east of the Continental Divide. Monitoring for this species under the action alternatives would not only help evaluate and inform restoration efforts, but would improve our understanding of the integrity of cold water fisheries in general in light of the uncertain impacts of climate change and other stressors.

3.5 Aquatic Ecosystems

3.5.1 Introduction

This section considers numerous physical and biological resources such as: water quality, native and non-native desirable species, and aquatic habitats. Managing for high quality soil, water and hydrologic function are fundamental in maintaining and restoring watershed health. Soil is the primary medium for regulating the movement and storage of energy and water and for regulating cycles and availability of plant nutrients (ICBEMP, 1997). The physical, chemical, and biological properties of soils determine biological productivity, hydrologic response, site stability, and ecosystem resiliency.

Analysis Area

The analysis area for the watershed, soils and aquatic species include all the lands within the boundary of the HLC NF and connected waterways. The connected river systems are included because migratory bull trout and westslope cutthroat trout that emerge from forest streams move downstream to reach sexual maturity and then return to their natal streams to complete the spawning cycle and depend on connectivity for their survival.

The Forest Plan area is located within two hydrologic unit code (HUC) regions:

- The Missouri Region (HUC = 10) is on the eastern side of the Continental Divide. Within this region, the plan area is located in 3 subregions: Missouri Headwaters (HUC=1002), Missouri-Marias (HUC=1003), and Missouri-Musselshell (HUC=1004). Within these subregions, the plan area is located in 14 fourth level watersheds. Within these fourth level watersheds the plan area is located within 88 fifth level watersheds which are further broken down into 301 sixth level watersheds.
- The Pacific Northwest Region (HUC = 17) drains to the west. Within this region, the plan area is located in one subregion, the Kootenai-Pend Oreille- Spokane (HUC=1701). Within this subregion, the plan area is located in two fourth level watersheds: Upper Clark Fork and Blackfoot River. Within these fourth level watersheds, the plan area is within 16 fifth level watersheds which are further broken down into 72 sixth level subwatersheds.

The analysis scale varies by resource and uses the fourth, fifth and sixth level watershed scales to assess current conditions across the HLC NF.

The FS commonly evaluates how proposed management activities meet the requirements of the Clean Water Act from a holistic perspective that considers land management activities occurring throughout the watershed and their effects on water quality and aquatic habitat integrity. The goal of the Clean Water Act is “to restore and maintain the chemical, physical, and biological integrity of the nation’s water”. Listings of waterbodies and development of Total Maximum Daily Loads (TMDLs) under Section 303(d) of the Act are symptomatic of the effects from historical and some ongoing management activities. Maintaining healthy watersheds and restoration of degraded watersheds would contribute towards the de-listing of impaired waterbodies and to the survival and recovery of aquatic species.

Productivity of soil and vegetation, proximity to water, and the general attractiveness of riparian and aquatic systems continue to make these areas ideal for many land uses managed by the FS. Conflicts between some human uses and the resources dependent on resilient riparian conditions may continue unless management provides for sufficient land use limitations and resource protection that maintain the

disturbance processes and pathways associated with resilient riparian conditions (Lake, 2000; Lee et al., 1997; Poff, Koestner, Neary, & Henderson, 2011; Reeves, Benda, Burnett, Bisson, & Sedell, 1995). The revision of these forest plans is designed to provide direction that addresses, if not resolves, these conflicts.

The variety of landscapes and associated aquatic ecosystems on the Forest support an array of different aquatic, terrestrial, and botanical species. Population sizes and distribution of some species, such as bull trout, have declined in most locations across its range in recent decades, with special protection granted under the ESA. Across the range of bull trout, reasons for the decline of some populations are many (Allendorf, Leary, Spruell, & K., 2001; Lee et al., 1997; Martinez et al., 2009). Aquatic species viability is dependent upon maintaining an array of desirable, well-connected habitat conditions. Past activities throughout the planning area, federal and private lands have contributed to fragmentation and degradation of habitat for fish and other riparian-dependent species. Humans have caused changes in habitat conditions through such activities as timber management, livestock grazing practices, road and facility construction, recreation uses, and introduction of non-native species. Future management activities have the potential to impact or restore habitat for species associated with aquatic and riparian ecosystems. For aquatic species, this analysis looks at how the management alternatives proposed in the forest plan either contribute to or mitigate common threats to aquatics within FS authority and capability of lands to sustain native species.

The diverse lithology, structure, and climate over time have resulted in a spatially complex pattern of landforms and soils across the forest that responds differently to management activities. Most management activities and natural processes, such as recent wildfires, affect soil resources to varied extents. Impacts or indicators of stress include: surface erosion, compaction, and nutrient loss through removal of coarse woody debris, high severity burns, flooding or landslides. These effects may be in the uplands or within streams. Soil effects or stresses are not always detrimental or long lasting. In order to maintain and where necessary restore the long term quality and productivity of the soil, detrimental impacts to the soil resource must be managed within tolerable limits.

Measurement Indicators

The primary effects to aquatic ecosystems to be analyzed would result from the implementation of the revised plan (alternatives B-E) compared to alternative A. Comparison is made between alternatives based on their relative ability to move the resources toward desired conditions for:

- Watershed resources
- Water quality
- Riparian areas
- Stream Function
- Aquatic Habitat
- Soils

3.5.2 Regulatory framework

Federal Law

Safe Drinking Water Act of 1977 and amendments (1996) - In 1996, the Safe Drinking Water Act was amended with requirements to identify "*Source water protection areas*" and to assess their susceptibility of contamination. This provides states with more resources and authority to enact the Safe Drinking Water Act. This amendment directs the state to identify source water protection areas for public water supplies that serve at least 25 people or 15 connections at least 60 days a year. In terms of relative size

and scope, while an individual NF unit may have 4 designated municipal watersheds, there may be over 100 source water protection areas that intersect with that NFS lands managed by that unit.

Source water protection areas have been established to protect public water systems from contamination. Public water systems are defined as entities that provide "water for human consumption through pipes or other constructed conveyances to at least 15 service connections or serves an average of at least 25 people for at least 60 days a year" and the term "public" in "public water system" refers to the people drinking the water, not to the ownership of the system (www.epa.gov/sourcewaterprotection). These systems can be dependent on any type of water source, including streams, lakes, reservoirs, springs, wells, or infiltration galleries, and includes systems used either year-round or only seasonally.

State governments were given the option to accept primacy or responsibility for delineating and developing assessments for these source water protection areas. The State of Montana has accepted this responsibility and should be contacted for the most up-to-date information regarding the source water protection delineations, assessments, and management requirements or goals.

Regulation and Policy

Municipal Watersheds – 36 CFR 251.9 authorizes the Chief of the FS to enter into agreements with municipalities to restrict the use of NFS lands from which water is derived to protect the municipal water supplies (FS Manual 2542).

Executive Orders

Executive Order 11988: Directs federal agencies take action on federal lands to avoid, to the extent possible, the long-and short-term adverse impacts associated with the occupancy and modification of floodplains. Agencies are required to avoid the direct or indirect support of development on floodplains whenever there are reasonable alternatives and evaluate the potential effects of any proposed action on floodplains.

Executive Order 11990, as amended: Requires federal agencies exercising statutory authority and leadership over federal lands to avoid to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands. Where practicable, direct or indirect support of new construction in wetlands must be avoided. Federal agencies are required to preserve and enhance the natural and beneficial values of wetlands.

Executive Order 12962 (June 7, 1995): Acknowledges the recreational value of aquatic biota by stating the objectives "to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities by: "(h) evaluating the effects of federally funded, permitted, or authorized actions on aquatic systems and recreational fisheries and document those effects relative to the purpose of this order".

Executive Order 13112 - Directs federal agencies whose actions may affect the status of invasive species to (1) prevent the introduction of invasive species, (2) detect and respond rapidly to and control populations of such species in a cost effective and environmentally sound manner, as appropriations allow.

State of Montana

Montana ARM 16.20.603 - This states that BMPs are the foundation of water quality standards for the State of Montana. The FS has agreed to follow BMPs in a Memorandum of Understanding with the state. Many BMPs are applied directly as mitigation at the project level. Implementing and effectiveness monitoring for BMPs are routinely conducted by contract administrators and during other implementation and annual monitoring events.

Montana State's Nondegradation policy MCA 75-5-303 and ARM 17.30.701 states that existing and anticipated uses and the water quality necessary to protect those uses must be maintained and protected. Many land management activities on NFS lands are considered nonsignificant activities under state law as long as reasonable land, soil, and water conservation practices are applied to protect existing and anticipated beneficial uses. State-defined non-significant activities are found in Montana Code Annotated (MCA) 75-5-317.

Stream Protection Act (SPA 124) – This is the State of Montana's stream permitting system to protect and preserve fish and wildlife resources, and to maintain streams and rivers in their natural or existing state. It applies to any agency or subdivision of state, county, or city government proposing a project that may affect the bed or banks of any stream or its tributaries in Montana. It is a required process for any project including the construction of new facilities or the modification, operation, and maintenance of an existing facility that may affect the natural existing shape and form of any stream or its banks or tributaries. The FS and the State of Montana have entered into a Memorandum of Understanding that commits the Forest to comply with the Stream Protection Act for all road planning and construction and water or hydraulic projects.

3.5.3 Assumptions

Legacy effects from past livestock grazing, timber harvest, mining, and other human-caused disturbances continue to effect watershed health and the aquatic ecosystem. Generally, under the direction of the 1986 Helena and the Lewis and Clark Forest Plans the intensity and the risks associated with new and ongoing developments and human-induced disturbances has been, and would be reduced as compared to the last several decades. However, effects from these activities are likely to continue to occur but are expected to be less than prior to the 1986 plan. The 1986 Forest Plan directions for the east side of the Continental Divide, as well as the 1996 amendment by the Inland Native Fish Strategy (INFISH) on the west side (U.S. Department of Agriculture, Forest Service, Intermountain, Northern, and Pacific Northwest Regions, 1995; USDA, 1995a), reduces the risk to watersheds and aquatic biota from new and ongoing activities. For some resources on the west side of the divide, the INFISH contain additional general direction for repairing past damage from land management associated with roads, grazing, and recreation activities.

There would continue to be localized improvements to watershed, soil, riparian and aquatic habitat conditions as projects are implemented, but watershed-scale improvements may occur slowly given current and anticipated funding levels. With the direction and emphasis in the Forest Plan, watershed restoration may tend to be prioritized and directed by more commodity-based resource decisions, such as restoration associated with timber harvest activities and integrated vegetation restoration projects.

Since the 1980s, improvements in soil productivity should be reflected through an increase in protections resulting in a reduction in adverse impacts and continued restoration efforts. Additional guidelines have provided further direction for soil nutrient management, protection of watershed health improvement in soil quality, and maintenance of soil productivity. This is the rationale that justifies understanding of the expected effects from other resources that influences anticipated effects.

3.5.4 Best available scientific information used

The most important change between the current 1986 plan directions for the HLC NF and the proposed new 2012 planning rule(36 CFR 219.8) is the requirement to establish RMZ widths. The 2012 Planning Rule directed that during plan revision efforts, riparian management areas shall be established in all NFS lands. The 2012 Planning Rules states that the:

> (ii) Plans must establish width(s) for RMZs around all lakes, perennial and intermittent streams, and open water wetlands, within which the plan components required by paragraph (a)(3)(i) of

this section will apply, giving special attention to land and vegetation for approximately 100 feet from the edges of all perennial streams and lakes.

(A) RMZ width(s) may vary based on ecological or geomorphic factors or type of water body; and will apply unless replaced by a site-specific delineation of the riparian area.

(B) Plan components must ensure that no management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses, or deposits of sediment that seriously and adversely affect water conditions or fish habitat shall be permitted within the RMZs or the site-specific delineated riparian areas.

Best available science was used to determine effects of implementing the revised forest plan across aquatic ecosystems. A full report of the aquatic ecosystems BASI is located in appendix C.

3.5.5 Affected environment

Watershed condition

Watersheds are described across the planning area and the Watershed Condition Framework is used to describe conditions in GAs. Water quality, source water protection areas and groundwater resources are also discussed. Aquatic ecosystems are described by GA, focusing on habitat for bull trout west of the Continental Divide, and habitat for westslope cutthroat trout west and east of the divide. Management effects are described by GA, and system drivers and stressors of water resources and aquatic ecosystems are detailed together. The soil resources section details information and considerations for soils in the planning process.

Watershed condition

The primary hydrologic unit upon which watershed condition has been assessed is the sixth-level hydrologic unit, or subwatershed, which is a watershed of about 10,000-40,000 acres. To evaluate baseline watershed conditions across the analysis area, a watershed condition rating was determined for each subwatershed. This characterization estimated the existing condition based on physical characteristics (e.g., hydrologic, geomorphic, landscape, topographic, vegetative cover, and aquatic habitat) and human-caused disturbances (e.g., road construction and vegetative treatments).

Watershed condition classification ultimately ranks watersheds in one of three discrete categories (or classes) that reflect the level of watershed health or integrity. Watershed health and integrity are considered conceptually the same (Regier, 1993). Watersheds with high integrity are in an unimpaired condition in which ecosystems show little or no influence from human actions (Lackey, 2001).

Within this context, the three watershed condition classifications are directly related to the degree or level of watershed functionality or integrity:

- Class 1 – Functioning Properly
- Class 2 – Functioning at Risk
- Class 3 – Impaired Function

The watershed condition framework (USDA, 2011b) characterizes a watershed in good condition as one that is functioning in a manner similar to natural wildland conditions (Karr & Chu, 1999; Lackey, 2001). A watershed is considered to be functioning properly if the physical attributes are adequate to maintain or improve biological integrity. This consideration implies that a class 1 watershed that is functioning properly has minimal undesirable human impact on its natural, physical, or biological processes, and it is resilient and able to recover to the desired condition when disturbed by large natural disturbances or land management activities (Yount & Niemi, 1990). By contrast, a class 3 watershed has impaired function because some physical, hydrological, or biological threshold has been exceeded. Substantial changes to

the factors that caused the degraded state are commonly needed to return the watershed to a properly functioning condition.

Watershed conditions vary across the plan area with conditions ranging from those unaffected by direct human disturbance to those exhibiting various degrees of modification and impairment. The Forest completed the first round of watershed condition classification in the summer of 2011 (USDA, 2011b). In summary, 103 watersheds were rated as functioning properly, 159 were rated as functioning at risk, and 34 were rated as impaired. The most significant drivers of the ratings in the plan area were roads, grazing, and mining. These conditions would be re-assessed in the future to assess change.

Mineral extractions and ancillary mining-related activities have left a history of impacts to watersheds and water quality in a number of watersheds across the planning area. Historic mining of minerals including gold, silver, lead and zinc has occurred in many of the GAs; notably the Little Belt, Big Belts, Elk Horn and Divide GAs. Water quality is impacted from acid mine drainage and heavy metals contaminated runoff from mined materials. Streambanks and riparian habitats have been degraded through large and small placer operations. Many of these watershed and water quality impacts have been, or are currently being addressed through response actions conducted by federal agencies in accordance with delegated authorities under the Comprehensive Environmental Response Compensation and Liability Act, as amended. FS actions taken under this act to date across the planning area have been largely individual mine site focused or area specific, while the Environmental Protection Agency’s actions under the National "Superfund" Program have sought to address impacts by defining "Sites" at the watershed scale. The forest is also addressing mining impacts through restoration of streambanks and riparian areas. Watersheds that support bull and westslope cutthroat trout are an emphasis for restoration using the priority watershed designation under watershed condition framework as well as when designated under conservation watershed network. Bull trout are a listed species and a goal under the Bull Trout Conservation Strategy. The Recovery Unit Implementation Plan goal is to improve habitat conditions of the five-Class 2 watersheds found in the Divide and Upper Blackfoot GAs.

Geographic areas

Watershed conditions vary across the plan area by GA range from those unaffected by direct human disturbance to those exhibiting various degrees of modification and impairment. According to the model, 40 percent of watersheds within the plan area are in watershed condition class 1 and “exhibit high geomorphic, hydrologic and biotic integrity relative to their natural potential condition” ” (Potyondy & Geier, 2011). The summary by GAs of the results are displayed in Table 14 and in appendix A, Watershed Condition Class Framework. In summary, 103 watersheds were rated as functioning properly, 159 were rated as functioning at risk, and 34 were rated as impaired. The most significant drivers of the ratings in the plan area were roads, livestock grazing, and mining. These conditions would be re-assessed in the future to assess change.

Table 14. Summary of sixth level watersheds by GA rated in each category under the WCC

GA	Class 1 Functioning Properly	Class 2 Functioning at Risk	Class 3 Impaired Function	Grand Total
Big Belts	3	35	7	45
Castles	2	9	1	12
Crazies	5	5		10
Divide	1	13	14	28
Elkhorns	1	18	2	21
Highwoods	3	4		7

GA	Class 1 Functioning Properly	Class 2 Functioning at Risk	Class 3 Impaired Function	Grand Total
Little Belts	21	39	4	64
Rocky Mountain Range	40	13	1	54
Snowies	15	3		18
Upper Blackfoot	12	20	5	37
Total	103	159	34	296[1]

1. 8 watersheds are within 2 GAs, making the total 296 rather than 288.

Across the plan area, watersheds were most commonly rated as impaired for the indicators: aquatic biota, roads and trails, and water quality. Of the 24 attributes, watersheds were most commonly rated impaired for rangeland vegetation, aquatic invasive species, road proximity to water, soil contamination and insects and disease.

Stream Channels

Streams carry water, sediment, dissolved minerals, and organic material derived from hillsides and their vegetation cover. The shape and character of stream channels constantly and sensitively adjust to the flow of this material by adopting distinctive patterns such as pools-and-riffles, meanders, and step-pools. The vast array of physical channel characteristics combined with energy and material flow, provide diverse habitats for a wide array of aquatic organisms.

Varied topography coupled with the irregular occurrences of channel-affecting processes and disturbance events such as fire, debris flows, landslides, drought, and floods, result in a mosaic of river and stream conditions that are dynamic in space and time under natural conditions. The primary consequence of most disturbances is to directly or indirectly provide large pulses of sediment and wood into stream systems. As a result, most streams and rivers undergo cycles of channel change on timescales ranging from years to hundreds-of-years in response to episodic inputs of wood and sediment. The types of disturbance, that affect the morphology of a particular channel depends on watershed characteristics, size, and position of the stream within the watershed. Many aquatic and riparian plant and animal species have evolved in concert with stream channels. They develop traits, life-history adaptations, and propagation strategies that allow persistence and success within dynamic landscapes.

Human uses have altered some stream channels in the last century. Stream channels have changed as a result of channelization, livestock grazing, placer and hard rock mining, road building, logging, splash dams, the extirpation of beaver and their habitat, and indirectly by altering the natural incidence, frequency, and magnitude of disturbance events such as wildfire. Some characteristics of channels commonly measured to help identify changes caused by management include frequency and depth of large pools, the width-depth ratio of stream channels, and the percent of fine sediment contained in substrate (Al-Chokhachy, 2010). Low gradient (less than 2%) stream channels show the most response to land management activities. Lower pool frequencies and higher fine sediment concentrations are most obvious in watersheds with higher road densities such as the Little Belts, Big Belt and Divide GAs. Placer and hard rock mining have altered stream morphologies in streams throughout most of the planning area notably in the Big Belts, Upper Blackfoot, Elkhorn, Little Belts, Castles and Divide GAs. Placer mining reshapes and straightens as well as removes fine sediment from stream channels. Hard rock mining changes the morphology of the streams by adding mine waste to stream channels and altering groundwater flows regimes. These findings are consistent with observations that indicate past road construction/maintenance, grazing, mining, and timber harvest practices altered sediment delivery and routing, and potentially other habitat components, which in turn has led to fewer pools, higher fine sediment resulting in stream aggradation, as well as the lack of fines as resulting from placer mining.

Consequently, watersheds, stream channels, and aquatic habitats in many locations on the forest are now subject to continued compounding effects of watershed disturbance. This contrasts with a more pulse-like pattern of disturbance under which most streams and associated species evolved. Consequently, many stream channels are less than optimal for aquatic and riparian-dependent species, which evolved in environments that had more high-quality habitat areas spread across the landscape. These degraded conditions are prevalent on much of the GAs throughout the HLC NF.

Water Quality

Impaired and threatened water bodies

Water quality is regulated under the authority of the Clean Water Act, and Montana assess the waters within their jurisdiction and identifies stream segments and other water bodies whose water quality is “impaired” or generally not meeting water quality standards for beneficial uses. Individual stream segments, lakes, and other water bodies have been listed as "Water Quality Limited Segments" (i.e., "impaired") by the state of Montana (MTDEQ, 2014) and are described in subsection 303(d) of the Clean Water Act as waters that do not meet state standards; a broad term that includes water quality criteria, designated uses, and anti-degradation policies. The 2016 state’s list of impaired waterbodies indicated the planning area includes 313 miles of streams on the forest that were listed as impaired due to sedimentation/siltation; 107 miles of stream segments listed for nutrients and 277 miles listed for metals.

According to the 2016 draft State 303(d) list, 110 stream segments or 617 miles within the plan area are not meeting water quality standards (MTDEQ, 2016), Montana State 303(d) Listed Water Quality Impaired Streams). 31 segments or 150 miles of these are listed for mining related impacts, and the remaining 79 or 467 miles are listed for agricultural practices, grazing impacts, forest roads or habitat quality issues.

The Montana Department of Environmental Quality (MTDEQ) develops TMDLs, which is the maximum amount of a pollutant a waterbody can receive and still meet water quality standards. They are submitted the U.S. Environmental Protection Agency for approval. The Montana Water Quality Act requires its Department of Environmental Quality to develop TMDLs for streams and lakes that do not meet, or are not expected to meet, Montana water quality standards. TMDLs provide an approach to improve water quality so that streams and lakes can support and maintain their state-designated beneficial uses.

TMDL assessments have been prepared and are being implemented for several sub-basins in the plan area, including those in the Little Belts, Castles, Crazies, Divide, Elkhorns, and Upper Blackfoot GAs. The streams with mining related issues are also discussed in the minerals and geology section of this DEIS.

To understand the current conditions of water quality within the planning area, the amount of currently listed waterbodies needs to be put into context. Many streams within the Forest’s administrative boundary have not yet been assessed. There are approximately 10,290 miles of streams within the Forest’s administrative boundary, and the MTDEQ has assessed about 6 percent or 617 miles of those streams (MTDEQ, 2016). All waterbodies are assigned to a category, which defines the status of the waterbody.

The breakdown of the categories of the assessed streams in the planning area are:

- Category 1: 13 percent of the waterbody’s assessed were found to be fully supportive of all beneficial uses.
- Category 2: 3 percent of the waterbody’s assessed had information that showed some, but not all, of the beneficial uses are supported.
- Category 3: 4 percent insufficient data prevents assessing the use support of any beneficial use for the waterbody.

- Category 4A: 26 percent of the waterbody's assessed were required to have TMDLs, which have subsequently been prepared and approved by the U.S. Environmental Protection Agency.
- Category 4C: 3 percent of the waterbody's assessed are impaired in pollution categories such as dewatering or habitat modifications, and thus a TMDL is not required.
- Category 5: 43 percent of the waterbody has at least one impaired or threatened use, but a required TMDL or other control program is not in place.
- Category 5N: 8 percent of the waterbody's has at least one standard that is not met, and available data/information indicates that the cause could not be a natural condition (i.e.no human-cause source have been identified).

Habitat quality monitoring methodologies, such as Proper Functioning Condition (PFC) (Dickard et al., 2015) assessments and channel stability index (Pfankuch, 1975) have been conducted across the forest. The current trends in stream conditions and aquatic habitat have been documented to be stable or no meeting desired conditions in a timely manner.

The results are not indicative of actual water quality, as the MTDEQ focuses its assessment on impaired water. Most of the healthy stream miles have not been assessed and entered into Montana's Waterbody System (MTDEQ, 1998).

On the Forest, the MTDEQ determined that sediment continues to impair aquatic life. The MTDEQ provided sediment TMDLs for those waterbody segments. Therefore, TMDLs have been developed for all streams on the Forest where required.

For the streams with sediment TMDL, excess sediment may be limiting their ability to support aquatic life. Water quality restoration goals for sediment were established on the basis of fine sediment levels in trout spawning areas and aquatic insect habitat, stream morphology and available in-stream habitat as it related to the effects of sediment, and the stability of streambanks. The MTDEQ believes that once these water quality goals are met, all water uses currently affected by sediment will be restored. The MTDEQ's water quality assessment methods for sediment impairment are designed to evaluate the most sensitive use, thus ensuring protection of all designated uses. For streams in western Montana, the most sensitive use assessed for sediment is aquatic life.

Groundwater

Ground water-dependent ecosystems are communities of plants, animals, and other organisms whose extent and life processes depend on ground water (USDA Forest Service 2007). The following are examples of some ecosystems that may depend on ground water:

- Wetlands in areas of ground water discharge or shallow water table
- Terrestrial vegetation and fauna, in areas with a shallow water table or in riparian zones
- Aquatic ecosystems in ground water-fed streams and lakes
- Caves and Karst systems
- Aquifer systems, and
- Springs and seeps

Groundwater is an important resource in Montana, and it will likely become more important in the future as the State's population and industries grow. More than half of Montanans depend on groundwater for their primary water supply. Water generated in the mountains of the Forest is an important source of recharge for valley aquifers and is therefore an important Forest product.

Because of limited supply and lack of development opportunities, beneficial use of Forest groundwater is generally low. Consumption is limited to special-use permits and FS campgrounds or administrative sites with domestic wells. Off-Forest, groundwater is used extensively for pump irrigation and drinking water

wells in the prairies/mountain valleys. There are very few natural sources of groundwater contamination. Most threats to groundwater quality are linked directly or indirectly to a variety of human activities. Groundwater contamination on forest has occurred in areas of past mining activities. Large areas of acid mine drainage are present in the Little Belt, Divide, Upper Blackfoot, and Castles GAs. Particular threats to groundwater in the plan area include facility and road development, grazing impacts, contamination from roads, and clearing of vegetation.

Bull trout are present in streams on the west side of the Continental Divide in the Upper Blackfoot and the west side of the Divide GAs. Bull trout are highly dependent on groundwater areas that influence spawning and winter habitat conditions.

Aquatic habitat condition

The most comprehensive and consistent data set on stream channel conditions is provided by the Pacfish/Infish Biological Opinion (PIBO) monitoring program, which is a highly organized monitoring effort that collects data systematically across NFS and BLM lands across the Interior Columbia River Basin and Upper Missouri River basin. PIBO monitoring was developed to determine if components in PACFISH/INFISH were effective at preventing further habitat degradation at the scale of the entire Columbia River Basin, This monitoring program collects reach-level stream habitat, temperature, macroinvertebrate, sediment, and riparian data to evaluate if key biological and physical components of aquatic and riparian communities are being degraded, maintained or restored. With over a decade of consistently collected data and improvements in data analysis, comparisons between managed and reference watersheds can now be scaled down to conditions on an individual NF. Currently, PIBO monitoring provides rigorously collected local data that can be statistically compared to reference conditions in the same geophysical province.

Monitoring began on the NFs west of the Continental Divide in 2001. The program was expanded to the east side of the Continental Divide to the Upper Missouri River Basin in 2006. Over a 5 year period, 1,300 sub-watersheds are sampled in the Columbian River basin and 250 sub-watersheds in the Missouri River basin, which equates to about a third of the sub-watersheds managed by the BLM and the FS within the study area. Once three sampling rotations have been completed, this program allows for the evaluation of status and trends comparison of the reference and managed conditions. An analysis of stream habitat conditions using the PIBO data can be found in the project files. As of 2017 all of the west side sites have been sampled at least three times and the third rotation of sampling has been initiated on the east side.

Two types of data comparison are made with PIBO data, “status”, and “trend”. Status compares conditions between a group of managed stream reaches against a group of unmanaged stream reaches (unmanaged reaches have little or no road development, mining, timber harvest, grazing, recreation development, etc.) Because of a century plus of management in what is now the HLC NF, it has been difficult to find reference reaches on the HLC NF, so comparisons are made at the larger ecoregion scale (Ecoregions are defined to be areas of relative homogeneity in ecological systems). Trend comparisons look at conditions for a group of reaches measured at least 3 time intervals, usually about 5 years apart. Looking at how conditions change for a group (either managed or reference) and how a group of managed sites compares to reference sites over that time allows managers to judge the trend in conditions in managed sites and whether or not managed site conditions are moving towards the desired conditions described in the Forest Plan.

In addition to a forest-scale analysis, PIBO data was grouped into drainages and/or individual units for the HLC NF portions of the combined forest to provide trend information for more discrete areas. Regardless of how the HLC NF PIBO sites are broken down, trend data show fewer trends in the desired direction for habitat attributes for managed sites or reaches when compared to all PIBO managed reaches monitored in Region 1. The overall index score of integrator sites (located at the lowermost, low gradient reach occurring on federal land, which are influenced by the watershed area upstream, and considered the most

sensitive area to sediment and flow regimes) is also lower for all areas on the HLC NF for managed areas when compared to Region 1 as a whole. Additionally, the overall index score for integrator sites located on the HLC NF west of the Continental Divide are higher than for the Lewis and Clark portion of the forest (all east of the Continental Divide) or that portion of the Helena unit east of the Continental Divide. When compared to the overall index scores for reference sub-watersheds from the within the appropriate ecoregion, the managed areas scores were statistically lower. Ecoregions are defined to be regions of relative homogeneity in ecological systems or in relationships between organisms and their environments. The comparison between reference and managed reaches are not meant to be used as goals to be attained in managed reaches, but rather an indication of management-induced disturbance. Although this suggests that measures implemented west of the Continental Divide have improved habitat conditions somewhat more than east of the Continental Divide, managed areas on both sides would still need to be improved to meet desired conditions.

PIBO data show streams in managed sub-watershed across the planning area have lower median values or habitat conditions for many of the measured indexes (Archer & Ojala, 2016) (Archer & Ojala, 2017). The PIBO data methodology selects managed sites based on a rigorous and repeatable methodology that attempts to find sites that are representative of managed conditions in that portion of the forest. Managed sites in grazed sub-watersheds are considered representative of grazing impacts typical for low gradient habitat in that pasture. When we have qualitatively compared PIBO data sets to forest collected data, many areas have shown that livestock impacts to streams and riparian areas continue to occur.

Benefits to People

Watersheds across the planning area provide many benefits to people that include clean water for drinking, high quality habitat for fish and sport fishing, wildlife, livestock, and agricultural irrigation. FS-managed lands include the headwater tributaries for a large percentage of source (drinking) water protection areas in the U.S. High quality water and habitats provides high elevation refugia for fish across the planning area in a warming environment. Watersheds provide many agricultural benefits for local rural communities in the form of grazing forage for livestock, and agricultural irrigation water on and downstream of the forest.

Drinking water

Water draining off NFS lands is often used for drinking water supplies. A lot of confusion exists around current agency policies to protect drinking water supplies and their importance during Forest Plan revision efforts. The following discussion will provide an overview of Municipal Supply Watersheds and Source Water Protection Areas, which are two separate constructs for drinking water protection that are applicable to NFS land management.

Municipal Supply Watersheds

The 1986 forest plans currently recognize 4 municipal supply watersheds diverting surface water from streams within or just downstream of the HLC NF and are recognized in accordance with 36 CFR 251.9. Big Spring Creek watershed provides drinking water for the City of Lewistown and is proposed as a new municipal watershed under the draft forest plan revision. Together, these 5 municipal supply watersheds serve approximately 36,690 people, including some travelers, i.e. transients.

- The town of Neihart, population of 50, uses O'Brien Creek and Shorty Creek. Both of these are within Belt Creek-Carpenter Creek sixth level watershed in the Little Belts GA. Neihart has had some issues with turbidity in O'Brien Creek not meeting EPA Safe Drinking Water Standards, so it installed an infiltration gallery in Shorty Creek to use during those times when waters do not meet the standard. The City received a State Treasure State Endowment Program planning grant in 2015 and has applied for a project grant to improve their overall system.
- The City of Helena uses Tenmile Creek in the Divide GA (Management Areas H1 and H2 in the existing Helena Forest Plan) and its tributaries as its primary source of drinking water for a

population of around 28,190. Streams in the lower portion of the Tenmile watershed do not meet drinking water quality standards, but above the diversions, water quality does generally meet standards. Diversions are located on Tenmile Creek above Rimini and near the mouths of Beaver Creek, Minnehaha Creek, Moose Creek, and Walker Creek. Water from all diversions is carried to the Tenmile Water Treatment Plant in a common buried pipeline. In addition, the City of Helena stores water from several tributaries in Scott and Chessman Reservoirs (in the upper part of the watershed) when streamflow is high. The Red Mountain Flume carries water from some of these tributaries to Chessman reservoir. Vegetation treatment efforts are occurring in the watershed under the Red Mountain Flume Chessman Reservoir Project. This project treats the areas around the flume and reservoir. Further treatments in the rest of the watershed are in the planning process for the Tenmile South Helena Project. The primary objective of this project is to reduce the risk for a high intensity wildfire and associated adverse post-fire watershed effects in the watershed.

- The city of White Sulphur Springs, population of 984, uses Willow Creek (part of the Smith River-Trout Creek sixth level watershed). The Willow Creek municipal watershed is located in the Castles GA. The Castle Mountains landscape assessment of 2012 described conditions within the municipal watershed as good. Specifically, the watershed is fenced out and with the exception of few trespass cows, livestock access is nonexistent. It has a healthy riparian area with a great diversity of plants including cottonwood, aspen, dogwood, alder, and willow. Mixed conifers adjacent to the channel provide an excellent source of large woody debris which forms numerous log jams along the profile. A boulder dominated channel bed, less-prone to degradation when compared to other project area channels within the GA, dissipates the 500 year flood energy efficiently and shows no detrimental effects from the natural event. The overall condition of the watershed is excellent but hillslopes surrounding the creek have high fuel loading (dead lodgepole pine) which could potentially trigger a wildfire. Treatments have been proposed for the watershed, which include thinning and prescribed burning.
- Also included in the 1986 Helena NF Plan, is the municipal watershed for the City of East Helena, population of 1,642. The city uses McClellan Creek, located in the Elkhorn GA for one source of municipal water. This source is an infiltration gallery located approximately five miles south of East Helena, in the McClellan Creek drainage, downstream of the forest boundary. The infiltration gallery draws water into two collection systems installed into alluvium near the creek. Recharge to McClellan Creek occurs in the Elkhorn Mountains on the Forest.
- Not included in the Lewis and Clark NF 1986 plan is the city of Lewistown's source water protection area. This municipality receives its water from Big Spring Creek. The recharge area for Big Spring Creek extends into the Madison limestone within the Snowies GA to the south. This includes the Middle and East Fork Big Spring Creek watersheds above the forest boundary.

Source Water Protection Areas

Source water protection areas protect public water systems from contamination in accordance with the 1996 amendments to the Safe Drinking Water Act. Public water system intakes on surface water sources, i.e. streams, are the most susceptible to contamination from land management activities within the HLC NF. The City of Helena is the only public water system diverting surface water from streams within the HLC NF, specifically from Beaver Creek, Minnehaha Creek, and Moose Creek in the Tenmile Creek watershed. The source water protection areas of these surface water intakes includes a "Spill Response" area that is buffered along each source stream measuring a maximum of 10 miles in length, 1/2 mile from both streambanks, and 1/2 mile downstream from the surface water intake and is confined to the extent within the contributing watershed. These spill response regions are to be managed to prevent releases of contaminants where they can be drawn directly into a water intake with little lag time. In addition to the City of Helena's surface water intakes, 2 other communities have Spill Response areas that overlap the HLC NF, specifically the Town of Neihart's surface water intake on O'Brien and Shorty Creeks and the City of White Sulphur Springs intake on Willow Creek.

In addition to the spill response region, the rest of the contributing watershed upstream of each surface water intake is the "watershed region" part of the source water protection area, in which management is to maintain and improve the long-term quality of surface water used by the public water system. In addition to the 3 spill response regions that overlap the HLC NF, 12 public water systems located downstream of the forest have watershed regions that extend up into the forest. All 15 of these surface public water systems collectively serve approximately 100,000 people.

Groundwater sources also supply drinking water in and around the HLC NF. There are 9 public water systems withdrawing groundwater at 12 locations within HLC NFS lands, coming from 9 wells and direct from 3 springs. Montana's Source Water Protection Program states that areas located within 100 feet of these ground water sources is the "control zone" for each intake, and this area is to be managed to protect sources from damage and to prevent direct introduction of contaminants into sources or the immediate surrounding areas. These 9 public water systems withdrawing groundwater at 12 locations on NFS lands are the only control zones that intersect the HLC NF.

Beyond the 100 foot control zones, the areas within 1 mile of each ground water public water system source are typically designated as "inventory regions" by MTDEQ that will be managed to minimize susceptibility to contamination. The delineation of these inventory regions can also be defined using other methodologies than a simple 1-mile buffer depending on the information available and circumstances, and these areas are delineated by MTDEQ. Management in these inventory regions will be focused on pollution prevention activities where water is likely to flow to a public water system well intake within a specified time-period. These inventory regions have various degrees of delineation on the Forest and management in these inventory regions will be considered at the site-specific project level. BMPs can be implemented to control non-point sources of contamination in these areas (Montana Department of Natural Resources and Conservation, 1999).

Riparian areas

Riparian areas

The vegetation composition and structure, and the pattern of the riparian and wetlands across the planning area are highly diverse. Plant communities may be dominated by grasses with few shrubs and trees, or they may be heavily forested. Riparian vegetation on the west side of the divide may be dominated by broadleaved trees, particularly black cottonwood, or by coniferous species. Spruce and subalpine fir are most common, with other species such as Douglas-fir and a rare occurrence of larch in the Blackfoot GA, are also present in many riparian areas. Forbs and grass-like plants that occupy these sites are quite diverse. East of the Continental Divide, riparian species may consist of broadleaved trees including black, narrow-leaved cottonwood or aspen. Spruce and subalpine fir are most common in high elevations and Douglas-fir on cooler slopes and in many riparian areas. Shrubs include alder, rocky mountain maple, willow species, red-osier dogwood, elderberry, buckthorn, thimbleberry, twinberry honeysuckle, common chokecherry and hawthorn. The vegetative structure may include many decayed and dead trees, and multiple layers of vegetation that include submerged vegetation along open water margins, as well as plants that grow in conditions with variable amounts of soil saturation. Patterns of riparian and wetland ecosystems vary from relatively narrow strips of land along perennial and intermittent streams in deeply incised, steep mountain valleys, to marshes and adjacent wetlands within the wide valleys of the major river bottoms. They may be interconnected in a linear fashion down hillsides and in valleys, they may occur in clusters, or they may occur as isolated microsites in other ecosystems. Riparian areas are widely distributed across the planning area and occur at all elevations. Refer also to the Terrestrial Vegetation section for additional information regarding riparian and wetland vegetation.

The effects of livestock effects can be seen across the planning area, particularly in riparian areas where they concentrate. Historical grazing and agricultural activities such as irrigation has led to riparian vegetation changes. Various allotments have seen improvements through BMPs and updated allotment

management plans, however riparian and aquatic habitat improvements within grazing allotments continue to be a challenge across the plan area. Most allotments managed under a season long grazing strategy continue to have impacts to RMZs.

Across the forest, road encroachment into riparian areas and wet meadows are found in all GAs. Runoff from roads in the proximity of riparian areas deliver sediment. Dispersed camping across the forest has also resulted in compacted soils and removed riparian vegetation.

Natural disturbance processes

In the ecosystems of the HLC NF, primary natural disturbances that affect riparian areas include flooding, fire, insects, disease, and weather events (i.e., windstorms). These disturbances are an integral part of the creation, maintenance and renewal of forests.

Periodic flooding in wide, low-gradient drainages maintains a diverse mosaic composed of vegetation patches of varying compositions and structures, interspersed with sloughs and wetlands. Flooding is much less of a factor in moderate or steep gradient streams or for wetlands farther removed from rivers and streams. Fire and other disturbances play a larger role.

Fire has shaped the vegetation conditions across the planning area for millennia, influencing forest ages, structure, plant species composition, productivity, carbon storage, water yield, nutrient retention, and wildlife habitat across all areas of the forest, including riparian areas.

In more normal or wet climatic periods, fires still occurred across the planning area but tended to be smaller and more mixed severity. The more moist vegetation types that are characteristic of riparian areas tended to either not burn or burn at low to moderate severity during these years. More forest in the riparian areas would remain intact across the landscape, with individual or small patches of burned trees, and occasional large, more extensive burned areas within riparian.

Other natural disturbances that historically influenced the forests within riparian areas are insects, disease and weather events, such as windstorms and blowdown. These effects cause varying amounts and extent of tree mortality, from nearly all trees killed (such as in a mountain pine beetle epidemic in a lodgepole pine dominated stand), to only scattered trees killed. As with fire, forest structure is affected, including changes/decreases in forest density and canopy closure and increased amounts of dead wood. Reduced canopy closure may stimulate growth of understory grasses, forbs and shrubs, as well as improve growth on remaining live trees. Tree species compositions may change.

Wetlands

Wetlands and other ground water-dependent ecosystems are communities of plants, animals, and other organisms whose extent and life processes depend on ground water (USDA Forest Service 2007). The following are examples of some ecosystems that may depend on ground water:

- Wetlands in areas of ground water discharge or shallow water table
- Terrestrial vegetation and fauna, in areas with a shallow water table or in riparian zones
- Aquatic ecosystems in ground water-fed streams and lakes
- Caves and Karst systems
- Aquifer systems, and
- Springs and seeps

These areas contain ecological resources that potentially are highly susceptible to permanent or long-term environmental damage from contaminated or depleted ground water. Ground water extraction by humans modifies the pre-existing hydrologic cycle. It can lower ground water levels and alter the natural variability of these levels. The result can alter the timing, availability, and volume of ground water flow to

dependent ecosystems. Ground water-dependent ecosystems vary in how extensively they depend on ground water, from being wholly dependent to having occasional dependence. Unique ecosystems that depend on ground water, such as fens or bogs for example, can be entirely dependent on ground water, which makes them very susceptible to local changes in ground water conditions (USDA Forest Service 2007). Particular threats in the plan area include facility and road development, grazing impacts, contamination from roads, and clearing of vegetation.

Riparian and wetland vegetation types are mapped on over 70,000 acres of the HLC NFs administrative area, less than 3% of the total planning area. Forests adjacent to wetlands have historically been influenced by the natural disturbance processes characteristic of this ecosystem. These include fires, insects, disease, and weather events (e.g., windstorms). These disturbances caused various amounts of tree mortality, altering forest structures, species and densities. Mixed or stand replacement fire regimes, where greater than 75 percent mortality of trees occurs across portions or all of a burn area, are the most common natural fire regimes on the planning area, encompassing 90% of the area (see assessment). Forested lands adjacent to wetlands burned as well. Periodic high severity fires would revert older forests to early successional stages where grass, forbs, shrubs, tree seedlings and snags dominated. Mixed severity fires would have some areas burned at high severity, some burned at moderate severity, and some areas at low severity or unburned. All these fire severities may occur in the forested lands immediately adjacent to wetlands, depending upon forest conditions, moisture levels, weather, and luck.

Fisheries, aquatics and conservation watershed networks

Watershed condition is the state of the physical and biological characteristics and processes within a watershed that affect the soil and hydrologic functions supporting aquatic ecosystems. Broadly speaking, watershed condition can range from natural pristine (functioning properly) to degraded (impaired). The FS Manual (FSM 2500) defines watershed condition in terms of ‘geomorphic, hydrologic, and biotic integrity’ relative to ‘potential natural condition.’ In this context, integrity relates directly to functionality.

Within the planning area, the trends for the viability of individual populations of species of concern are mixed. Several populations of westslope cutthroat trout are at imminent risk of hybridization and/or extirpation through predation or replacement by nonnative species (L. Nelson et al., 2011). With recovery efforts, the number of known westslope cutthroat trout populations has remained constant at best; populations added through recovery projects have roughly equaled those lost in areas where greater protection wasn’t feasible or invasion by non-native species was not expected. Populations are mostly small isolates while the meta-population sized objectives outlined in the restoration goals (MFWP 2007) have yet to be achieved. Efforts underway in the Dry Fork of Belt Creek in the Little Belt Mountains would create over 20 miles of connected habitat and move towards partial achievement of meta-population objectives. Other proposed projects west of the divide, such as removal of hybridized fish in the headwaters of the North Fork Blackfoot River, would also provide meta-populations that have greater probabilities for long-term persistence. This opportunity exists because several somewhat rare basin characteristics combine to allow for a probability of success that isn’t readily available in most other locations.

Bull trout express two life histories within this plan area, resident and migratory. Resident populations in tributaries are mostly known to be displaying stable trends based on monitoring survey efforts. There are long-term concerns with smaller, isolated populations, since habitat patch-size is known to be a determining factor in viability even under natural disturbance regimes influenced by conditions such as wildfire and climatic change (Eby, Helmy, Holsinger, & Young, 2014; Rieman et al., 2007). Bull trout also express a fluvial life history in the Blackfoot River and historically in the Little Blackfoot River drainages.

The USFWS now considers the fluvial life-form to be extirpated from the Little Blackfoot River. Surveys conducted by MTFWP personnel have been negative for occurrence in the Little Blackfoot. Personnel

from the Forest located a few fluvial-sized bull trout in tributaries to the Little Blackfoot River about ten years ago and observed one angler catch more recently. The most recent genetic test of remnant fluvial-sized fish documented hybridization (Harper 2014). Even though bull trout are considered extirpated in the Little Blackfoot, recent sampling utilizing the environmental DNA technique verified that bull trout persist in the drainage (Young et al. 2017).

The viability of the fluvial life-history form of bull trout in the upper Blackfoot River basin, which correlates well with the boundaries of the NF, is believed to be at low risk under current and forecasted climatic change conditions (Isaak et al 2017). The same survey and assessment efforts put the viability of fluvial populations at high risk lower in the Blackfoot River drainage. Tributaries on the Forest are known to contribute fluvial fish to lower portions of the Blackfoot River.

The plan components of this plan revision were developed to protect the strict habitat requirements of westslope cutthroat trout (*Oncorhynchus clarki lewisi*) and bull trout (*Salvelinus confluentus*) that require colder and cleaner water. The coarse scale components are designed to protect riparian habitat. If these measures are found to be insufficient, fine scale components are developed to protect these habitat requirements. Therefore, habitat conditions for these species will be used to assess the indirect effects of this plan revision. The plan components developed for aquatic habitat and dependent species will provide stream habitat conditions suitable for not only bull trout and westslope cutthroat, but also for numerous other aquatic organisms including sculpins, mountain whitefish and amphibians. Native species west of the Continental Divide whose range includes the Blackfoot and Little Blackfoot River drainages include mountain whitefish (*Prosopium williamsoni*), largescale sucker (*Catostomus macrocheilus),* longnose sucker *(Catostomus catostomus),* longnose dace *(Rhyinichthys cataractae)* and sculpin (*Cottus sp.*). Native species found in lakes include, Northern pikeminnow (*Ptychocheilus oregonensis),* Peamouth chub *(Mylocheilus caurinus),* and Redside shiner *(Richardsonius balteatus).* Many of these species are found at lower elevations in the drainages or in lake systems off forest.

East of the divide mountain sucker *(Catostomus platrhynchus),* longnose sucker *(Catostomus catostomus),* white sucker *(Catostomus commersoni)* burbot *(Lota lota),* stonecat (*Noturus flavus*), longnose dace *(Rhyinichthys cataractae*and), and sculpin (*Cottus sp.*) are also native species in the plan area. Arctic grayling *(Thymallus arcticus*) were also a native salmonid in the Missouri River drainage above the Great Falls and now largely absent from the plan area except in some mountain lakes.

Amphibians whose range overlaps with the plan area include tailed frogs (*Ascaphus montanus*), boreal chorus frog (*Pseudcris maculata*), northern leopard frog (*Lithobates pipiens),* Columbia spotted frog (*Rana luteiventris*), western toad (*Anaxyrus or Bufo boreas*), plains spadefoot (*Spea bombifrons),* long-toed salamander (*Ambystoma macrodactylum*), and western tiger salamander (*Ambystoma mavortium).*

Non-native brook trout (*S. fontinalis*), rainbow trout (*O.mykiss*), and brown *trout (Salmo trutta)* are also present within the planning area, as is the non-native cyprinid, the common carp *(Cyprinus carpio).* Warmwater sport fish species including northern pike (*Esox lucius*), perch (*Perca flavescens*), and walleye (*Sander vitreus*) can be found in some lakes, rivers and reservoirs primarily in the Missouri River Reservoir complex or at lower elevations off forest. These non-native sport fish are desired by some anglers and provide recreational angling opportunities, however no plan components are being specifically developed for these species since the plan components for trout will provide stream habitat conditions suitable for all coldwater and trout species.

Conservation watershed networks

Conservation Watershed Networks are intended to identify important areas needed for conservation and/or restoration, maintain multi-scale connectivity for at-risk fish and aquatic species, and to ensure ecosystem components needed to sustain long-term high-quality water and persistence of species. The proposed Conservation Watershed Network in the revised forest plan is designed to provide that long-

term conservation strategy to conserve native fish in watersheds that are expected to be long-term cold water refugia in the face of climate change (Isaak, Young, Nagel, Horan, & Groce, 2015).

Aquatic at risk species

The 2012 Planning Rule states that, where plan components designed to provide for ecosystem integrity do not sustain the ecological conditions required by an at-risk species, species-specific plan components may be needed. For some at-risk species, specific components have been included in the Draft Plan in order to sustain the ecological conditions (including but not limited to specific amount or distribution of habitat features, protection from human disturbance, etc.) required by that species. Federally listed and proposed species will be analyzed in a Biological Assessment for consultation with the USFWS after a preferred alternative is chosen and concurrent with preparation of a FEIS. At the time this report was prepared, there are three at-risk aquatic species found on the HLC NF. Those species are as follows:

- Federally listed, proposed, or candidate species:
    - Bull Trout – Threatened
- Species of Conservation Concern:
    - Western Pearlshell Mussel
    - Westslope Cutthroat Trout

Bull trout (threatened species)

In November 1999, the USFWS listed all populations of bull trout within the coterminous U.S. as a threatened species pursuant to the ESA of 1973, as amended (Act) (USFWS, 1999). The 1999 listing applied to one distinct population segment (DPS) of bull trout within the coterminous U.S. The Forest is in the Columbia Headwaters recovery unit. Two core areas of the Columbia Headwaters recovery unit are within HLC NF Lands; they are the Blackfoot River Core Area (Number 31) and that portion of the Clark Fork River (Section1) Core Area (Number 34) in the upper Little Blackfoot River drainage. Recovery actions for bull trout (USFWS, 2015b), developed in cooperation with Federal, State, tribal, local, and other partners, fall generally into four categories:

- Protect, restore, and maintain suitable habitat conditions for bull trout.
- Minimize demographic threats to bull trout by restoring connectivity or populations where appropriate to promote diverse life history strategies and conserve genetic diversity.
- Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.
- Work with partners to conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, and considering the effects of climate change.

The Northern Region of USDA FS also developed a Bull Trout Conservation Strategy for Forests in western Montana, including that portion of the HLC NF in 2013. In addition to the recovery plan, the USFWS also released the Columbia Headwaters Recovery Unit Implementation Plan (USFWS, 2015a) in 2015.

Two basic life history forms of bull trout are known to occur: resident and migratory. Resident bull trout spend their entire lives in their natal streams, while migratory bull trout travel downstream as juveniles to rear in larger rivers (fluvial types) or lakes (adfluvial types). The populations in the Blackfoot River drainage include both residents and fluvial life history form, where juveniles remain in their natal stream or move downstream to rearing streams, and then returning around age 6 to spawn.

Extensive sampling from 2008-2010 suggests that bull trout are nearly extinct in the Little Blackfoot drainage (USFS, 2013). It is hypothesized that up to 1,000 bull trout redds may have been historically present in the Blackfoot River Core Area. As with most bull trout populations, overall numbers were likely highly variable from year to year, based on natural climatic and disturbance patterns. Bull trout

populations in the Blackfoot River were likely first exposed to mining-caused impacts in the late 1800's in the form of small scale mining. The mining method was often an instream "placer" type operation that directly disrupted fish habitat and stream functions. Once disturbed in this fashion after being moved and straightened, streams rarely have the ability or the power to naturally recover to their pre-disturbance condition.

Western Pearlshell Mussel (SCC)

Western pearlshell (*Margaritifera falcate*) is a state species of special concern in Montana (S2) and is a species previously identified as sensitive on the Region 1 Sensitive Species (RFSS) list (USDA, 2011a). Montana's populations of *M. falcata* have significantly declined over the last century in Montana and have become less viable with stream-decreased flows, warming, and degradation. Previously reported mussel beds in the larger rivers (Smith, Blackfoot, Big Hole, Bitterroot, Clark Fork,) have been extirpated or decreased to such low densities that long-term viability is unlikely.

Westslope cutthroat trout (SCC, Focal Species)

The USFWS was petitioned by interested parties to include the westslope cutthroat trout under the protection of the ESA. In 2003, the USFWS determined that the listing was not warranted due to wide species distribution, available habitat on public lands, and conservation efforts underway by state and federal agencies. The planning area headwater streams are considered a stronghold for westslope cutthroat trout throughout its range (Shepard, May, & Urie, 2005).

The primary reasons for this species' decline are similar to those discussed above for the bull trout. Habitat loss is considered a widespread problem. Cutthroat trout have declined across their range due to poor grazing practices, historic logging practices, mining, agriculture, residential development, and the lingering impact of forest roads. Locally on forest, logging and associated road building have had the greatest impact upon populations. Fish have been unable to use spawning habitat due to barriers created by dams and road culverts. Genetic introgression with rainbow trout threatens long-term persistence of westslope cutthroat trout, and is most likely the greatest threat (Hitt, Frissell, Muhlfeld, & Allendorf, 2003). Climate change may likely exacerbate the rate of introgression (Muhlfeld et al., 2014). Efforts of a wild trout restoration and conservation initiative have been underway since 1988 in the Blackfoot River drainage and is an iterative tributary-based priority-driven process whereby the scope and scale of restoration expands as information and stakeholder cooperation is generated (Pierce & Podner, 2006). Restoration methods include enhancing flows in rearing areas, preventing adult and juvenile fish loss to irrigation in migration corridors, reconstructing damaged streams, fencing livestock from spawning areas, and expanding similar actions in adjacent tributaries to address human-induced limiting factors when opportunities allow. The primary geographic focus of stream improvement activities had been bull trout "core area" streams and tributaries downstream from the North Fork Blackfoot until early in this decade However, restoration and conservation measures have now expanded to streams in the Lincoln valley and headwater areas on the HLC NF. Conservation actions in the headwaters of the Blackfoot River are especially important because this large GA harbors genetically pure native westslope cutthroat trout and may hold the highest potential for native cutthroat trout conservation based at the sub-basin scale. Electrofishing and genetic status monitoring of westslope cutthroat trout is also expected to continue in cooperation with MFWP and other signators of the westslope cutthroat trout Conservation Agreement Memorandum of Understanding (MFWP 2007).

Non-native fish

The Columbia Headwaters Recovery Unit Implementation Plan for Bull Trout Recovery Plan (USFWS, 2015a) identified action items that included suppression of nonnative fish invaders to protect the intact native species assemblages as in the Copper Creek/Landers Fork drainage on the HLC NF. Brown trout may be simply replacing bull trout in areas where habitat quality has declined or they may be actively

displacing bull trout. However, additional study is required before definitive conclusions can be made regarding their interactions and their level of threat to bull trout.

Hybridization of westslope cutthroat trout with non-native rainbow trout is increasing in the Blackfoot River drainage (Hahn and Landres 2016). Hybridization reduces reproductive success of westslope cutthroat trout and can lead to a loss of the species and genetic material (Muhlfeld et al. 2009a). Efforts are ongoing to reduce hybridization. Habitat enhancement in streams with native fish assemblages continues to be a priority. In the upper Missouri Subbasin, only 3.3% of the historic distribution is known to be occupied by genetically unaltered westslope cutthroat (Nelson et al., 2011). Conservation populations, those less than 10% genetically introgressed, that reflect the Lewis and Clark portion of the planning unit in northcentral Montana only occupy approximately 10% of the historic range (MFWP 2014). Temperature may play a key role in reducing hybridization between the two species with westslope cutthroats favoring colder water, thus climate change is a concern in the long term.

Soils

Originally adopted in 1986, the Helena and the Lewis and Clark Land Resource Management Plans are the primary documents that establish management standards and guidelines governing activities on NFS lands within the boundaries of the HLC NF. The forest plans do not provide a variety of management direction related to the soil resource. Since 1999, physical soil disturbance has been the focus of soil management on NFS lands. FSM Chapter 2550 Region 1 Soil Management Supplement provides a benchmark that indicates when changes in soil properties and conditions may result in a notable change or impairment of soil quality. Not all soil disturbance results in substantial or permanent impairment of productivity. The R1 FSM defines levels of soil disturbance (compaction, displacement, rutting, severe burning, surface erosion, loss of surface organic matter, and soil mass movement) that are considered detrimental (of a great enough magnitude to potentially cause substantial impairment). No more than 15% of an activity area may have detrimental soil disturbance. This low level of detrimental soil disturbance allows recovery to occur between management activities. The NFMA states that management activities on NFS lands will not produce substantial and permanent impairment of productivity. The agency assures that productivity is maintained by establishing soil quality standards.

In 2010, FSM Chapter 2550 Soil Management was revised at the national level. The emphasis of soil management was changed to include long-term soil quality and ecological function. The FSM defines six soil functions: soil biology, soil hydrology, nutrient cycling, carbon storage, soil stability and support, and filtering and buffering. The objectives of the national direction on NFS lands are 1) to maintain or restore soil quality, and 2) to manage resource uses and soil resources to sustain ecological processes and function so that desired ecosystem services are provided in perpetuity.

The 2012 planning rule broadened soil management direction, requiring plans to maintain or restore terrestrial ecosystems, put more succinctly in terms of ecosystem services. The FS manual outlines these services as soil biology, soil hydrology, nutrient cycling, carbon storage, soil stability and support, and filtering and buffering.

Land use practices, such as grazing, logging, and mining, have been occurring on the HLC NF since their inception. Activity impacts are evident on the landscape today. Dynamic soil characteristics may be indicators of impaired productivity. Compaction may restrict plant rooting, may lower water-holding capacity, and may decrease infiltration. Loss of surface soil through displacement and mixing may decrease soil productivity. Displacement occurs during temporary road construction, excavation of skid trails and landings, and displacement of soils during ground-based harvest. Areas with ground disturbance may become more favorable for weed invasion, which can reduce overall soil productivity and quality.

Since soil function is difficult to measure in the field, associated factors that can be readily observed and measured. These factors include disturbance to surface organic matter and disturbance to topsoil. Most

management activities affect surface organic matter that can rebound relatively quickly as surface leaf litter and roots in the soil rebuild organic matter stocks. In contrast, the mineral topsoil could be considered a summation of a site's potential to support growth based on bedrock, terrain, climate, and rate of soil development. When management activities displace or remove portions of the topsoil, this impact involves a longer term recovery than disturbance. These consequences can vary depending on the soil depth and the place in the landscape. Topsoil disturbance on drought prone sites could proportionally affect the soil's ability to provide water to trees more than on wet sites where seasonal moisture stress is less.

Management can also use soil function to inform prescriptions (Craigg et al. 2015). Managers often refer to historic range of variability as an analogue to manage for tree species composition and structure. Soils provide a historic record of vegetation distribution with grassland types and deciduous trees creating darker top soils than sites dominated by forests and shrubs. Soil characteristics of depth, texture and even the accumulation of ash laden loess can indicate areas most able to provide water through the summer. These characteristics inform managers of where best to plant species requiring high summer water and where trees have the best growing conditions.

Existing condition

The Forest has a wide diversity of soil types from the minimally-developed, nutrient poor soil and rock complexes of the steep mountain slopes and ridges to the deep, fertile soils of the lower valleys. Steep terrain prone to intermittent surface movement combined with recent ablation of glaciers have limited soil development. Soil provides ecosystem services through thermoregulation, nutrient cycling, and water purification and storage. It also contributes to provisioning ecosystem services by providing wildlife habitat, plant-growth media, and fill (construction).

The diverse and productive soils of the HLC NFs are described, characterized, and classified in the Soil Survey of Helena NF Area, and Soil Survey of Lewis and Clark NF Area respectively.

Hydric soils

Hydric soils are defined by the National Technical Committee for Hydric Soils as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil profile (USDA-SCS, 1994). These soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophilic flora. Hydric soils occur across the landscape in areas along stream channels, on floodplains, and in isolated springs and seeps. Hydric soils are a primary indicator of wetlands and are used in the assessment of FS compliance with Executive Orders 11988 and 11990, directives relative to the management and disposition of floodplains and wetlands.

Sensitive soils

Certain attributes associated with soils on the forest make them sensitive or susceptible to impairment of soil quality and productivity caused by management activity.

Soil organic matter is fundamentally important to sustaining long-term soil productivity and quality, and is influenced by fire, harvest activities, decomposition, and accumulation rates. The organic component of soil is a large reserve of nutrients and carbon and is the primary site for microbial activity. Forest soil organic matter influences many critical ecosystem processes, including the formation of soil structure. Soil organic matter is also the primary location for nutrient recycling and humus formation, which enhances nutrients, water storage, and overall fertility. Soil organic matter depends on inputs of biomass (e.g., vegetative litter, fine woody debris) to build and maintain the surface soil horizons, support soil biota, enhance water-holding capacity, and prevent surface erosion. A review of the soil data and interpretations from the Natural Resource Conservation Service Web Soil Survey shows that a majority of the plan area has soils easily eroded if the organic layer is removed.

Soils formed from granitic rocks comprise another group of sensitive soils on the forests (especially in the Divide, Castles and Elkhorn GAs.). These soils are typically non-cohesive, coarse textured and are susceptible to erosion and mass wasting. These soils are droughty with low water and nutrient holding capacities; therefore, keeping the thin surface organic layer intact is extremely important.

Soils with an ash cap are another group of sensitive soils on the NF which are spread across the Upper Blackfoot, Divide, Elkhorn, and the central section of the Big Belts GAs of the Helena NF). These soils are characterized by a low bulk density, high water holding capacity, and high cation exchange capacity that can lead to a concentration of nutrients. Ash caps are extremely susceptible to compaction, erosion, and soil mixing. Ashy soils do not recover from compaction as quickly as other soil types. Since volcanic ash is not replaced, the effects of losing the ash cap would be permanent.

Mollic soils are another group of sensitive soils that occur on the forest. These are soils with a large amount of organic matter (excluding wetlands). They are very productive and support primary grazing. These soils do not generally develop under forested vegetation, but can develop under aspen stands. Areas with these soil types will be overlaid on a map with vegetation, and anything that shows as transitory grazing will become priority lands to be restored to primary grazing. These soils will also be used as an indicator in areas that have conifer encroachment, but that should be restored to meadow or rangeland. This is thought to be occurring over 10s of thousands of acres across the plan area. This analysis will be undertaken when the soil maps are completed.

The final group of sensitive soils are the fine-textured, shallow soils (defined as soils less than 20 inches deep) that occur on the forest. These soils are sensitive because they are susceptible to erosion and detrimental effects from management actions. They are generally weakly developed, have relatively little organic matter, and therefore have low nutrient levels. Any soil displacement or loss can greatly affect their productivity because there is little nutrient-rich soil left when even a small amount is removed. Further, when soil is shallow, runoff can infiltrate to the bedrock layer and run along that layer, carrying the overlying shallow soil with it.

3.5.6 Environmental consequences

Watershed condition

Effects common to all action alternatives

There is a need to update what was intended to be interim INFISH Plan components in place west of the Continental Divide and to improve aquatic habitats are management elsewhere in the Draft Plan and DEIS to remain consistent with strategies in place across public lands in the western United States. Comments received since the proposed action was published have been used where appropriate to improve the proposed action and have helped inform this DEIS. In the Draft Plan and action alternatives, additional management direction has been included to address aquatic and riparian ecosystem integrity and connectivity. Components have been added to the proposed action that increase attention for watersheds identified for conservation (see appendix E.) The HLC NF Plan Revision is also being completed under the 2012 Planning Rule so text and style of original INFISH component standards and guidelines have been adjusted to be compliant with the current Planning rule.

The Draft Plan proposes to maintain the use of PIBO monitoring data collected at a subset of sites on the forest every year in combination with improved desired conditions. While the Draft Plan does not contain numerical Riparian Management Objectives like INFISH did, descriptive desired conditions contained in the Draft Plan would be used to guide project location, development, and actions. Because of the lag time between projects and effects, as well as the tremendous variability that can result from localized weather events, PIBO data analyzed at the Forest Scale is actually a more rigorous method to ascertain whether or not plan components designed to protect and restore the aquatic environment are effective. All of this

information will enable the Forest to adapt its management strategies and adjust decisions in the future, if needed, based upon what has been learned.

Another change is the inclusion of a multi-scale analysis strategy in appendix C of the draft plan. Multi-scale analysis, a refinement of watershed analysis, has been a widely applied methodology that was first required for use by the USFS in the Pacific Northwest Region (Henjum et al., 1994). It was also described and recommended for use in the interior Columbia Basin key and priority watersheds by PACFISH and INFISH Strategies (1995), and is recommended for inclusion in plan revisions by the Interior Columbia Basin Ecosystem Management Project (2014) strategy. The multi-scale analysis strategy included in appendix C has been simplified and clarified to sharpen focus on necessary integration.

Watershed condition in geographic areas

The largest change of the revised forest plan to GAs would be the implementation of plan directions for RMZs. All action alternatives would adopt RMZs required plan directions across all GAs (FW-RMZ-STD-01). All plan direction would be implemented across the planning area. Also the Draft Plan direction would result in additional protection for riparian areas with the adoption of RMZs forestwide. The inner and outer riparian zone plan directions would also provide increased aquatic habitat and water quality protection which would maintain or move riparian resources towards desired conditions. These effects would be most dramatic on the east side of the Continental Divide. In the planning areas west side of the Continental Divide (15 percent of the planning area), the RMZs would largely not lead to different outcomes from current INFISH directions in alternative A.

All previous 1986 plan components for municipal watershed were brought forward into the Draft Plan. The addition of the Lewistown municipal watershed in the Snowies GA will affect management actions with those watersheds. Forest plan directions will be more restrictive to maintain high quality drinking water for the city. See discussion on individual municipal watershed in their respective GAs.

General watershed condition

Many land management activities carried out on the forest have the potential to adversely affect watershed and water quality resources to some degree, particularly those activities that disturb the ground in close proximity to water resources. Table 15 provides a summary of draft forest plan components for aquatic ecosystems.

Current and proposed forestwide standard FW-WTR-STD-03 requires the use of project specific BMPs to be incorporated in all land use and project planning as the principle mechanism for controlling nonpoint source pollution to meet watershed desired conditions. Implementation and effectiveness monitoring of BMPs are performed primarily through three administrative processes: the biennial Montana State Forestry Practices BMP review, forest plan monitoring, and the FS's National BMPs (USDA, 2012d) annual reviews. During the 2014 Montana BMP review, forest BMPs applied on federal lands, including NFS and BLM lands, were found to be over 96% effective at preventing impacts to water quality (Ziesak, 2015). Implementation and effectiveness monitoring of watershed conservation practices, and forest plan standards and guidelines can be carried out by a variety of personnel including timber sale administrators, contract officer representatives, resource specialists, and line officers. Systematic monitoring and adjustment of land management activities, where necessary, would ensure the highest possible level of BMP implementation and effectiveness.

All streams with assigned TMDLs receive special emphasis to improve water quality conditions under all alternatives due to the FS's legal obligation to meet requirements under the Clean Water Act. For the action alternatives, this obligation has been emphasized with a forestwide guideline to comply with the TMDL implementation plans (FW-WTR-GDL-01).

Table 15. Summary of plan components for aquatic ecosystems– revised forest plan alternatives B, C, D, and E

Plan Component(s)	Summary of expected effects
FW-WTR-DC, GO, OBJ, STD, and GDL	Forestwide watershed plan components provide extensive direction to guide management actions to maintain and enhance watershed conditions across the Forest. Collectively, they would improve stream channel function, water quality, groundwater, and enhance aquatic habitat. They will help provide resiliency in the face of warming climate.
FW-RMZ-DC, GO, OBJ, STD, and GDL	Implementation of the riparian management standards and guidelines include directions for management actions within RMZs would improve riparian, floodplain, water quality and stream channel conditions across the planning area. The new riparian zone widths would increase width and would have a limiting effect of management actions that could occur with RMZs. The exception would be the west side of the divide as there would be little difference between (Amendment 14) INFISH and proposed RMZ widths. They will help provide resiliency in the face of warming climate.
FW-FAH-DC, GO, OBJ, STD, and GDL	Implementation of the fish and aquatic habitat standards and guidelines include directions for management actions within streams, riparian and wetlands areas would benefit habitat conditions.
FW-CWN-DC, GO, OBJ, STD, and GDL	Implementation of the conservation watershed network standards and guidelines include directions for management actions within native fish populated watersheds would improve habitat and provides additional protection to maintain the viability of the populations. They will help provide resiliency in the face of warming climate.
FW-SOIL-DC, GO, OBJ, STD, and GDL	Soil standards, guidelines and desired conditions provide management directions that would avoid detrimental soil conditions and maintain soil organic material.

Municipal supply watersheds and drinking water, source water protection

Table 16 provides a summary of draft forest plan components for municipal watershed sources. FW-WTR-DC-06, requires that water quality will meet or exceed state water quality standards and fully support designated beneficial uses, and water is of sufficient quality to support surrounding communities. FW-WTR-STD -01 ensures management activities conducted in source water protections areas would be consistent with source water protections and activities in source water protection areas support long-term benefits to aquatic resources and water quality.

The current four municipal watersheds and their current 1986 plan directions (Management Area J on the Lewis and Clark and MA H-1 for the Helena NF) were brought over to the proposed plan revision. Drinking water systems receive additional protections under the current legal framework than just the FS designation of being a municipal watershed. Lewistown municipal watershed was not recognized in the 1986 forest plan and would be designated within the Draft Plan. Lewistown uses Big Spring Creek in the Snowy Mountain GA. Specific plan direction for individual municipal watershed are listed under the appropriate GA.

Activities that alter the quantity, timing, or quality of water resources have the greatest potential for adverse effects, and that risk generally decreases as the distance away from streams or wetlands increases. Some land management actions would be undertaken with the explicit purpose of improving water quality, such as streambank restoration, riparian planting, installing bridges or larger capacity culverts in roads, or undertaking road storage or decommissioning. Actions that are intended to improve water quality often result in short-term adverse effects to water quality, specifically if the implementing actions occur within a water body. Short-term adverse effects are anticipated and considered acceptable when activities are needed to provide long-term protection or improvement of water quality (FW-WTR-STD-01 and FW-WTR-GDL-04).

The greatest change in the revised forest plan with respects to watershed, aquatic and water quality would be the adoption of plan components for activities that occur inside RMZs (FW-RMZ-STD-01). The Draft Plan components were based on INFISH guidance with modifications and would be implemented across

the planning area to move watershed, aquatic habitat, and riparian areas towards desired conditions. Desired conditions are meant to provide for "healthy, functioning watersheds, riparian areas, and associated fish habitats." This Draft Plan direction would result in additional protection for watersheds and riparian areas by implementing RMZ widths. Plan directions would also provide increased aquatic habitat and water quality protection which would maintain or move watershed resources towards desired condition. These effects would be most dramatic on the east side of the Continental Divide since management in riparian areas do not have a fixed width. The widths are determined based on "geographic boundaries of riparian areas by onsite characteristics of water, soil, and vegetation." Vegetation management buffers on the Forest are currently primarily constrained by Montana State SMZs and desired conditions are better defined in the revised plan. See Riparian areas, environmental consequences section for detailed discussion on riparian plan components.

Table 16. Summary of plan components for municipal watershed sources, proposed forest plan, alternatives B, C, D, E

Plan Component(s)	Summary of expected effects
FW-WTR-STD-01 thru 03 and GDL-01 thru 04, FS-RMZ-STD and GDL, FW-FAH-STD and GDL	Standards and guidelines include direction that would continue to maintain or improve water quality and aquatic resources. All 1986 plan components for existing municipal watersheds have been revised, updated and carried forward into the revised Draft Forest Plan. Lewistown would be added to the proposed plan and will be included on the municipal water supply map and be subject to the municipal watershed components.

Alternative A

There are currently three guiding documents providing management directions within the planning area. The Lewis and Clark NF is currently under the management directions in their 1986 Forest Plan (USDA, 1986b). The Helena NF is at present under management direction in their 1986 Forest Plan (USDA, 1986a) and for areas west of the Continental Divide, INFISH (USDA, 1995a) amended to the forest plan (Amendment 14) in 1996. All current management activities are required to follow the 2011 national best management practices and the State of Montana Streamside Management Rule (Montana Department of Natural Resources and Conservation, 2006) for timber management. Also required throughout the planning area is the Montana Stream Nondegradation Act which assures that all reasonable land, soil, and water conservation practices are applied and existing and anticipated beneficial uses would be fully protected.

The current 1986 forest plans are not consistent with the 2012 Planning Rule, since the current plans do not contain the direction "water resources in the plan area, including lakes, streams, and wetlands; ground water; public water supplies; sole source aquifers; source water protection areas; and other sources of drinking water (including guidance to prevent or mitigate detrimental changes in quantity, quality, and availability)." The plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of riparian areas in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity. The plans must take into account, water temperature, blockage of water course, sediment, aquatic and terrestrial habitats, connectivity restoration needs, and floodplain needs, as well as establishment of RMZs around all lakes, perennial and intermittent streams, and open water wetlands.

Table 17. Effects of plan components for aquatic ecosystems, alternative A

Plan Component(s)	Summary of expected effects
Helena NF	

Plan Component(s)	Summary of expected effects
Forestwide Fisheries Standards II/22.	This section provides standards that would guide and/or limit management activities. Water quality, habitat for fish and riparian areas receive the maximum protections for spring and fall spawning habitats. See below for INFISH amendment.
Forestwide Watershed, Soil, & Air Standards II/24-26.	This section provides standards that would guide and/or management activities. These standards are generally more qualitative and less specific than the revised plan components found in the action alternatives.
Forestwide Riparian Standards, II/34-36	These standards would limit activities in riparian areas, and are less quantitative than the plan components found in the draft revised plan.
Management Areas (III/2-III/93)	Management area guidance describes management standards and goals providing protections for watershed, soil, water quality, fisheries and riparian areas.
1996 INFISH amendment: west side of the Continental Divide: Amendment 14	INFISH standards and guidelines impose directions for management actions within riparian habitat conservation areas. These have been effective at improving and maintaining riparian habitats and water quality on the west side of the Continental Divide.
Lewis and Clark NF	
F-3, Soil, Water and Air Protection (2-51 and 52)	This section provides standards that guide and/or limit management activities. This standard includes components that guide management actions to maintain water quality, sustaining soil and site productivity, and prompted revegetation of disturbed areas.
Management Areas MA-R (3-88 thru 95)	This section provides standards for specific to riparian areas that guide and/or limit management activities. Management area guidance describes special considerations for the minimization of activities in riparian areas, standards for stream crossings, and measures to avoid stream contamination.

As discussed under the affected environment section, there are source water protection areas as delineated by MTDEQ on and downstream of NFS Lands. The greatest concern is with surface water intakes. It has been found that pollution impacts on water quality from forestry activities are generally local in nature, short-lived, less frequent, and are less extensive in nature than activities related to either agricultural or urban activities (Dissmeyer, 2000).

The Lewis and Clark and Helena 1986 forest plans have directions for the protection and management of municipal watersheds and water quality (Table 18). The Lewis and Clark forest plan includes management direction for municipal watershed under MA-J. Forestwide directions specific to riparian areas (MA-R) for soil and watershed protections during all management actions and includes directions to implement BMPs, meet state water quality standards and revegetate disturbed areas. The Helena forest plan includes general watershed guidelines for protection of water quality during management actions. The Helena NF plan also includes directions to delineate riparian areas prior to any management activities and includes a riparian buffer of 100 feet from the edge of all perennial streams. Both plans require the adherence to the State of Montana water quality standards and the State of Montana Streamside management zone (SMZ) laws during timber harvest. Additionally, both forest are required to design and implement mitigation measures through the use of the 2012 National BMPs to control erosion and protect water quality.

Table 18. Summary of plan components for municipal watershed sources, 1986 forest plan, alternative A

Plan Component(s)	Summary of expected effects
Helena 1986 Forest Plan: Municipal Watershed Guidance's	Numerous Municipal directions would continue to maintain water quality.
Lewis and Clark 1986 Forest Plan: MR-1	Numerous Municipal watershed directions would continue to maintain water quality. Lewistown (Big Springs Creek) would not be allotted additional protections under alternative A.

Plan Component(s)	Summary of expected effects
Municipal Watershed Guidance's	

Unchanged from its original wording in alternative A, INFISH amended (Amendment 14) the Helena Forest Plan in 1996 and currently only affects planning areas west of the Continental Divide; the west side of the Divide and all of the Upper Blackfoot GAs. INFISH reduced the risk to watersheds, riparian and aquatic resources by improving riparian habitat conservation area protections. There are riparian management objectives and goals to protect and restore, water quality, stream channel integrity, instream flows, meadow and wetland standards, riparian plant, and aquatic habitat. Included are numerical riparian management objectives that include pool frequency, water temperature, large woody debris, bank stability, lower bank angle, and width/depth ratio. INFISH includes management directions for timber, roads, grazing, recreation, minerals, and fire management.

Riparian areas

Effects common to all alternatives

The road network on the Forest affects water and aquatic resources on both a short and a chronic, long term basis. There are motorized roads open to the public as well as administrative use within the forest administrative boundary, including roads managed by other entities such as state highways, a variety of county roads, federal/state land management agencies, and private timber companies. Many roads and motorized trail are located within RMZs that include many road-stream crossings. Routes located closest to water resources potentially provide a background level of disturbance that contributes to direct and indirect effects on aquatic and riparian resources. Motorized trails function similar to roads in regards to soil disturbance however impacts are generally less as there is less disturbed surface area.

Past culvert failures and road slumps have impacted water quality of the HLC NF, particularly at the site-level scale. Forest roads that are maintained on an annual basis are typically those roads that have the most administrative and visitor use. Closed roads receive less maintenance, and not all of these roads were put into proper long-term storage or had their culverts removed. There are stream crossings located on administratively closed FS roads with some culverts remaining that do not receive regular maintenance. Inspection and monitoring of culverts is a monitoring item to address this concern and provide maintenance.

Effects common to all action alternatives

No significant adverse impacts on wetlands or floodplains are anticipated. Wetlands values and functions would be protected in all action alternatives through the implementation of the RMZs and by following the FS's National BMPs for Water Quality Management on NFS Lands. Under the requirements of Executive Order 11990 and Clean Water Act, Section 404, wetland protection would be provided by ensuring that new construction of roads and other facilities would not have an adverse effect on sensitive aquatic habitat or wetland functions. In addition, wetland evaluations would be required before land exchanges or issuance of special-use permits in areas where conflicts with wetland ecosystems may occur.

Plan components have been designed to conserve riparian areas and protect floodplains under the action alternatives. Executive Order 11988 also requires site-specific analysis of floodplain values and functions for any project occurring within the 100-year floodplain zone, and prior to any land exchange involving these areas.

Protective measures for riparian areas include the delineation of RMZs around all water resources and the extent of unstable areas. Management activities within the RMZ must comply with all proposed direction, as well as the previously mentioned national and state BMPs and other state water quality regulations.

Floodplains would be managed by locating critical facilities outside of floodplains or by using structural mitigation measures. Further protections are provided in forestwide standards and guidelines for management of RMZs.

Livestock grazing in the planning area has the most impacts to wetlands. Livestock degrade wetland habitat through vegetation removal, bank trampling and hoof damage to wetland sub straights. The removal of organic material and increase in water surface area has resulted in the loss or reduction in the size of many wetlands throughout the forest.

All action alternatives include new forest plan direction that would establish designated widths of an inner and outer RMZ bordering streams, lakes, wetlands and other water features, as well as requires plan direction for management actions within the inner and outer RMZs. The width of the RMZs for all action alternatives are delineated as follows (FW-STD-RMZ-01):

> Category 1 Fish-bearing streams: RMZs consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream channel), whichever is greatest.
>
> Category 2 Permanently flowing nonfish bearing streams: RMZs consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.
>
> Category 3 Constructed ponds and reservoirs, and wetlands greater than 1 acre: RMZs consist of the body of water or wetland and: the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or the extent of unstable and potentially unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance from the edge of the wetland greater than 1 acre or the maximum pool elevation of constructed ponds and reservoirs, whichever is greatest.
>
> Lakes and natural ponds - RMZs consist of the body of water and: the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance, whichever is greatest.
>
> Category 4 seasonally flowing or intermittent streams, wetlands, seeps and springs less than 1 acre, and unstable and potentially unstable areas: This category applies to features with high variability in size and site-specific characteristics. At a minimum, the RMZs should include:
>
> •The extent of unstable and potentially unstable areas (including earthflows).
>
> •The stream channel and extend to the top of the inner gorge.
>
> •The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation, extending from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest. A site-potential tree height is the average maximum height of the tallest dominant trees for a given site class.
>
> •Intermittent streams are defined as any non-permanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria. Fish-bearing intermittent

streams are distinguished from non-fish-bearing intermittent streams by the presence of any species of fish for any duration. Many intermittent streams may be used as spawning and rearing streams, refuge areas during flood events in larger rivers and streams or travel routes for fish emigrating from lakes. In these instances, the guidelines for fish-bearing streams would apply to those sections of the intermittent stream used by the fish.

In order to achieve watershed desired conditions, the RMZ is broken into two areas called the inner and outer zones (Table 19). Some activities are prohibited or restricted in the inner zone, whereas more active management is allowed in the outer zone. RMZs are not intended to be "no touch zones," but rather "carefully managed zones" with an increase in protections in close proximity to water resources.

Table 19. Typical widths[1] of inner and outer areas within RMZs proposed as standards for all action alternatives

Stream type/habitat feature	Inner RMZ width (ft)	Outer RMZ width (ft)	Total RMZ width[1] (ft)
Category 1 – Fish bearing stream	100	200	300
Category 2 – Perennial, nonfish bearing Stream	100[2]	50	150[1]
Category 3 – Natural Lakes and ponds, Constructed Ponds and Reservoirs, and wetlands greater than 1 acre	100	50	150[1]
Category 4a – Intermittent steep (>35% side slope)	100[1]	0	100
Category 4b – Intermittent flat (<35% side slope) Disconnected intermittent MT State SMZ Class 3 and wetlands <1 acre.	50	50	100

1. Widths listed are for each side of the stream, total width would be double the numbers listed.
2. Management zone widths extend either to the distance listed or to the top of the inner gorge slope break, whichever is greater.

RMZs are portions of watersheds where riparian associated resources receive primary emphasis, and management activities are subject to specific plan components including standards and guidelines. In order to achieve watershed desired conditions, some activities are prohibited or restricted in the inner RMZ, whereas more active management is allowed in the outer RMZ.

As compared to current standard INFISH widths west of the Continental Divide, RMZ total widths remain the same for Category 1, 2 and 3 habitat features while all Category 4 habitat features would have a 100 foot RMZ width in contrast to some INFISH features which had only a 50 foot width. The inner RMZ, which is the most restrictive area, would be at least 100 feet on either side of the edge of the active channel for all stream and waterbodies except those in Category 4b (intermittent flat streams <35% slope, disconnected intermittent MT State SMZ Class 3 streams and wetlands <1 acre), where it remains a 50 foot width. With properly implemented BMPs, best available science information indicates the inner RMZ widths are the minimum required to protect aquatic habitat and water quality.

East of the Continental Divide, fixed widths for RMZs would be established on each side of the stream or river from the edges of the active channel to 150 feet on non-fish bearing, perennial streams, and 300 feet on each side for fish bearing streams. For riparian areas east of the Continental Divide the adoption of RMZs would increase the area protected by plan components (Table 20). This change expands protections from one hundred feet from the edge of all perennial streams, lakes, and other bodies such as aquatic ecosystems, floodplains, and areas dominated by riparian vegetation on the Helena portion of the combined forest. On the Lewis and Clark portion of the combined forest, the change would be substantive since standards only require adherence to state water quality standards and to maintain soil productivity. In addition, all areas would continue to comply with State SMZ rules. The additional plan directions would provide protection to riparian areas and move them towards desired conditions. The adoption of RMZs would substantially increase protection of water quality and habitat conditions. In the planning

area west side of the Continental Divide, which is 13 percent of the area within the HLC NF, adoption of RMZs would not be expected to provide largely different outcomes than from current INFISH directions in alternative A.

Table 20. Comparison of RMZs across the HLC NF

	West of Continental Divide, Helena	East of Continental Divide, Helena	East of the Continental Divide, Lewis and Clark
Percentages of lands, old Forest boundaries	34%	66%	100%
Percentages of Lands, HLC Combined Forest	13% of entire HLC	25% of entire HLC	62% of entire HLC
Alternative A (current Plans)	subject to INFISH Widths	subject to 100' buffers, plus State SMZ rules for Timber, 50'	Buffers unspecified, TBD on the ground, plus SMZ rules for Timber, 50'
Action alternatives B-E	RMZs, not a significant change, increase in flexibility with inner/outer rules	RMZs, more significant change	RMZs, most significant change

The proposed direction change in action alternatives for RMZs is based on research in recent years that documented that in some cases active RMZ management can advance riparian condition while preserving the functional attributes for riparian, aquatic, and water resources. The proposed RMZ plan components were designed to improve riparian vegetation within the RMZs, while limiting activities that create long-term degradation, such as road building and clearcutting. Treatments would be designed to reflect the composition, structure and pattern of vegetation that would be consistent with the NRV, as described in the desired conditions. The proposed RMZ standards in all action alternatives establish a differentiation between the inner and outer portions of RMZs with regard to limitations on vegetation management (FW-STD-RMZ-01, 03, 04). Management of the outer RMZ would allow for other management objectives such as the reduction of uncharacteristic fire as long as treatments did not create long-term degradation to riparian and aquatic condition. The proposed standards were developed to explicitly recognize that RMZs can benefit from active management and that the areas closest to water have greater importance for protection of water quality and aquatic resources based on the best available science.

Table 21 displays the estimated size of RMZs in acres. This was estimated from MTFWP fish distribution data for only perennial fish bearing streams east and west of the Continental Divide. The information can be used to provide a programmatic comparison of changes in the size of areas across alternatives.

Table 21. Stream type/habitat feature acres by GAs proposed as standards for all action alternatives[1]

GA	Category 1	Category 2	Category 3	Category 4	Total
Big Belts	15,055	5,291	3,155	27,852	51,352
Castles	2,258	3,098	2,078	2,975	10,408
Crazies	1,585	3,278	918	2,244	8,025
Divide	11,923	5,769	4,611	6,814	29,117
Elkhorns	7,058	3,892	1,959	4,919	17,828
Highwoods	3,257	568	27	1,953	5,806
Little Belts	43,733	11,261	12,591	47,197	114,783
Rocky Mountain Range	37,387	34,005	7,720	26,236	105,349

GA	Category 1	Category 2	Category 3	Category 4	Total
Snowies	3,610	367	596	8,134	12,707
Upper Blackfoot	24,323	4,633	8,979	12,729	50,665
Grand Total	150,189	72,162	42,635	141,053	406,039

1. See Table 9 for category descriptions

While the proposed implementation of inner RMZs east of the Continental Divide essentially doubles the existing comparative widths on some, but not all, streams, the largest change in action alternatives east of the Continental Divide is in the outer RMZ area, which is also the area where greater flexibility for management activities would be maintained (Table 22). For comparative purposes, 80,620 acres would be the estimated size of the outer RMZs for perennial fish bearing stream reaches east of the Continental Divide for all action alternatives, and 20,630 acres west of the divide for a total of 101,250 acres forest wide. The acreage estimated west of the Continental Divide represents greater flexibility for management when compared to alternative A and does not represent an increase in riparian protection widths west of the divide. While this example for fish bearing streams examines just a single subset of the RMZ categories, it provides a relative comparison of action alternatives with the existing condition. This comparison does not include other categories than fish bearing streams and it includes areas on the HLC NF that cannot be harvested as well as areas within current or RWAs.

Table 22. Estimated size (acres) of RMZs for only perennial fish bearing streams (minimum SMZ east of divide and INFISH Category 1 west of the divide)

Planning area location	Alternative A – existing conditions	Alternatives B,C,D,E 100 foot Inner RMZ	Alternatives B,C,D,E 200 foot outer RMZ
East of the Continental Divide	20,240[1]	40,450	80,620
West of the Continental Divide	30,870[2]	10,340	20,630
Total	51,110	50,790	101,250

1. Represents the minimum State SMZ size
2. Category 1 fish bearing streams

The 2012 planning rule emphasizes integration of management direction in recognition of ecological sustainability and the interdependence of ecological resources, and the proposed RMZ areas would also contribute to wildlife habitat connectivity and protection of plant species and animal communities associated with wetlands. RMZ direction under all action alternatives was refined through plan components to guide appropriate management based upon best available science. The entire RMZ is classified as not suitable for timber production, based on the determination that a scheduled flow of commercial timber products using a rotation age could not be expected to occur on these lands due to management requirements and desired conditions for other resources. However, timber harvest is allowable, with restrictions as specified in the plan, such as to meet the RMZ desired conditions outlined in the revised plan. Other vegetation management activities that may occur and are expected to occur to maintain riparian conditions include prescribed fire, thinning, planting of trees or shrubs, and fuel reduction. Vegetation management in the inner RMZs for categories 1, 2, 3, 4a and 4b would occur expressly for the purposes to restore or enhance riparian, fish and aquatic resources (FW-STD-RMZ-03), with specific exceptions. Vegetation management in the outer RMZ (FW-STD-RMZ-04), would allow more opportunity to manage vegetation resources to achieve desired vegetation and riparian conditions so long as conditions in the inner RMZ were not adversely affected and wildlife needs were met to achieve desired conditions (FW-RMZ-DC-01 and 02). Refer also to later section on effects to riparian areas from timber and vegetation management.

Fire is a natural disturbance process that has historically influenced the forests within watersheds, including riparian areas and forests adjacent to water features. The natural role of fire, as well as other

natural disturbances, in creating the diversity of successional stages, species compositions and structures in riparian areas is incorporated into the design of the desired forest and vegetation conditions outlined in the plan (FW-RMZ-DC-01 through 02). In areas where use of fire (including wildfire) or other natural disturbances is limited or not feasible, vegetation treatments could be applied where determined appropriate to achieve desired conditions within riparian areas.

Alternative A

Alternative A does not incorporate a watershed approach to the management of hydrology and watershed processes; there would not likely be watershed scale consideration and protection of hydrologic and riparian area/wetland processes and functions. Current plan directions do not establish fixed RMZs, standard, guidelines or desired conditions for riparian areas. This would likely result in the continued maintenance of areas currently in satisfactory condition and areas currently in unsatisfactory would remain unchanged.

The existing 1986 forest plans are unchanged in alternative A. Forestwide direction in the current forest plans address water quality, stream channel integrity, and other features associated with aquatic and riparian areas that provide protection for the riparian-associated resources and values. East of the Continental Divide, the Lewis and Clark NF riparian areas are currently protected by forest plan direction (Management Area R), which requires adherence to State of Montana water quality standards, Montana SMZ laws during timber vegetation management, and FS National BMPs. Riparian areas are delineated and evaluated prior to implementing any project activity. On the east side of the divide, there are currently no fixed riparian widths. The widths are determined based on “geographic boundaries of riparian areas by onsite characteristics of water, soil, and vegetation.” For vegetation management the Montana SMZs widths (Table 23) are required statewide for timber management only and do not affect many activities occurring on the forest, like recreation, grazing, and wildfire suppression. The 1986 Helena forest plan has specific management directions for riparian areas for timber harvest. Harvest would only occur in riparian acres in conjunction with sale activities adjacent to lands and should be on a 240 year rotation. These directions and BMPs (i.e. upsizing and replacing old culverts, and upgrading and eliminating roads in riparian areas) during timber harvest have prevented adverse impacts to riparian habitats in close proximity to water resources.

Table 23. Basic widths of SMZs (SMZ) in Montana

Stream type	Inner (ft)	Total width (ft)
Class 1 and 2 Streams <35 percent slope	50	50
Class 1 and 2 Stream > 35 percent slope	100[1]	100[1]
Class 3 Streams and other bodies of water	50	50
Wetlands	**Edge of wetland**	

1. Management zone widths extend from both sides of streams and rivers from the Ordinary High Water Mark

The Inland Native Fish Strategy (INFISH) (USDA, 1995a), as it was amended to the Helena NF plan in 1996, is unchanged from its original wording in alternative A. This amendment only affects the GAs west of the Continental Divide; the Upper Blackfoot and west portions of the Divide GAs. INFISH reduced the risk to watersheds, riparian and aquatic resources by improving riparian zone protections.

Riparian habitat conservation areas (RHCAs) are established as management zones bordering streams, wetlands and other water features (Table 24). The RHCA direction from INFISH was added in addition to all other direction in the 1986 forest plans. The delineation of RHCAs is completed at the project site specific level on the ground (i.e. identified in the forest based on site characteristics) and the methods for delineating RHCAs is described in the amendment, including their minimum widths. INFISH PIBO monitoring results have shown statistically significant improvements in the majority of stream habitat

attributes, including the overall index at the Regional scale since the standards and guidelines were implemented in 1996.

Table 24. Standard widths defining INFISH RHCAs[1] by stream category or water body, alternative A, west side of the Continental Divide on the HLC NF

Stream type/habitat feature	Width on each side of stream (ft)
Category 1 – Fish bearing streams	300[1]
Category 2 – Perennial, non-fish bearing streams	150[1]
Category 3 – Natural Lakes and ponds, constructed ponds and reservoirs, and wetlands greater than 1 acre	150[1]
Category 4a – Intermittent or seasonal streams and wetlands <1 acre in Priority Watersheds[2]	100
Category 4b – Intermittent or seasonal streams and wetlands <1 acre in not in Priority Watersheds	50

1. RHCA widths extend either to the distance listed or to the top of the inner gorge slope break, or to the outer edges of the 100 year floodplain, whichever is greater.
2. Priority on HLC include Copper Creek in the Blackfoot River Drainage and the Little Blackfoot River upstream of the confluence with Dog Creek and includes Dog Creek.

Under alternative A, current forest plan directions for riparian, water quality, and wetlands would continue on the east side of the Continental Divide. The plan has directions to define riparian areas on the project level with onsite characteristics of vegetation and soils. With the exception of the Montana SMZ rule for timber management actions, there are no fixed riparian areas. For areas on the west side of the divide, current forest plan directions would continue to apply as well as incorporated INFISH standards and guidelines that protect or minimize effects to riparian and aquatic resources. Current trends in riparian area across the planning area would be expected to continue.

Alternative A is not consistent with the 2012 Planning Rule, since the current plans do not establish RMZs around all lakes, perennial and intermittent streams, and open water wetlands, specifically on the old Lewis & Clark NF.

Wetlands

Effects common to all alternatives

Under all alternatives, stewardship projects could result in funds being available for restoration. The highest priority for these restoration actions would be within the conservation watershed network under the action alternatives to benefit native fish (FW-CWN-GDL-02). It is expected that temporary and short-term impacts to fish, stream channels, water quality, etc. from culvert removals, in-channel restoration, and habitat surveys would still occur. It is also expected that long-term positive effects would occur from these restoration activities.

Effects common to all action alternatives

Plan components would promote watershed restoration projects to improve the long-term ecological integrity of ecosystems and conserve genetic integrity of native species (FW-WTR-GDL-04). The highest priority for restoration actions would be within the conservation watershed network (FW-CWN-OBJ-02) to benefit native fish. Riparian areas in these watersheds would receive the greatest benefits and actions would focus on stream crossings. The benefit of re-establishing riparian vegetation at these sites would not vary between alternatives.

For riparian areas east of the Continental Divide, the adoption of RMZs would increase the area protected by plan components. Therefore, the adoption of RMZs would provide more protection for water quality

and riparian resources. The planning areas west side of the Continental Divide RMZs would largely not lead to different outcomes from current INFISH directions in alternative A.

The effect on aquatic resources would be the same across all GAs for restoration projects because all plan directions for restoration would be required across the planning area. Effects from restoration projects would have a long-term positive effect, but the short-term effects may be negative. Typically short term effects occur during implementation due to increased sediment, however, long term sediment reductions are accrued. Standards and guidelines would mitigate the general negative effects described above under all alternatives through the required implementation of BMPs, such as FW-WTR-STD-03.

The restoration directions under the revised forest plan include guidance to promote the long-term ecological integrity of ecosystems and conserve the genetic integrity of native species (FW-WTR-STD-04). Objective for restoration work is 1 to 5 acres of groundwater dependent systems with a focus on priority watersheds as determined in the watershed condition framework (FW-FAH-OBJ-01) and conservation watershed networks have the highest priority for restoration actions for the aquatic environment (FW-CWN-OBJ-02).

Restoration effects can be of a long term positive effect but be of a short negative nature; typically short term effects occur during implementation by increasing sediment, however, long term sediment reductions are accrued. Plan directions would mitigate the general negative effects described above under all action alternatives through required implementation of BMPs (FW-WTR-STD-03). Standards and guidelines would limit management in RMZs, and road construction.

Alternative A

A wide variety of watershed restoration activities may occur throughout the life of this plan. These activities include instream restoration projects, including the installation of large woody debris, riparian planting, fish barrier installations, and road restoration projects, including road relocation projects, road decommissioning, and fish passage projects.

The current 1986 Lewis and Clark and Helena forest plans do not specifically have plan directions for restoration projects. However, INFISH amended the 1986 Helena NF plan for those planning areas on the west of the Continental Divide and includes four guidelines for restoration. Restoration actions since that time have primarily focused on culvert removals, road decommissioning, road relocation and slump stabilization. These activities resulted in improved fish passage and sediment reduction. These activities would continue under alternative A. Stewardship funding is currently a tool often used for restoration projects as well as appropriated dollars for watershed and fisheries and would likely continue under alternative A.

There are no guidelines for restoration in either the 1986 Lewis and Clark or the Helena forest plans. Much of the restoration efforts in the planning area have been focused in riparian areas to restore mining and grazing impacts. Restoration activities have included planting, fencing, bank stabilization, and stream restoration. These activities have resulted in benefits to riparian functions and stream processes. Future benefits from these restoration projects are expected to continue under alternative A. On the west side of the divide, the INFISH amendment to the Helena 1986 plan includes four guidelines for fisheries and wildlife restoration (FW-1 thru FW-4) and two general watershed and habitat restoration guidelines (WR-1 and 2). These directions include instructions to design and implement restoration projects that promote long-term ecological integrity of ecosystems, conserve the genetic integrity of native species and contributes to the attainment of the riparian management objectives. Restoration actions since that time have primarily focused on culvert removals, road decommissioning, road relocation and slump stabilization.

Alternative E

Alternative E would result in the highest volume of timber production and therefore have the potential to generate more money from timber receipts for restoration projects for watershed and fisheries. If more money is available from alternative E then there would be more short-term impacts from restoration projects but there would be more long-term gains.

Removing aggrading substrate behind placed stream-structures can reduce the low-flow wetted channel width and the width-to-depth ratio, increase sinuosity and meander pattern, and over time restore floodplain connectivity. Installing woody debris structures can stabilize stream channels over the long term and make them more resistant to erosion by dissipating stream energy during periods of high runoff. Gravel bars typically re-vegetate with riparian species such as alder or willow, ultimately leading to channel narrowing and stabilization. Restoration of floodplain connectivity over time would result in more frequent inundation of the floodplain, fostering the creation of side channels, seasonally flooded potholes, and other kinds of off-channel habitats.

Placement of large wood can improve sediment routing while creating more physically complex fish habitat. The stability or longevity of this wood within streams is strongly linked to its size, orientation to flow, channel dimensions, watershed area above the structure, and the percentage of the log that is in the active channel. Eventually some movement downstream would take place. Pieces that move can become incorporated in larger wood complexes or hang up on streamside trees or other channel features.

Fisheries, aquatics and conservation watershed networks

Effects common to all alternatives

Many watersheds in the Rocky Mountain Range and Upper Blackfoot GAs that support the healthiest populations of native trout already have their headwaters protected through lands managed as Congressionally-designated wilderness areas (Bob Marshall and Scapegoat Wilderness) or the HLC NFs eligible wild and scenic rivers. These special places are the building blocks of a conservation network as naturally functioning headwaters have a large influence on the function of downstream reaches.

Effects common to all action alternatives

The greatest benefit to aquatic species occurs where non-native species do not negatively impact native populations. The effects of plan components on aquatic species do not vary between alternatives. Proposed estimated acres of wilderness would vary by alternative. However, the proposed acres are located in inventory roadless. Therefore the difference in roaded acres would not change substantially.

The most significant change between action alternatives and the existing plan (alternative A), is the incorporation of forestwide standards and guidelines that are specifically designed to protect aquatic resources. The impacts to aquatic resources from all action alternatives would provide a greater level of protection for aquatic and riparian resources than alternative A. Additional riparian protection would also be provided since the RMZ would be increased to 100’ for intermittent streams in all watersheds. There would also be a 300’ RMZ on all ponds and wetlands regardless of size which is a change from alternative A. RMZs are not exclusion zones but forest management is allowed to occur with greater flexibility in the outer portion of RMZs. Guidelines (FW-RMZ-GDL-01 and 02) are designed to protect riparian and aquatic resources by taking a multi-scale, multi-resource hard look at stream habitat and riparian conditions prior to entry. The greater protection provided by plan components, including RMZs and conservation watershed networks, in the action alternatives east of the Continental Divide would maintain and enhance habitat for aquatic species, including SCC, more rapidly than the no-action alternative.

Standard FW-FAH-STD-01 and FW-FAH-GDL-01 assures when improving stream diversion or constructing new diversions and associated ditches they are designed and screened to prevent fish capture.

FW-FAH-GDL-04 guides the development of allotment management plans to be designed to maintain water quality by minimizing disturbance from livestock grazing in active allotments. FW-FAH-GDL-05 states that all construction activities within the ordinary high water mark that may result in adverse effects to native or nonnative aquatic species would be limited to times outside of spawning and incubation periods.

Restoration activities would focus on "storm proofing" the existing road network in light of climate change. Maintaining migratory life histories is an important element of conservation. Selecting numerous watersheds rather than a select few provides the greatest opportunity to maintain connectivity and a migratory life history. Watersheds occupied by both bull trout and westslope cutthroat trout populations, which are, or are nearly genetically pure, correspond well with the primary conservation area for grizzly bears, which would also limit the road network.

Spread and introduction vectors are inherent to most projects and types of forest use. Thus, components of the plan require mechanisms for addressing aquatic invasive species. More general or universal objectives and procedures, such as using current best practices for equipment washing before and after entering an area, are recommended for inclusion in the fish and aquatic wildlife sections of the document. This better assures that these components are included as resource protection measures at the project level. These activities would include, but aren't limited to: transporting water across drainage boundaries for fire suppression, constructing stream fords, operating equipment in a riparian area and near a water course, and the use of pumps and sumps for fire suppression, or construction related dewatering activities.

All action alternatives would emphasize RMZs and would facilitate management of multiple ecological goals and long term ecological sustainability on a landscape basis. Updated aquatic and riparian desired conditions, objectives, standards, and guidelines would be applied in a consistent manner across the forest. The action alternatives would provide a mechanism to effectively prioritize activities and weigh multiple risks to various resources.

Under all action alternatives, the Conservation Watershed Network (appendix E of the Draft Plan) provides a network of watersheds designed to emphasize conservation of westslope cutthroat and bull trout by protecting and restoring components, processes, and landforms that provide quality habitat. The objective for selecting conservation watersheds is to contain the largest intact populations and provide long term protection to bull and westslope cutthroat trout populations across the Forest. All occupied or expected to be occupied bull trout streams were designated conservation watersheds networks. An objective of the conservation watershed network is to identify and conserve watersheds that would have cold water to support native fish into the future in the face of climate change.

A key strategy in these watersheds is no net increase in the road network and stream crossings as identified in guideline, FW- CWN-GDL-01. Reducing roads would reduce potential sediment inputs, benefit aquatic species, and improve ecological function.

The effects of implementing the conservation watershed network plan components would be similar across all action alternatives. All CWN priority watersheds on the east side of the divide are new for the proposed forest plan. West of the Continental Divide, priority watersheds were identified in 1996 after adoption of INFISH. Additional watersheds have been included in the proposed plan as part of the action alternative where native fish such as westslope cutthroat are present. These plan components provide direction that makes these watersheds a priority for restoration (FW-CWN-OBJ-02). Across the planning area, aquatic habitats and water quality within CWNs would receive additional protection from plan components that limit net increases in stream crossings and road lengths within RMZs (FW-CWN-GDL-01) and CWNs would receive priority for road closures or other strategies to reduce sediment (FW-CWN-GDL-02). Livestock grazing management would be subject to plan components designed to minimize damage to aquatic ecosystems, vegetation and streambanks (FW-CWN-GDL-03). The action alternatives

provide additional protection to native species assemblages throughout the plan area compared to the no-action alternative.

The effects on fisheries and aquatics from other resources such as restoration, wilderness, noxious weeds, wildlife management, and recreation are the same as the riparian section since wetlands are a type of riparian area and can be found in those sections.

The Conservation Watershed Network (appendix E of the draft plan) provides a network of watersheds designed to emphasize conservation of westslope cutthroat and bull trout by protecting and restoring components, processes, and landforms that provide quality habitat. The objective for selecting Conservation Watersheds is to contain the largest intact populations and provide long term protection to bull and westslope cutthroat trout populations across the Forest. All occupied or expected to be occupied bull trout streams were designated conservation watersheds networks. An objective of the Watershed Conservation Network is to identify and conserve watersheds that would have cold water to support native fish into the future in the face of climate change. A key strategy in these watersheds is no net increase in the road network and stream crossings as identified in guideline, FW- CWN-GDL-01. Reducing roads would reduce potential sediment inputs, benefit aquatic species, and improve ecological function.

Many watersheds in the Rocky Mountain and Upper Blackfoot GAs that support the healthiest populations of native trout already have their headwaters protected through lands managed as Congressionally-designated wilderness areas (Bob Marshall and Scapegoat Wilderness) or the Helena-Lewis and Clark's WSRs. These special places are the building blocks of a conservation network as naturally functioning headwaters have a large influence on the function of downstream reaches. See additional conservation watershed network information in appendix E of the Draft Plan.

Alternative A

East of the Continental Divide the Helena and the Lewis and Clark 1986 forest plans are unchanged from their original wording in alternative A. The plans have directions for the protection and management of watersheds and water quality. The 1986 Lewis and Clark forest plan includes forestwide directions specific to riparian management areas (MA-R) for soil and watershed protections during all management actions and includes directions to revegetate disturbed areas. The Helena forest plan also includes general watershed guidelines for protection of water quality during the management actions. Included are directions to delineate riparian areas prior to any management activities and includes a riparian buffer of 100 feet from the edge of all perennial streams. Both plans require the adherence to the State of Montana water quality standards and the State of Montana SMZ standards would still apply during timber harvest. All management actions would continue to require design and implantation of mitigation measures through the use of the 2012 National BMPs to control erosion and protect water quality.

The INFISH implemented west side of the Continental Divide, as it was amended to the Helena forest plan in 1996, is unchanged from its original wording in alternative A. INFISH reduced the risk to watersheds, riparian and aquatic resources by improving riparian zone protections to protect habitat and populations of native fish. INFISH has standards and guidelines for timber, roads, grazing, recreation, minerals, and fire management that have improved water quality and stream habitat within the Upper Blackfoot GA and the western portion of the Divide GA. The continued implementation of INFISH direction, TMDL plan implementation, BMPs, reduction of road construction, and a reduction of timber harvest along streams due to riparian habitat conservation areas likely helped and continue to reduce sediment delivery to streams from roads, mining related impacts, and other actions.

As protection measures outlined in the 1995 INFISH BO continue to be implemented on the west side GAs (Divide and Upper Blackfoot), the goal of improving habitat conditions as well as benefitting designated critical habitat and stabilizing or increasing populations of TES would have a greater probability of success.

For the east side GAs, continued efforts to restore, enhance and stabilize riparian ecosystems would continue. The implementation of the State's streamside management law during timber management would continue in both east and west side GAs. Efforts directly related to protecting and maintaining the viability of existing populations of sensitive species in east side GAs would continue.

Under alternative A, it is anticipated that the level of diversity for the water quality indicator macroinvertebrate assemblage across the entire planning unit would be at least maintained, at current proportions. The discussion of effects of forestwide direction on water quality and INFISH also apply to the effects alternative A would have on aquatic threatened and endangered species and sensitive species.

At the time of the draft EIS, bull trout were listed as threatened while westslope cutthroat trout and western pearlshell mussels were sensitive species known to occur on the HLC NF. East of the Continental Divide, alternative A would not provide as much protection for fisheries and aquatics as the action alternatives and may provide for less and more gradual movement towards desired conditions.

The no-action alternative did not consider impacts from non-native and invasive species and plan components such as FW-CONNECT- GDL-01 would help educate the public about aquatic invasives species.

Conservation watershed networks are only delineated under the 2012 planning rule and are not included in the 1986 forest plans east of the Continental Divide. West of the divide, CWN adopted INFISH priority watersheds would maintain their status under alternative A.

Alternative A does not incorporate a watershed approach to the management of hydrology and watershed processes; there would not likely be watershed scale consideration and protection of aquatic habitat and riparian area functions. This would result in the continued protection of areas currently in satisfactory condition and areas currently in unsatisfactory would remain unchanged.

Soils

Effects common to all action alternatives

All action alternatives would emphasize RMZs and would facilitate management of multiple ecological goals and long term sustainability of soil resources on a landscape scale with consistency across the Forest. These alternatives would also provide a mechanism to effectively prioritize activities and weigh multiple risks to various resources.

Additional research is needed to establish minimal necessary amounts of organic matter by habitat type. In the interim, the soil management on the HLC NF has adopted the guideline FW-SOIL-GDL-05 that conserves the forest floor and coarse wood levels. This component would help ensure that soil productivity is maintained in the long term.

Alternative A

The existing forest plans have protections for native soil and dictates soil productivity will be maintained. Regional standards include a 15 percent detrimental soil disturbance limitation that are not included in the current plans. Alternative A does not incorporate a watershed approach to the management of soil resources. There would not be watershed scale consideration and protection of soil processes and functions. The result would be the continued protection of areas currently in satisfactory condition and areas currently in unsatisfactory would remain unchanged.

Effects of plan components associated with:

Recommended wilderness

Effects common to all action alternatives

Plan components for RWAs would be beneficial for water resources. The amount of RWAs varies by alternative; alternative D includes the most, followed by B/C, and E includes no RWAs (Table 25). The overall effect of RWAs in the Draft Plan are expected to be beneficial to water quality and quantity because of the limitation on land management activities within RWAs. However, the proposed RWAs are already, for the most part, located in IRAs which impose limitations on management actions (i.e. roads building, vegetation management) within those areas. Only 3 to 7 percent of the RWAs in the action alternatives are outside of the IRAs. Therefore, the magnitude of the positive effects to water resources of the action alternatives relative to the no-action alternative are small. Alternative E includes no RWAs therefore no additional protection outside of IRAs would apply. Recommending these areas as wilderness would ensure that wilderness characteristics are maintained and would provide protection of habitat conditions. If Congress were to designate the RWAs, activities that would negatively impact wilderness character, such as road building or timber harvest, would likely not occur.

Table 25. Summary of RWA acres in IRA acres by alternative

Alternative	Total RWA (Ac)	Total Acres Of RWA within IRA	Percent of RWA In IRA
A	34,225.87	33,759.73	98.64
B and C	213,075.67	207,403.62	97.34
D	474,588.71	441,044.92	92.93
E	0	0	0

RWAs would confer beneficial effects to riparian areas. However, these acres are largely IRAs and there is currently little active management. Recommending these areas would ensure that wilderness characteristics are maintained and protected and active management of RMZs limited to prescribed fire or use of wildfire. Revised forest plan components for the protection and management of riparian management areas would be the same for all action alternatives and provide the same level of plan direction.

The best remaining trout habitat conditions are found in wilderness and unroaded landscapes (Hitt & Frissell, 2000; Kershner, Bischoff, & Horan, 1997; Rhodes, McCullough, & Espinosa, 1994; USDA, 1995b). Across the west, roadless areas tend to contain many of the healthiest of the few remaining populations of native trout, which are crucial to protect (Kessler, Bradley, Rhodes, & Wood, 2001). Most of the recommended wilderness would be located in areas already designated inventoried roadless areas. These areas are a source of high quality water essential to the protection and restoration of native trout. The high quality habitats in roadless areas help native trout compete with non-native trout, because degraded habitats can provide non-natives with a competitive advantage (Behnke, 1992). Roadless areas tend to have the lowest degree of invasion of non-native salmonids (Huntington, Nehlsen, & Bowers, 1996). Areas of low road density also act as the foundation for the needed restoration of larger watersheds.

The RWAs are already situated in IRAs, RNAs, and proposed wilderness areas which already have limited management direction that minimizes disturbance in those areas. Therefore, the magnitude of the potential differences to water resources based on RWAs is relatively small at the programmatic level.

Alternative A

The current 1986 Helena NF plan as amended include 34,226 acres of RWAs. No RWAs are still proposed in the 1986 Lewis and Clark NF plan. The areas of RWAs are high elevation and would protect headwater habitats that would provide cold clean water downstream to fish and habitat and natural conditions would be maintained in the RWAs. Under the current plan, 99 percent of the RWAs are currently in IRAs and already have a high degree of protection from management activities which further protects water quality.

Wildfire and fuels

Effects common to all alternatives

Fire is a natural disturbance process that has historically influenced the forests within watersheds, including riparian areas and forests adjacent to water features (see section 3.2.5 Riparian areas and wetlands affected environment, natural disturbance processes). Fire is expected to continue to function as a natural process across the planning area, especially within designated wilderness and unroaded lands. Wildfires can affect water chemistry, water quantity, and stream channel structure through changes in transpiration, infiltration, ground water recharge, erosion and mass wasting, riparian shading, and the recruitment and delivery of coarse debris (Benda & Dunne, 1997; Gresswell, 1999; Moody & Martin, 2001a, 2001b; Wondzell, 2001). Potential post-wildfire risks from floods, landslides, and debris flows to human life, property, and/or municipal supply watersheds are an increasing concern across the western United States (Moody & Martin, 2001a).

Climatic events following wildfire can trigger surface erosion or mass failures (landslides), which in turn can deposit sediment that alters stream channel structure and function. Severe wildfire can result in large expanses of blackened areas that have a high potential for generating runoff and delivering sediment to streams during intense rainstorms. When wildfire burns through riparian areas, streams may be left with no shade leading to an increase in water temperatures.

The Forest has experienced an increase in large fires over the last two decades. Based upon monitoring from MTDFWP following the Fool Creek Fire (2007), juvenile fish populations increased in streams that experienced large fires. Additionally, bull trout redd counts demonstrated a strong increase following the Snow-Talon Fire in 2003 in the Copper Creek drainage. This is largely due to an increase in nutrients following the fire. Overall, fire is beneficial to fish as fish have evolved with fire over the last 10,000 years, with the exception of the last century due to fire suppression. Impacts to fish are largely a result of fire suppression activities due to increases in sediment, misapplication of retardant, withdrawing water if proper screens are not in place, and other actions. Standards and guidelines for fire management were first adopted with INFISH on the west side of the divide and are included across the planning area in this plan. Plan components do not differ between alternatives and the effects would be the same across alternatives: wildfires may result in short term impacts with long term benefits due to nutrients while suppression activities result in impacts that should be mitigated with plan components.

For the past twenty years fuels were treated with a combination of mechanical treatment and predominantly underburning instead of broadcast burning. Broadcast burning removes slash and understory vegetation to facilitate reforestation, but has had negative consequences by consuming the forest floor and groundcover. Underburning, on the other hand, results in low and moderate burn severity that retains soil groundcover and forest floor. It is also used in conjuncture with whole tree yarding that removes fuel even before burning. A tradeoff of whole tree yarding, however, is the export of nutrients offsite by removing foliage.

For the next planning period, the Forest would continue to treat fuels using a mixture of pile burning, mechanical removal and under burning. The treatment type affects soil condition by removing vegetation that would otherwise decompose in soil and build up soil carbon. The loss of vegetation by treating fuels is not far removed from natural processes since fire regularly removed vegetation. However, the impacts

may vary by site type. In some areas, treating fuels aligns with ecological processes and the soils have a higher proportional amount of organic matter in the mineral soils to buffer the removal. For other moist types, the fuels treatment may not directly align with natural cycles. Treating fuels temporarily removes dense growth but the moist conditions favor quick regrowth. Repeated removal of vegetation to mitigate fire hazard would be out of sequence with the long periods between fires that these vegetation communities typically experienced. These treatments would reduce vegetation leaf and root litter contributions to soil with overall impacts depending on soil fertility.

Managing prescribed fire and wildfire for resource benefit poses temporary risk for erosion/ deposition during at least three years post fire depending on remaining groundcover. After fire, the blackened ground stabilizes as plant cover and roots secure the surface, and loose exposed soil transports downslope.

Effects of wildfire on stream runoff, sedimentation and nutrients are largely beyond the forest planning scope because we cannot predict when and where wildfires will burn.

Effects common to all action alternatives

All action alternatives would have similar direction for fire management. Specific plan directions to limit impacts from fire suppression activities include:

- RMZs and habitat may still be impacted in certain circumstances when no other suitable locations for incident bases, camps, heli-bases, staging areas, etc., exists (FW-GDL-RMZ-08).
- RMZs would have limited exposure to fire retardant (FW-RMZ-GDL-09)
- Fuels treatments often require the use of ground based equipment, the Forest would apply the same mitigation as for timber harvest to limit soil disturbance. The same guidelines for timber would also apply for retaining minimum levels of soils organic matter and ground cover (FS-SOIL-GDL-05). The levels may vary depending on the fire risk, site type, and soil condition (FW-TE&V-GDL-10).
- Only allow location of temporary fire facilities in rare circumstances (FW-RMZ-GDL-07)
- New direction strengthens protection against adverse impacts from fire suppression activities across the entire planning area to riparian zones.
- Fire line construction and use of heavy machinery would be conducted to minimize impacts to riparian areas (FW-RMZ-GDL-05).
- Storage of fuels or other toxicants would not be allowed except in rare circumstances, under which the approval of an aquatic or resource specialist is required (FW-RMZ-STD-03 and 06).
- Areas of high risk would be mapped to improve the communication of where aerial operations need to avoid dropping fire retardant (FW-RMZ-GDL-10).

Standards and guidelines would mitigate general fire management effects under all action alternatives. There is no differences in effects between alternatives because it is nearly impossible to predict the extent and location of large wildfires. However, it is assumed that impacts to riparian areas would still occur where fire management activities, primarily suppression efforts take place. Impacts to RMZs and habitat may still occur in certain circumstances when no other suitable locations for incident bases, camps, helibases, staging areas, etc., exists. Delivery of chemical retardant, foam, and other additives near or on surface waters may occur when there is imminent threat to human safety and structures or when a fire may escape causing more degradation to RMZs, than would be caused by addition of chemical, foam or additive delivery to surface waters in RMZs. Conversely, where management treatments are used to reduce wildfire hazard, positive long-term effects to riparian areas by not burning may be realized.

Wildfire suppression and prescribed fire tactics can affect watershed resources through the process of building fire line and large fuel-breaks, using fire retardant, causing soil disturbance, and removing vegetation. Ground-disturbance from wildfire suppression can cause a net decrease in effective ground cover that no longer resists rainfall runoff. These activities can route sediment to streams from compacted machine paths and linear features that channels runoff. Rehabilitation efforts after fire would mitigate

these effects across the fire area. The action alternatives would minimize these effects by limiting fire suppression activities away from the most sensitive areas, RMZs (FW-RMZ-GDL-05 and 06). The action alternatives carry forward forest plan components to locate fire camps away from riparian areas where risk of sedimentation and risk of degradation to water quality are highest (FW-RMZ-GDL-08). The action alternatives would have stronger language to avoid degrading water quality from suppression activities by minimizing suppression activities in RMZs (FW-RMZ-GDL-06 and 11), and with specific direction to avoid prescribed fire ignition in RMZs without site specific analysis (FW-RMZ-STD-03).

All action alternatives include plan direction that supports the role of fire and its use across the Forest to a greater degree compared to current plan direction (see Fire and Fuels section). Managing fire (both planned and unplanned ignitions) for resource benefit would promote ecological processes by allowing low and moderate severity fire to burn within riparian areas at a more natural rate. It would also help create desired forest compositions and structures. Use of fire as a tool within RMZs would likely occur to a similar extent under all action alternatives, because of the potential ecological benefits and ability to help maintain or achieve desired vegetation conditions within RMZs.

The proposed riparian directions for fire management within riparian areas would be more restrictive on the east side of the divide (approximately 85 percent of the planning area) than the current forest plans. They would aid in the maintenance of water quality and riparian desired conditions from fire management. There would be no difference in fire management effects of plan components on the west side of the divide as the proposed plan components were adapted from INFISH standards.

All action alternatives would increase the area where fire may be used as a tool for resource benefit when compared to current direction under alternative A. Managing fire (both planned and unplanned ignitions) for resource benefit could increase incidents of sediment deposits, but would promote ecological processes by allowing low and moderate severity fire at a more natural rate. The amount of acres burned across all action alternatives are relatively small and the effects would not vary. Therefore the effects to water quality and quantity would not vary by alternative.

Alternative A

Fuels treatment would continue as a method to reduce fire risk. Prior to year 2000, fuels treatment was primarily a connected action to timber treatment. With the National Fire Plan passed in 2000, fuels treatment intensified steadily in tandem with commercial harvest and as a separate treatment. Fuels treatment also involves managing wildfire for resource benefit since many areas on the forest have not been subjected to fire over the last 100 years.

The 1986 Lewis and Clark NF and Helena NF plans includes plan directions for fire in riparian areas (Table 26). On the west side of the divide, INFISH standards include:

- FM-1 to design fuels treatments and fire suppression as not to prevent attainment of riparian management objectives.
- FM-2 has specific requirements for locating bases, helibases, staging areas and other centers for incident activities outside of Riparian Habitat Conservation Areas.
- FM-3 avoid delivery of chemical retardant, foam, or additives to surface water.
- FM-4 design prescribed burn project to contribute to the attainment of the riparian management objectives.
- FM-5 Develop a rehabilitation treatment plan to attain riparian management objectives and avoid adverse effects on inland native fish whenever RHCA are damaged.

Table 26. Effects of plan components for prescribed fire and wildfire for aquatic ecosystems – alternative A

Plan Component(s)	Summary of expected effects
Helena NF Forestwide Prescribed fire Standards II/33.	This section provides standards that would guide and/or limit prescribed management activities. Prescribed fire would not exceed natural fire intervals. Soil surveys would be used to assist with site selections to avoid potential soil and watershed degradation. See below for INFISH amendment.
Lewis and Clark NF Management Areas MA-R (3-91)	This section provides standards for specific to riparian areas that guide and/or limit management activities. Management area guidance describes special considerations for the minimization of activities in riparian areas, standards for active fuels reduction methods and planned ignitions for the enhancement and maintenance of riparian areas resources.

Invasive weed treatments

Effects common to all alternatives

Noxious weeds are often treated using an integrated approach, with a combination of control methods that include mechanical, biological, and chemical. The effects of some of these methods are discussed here.

Effects from herbicide application depend on the type, extent, and amount of herbicide that is used, the sites' proximity to a stream or wetland, a stream's ratio of surface area to volume, and whether transport from the site is runoff or infiltration controlled. Chemical persistence in the soil profile and surface water depends on the potential for the chemical to leach through groundwater, the size of the treatment area, velocity of streamflow, and hydrologic characteristics of the stream. Herbicide use on the forest abides by MCA 75-5-605 and Section 402 of the Clean Water Act.

Mechanical treatments can result in localized soil disturbance as plants are pulled. Increased sediment to streams along road cuts and fills within riparian areas is possible, but the increase would likely be undetectable due to several factors. First, not all vegetation in a treated area would be pulled, so some ground cover would still be in place. Second, not all sediment from pulling weeds along roads would reach a stream because many relief culverts divert ditch flow onto the forest floor away from streams. Finally, hand pulling is very labor intensive and costly; thus, only a few acres per year could be treated using this technique across a watershed.

Effects common to all action alternatives

Although many threats to water quality from chemical application may be reduced by applying BMPs, they cannot be eliminated. The Draft Plan include specific directions for invasive weed treatment in and around RMZs to protect water quality. Standard FW-STD-RMZ-05 would apply to RMZs to minimize effects to water quality by allowing the use of alternatives to chemicals for treatments within RMZs, thus reducing leaching or drift from chemicals into the water.

Alternative A

The 1986 plans have directions to apply soil and conservation and BMPs to protect water quality. The Lewis and Clark NF 1986 plan emphasizes preventing noxious weeds by reseeding, and adherence to state water quality standards (Soils and Water Management Standards F-3) as required in the Clean Water Act. The 1986 Helena NF plan has the following specific directions for the use of chemicals within riparian areas, "will be minimized to the extent feasible, and will be coordinated with wildlife, watershed, and fisheries personnel and a certified pesticide applicator."

Wildlife management

Wildlife management activities that could affect water quality may include road decommissioning, vegetation management, and stream and riparian restoration. The effects on water quality from those activities are discussed in the timber, RMZ, restoration, motorized travel, infrastructure and other appropriate sections.

Recreation

Effects common to all alternatives

General effects from recreational use, construction of facilities, and maintenance of facilities and sites to watershed resources can include undesirable changes to: (1) upland and riparian soil and vegetation conditions, causing increased erosion and runoff, decreased soil-hydrologic function, loss of vegetative cover and wood recruitment, and reduced water quality; (2) stream morphology, water quality, streamflow, and substrate; and (3) water quality from spills of fuel, oil, cleaning materials or human waste associated with equipment, and the pumping of toilets.

Trail maintenance can affect large wood recruitment and function that influences stream channel morphology and aquatic habitat. Bucking out fallen trees can reduce the tree's length and sever the bole from its root wad. Smaller tree lengths are not likely to contribute as much to stream channel stability and are more likely to be washed out during high stream flow events. Smaller instream wood would also delay the recovery of channel features needed to maintain habitat for aquatic species, including overhead cover and low-velocity refugia during high-flow events.

Impacts from trails may include rutting, erosion, and loss of ground cover from user-created trails, trampling of vegetation, vegetation removal, and soil compaction of streamside and upland sites. Rutting may increase surface erosion associated with heavily used trails. High-use campsites may cause root damage in trees resulting in reduced vigor and mortality. In combination, these activities can lead to increased erosion and a reduction in water quality. Increases in recreational visitors increase risks to aquatic communities. The greatest threat from recreation is introduction of aquatic nuisance species. These species include any non-native plant or animal species and disease which threaten the diversity or abundance of native species, the ecological stability of infested waters, or commercial, agricultural, or recreational activities dependent on such waters. The Montana Aquatic Nuisance Technical Committee (2002) identifies over 70 nuisance species. Some, well known in Montana, include the New Zealand mudsnail, curley-leaf pondweed, whirling disease, and non-native fish. While non-native fish like brook and rainbow trout are desirable in many locations, there are places where they are not. An environmental assessment by the MFWP is now required before fish introductions can legally occur.

Most of the pathways of introduction and spread of aquatic nuisance species are related to human activities, both accidental and intentional. The New Zealand mudsnail and whirling disease can be accidentally transported and spread by way of recreational boats and wading boots. The Forest would continue to cooperate and support measures taken to limit the spread of aquatic invasive species. Streambank trampling, camping along the stream's edge, heavy sport fishing, and wheeled motorized vehicle use on designated routes and areas usually result in the loss of vegetation within riparian areas. Loss of vegetation from shorelines, wetlands, or steep slopes can cause erosion and water pollution problems (Burden & Randerson, 1972).

Montana Fish, Wildlife, and Parks enforces laws, rules and regulations that are designed to prevent over-exploitation of fish populations through angling with catch and release fishing or low daily and possession limits for westslope cutthroat trout throughout most of the forest. All waters are closed to angling for bull trout and all fish must be release immediately. There is some incidental mortality to fish when they are caught and released. Habitat alteration from recreational camping and day use sites may cause site-specific impacts, but should not extensive enough to measurably limit fish populations. Localized impacts to vegetation and banks in riparian areas occur at lakes with trout and at river access sites. Effects would be the same between all alternatives. Unmeasurable effects on aquatic and riparian resources from fishing are to be expected.

In general, people who recreate in NFs participate in activities such as driving, hiking, horseback riding, hiking, and camping in the vicinity of lakes and streams. Recreational use is anticipated to increase in the coming decades. Projected increases in recreational use are commensurate with all alternatives.

Implementation of current forest plan direction and BMPs to protect aquatic and riparian resources notwithstanding, impacts to these resources would likely increase given increased public use because stream and lake environments would continue to attract forest users.

Effects common to all action alternatives

Table 27 summarizes the effects of Draft Plan components for recreation on aquatic ecosystems. The Draft Plan includes guidance to manage developed recreation facilities to be responsive to environmental changes such as water flow, fish and wildlife habitats (FW-REC-GDL-01). Plan components in all action alternatives direct the placement of new developed recreation facilities to avoid the inner RMZ to protect fishery resources and riparian-associated plant and animal species (FW-REC-GDL-03 and 04). The Forest should consider relocating recreation facilities that are currently located within RMZs that have documented degradation of aquatic or riparian resources (FW-REC-GDL-05). Forestwide guideline (FW-REC-GDL-06) would protect water resources by guiding new and reconstruction of sanitary waste facilities outside of the inner RMZ.

There are no differences in effects between action alternatives as all would adopt the RMZ plan components across the planning area. For riparian areas east of the Continental Divide, the adoption of RMZs would increase management directions within these areas. Therefore, the adoption of RMZs would provide more protection of water quality over the existing forest plan. On the west side of the Continental Divide RMZs would largely not lead to different outcomes from INFISH directions in alternative A.

Table 27. Effects of plan components for recreation– all action alternatives

Plan Component(s)	Summary of expected effects
FW-REC-GDL 01	Forestwide direction for developed recreation facilities should be responsive to environmental changes including stream flow, fish and wildlife habitats and vegetation.
FW-REC-GDL 03, 04, and 05	These directions restrict the location and placement of facilities outside riparian areas, groundwater dependent ecosystems, wetlands, channel migration zones. These new guidance's would have a limiting effect of management actions that could occur with these areas and would maintain or enhance habitats and water quality. The exception would be the west side of the divide as there would be little difference between (Amendment 14) INFISH and proposed RMZ widths. They would help provide resiliency in the face of warming climate.
FW-REC-GDL-05	This guideline provides directions where existing facilities within RMZs and are degrading aquatic or riparian resources they would be considered for relocation and the site restored. This would have a benefit to water quality and aquatic habitat.

Alternative A

The Lewis and Clark NF plan includes direction that protects riparian resources (MA-R) during the management of recreation. Riparian areas are delineated during project development. The plan provides direction to avoid construction of recreation facilities to protect riparian areas (i.e. roads, trails). The Helena forest plan east of the divide provides similar protections that discourage concentrated use in riparian areas, as well as the construction of roads in riparian areas.

The current 1986 Forest plans have forestwide direction to adhere to state water quality standards. On the west side of the Continental Divide, the INFISH provides additional standards and guidelines for recreation management mainly relocating or constructing new developed and dispersed sites outside of riparian areas. Many sites have been identified where excessive sediment from these sites are a concern. Dispersed sites typically do not have toilet facilities and concentrations of human waste at some locations have been found. Dispersed and developed sites are often located within riparian areas; the ground is often hardened and ground vegetation may have been removed. Trees have been felled for safety reasons in campgrounds and would continue to be felled. Under current direction, these trees would be removed or used as firewood and would not contribute to instream bank stability, thermal regulation, or fish habitat

needs. Throughout the planning area, many developed recreation sites have been relocated due to adverse impacts to riparian management objectives and fish.

Motorized trails, travel management and roads

Effects common to all alternatives

The road network on the Forest affects water and aquatic resources on both a short and a chronic, long term basis. There are motorized roads open to the public as well as administrative use within the forest administrative boundary, including roads managed by other entities such as state Highways, a variety of county roads, federal/state land management agencies, and private timber companies. Many roads and motorized trail are located within RMZs that include many road-stream crossings. Routes located closest to water resources potentially provide a background level of disturbance that contributes to direct and indirect effects on aquatic and riparian resources. Motorized trails function similar to roads in regards to soil disturbance however impacts are generally less as there is less disturbed surface area.

Past culvert failures and road slumps have impacted water quality of the HLC NF, particularly at the site-level scale. Forest roads that are maintained on an annual basis are typically those roads that have the most administrative and visitor use. Closed roads receive less maintenance, and not all of these roads were put into proper long-term storage or had their culverts removed. There are stream crossings located on administratively closed FS roads with some culverts remaining that do not receive regular maintenance. Inspection and monitoring of culverts is a monitoring item to address this concern and provide maintenance.

A potential source for nutrients is phosphorus bonded to sediment (Ballantine, Walling, Collins, & Leeks, 2008; Wood, Heathwaite, & Haygarth, 2005). Detachment of soil particles and associated phosphorus is often linked to soil erosion, which provides a physical mechanism for mobilizing phosphorus from soil into waters (Wood et al., 2005). The greatest input of sediment is from roads.

Effects common to all action alternatives

Forestwide direction includes guidance that would alter road management on the Forest to address the detrimental effects of roads on water quality, wetlands, riparian areas, and aquatic species. The Draft Plan includes continued directions that road maintenance along open roads would include BMPs to minimize adverse impacts on water quality (FW-RT-DC-06). This desired condition along with those under other resource areas are intended to focus future road management to address the impacts of roads on water quality, aquatic, and riparian resources.

Many proposed plan directions that directly affect water quality related to routes and/or road management are the same or modified slightly from current direction, including:

- FW-RT-GDL-01, which is comparable to INFISH RF-2d, requires the Forest to minimize sediment delivery to streams from roads and road drainage to be routed away from potentially unstable channels, fills, and hillslopes. This guideline would reduce the amount of sediment delivered to streams both directly off road and from gullies and mass failures associated with unstable areas adjacent to streams.
- FW-RT-GDL-05, which is comparable to standards Facilities, Road Standard 3 under the Helena and Facilities L4 (22) under the Lewis and Clark forest plans (1986), requires that new and relocated roads, trails and other linear features should avoid lands with high mass wasting potential. This standard is intended to reduce road-related mass wasting and sediment delivery to watercourses, and is expected to prevent degradation of water quality at individual sites.
- FW-RT-STD-08, which is comparable to INFISH RF-2f, requires minimizing side casting into or adjacent to waterbodies when blading roads and plowing snow. This guideline is intended to prevent sediment and debris that are mobilized through blading and plowing from reaching streams and affecting water quality (suspended sediment) and fish habitat.

- FW-RT-GDL-11 requires that the transportation infrastructure should maintain natural hydrologic flow paths, (e.g., streams should be kept flowing in original channels). This guideline would ensure streams are not routed down ditches and into other stream channels in an effort to maintain current discharge and streamflow patterns and not increase erosion in roadside ditches.

Several plan components are modified slightly from current direction to have increased benefits for water quality and aquatic resources, including:

- FW-RT-STD-02, which is comparable to INFISH RF-4 and a new requirement carried over to the east side, requires that new, replacement, and reconstructed stream crossing sites accommodate at least the 100-year flow, including associated bedload and debris. This standard addresses stream crossing structures installed on roads and trails, including bridges and culverts, in order to, at a minimum, pass the 100-year flow plus associated bedload and debris, which would reduce the likelihood of blockages and mass failures at stream crossing sites. This standard differs from previous direction in that it applies more broadly to road and trail crossing structures, whereas INFISH RF-4 only required installation of a 100-year crossing structure where "a substantial risk to riparian conditions" exists.
- FW-RT-STD-04 prohibits side casting fill material when reconstructing or constructing new road segments within or adjacent to RMZs, which is comparable to the second part of INFISH RF-2f. This standard would apply across the entire forest, whereas the INFISH RF-2f standard only applies to INFISH priority watersheds. This standard is intended to expand benefits to riparian and water resources across all GAs, thereby reducing the likelihood of road failures and mass wasting into waterbodies across the entire forest.

Several plan components are new or expand upon concepts and benefits, such as:

- FW-RT-GDL-06 requires that roads that are to be decommissioned, made impassable, or stored would need to be left in a hydrologically stable condition. This standard would apply the concept of leaving a road in a stable condition if it is expected to no longer receive routine maintenance, including roads that are actively/newly stored, closed, or made impassable on the forest. Similarly, FW-RT-GDL-03 requires that travel routes that are to have a physical barrier blocking future access are first assessed for drainage features and treatments must be completed to avoid future risks to aquatic resources. In effect, this standard would require the forest to assess and treat drainage features on roads, skid trails, temporary roads, and trails prior to blocking off vehicular traffic to ensure the road is left in a hydrologically stable condition. The combination of these two standards would improve water quality downstream and adjacent to roads as a result of reducing the likelihood of sediment delivery from road failures where unmaintained culverts have become blocked and have failed.
- FW-RT-GDL-01 requires that the water drainage systems on roads, skid trails, temporary roads and trails should be hydrologically disconnected from surface waterbodies to prevent the delivery of sediment and pollutants and maintain the hydrologic integrity of watersheds. This guideline is a critical element to reduce non-point source pollution from forest roads and trails and is expected to have the greatest impact to maintain current water quality, prevent increased peak flows and water elevation in waterbodies, and maintain current hydrologic regimes across the forest. Under this guideline, water that is collected on hardened surfaces or in road ditches would be routed to the forest floor and allowed to infiltrate subsurface water systems in stable areas.
- FW-RT-GDL-04 requires that new or redesigned stream crossing sites should be designed to prevent diversion of streamflow out of the channels in the event that the crossing becomes plugged or experiences more water than the crossing was designed to handle. Under this guideline, effort would be taken when designing and installing stream-crossing structures to route high flows directly over the top of the road at that site to prevent water from running down the ditch or road surface, which can exacerbate more road failures and sediment delivery to streams. This guideline could be

considered similar to INFISH RF-2e, which requires each existing or planned road to avoid disrupting natural hydrologic flow paths.

- FW-CWN-GDL-01 requires that subwatersheds included in the conservation watershed network allow no net increases in stream crossings or road lengths (similar to the HNF road standard 1) within RMZs unless the net increase improves ecological function in aquatic ecosystems. This net increase is to be measured from beginning to end of each project. The no net increase of road lengths within RMZs is also expected to reduce the impacts of roads on water quality, as there would be less likelihood for road failures and mass wasting in the RMZ that could deliver sediment to streams.
- Relocation of current roads within riparian areas would be a priority for watershed restoration which would greatly improve riparian conditions and floodplain processes. There would be no net increase in the road network and stream crossings inside of RMZs for watersheds within the Conservation Watershed Network (FW-CWN-GDL-02).
- FW-RMZ-GDL-04 requires that new road construction, including temporary roads, is avoided in RMZs except where necessary to cross streams, a road relocation contributes to attainment of aquatic and riparian desired conditions, or FS authorities are limited by law or regulations. This guideline is consistent with and similar to the requirements of Montana's SMZ law, which only allows road construction within the SMZ to cross streams, but the RMZs under the proposed plan are more comprehensive than the state-mandated SMZs. This guideline is expected to maintain water quality by reducing the likelihood for road failures and mass wasting in the RMZ that could deliver sediment to streams.
- FW-SOIL-STD-04 requires that soil function be restored when temporary roads are no longer needed and existing roads are decommissioned. The exact treatments necessary at any site would be determined based on site-specific characteristics, but in many cases, these standards would result in these road surfaces being decompacted and available slash would be applied. If the road has already revegetated and is found to already be in a hydrologically stable condition, these roads may not receive further treatment so as not to prevent disruption of the natural restoration process that has begun. But in the case when roads are decompacted and covered in slash, rainfall and water drainage is expected to infiltrate into the ground and no longer be delivered to waterbodies, which would reduce the likelihood of concentrating flow and improve water quality.
- FW-WTR-STD-03 and FW-SOIL-STD-03 require the use of BMPs to protect water quality.

Due to the programmatic nature of the DEIS, it is difficult to determine the effects of alternatives with respect to the use of roads during timber harvest. The effect on log hauling on aquatic resources is dependent upon a number of variables, such as, but not limited to: road surface, miles to access harvest units, number of stream crossings, proximity of a road to a stream, and amount of timber removed. These types of impacts are evaluated on a project-specific basis. Plan direction relative to roads is expected to minimize effects on aquatic resources.

The removal of stream-crossing culverts and reestablishment of a natural stream grade is expected to have the greatest impact on water quality and aquatic habitat in the action alternatives. As mentioned previously, Cook and Dresser (2007) found that stream-crossings that were restored through decommissioning delivered only 3 to 5 percent of the amount of fill material that was originally located in the road prism at the stream-crossing location. The action alternatives would sequentially improve crossings and reduce the risk of failure as funding is available across the forest and particularly in the conservation watershed network, which would decrease the amount of sediment delivery to streams that would result from potential road failures. These reductions would also result from the application of BMPs that prevent gully formation and downcutting through newly excavated stream channels, such as establishing a stream bed that mimics the natural stream gradient above and below the crossing, placing cobble-size rock in newly excavated streambeds, and distributing any uprooted vegetation and slash across stream-adjacent disturbed areas. Overall, all action alternatives are expected to provide a decrease

in stream turbidity in forest waterbodies and streams, as well as an improvement of bedload size distribution and channel morphology over the long term.

The Draft Plan direction as well as the adoption of the RMZ directions would result in additional protection for riparian areas forestwide. The inner and outer riparian zone plan directions would also provide increased aquatic habitat and water quality protection which would maintain or move riparian resources towards desired condition. These effects would be most dramatic on the east side of the Continental Divide as indicated previously. Planning areas west side of the Continental Divide (approximately 421,000 acres or 15 percent of the planning area), the RMZs would largely not lead to different outcomes from current INFISH directions in alternative A.

Alternative A

Both east and west sides of the Continental Divide would continue to use the current forest plan directions and the application of national BMPs, all of which have shown to be effective at reducing the effects from roads on water quality. The 1986 Lewis and Clark NF plan has direction for riparian areas (Management R). Standards include the adherence to State water quality standards and maintain soil productivity. Require the use of flood proofing or alternative locations outside of flood plains. Soil and water standards specific to riparian areas require meeting state water quality standards, resource protections and watershed analysis to protect water quality require the design of roads and trails to mitigate damage to soil, watershed, and fish by road restrictions, other road management actions as necessary (L-2). Road and other facilities must be designed located (generally no closer than 100 feet) and constructed to protect riparian areas and to control erosion (L-4). L-4 also has restrictions for crossing of riparian areas and the operation of heavy equipment in streams. The 1986 Helena NF plan has road standards for road density and resource protection. The plan requires that a specialist in soils, watershed and fisheries to identify potential soil erosion, water quality, and fisheries problems and provide input to developing road design standards and maintenance. Unacceptable damage to soils, watershed, fisheries, wildlife, would be mitigated by road restrictions or other road management actions.

INFISH directions for GAs on the west side of the divide, require that all water bodies affected by existing or planned roads meet Riparian Management Objectives (RF-2) and a suite of protective measures, such as:

- Minimize road and landing locations in RHCA (RF-2b).
- Route road drainage away from potentially unstable stream channels, fill and hillslopes (RF-2d2)
- Avoid the disruption of the natural hydrologic flow paths. (RF-2e)
- Avoid side cast materials. (RF-2f).

RF-3 requires the influence of each road on the Riparian Management Objectives to be determined and to meet RMO and avoid adverse effects to inland native fish. Directions for the construction of new and improvements to existing culvert, bridges, and other crossings to accommodate a 100 year flood (RF-4) including associated sediment and debris and to provide, and maintain fish passage at all road crossings of existing and potential fish-bearing streams (RF-5).

In summary, outside of the INFISH areas, east of the Continental Divide, road building would continue to be allowed in riparian areas that surround water resources. Where new roads are constructed, including temporary roads, vegetation would be removed, the ground would become compacted, and gravel would be dumped to make a drivable surface for passenger vehicles. The amount of road building in riparian areas west of the divide would be constrained do to INFISH standards, but would be unconstrained on the east side of the divide.

Road maintenance is expected to continue at similar levels or slightly decreased levels compared to more recent management. Portions of the road network would be treated to repair and improve drainage structures, improve the running surface of the road, and to clear vegetation along roadsides. Short-term

increases of sediment delivery to streams and waterbodies is expected as a result of road surface grading, and culvert and ditch cleaning near waterbodies.

Portions of the road system that are in particularly poor condition or are currently closed and in long-term storage would be reconstructed periodically, particularly in connection with land management activities, such as timber harvest projects. Road reconstruction includes application of surface rock, replacing damaged or poorly functioning culverts, adding stream-crossing or ditch relief culverts where necessary, some road widening, and removing roadside vegetation that is encroaching on the road surface and preventing vehicular passage. Again, these activities are expected to create some turbidity increases in nearby waterbodies, but BMPs would be employed to minimize erosion and sediment transport to waterbodies.

Watershed restoration actions within the HLC NF over the years have primarily focused on culvert removals/upgrade, road decommissioning, and road relocation. Under alternative A, road removal would continue to occur as funding allows. Water resources benefit from this decommissioning in the long term depending upon the proximity and extent of road near water. As described in the general effects, there would be some short term impacts to water quality from the sediment delivery during excavation activities in or adjacent to waterbodies.

Proper decommissioning or storing a road can eliminate long term effects from roads. Culverts that are not maintained or are undersized may become blocked with sediment and debris, eliminating its ability to pass water, bedload and debris downstream and increasing the likelihood of road failure and mass wasting. Many roads found during road decommissioning surveys were found to still contain culverts at stream-crossings. Most culvert found during these surveys have been removed. There would be no requirement to reduce stream crossing numbers and the lengths of roads in RMZs within the conservation watershed network, as required in the action alternatives (FW-CWN-GDL -01).

Motorized and nonmotorized winter recreation

Effects common to all alternatives

Nonmotorized winter uses may include but is not limited to cross country and alpine skiing, snowshoeing, and ice fishing. Motorized winter uses include motorized over-snow vehicle use, such as snowmobiling. Damage to vegetation and soil erosion may occur if there is inadequate snowpack to protect these resources. Also, winter motorized activities can result in compacted snow from grooming which often forms barriers that alter spring runoff patterns which can result in soil erosion and gullies.

Contamination by petroleum products such as motor oil and gasoline may degrade water quality in waters adjacent to areas of concentrated use such as parking lots and snowmobile staging areas. The likelihood and magnitude of the these impacts due to these activities are dependent on site-specific factors such as average slope, aspect, elevation, vegetation, weather conditions, available facilities, and the amount of use. Because site conditions vary, and because these sites are relatively small in area and widely dispersed, it is reasonable to assume that cumulative impacts would not be measurable at the forestwide scale.

Effects common to all action alternatives

For riparian areas east of the Continental Divide, the adoption of RMZs would increase the area protected by plan components. Therefore, the adoption of RMZs would provide more protection of water quality and resources. The planning areas west side of the Continental Divide RMZs would largely not experience different outcomes from current INFISH directions in alternative A.

Alternative A

The Forest has identified very few impacts from winter recreation on riparian areas while implementing the two 1986 forest plans as amended. Damage to vegetation and soil erosion may occur if there is

inadequate snowpack to protect these resources. Also, winter motorized activities could result in compacted snow from grooming which often forms barriers that alter spring runoff patterns which can result in soil erosion and gullies.

Hiking and stock (nonmotorized)

Effects common to all alternatives

Hiking and stock trails are popular among forest users on the forest, though trail networks and trail use can adversely affect water quality. Given the popularity of trails among forest users, and the expected increase in recreation use, it is reasonable to expect demands by the public for additional hiking trails over the coming decades. If those demands are met, an expanded trail system could result in the alteration and degradation of water resources.

Nonmotorized trails typically have very little impact on water resources relative to roads. Sediment from trails generally gets routed onto the forest floor with no impact to water quality. However, there are locations where sediment is routed to streams at crossings. There are time when trails have slumped into streams due to their location paralleling a stream and not due to their use. Wildfires as well as high flow events have washed out trails both inside and outside of wilderness areas. These are temporary, localized impacts whish would not result in watershed scale impacts.

If facilities are insufficient for developed recreation, then recreational use may be shifted to dispersed sites. The result of this could be additional and unregulated deleterious effects on soils, vegetation, and riparian values. Recreational use is expected to increase in all alternatives and with the increased use, impacts would be expected to increase. These affects would be the same between alternatives as nonmotorized trails generate very little sediment and they are often located on ridges leading from trailheads to higher locations with views.

Effects common to all action alternatives

Forestwide guidelines FW-GDL-RT-01, 03, 04, 05, 06, 07, 09, 11, and 12 are designed to maintain the hydrologic integrity and water quality from the delivery of sediments and pollutants to water. This guidance would provide for drainage systems to minimize sediment input by assuring that water bars are in place, stream crossings are hardened, and the risk of slumps has been reduced. By doing so, any potential pollutants such as sediment, nitrogen and phosphorus would be routed to the forest floor rather than the stream network. Protection and direction for riparian areas includes limiting activities in RMZs to those would protect key riparian processes, including maintenance of streambank stability, input of organic matter, temperature regimes and water quality (FW-RMZ-GDL-13). To maintain hydrologic integrity of watersheds trails would be hydrologically disconnected from delivering water, sediment and pollutants to water bodies (FW-RT-GDL-01, 07, 11).

These Draft Plan directions result in additional protection for riparian areas by adopting RMZs. The inner and outer riparian zone plan directions would also provide increased aquatic habitat and water quality protection which would maintain or move riparian resources towards desired conditions. These effects would be most dramatic on the east side of the Continental Divide as indicated above. In the planning areas west side of the Continental Divide (421,000 acres or 15 percent of the planning area), the RMZs would largely not lead to different outcomes from current INFISH directions in alternative A.

Alternative A

The Lewis and Clark and the Helena 1986 forest plans include directions for resource protections to mitigate unacceptable damage to soils and watersheds. The plans direct the Forest to design and construct tails to protect riparian areas and control erosion.

Livestock grazing

Effects common to all alternatives

Approximately 1,756,541 acres (61%) of the HLC NF are classified as capable for cattle grazing, while 483,159 acres (17%) are suitable for grazing. There are a total of 234 grazing permittees with 240 active allotments in the planning area; 12 are vacant and 23 are closed allotments. There are 94,785 head months currently used on the HLC. The forest plan alternatives do not propose changes to allotment boundaries or use.

When mismanaged, livestock grazing can have numerous direct and indirect effects on soil and water resources, particularly along water courses and in riparian areas. Soil trampling can cause decreased infiltration, greater soil compaction, and loss of vegetation cover on both upland and riparian sites. Reduced infiltration by soil compaction can lead to overland flow of sediment. Soil and water quality can be indirectly affected by the resulting increased soil runoff and erosion, and sediment delivery to riparian areas and streams.

Impacts are often greater in riparian zones because they are preferred by livestock due to the availability of shade, water and more succulent vegetation. Overgrazing in riparian zones can reduce bank stability through vegetation removal and bank trampling, it can compact soil, increase sedimentation, cause stream widening or down cutting and often changes riparian vegetation, resulting in insufficient overhead cover for fish (Platt, 1991). Livestock grazing near streams can result in changes in channel morphology (A. J. Belsky, Matzke, & Uselman, 1999). Livestock trailing, chiseling, and general soil displacement along stream bank areas can result in collapse of undercut bank areas and an overall increase in bank angle, loss of bank cover, and stream widening along the entire stream reach. Over long time periods, loss of riparian habitats by stream channel widening or degradation, and lowering of water tables through channel degradation may occur. Fecal wastes can increase bacterial concentrations in water through direct introductions into live water or riparian areas.

Removal of riparian vegetation through livestock management can influence the amount of solar radiation and alter water temperature regimes. Greater temperature fluctuations (diurnal and seasonal) can occur when riparian vegetation is removed or decreased. These changes can ultimately lead to shifts in dissolved oxygen and pH. In addition, removal of riparian vegetation and increased temperatures combined with increased nitrate levels can increase undesirable or nuisance biological production in water.

The effects of livestock can be seen across the planning area, particularly in riparian areas. Historical grazing and agricultural activities such as irrigation, led to riparian vegetation changes and stream channel degradation on grazed streams. Various allotments have seen improvements through BMPs and updated allotment management plans. However riparian and aquatic habitat improvements within grazing allotments continue to be a challenge across the plan area. Most allotments managed under a season long grazing strategy continue to have impacts to RMZs.

The severity of the effects of livestock grazing on aquatic wildlife populations can be expected to increase under warmer climatic conditions with lower summer flows. Within current conditions, these impairments impact population sizes and recruitment success at levels of occurrence. These impacts can accelerate the replacement of native species with nonnative populations. However, effects are not limited solely to native trout and char species. Several recreational fisheries are limited by habitat loss and lower recruitment rates.

PIBO monitoring data show streams in managed sub-watershed across the planning area have lower median values or habitat conditions for many of the measured indexes (Archer & Ojala, 2016) (Archer & Ojala, 2017). The methodology selects managed sites that are representative of managed conditions for that portion of the planning unit. Managed sites in grazed sub-watersheds are considered representative of

grazing impacts typical for low gradient habitat in that pasture. Qualitative comparisons of PIBO data sets to data collected by the forest collected data show that livestock impacts in riparian areas and streams continue to occur.

Effects common to all action alternatives

Table 28 summarizes the effects of Draft Plan components for livestock grazing on aquatic ecosystems. Existing grazing permits would continue to be administered under current allotment management plans. However, they would be required to meet or be moving towards desired conditions for riparian areas as outlined in the revised forest plan. When allotment plans are updated they would need to be adapted to meet or move toward RMZs desired conditions FW-RMZ-DC-01and 02, FW-FAH-DC-01 through 04, and 07, and FW-GRAZ-DC-02 and 03.

Forestwide plan components would protect and minimize the effects of grazing on riparian resources in all action alternatives. Standards specific to grazing, FW-GRAZ-STD-01, 02, 03 and 04 require authorization of new and existing management plans to avoid, minimize, or mitigate adverse effects to riparian habitats. Indicators such as forage use, bank alteration or riparian stubble height would be used to move rangeland vegetation, riparian function and wildlife habitat towards desired conditions. Forestwide guidelines would limit management activities inside RMZs (FW-RMZ-GDL-01 through 13 and FW-GRAZ-GDL-03 through-07). Specifically, all activities within RMZs, including grazing, should protect key riparian processes, including maintenance of streambank stability, input of organic matter, temperature regimes, and water quality (FW-RMZ-GDL-13).

Effects to fisheries would be similar to alternative A west of the divide, as the RMZ plan components generally meet the intent of the standard and guidelines from INFISH. East of the Continental Divide, the RMZ plan components for grazing provide additional protection to riparian areas compared to the current plans. There are no differences in effects between the action alternatives as all would adopt the RMZ standards and guidelines. Regional PIBO monitoring indicates that implementation of grazing standards adopted from INFISH led to improving trends to some monitoring indicators. That trend is projected to continue in the west side GAs and is expected to occur within eastside GAs as RMZ plan directions would be adopted forestwide. The proposed forest plan would provide directions to move RMZs towards desired conditions under all action alternatives.

Implementation of these RMZ plan directions would result in an improving water quality trend under all action alternatives. There is no differences in effects between action alternatives, as all would adopt the RMZ plan components across the planning area. For riparian areas east of the Continental Divide, the adoption of RMZs would increase management directions within these areas. Therefore, the adoption of RMZs provide more protection of water quality. As the proposed forest plan directions are incorporated into allotment management plans and implemented, it is concluded that degraded riparian areas would move toward desired conditions. West side of the Continental Divide RMZs would lead to similar outcomes from current INFISH directions in alternative A.

Table 28. Effects of plan components for livestock grazing– all action alternatives

Plan Component(s)	Summary of expected effects
FW-GRAZ-DCs	Desired conditions for livestock grazing emphasize sustainable grazing, stable soils, diverse vegetation and native plant communities, as well as riparian and wetland health. Movement toward these desired condition will be achieved through implementation of the standards and guidelines for grazing as well as the other resource areas. Changes toward meeting DCs on some allotments would likely not be realized until implementation of new allotment management plan/project are completed.
FW-GRAZ-STDs and GDLs	Generally would affect how allotment planning is implemented. Collectively with the additional WTR, FAH and RMZ plan components, the allotment management planning process will be guided by this directions so that future grazing management will move resource conditions within allotments toward desired conditions.

Alternative A

The 1986 Lewis and Clark NF plan includes forestwide standards for the management of livestock in riparian areas. Management Standard D-3 is specific to protecting riparian areas, water quality, and soils. D-3 (2) requires the use of BMPs to minimize livestock damage to soil, stream sides and other fragile areas. D-3 (3) necessitates the use of offsite water away from riparian areas, fencing springs, and directing salt blocks to be located away from riparian areas. The 1986 plan also includes measurement indicators of livestock damage to aquatic habitats adjacent to low gradient (less than 2%) streams, including: total physical bank damage on key areas in excess of 30%, poor reproduction survival of streamside shrubs, and excessive grass/forb use. If these standards "are not effective at keeping livestock use of riparian areas within management objectives, the plan directs the FS to construct and maintain fencing as necessary to achieve these objectives". The plan also include limitations of livestock use in municipal watersheds and research natural areas (RNAs). PIBO data indicates there are fewer metrics trending in the desired direction on the HLC NF than in Region 1 as a whole, which suggests less movement towards desired conditions. Effects from the livestock grazing components are discussed in the watershed effects of plan components above and in the livestock grazing section.

Grazing is a major component of land management within the planning area and would continue to occur across all GAs. Livestock grazing management has been and continues to have a major impact on watershed, riparian, and water quality throughout the planning area. Livestock management has only slightly changed since the last planning period and livestock rates are less than or equal to historical levels. The1986 Lewis and Clark and the Helena NF Plans include standards to manage livestock grazing as well as riparian grazing standards to incorporate the use of BMPs and requisites to meet state water quality standards as required in the Clean Water Act. The plans also have requirements to maintain current soil productivity. A breakdown for grazing within specific GAs is provided in the Livestock Grazing section.

On the east side of the divide current forest plan components for water quality, riparian areas and wetlands would continue to apply. Monitoring of allotments by the forest over the last decade has shown impacts to stream banks and streamside vegetation. Geomorphic changes (i.e. increasing width depth ratio, and decrease in sinuosity) have also been observed. Management under alternative A would continue to have an effect on riparian areas as a whole with continued reduction in stubble height, impacts to streambank vegetation, and shrub components may continue to occur unless management changes occur.

On the west side of the Continental Divide, INFISH standards and guidelines that protect or minimize effects to riparian and aquatic resources from livestock grazing include modifying grazing practices, locating new facilities outside of RHCAs, relocating or closing facilities, and limiting livestock handling efforts (INFISH GM-1, 2, and 3).

The 1986 Helena NF Plan includes a forestwide standard that grazing management "will protect soils and water resources, riparian areas and threatened and endangered species." Where analysis shows range damage, the cause would be identified and corrective action would be initiated through allotment management plans. Allotment management plans would specify utilization standards of key plant species needed to protect the soil and water quality.

For areas on the west side of the divide, current forest plan directions would continue to apply, and INFISH standards and guidelines that protect or minimize effects to riparian and aquatic resources from livestock grazing would also apply. Existing grazing permits would continue to be administered under current allotment management plans and new plans would be adopted as funding allows.

As indicated above, livestock grazing impacts are substantial throughout the planning area resulting in habitats and water quality that do not meet desired conditions on many streams and riparian areas. It is expected that the current trends in watershed conditions across allotments would continue.

Timber and vegetation management

This focuses on the effects of the action alternatives in respect to harvest of forest canopy and skidding systems, fuel reduction activities, and prescribed fire. Effects from roads are treated separately due to their higher risk for affecting water quality and quantity.

Effects common to all alternatives

Vegetation management would occur under all alternatives, including timber harvest and prescribed burning. Water quality effects attributed to timber harvest could include increased sediment, nutrient load, and temperature. The difference in alternatives would be subtle since management controls the extent of harvest within drainages. Risk may be somewhat arbitrary since management controls harvest extent across the watershed and below a threshold of concern. Instead of harvesting whole watersheds, harvest is scattered. Also, recent studies showing the water yield changes from beetle epidemic have brought out the complex relationships between forest canopy and water yield in snow dominated regimes (Biederman et al., 2015). Though decreases in forest cover can increase snowpack and available moisture, the lack of shading can accelerate snowpack runoff (Varhola, Coops, Weiler, & Moore, 2010). Shading can offset snowmelt losses where the forest canopy remains. Furthermore, (Grant, Lewis, Swanson, Cissel, & McDonnell, 2008) a review of water yield studies showed that fall soil deficits between cut and uncut stands explained water yield differences; cut stands lacked the transpiration and thus were prone to generate greater yield since soils had more available water and thus were less prone to infiltrating fall storm moisture. For the HLC NF, soils rarely have saturated soil conditions during fall and thus these differences would be subtle.

The impacts from prescribed burning would be minor since burning is designed to result in low and moderate severity that has low potential for delivering sediment. The effects of prescribed burning are generally insignificant with regard to a wide range of hydrologic and water quality variables (Robichaud, Beyers, & Neary, 2000).

Effects common to all action alternatives

The effects related to timber harvest and prescribed burning would vary only slightly by alternative, based on modeling of expected prescribed burning acres. Alternative E may result in fewer harvest and prescribed burning acres and associated impacts as compared to the other alternatives.

The action alternatives would not increase risk for impairing water quality over the current direction. For uplands, the Draft Plan directions continue using BMPs to reduce offsite transport of sediment to streams from either timber harvest area or prescribed burn slopes. Standard FW-WTR-STD-03 re-enforces this commitment. Additional improvements in water quality may offset past impacts with FW-OBJ-WTR-01 and 02 that directs restoration activities to priority watersheds and conservation watershed networks. The effectiveness of BMPs for avoiding sediment was reviewed in a contemporary study in California. Out of 220 units examined, sixteen instances were found where skid trails delivered sediment to streams (Litschert & MacDonald, 2009). The authors concluded that in most cases the BMPs were effective. Surface roughness on skid trails was one of the factors that was found to alleviate overland flow and sediment delivery. The HLC NF uses slash in addition to waterbars to stem overland flow and reduce sediment delivery. Also, the belt rock geology of the Forest would have less potential for producing sediment than the granitics in the Litschert and MacDonald (2009) study area based on findings from Sugden and Woods (2007).

The action alternatives would carry on similar protections using BMPs to stabilize skid trails and landings and disconnect these from road ditch and stream networks drawing from Region 1 Soil and Water

Conservation Practices (FSH 2509.22, Region 1/Region 4 Amendment No. 1). The effects would reduce risk for runoff and sediment. As discussed above, protections were strengthened in the Draft Plan by increasing widths of RMZs (FW-RMZ-STD-01) and limiting designated skid trails and landing constructions in RMZs.

Effects from timber harvest on nutrient loads in streams would not vary measurably across alternatives. However, the use of wider RMZs (FW-RMZ-STD-01) would substantially reduce increase nutrient loading from adjacent harvest areas.

Stream temperatures would likely not vary by alternatives from vegetation management actions. The established RMZs would preserve streamside vegetation, and vegetation management would only be allowed in the inner RMZ in order to restore or enhance aquatic and riparian-associated resources (FW-RMZ-STD-03). In the outer RMZ, vegetation management to meet desired conditions for fuel loading and silvicultural desired conditions are allowed as long as they do not prevent attainment of desired conditions (FW-RMZ-STD-04). The Forest would not clear-cut forest within RMZs (FW-RMZ-GDL-12).

Draft Plan direction and the adoption of RMZs forestwide would result in additional protection for RMZs. The inner and outer riparian zone plan directions would also provide increased aquatic habitat and water quality protection, which would maintain or move riparian resources towards desired condition. These effects would be most dramatic on the east side of the Continental Divide as indicated previously. In the planning areas west of the Continental Divide (15 percent of the planning area), the RMZs would largely not lead to different outcomes from current INFISH directions in alternative A. The action alternatives would also provide a greater level of protection for aquatic and riparian resources than alternative A. The adoption of the plan components for RMZs would increase RMZ widths more than the current required SMZ widths across the planning area. These greater widths would also result in a higher proportion of acres in RMZs within the boundaries of the areas designated suitable for timber production.

The proposed forest plan includes standards and guidelines that serve to reduce risk of impacts that might occur with vegetation management. This direction includes the following:

- A standard that controls the use of herbicides, pesticides and other toxic chemicals, with exceptions only if necessary for restoration and when aquatic and riparian resources are maintained (FW-RMZ-STD-05).
- For timber harvest treatments, FW-RMZ-GDL-02, 03, 04, 05, 07, 08, and 12 control activities, including temporary roads and landings, that may disturb soils or result in ground disturbance that may result in sediment input to streams or wetlands. Guidelines for treatments in RMZs are designed to avoid ground-disturbances that may deliver sediment to streams and wetlands (FW-RMZ-GDL-04, 09, and 13; FW-RT-STD-02, 03 and 04). New and temporary road construction and new landing construction would not be allowed within the entire width of category 1, 2 and 3 RMZs, except where needed to cross streams or when site-specific analysis and mitigation measures are determined appropriate by an aquatic resource specialist to protect resources (FW-RMZ-GDL-11).
- FW-RMZ-GDL-09 restricts logging and yarding methods that may cause ground disturbance in category 1, 2 and 3 RMZs.
- These same restrictions on road and landing construction and logging methods apply to the inner portion of category 4a and 4b RMZs (FW-RMZ-STD-01). The character and terrain typical of wetlands and pond features is different from stream features. Establishing higher level of restrictions on ground disturbance in the inner RMZ, in combination with the other plan direction, would be adequate to protect the ecological values associated with category 4a and 4b. Other plan direction includes all the RMZ desired conditions, standards, and guidelines that would guide and influence the type and extent of treatments that may occur in RMZs. For example, desired conditions describe the diverse vegetation structure, habitat connectivity and other key ecological conditions to maintain or move toward in RMZs; guidelines specify criteria for leaving live trees, snags and wildlife cover.

Other plan direction also includes the forest plan standards and guidelines associated with soil disturbance (FW-SOIL-STD-01 and 02, FW-SOIL-GDL-01, 02 and 03), and with road construction, reconstruction and maintenance in the infrastructure section (FW-RT-STD-01, 02; FW-RT-GDL-01, 03 through 13).

- Tree canopy would be retained, as described earlier, with retention of live trees in harvest areas (e.g., no clearcutting) and retention of forest cover to meet wildlife connectivity needs (FW-RMZ-GDL-11 and 12. The use of prescribed fire, particularly under burning, may be desirable in RMZs to restore natural ecosystem function, reduce forest density or fuel loadings. FW-RMZ-DC-01 promotes the use of prescribed fire consistent with natural fire regimes.

RMZs are not exclusion zones but areas where vegetation management is allowed to occur, guided by the desired conditions for vegetation and aquatic resources associated with RMZs. Revised forest plan components were developed to reduce risk of potential effects to riparian and aquatic resources. An inner RMZ area is defined with greater restrictions on treatments, to provide a higher level of protection to the most critical areas closest to the stream or wetland (FW-RMZ-STD-03). FW-RMZ-STD-04 provides more management flexibility in the outer RMZ, recognizing the role that active management (i.e., thinning, harvest, fuel treatments, and prescribed fire) could achieve in some areas and landscapes, as long as those treatments promote desired conditions within the inner RMZ. Vegetation management inside of RMZs would consider condition of the riparian vegetation as well as stream conditions. Site specific, interdisciplinary analysis at multiple scales would occur before actions proceed within RMZs.

One aspect of vegetation management is fuel reduction, primarily within the wildland-urban interface. FW-FIRE-DC-02 “Within the wildland-urban interface and around high value resources, surface fuel loading and crown spacing provide conditions for low severity surface fire that minimizes threats to values,” is designed to maintain the natural function of fire to mitigate the effects of wildfire. To achieve this desired condition, fuel reduction activities could be conducted in portions of the WUI. Standard FW-STD-RMZ-01 is designed to protect riparian and stream related function and processes by restricting vegetation management activities within the inner RMZ. However, exceptions are made for the non-mechanical treatments of prescribed fire and sapling thinning, which may be a tool used to achieving desired ecological conditions. Guidelines FW-RMZ-GDL-05, 06, 08, 10, and 11 would apply to any treatments occurring within RMZs. These guidelines provide direction on the implementation of ground-disturbing management activities within RMZs. Based upon the very small proportion of the RMZs that might be affected by the exception, allowing mechanical fuel treatments, and the direction within these guidelines, the potential impacts to RMZs under the action alternatives should be minimal from mechanical fuel treatments.

Revised forest plan direction provides protection for soils that would also protect aquatic habitats and values associated with riparian areas. Refer to Soils section for additional discussion on effects associated with timber harvesting. Project-specific BMPs shall be incorporated into road maintenance activities (FW-WTR-STD-03) which would protect riparian values.

The Draft Plan direction would result in additional protection for riparian areas with the adoption of RMZs forestwide. The inner and outer riparian zone plan directions would also provide increased aquatic habitat and water quality protection which would maintain or move riparian resources towards desired condition. These effects would be most dramatic on the east side of the Continental Divide since vegetation management buffers on the forest are primarily constrained by Montana State SMZs. Vegetation management in the inner RMZ would be limited and only occur in order to restore or enhance aquatic and riparian-associated resources. Plan directions for the outer RMZ does not prevent vegetation management in that zone as long as those actions would not prevent attainment of desired conditions of the inner RMZ. The west side of the divide has been using INFISH standards and the effects would be the same as current vegetation management as the new RMZ were developed from the INFISH (RHCA) standards.

The direction for FS management of soil directly tiers to the NFMA (16 USC 1604) which stipulates to "ensure…evaluation of the effects of each management system to the end that it would not produce substantial and permanent impairment of the productivity of the land." The past forest plan standards along with current guidance from the Regional and Washington offices interpret NFMA's direction to manage for sustained soil productivity. The proposed forest plan would continue to manage for long term soil and site productivity on lands designated for growing vegetation. Areas dedicated to infrastructure such as administration sites, mines, system roads and campgrounds are not part of the productive land base.

The revised forest plan includes requirements to design and implement management activities that conserve soils physical, chemical, and biological function and improve these functions if they are impaired (FW-SOIL-STD-01). Current regional direction includes the requirement that all vegetation management activities shall not create detrimental soil conditions on more than 15 percent cumulatively of an activity area (FW-SOIL-STD-02) and the requirement to incorporate project specific BMPs and design features to protect soil resources (FW-SOIL-STD-03). These standards are currently required on the forest and would be continued to provide protections to soil quality and function.

Management guidelines specific to timber management include direction that ground based equipment should only operate on slopes less than 35 percent (FW-SOIL-GDL-01) and should not occur on landslide prone areas in order to protect and maintain soil stability and quality. Guidelines are included that would require maintenance of 85 percent effective groundcover (FW-SOIL-GDL-04) and maintain organic matter for soil functions (FW-SOIL-GDL-05).

The Draft Plan leaves flexibility for coarse wood levels to vary at the project level depending on the fire risk, site type, and soil condition, but guidelines range between 5 to 30 tons per acre. See Snags and Downed Wood section, FW-VEGF-DC-09 and FW-VEGF-GDL-06, coarse wood debris components.

Standard practices in addition to new reclamation measures would contain offsite erosion. FW-SOIL-GDL-04 would lessen surface soil erosion by ensuring management activities maintain at least 85 percent cover. Use of slash on skid trails is one measure adopted more commonly that increases groundcover and facilitates vegetation regrowth on disturbed soil surfaces.

The proposed HLC NF plan has, as a desired condition, management activities that do not de-stabilize areas with highly erodible soils or mass failure potential. Most of the erosion issues from road failures associate with either decommissioned or abandoned roads. Due to current engineering techniques and harvest equipment, the risk would be less than the initially proposed jammer logging in the 1970's. The main triggers for road failure involve saturating rain on snow events. FW-SOIL-GDL-03 guides management to avoid landslide-slump prone areas.

Forest reduction in system roads has increased reliance on temporary roads to access timber. Most temporary roads are historical routes that have existing prisms. Direction for temporary roads continues to evolve, although once the forest removes the roads from administrative infrastructure then these areas become part of the productive landbase. Soil function shall be restored on temporary roads when management completes activities that use these roads. Restoration treatments shall be based on site characteristics and methods that have demonstrated to measurably improve soil productivity (FW-SOIL-STD-04). The standard applies to both newly constructed and re-used templates.

Standard mitigation techniques to limit soil damage from ground based equipment would be carried forward into this next planning cycle. Standard practices limit equipment operation on steep slopes (FW-SOIL-GDL-01) and control seasonal operation when soils are more vulnerable to compaction and displacement (FW-SOIL-STD-03). However, the plan does not stipulate operation restrictions to particular conditions. Such limitations would be evaluated on a project basis due to variable soil properties.

The forest plan further addresses potential soil damage by avoiding certain sensitive soils (Table 29). These areas were considered not suitable for timber production since harvest operations could produce irreversible soil damage and reforestation is uncertain. The areas were selected using mapping from the Helena-Lewis and Clark NF land system inventory (USDA-NRCS 2017) and the R1 Potential Vegetation Type (PVT) Layer. The forest plan lowers risk of soil damage outside of these unsuitable areas with guidance that ground-disturbing management activities should not occur on landslide prone areas (FW-GDL-SOIL-03).

Table 29. Landtypes with sensitive soil

Landtype	Soil Geologic Hazards	Sensitive Soil Group
15, 15C, 150	Landslide-prone and wet soils	Landslide and Slump Prone (Wet Soil)
14, 14A, 14B, 14C	Slump-prone and wet soils	Landslide and Slump Prone (Wet Soil)
12A, 12B, 12C, 12D, 13A, 14, 14A, 14B, 14C, 15, 15C, 36B, 100, 101, 130, 136, 150	Vulnerable to compaction and rutting	Wet Soil and Flood Prone
100, 101	Flood Prone areas and wet soils	Wet Soil and Flood Prone
110	Flood-prone areas	Wet Soil and Flood Prone
12B, 12C, 49B, 56, 57, 57A, 58, 59, 59A, 59B, 76, 76A, 77, 77B, 79, 89, 90, 790, 791	Highly erodible soils and vulnerable to compaction	Loess with Volcanic Ash

Alternative A

1986 Helena NF and Lewis and Clark NF Forest Plan direction for water quality includes the requirement to incorporate BMPs and to follow Montana Streamside Management rules to ensure state water quality standards are met or exceeded. Current vegetation management activities have been restricted under the state of Montana streamside management laws since 1991. These laws prohibit certain forest practices along stream channels and directs suitable streamside management practices. These forest practices also included slope limitations, buffer widths, hauling and broadcast burning. These laws have been the main mechanism to regulate forest practices along streams in the NF. Timber management action include the requirement to meet state water quality standards per CWA (33 U.S.C. 1232) and memorandums of understanding. Also, standards include requirement to complete project analysis of watersheds that would involve significant vegetation removal and the prerequisite not increase water yield or sediment delivery beyond acceptable limits.

The 1986 Helena NF and Lewis and Clark NF plans include vegetation management directions for riparian areas. The Helena plan includes management area directions to maintain water quality, stream bank stability and not to increase runoff that would result in long term stream channel degradation. Also included are directions that limit when and what age class would be harvested within riparian areas. The Lewis and Clark forest plan includes direction within riparian areas; management area R (MA-R). Management area R direction includes type and age of trees and the type of logging systems allowed in riparian areas while maintaining or enhancing other resource values. Both plans require the adherence to the State water quality standards and current soils productivity.

The GAs west of the Continental Divide, approximately 15 percent of the planning area, have had limited riparian harvest since 1996 when INFISH amended (Amendment 14) the Helena 1986 plan. Under alternative A timber harvest within riparian habitat conservation areas except for salvage or where silvicultural practices were needed to attain Riparian Management Objectives would continue to be limited. Monitoring data from PIBO demonstrates that stream habitat conditions (temperature, LWD, pool

frequency, etc.) associated with riparian protections have trended in desired directions for some indicators.

Timber and fuels projects would continue as the management activities with the highest areal impact on soil condition over the next planning period. The amount of regeneration harvest has trended downward, and intermediate harvest (thinning) and salvage harvest has trended upward. There has also been increased emphasis on timber harvest in the WUI.

The majority of harvest would occur on lands designated as suitable for timber production in the plan (see Timber section of the DEIS). The exact location of future timber harvest would depend largely on factors of road access and site specific forest conditions relative to the desired conditions as outlined in the forest plan. However, uncertain disturbance events would also influence location and extent of harvest. For example, outbreaks of mountain pine beetle in lodgepole pine stands, and salvage harvests.

Road access would largely dictate timber harvest since the HLC NF continues to reduce the road network to a manageable level. The costs of road maintenance and managing for habitat were also factors in the Forest's decision to decrease the road template.

Within an activity area, typically defined as a treatment unit, timber harvest over the next planning cycle may impact soils at the same disturbance intensity as over the last five years. HLC NF soil monitoring over this period found logging systems resulted in detrimental soil disturbance, on a percent area basis, of 8 percent average for ground based, 4 percent average for skyline, and 4 percent for hand treatments based on HLC NF Soil Monitoring data from 2012-2016 (see project record). Historical timber harvest and site preparation practices left up to 30 percent of the soil area severely impacted (Clayton, 1990; Klock, 1975) at least twice the disturbance area of contemporary harvest practices.

Minerals, oil, and gas

Effects common to all alternatives

Historically, there have been hundreds of locatable mineral mining operations across the forest, having occurred both on patented and unpatented mining claims. The largest historic mining areas identified on the Forest with severe water quality impacts include the Upper Little Blackfoot River as well as the upper reaches of the Blackfoot River in the vicinity of the Upper Blackfoot Mining Complex in the Upper Blackfoot GA, the Upper Tenmile Creek including their tributaries drainages in the Divide GA, the Dry Fork Belt and Carpenter Creek, in the Little Belt GA.

Recreational mining activities such as panning (gold and/or sapphires), metal detecting, hand-sample collection, and the use of small-scale sluice or suction dredge systems occur across the forest, particularly in areas of historic lode or placer mining activities. Unless an authorized officer determines that an activity is or will cause a significant disturbance to surface resources, a Plan of Operations is not likely to be required. Recreational activities, to include suction dredging, often do not require a FS authorization in advance, however factors such as access, scale and duration may dictate otherwise. Suction dredging is regulated by federal and State mining laws and regulations. MTDEQ has seasonal restrictions on suction dredging and other in-stream mining activities on many of the forest's bull trout and cutthroat streams, therefore impacts will not be seen in those streams. Large increases in mining activity are not anticipated for the future, but cannot be ruled out. In accordance with laws governing locatable minerals activities on NFS lands (the 1872 General Mining Law, the Organic Administration Act of 1897, the Mining and Minerals Policy Act of 1970, et al.), the public has a statutory right to conduct locatable mineral exploration and development activities, provided such activities are reasonably incidental to mining and comply with all other Federal laws and regulations. The FS role as directed by Federal regulations (36

CFR 228A) is to ensure that mining activities minimize adverse environmental effects to surface resources and comply with all applicable environmental laws. Congress has not given the FS authority to unreasonably circumscribe or prohibit reasonably necessary activities under the 1872 General Mining Law that are otherwise lawful.

Salable minerals include common varieties of sand, stone, gravel and decorative rocks. The FS salable mineral material policy (FSM 2850) states that disposal of mineral material will occur only when the authorized officer determines that the disposal is not detrimental to the public interest and the benefits to be derived from proposed disposal will exceed the total cost and impacts of resource disturbance. The forest uses gravel, riprap, and crushed aggregate for maintenance and new construction of roads, recreation sites and repair of damages caused by fire, floods and landslides. These materials come from FS developed pits and quarries. The type, volume, and source location of in-service mineral material varies year-by-year and according to need.

There are no active oil and gas leases on the forest and therefore no effect to watersheds, fish or riparian areas from any of the alternatives.

There are no effects to fish, watersheds, or riparian areas from any of the alternatives from free-use permits issued to the general public for the collection of limited volumes of rock for personal uses (i.e., non-commercial).

Effects common to all action alternatives

Table 30 summarizes the effects of Draft Plan components for minerals, oil and gas on aquatic ecoystems. The effects of additional RWAs would not be changed from alternative A. Generally, gravel pits would be situated away from riparian areas. FW-RMZ-GDL-07 would exclude gravel pits and sand operations from RMZs. Hauling of gravel, rocks and materials from these sites may impact water quality along haul routes and would be the same for all alternatives. FW-EMIN-GDL-01 and 02 are designed to minimize effects on water quality through guidance's of mineral and energy authorization and development in RMZs. The effects of minerals management would be the same for all action alternatives.

Table 30. Effects of plan components for minerals, and oil and gas – all action alternatives

Plan Component(s)	Summary of expected effects
FW-EMIN-GDL-01 and 02	Direction would minimize adverse effect to aquatics and riparian resources. Mineral operations would avoid RMZs or would ensure operations take all applicable measures to maintain, protect and rehabilitate water quality.
FW-RMZ-GDL-07	This guideline exclude gravel pits and sand operations from RMZs. This would benefit water quality and riparian habitats.

Alternative A

The 1986 Lewis and Clark NF plan includes directions (G-1) to avoid unnecessary damage to improvements, and prevent pollution of soil, water and air resources. It also requires the soil and water protection as outlined in forestwide Soil and Water Management Standard F-3. No surface occupancy stipulations are required to be applied to drainages supporting populations of westslope cutthroat trout that are considered either "managed-as-pure (98-100% genetically pure) or "indicator" (90-70% genetically pure). The 1986 Helena NF plan has directions to maintain water quality and bank stability.

Lands and special uses

Effects common to all alternatives

The forest issues a variety of permits for projects under the lands and special uses programs. FS permits can lead to interrelated and interdependent effects on private lands that are enabled by issuing a road use permit or right-of-way grant.

Management activities that result in ground disturbance near streams and other bodies of water have the potential to affect water quality. These potential increases are based on site-specific factors such as slope, soil types, proximity to waterbodies, residual ground cover, re-vegetation, etc. Conversely, soil erosion, loss of long-term soil productivity, stream sediment, and turbidity can increase due to increased road activity from issuance of road use permits or granting of right-of-ways.

Effects common to all action alternatives

The proposed guidelines (FW-LAND USE-GDL-03 and 04) would require new authorizations or reauthorizations of exciting facilities to include conditions to avoid or minimize adverse effects to fish, water, and riparian resources. Potential impacts on RMZs would strive to improve conditions or site them outside of RMZs. New hydropower support facilities would be sited outside of RMZs to reduce effects to fish, water, and riparian resources. Support facilities include any facilities or improvements (e.g., workshops, housing, switchyards, staging areas, transmission lines) not directly integral to its operation or necessary for the implementation of prescribed protection, mitigation, or enhancement measures. Some riparian vegetation could be removed or curtailed from re-establishing at the site-specific scale due to clearing of power lines, outfitter camps, etc., but that the cumulative effect is minor and would not affect riparian processes. Acquisition of areas along designated WSRs would continue to be a priority for land exchanges. The guidelines are similar for each action alternative as they were modified from alternative A, which adopted the INFISH guidelines in 1996 under an amendment to the Helena 1986 plan and would be implemented across the two forests. Permitted power and telephone line construction and maintenance would continue under all alternatives. Clearing brush and trees in riparian areas may increase solar radiation to streams and the forest floor, increasing water temperature. The limbing, topping, or removal of hazard trees near utility lines can also reduce in-channel wood. The very nature of power and telephone lines would result in riparian vegetation to be reduced where they cross and/or adjacent to the stream network. The permitting process for new authorizations would look at options to minimize this effect.

However, it is assumed that temporary and short-term impacts would still occur where special uses are allowed or mandated. Actions may also occur where the risk of short-term effects is worth taking because there would be significant benefits to watershed resource conditions over the long term. Where facilities cannot be located outside of RMZs, effects would be minimized to the greatest extent possible, but not completely eliminated.

Alternative A

The Helena NF and the Lewis and Clark NF 1986 plans have standards that govern activities that would impact soils and water resources. In the Lewis and Clark NF plan, new land use permits must not conflict with the goals of the management area (MA-R). The Lewis and Clark plan standards J3 (5 and 6) require all new special uses to avoid riparian areas if possible and all special uses protect soil and water resources. The Helena NF plan, as amended by INFISH, includes four plan components on the area west side of the Continental Divide, specifically LH-1 through LH-4. These require riparian resources to be restored, and new hydroelectric ancillary facilities to be located outside of RHCAs. This would avoid effects that would retard or prevent attainment of the riparian management objective. Land acquisitions, exchanges, and conservation easements would meet riparian management objectives.

Ski facilities

Effects common to all alternatives

All alternatives would continue to permit the existing ski areas as well as cross country ski areas.

Two special use downhill ski areas, Showdown located in the Little Belt GA and Teton Pass Ski Resort located in the Rocky Mountain Range GA operate under special-use permits. Both ski areas are located on the east side of the divide. Both areas contain many RMZs within their permitted areas. Showdown is located in the headwaters of Sheep Creek and includes approximately 1.5 miles of stream corridor. The permitted area also has many springs and seeps. Teton Pass Ski area is located in the headwaters of Waldron Creek, a tributary to the West Fork Teton River, and includes riparian areas along streambanks and springs.

Ski area development can lead to increased runoff and erosion through timber clearing for lifts, runs and other facilities. Ski areas and snow resorts typically remove forest vegetation from much of the area, which would no longer be allowed in RMZs under the action alternatives. Snowmelt runoff is increased, especially when cleared areas are compacted. Substantial amounts of such disturbances can increase the size and duration of spring high flows. Maintenance roads on the ski slopes can route runoff and sediment to streams and wetlands. Stream channel damage can result from increased runoff that leads to erosion. Ski areas also typically disturb soils throughout cleared areas. Erosion and sediment can result, especially from soils that are near streams, unstable, or highly erosive. Aquatic habitat can be damaged as a result. In addition, these uses can also degrade wetlands and riparian areas by draining or filling them or by altering their vegetation.

Effects common to all action alternatives

The draft plan would require the adoption of the RMZs directions which would result in an increase widths over current plan directions. Management directions for riparian areas would also be more restrictive. Under the draft forest plan standards, RMZs standards would be required. Extra protection for wetlands, fens, peatlands, and other groundwater dependent ecosystems (FW-RMZ-GDL-03) would be protected by a RMZ measuring 100 feet from management activities that disturb or compact soil, vegetation, and/or alter water chemistry. Plan directions would establish 300 feet RMZ for (FW-RMZ-STZD-01) fish bearing streams. Management actions would be limited to protect key riparian processes (FW-RMZ-GDL-14).

Because the ski areas are both located east of the Continental Divide, the RMZ plan components would provide more protection for water resources under the action alternatives than under alternative A.

Alternative A

Under the current 1986 Lewis and Clark NF Plan riparian widths are not designated within the special use permit areas. The 1986 forest plan standards required riparian areas to be delineated and considered at the project planning stage and the state of Montana SMZ laws are required during timber management actions within permit areas.

Past effects have been identified with regards to operation of developed winter sites. For example, high sediment deliveries from large runoff events have been documented on both permitted ski areas. Showdown Montana uses groomers that have concentrated snow in the headwater tributaries of Sheep Creek. Impacts from these types of activities are localized. These effects are few in nature but they can and do occur at times and can be prevented through proper monitoring and road maintenance. Current size of riparian areas during harvest are currently managed under the state SMZ rules. Effects associated with potential increases in water yield from clearing for ski runs would be the same as effects for timber harvest as discussed in that section.

Infrastructure

Effects common to all action alternatives

As a means to sustain productivity, the forest would evaluate not only stabilizing these old road areas but prescribe treatments to promote soil recovery (FW-SOIL-STD- 4).

Alternative A

The forest would continue to reduce the road system towards a manageable amount as funding allows. Future road building would likely be confined to realignment, while the main emphasis would continue. Where roads are built, the average amount of soil disturbed is 2.5 acres per mile, assuming a fifty foot wide prism. The road decommissioning treatment repurposes the road area back to productive land base and no longer manages these as administrative areas.

Cumulative effects

Cumulative effects to water quality can only be described in terms of potential to generally affect trends on a subwatershed to basin scale. In other words, the cumulative effects of a program at the forest plan scale as opposed to the effects from a project at the project scale can only be discussed in terms of general programmatic tendencies either toward improved or declining water quality or fisheries habitat at no specific site.

Other federal agency plans were reviewed. These include: Glacier National Park, Blackfeet Tribe, BLM and Bureau of Reclamation. Glacier National Park borders the north end of the Rocky Mountain Range GA. There would be little to no cumulative effects from park management actions as most areas are managed to protect ecological values. East of the Rocky Mountain GA, the Blackfeet tribal lands are located downstream therefore there would be no effects from management actions on these lands. The BLM lands are also located downstream of the planning area and would have little effect on the forest. The Bureau of Reclamation manages large dams across the planning area, i.e. Gibson and Swift.

Non-federal land management policies would be likely to continue affecting riparian and aquatic resources. The cumulative effects in the planning area are difficult to analyze, considering the broad geographic landscape covered by the GAs, the uncertainties associated with private actions, and ongoing changes to the region’s economy. Whether those effects would increase or decrease in the future is a matter of speculation. However, based on the growth trends and current uses identified in this section, cumulative effects could increase.

State owned school trust lands managed by the MTDNRC in the State Forests, would continue to support a variety of uses from livestock grazing to mining, timber harvest and recreational fishing and hunting. A host of activities would occur on private lands within the planning area. These include, water diversion; irrigation; livestock grazing; farming with varied cash crops; timber harvest, mining, water based hunting, outfitted and non-outfitted angling, establishment of sub- divisions, housing and commercial development, building and stocking of private fish ponds, chemical treatment of noxious weeds, flood control and stream channel manipulation, and hydropower management. The effects of these activities on federal lands would likely be minimal as they are mostly located downstream from the forest. Impacts to streams in known fisheries may have impacts to migration and spawning habitats downstream.

Stream systems in the planning area originate in high elevation headwater drainages and flow downstream through the planning area onto some lands owned or administered by entities other than the FS. The streams ultimately flow into three major river systems; the Missouri, Blackfoot or Clark Fork Rivers. Many fish populations, whether they move off-forest as part of their life cycle or are resident populations, require interconnectivity of these streams to survive as a population. For most all species, genetic interchange between subpopulations is necessary to maintain healthy fish stocks. The more wide-ranging a species such as bull trout is, the more critical interconnectivity may be in order to access important

habitat components. Thus, activities off-forest that disrupt fish migration corridors can have significant impacts to fish populations upstream on the HLC NF.

The potential for introduction of disease and aquatic nuisance species exists on all lands within the cumulative effects analysis area. The extent of influence exerted by disease or exotic species is often determined by an area's suitability. If conditions are favorable enough to promote and perpetuate them, then effects are determined by the fishery's susceptibility to be influenced. The effects of these introductions could range from extreme to negligible, based upon the species.

MTDFWP is the responsible agency for managing fish populations throughout the planning area. Regulations would most likely continue to allow angling and harvest of fish, with variations on fishing limits and times when angling can occur and some gear restrictions. The Upper Blackfoot and Divide GAs are critical to maintaining bull trout in the Blackfoot and Clark Fork river systems. The east side GAs are as important for maintaining westslope cutthroat trout populations in headwater streams of the upper Missouri River basin. For the most part, fish populations within the planning area are isolated with little connectivity in upper headwater tributaries. MTDFWP is also responsible for administrating water quality requirements under the Clean Water Act for instream restoration work and construction activities.

The most complex cumulative effects are related to the restoration of bull trout and westslope cutthroat trout habitats within the planning area. The complexity of these life histories have exposed them to many factors affecting their abundance and viability. Cumulative effects to native fish include: (1) predation, hybridization, and competition with non-native fish; (2) destruction or degradation of spawning and rearing habitat from logging, livestock grazing, placer mining, road construction/maintenance and urban development on private and other non-federal lands; (3) degraded water quality as a result of polluted runoff from urban and rural areas; (4) heavy-metals contaminated or acidic mine drainage and runoff; and (5) migration barriers that result from roads on private or other non-federal lands.

Conclusions

Alternative A is not consistent with the 2012 Planning Rule (36 CFR Part 219.8(3)(ii)), since the current plans do not establish RMZs around all lakes, perennial and intermittent streams, and open water wetlands. Alternative A does not incorporate a watershed approach to the management of hydrology and watershed processes; there would not likely be watershed scale consideration and protection of hydrologic and riparian area/wetland processes and functions. As such, alternative A has been described herein to establish the baseline from which all action alternatives would be compared against.

All action alternatives would emphasize a watershed approach to the management of hydrology and watershed processes as well as a Conservation Watershed Network to identify important watersheds to conserve native fish. These alternatives puts emphasis on RMZs and would facilitate management of multiple ecological goals and long term ecological sustainability on a landscape basis. Updated watershed, riparian, and aquatic desired conditions, objectives, standards and guidelines would be applied in a consistent manner across the Forest to provide a mechanism to effectively prioritize activities and weigh multiple risks to various resources to move watersheds to a desired condition.

The biggest change in the proposed forest plan would be that all action alternatives would adopt forest plan direction that would establish designated widths of an inner and outer RMZ (RMZ) bordering streams, lakes, wetlands and other water features, as well as require plan direction for management actions within the inner and outer RMZs. The width of the RMZs for all action alternatives are delineated in the RMZ section above. The new standards and guidelines would limit management actions within these areas. These new directions would have the beneficial effect and increase protections for water quality and aquatic habitats, particularly east of the Continental Divide. Conservation watershed networks and those riparian areas currently not in desired conditions would receive priority for restoration.

Municipal watersheds for the Cities of Helena, Neihart, East Helena, and White Sulphur Springs would continue to receive special forest plan directions to protect water quality as all 1986 forest plan directions were brought into the new plan, as well as additional directions to insure attainment of water quality standards. The municipal watershed for the city of Lewistown would be added to the proposed plan.

The following key points summarize the conclusions for the soil resources:

- The current Forest plan does not sufficiently address current soil related issues on the Forest.
- The revised Forest plan would address these soil functions: soil biology, soil hydrology, nutrient cycling, carbon storage, soil stability and support, and filtering and buffering.
- The action alternatives contain desired conditions and standards that would help to ensure that the soil functions listed are maintained to greater extent than the current forest plan.
- Soil is the foundation of the ecosystem; in order to provide multiple uses and ecosystem services in perpetuity these functions must be maintained.

Table 31 provides a summary of the relative contribution of soils desired conditions by alternative. The land use categories are ranked in descending order of existing and potential impact to uplands and riparian resources.

Table 31. Comparison of alternatives by resource issue - magnitude or relative contribution to desired condition

Resource Area	Indicator	1	2	3	4	5
Watersheds	Water Quality	BCD	E	A		
	Water Quantity	ABCDE				
	Movement toward desired conditions	BCD	E	A		
Municipal Supply watersheds, drinking water and source water protection	Water quality	ABCDE				
Riparian areas	Riparian desired condition	BCDE	E	A		
Watershed and stream restoration projects	Stream function	BCDE	A			
Fish and Aquatics	Habitat	BCDE	A			
Soils	Riparian	BCDE	A			
	Uplands	D	BC	A	E	

Aquatic species

The analysis in the DEIS of existing habitat conditions based upon PIBO monitoring form the basis of the desired conditions in the plan, as well as the effects that may occur with implementation of the plan. The revised plan includes plan components that would provide the ecological conditions necessary to maintain, improve and restore ecological conditions within the plan area that maintain viable populations of at-risk aquatic species. Based on the analysis of alternatives, other interrelated and interconnected activities, and the cumulative effects of other federal and non-federal activities within the plan area, the implementation of the plan components would support recovery of bull trout.

The USFWS (USFWS, 2015a, 2015b) released the final Bull Trout Recovery Plan in September 2015. That plan outlines the conservation actions needed to recover bull trout. The overarching goal of the recovery plan is to conserve bull trout so that the fish are geographically widespread with stable populations in each of the six recovery units. Accordingly, the plan's recovery criteria focus on effective management of known threats to bull trout. The Coastal, Columbia Headwaters, Klamath, Mid-Columbia,

Saint Mary and Upper Snake are the six designated recovery units that are home to the threatened population in the lower 48 states. That portion of the HLC NF west of the Continental Divide is in the Columbia Headwaters recovery unit. The Columbia Headwaters Recovery Unit Implementation Plan has identified threats and recovery actions. The habitat threats to bull trout identified on the Forest by the Recovery Unit Implementation Plan were upland/riparian land management and water quality (U.S. Department of Interior, 2015). The Recovery Unit Implementation Plan listed actions to address habitat threats that included these that are applicable to the HLC: 1) Prioritize Blackfoot River Tributaries for restoration, 2) Improve habitat through BMPs (BMPs) and conservation easements, 3) Protect and improve water quality, and 4) supply cold water. In addition, there are other actions identified under demographic threats and non-native species that the Forest would need to work cooperatively with our partners to address.

A conservation watershed network would conserve bull trout and genetically pure stocks of westslope cutthroat trout by identifying areas where cold water is expected to occur into the future. A conservation watershed network is a collection of watersheds where management emphasizes habitat conservation and restoration to support native fish and other aquatic species. The goal of the network is to sustain the integrity of key aquatic habitats to maintain long-term persistence of native aquatic species. Designation of conservation watershed networks, which include watersheds that are already in good condition or could be restored to good condition, are expected to protect native fish and help maintain healthy watersheds and river systems and benefit aquatic systems as part of the action alternatives.

Coarse filter plan components primarily related to watersheds, RMZs, Conservation watershed network, and road management would improve ecological conditions for bull trout, westslope cutthroat trout, and other aquatic species and maintain persistence of the species across the planning area. The conservation watershed network protects a network of connected aquatic species populations in cold water refugia by reducing effects associated with roads. The revised forest plan adds an active restoration component through desired conditions, objectives, guidelines, and standards that would supplement the retained passive components of INFISH and expands those protections forestwide. The revised forest plan would also help move projects and activities towards the desired conditions and improve aquatic habitats.

As part of the revision process, the forest will consult with the USFWS on the plan's effects. A biological assessment will disclose the effects of the revised HLC NF Plan on the threatened bull trout and designated bull trout critical habitat.

3.6 Air Quality

3.6.1 Introduction

There are two primary types of air quality effects concerning the Forest and forest operations. First is the effect of regional air pollution on forest natural resources and human health. Second is the effect of forest emissions on forest natural resources, human health, and regional air sheds.

Air quality on the HLC NF is dependent on the type and amount of pollutants emitted into the atmosphere, those that currently exist, or are in the "background" in the atmosphere, the size and topography of the airshed, and the prevailing meteorological and weather conditions. Sources of pollution within the Forest may include particulates and ozone precursor gases generated from timber and mining operations, prescribed and wildland fire, forest administrative operations, and recreational use.

The focus of this section is on smoke and how the various alternatives could affect smoke production through the use of prescribed fire, the management of naturally caused wildfires to meet resource objectives, and the management of damaging wildfires. Of all potential sources of air pollution from management activities that occur on the Forest, smoke is the most substantial contributor to air quality and visibility. Smoke can exacerbate human health conditions as well as reduce the ability to view the