APPENDIX B - BITTERROOT RIVER WATERSHED DESCRIPTION

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B1.0 INTRODUCTION

This report describes the physical, ecological, and cultural characteristics of the Bitterroot River watershed. The characterization establishes a context for impaired waters to support total maximum daily load (TMDL) planning. The area described is known as the Bitterroot TMDL Planning Area (TPA), and is shown on **Map A-1** found in **Appendix A**.

The Montana Department of Environmental Quality (DEQ) has identified 18 impaired waterbodies (category 5) within the Bitterroot TPA: Ambrose, Bass, Lick, Lolo, McClain, Mill, Miller, Muddy Spring, North Burnt Fork, North Rye, Rye, Skalkaho, Sleeping Child, Sweathouse, Threemile, Tin Cup, and Willow Creeks and the Bitterroot River. The impairments total 303 miles of stream. The impairment listings are detailed in DEQ's Integrated 305(b)/303(d) Water Quality Report (Montana Department of Environmental Quality, 2010), and are shown on **Map A-1** found in **Appendix A**. Impairment listings are summarized in **Section 1.0** of the main document.

B2.0 PHYSICAL CHARACTERISTICS

B2.1 LOCATION

The TPA is located in the Pend Oreille River Basin (Accounting Unit 170102) of western Montana, and within the Bitterroot River (17010205) 4th code hydrologic unit. The Bitterroot River hydrologic unit is subdivided into three TMDL planning areas: Bitterroot Headwaters, Bitterroot, and Upper Lolo. This document considers only the latter two. The Upper Lolo TPA consists of the headwaters of Lolo Creek, and is the area above Lolo Hot Springs. The Bitterroot Headwaters TPA includes the watershed area south of Conner and above the confluence of the East and West Forks of the Bitterroot River, and is not addressed in this document.

The Bitterroot TPA is bounded by the Bitterroot Range to the west, the Sapphire Range to the east and the Beaverhead Range to the south. The total area is 1,210,740 acres, or approximately 1,891 square miles. Approximately 75% of the Bitterroot TPA is within Ravalli County, just under 25% in Missoula County, and a very small area is in Mineral County.

B2.2 ECOREGIONS

The TPA includes 3 Level III Ecoregions: Idaho Batholith (16), Middle Rockies (17) and Northern Rockies (15). Seven Level IV Ecoregions are mapped within the Bitterroot TPA (Woods et al, 2002), as shown on **Map A-2** in Appendix A. These include: Bitterroot-Frenchtown Valley (17s), Rattlesnake-Blackfoot-South Swan-Northern Garnet-Sapphire Mountains (17x), Glaciated Bitterroot Mountains and Canyons (16e), High Idaho Batholith (16h), Eastern Batholith (16a), Lochsa Uplands (16b) and Grave Creek Range-Nine Mile Divide (15a).

B2.3 TOPOGRAPHY

Elevations in the Bitterroot TPA range from 3,087 - 10,157 feet above mean sea level (**Map A-3 in Appendix A**). The lowest point is the confluence with the Clark Fork River. The highest point is Trapper Peak, in the Bitterroot Range on the western margin of the TPA. The TPA geography is characterized on the west by glacially sculpted U-shaped alpine valleys draining the Bitterroot Mountains and on the east by dendritic V-shaped valleys draining the Sapphire Mountains. Slopes (discussed further below) are generally 10 to 20 percent steeper in the Bitterroot Range than in the Sapphire Range. The Bitterroot Valley is roughly 10 miles across at the widest.

B2.4 GEOLOGY

Map A-4 (found in **Appendix A**) provides an overview of the geology, based on the 1:500,000 scale statewide map (Ross et al., 1955). This map is generalized and does not reflect much of the current understanding of the region's geology.

Bedrock

The bedrock of the TPA includes Precambrian metamorphic and metasedimentary rocks, Cretaceous and Tertiary igneous intrusions, and Tertiary volcanic rocks (Ross et al., 1955). Granitic rocks of the Idaho Batholith and similar igneous bodies dominate the Bitterroot Range and the Sapphire Range south of Skalkaho Creek. The distinctive slope of the range-front of the Bitterroot Mountains is a dip slope

formed on the foliation in the Bitterroot mylonite zone, a 500-1,500 meter (1,640-4,920 feet) thick shear zone on the edge of the Idaho Batholith (Renard et al., 1997). Metasedimentary rocks of the Precambrian Belt Series dominate the Sapphire Range north of Skalkaho Creek and most of the Lolo Creek watershed.

Valley Sediments

Valley sediments are divided into Tertiary sedimentary units and younger Quaternary deposits. There are two Tertiary units: alluvial deposits of the ancestral Bitterroot River, and the Sixmile Creek Formation, representing alluvial fan deposits shed from the Bitterroot and Sapphire Ranges. The ancestral Bitterroot River deposits record source areas and drainage patterns unrelated to the current geomorphology. These deposits are well-sorted cobble, gravel and sand beds, with local interbeds of silt and clay. The Sixmile Creek Formation, however, is generally unsorted boulders and cobbles in a sandy, silty clay matrix (Briar and Dutton, 2000). North of Corvallis, the eastern margin of the valley is underlain by Tertiary sedimentary deposits. Tertiary deposits are present on the western side of the valley from Victor northwards. Valley sediments reach a thickness of 3,000 feet near Hamilton (Kendy and Tresch, 1996). Later uplift caused the Bitterroot River and tributary streams to incise these deposits, isolating them above successive alluvial plains. This same mechanism has resulted in terraces of Quaternary alluvium in the valley bottom. Glacial deposits are more limited in extent, and are primarily found in terminal moraines at the mouths of glacial valleys on the western end of the valley. In general, the moraines are larger to the south, where the elevation is higher.

B2.5 SOILS

The U.S. Geologic Survey (USGS) Water Resources Division (Schwartz and Alexander, 1995) created a dataset of hydrology-relevant soil attributes, based on the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) State Soil Geographic (STATSGO) soil database. The STATSGO data is intended for small-scale (watershed or larger) mapping, and is too general to be used at scales larger than 1:250,000. It is important to realize, therefore, that each soil unit in the STATSGO data may include up to 21 soil components. Soils analysis at a larger scale should use NRCS Soil Survey Geographic (SSURGO) data. The soil attributes considered in this characterization are permeability, erodibility and slope.

Soil permeability is reported in inches per hour (weighted average across soil unit thickness), and is shown on **Map A-5** in Appendix A. Permeability varies widely across the TPA, from 0.44 to 13.79 inches per hour. The lowest permeability soils are mapped on the eastern benches, the flanks of the Sapphire Range and the Lolo Creek subwatershed. The highest permeability soils are mapped both along the base and the crest of the Bitterroot Range.

Soil erodibility is based on the Universal Soil Loss Equation (USLE) K-factor (Wischmeier and Smith, 1978). K-factor values range from 0 to 1, with a greater value corresponding to greater potential for erosion. Susceptibility to erosion is shown on **Map A-6** (Appendix A), with soil units assigned to the following ranges: low (0.0-0.2), low-moderate (0.2-0.29) and moderate-high (0.3-0.4). values of >0.4 are considered highly susceptible to erosion. No values greater than 0.33 are mapped in the TPA. Nearly half (49%) of the TPA is mapped with low susceptibility soils, and another 41% is mapped with low-moderate susceptibility. Nearly all of the moderate-high susceptibility soils correspond to the Tertiary benches and the foothills of the Sapphire Range. Susceptibility to erosion exhibits a loose inverse relationship to permeability.

A hydrologic soil group is indicative of the soils potential for runoff based on water infiltration of bare, thoroughly wet soil during a long duration storm (Natural Resources Conservation Service, Soil Survey Staff, 2008). There are four hydrologic soil groups: group A soils have a high infiltration rate and a low runoff potential, group B soils have a moderate infiltration rate / moderate runoff potential, group C soils have a slow infiltration rate and a moderate-high runoff potential, and group D soils have a very slow infiltration rate and a high runoff potential (Natural Resources Conservation Service, Soil Survey Staff, 2008). **Map A-7** (Appendix A) shows that the majority (80%) of the planning area is mapped with B soil types. The C type soils are limited to the modern floodplain and some portions of the eastern benches (3%). Many of the Quaternary sediments along the front of the Bitterroot Range are mapped as A type soils.

A map of slope is provided on **Map A-8** in Appendix A. Slope is mapped as averaged over soil units, in percent. Average slopes in the Bitterroot Range are roughly 10 to 20 percent steeper than slopes in the Sapphire Range.

B2.6 SURFACE WATER

Within the Bitterroot TPA, the Bitterroot River flows from the confluence of the East Fork and the West Fork of the Bitterroot River, to the confluence with the Clark Fork River, a distance of approximately 84 river miles. The Bitterroot Mountains contribute nearly four times as many tributary streams as the drier Sapphire Mountains (Briar and Dutton, 2000).

Stream Gaging Stations

The USGS maintains four gaging stations within the TPA, as detailed below in **Table B2-1**. An additional 18 stations were formerly present in the TPA but are now inactive. The USGS gaging are also shown on **Map A-9** in Appendix A.

Table B2-1. Stream Gages in the Bitterroot TPA

Name	Number	Drainage Area	Agency	Period of Record
Bitterroot River nr Missoula	12352500	2,814 miles2	USGS	1898-1904; 1989-
Bitterroot River nr Florence	12351200	2,354 miles2	USGS	1957-
Bitterroot River at Bell Crossing nr Victor MT	12350250	1,963 miles2	USGS	1987-
Bitterroot River nr Darby	12344000	1,049 miles2	USGS	1937-

Stream Flow

Stream flow within the TPA generally peaks in the late spring, declines in the summer, and remains stable through the winter (Briar and Dutton, 2000).

Stream flow data is based on records from the USGS stream gages described above, and is available on the Internet from the USGS (2010). Flows in the Bitterroot River and its tributaries vary considerably over a calendar year. Hydrographs summarizing flows at two stations (Darby and Missoula) are provided in **Figures A-1 through A-4** in Appendix A. The hydrographs are based on weekly mean flows over 72-year and 25-year periods of record.

Monthly mean discharges in the mainstem Bitterroot River vary over an order of magnitude. Statistically, flow peaks in June and is lowest in January. Annual peak flows occur almost exclusively (>97%) in May and June.

B2.7 GROUNDWATER

Hydrogeology

Groundwater is present in both valley and bedrock aquifers. Porosity in valley aquifers is determined by the type of sediment, with coarse-grained, well-sorted sediments (*e.g*. gravel, coarse sand) having the highest porosity. Porosity in bedrock aquifers is of two types: primary (interstitial spaces between sediment grains) and secondary (void space created by dissolution or structural deformation). Recharge of the valley aquifers occurs from infiltration of precipitation, seepage from irrigation canals, stream loss, and flow out of the adjacent bedrock aquifers. Bedrock aquifers are primarily recharged by infiltration of melting snow pack (Briar and Dutton, 2000).

Due to the importance of groundwater for drinking water and irrigation, several studies have been published on the hydrogeology of the Bitterroot Valley [*e.g.* (Kendy and Tresch, 1996) (Briar and Dutton, 2000)]. In general, there are two principal aquifers: the shallow alluvial aquifer and the deeper basin-fill aquifer composed of older sedimentary deposits. These aquifers are delineated based on their differing composition and location, but they are hydraulically connected.

The average groundwater flow velocity in the bedrock is probably several orders of magnitude lower than in the valley fill sediments. Bedrock groundwater flow is complicated by variability in lithology and geologic structures. However, carbonate and siliciclastic sedimentary rocks in the mountains may have zones of significant permeability. The hydrologic role of the structural geology (faults and folds) is uncertain. Faults may act as flow conduits or flow barriers.

Groundwater Quality

Briar and Dutton (2000) reported that groundwater in the Bitterroot Valley is predominantly of a calcium-bicarbonate character.

The Montana Bureau of Mines and Geology (MBMG) Groundwater Information Center (GWIC) program monitors and samples a statewide network of wells (MBMG, 2011). As of October 2009, the GWIC database reported 18,037 wells within the TPA. Water quality data are available for 103 of those wells. The water quality data include general physical parameters: temperature, pH and specific conductance, in addition to inorganic chemistry (common ions, metals and trace elements). MBMG does not analyze groundwater samples for organic compounds. The locations of these data points are shown on **Map A-10** in Appendix A.

There are 145 public water supplies within the TPA, all but 2 of which use groundwater for their supply. Pinesdale and Stevensville have surface water supplies. The majority of these are small transient, non-community systems (*i.e*. that serve a dynamic population of more than 25 persons daily). There are 38 community water systems within the TPA. Water quality data are available from these utilities via the Safe Drinking Water Information System (SDWIS) State database (DEQ, 2007), although these data reflect the finished water provided to the public, not the quality of water at the source.

B2.8 CLIMATE

The wettest months in the TPA are May and June. Annual average precipitation ranges from 13-83 inches in the Bitterroot TPA. The Bitterroot Mountains receive considerably more precipitation than the Sapphire Range. In a water resources study of water years 1939-1958 (Swenson, 1972) the USGS calculated that runoff from the western side of the valley is greater than that from the eastern side by a

factor of 4 (33.6 inches versus 7.8 inches).; **Map A-11** in Appendix A shows the distribution of average annual precipitation. The precipitation data are mapped by Oregon State University's PRISM Group, using records from National Oceanic and Atmospheric Administration (NOAA) stations (PRISM, 2010).

Climate Stations

The National Oceanic and Atmospheric Administration currently operate five weather stations in the TPA. See **Tables B2-2 through B2-6** for climate summaries from these stations. Climate data are provided by the Western Regional Climate Center, operated by the Desert Research Institute of Reno, Nevada.

The USDA Natural Resources Conservation Service operates four Snowpack Telemetry (SNOTEL) monitoring stations within the TPA. These sites include: Skalkaho Summit (13C03S), Daly Creek (13C39S), Twin Lakes (14C08S), and Twelvemile Creek (14C13S). **Map A-11** in Appendix A shows the locations of the NOAA and SNOTEL stations, in addition to average annual precipitation.

Table B2-2. Monthly Climate Summary: Stevensville

Stevensville, Montana (247894) Period of Record : 8/23/1911 to 7/31/2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	33.3	39.8	49.0	59.6	68.2	75.3	85.3	83.6	72.3	59.1	43.4	34.5	58.6
Average Min. Temperature (F)	15.2	19.1	24.6	30.6	37.4	44.0	47.3	45.3	38.3	30.6	23.3	17.0	31.1
Average Total Precipitation (in.)	1.05	0.83	0.77	0.83	1.49	1.62	0.84	0.92	1.08	0.87	1.06	1.08	12.44
Average Total Snowfall (in.)	6.8	5.1	3.7	0.3	0.1	0.0	0.0	0.0	0.0	0.2	2.6	5.1	23.9
Average Snow Depth (in.)	2	2	1	0	0	0	0	0	0	0	1	2	1

Table B2-3. Monthly Climate Summary: Western Ag Research Station

Western Ag Research Station, Montana (248783) Period of Record : 4/01/1965 to 7/31/2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	35.0	41.8	50.2	58.8	67.5	75.5	84.5	83.1	72.1	59.1	43.7	34.4	58.8
Average Min. Temperature (F)	18.1	21.5	26.5	31.6	38.4	45.0	49.3	47.8	40.5	32.0	24.2	17.5	32.7
Average Total Precipitation (in.)	0.74	0.49	0.65	0.96	1.63	1.57	0.84	1.06	1.03	0.73	0.68	0.71	11.11
Average Total Snowfall (in.)	1.9	1.7	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.3	7.2
Average Snow Depth (in.)	0	1	0	0	0	0	0	0	0	0	0	0	0

Table B2-4. Monthly Climate Summary: Hamilton

Hamilton, Montana (243885) Period of Record : 6/01/1895 to 7/31/2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	34.8	40.6	49.2	59.2	67.9	74.9	84.8	83.1	72.4	59.8	45.2	35.9	59.0
Average Min. Temperature (F)	16.7	20.2	26.3	32.8	39.6	45.9	50.4	48.8	41.5	33.2	25.0	18.4	33.2
Average Total Precipitation (in.)	0.97	0.79	0.77	0.87	1.58	1.68	0.80	0.86	1.08	0.90	1.03	0.98	12.32
Average Total Snowfall (in.)	7.4	5.1	4.0	0.7	0.3	0.0	0.0	0.0	0.0	0.3	3.3	5.2	26.3
Average Snow Depth (in.)	2	2	1	0	0	0	0	0	0	0	1	1	1

Table B2-5. Monthly Climate Summary: Darby

Darby, Montana (242221) Period of Record : 9/01/1898 to 7/31/2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	35.7	41.6	49.1	58.3	66.9	74.2	84.4	82.9	72.4	60.9	45.4	37.1	59.1
Average Min. Temperature (F)	17.5	20.8	25.6	31.3	37.8	43.6	47.8	46.3	39.7	32.9	25.1	19.3	32.3
Average Total Precipitation (in.)	1.43	1.14	1.07	1.07	1.79	1.92	0.89	0.98	1.26	1.14	1.63	1.43	15.75
Average Total Snowfall (in.)	8.7	9.2	5.7	1.7	0.3	0.0	0.0	0.0	0.2	1.0	4.9	8.4	40.1
Average Snow Depth (in.)	3	4	1	0	0	0	0	0	0	0	1	2	1

Table B2-6. Monthly Climate Summary: Lolo Hot Springs 2 NE

Lolo Hot Springs 2 NE, Montana (245146) Period of Record : 1-/01/1959 to 7/31/2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	32.2	38.8	43.5	53.3	64.6	72.7	83.1	81.6	70.8	55.8	40.7	32.3	55.8
Average Min. Temperature (F)	13.5	17.1	19.3	25.7	31.6	38.4	40.5	39.7	32.9	27.2	22.0	14.9	26.9
Average Total Precipitation (in.)	3.43	1.99	2.07	1.64	1.92	2.27	1.14	1.38	1.44	1.78	2.42	2.74	24.22
Average Total Snowfall (in.)	32.0	17.4	13.0	6.3	0.3	0.0	0.0	0.0	0.2	1.5	10.5	21.9	103.2
Average Snow Depth (in.)	14	13	10	1	0	0	0	0	0	0	1	6	4

B3.0 ECOLOGICAL PARAMETERS

B3.1 VEGETATION

The primary cover in the TPA is conifer forest. Spruce-Fir communities dominate in the Bitterroot Range. Lodgepole Pines are more common in the Sapphire Range. Land cover is shown on **Maps A-12 and A-13** in Appendix A. Data on vegetative cover is from the ReGAP project (Montana Natural Heritage Program,2009) and land use and land cover data are from the USGS National Land Cover Dataset (Homer et al.,2004).

B3.2 AQUATIC LIFE

Two fish species found in the TPA are of particular note. Bull trout, and to a lesser extent, westslope cutthroat trout, are viewed as an important indicator species for environmental disturbance, due to their specific requirements for spawning and rearing habitat and general sensitivity of each life history stage (Fraley and Shepard, 1989). Bull trout are designated "threatened" by the U.S. Fish and Wildlife Service (USFWS). Westslope cutthroat trout are designated "Species of Concern" by Montana Department of Fish, Wildlife and Parks (FWP). Within the TPA, the USFWS has designated 131 miles of stream as bull trout critical habitat. Critical habitat is designated in the Bitterroot River and in Blodgett, Burnt Fork, Fred Burr, Mill, Skalkaho, and Sleeping Child Creeks. Non-native brook, rainbow and brown trout are also present in the TPA.

Data on fish species distribution are developed and provided by FWP (Montana Department of Fish, Wildlife and Parks, 2010). Fish species distribution is shown on **Map A-14** in Appendix A.

B3.3 FIRES

The United States Forest Service (USFS) Region 1 office and the USFS remote sensing applications center provide data on fire locations from 1940 through 2009. Large areas of the TPA have burned within the last two decades, particularly in the Sapphire Range. The Bear and Coyote fires of 2000 burned much of the southeastern portion of the TPA, an area that includes the headwaters of Skalkaho Creek and much of the drainages of Sleeping Child and North Fork Rye Creeks. Fire history is shown in **Map A-15** in Appendix A.

B4.0 CULTURAL PARAMETERS

B4.1 POPULATION

An estimated 68,000 persons lived within the TPA in 2000 (NRIS, 2002). Nearly half (33,093) of that population is reported from Missoula County, which includes portions of Missoula and its southern suburbs. Some of the population is concentrated in or near the towns and unincorporated communities: Hamilton, Lolo, Stevensville, Grantsdale, Florence, Victor, Pinesdale, Darby, Corvallis and Woodside. These communities had a cumulative population of 13,584 in the 2000 census. The remaining population is distributed across the valley floor. Much of the TPA is unpopulated. Population estimates are derived from census data (United States Census Bureau, 2000), based upon the populations reported from census blocks with centroids within the TPA boundary. Census data are shown in **Map A-16** in Appendix A.

B4.2 LAND OWNERSHIP

Land ownership data are provided by the Montana Natural Heritage Program via the Natural Resources Information System (NRIS) website (2010) and are shown on **Map A-17** in Appendix A and in **Table B4-1**. The dominant landholder is the USFS, which administers 57% of the Bitterroot TPA, mostly in the higher elevations. Private land is extensive. Individual private smallholdings comprise 33.5% of the Bitterroot TPA; the Plum Creek Timber Company owns another 7% of the TPA.

Table B4-1. Land Ownership

Owner	Acres	Square Miles	% of Total
US Forest Service	686,580	1,072.78	56.6%
Private	406,469	635.11	33.5%
Plum Creek Timber Co.	81,288	127.01	6.7%
Montana State Trust	24,537	38.34	2.0%
Montana FWP	8,956	13.99	0.7%
US FWS	2,677	4.18	0.2%
Water-reserved/withdrawn by federal agency	1,485	2.32	0.1%
City Government	242	0.38	<0.1%
US Dept of Defense	29	0.05	<0.1%
Montana Dept of Transportation	13	0.02	<0.1%
Five Valleys Land Trust	6	0.01	<0.1%
BLM	5	0.01	<0.1%
Water-navigable (MT DNRC)	1	0.00	<0.1%

B4.3 LAND USE AND LAND COVER

Land cover within the Bitterroot TPA is dominated by evergreen forest. Information on land use is based on the USGS National Land Cover Dataset (2000). The data are at 1:250,000 scale. Land use is illustrated on **Map A-13** (Appendix A) and **Table B4-2**.

Table B4-2. Land Use and Land Cover

Land Use	Acres	Square Miles	% of Total
Evergreen Forest	642,101	1,003.28	52.9%
Grassland Herbaceous	198,789	310.61	16.4%
Shrubland	150,409	235.01	12.4%
Pasture/Hay	99,571	155.58	8.2%
Bare Rock	55,032	85.99	4.5%
Small Grains	28,574	44.65	2.4%
Woody Wetlands	8,458	13.22	0.7%
Transitional	6,499	10.15	0.5%
Water	5,294	8.27	0.4%
Fallow	4,322	6.75	0.4%
Emergent Herbaceous Wetlands	4,292	6.71	0.4%
Commercial/Industrial/Transportation	2,903	4.54	0.2%
Deciduous Forest	2,418	3.78	0.2%
Low Intensity Residential	1,904	2.98	0.2%
Row Crops	919	1.44	0.1%
Mixed Forest	767	1.20	0.1%
Urban/Recreational Grass	424	0.66	0.03%
High Intensity Residential	208	0.33	0.02%
Perennial Ice and Snow	100	0.16	0.01%

Irrigation and Dams

A substantial quantity of streamflow within the Bitterroot River watershed is diverted and used for irrigation throughout the valley. **Map A-18** in Appendix A shows locations of irrigation diversions and dams within the TPA, and also chronically dewatered streams.

B4.4 TRANSPORTATION NETWORKS

Transportation networks (road and railroads) are illustrated on **Map A-19** in Appendix A.

Roads

The principal transportation routes in the TPA are US Highways 93 and 12. Highway 93 runs the length of the Bitterroot Valley, and Highway 12 runs along Lolo Creek. The network of unpaved roads on public and private lands will be further characterized as part of the sediment source assessment in **Section 5.0**.

Railroads

An active Montana Rail Link railway extends from Missoula to Darby. Information on traffic and use is not available.

B4.5 MINING

The TPA's mining history is described in DEQ's Abandoned Mine Lands historical narratives (MDEQ,2009). Mining never became as prominent in the Bitterroot Valley as in other watersheds in western Montana. Abandoned and inactive mines are present, but at relatively low density. Placer mines were not significantly productive, and neither were subsequent lode mines. The most significant

mining district within the TPA was the Woodman or Lolo district, located in the Lolo Creek subwatershed. Abandoned mine inventory locations are plotted on **Map A-20** in Appendix A. Lode mines are nearly absent in the Bitterroot Range, with the exception of the Bass Creek and Lolo Creek drainages.

B4.6 TIMBER HARVEST

The Bitterroot TPA contains portions of both the Bitterroot and Lolo National Forests. Within the Bitterroot portions of the national forests, a total of 3,986 timber harvests have occurred between 1906 and 2007. The total acreage harvested during this time was 88,228 acres. Timber harvests have ranged in size from a low of an acre to a high of 468 acres. **Map A-21** in Appendix A shows the majority of timber harvests have occurred in the northeastern and southwestern portions of the planning area.

Timber harvests peaked in the 1960s and 1970s. Approximately 59% (52,431 acres) of the total timber harvests within the Bitterroot TPA took place during these two decades (**Table B4-3**). Additional timber harvest may also have occurred on private lands, though no data are available for those areas.

Table B4-3. Timber Harvest on USFS lands

Decade	Acreage
1906-1910	242
1935 -1940	84
1941-1950	479
1951-1960	4,573
1961-1970	29,887
1971-1980	22,544
1981-1990	15,940
1991-2000	10,594
2001-2007	3,885

B4.7 WASTEWATER

The communities of Hamilton, Lolo, Stevensville, Victor, Darby and Corvallis are sewered. Hamilton, Lolo, Stevensville and Darby systems discharge to surface water. These discharges are permitted under the Montana Pollution Discharge Elimination System (MPDES). **Table B4-4** shows the MPDES permitted facilities within the TPA, including general stormwater permits for industrial and mining activities.

The Victor wastewater treatment system consists of lagoons, and sludge is land applied at agronomic uptake rates and therefore does not need a Montana Ground Water Pollution Control System (MGWPCS) permit. The Corvallis wastewater treatment systems consist of a wetland system, aerated lagoons and infiltration ponds that discharge to groundwater and therefore is required to have an active MGWPCS permit.

As of June 2010, there are seven active or pending MGWPCS groundwater discharge permits for human waste disposal within the TPA (**Table B4-5**). These include the Corvallis wastewater treatment plant, five subdivisions (Wildflower, Falcon Estates, One Horse Estates, Hawks Landing and Grant Addition) and Peak Health & Wellness Center.

Multiple-user systems have 3-14 connections, serve fewer than 25 persons and are not regulated via the MGWPCS unless they are aerobic package plant systems, mechanical treatment plants, and nutrient removal systems, which require a high degree of operation and maintenance or systems which require monitoring pursuant to ARM 17.30.517(1)(d)(ix). The DEQ Subdivision Review Section database records 16 multiple-user wastewater treatment systems that were approved since 2000. Records are not available for earlier approvals.

Outside of the sewered communities, wastewater treatment and disposal is via septic system drainfields. DEQ estimates that the TPA includes ~18,000 residential septic systems. The estimate is based upon a GIS layer of residential structures. The highest densities are clustered south of Missoula, and around Lolo and Hamilton. Other population centers such as Grantsdale, Darby, Woodside, Victor, Stevensville, and Florence corresponded to increased density of septic systems, as compared with the "background" density of 11-50 drainfields per square mile across much of the valley. Septic system density and permitted wastewater discharge locations are shown on **Map A-22** in Appendix A.

Table B4-4: Active MPDES Permits in the Bitterroot TMDL Planning Area

Permit Type	MPDES No	County	Facility	Receiving Stream
WWTP – Individual	MT0020028	Ravalli	City of Hamilton WWTP	Bitterroot River
WWTP – Individual	MT0020168	Missoula	Lolo WWTP	Bitterroot River
WWTP – Individual	MT0022713	Ravalli	Stevensville WWTP	Bitterroot River
WWTP – General (sewage treatment lagoon)	MTG580011	Ravalli	Town of Darby WWTF	Bitterroot River
Industrial Stormwater (Fabricated Metal)	MTR000069	Ravalli	Selway Corporation	Flood Irrigation Ditch (Summer only)
Industrial Stormwater (Prefab Wood Bldgs)	MTR000260	Ravalli	Alpine Log Homes	Bitterroot River
Industrial Stormwater (Used Motor Vehicle Parts)	MTR000264	Ravalli	Truck Parts Unlimited	Bitterroot River
Industrial Stormwater (Airports)	MTR000399	Ravalli	Ravalli County Airport	Gird Creek
Industrial Stormwater (Sawmill & Planing Mill)	MTR000406	Ravalli	J & R Planing Inc	Tie Chute Creek
Mining Stormwater (Construction Sand & Gravel)	MTR300074	Missoula	JTL Group Inc - Pattee Canyon Pit	Pattee Creek
Mining Stormwater (Construction Sand & Gravel)	MTR300173	Missoula	Stan Billingsley - Billingsley Placer Mine	Lolo Creek
MS4*	MTR040007	Missoula	City of Missoula	Bitterroot River*

* Only a portion of the Missoula Municipal Separate Storm Sewer System (MS4) permit discharges within the TPA and to the Bitterroot River

Table B4-5: Active Groundwater Permits in the Bitterroot TPA			
MPDES No	**County**	**Facility**	**Permit Status**
MTX000122	Ravalli	Corvallis County WWTF	Effective
MTX000142	Ravalli	Bitterroot Land Co – Wildflower Subdivision	Effective
MTX000163	Ravalli	Kearns Properties LLC – Grantsdale Addition	Effective
MTX000166	Ravalli	Falcon Estates Subdivision	Effective
MTX000170	Ravalli	Kootenai Creek Village	Effective
MTX000185	Missoula	Bitterroot Resort WWTP	Pending
MTX000208	Ravalli	One Horse Estates Sewer System	Effective
MTX000209	Ravalli	Hawk's Landing Homeowners Assoc. – Community Septic System	Pending
MTX000213	Missoula	Peak Health and Wellness Center	Effective

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