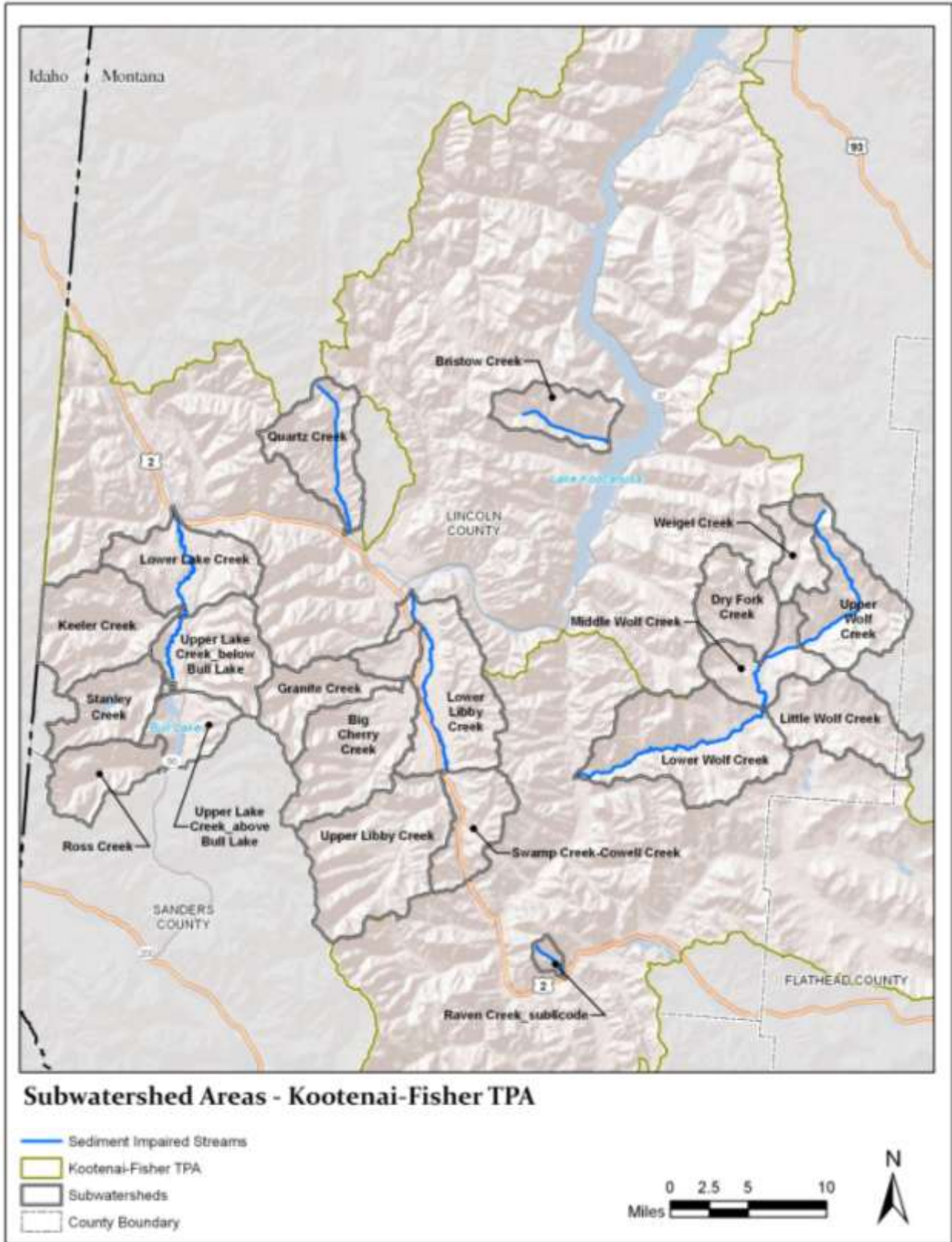


Figure 1. Subwatersheds in the Kootenai-Fisher TPA.

2.4 LANDSCAPE LAYERS

Landscapes are delineated according to the EPA 2002 Level IV ecoregions (Woods *et al.*, 2002). There are six Level IV ecoregions within the Kootenai-Fisher TPA:

- Tobacco Plains (15d)
- High Northern Rockies (15h)
- Salish Mountains (15l)
- Purcell-Cabinet-North Bitterroot Mountains (15q)
- Stillwater-Swan Wooded Valley (15t)
- Western Canadian Rockies (41c)

All but one of the Level IV ecoregions within the Kootenai-Fisher TPA are constituents of the Northern Rockies Level III ecoregion, while the Western Canadian Rockies Level IV ecoregion is a constituent of the Canadian Rockies Level III ecoregion. Watersheds contributing to sediment listed stream segments in the Kootenai-Fisher TPA are comprised of three of the above listed Level IV ecoregions: High Northern Rockies, Salish Mountains, and Purcell-Cabinet-North Bitterroot Mountains.

2.5 ROAD CROSSINGS

Road crossings were generated using the 'Intersect' tool in ArcGIS. Input layers for this operation included the fully attributed roads layer discussed in **Section 2.2**, along with the 1:24,000 NHD stream layer. Information on ecoregion, annual precipitation, land ownership, and the watershed/subwatershed was extracted and joined to the roads data by use of the 'Identity' tool. Through this process, the roads were cut by the boundaries of these various polygons and received the attributes of each. The 'Identity' tool was run on the roads dataset for one polygon dataset, which produced an output dataset, which was then run through 'Identity' on the next shapefile, and so forth, to create one final roads dataset. The result is a point feature class located at the intersections of the road and stream line features, and which includes surface type, land ownership and ecoregion attributes in one attribute table. This final road dataset was then imported to a geodatabase and run through topology checks to eliminate multipart features and any overlapping or intersecting lines. The roads data was further refined by visual inspection for duplicate data. The GIS model of road crossings yields an estimate of 1,989 crossings within the Kootenai-Fisher TPA (**Tables 4 and 5**). Road crossings are presented in **Figure 2** and this information is summarized by subwatershed, ownership and ecoregion in **Attachment A**.

Table 4. Number of road crossings per Level IV ecoregion in the Kootenai-Fisher TPA.

Level IV Ecoregion	# of Crossings
High Northern Rockies	1
Salish Mountains	1448
Purcell-Cabinet-North Bitterroot Mountains	540
Total	1989

Table 5. Number of road crossings per land ownership in the Kootenai-Fisher TPA.

Land Ownership	# of Crossings
Private	855
Montana State Trust Lands	61
US Forest Service	1072
Montana Fish, Wildlife and Parks	0
Unknown	1
Total	1989

2.6 PARALLEL ROAD SEGMENTS

Road segments within 150 feet streams were also modeled using GIS. A distance of 150 feet was selected as a compromise between the maximum expected sediment transport distance (~300 feet) and accuracy limitations of the road and flowline data. A 150-foot buffer was applied to stream features in the 1:24,000 NHD stream layer to create a buffer polygon feature class, which was then intersected with the roads layer to create a layer of roads found within 150 feet of streams. This method duplicates the road/stream crossings described in **Section 2.5**. To address this, a 200-foot radius buffer of the crossing points was created. Using the 'Erase' tool, the buffered areas were removed, creating the final parallel road segment layer. The 200-foot radius was derived from the WEPP model documentation for runoff from roads, which references 120 meters (roughly 400 feet) as the maximum expected flowpath length along a road with no cross drain (Elliot *et al.*, 1999). The GIS model of parallel road segments yields an estimate of 76.58 miles within the Kootenai-Fisher TPA (**Tables 6 and 7**). Parallel road segments are presented in **Figure 3** and this information is summarized by subwatershed, ownership and ecoregion in **Attachment A**.

Table 6. Length of parallel road segments per Level IV ecoregion in the Kootenai-Fisher TPA.

Level IV Ecoregion	Road Length (Miles)
High Northern Rockies	0.00
Salish Mountains	49.96
Purcell-Cabinet-North Bitterroot Mountains	26.61
Total	76.58

Table 7. Length of parallel road segments per land ownership in the Kootenai-Fisher TPA.

Land Ownership	Road Length (Miles)
Private	36.89
Montana State Trust	3.86
US Forest Service	35.72
Montana Fish, Wildlife and Parks	0.03
Unknown	0.07
Total	76.58

3.0 SAMPLING AND ANALYSIS PLAN

A Quality Assurance Plan (QAPP) and Sampling and Analysis Plan (SAP) was developed for the Kootenai-Fisher TPA road assessment and modeling project using the summary information presented in this memo as well as other available resources. The goal of the QAPP/SAP is to assess a statistically representative portion of the road network that can be extrapolated to the entire TPA. A random selection of 40 road crossings in the Kootenai-Fisher TPA was developed using the 'Create Random Selection' tool in the Hawth's Tools extension for ArcMap to provide a representative sample, with 28 road crossings selected for field data collection and 12 road crossings selected as alternate sites.

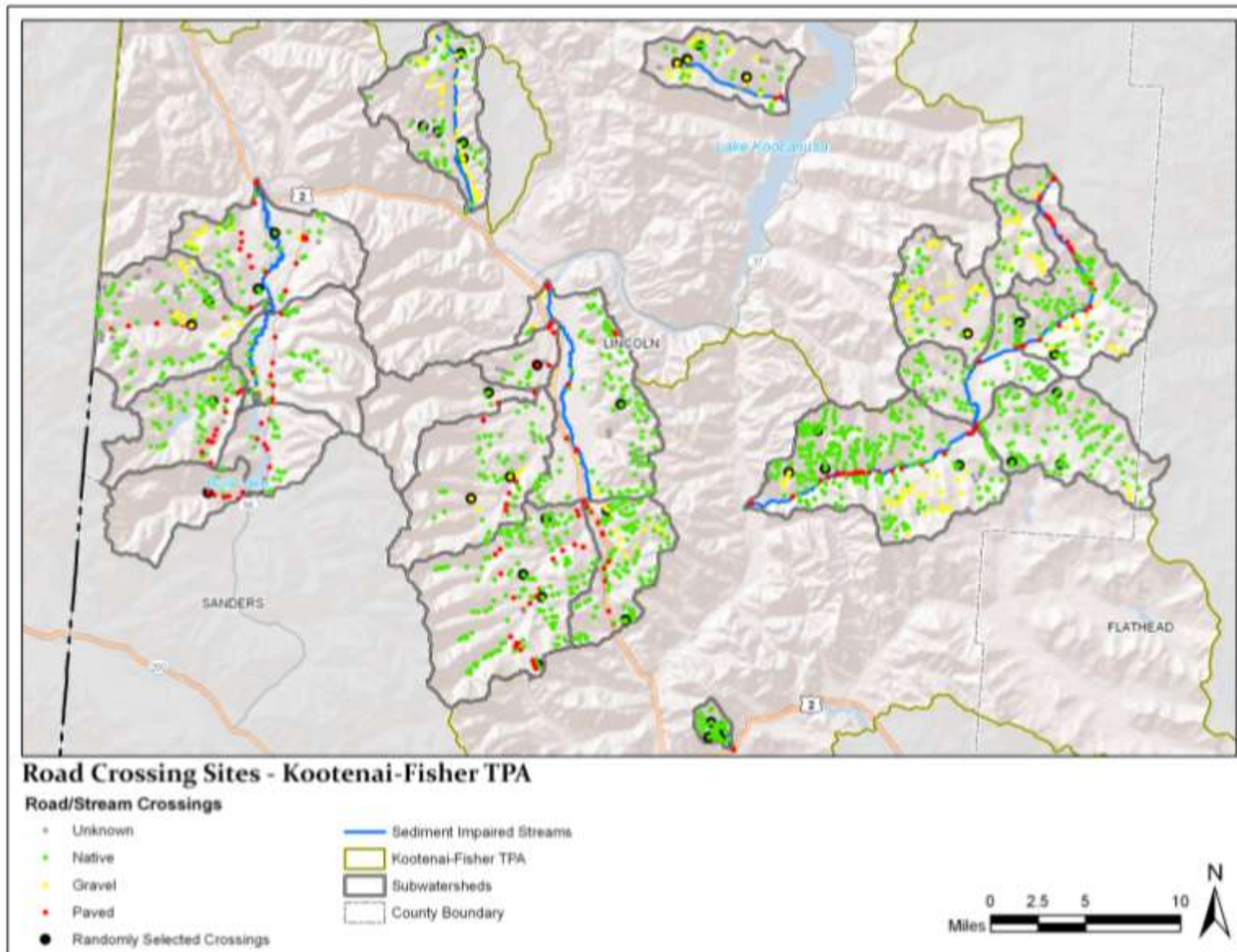


Figure 2. Road crossings in the Kootenai-Fisher TPA.

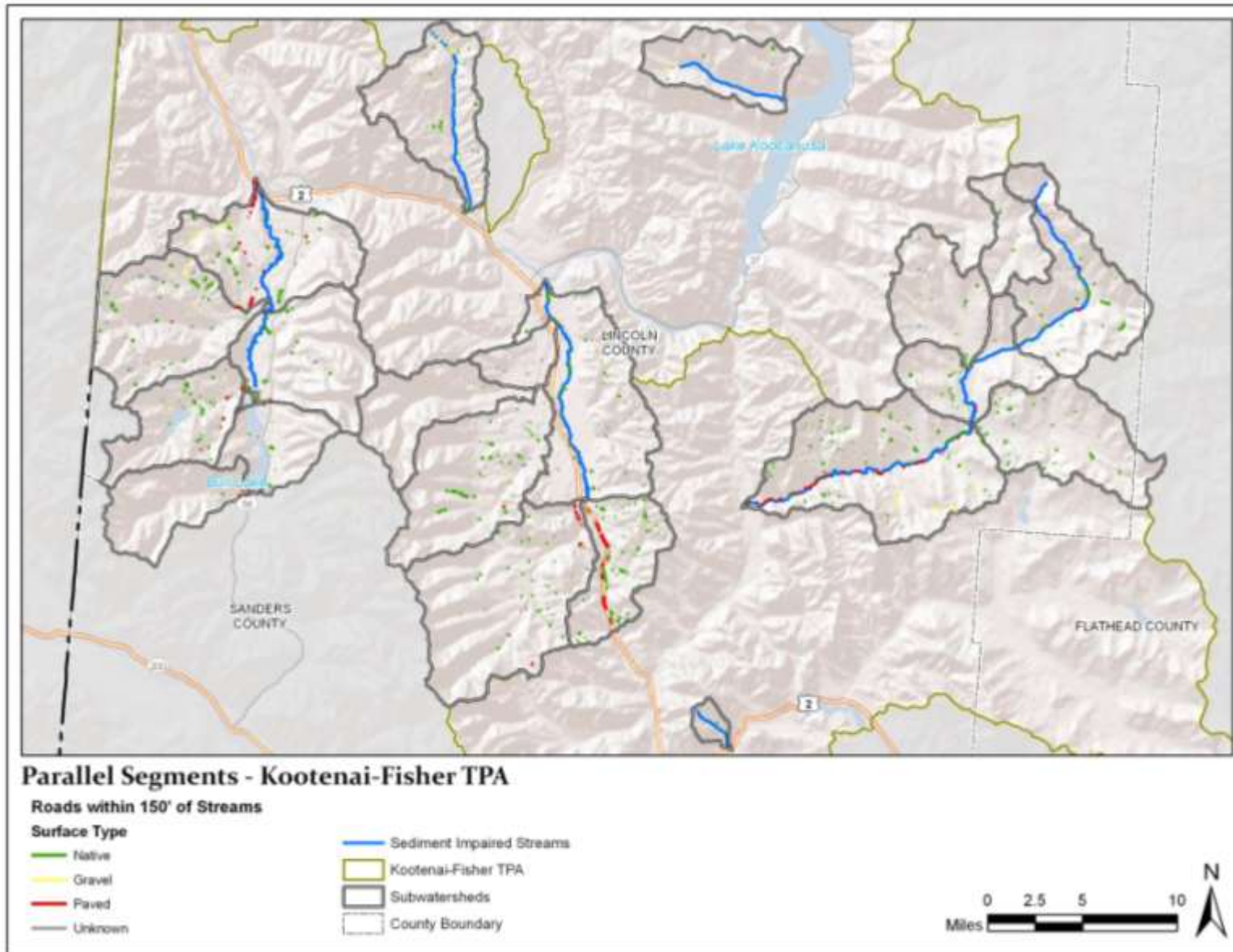


Figure 3. Road segments parallel to streams in the Kootenai-Fisher TPA.

4.0 REFERENCES

Elliot, W.J., D.E. Hall, and D.L. Scheele. 1999. WEPP:Road WEPP Interface for Predicting Road Runoff, Erosion and Sediment Delivery Technical Documentation. USDA Forest Service, Rocky Mountain Research Station and San Dimas Technology and Development Center. Accessible at: <http://forest.moscowfs1.wsu.edu/fswcpp/docs/wepproadoc.html>

Woods, A.J., J.M. Omernik, J.A. Nesser, J. Sheldon, and S.H. Azevedo. 1999. Ecoregions of Montana (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).

Attachment A
Road Summary Statistics

SUBWATERSHED	ROAD LENGTH (MILES)					ROAD DENSITY			TOTAL CROSSINGS	CROSSINGS BY ROAD CLASS				CROSSINGS BY LAND OWNER					CROSSINGS BY ECOREGION IV		
	TOTAL ROADS	PAVED	GRAVEL	NATIVE	UNKNOWN	AREA (SQUARE MILES)	TOTAL ROAD LENGTH (MILES)	MILES OF ROAD PER SQUARE MILE		PAVED	GRAVEL	NATIVE	UNKNOWN	PRIVATE	STATE TRUST	USFS	FWP	UNKNOWN	15h	15l	15q
Big Cherry Creek	129.70	22.02	6.96	89.01	11.72	58.6	129.70	2.21	85	11	5	62	7	22	1	62			79	6	
Bristow Creek	71.46	1.44	22.11	39.81	8.11	23.4	71.46	3.06	60	2	22	29	7	1		59			60		
Dry Fork Creek	90.80	0.00	32.43	49.95	8.43	26.4	90.80	3.44	88		38	41	9	14		74			88		
Granite Creek	10.78	2.64	0.00	6.56	1.58	27.1	10.78	0.40	5	2		3		1		4			5		
Keeler Creek	160.11	9.84	15.96	104.53	29.77	44.8	160.11	3.58	148	9	17	88	34	12	1	135				148	
Little Wolf Creek	129.82	0.15	3.14	126.34	0.18	38.1	129.82	3.41	138	1	3	134		108	12	18			138		
Lower Lake Creek	130.75	27.71	15.65	84.18	3.22	40.2	130.75	3.25	79	17	12	49	1	57	2	20				79	
Lower Libby Creek	207.96	39.72	14.70	136.63	16.91	54.4	207.96	3.82	139	12	7	105	15	32	4	102	1		139		
Lower Wolf Creek	335.06	13.96	38.14	277.00	5.97	67.0	335.06	5.00	367	26	31	304	6	266	39	62			367		
Middle Wolf Creek	94.19	5.60	0.28	86.46	1.84	25.8	94.19	3.65	69	2		65	2	44		25				69	
Quartz Creek	106.34	0.00	25.63	74.46	6.25	35.8	106.34	2.97	92		28	55	9	7		85		1		91	
Raven Creek_sub6code	22.89	0.18	0.00	22.71	0.00	3.5	22.89	6.58	39	2		37		38		1			39		
Ross Creek	29.50	3.81	0.00	17.73	7.96	25.2	29.50	1.17	12	7		5		1		11				12	
Stanley	96.63	9.64	5.86	72.24	8.90	27.9	96.63	3.46	81	12	5	62	2	26		55				81	
Swamp Creek-Cowell Creek	135.90	7.41	9.84	116.23	2.42	27.0	135.90	5.03	136	11	13	111	1	56	1	79			136		
Upper Lake Creek_below Bull Lake	78.52	7.49	4.60	63.27	3.17	39.3	78.52	2.00	55	10	1	41	3	29		26				55	
Upper Lake Creek_above Bull Lake	39.06	9.28	1.43	27.25	1.11	20.2	39.06	1.93	27	7		20		25		2				27	
Upper Libby Creek	210.66	21.05	0.00	181.67	7.94	67.1	210.66	3.14	182	24		155	3	15	1	166			141	41	
Upper Wolf Creek	117.83	12.92	12.29	90.09	2.53	44.2	117.83	2.67	151	29	16	104	2	101		50			151		
Weigel Creek	37.20	0.00	12.95	23.53	0.71	14.7	37.20	2.53	36		15	20	1			36				36	
SUM:	2235.16	194.83	221.96	1689.64	128.73	710.76	2235.16	3.14	1989	184	213	1490	102	855	61	1072	0	1	1	1448	540

SUBWATERSHED	PARALLEL SEGMENT ROAD LENGTH (MILES)					LAND OWNER ROAD LENGTH (MILES)					ECOREGION IV ROAD LENGTH (MILES)		
	TOTAL PARALLEL ROADS	PAVED	GRAVEL	NATIVE	UNKNOWN	PRIVATE	STATE TRUST	USFS	FWP	UNKNOWN	15h	15l	15q
Big Cherry Creek	4.97	0.21	0.13	4.00	0.63	0.79		4.18				3.45	1.52
Bristow Creek	0.96		0.33	0.40	0.23			0.96				0.96	
Dry Fork Creek	1.98		0.56	1.09	0.34	0.55	0.06	1.38				1.98	
Granite Creek	0.19	0.01		0.13	0.06	0.12		0.07				0.19	
Keeler Creek	6.83	0.19	0.55	3.94	2.15	0.17	0.01	6.65					6.83
Little Wolf Creek	2.96	0.03	0.03		2.90	2.54	0.31	0.12				2.96	
Lower Lake Creek	7.02	2.45	1.38	3.16	0.04	5.36	0.12	1.55					7.02
Lower Libby Creek	5.24	0.14	0.08	4.62	0.40	2.99	0.26	1.93		0.07		5.24	
Lower Wolf Creek	13.92	4.26	1.97	7.60	0.10	8.52	2.77	2.63				13.92	
Middle Wolf Creek	2.15	0.21		1.94	0.01	1.62		0.53				2.15	
Quartz Creek	3.58		1.39	2.06	0.12	0.29		3.29					3.58
Raven Creek_sub6code	0.44			0.44		0.44						0.44	
Ross Creek	0.34	0.15		0.15	0.04	0.07		0.23	0.03				0.34
Stanley	3.65	0.64	0.24	2.75	0.01	1.25		2.40					3.65
Swamp Creek-Cowell Creek	8.91	3.15	0.22	5.54		5.62	0.00	3.29				8.91	
Upper Lake Creek_below Bull Lake	2.15	0.09	0.05	1.84	0.16	1.54		0.61					2.15
Upper Lake Creek_above Bull Lake	1.11	0.13		0.97		1.06		0.05					1.11
Upper Libby Creek	4.83	1.41		2.93	0.49	1.32	0.34	3.16				4.40	0.43
Upper Wolf Creek	4.55	0.70	0.04	3.76	0.05	2.64		1.90				4.55	
Weigel Creek	0.79		0.38	0.38	0.03			0.79				0.79	
SUM:	76.58	13.76	7.35	47.69	7.77	36.89	3.86	35.72	0.03	0.07	0.00	49.96	26.61