APPENDIX A

WATER QUALITY AND HYDROLOGY REPORT

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1.0 INTRODUCTION AND BACKGROUND

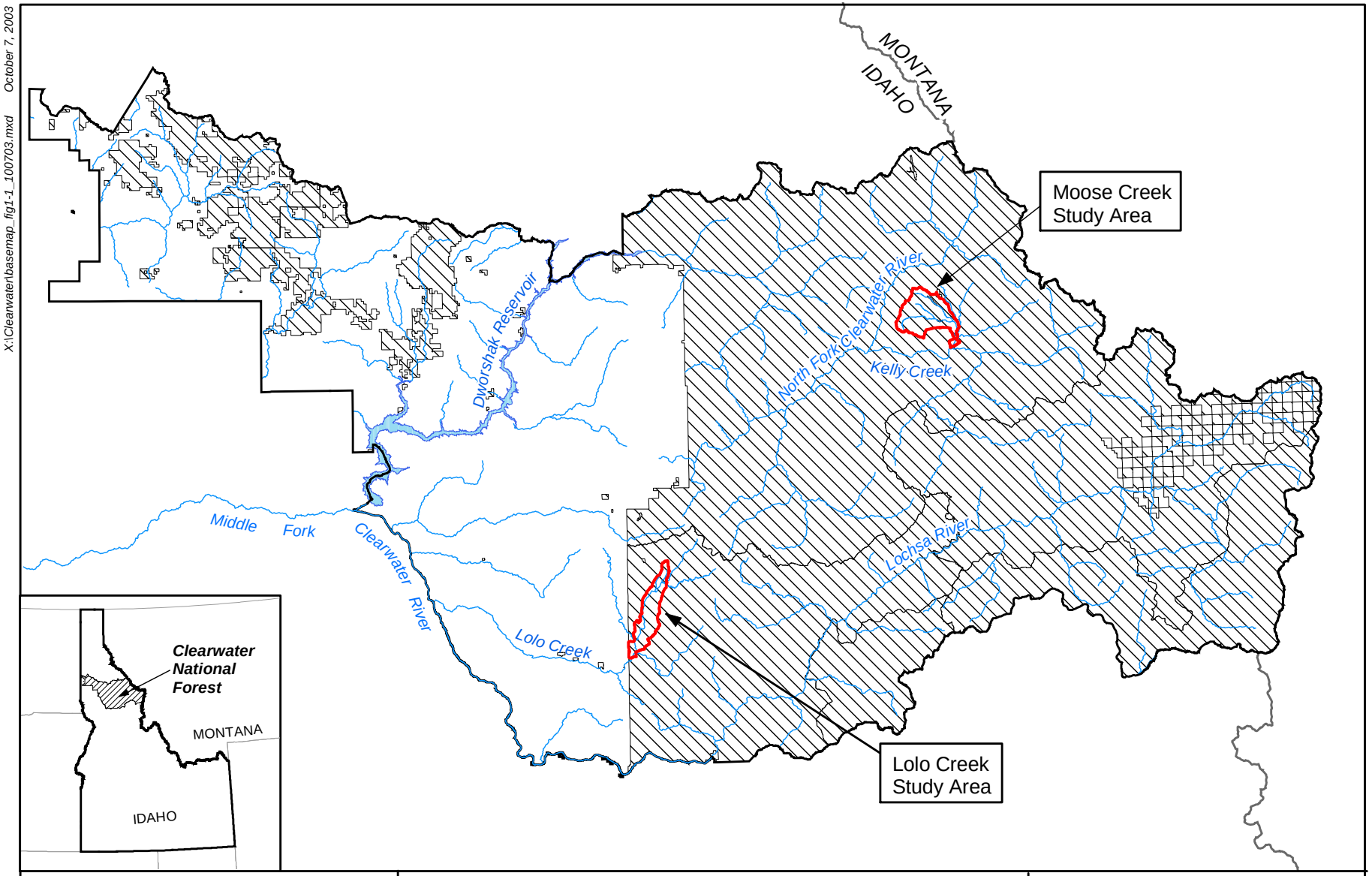
The Clearwater National Forest is a geographically diverse area in central Idaho that contains occurrences of gold, silver, antimony and copper. Since the 1860s, placer gold mining has occurred in rivers and streams across the Forest. Two of the more productive streams, Lolo Creek and Moose Creek (including two Moose Creek tributaries, Independence Creek and Deadwood Creek), have had sporadic mining activity over the years. Figure 1-1 depicts locations of the Lolo and Moose Creek drainages within the Clearwater National Forest. With the rise in prices in the 1970s, both streams experienced a renewed interest in prospecting for gold. It was also around this time that prospectors started using suction dredges to explore and mine instream gravels. While the numbers who actually mine varies from year to year, miners have established and maintained 17 placer mining claims on Lolo Creek and 26 claims on Moose Creek within the Clearwater National Forest. The claims were made under the Mining Law of 1872 and Forest Service regulations at 36 CFR Part 228. Lolo Creek and Moose Creek are most frequently mined by part-time, small-scale operations using suction dredges with nozzles from two to five inches in diameter and gasoline-powered pumps.

Until the late 1990s, Lolo Creek and Moose Creek miners conducted their suction dredge operations under Forest Services Regulations (40 CFR Part 228) by notifying the Forest of their activities through a Notice of Intent (NOI). In 1997, steelhead trout were listed as a threatened species within the Snake River drainage under the Endangered Species Act (ESA). In 1998, bull trout were also listed as a threatened species within the Snake River drainage.

In a 2002 Biological Assessment (BA) completed by the Forest for Lolo Creek (United States Forest Service [USFS] 2002a), the determination was made that suction dredging was "likely to adversely affect" steelhead trout, but was "not likely to adversely affect" Lolo Creek bull trout. In a BA for Moose Creek (USFS 2002b), the Forest determined that suction dredging was "likely to adversely affect bull trout"[1]. In their respective Biological Opinions (BOs), the National Marine Fisheries Service (NOAA 2003) and the United States Fish & Wildlife Service (USFWS 2003) agreed with the Forest's determinations. Both agencies further concluded that suction dredging would not jeopardize either species if specific conservation measures minimizing impacts to streams and minimizing take were adopted.

[1] Steelhead are not listed in Moose Creek because their upstream migration was blocked by a downstream dam and so they are not present.

Because approving small-scale suction dredging action may adversely affect species listed as threatened or endangered under the Endangered Species Act, the Forest Service has determined that an Environmental Impact Statement (EIS) must be prepared in accordance with the National Environmental Policy Act (NEPA) to evaluate and disclose the potential environmental impacts that would be associated with approving suction dredging in the Lolo Creek and Moose Creek drainages, and of feasible alternatives.



Lolo Creek and Moose Creek Study Areas

Clearwater National Forest Boundary

Clearwater National Forest Land and Wilderness Areas

Surface Water

FIGURE 1-1

Lolo Creek and Moose Creek Study Areas Within the Clearwater National Forest

0 5 10 20

Miles

NAD 1983 UTM Zone 11N

N

X:\Clearwater\basemap_fig1-1_100703.mxd October 7, 2003

This report was prepared to provide an analysis of available baseline data concerning hydrology and water quality within the Lolo Creek and Moose Creek drainages. The purpose of this report is to provide detailed data and analysis to support the preparation of the Environmental Impact Statement (EIS) to evaluate effects on hydrology and water quality from the proposed action and alternatives. The report was prepared using available reports, information, and data supplied by the Clearwater National Forest. Section 2 of this report describes current conditions (i.e. the affected environment) of these watersheds and Section 3 of this report analyzes potential impacts that would be associated with the proposed alternatives.

2.0 AFFECTED ENVIRONMENT

2.1 Lolo Creek

2.1.1 Watershed Description

Lolo Creek is a major tributary to the Middle Fork Clearwater River, near Greer Idaho. The size of the Lolo Creek watershed from its mouth is 243 square miles, with 42 square miles being above Musselshell Creek (USFS 2003a). The watershed ranges in elevation from 1,098 feet at its mouth and 2,775 feet at the U.S. Forest Service Boundary, to 6,051 feet at its headwaters (Clearwater Biostudies, Inc. 1998). Parts of Lolo Creek were placer mined in the 1970s and early 1980s. This was associated with the Lolo #5 mining claim and was called the Collette Mine. This site has not been reclaimed.

Beneficial uses listed for the Clearwater River are domestic water supply, cold-water biota, salmonid spawning, primary contact recreation, and special resource waters. (Idaho Department of Environmental Quality [IDEQ] 2000). The State of Idaho has not listed beneficial uses for Lolo Creek. Beneficial uses listed in the Forest Plan for the Lolo Creek watershed are steelhead trout and cutthroat trout (USFS 1987). Water Quality Limited Segments (WQLS) are streams where the State of Idaho has identified water quality concerns. Lolo creek below Eldorado Creek is listed as not supporting designated uses for bacteria, dissolved oxygen, flow alteration, habitat alteration, nutrients, oil and grease, sediment, and temperature (IDEQ 1999). This is well downstream of the project area for the EIS; there are no WQLS-listed stream segments within the Lolo Creek project area for the EIS.

Tributaries within the Lolo Creek project area include Nevada Creek, Mike White Creek, White Creek, Utah Creek, Siberia Creek, and Dutchman Creek. Intermittent streams are rare as most streams are perennial that emerge near ridges. The drainage density within the Lolo Creek watershed is 4.1 miles of stream per square mile (USFS 2002c). The Lolo Creek drainage above Musselshell Creek has had timber harvested on 42 percent of the area since 1954. About 218 miles of roads have been constructed, creating an average density of 5.2 miles of road per square mile (USFS 2002c). Grazing allotments have been managed on approximately 20 percent of the watershed, primarily at the lower elevations, and past wildfires have occurred on 3,800 acres, approximately 47 percent of the watershed.

Clearwater National Forest resource hydrology and fisheries specialists analyzed the Clearwater watershed condition for hydrologic integrity in 1997 (USFS 2003a). Lolo Creek was rated as having a “moderate” condition (USFS 2002d). A “high” condition is defined as a watershed having a robust condition in which no long-term changes occur even with major storm events. These watersheds have stable drainage networks and are in a desired functional condition. A watershed with a “moderate” condition is not meeting the requirements of a watershed in a “high” condition but still maintains a dynamic equilibrium and is functioning within its geomorphic threshold. Moderate watersheds often have higher levels of instream sediment, but the stream network remains stable. Most of the streams in the Lolo Creek drainage were rated moderate because of relatively high levels of cobble embeddedness (i.e. relatively high levels of sediment surrounding stream cobbles and bedrock).

2.1.2 Climate

Precipitation within the Lolo Creek watershed is driven by Aleutian Low and Pacific High maritime air masses (USFS 2003a). Aleutian lows that are prevalent in winter bring periods of heavy precipitation as snow and spring rains. Rain on snow events are common, and these can cause flooding. The summer climate is driven by predominant Pacific highs causing hot, dry weather. Precipitation during this period often occurs as short-term, high intensity thunderstorms. Although there are no precipitation or SNOTEL stations in the watershed, the Clearwater National Forest has estimated average annual precipitation to be 40 inches per year with over half the annual precipitation contributing to stream flow (USFS 2003a).

2.1.3 Geomorphology

The Lolo Creek watershed above Musselshell creek has moderate topographic relief. Generally, land types are rated moderate to high for sediment delivery efficiency, and many stream channels are moderately to extremely sensitive to changes in flow and sediment (USFS 2003a). Sediment deliverery efficiencies in this watershed are relatively high because of a relatively high drainage density; especially in first and second order streams higher in the watershed, and distance to stream channels are relatively short. This means that sediment generated on hillsides and steep slopes does not have long distances to travel to stream channels.

USFS (2003a) reports that these are basically historical processes that can be considered as “background" effects, and are ongoing whether there are human activities or not. Management actions such as road construction, timber harvest, and fire suppression do not add new processes to the existing natural forces; they may, however, change their frequency and magnitude.

Lolo Creek has predominantly B3 and C3 channel types as defined by the Rosgen (1994) method (USFS 2002c). In general, Type B channels are dominated by riffles with some reaches containing “rapids” and infrequently spaced scour-pools at bends or areas of constriction. Type C channels have lower gradients and are dominated by riffle/pool systems. The numbers given to the stream types generally describe the material making up the channel substrate such that 1 is bedrock, 2 is boulder, 3 is cobble, 4 is gravel, 5 is sand and 6 is silt/clay (Rosgen 1994).

Studies conducted by the Clearwater National Forest in 1998 showed that Lolo Creek had an average gradient of 2.0 percent (USFS 2002c). Results of these studies are provided in Table 2-1. Channel stability was rated “good” on 22 reaches and “fair” on 15 reaches. Mean channel stability for the 37 reaches is 77.1 or “fair”. The mean stream bank stability rating was 4.9 in 1993 and 4.7 in 1998. The overall decrease in stable stream banks was attributed to high flows in 1995 and 1996 (USFS 2002c). The survey identified one area (Reach LO-34) where past mining activities caused a substantial decrease in bank stability. Lolo Creek Reach LO-34 is unstable due to localized activities that occurred at the Collett Mine. In this reach, unstable stream banks have increased from 56 to 418 meters per kilometer. All reaches, except LO-34 are stable, however cobble embeddedness levels (i.e. the amount of sediment surrounding cobbles and bedrock in the substrate) exceed Desired Future Condition (DFC) of 30 to 35 percent as defined by the Forest Service. Cobble embeddedness in 1993 was 44.7 percent and in 1998 was

42.8 percent. Cobble embeddedness levels in Lolo Creek are associated with natural geomorphic conditions and past management activities such as road construction (USFS 2002c).

Numerous monitoring studies have been conducted by Clearwater National Forest to evaluate sediment levels and particle size distributions in the substrate of Lolo Creek. Wolman pebble counts (Wolman 1954) were collected in the summer of 1998 in Lolo Creek below Yoosa Creek, above White Creek and below Nevada Creek (USFS 2002c). The Wolman pebble count data were collected in three riffles in each reach, representing over 600 individual particle size measurements for each reach. In addition, cores were abstracted from the deeper substrate of the creek and also analyzed for particle sizes. Figure 2-1 depicts combined results from the pebble counts and subsurface cores showing the percent distribution for several particle size classes. Percent distribution is shown by size class and as an accumulated percentage. These data show a normal distribution of particle sizes in the surface substrate for all three reaches. This distribution is typical of channels that are geomorphologically stable with only moderate levels of substrate sediment. An evaluation of Figure 2-1 shows that particle sizes making up less than 2 mm or less are approximately 12 percent of the surface substrate and 13 percent of the subsurface substrate. The United States Department of Agriculture defines particle sizes between 2 mm and 0.05 mm as sand and particle sizes between 0.05 mm and 0.002 mm as silt (Brady 1974). These data indicate that a very small amount of the substrate material consists of sands, silts, and clays, while a majority of the material is made up of larger gravels, cobbles and rock.

2.1.4 Stream and Sediment Discharge

Clearwater National Forest applied a flow-sediment yield model (WATBAL) to evaluate potential effects from the proposed White-White timber sale in upper Lolo Creek above Musselshell Creek in 2002 (USFS 2002c). The WATBAL model was used to predict the relative differences in sediment yields that occur naturally, based on land-types and management activities. Based on WATBAL, the Lolo Creek watershed (above Musselshell Creek) has 40 inches of precipitation annually (86,278 acre-feet) and 18 inches of runoff (38,192 acre-feet) (USFS 2002c). The watershed efficiency is 44 percent, which is common for forested montane stream systems. Natural sediment production was estimated at 6 tons per square mile per year. This would be considered the average rate of erosion and sediment transport through a natural system.

The Forest Plan standard for Lolo Creek is a C channel type, steelhead high fishable stream (USFS 1987). The approximate maximum sediment loadings that generally support this criterion are 50 percent over natural. According to the Forest Plan standard, sediment production can be between 35 percent and 50 percent for 10 out of 30 years. Sediment production should be at or below 35 percent over natural for 20 out of 30 years. Current sediment production in Lolo Creek was 44 percent over natural in 2002 and exceeded 35 percent over natural for 17 out of 30 years. Therefore, Lolo Creek does not meet the Forest Plan sediment standard (USFS 2002c).

In 2002, Equivalent Clearcut Acres (ECA) was 11.5 percent in the upper Lolo Creek watershed, but Clearwater National Forest indicates that this level is declining (USFS 2002c). WATBAL showed a peak flow increase of five percent over natural for 2002. This is less than the level of

15 to 20 percent that is considered to be potentially detrimental to the stream system. WATBAL predicted no accumulated sediment in Lolo Creek from road construction and logging activities. However, sediment does accumulate behind log weirs that have been placed in the creek to improve fishery habitat, but were not designed to pass sediment.

Stream discharge, suspended sediment, turbidity, and bedload have been monitored at the Section 6 Bridge on Lolo Creek since 1986. Results show low levels of suspended sediment and turbidity with no significant trend over time (Table 2-2). These turbidity data represent nearly 1,000 samples collected since 1986, all of which remain below the State turbidity standard of 50 NTU. These data show that sediment production in Lolo Creek is meeting State water quality standards and beneficial uses for steelhead and cutthroat trout as listed in the Forest Plan for the Lolo Creek watershed (USFS 1987).

Bedload is a measurement of sediment and larger size particles that move by saltation (i.e. jumping), rolling, or sliding along the stream bottom. Bedload can be added to the suspended load to determine the total sediment load for a stream. A total of 141 bedload samples have been taken at the Lolo Creek Section 6 Bridge monitoring station between 1980 and 2002. Table 2-3 shows average monthly stream discharge, suspended sediment concentration, suspended sediment load, bedload and total sediment load. These data show the relationship between stream discharge and the total transport of sediment throughout the year. Peak stream discharge occurs in April and May with peak total sediment loads ranging between 11,665 pounds per day (lbs/day) in April and 12,378 lbs/day in May. Total sediment load is reduced approximately 10 fold with lower stream flows later in the water year. The average total sediment load for July is 1,780 lbs/day and 957 lbs/day in August. These data further show that a majority of the total sediment load is suspended. The bedload ranges between 5 percent and 48 percent of the total sediment load. Relationships between mean monthly stream discharge and sediment load are depicted in Figure 2-2.

The relationship between stream discharge and sediment transport, depicted in Figure 2-2, is related to stream velocity. There are several factors, such as channel width, depth, and slope that determine the velocity of a stream at any given flow rate and at any given point. However, the velocity of the water flowing in a stream generally increases with increasing stream flow.

Increasingly higher velocities are required to entrain (i.e. dislodge) suspend and transport increasingly larger sizes of sediment material. As flow velocity decreases, sediment particles settle out according to size. At low velocities the stream only has enough energy to keep very fine sediments (i.e. silts and clays) suspended. Sand and larger fractions drop out to the channel substrate.

A relationship between stream discharge and stream velocity near the Section 6 monitoring station was estimated using channel cross-section information provided by USFS (2003c). This relationship is shown in Table 2-4 and Figure 2-3.

2.2 Moose Creek, Independence Creek, and Deadwood Creek

2.2.1 Watershed Description

Moose Creek is a major tributary of lower Kelly Creek located within the upper North Fork Clearwater River drainage (Figure 1-1). Independence Creek and Deadwood Creek are two major tributaries of Moose Creek within the study area. The size of the Moose Creek watershed from its mouth is 66 square miles (USFS 1994). The Independence Creek and Deadwood Creek watersheds are 5.4 and 3.4 square miles, respectively. Both Deadwood Creek and Independence Creek were heavily placer mined in the 1930's and 1940's. Both dredging and hydraulic mining were employed. Moose Creek has been dredged mined above Independence Creek for approximately three miles and from the mouth to approximately two miles above the Deadwood Creek confluence.

Beneficial uses listed for the Clearwater River are domestic water supply, agricultural water supply, cold-water biota, salmonid spawning, primary contact recreation, secondary contact recreation, and special resource waters (IDEQ 2000). Beneficial uses listed in the Forest Plan for the Moose Creek and Deadwood Creek watersheds are cutthroat trout (USFS 1987). Cutthroat trout are also known to occur in Independence Creek. Water Quality Limited Segments (WQLS) are streams where the State of Idaho has identified water quality concerns. There are no WQLS listed stream segments within the project area for the EIS.

<u>Deadwood Creek</u>

Past activities in the Deadwood Creek watershed include mining, road building, and timber harvest. Mining was primarily in the floodplain and activities such as dredging and the use of flash dams for hydraulic mining altered channel characteristics, channel stability and substrate composition. An analysis conducted by Clearwater National Forest in 1994 showed that the Deadwood Creek watershed had a road density of 2.3 miles per square mile (USFS 2003b). Many of the roads were built using inslope construction which impacted the natural drainage and sediment delivery of the watershed. Intermittent timber harvesting conducted from 1968 through 1977 and timber regeneration cut acres total 600 acres, which amounts to 29 percent of the watershed (USFS 1994a).

<u>Independence Creek</u>

Past activities in the Independence Creek watershed include mining, road building, and timber harvest. Mining was primarily in the creek itself and the floodplain adjacent to the creek and its tributaries. Activities such as dredging and the construction of stream diversions altered channel characteristics and channel stability (USFS 1994). USFS (1994) showed that the Moose Creek watershed had a road density of 5.9 miles per square mile. Many of the roads were constructed using inslope construction which impacted the natural drainage and sediment delivery of the watershed. Sediment is delivered to first and second order streams from eroding cutslopes, ditches, and from road surfaces. A diversion that was built to divert water from the East to the West Fork of Independence Creek causes significant erosion from hillslopes cut during construction. Tree harvesting within riparian areas reduced potential large woody debris,

decreasing the ability to store and trap sediment. Timber harvesting and broadcast burning began in 1959 and continued until 1982 (USFS 1994). There were intermittent timber harvests and timber regeneration cuts on 2,370 acres, which amounts to 68% of the watershed.

Moose Creek

Most activities in the Moose Creek watershed were in the Osier, Deadwood and Independence Creek watersheds. However, dredge mining occurred from the mouth to approximately two miles above the Deadwood Creek confluence. The dredge mining greatly impacted the channel, which continues to show the effects. Streambanks remain unstable and a majority of the original channel substrate has been sorted and moved by the dredge activities. USFS (1994) reports that the one major road adjacent to Moose Creek has not disrupted the natural drainage of the watershed. There is a total of 158 miles of road at a density of 2.2 miles per square mile (USFS 1994). Timber harvesting and broadcast burning was also conducted in the Moose Creek watershed between 1959 and 1982 (USFS 1994). A total of 4,853 acres were clearcut (10.4 percent of the watershed).

2.2.2 Climate

Specific climate information for the Deadwood, Independence, and Moose Creek watersheds is not available. However, similar to the Lolo Creek watershed, precipitation would be driven by Aleutian Low and Pacific High maritime air masses (USFS 2003a). Aleutian lows that are prevalent in winter bring periods of heavy precipitation as snow and spring rains. Rain on snow events are common which can cause flooding. The summer climate is driven by predominant Pacific highs causing hot, dry weather. Precipitation during this period often occurs as short-term, high intensity thunderstorms. There are no precipitation or SNOTEL stations in these watersheds. However, the Clearwater National Forest has estimated average annual precipitation of 40 inches per year for the Lolo Creek watershed (USFS 2003a). The average annual precipitation for the Moose Creek watersheds can be expected to be similar to that of Lolo Creek or slightly higher because much of the watershed occurs at higher elevations.

2.2.3 Geomorphology

Deadwood Creek

The Deadwood Creek watershed is primarily made up of the following land types: glaciated lands, colluvial and frost-churned uplands, and fluvial lands (USFS 1994).

Glaciated lands are characterized by steep, high elevation, rocky peaks and ridges that were shaped by glaciation. Slopes are frequently above 60 percent. Cirque basins are common above 5,500 feet. Streams range from being weakly entrenched in bedrock with moderately steep gradients to gentle, weakly entrenched low gradient streams in valley floors.

Many streams originate in *colluvial and frost-churned uplands* and are located on debris above bedrock with moderately steep gradients. This land group sustains stream flow from ground

water throughout the year. Water yields average 60 to 85 percent of precipitation at higher elevations and 40 to 75 percent at lower elevations.

Fluvial lands geomorphologically represent a progression from the higher relief landforms with generally seep gradient streams to lower relief, rolling hill-type topography. Streams in this land type have low gradients and meandering channels are common.

Deadwood Creek has predominantly B3 and B4a channel types as defined by the Rosgen (1994) method (USFS 1994). In general, Type B channels are dominated by riffles with some reaches containing "rapids" and infrequently spaced scour-pools at bends or areas of constriction. The numbers given to the stream types generally describe the material making up the channel substrate such that 1 is bedrock, 2 is boulder, 3 is cobble, 4 is gravel, 5 is sand and 6 is silt/clay (Rosgen 1994). The letter "a" denotes a creek with a gradient above 4 percent. Studies conducted on two reaches within the stream rated Deadwood Creek as having "fair" stability (USFS 1994) and low levels of cobble embeddedness (USFS 1995).

Data are not available describing the particle size distribution of the substrate within Deadwood Creek. However, past activities would suggest that a relatively higher proportion of the substrate could be fine sediments (those by definition that are less than 4 mm in size) as compared to an undisturbed watershed with similar geology. USFS (1994) indicates that Deadwood Creek is an energy limited system, suggesting that sediments produced in the watershed would have a tendency to fall out and collect in the bottom of the channel until high flow events occur. However, the low levels of noted embeddedness, may suggest that fine sediments have been transported out of the stream from large flow events.

Independence Creek

The Independence Creek watershed is dominated by colluvial and frost-churned uplands, and fluvial lands (USFS 1994). The general geomorphologies of these land-types were described for Deadwood Creek above.

Independence Creek has stream reaches with a broad range of types as defined by the Rosgen (1994) system (USFS 2002c). Stream reaches have been surveyed to have the following range of types: A2, A4, A5, A6, B3, B4, B5, G5 and G6, with many reaches denoted with the letter "a" indicating a stream with a gradient above 4 percent. These stream types are described in Table 2-5. Studies conducted on twenty reaches within the stream rated Independence Creek as having "fair" to "poor" stability (USFS 1994) and moderately high levels of cobble embeddedness (USFS 1995).

Data are available from one cross section describing the particle size distribution of the substrate within Independence Creek (USFS 2003b). Figure 2-4 depicts results from pebble counts showing the percent distribution for several particle size classes. Percent distribution is shown by size class and as an accumulated percentage. These data show a moderately high proportion of the substrate consists of fine sediments in the 0-2 mm size class. These data confirm probable impacts from past activities, such as mining and timber harvests. USFS (1994) further indicates that Deadwood Creek is an energy limited system. This suggests that fine sediments produced in

the watershed would have a tendency to fall out and collect in the bottom of the channel until high flow events occur. Studies conducted on two reaches within the stream rated Independence Creek as having "fair" stability (USFS 1994) and low levels of cobble embeddedness (USFS 1995).

Moose Creek

The Moose Creek watershed is dominated by glaciated lands, colluvial and frost-churned uplands, and fluvial lands (USFS 1994). The general geomorphologies of these land-types were described for Deadwood Creek above.

Two stream reaches surveyed by Clearwater National Forest both show Moose Creek with a B3 channel type as defined by the Rosgen (1994) system (USFS 1994). Type B channels are dominated by riffles with some reaches containing "rapids" and infrequently spaced scour-pools at bends or areas of constriction. The number 2 denotes a substrate that is predominately composed of boulders. Studies conducted on these two reaches within the stream rated Moose Creek as having "fair" stability (USFS 1994) and low levels of cobble embeddedness (USFS 1995).

Data are available from two reaches describing the particle size distribution of the substrate in Moose Creek (USFS 2003b). These reaches were surveyed using the Wolman pebble count method (Wolman, 1954). One surveyed reach was on Moose Creek near the mouth and one reach was surveyed above the Independence Creek confluence. Figure 2-5 depicts results from pebble counts showing the percent distribution for several particle size classes. Percent distribution is shown by size class and as an accumulated percentage. These data show a moderately high proportion of the substrate consists of fine sediments in the 0-2 mm size class. These data confirm probable impacts from past activities, such as mining and timber harvests. However, USFS (1994) indicates that Moose Creek is an energy surplus system. This suggests that fine sediments produced in the watershed would have a tendency to be transported out of the watershed. An energy surplus stream also has the potential to impact channel morphology through scouring of the bed and erosion of the banks during very high flows.

2.2.4 Stream and Sediment Discharge

Clearwater National Forest applied a flow-sediment yield model (WATBAL) to evaluate sediment yields and hydrologic response of the Moose Creek watershed including the Deadwood Creek and Independence Creek tributaries (USFS 1994). The WATBAL model is designed to simulate the potential and most likely effects of forest management practices, such as timber harvest, road construction, or fire on watershed hydrology and sediment yield.

Deadwood Creek

Based on WATBAL, sediments produced in the Deadwood Creek watershed from logging and road construction tend to deposit in the channel. Natural sediment production was estimated at 18 tons per mile per year (USFS 1994). This would be considered the average rate of erosion and sediment transport through an undisturbed natural system. The sediment yield from the

watershed was 9 percent over "natural" in 1994 and 5 percent over "natural" projected for 2003 (USFS 1993a)

The Forest Plan standard for Deadwood Creek is a B channel type, cutthroat high fishable stream (USFS 1987). The approximate maximum sediment loadings that generally support this criterion are 55 percent over "natural". Nine percent is below the Forest Plan standard that must be met for sediment production 10 out of 30 years. Sediment production should be at or below 35 percent over natural for 20 out of 30 years. Based on this analysis, Deadwood Creek is currently meeting goals established by the Forest Plan.

In 2003, Equivalent Clearcut Acres (ECA) was 5.3 percent in the Deadwood Creek watershed. WATBAL showed a peak flow increase of 3 percent over natural for 2003 (USFS 1994). This is less than the level of 15 to 20 percent that is considered to be potentially detrimental to the stream system (USFS 2003d).

Stream discharge, suspended sediment, turbidity, and bedload were studied on Deadwood Creek in 1981 (USFS 1993b). Table 2-6 provides average monthly data. Bedload is a measurement of sediment and larger size particles that move by saltation (i.e. jumping rolling, or sliding along the stream bottom. Bedload can be added to the suspended load to determine the total sediment load for a stream. These limited data show relatively a moderately high levels of total sediment load in June (1,031 lbs/day) and July (1045 lbs/day) and low levels in August (9.6 lbs/day). Turbidity levels ranged between 0.7 and 1.9 Nephelometric Turbidity Units (NTU) which is well under the State turbidity standard of 50 NTU. Turbidity data show that sediment production in Lolo Creek is meeting State water quality standards. These 1981 data represent a worse-case scenario for Deadwood Creek as stream discharge was at its highest above "natural" according to the WATBAL model (USFS 1994). Relationships between mean monthly stream discharge and sediment load are depicted in Figure 2-6.

Independence Creek

Based on WATBAL, sediments produced in the Independence Creek watershed from logging and road construction tend to deposit in the channel, and surveys conducted noted high amounts of fine sediments in the channel (USFS 1994). Natural sediment production was estimated at 17 tons per square mile per year (USFS 1994). This would be considered the average rate of erosion and sediment transport through an undisturbed "natural" system. The sediment yield from the watershed was projected to be 33 percent over "natural" for 2003. USFS (1993b) reports that the 43 percent value was a large reduction in the amount of sediment yields that WATBAL estimated for the 1960s and 1970s, thus concluding that impacts associated with road construction and timber harvesting had mostly subsided.

The Forest Plan standard for Independence Creek is a B channel type, cutthroat moderate fishable stream (USFS 1987). The approximate maximum sediment loadings that generally support this criterion are 150 percent over natural. The 33 percent level is well below the Forest Plan standard that must be met for sediment production 10 out of 30 years. Based on this analysis, Independence Creek is currently meeting goals established by the Forest Plan.

The Equivalent Clearcut Acres (ECA) was 14 percent in the Independence Creek watershed in 2003. WATBAL showed a peak flow increase of 8 percent over natural for 2003. This is less than the level of 15 to 20 percent that is considered to be potentially detrimental to the stream system (USFS 2003d).

Stream discharge, suspended sediment, turbidity, and bedload were studied on Independence Creek in 1981. Average monthly data are provided in Table 2-7. These limited data show relatively high levels of total sediment load in June (1,441 lbs/day) and July (667 lbs/day) and low levels in August (27 lbs/day). Turbidity levels range between 1.1 and 5.2 NTU and are well under the State turbidity standard of 50 NTU above background. Turbidity data show that sediment production in Lolo Creek is meeting State water quality standards. These 1981 data represent a worse-case scenario for Independence Creek as stream discharge was at its highest above "natural" according to the WATBAL model (USFS 1994). Relationships between mean monthly stream discharge and sediment load are depicted in Figure 2-7.

Moose Creek

Based on WATBAL, sediments produced in the Moose Creek watershed from logging and road construction tend to be transported out of the watershed because of a relatively high energy system (USFS 1994). Natural sediment production was estimated at 15 tons per square mile per year (USFS 1991). This would be considered the average rate of erosion and sediment transport through an undisturbed "natural" system. The sediment yield from the watershed was projected to be 0 percent over "natural" in 2003. USFS (1994) reports that the 0 percent value was a large reduction in the amount of sediment yields that WATBAL estimated for the 1960s.

The Forest Plan standard for Moose Creek is a B channel type, cutthroat high fishable stream (USFS 1987). The approximate maximum sediment loadings that generally support this criterion are 55 percent over "natural". The 0 percent level is well below the Forest Plan standard that must be met for sediment production 10 out of 30 years.

The Equivalent Clearcut Acres (ECA) was 4.8 percent in the Moose Creek watershed in 2003. WATBAL showed a peak flow increase of 3 percent over natural for 2003. This is less than the level of 15 to 20 percent that is considered to be potentially detrimental to the stream system.

Stream discharge, suspended sediment, turbidity, and bedload were monitored on Moose Creek between 1979 and 1981. Average monthly values are presented in Table 2-8. These data show relatively low levels of suspended and total sediment load for most months. Turbidity levels range between 0.7 and 4.3 NTU and are well under the State turbidity standard of 50 NTU above background. Turbidity data show that sediment production in Lolo Creek is meeting State water quality standards. Relationships between mean monthly stream discharge and sediment load are depicted in Figure 2-8.

The relationship between stream discharge and sediment transport, depicted in Figure 2-8, is related to stream velocity. There are several factors, such as channel width, depth and slope that determine the velocity of a stream at any given flow rate and at any given point. However, the velocity of the water flowing in a stream generally increases with increasing stream flow.

Increasing higher velocities are required to entrain (i.e. dislodge) suspend and transport increasingly larger sizes of sediment material. As flow velocity decreases, sediment particles settle out according to size. At low velocities the stream only has enough energy to keep very fine sediments (i.e. silts and clays) suspended. Sand and larger fractions drop out to the channel substrate.

A relationship between stream discharge and stream velocity for a reach near the mouth of Moose Creek was estimated using cross-section survey data provided by USFS (2003e) and Manning's equation. This relationship is shown in Table 2-9 and Figure 2-9.

3.0 ENVIRONMENTAL CONSEQUENCES

3.1 Description of Alternatives

This section summarizes the alternatives selected for detailed consideration.

3.1.1 Alternative 1: No Action Alternative

The "no action" alternative is required by regulation in 40 CFR 1502.14(d). It is used, in part, to compare against the action alternatives to determine the effects of not implementing an action alternative. For purposes of this EIS, the No Action Alternative is defined as not approving proposed plans of Plans of Operations. Under this alternative, miners who submit Plans of Operations for suction dredging in Lolo Creek and Moose Creek would not receive approval for their plans of operations. No suction dredging would be allowed under the mining law or under any other authorization. This alternative could not be implemented under current law, including the Mining law of 1872, and violates Forest Service regulations at 36 CFR 228A. However, this alternative provides a comparable environmental baseline against which to evaluate effects of the action alternatives. This is consistent with and legal under NEPA, which allows for analysis of alternatives that are not allowed under current law or regulations but that are valuable for exploring the range of effects.

Under this alternative, there would continue to be approximately the same level of traffic on Forest roads and approximately the same level of dispersed camping and other recreational activities.

3.1.2 Alternative 2: Proposed Action

Clearwater National Forest proposes to approve, with no further NEPA analysis, proposed Plans of Operation in specified reaches of Lolo Creek and Moose Creek (including two tributaries, Independence Creek and Deadwood Creek) if the operator agrees to specified operating conditions and mitigation measures as described below. The maximum number of operations approved in any year under this analysis is assumed to be 18 for Lolo Creek and 38 for Moose Creek. These numbers correspond with the maximums listed in the USFWS and NOAA Fisheries Biological Opinions (USFWS 2003 and NOAA Fisheries 2003). Proposed operations exceeding the maximums will require reinitiation of consultation with USFWS and NOAA Fisheries and separate NEPA analysis.

The terms and conditions (T&C) with which proposed plans of operations have to comply in order to qualify for approval under the proposed action are listed below:

1. Operations may occur only below the ordinary high water line during a dredge season extending from July 1 through August 15.

2. The suction dredge may have a nozzle diameter of 5 inches or less and a horsepower rating of 15 horsepower or less.

3. Dredge sites must be located in areas of large substrate not preferred for spawning steelhead trout and bull trout.

4. If streambanks are disturbed in any way, they must be restored to the original contour and revegetated.

5. Prior to dredging, operators must meet with a Forest Service fisheries biologist who will inspect the proposed dredge sites. No dredging will be allowed in areas of known bull trout (or steelhead, in the case of Lolo Creek) spawning or in areas identified as spawning habitat.

6. Operators may not move cobbles in the stream course to the extent that the deepest and fastest portion of the stream channel (the thalweg) is altered or moved.

7. Operators must cease activities during wet periods when project activities are causing excessive ground disturbance or excessive damage to roads.

8. All human waste must be kept more than 200 feet away from any live water. All refuse from dredging activities must be packed out and disposed of properly.

9. Mechanized equipment may be operated below the mean high water mark except for the dredge itself and any life support system necessary to operate the dredge. No mechanized equipment other than the suction dredge may be used for conducting operations.

10. Dredging must be conducted in a manner so as to prevent the undercutting and destabilization of stream banks, and may not otherwise disturb streambanks.

11. Dredging may not dam the stream channel.

12. Operators must maintain a minimum spacing of at least 100 linear feet of stream channel between suction dredging operations.

13. Dredges may not operate in the gravel bar areas at the tails of pools.

14. Dredges may not operate in such a way that fine sediment from the dredge discharge blankets gravel bars.

15. Operators must visually monitor the stream for 300 feet downstream of the dredging operation after the first half hour of continuous operation. If noticeable turbidity is observed downstream, the operation must cease immediately or decrease in intensity until no increase in turbidity is observed 300 feet downstream.

16. Dredges must not operate in such a way that the current or the discharge from the sluice is directed into the bank in a way that causes erosion or destruction of the natural form of the channel, that undercuts the bank, or that widens the channel.

17. Operators may not undermine, excavate, or remove any stable woody debris or rocks that extend from the bank into the channel.

18. Operators may not remove, relocate, or disturb stable in-stream woody debris or boulders greater than 12 inches in diameter.

19. Gasoline and other petroleum products must be stored in spill-proof containers at a location that minimizes the opportunity for accidental spillage.

20. The suction dredge must be checked for leaks, and all leaks repaired, prior to the start of operation. The fuel container used for refueling must contain less fuel than the amount needed to fill the tank. The suction dredge must be on stilts or anchored to the stream bank when refueling while afloat, so that the distance over which fuel must be carried over water is minimized. Unless the dredge has a detachable fuel tank, operators may transfer no more than one (1) gallon of fuel at a time during refilling. Operators must use a funnel while pouring, and place an absorbent material under the tank while refueling to catch any spillage. A spill kit must be available in case of accidental spills. If soil is contaminated by spilled petroleum products, the soil must be excavated to the depth of saturation and removed from the National Forest for proper disposal.

21. All dredge piles must be broken down and all dredge holes must be backfilled by the end of the operating season, no later than August 15.

22. Dredging operations must be shut down immediately if fish eggs are excavated, if sick, dead, or injured steelhead or bull trout are observed, or if destruction of redds is observed. Operators must contact the Clearwater National Forest and receive authorization to proceed prior to resuming operations. Operators must record the date, time, location, and possible cause of fish injury or death. Also, operators must notify the Forest if any emergency or unanticipated situation arises that may be detrimental to bull trout relative to suction dredging.

23. Camping areas, paths, and other disturbed sites that are located along stream banks and that are associated with dredge operations must be revegetated or otherwise restored to their original conditions at the end of the dredge season.

24. Dredging operations must be shut down immediately if the operator observes bull trout in either creek or steelhead in Lolo Creek. The operation must remain shut down until the fish move out of the area, to a point at least 100 feet upstream of the operation or at least 500 feet downstream.

25. Operators must obtain and comply with all required permits, including the Idaho State Permit to Alter a Stream Channel, and comply with all required conservation measures and Best Management Practices.

26. Intakes must be screened with 3/32 mesh.

27. Dredging operations must take place during daylight hours.

28. Shallow areas must be restored to their original grade each day and natural pools may not be filled. Tailings must be redistributed to avoid creating unstable spawning gravels.

29. If operators encounter mercury in dredged material, it may not be returned to the active stream channel or disposed of on Forest Service lands. Operators must cease operations and notify the Forest if more than two droplets of mercury are discovered during the dredging process. Operators may not use mercury, cyanide, or any other hazardous or refined substance to recover or concentrate gold.

30. At the end of the operating season, no later than September 15, the operator must provide Clearwater National Forest a description of the actual location(s) of the operation, the surface areas dredged, and the number of days operated.

Other components of the proposed action, which also are based on terms and conditions required to implement the reasonable and prudent measures in the Biological Opinions, involve monitoring by the Forest Service and reporting to USFWS and NOAA Fisheries. Specific monitoring and reporting that will be implemented by the Forest Service include the following:

1. Monitor active operations and the impact of mining on fish habitat in each creek at least five times during the mining season.

2. Monitor changes in stream morphology as a result of mining through specific measures specified in the Biological Opinion.

3. Upon notice by an operator under item 22 above of dead, injured, or sick bull trout, or of the destruction of redds, notify USFWS Division of Law Enforcement and the Snake River Basin office within 24 hours.

4. Upon notice by an operator under item 22 above of dead or injured steelhead, or if eggs are excavated, notify NOAA Fisheries Law Enforcement Office in the Vancouver Field Office, and the Grangeville Field Office, prior to authorizing a resumption of dredging.

5. Inspect dredged areas after all dredging activities have been completed for the season.

6. Provide written report or letter to USFWS, within 90 days of the end of each dredging season, indicating the actual number of bull trout taken, if any, and any relevant biological/habitat data or other pertinent information on bull trout that was collected.

7. Provide annual monitoring report, by November 30, to NOAA Fisheries that describes operator compliance with suction dredging rules, the amount of stream area mined at each site, a photo of the mined area, and details about streambank disturbance and revegetation, if any.

8. Provide NOAA Fisheries an update of pre-season monitoring no later than June 15, and a report on post-season monitoring progress no later than September 15.

Under this proposed action, a claimant or operator would submit to the District Ranger a proposed Plan of Operations that included all 30 of the terms and conditions above. The proposed plan would provide site-specific information sufficient for the District Ranger to determine that the terms and conditions of the proposed action are adequate for protection of surface resources on that specific site.

If the District Ranger determines that the proposed plan of operations meets the conditions described above and they are sufficient to protect surface resources on that site, the plan of operations could be approved with no further NEPA analysis. If the Ranger determines that the plan of operations does not meet these conditions, the District Ranger would not approve the plan of operations pending revisions to the plan or completion of a separate NEPA analysis on that plan. Any separate NEPA analysis would require a separate Endangered Species Act §7 consultation with USFWS and/or NOAA Fisheries.

Plan approval would be in effect for the duration of the operating season, as long as the operation is conducted within the terms and conditions. A new plan of operations would have to be submitted and approved for each operation before each mining season.

3.1.3 Alternative 3: Suction Dredging and Stream Improvement Projects

This alternative is the same as alternative 2, except that it includes two specific mitigation projects.

The first project involves bank stabilization and reclamation of the abandoned Lolo #5 mining claim on Lolo Creek. Lolo #5 was placer mined by backhoes and dozers into the late 1970s, and the site was never reclaimed. The mining also caused Lolo Creek to be rerouted from its original floodplain and channel. Stockpiled overburden and bermed placer tailings along the creek have remained unstable and continue to be a major contributor of fine sediment to the stream system. Studies conducted by the Clearwater National Forest in 1998 showed unstable stream banks had increased from 56 to 418 meters per kilometer since being surveyed in 1993 (USFS 2002a). The mitigation project would stabilize and reclaim approximately 260 meters of Lolo Creek, and would include the following components.

- Regrade and reclaim existing placer tailings away from the current channel to provide stable non-erodable slopes and to blend the local landscape into existing topography.

- Regrade and reclaim existing placer tailings away from existing emergent wetlands that have formed in parts of the old channel and prevent erosion of materials into these wetlands.

- Rehabilitate and restore the existing creek to provide stable banks and a new channel that is geomorphologically and hydraulically stable and provides suitable aquatic habitat, and provides riparian vegetation along stream banks. This may include rerouting the channel

to provide increased meandering, lower the existing gradient and regrading to provide a functional floodplain.

The second project would involve installation of a fish-friendly drainage device or ford with concrete planking where there is now a ford where Forest Road 5440 crosses Independence Creek. Road 5440 is a native surfaced local Forest road used to access the mining claims along Moose and Independence Creeks. The present Independence Creek crossing is a ford that is a potential fish barrier and also a source of sediment to downstream Independence Creek and Moose Creek.

3.2 Environmental Consequences Associated with Each Alternative

This section discusses potential impacts to hydrology, channel morphology and water quality for each alternative.

3.2.1 Hydrology and Stream Discharge

Alternative 1: No Action

Hydrologic conditions, such as water yield, peak runoff and annual sediment yield within any watershed are a function of land use activities and management. Land use activities and management goals are specified within the guidelines of the Forest Plan (USFS 1987) and would not change as a result of any alternative. These conditions would remain the same under the No Action alternative as well as for all alternatives. Not approving small-scale suction dredging would not affect stream flow or annual sediment yield within the Lolo Creek or Moose Creek watersheds. There would continue to be an elevated sediment yield from the Lolo #5 mining claim on Lolo Creek, and from the unimproved road crossing on Independence Creek.

Alternative 2: Proposed Action

Hydrologic conditions, such as water yield, peak runoff and annual sediment yield within any watershed are a function of land use activities and management. Watershed conditions and management would remain the same under the Proposed Action alternative as under the No Action alternative. Suction dredging would not introduce sediment to or increase sediment in the Lolo Creek or Moose Creek study areas but rather would relocate it by removing it from the substrate, passing it through the suction dredge, and replacing it into the creek, where it would settle out within a short distance. Thus, allowing approval of small-scale suction dredging plans of operations would not affect the amount of stream flow, water yield, or annual sediment yield produced in either the Lolo Creek or Moose Creek watersheds.

Alternative 3: Suction Dredging and Stream Improvement Projects

Potential impacts from suction dredging under this alternative would be the same as under Alternative 2. During construction, there would be a temporary increase in sediment yield from the Lolo#5 project on Lolo Creek. These would be reduced by the use of standard construction

erosion control and runoff practices. Over the longer term, there would be a permanent reduction in sediment yield from this reach of Lolo Creek.

Similarly, in Independence Creek construction of a properly designed ford or crossing structure would increase sediment during construction. After completion of construction, the newly improved crossing would slightly reduce sediment yield in Independence Creek from current levels.

3.2.2 Stream Geomorphology

Alternative 1: No Action

Channel geomorphologic conditions would be expected to be unchanged under the No Action alternative. Not approving small-scale suction dredging would decrease the likelihood of impacts to the channel substrate or channel condition. However, minor impacts to channel banks, and channel conditions that result from other small-scale uses such as fishing, camping, wading, or swimming would still occur.

The terms and conditions (i.e. mitigation measures) for the proposed action stipulate that the creek can not be dammed, large woody debris and large boulders can not be moved, tailings can not be piled on banks or in a manner that stream flow is directed into a bank, and that all displaced substrate materials be replaced after dredging activities. Although these conditions would prevent any significant impacts to the stream channel, potential impacts from these activities would be completely negated under the No Action alternative

Bank stabilization and reclamation proposed for the abandoned Lolo #5 mining claim on Lolo Creek would not be conducted under the No Action alternative. Unstable banks in the area would remain the same providing an exposed source of sediments to the creek. The channel in the area of the claim would remain channelized which can result in increased channel scour both upstream and downstream of the site. These impacts can propagate over time, affecting additional lengths of the channel each year.

Installation of a drainage device or ford with concrete planking at the Forest Road 5440 crossing on Independence Creek would not be conducted under the No Action alternative. The present road crossing is a ford that is a potential fish barrier and also a source of sediment to downstream Independence Creek and Moose Creek caused by localized scouring of the channel. Improperly designed or unstable road crossings can locally affect stream channel morphology. These effects cause erosion of the channel bottom or channel banks. In time, changes to channel morphology can be propagated both up and downstream until the stream comes back into equilibrium.

Alternative 2: Proposed Action

In-stream structures, such as large boulders and large woody debris, provide local stability to a channel. These structures control stream gradient, flow direction, or produce localized pools or cover for fish. Removal of large boulders or other large structures can locally affect the energy

and direction of stream flow and cause the channel to change over the long term by eroding the channel bottom or channel banks. In time, these changes can be propagated both up and downstream until the stream comes back into equilibrium. The terms and conditions (i.e. mitigation measures) for the proposed action stipulate that the creek can not be dammed, large woody debris and large boulders can not be moved and tailings can not be piled on banks or in a manner that stream flow is directed into a bank. Long-term impacts to channel morphology would not be expected if large structures are not moved in the channel.

Suction dredging typically involves dredging one or several cone-shaped holes in the streambed, with the excavated material then placed in a pile or placed into a previously dredged hole. A single hole typically involves removal of one or a few cubic yards of material. Small-scale suction dredging would cause impacts to localized areas of the channel bottom by moving substrate materials, and some redirection of stream flow could result from moving and piling bottom materials in the channel. While dredging activities would cause a temporary disruption of channel substrate materials, the terms and conditions (condition 21) state that all displaced substrate materials must be replaced after dredging activities are completed. In addition, the Forest Service will monitor all active sites at least five times during the mining season, and again after reclamation is complete, to monitor potential changes in morphology. If these stipulations are followed, impacts would be temporary and not result in long-term alteration of the channel morphology or stream equilibrium.

The bank stabilization and reclamation proposed for the abandoned Lolo #5 mining claim on Lolo Creek and the installation of a drainage device or ford with concrete planking at the Forest Road 5440 crossing on Independence Creek would not be conducted under the Proposed Action alternative. Long term impacts would be the same as those discussed for the No Action alternative.

Alternative 3: Suction Dredging and Stream Improvement Projects

The bank stabilization and reclamation proposed for the abandoned Lolo #5 mining claim on Lolo Creek and the installation of a drainage device or ford with concrete planking at the Forest Road 5440 crossing on Independence Creek would be conducted under this alternative.

The bank stabilization activities would directly reduce bank erosion, which alters the stream channel morphology and sedimentation of the creek. Restoration of the stream channel to match expected stream gradients, natural pool-riffle ratios and channel sinuosity would mitigate impacts associated with increased stream flow velocities and channel erosion that are associated with the current channelized condition.

Installation of a properly design and stable ford or drainage culvert system at the Forest Road 5440 crossing on Independence Creek would reduce or eliminate the current channel erosion and sedimentation that is associated with the current crossing.

3.2.3 Water Quality

Alternative 1: No Action

Any potential impacts that could be associated with the accidental spills or discharge of wastes or chemicals to the stream from suction dredging activities would be completely negated under the No Action Alternative. Accidental spills of chemicals or wastes near or in streams could still potentially occur from activities associated with other uses of the area.

The terms and conditions (i.e. mitigation measures) for the proposed action are designed to prevent or minimize the contamination of the creek from the spill of chemicals, wastes or other agents. Although these conditions would prevent any significant impacts to the stream channel, accidental spills associated with these activities would be completely negated under the No Action alternative.

Fine sediment and turbidity levels in Lolo, Deadwood, Independence and Moose Creeks would be expected to remain low under the No Action alternative. The local sediment delivery to the stream channels would be unchanged. Dredging sites are usually located near established campgrounds with their associated pullouts or access roads and additional road construction would not be conducted or allowed under the proposed alternative. Therefore, fine sediment and ground disturbance associated with camping activities and vehicular traffic due to suction dredging activities would not be expected to be significantly reduced over those associated with recreational activities such as fishing, hunting, hiking and camping.

Regrading and stabilization of the tailing materials and disturbed areas at the Lolo #5 mining claim would not be conducted under the No Action alternative. Exposed sediment sources from pile dredge tailings and overburden materials would remain and provide localized delivery of sediments to Lolo Creek. Erosion of unstable stream banks would continue to be a source of sediment to the creek.

Installation of a drainage device or ford with concrete planking at the Forest Road 5440 crossing on Independence Creek would not be conducted under the No Action alternative. The present road crossing is a ford that is a potential fish barrier and is also a source of sediment to downstream Independence Creek and Moose Creek. Localized scouring of the channel and the resulting increases in sediment and turbidity would remain unchanged.

Alternative 2: Proposed Action

Potential impacts to water quality could result from accidental spills of chemicals or wastes near or in the streams by suction dredge operators. A number of the terms and conditions for the proposed action are designed specifically to prevent or minimize spills, including conditions intended to keep refuse and human wastes away from water (condition 8), to ensure fuels are stored and used safely (conditions 19 and 20), to prohibit the use of hazardous or refined substances to recover gold (condition 29), and to avoid dispersal of any mercury encountered in old dredged material (condition 29). These conditions will prevent any significant impacts from

spills, and Forest Service inspections under this alternative would ensure that operators are following the stipulated conditions.

Suction dredging that would be approved under this alternative occurs in the confines of the stream channel (condition 1) and does not result in the discharge of any new sediment to the creeks. The suction dredge pulls stream sediment, gravel and small rocks, and other materials (collectively, the "overburden") from the stream bottom, along with any gold. All this material is routed through a sluice box, which channels the water and other material over a series of riffles that serve to create pockets of slow water immediately behind each riffle -- the heavier material, including any gold, settles behind the riffles and the rest goes directly back into the stream. Dredging can entrain and discharge fine sediments from the stream bed material and increase turbidity[2] in the stream immediately downstream of the discharge point. Idaho DEQ requires that background turbidity levels not be increased by more than 50 NTU[3] instantaneously or 25 NTU for more than 10 days (IDEQ 2000). The degree that turbidity is increased by dredging is expected to be highly variable and dependent on the amount of very fine sediments (i.e. silts and clays) that occur in the bed material and the velocity of the stream flow. As discussed in Chapter 3, the size and amount of sediment that can be carried by a stream is related to the stream flow velocity.

Suction dredging occurs in the confines of the stream channel and does not result in the discharge of any new sediment to the creek. The suction dredge pulls stream sediment, gravel and small rocks, and other materials (collectively, the "overburden") from the stream bottom, along with any gold. All this material is routed through a sluice box. The sluice box channels the water and other material over a series of riffles that serve to create pockets of slow water immediately behind each riffle -- the heavier material, including any gold, settles behind the riffles and the rest goes directly back into the stream.

Dredging can entrain (i.e. release) fine sediments from the stream bed material and locally increase turbidity in the stream. Turbidity results from an increase of suspended fine sediment that reduces water clarity. The State of Idaho standard states that background turbidity levels can not be increased by more than 50 NTU instantaneously or 25 NTU for more than 10 days (IDEQ 2000). The degree that turbidity is increased by dredging is highly variable and is dependent on the amount of very fine sediments (i.e. silts and clays) that occur in the bed material and the

[2] Turbidity results from an increase of suspended fine sediment that reduces water clarity.

[3] As noted in Chapter 3, Nephelometric Turbidity Units are measures of turbidity that result from a photogrammetric method of measuring light transmission through water. As turbidity increases, more light is scattered by suspended particles in the water and less light is transmitted through the water.

velocity of the stream flow. As discussed in Section 2.1.4, the size and amount of sediment that can be carried by a stream is related to the stream flow velocity.

Figure 2-1 shows that a very small fraction of the sampled bed material in Lolo Creek are fine materials (<0.25 mm). Stream flow velocities during the permissible operating season in July and August are also low with values of 1.29 and 0.93 fps, respectively (Table 2-4). At these levels, it is unlikely that detectable or significant increases in turbidity above the 50 NTU limit would occur during suction dredge operations in Lolo Creek. Any increases in turbidity would be for a short duration while the dredge is operating and any fine sediments that are released would drop out downstream in an area where stream velocities are greatly slowed, such as a pool. These impacts would not be considered significant compared to the background total sediment loads of 1,541 and 500 pounds per day in July and August, respectively (Table 2-3).

Figures 2-4 and 2-5 show particle size distributions for Independence and Moose Creeks. These data suggest that a larger fraction of fine materials may exist in these creek substrates than those found in Lolo Creek, although data is not available for very small size fractions that would include silt and clay material. Observed stream velocities in these creeks are also low during July and August (Table 2-9). Data is not available for Deadwood Creek but particle size distribution of the creek substrate would be expected to be similar because of similar historic watershed activities and impacts.

These data suggest that it is more likely that detectable increases in turbidity would occur during suction dredge operations in these creeks than in Lolo Creek. However, low observed background turbidity levels (Tables 2-7 through 2-9) would suggest that levels of very fine sediment that could potentially impact turbidity are low. Low stream velocities in July and August, which are also observed in these creeks, should prevent long-distance transport of even fine sediment disturbed and suspended by suction dredge operations, since suspended particles would settle out within a short distance.

Significant increases in turbidity, potentially above the 50 NTU standard, would be expected if dredging activities extend into channel banks. Stream banks would be a readable source of fine sands, silts, and clays. These impacts will be mitigated by stipulations stating that dredges must not be operated in such a way that causes erosion or destruction of the natural form of the channel, that undercuts the bank, or that widens the channel. Impacts from dredging into banks would not be expected if these terms and conditions are followed.

Terms and conditions have been established to mitigate potential increases in turbidity and release of fine sediments down stream should they occur. These stipulations state that operators must visually monitor the stream for 300 feet downstream of the dredging operation after the first half hour of continuous operation. If noticeable turbidity is observed downstream the operation must cease immediately or decrease in intensity until no increase in turbidity is observed 300 feet downstream.

Significant increases in turbidity, potentially above the 50 NTU standard, would be expected only if dredging activities extend into channel banks, since banks would be a ready source of fine sands, silts, and clays. Operators must agree not to undercut, destabilize, or otherwise disturb

streambanks (condition 10), and Forest Service inspections will ensure compliance and minimize the potential for bank disturbance and consequent increases in turbidity.

Under this alternative, the Lolo #5 areas and the Forest Road 5440 crossing would continue to contribute sediment and increase turbidity in downstream areas.

Alternative 3: Suction Dredging and Stream Improvement Projects

Impacts to water quality that would result from suction dredging activities would be the same as those discussed for Alternative 2.

Regrading and stabilization of the tailing materials and disturbed areas at the Lolo #5 mining claim would be conducted under this Alternative, and this would stabilize exposed stream banks and reduce or eliminate further sedimentation and increases in turbidity from this area. Exposed sediment sources from piles of dredge tailings and overburden materials would be regraded and reclaimed to prevent future erosion and delivery of sediments to Lolo Creek. There would be localized increases in turbidity during construction but the use of standard best management practices would mitigate these increases substantially. The net effect of this project would reduce sediment loadings into Lolo Creek and improve water quality over the longer term.

Similarly, installation of a drainage device or ford with concrete planking at the Forest Road 5440 crossing of Independence Creek would stabilize the channel and reduce the sediment and turbidity that result from and around the current ford. Again, there would be increases during construction but reductions over the longer term.

TABLES

Table 2-1. Comparison of Channel Characteristics Collected During Surveys in 1993 and 1998 for Mainstem Lolo Creek.

Reach [2]	Channel Type	Channel Stability[1] 1998	Bank Stability 1993	Bank Stability 1998	Cobble Embeddedness % 1993	Cobble Embeddedness % 1998
LO-13	B3	69	4.9	5.0	47	46
LO-14	B3	66	5.0	5.0	47	41
LO-15	B3	72	5.0	4.8	36	35
LO-16	B3	85	4.8	4.7	50	51
LO-17	B3	86	5.0	4.8	51	48
LO-18	C3	101	4.3	4.9	56	62
LO-19	B2	60	5.0	5.0	27	35
LO-20	C3	96	4.8	4.4	44	46
LO-21	B3c	76	5.0	4.9	51	42
LO-22	B3c	76	5.0	5.0	46	45
LO-23	B3c	83	5.0	5.0	58	52
LO-24	C3	93	4.8	4.8	57	54
LO-25	B3c	58	4.7	4.9	40	37
LO-26	C3	86	5.0	4.5	59	55
LO-27	B3	55	5.0	5.0	42	40
LO-28	C3	88	4.8	4.7	54	50
LO-29	B2c	66	5.0	4.9	52	46
LO-30	B3c	97	5.0	4.5	55	56
LO-31	B2c	74	5.0	5.0	46	45
LO-32	B3c	100	4.9	4.7	49	52
LO-33	B3	55	5.0	5.0	48	45
LO-34	C3	101	4.3	2.9	39	48
LO-35	B1c	62	4.7	4.3	34	36
LO-36	C3	90	5.0	4.0	53	55
LO-37	B3c	78	4.4	4.7	36	41
LO-38	C3	93	4.7	4.2	76	56
LO-39	C3	70	4.8	4.6	26	38
LO-40	C3	81	4.8	4.3	18	43
LO-41	B3c	67	4.9	5.0	28	34
LO-42	B2c	59	5.0	5.0	44	46
LO-43	A2	56	5.0	5.0	7	12
LO-44	B2	56	5.0	5.0	13	25
LO-45	A2	52	5.0	5.0	7	12
LO-46	B3c	61	5.0	5.0	14	24
LO-47	C3	65	5.0	5.0	45	39
LO-48	C3	57	5.0	4.7	35	34
LO-49	C3	68	4.9	4.8	30	28
Mean		77.1 (Fair)	4.9 (Stable)	4.7 (Stable)	44.7% (DFC 30-35%)	42.8% (DFC 30-35%)

Table adapted from (USFS 2002a); a map of the specific reach locations is not available.

[1] <39 = Excellent; 39-76 = Good; 77-114 = Fair; >114 = Poor.

[2] a map of reach locations is not available

c depicts a channel with a slope that is less than 2%.

Table 2-2. Annual Mean and Maximum Stream Discharge, Suspended Sediment, and Turbidity Measured at the Lolo Creek Section 6 Bridge.

Year	Mean Discharge cfs	Maximum Discharge cfs	Mean Suspended Sediment mg/l	Maximum Suspended Sediment mg/l	Mean Turbidity NTU	Maximum Turbidity NTU
1986	95.9	448	10.7	50.7	1.6	5.3
1987	121	1,040	21.7	199	3.5	18.0
1988	57.7	360	5.9	40	2.2	4.5
1989	82.3	570	7.6	48		
1990	77.2	332	8.4	95	1.6	9.0
1991	107	446	12.4	66		
1992	57.9	262	16.8	145		
1993	84.4	409	11.7	72		
1994	57.9	343	12.7	59		
1995	84.0	387	11.3	64		
1996	152	1,209	9.7	60		
1997	135	854	13.2	183		
1998	46.4	120	17.8	185	3.0	24.8
1999	108	543	9.4	47	3.0	12.1
2000	91.9	409	9.1	95	2.3	11.1
2001	75.3	365	6.1	76	1.9	18.8

Table adapted from (USFS 2002a).
cfs = cubic feet per second.
mg/l = milligrams per liter
NTU = Nephelometric Turbidity Units

Table 2-3. Average Monthly Discharge, Suspended Sediment Load, Bedload, and Total Sediment Load Measured at the Lolo Creek Section 6 Bridge.

Month	Average Stream flow Cfs	Average Suspended Sediment Conc. mg/L	Average Suspended Sediment Load lbs/day	Average Bedload lbs/day	Total Sediment Load lbs/day
Oct	32	10	859	NA	
Nov	49	25	3,317	388	3,704
Dec	49	NA	NA	NA	
Jan	51	NA	NA	NA	
Feb	88	15	3,511	NA	
Mar	140	12	4,399	212	4,611
April	244	14	9,113	2,552	11,665
May	242	15	9,459	2,918	12,378
June	138	15	5,372	1,288	6,660
July	55	10	1,541	239	1,780
Aug	25	7	500	458	957
Sept	21	8	455	721	1,175

Table adapted from USFS (2003b)
cfs = cubic feet per second.
mg/l = milligrams per liter
lbs/day = pounds per day
NTU = Nephelometric Turbidity Units

Table 2-4. Relationship between Stream Flow And Stream Velocity at the Lolo Creek Section 6 Bridge.

Month	Average Stream Discharge cfs	Average Flow Velocity Flow Velocity Fps
Oct	17	1.00
Nov	28	1.21
Dec	29	1.23
Jan	29	1.23
Feb	51	1.53
Mar	83	1.83
Apr	143	2.24
May	142	2.24
Jun	79	1.80
Jul	32	1.28
Aug	14	0.93
Sep	12	0.88

Table adapted from USFS (2003b)
cfs = cubic feet per second
fps = feet per second.

Table 2-5. Channel Descriptions by Channel Type

Rosgen Channel Type	Channel Description
A2	Entrenched, steep stream with a boulder substrate
A4	Entrenched, steep stream with a cobble substrate
A5	Entrenched, steep stream with a sand substrate
A6	Entrenched, steep stream with a silt/clay substrate
B3	Moderately entrenched stream with a boulder substrate
B4	Moderately entrenched stream with a cobble substrate
B5	Moderately entrenched stream with a cobble substrate
G5	Entrenched (Gullied) stream with a sand substrate
G6	Entrenched (Gullied) stream with a silt/clay substrate

Source: USFS (1994)

Table 2-6. Mean Stream Discharge, Suspended Sediment, Bedload, and Turbidity measured on Deadwood Creek in 1981.

Month	Mean Discharge (cfs)	Mean Suspended Sediment Conc. mg/l	Mean Suspended Sediment Load lbs/day	Mean Bedload lbs/day	Total Sediment Load lbs/day	Turbidity NTU
Oct	2.2	0.3	3	12	15	1.9
Nov	NA	NA	NA	NA	NA	NA
Dec	NA	NA	NA	NA	NA	NA
Jan	NA	NA	NA	NA	NA	NA
Feb	NA	NA	NA	NA	NA	NA
Mar	NA	NA	NA	NA	NA	NA
Apr	NA	NA	NA	NA	NA	NA
May	13.5	4.0	289	195	484	0.7
Jun	19.2	4.8	466	565	1,031	1.2
Jul	6.9	5.2	153	892	1,045	1.2
Aug	2.3	1.8	22	0	22	0.7
Sep	NA	NA	NA	NA	NA	NA

Table adapted from USFS (2003b)
cfs = cubic feet per second.
mg/l = milligrams per liter
lbs/day = pounds per day
NTU = Nephelometric Turbidity Units

Table 2-7. Mean Stream Discharge, Suspended Sediment, Bedload, and Turbidity measured on Independence Creek in 1981.

Month	Mean Discharge (cfs)	Mean Suspended Sediment Conc. mg/l	Mean Suspended Sediment Load lbs/day	Mean Bedload lbs/day	Total Sediment Load lbs/day	Turbidity NTU
Oct	2.9	2.5	39	NA	39	5.2
Nov	NA	NA	NA	NA	NA	NA
Dec	NA	NA	NA	NA	NA	NA
Jan	NA	NA	NA	NA	NA	NA
Feb	NA	NA	NA	NA	NA	NA
Mar	NA	NA	NA	NA	NA	NA
Apr	NA	NA	NA	NA	NA	NA
May	NA	NA	NA	NA	NA	NA
Jun	11.0	16.6	712	729	1,441	4.0
Jul	7.5	3.3	133	545	677	1.1
Aug	2.3	2.2	27	NA	27	1.2
Sep	3.1	NA	NA	NA	NA	NA

Table adapted from USFS (2003b)
cfs = cubic feet per second.
mg/l = milligrams per liter
lbs/day = pounds per day
NTU = Nephelometric Turbidity Units

Table 2-8. Mean Stream Discharge, Suspended Sediment, Bedload, and Turbidity measured on Moose Creek in 1980-81.

Month	Mean Discharge (cfs)	Mean Suspended Sediment Conc. mg/l	Mean Suspended Sediment Load lbs/day	Mean Bedload lbs/day	Total Sediment Load lbs/day	Turbidity NTU
Oct	37	3	401	0	401	1.2
Nov	71	1.8	690	NA	690	4.3
Dec	NA	NA	NA	NA	NA	NA
Jan	NA	NA	NA	NA	NA	NA
Feb	NA	NA	NA	NA	NA	NA
Mar	NA	NA	NA	NA	NA	NA
Apr	539	9	25103	488	25591	2.3
May	420	5	11189	488	11677	1.1
Jun	352	4	7148	376	7523	1.4
Jul	163	7	5619	254	5872	1.8
Aug	66	2	767	NA	767	0.7
Sep	48	1	325	NA	325	1.6

Table adapted from USFS (2003b)
cfs = cubic feet per second.
mg/l = milligrams per liter
lbs/day = pounds per day

Table 2-9. Relationship between Stream Flow And Stream Velocity at the Mouth of Moose Creek.

Month	Average Stream Discharge cfs	Average Flow Velocity Flow Velocity fps
Oct	72	1.3
Nov	93	1.4
Dec	107	1.5
Jan	92	1.4
Feb	110	1.5
Mar	123	1.6
Apr	362	2.4
May	726	3.0
Jun	513	2.7
Jul	147	1.7
Aug	14764	1.2
Sep	55	1.2

Table adapted from USFS (2003b)
cfs = cubic feet per second
fps = feet per second.

FIGURES

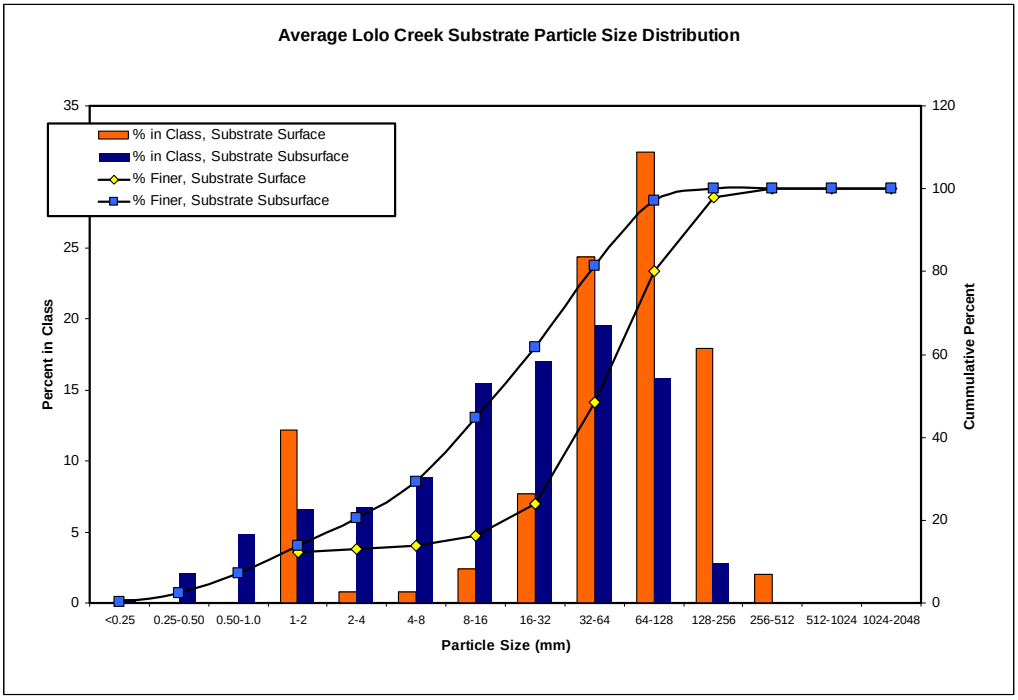


Figure 2-1. Average Particle Size Distribution of Lolo Creek Substrate Materials
Source: (USFS 2003b)

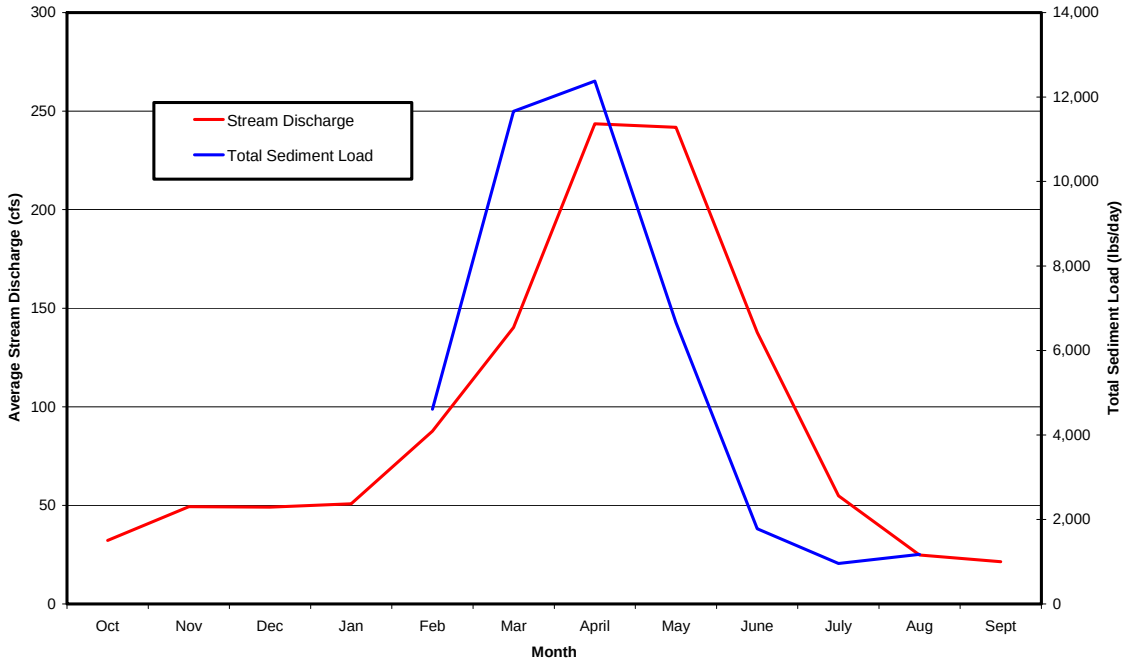


Figure 2-2. Relationship between Stream Discharge and Total Sediment Load at the Lolo Creek Section 6 Bridge.
Source: (USFS 2003b)

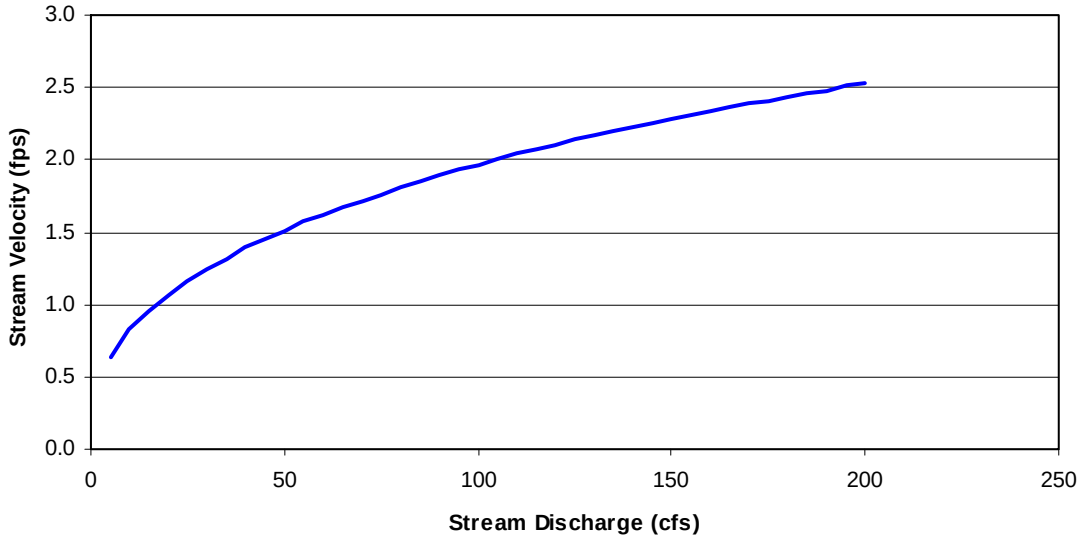


Figure 2-3. Relationship between Stream Flow And Stream Velocity at the Lolo Creek Section 6 Bridge.
Source: (USFS 2003b).

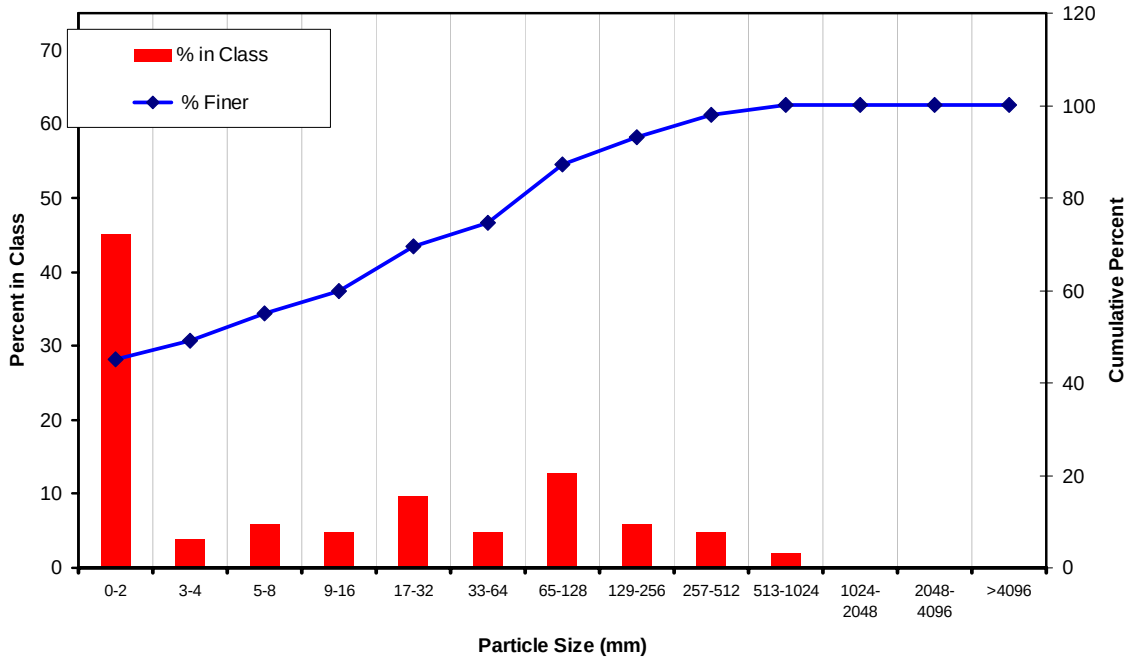


Figure 2-4. Particle Size Distribution of Independence Creek Substrate Materials.
Source: (USFS 2003b).

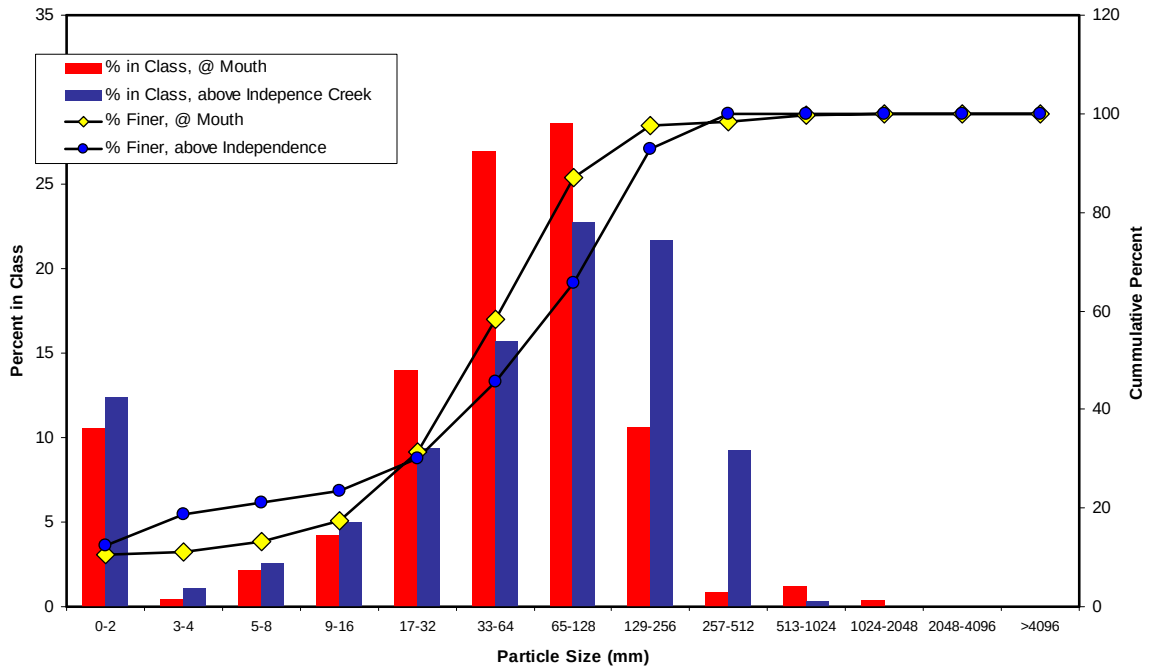


Figure 2-5. Particle Size Distribution of Moose Creek Substrate Materials
Source: (USFS 2003b).

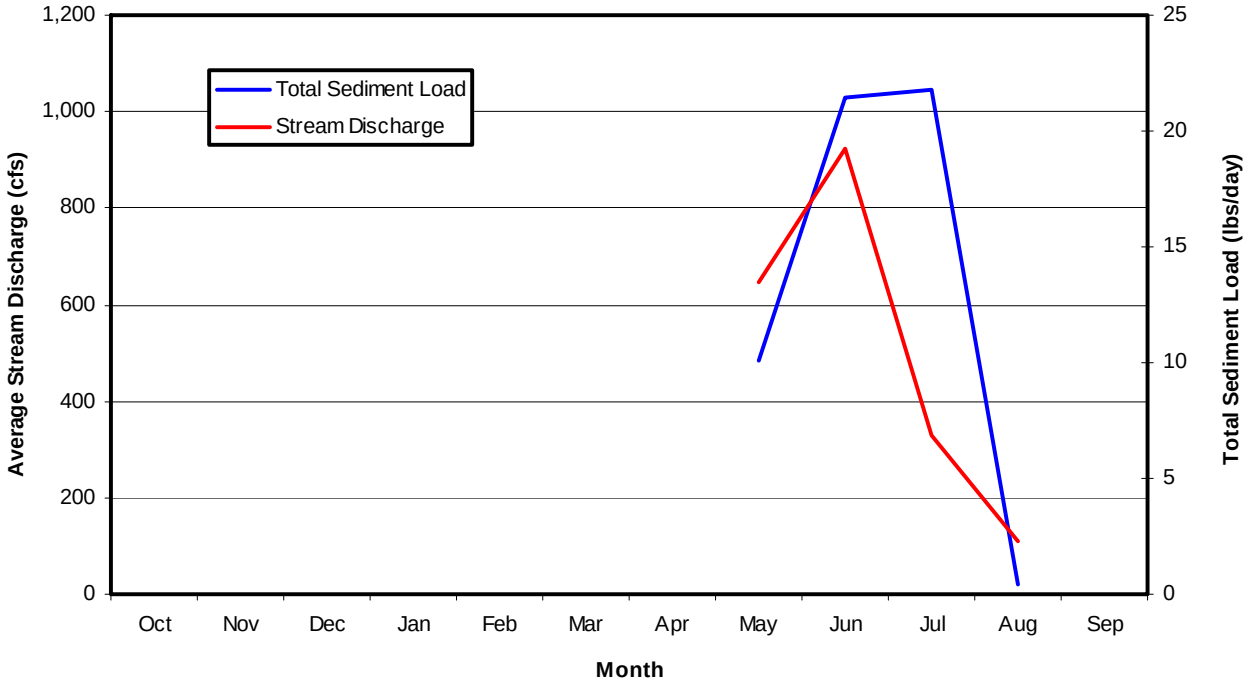


Figure 2-6. Relationship between Stream Discharge and Total Sediment Load for Deadwood Creek.
Source: (USFS 2003b).

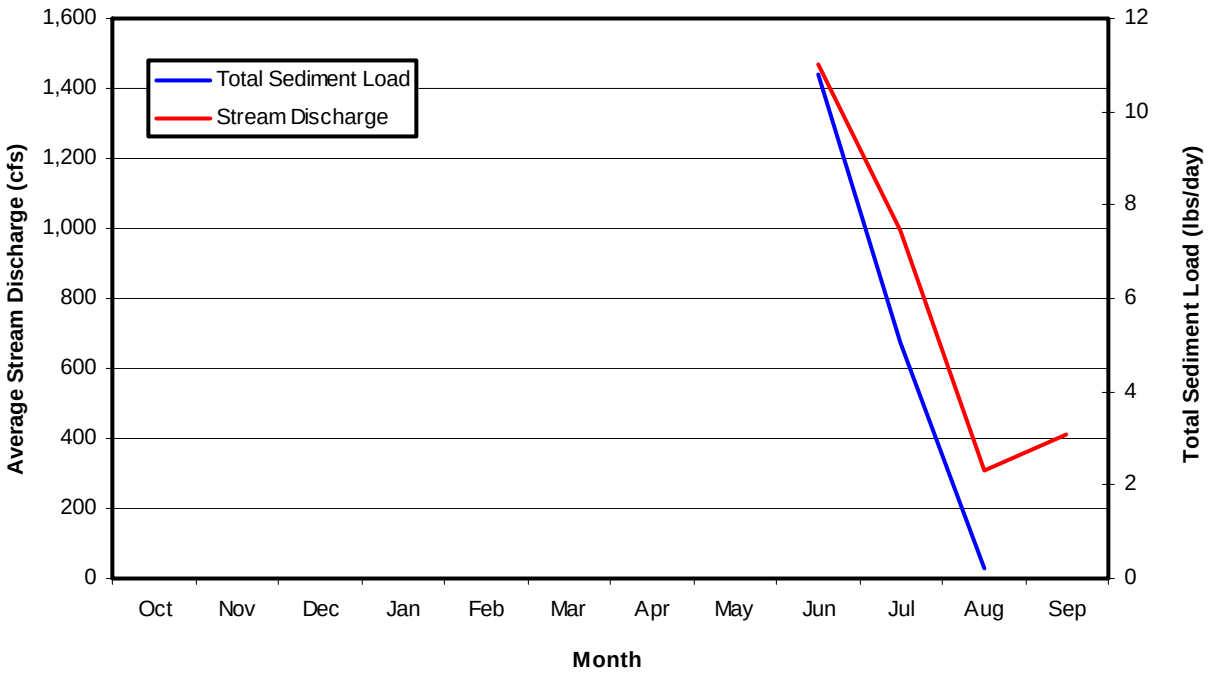


Figure 2-7. Relationship between Stream Discharge and Total Sediment Load for Independence Creek.
Source: (USFS 2003b).

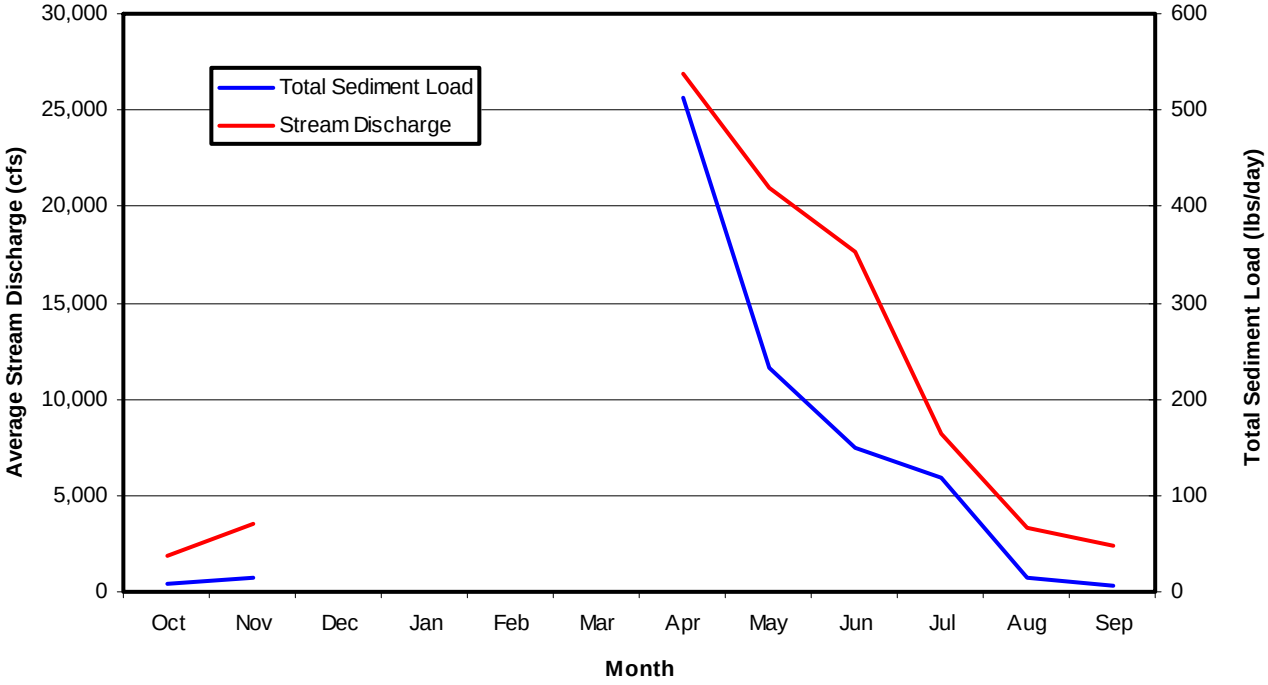


Figure 2-8. Relationship between Stream Discharge and Total Sediment Load for Moose Creek at Mouth.
Source: (USFS 2003b).

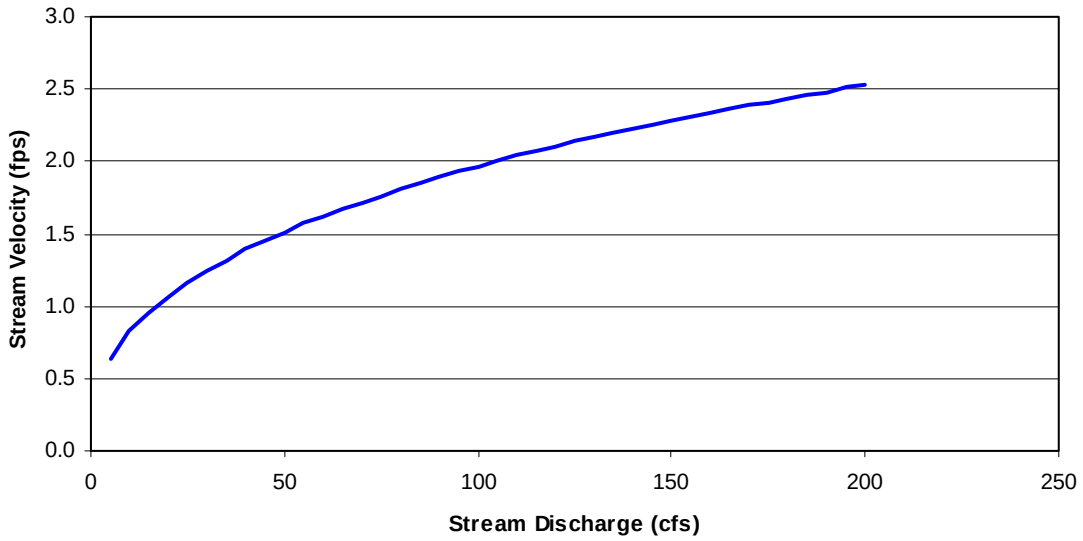


Figure 2-9. Relationship between Stream Flow And Stream Velocity at the Mouth of Moose Creek.
Source: (USFS 2003b).

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