Helena and Lewis & Clark National Forests

Forest Plan Assessment

Chapter 6, Multiple Uses and Ecosystem Services

2015

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Multiple Uses and Ecosystem Services

Introduction

The preamble of the 2012 planning rule for NFS land management planning recognizes that ecological, social, and economic systems are interdependent and equally important; none has priority over the other. Therefore, the planning rule requires the consideration of social, economic, and ecological factors in all phases of the planning process. The rule also states that forest plans must "contribute to economic and social sustainability and must provide for ecosystem services and multiple uses in the plan area. Responsible officials will use an integrated resource management approach to provide for multiple uses and ecosystem services in the plan area, considering a full range of resources, uses, and benefits relevant to the unit, as well as stressors and other important factors." In line with this emphasis, the planning rule requires the assessment to address both multiple uses and ecosystem services.

Multiple use is defined by the Multiple-Use Sustained-Yield Act (MUSY) of 1960 (16 U.S.C. 528–531) as follows:

> …the management of the various renewable surface resources of the NFS so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.

Additionally, the first paragraph of the MUSY Act states, "Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that, it is the policy of the Congress that the national forests are established and shall be administered for *outdoor recreation, range, timber, watershed, and wildlife and fish purposes*" (emphasis added).

The 2012 planning rule defines ecosystem services as "the benefits people obtain from ecosystems." Healthy forest ecosystems are life-supporting systems that provide a full suite of goods and services (ecosystem services) that are vital to human health and wellbeing.

Though in practice the categories of multiple use listed above (outdoor recreation, range, timber, watershed, and fish and wildlife) largely fall under the broader umbrella of ecosystem services (benefits people obtain from ecosystems), the multiple use mandate under the MUSY Act of 1960 (16 U.S.C. 528–531) and the National Forest Management Act (NFMA) of 1976 (16 U.S.C. 1600 et seq.) requires that land management plans address multiple uses. Therefore, this section includes assessments of the multiple use categories and any key ecosystem services that are not addressed in the multiple use section. The rest of this topic is organized as follows: a brief introduction to the concept of ecosystem services and a list of the multiple uses and key ecosystem services identified by the interdisciplinary team and the public; the assessment of multiple uses; and the assessment of key ecosystem services not already addressed in the multiple use section.

What are Ecosystem Services?

In a 2007 Pacific Northwest Research Station publication (Collins and Larry 2007), the authors describe ecosystem services as follows:

An ecosystem services perspective encourages natural resource managers to *extend the classification of "multiple uses"* [emphasis added] to include a broader array of services or values; managing for water, wildlife, timber, and recreation addresses the need to sustain "provisioning" services, but land managers are also stewards of regulating, cultural, and supporting services, all of which are critical to human health and well-being. (See Table 6.1 for examples of these other ecosystem services.)

Table 6.1 Ecosystem service examples

	Provisioning Services, such as • Clean air and fresh water • Energy and minerals • Fiber and forage • Food (game animals, fish, plants) • Biochemicals, natural medicines, pharmaceuticals
Supporting Services, such as • Pollination • Seed dispersal • Soil formation • Nutrient cycling, Biodiversity • Ecosystem resilience	**Regulating Services**, such as • Long-term storage of carbon • Climate regulation • Water filtration, purification, and storage • Soil stabilization • Flood control • Disease regulation
	Cultural Services, such as • Aesthetic values • Educational values • Spiritual and cultural heritage values • Recreational experiences and tourism opportunities

The requirements for plan components for ecosystem services in the 2012 planning rule are found in the section on social and economic sustainability and in the section on multiple use:

> *36 CFR 219.8(b): The plan must include plan components, including the plan area's contribution to social and economic sustainability, taking into account…(4) Ecosystem services*
>
> *§ 219.10 Multiple use. While meeting the requirements of §§ 219.8 and 219.9, the plan must provide for ecosystem services and multiple uses, including outdoor recreation, range, timber, watershed, wildlife, and fish, within Forest Service authority and the inherent capability of the plan area as follows: (a) Integrated resource management for multiple use. The plan must include plan components, including standards or guidelines, for integrated resource management to provide for ecosystem services and multiple uses in the plan area.*

The benefit to people (i.e., the goods and services provided) is what differentiates ecosystem services from the ecosystem itself. As stated in Kandziora et al. 2013, the "significance of human well-being lies in the concept and definition of ecosystem services itself, since there are no services without humans benefitting from the functions and processes that generate them." Additionally, though management actions (fire suppression, fuel treatments, etc.) and infrastructure (such as trails and roads) may also provide benefits to the public, the benefits are not provided by the ecosystem itself and therefore are not considered "ecosystem services." To help clarify the differences, Figure 6.1 shows the connections between ecosystem processes, functions, and structures; ecosystem services; benefits to people; management actions; and threats and drivers.

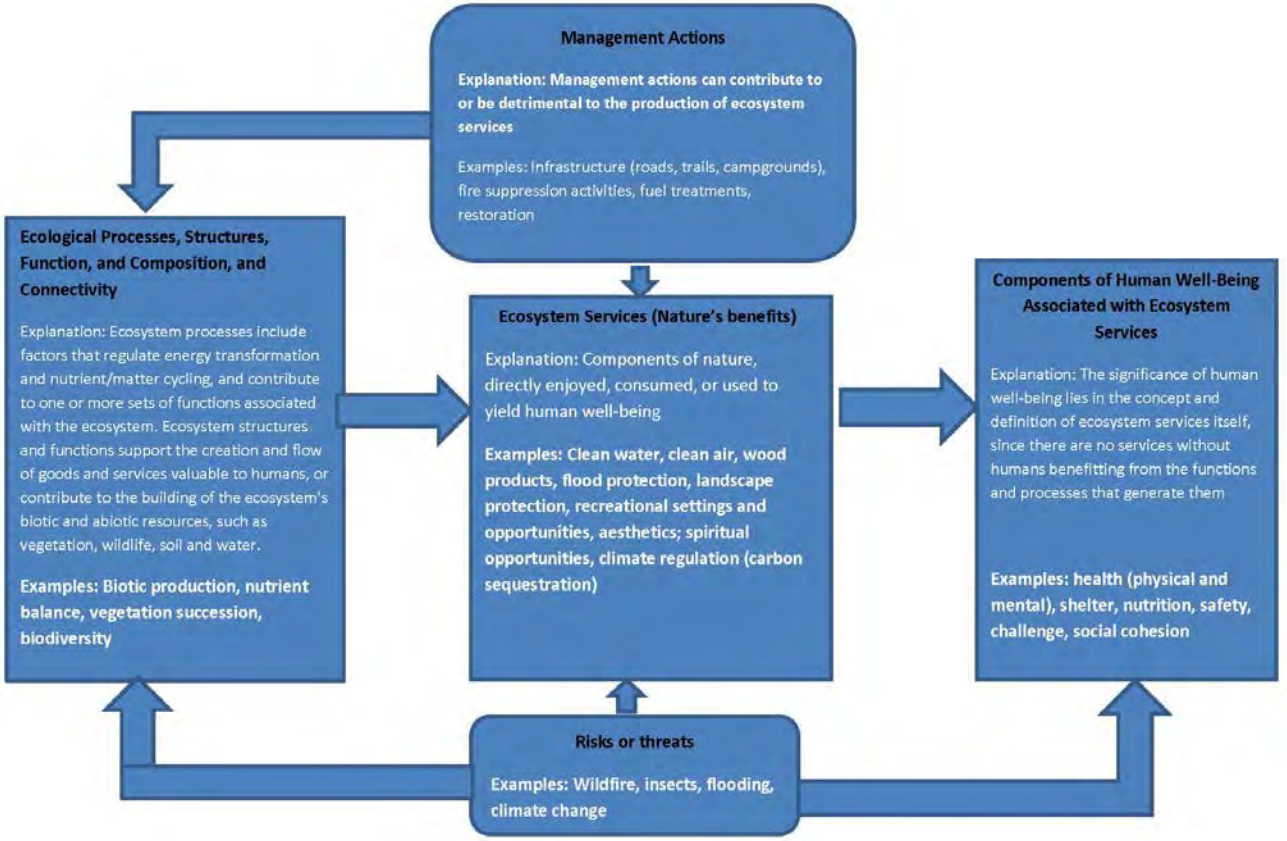

Figure 6.1 Relationship of ecosystem service components (source: diagram based on infrastructure provided in MEA 2003, Boyd, Banzhat, and Kandziora 2013)

The Role of Biodiversity

In discussions about ecosystem services, the question often arises whether biodiversity should be considered an ecosystem service. The term "biodiversity" combines two words: "biological" and "diversity." Biodiversity refers to all the variety of life that can be found on Earth (plants, animals, fungi, and microorganisms); the term also refers to the communities that these organisms form and the habitats in which they live (Convention on Biological Diversity 2013). Most studies acknowledge that biodiversity probably plays an important role in directly providing goods and services as well as regulating and modulating ecosystem properties (Balvanera et al. 2006), but the idea of biodiversity as an ecosystem service is more controversial. Benays et al. (2009) state the following: "[D]espite being the focus of major research attention, the relation between biodiversity and provision of ecosystem services remains uncertain." (Kandziora et al. 2013) make a different assessment: "In other studies, biodiversity has been mentioned as an ecosystem service itself, which it is obviously not (Haines-Young and Potschin 2010; deGroot et al. 2010).

Others take a broader view of the role of biodiversity in the delivery of ecosystem services. Mace et al. (2013) state the following:

> *Biodiversity has multiple roles in the delivery of ecosystem services, as a regulator of ecosystem processes, as a service in itself and as a good. Effective ecosystem management now, but even more in the future as pressures intensify, will require identifying and analyzing all roles both for the optimization of ecosystem service delivery and for the conservation of species, habitats and landscapes.*

Mace et al. (2013) believe these three roles of biodiversity are important for accounting for the complex ways in which biodiversity enhances human well-being. The right combinations of biotic and/or abiotic components are viewed as an important benefit of biodiversity when it is defined as a regulator of ecosystem processes; however, this definition or role may not account for other benefits, such as bird species richness. Viewing biodiversity as an ecosystem service takes into account the fact that "both genetic diversity (or surrogates, such as wild species richness or phylogenetic diversity) and wild species diversity (implicitly including genetic and phylogenetic diversity) directly contribute to ecosystem goods, such as wild medicines, genetic material for crops, etc." They also argue that biodiversity can be viewed as a good because many components of biodiversity have cultural value and retaining a full complement of wild species is important to many people.

In the context of forest plan revision on HLC NFs, biodiversity's many roles in contributing to human well-being are appreciated and acknowledged. However, explicitly accounting for the ways in which people value biodiversity, or assessing how management actions may affect those values, is not possible. For that reason, any analysis or assessment of biodiversity will be handled in the ecological sustainability sections of this assessment.

Key Ecosystem Services for the HLC NFs

Every National Forest or National Grassland provides important ecosystem services. However, describing or analyzing every ecosystem service is not feasible. Current direction (proposed directives) is to identify those ecosystem services that are most important to people in the broader landscape and that would be most affected by the land management plan. During the assessment phase of forest plan revision, the ID Team identified an initial list of ecosystem services that are provided by the Forests. This list was then vetted with the public during the open houses conducted in the summer of 2014. The list of key ecosystem services is listed below, along with the report section where they are discussed. For those services that are discussed in detail in other chapters of this assessment, the sections below contain minimal information with reference to the appropriate chapter in the assessment where information can be found.

- Water quality and quantity (multiple use section)
- Timber products (multiple use section)

- Wood for fuel (multiple use section - timber)
- Grazing (multiple use section)
- Energy and minerals (multiple use section)
- Clean air - breathing/particulate matter, scenic quality/haze (ecosystem services section)
- Outdoor recreation (multiple use section)
- Scenery (multiple use section)
- Fish and wildlife (multiple use section)
- Inspiration and non-use values – spiritual values and solitude (ecosystem services section)
- Cultural/heritage values (ecosystem services section)
- Research/Education (ecosystem services section)
- Carbon sequestration and climate regulation (ecosystem services section)
- Flood control (ecosystem services section)
- Erosion control (ecosystem services section)

Multiple Uses

The sections that follow describe the multiple uses and ecosystem services that are provided for in this plan area. More detailed information about these uses and services can be found in their respective sections in other parts of the assessment.

Outdoor Recreation

Recreation is an important use of the HLC NFs by both local residents and nonlocal visitors. Recreational opportunities and settings are also an important cultural service provided by the Forests. The term “cultural services” refers to the intangible benefits people receive from ecosystems, including nonmaterial spiritual, religious, inspirational, and educational experiences (Kandziora et al. 2013). Recreation on the Forests is characterized by the vast, wild, and remote forest landscapes (recreation settings) that support nature-based (water, snow, fisheries, wildlife) recreation activities and opportunities. These opportunities and settings provide people with a variety of benefits: relaxation/recreation; physical, mental, and/or spiritual health; experiencing nature, landscapes, and/or their own or other people’s cultures; environmental/outdoor education; eco/adventure/nature-based tourism; opportunities to socialize; and challenge and competition (SEQ 2013). The benefits people obtain from recreating in a natural environment are subjective and highly personal, with different people obtaining different benefits from the same piece of land or forest attribute. This assessment provides detailed information about the Forests’ recreation settings and opportunities, services, access, and recreational facilities in chapter 7 - Recreation Settings, Opportunities, Access, and Scenic Character. Hunting and fishing are discussed below in the fish and wildlife multiple use section below.

Scenery

Due to the natural scenic beauty of the HLC NFs, aesthetics is an important cultural ecosystem service associated with these landscapes. In addition, the aesthetics of an area is often associated with inspiration and art, another cultural ecosystem service. Aesthetics is “the visual quality of the landscape/ecosystems or parts of them which influences human well-being and the need to create something, esp. in art, music and literature. The sense of beauty people obtain from looking at landscapes/ecosystems as ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, advertising and technology” (Kandzioria et al. 2013). Sometimes called visual quality, scenic character, or scenic amenity by professionals, visual appreciation of the environment is a well-recognized and accepted dimension of aesthetic appreciation (SEQ 2013). The incredible scenery of the

Forests contributes to community identity and sense of place; quality of life (backdrop/backyard); the tourism industry (attraction); and increased real estate values.

Detailed information on scenic character can be found in chapter 7 - Recreation Settings, Opportunities, Access, and Scenic Character as well as in appendix C.

Range

Domestic livestock grazing has been, and continues to be, an important use of both National Forests lands. Although rangeland provides a variety of ecosystem services, such as wildlife habitat, recreation (including that associated with wildlife), watershed functions, carbon sequestration, and biodiversity conservation, these lands have primarily been managed for forage. Under the Ecosystem Services Assessment, forage is a provisioning service. Provisioning services include all tangible products from ecosystems that humans make use of for nutrition, materials, and energy. These products can be traded and consumed or used directly (Haines-Young and Potschin 2010); they are divided into the main subcategories of food, materials, and energy (Kandziori 2013).

Geographic Scale

Livestock grazing is permitted on designated grazing allotments within the Forests. Active grazing allotments occupy approximately 893,000 acres within the Lewis & Clark National Forest, 50% of National Forest System (NFS) lands and 543,000 acres within the Helena National Forest, 65% of NFS lands. Please refer to map 18 in appendix A, Grazing Allotments.

Table 6.2 Grazing allotments within the plan area

	Lewis & Clark NF	Helena NF
Grazing Permittees (Permit Entities)	151	83
Active Allotments	163	77
Active Allotment (total) (acres)	893,955	525,130
Active Allotment (Forest Service) (acres)	867,000	512,819
Active Allotment Waived (private) (acres)	26,955	12,311
Vacant Allotments	8	4
Closed Allotments	7	16

Current Condition, Trends and Drivers

Key Ecosystem Characteristics

Key ecosystem characteristics are identified to provide indicators of rangeland health. There are three interrelated attributes of rangeland health that can be indirectly measured by monitoring biological and physical components. Pellant et al. (2005) defines the three attributes of rangeland health as follows:

- Soil and Site Stability: The capacity of an area to limit redistribution and loss of soil resources (including nutrients and organic matter) by wind and water.
- Hydrologic Function: The capacity of an area to capture, store, and safely release water from rainfall, run-on, and snowmelt (where relevant), to resist a reduction in this capacity, and to recover this capacity when a reduction does occur.
- Biotic Integrity: The capacity of the biotic community to support ecological processes within the normal range of variability expected for the site, to resist a loss in the capacity to support these processes, and to recover this capacity when losses do occur. The biotic community includes plants, animals, and microorganisms occurring both above and below ground.

The following table outlines the three attributes of rangeland health and identifies qualitative indicators and quantitative measurements and their interpretations. The attributes are interrelated and as a result indicators and measurements are associated with more than one attribute. A consistent analysis across the HLC NFs plan area for the quantitative measures for rangeland health is not yet available at the writing of this assessment, but methods are currently being developed for the best available data and will be considered in the forest plan revision process.

Table 6.3 Key Ecosystem Characteristics for Rangeland Health

Rangeland Health Attribute	Qualitative Indicators	Quantitative Measurements	Interpretations adapted from Pellant et al. (2005) and Herrick et al. (2005).
Soil & Site Stability	Rills, Water flow patterns, Bare ground, Gullies, Wind-scoured, blowout, and/or depositional areas, Litter movement Soil surface resistance to erosion, Soil surface loss or degradation, and Compaction layer	Bare ground	Bare ground is positively correlated with runoff and erosion as well as risk of invasion by noxious weeds and other invasive plant species.
		Proportion of soil surface covered by canopy gaps longer than a defined minimum	Bare ground is positively correlated with canopy gaps because bare ground in large gaps usually has a larger effect on many functions than bare ground in small gaps. Increases in the proportion of canopy gaps are related to increased risk of wind erosion and invasive plant species establishment.
		Proportion of soil surface covered by basal gaps longer than a defined minimum	Basal gaps are positively correlated with water flow patterns because water gains energy as it moves unobstructed across larger gaps. Basal cover is negatively correlated with water flow patterns because plant bases slow water movement.
		Soil macro-aggregate stability in water	Surface aggregate stability is positively related to soils resistance to wind and water erosion. Sub-surface soil structure degrades and organic matter declines as surface soil is lost, thus sub-surface aggregate stability is negatively related to soil surface loss or degradation.
Hydrologic Function	Rills, Water flow patterns, Pedestals and/or terracettes, Bare ground, Gullies, Soil surface resistance to erosion, Soil surface loss or degradation, Plan community composition and distribution relative to infiltration and runoff, Compaction layer, Litter amount	Bare Ground	See above
		Proportion of soil surface covered by canopy gaps longer than a defined minimum	See above
		Proportion of soil surface covered by basal gaps longer than a defined minimum	See above
		Soil macro-aggregate stability in water	See above
Biotic Integrity	Soil surface resistance to erosion, Soil surface loss or degradation, Compaction layer, Functional/structural groups, Plant mortality/decadence, Litter amount, Annual production, Invasive plants, Reproductive capability of perennial plants	Soil macro-aggregate stability in water	See above
		Plant canopy (foliar) cover by functional group	Composition and richness of functional or structural groups are positively related to plant functional or structural groups. Functional composition has a large impact on ecosystem processes. Functional composition and functional diversity are the principal factors explaining plant productivity, plant percent nitrogen, plant total nitrogen, and light penetration
		Plant basal cover by functional group	
		Litter cover	The portion of litter in contact with the soil surface provides a source of soil organic material and raw materials for on-site nutrient cycling. All litter helps to moderate the soil microclimate and provides food for microorganisms (Hester et al. 1997). Also, the amount

Rangeland Health Attribute	Qualitative Indicators	Quantitative Measurements	Interpretations adapted from Pellant et al. (2005) and Herrick et al. (2005).
			of litter present can play a role in enhancing the ability of the site to resist erosion. Litter helps to dissipate the energy of raindrops and overland flow, thereby reducing potential detachment and transport of soil (Hester et al. 1997). Litter biomass is a significant obstruction to runoff (Thurow et al. 1988).
		Plant production by functional group	Annual production is defined as the net quantity of above-ground vascular plant material produced within a year. It is an indicator of the energy captured by plants and its availability for secondary consumers in an ecosystem given current weather conditions. Annual production will vary by ecological site and associated plant communities.
		Invasive plant cover	The number of invasive species and their densities or cover will directly relate to the qualitative indicator. Invasives can include noxious plants (i.e., plants that are listed by a State because of their unfavorable economic or ecological impacts), nonnative, and native plants. Native invasive plants (e.g., conifer encroachment into meadow areas) must be assessed by comparing current status with potential status described for the particular ecological site. Invasive plants may impact an ecosystem's type and abundance of species, their interrelationships, and the processes by which energy and nutrients move through the ecosystem. These impacts can influence biologic and physical attributes of an ecological site.
		Invasive plant density	

Grazing

Within the Lewis & Clark National Forest, 151 permittees are authorized to graze livestock on 148 cattle and 15 pack stock allotments. Records for the Lewis & Clark National Forest for 2011-2013 report 15,508 head of cattle and 40 horses were permitted to graze mid-June through mid-October, with the primary grazing season of approximately July 1 through September 30. The cattle grazing program averaged approximately 58,901 head months annually from 2011 to 2013 and horses averaged approximately 80 head months. A Head Month (HM) may be defined as one month's use and occupancy of the range by one animal. For grazing fee purposes, it is a month's use and occupancy of range by one weaned or adult cow with or without calf, bull, steer, heifer, horse, burro, or mule, or 5 sheep or goats.

The Helena National Forest currently has 83 permittees that are authorized to graze livestock on 77 allotments. Helena National Forest records for 2011- 2013 indicate 8,682 head of cattle, 39 horses and 5,000 head of sheep were permitted to graze at various times throughout the year on NFS lands, with the primary grazing season of approximately June 1 through October 15. The sheep grazing program was 8,648 head months in 2011-2013, cattle averaged approximately 27,114 head months and horses averaged approximately 42 head months.

Various analysis from 1995-2004 estimate that livestock grazing may have had an effect on the ecological status on 45 percent of the National Forest System lands and 78 percent of the other ownership acres within the plan area. This includes the grasslands, shrublands, conifer, riparian and broadleaf areas within the project area that are capable of supporting livestock grazing. Since the historical period, composition of rangelands within the Upper Missouri River Basin, which includes the HLC NFs plan area, has changed at unprecedented rates due to agricultural development, livestock, exotic plant species, elevated carbon dioxide levels, altered fire regimes and hydrologic cycles, recreation, mining, and climate change (USDA Natural Resource Conservation Service 2003).

Ecosystems and Rangelands

The term “rangeland” is often applied to suitable and capable lands within a grazing allotment that produce forage for livestock and wildlife. Capable rangelands are accessible to livestock, produce forage or have inherent forage producing capabilities, and can be grazed on a sustained yield basis. Suitable acres are capable acres minus acreages chosen to be unacceptable to graze for other reasons – research natural areas, developed recreation sites, fenced rights-of-way or areas closed by decision. These areas must also be accessible to a specific kind of animal and which can be grazed on a sustained yield basis without damage to the resource.

Rangeland comprises a variety of vegetation types, including many timbered plant communities, grasslands, shrublands, and riparian areas. Range condition is an assessment of the current health of the plant communities, often expressed as the degree of similarity or dissimilarity of current plant composition and abundance compared to potential or natural/historic conditions. On the Lewis and Clark National Forest a Range Vegetation Classification (USDA Forest Service 1996) was collected from 1991-1995 to describe vegetative characteristics, their distribution, to stratify herbaceous vegetation into community types and determine ecological status. An ecological status rating was assigned for each vegetative community. Ecological status is a rating of the over-all condition of the vegetation, whether human forces or natural induces the condition. This rating is identified in the Range Vegetation Classification for plant communities. Ecological status was rated in four categories based on similarity of the existing species composition to that of the potential natural community (PNC). PNC is equal to 76 to 100 percent similarity, high is equal to 51 to 75 percent similarity, mid is equal to 26 to 50 percent similarity, and low is equal to zero to 25 percent similarity.

The PNC is the plant species composition that would naturally occur if minimally disturbed. Ecological status may be the result of natural succession, fire, timber harvest, introduced species, grazing, or other disturbances. For example, a community type with a tree overstory is predominantly influenced by the natural succession of trees and fire, and grazing of the understory may have some effect on the overall similarity to the potential natural community. On the other hand, grazing may have a dominant influence on the overall similarity of a grassland community type.

Through fire and other agents, there has always been a mix of ecological status classes over the landscape. Different plant and animal species are favored by vegetation in each of the classes. To maintain forest ecosystem health, a mix of ecological status classes are desired for tree dominated habitat types, maintaining some areas of lower status classes. A high ecological status is desired for grasslands, shrublands and riparian ecosystems, because it provides an optimal mix of resource values. These resource values include: plant and animal species and structural diversity, wildlife forage and cover, soil stability and productivity, fish habitat, and usable livestock forage. Some areas classified in “low” ecological status are composed primarily of introduced species such as Kentucky bluegrass and common timothy.

Livestock grazing may have had an effect on the ecological status on 45 percent of the National Forest System lands and 78 percent of the other ownership acres within the plan area. This includes the grasslands, shrublands, conifer, riparian and broadleaf areas within the project area that are capable of supporting livestock grazing.

Table 6.4 Inventoried rangeland acreages by type

Forest	NFS Land	Capable Cattle	Capable Sheep	Suitable Cattle
Lewis & Clark	1,868,205	1,103,292	1,546,531	277,808
Helena	978,745	630,040	883,148	192,990
Beaverhead-Deerlodge (*Elkhorn Mtn. portion)*	30,973	23,208	29,301	12,360

Intensive collection of vegetation plot data was collected prior to 2005 for several range analyses across the Forests. This data was collected on roughly 42% of the HLC NFs, primarily on the east side of the planning area. Analysis of this data, which is believed to typify range conditions across the planning area, determined that approximately 87% of sampled areas retain high native species integrity (Eco-status at PNC or High). Grasslands that have lower amounts of natural community attributes and/or the substantial presence of invasive species (approximately 5% of samples) suggest that these plant communities have a low similarity to PNC ecological condition. A large portion of the assessment area is susceptible to invasive weeds, and a high risk of continued weed expansion exists. To provide a general depiction of the potential condition of rangelands across the planning area, the allotment specific data was extrapolated as shown in the table below.

Table 6.5 Inventoried rangeland acreages by type

Forest	Eco-Status PNC	Eco-Status High	Eco-Status Moderate	Eco-Status Low
Lewis & Clark	801,660	244,722	89,777	65,784
Helena	420,217	128,280	47,060	34,483
Beaverhead-Deerlodge	15,480	4,725	1,734	1,270

Timber canopy closure and conifer encroachment into meadows, shrublands, and grasslands have reduced usable forage throughout the plan area. Local district rangeland specialists estimate that timber canopy closure and conifer encroachment have reduced forage availability by at least 10% over the past 60 years on some grazing allotments on both National Forests. Analysis of grazing allotments within the Divide portion of the Helena National Forest and Little Belt Mountains of the Lewis & Clark indicates grass/forb understory is decreasing in clearcut lodgepole pine due to canopy closure. In some areas this forage loss is due to the restocking of clear cuts, back to lodge pole pine, while in others range managers suggest that this trend in timber canopy closure and the resulting loss of may be due to fire exclusion.

Over the next 20 years, certain environmental influences may negatively impact range condition and forage production. If temperatures continue to increase, there may be changes in vegetation, shifting from more mesic plant associations to more xeric communities, better adapted to the drier sites. Elevation will play a large role in plant species composition in conjunction with predicted climate change. High elevation, alpine or other fringe type environments may see plant species composition change first (Murphy and Weiss 1992). Invasive weeds may continue to spread and increase in abundance and density. Timber canopy may continue to close in areas where wildfires or other disturbances do not occur, and some grasslands/shrublands may see additional conifer encroachment and conversion to a timber-dominated community. Conversely, there is potential that wildfire may play a larger role in shaping vegetation in some areas, perhaps promoting nonforested vegetation communities, particularly given warmer climate regimes. Transitory range acreage will fluctuate: timber stands will become more open due to harvest, insects, and/or fire; with time and succession, overstory canopies will close in once again.

The continued gathering and analysis of data, utilizing best available science, to determine trends and track progress towards goal achievement; will be essential to meet objectives. The use of adaptive management options to reach site specific conditions will be necessary to guide livestock management and reach desired ecological conditions. Emphasis on protecting habitats for threatened, endangered, and sensitive fish, plants, and animals may require intensive livestock management and may necessitate fewer permitted livestock numbers or a shortened season of use to mitigate impacts (National Riparian Service Team 2006).

Influence of Non-NFS Lands or Other Conditions

Livestock grazing, especially cattle, on both Forests is likely to be still desired by the local livestock industry within the plan area over the next 20 years, due to the scarcity of private held forage that is available for lease. This should continue to be especially true for livestock operators whose private lands are adjacent to National Forest. The amount of livestock grazing may decline to some degree, due to reduced forage capacity (invasive weeds and timber canopy closure) and tighter administrative constraints for protection and enhancement of threatened, endangered, and sensitive species habitat and other resource concerns such as water quality. The section below includes further discussion of the stability or resiliency of the ecosystems connected to rangelands.

Cattle and horses that graze the National Forests during the summer months are provided forage from private lands during late fall, winter, and early spring. Forage from private lands during this period is in the form of native grass pasture, irrigated pasture, irrigated and dry land hay, and fall crop residue. The availability of private lands in the surrounding area that can provide summer forage is somewhat limited. This demand for grazed forage, especially during the months June through October, is greater than the National Forest lands can supply. Productive lands associated with the lands surrounding the plan area, are generally used for crops, including spring/winter wheat and along with other cereal grains. There are however, large expanses of grasslands associated the more non-arable lands that are generally obligated to cattle grazing. Some of these grasslands may produce forage at less than their full potential, due to the abundance of exotic annual grasses and invasive weed species. Grazed is forage is often measured in terms of Animal Units Months (AUM). This is the amount of forage required by one animal unit for one month. When the opportunity for grazing on private land does become available, the grazing is considerably more expensive, $14–$16 per Animal Unit Month (AUM), than grazing under Forest Service permits, which costs about $1.35 per AUM. Montana Department of Lands (MDL) issues 20-year leases for livestock that graze on lands managed by the MDL. Grazing fees for 2016 are approximately $18.00/AUM and may fluctuate annually. Upon expiration, a grazing lease is available for issuance through a formal bidding process, with the highest bidder obtaining the lease for the next 20-year period.

Importance to People in the Broader Landscape

Agriculture is an important economic sector in the plan area, providing a substantial amount of employment, particularly in the northern and eastern county areas. The percentage of land area devoted to farming and ranching in the primary plan area is very high, ranging from a low of 35 percent in Jefferson County to a high of 96 percent in Wheatland County. In comparison, the percentage of the nation's land in agriculture is 45 percent, and 66 percent of the state of Montana is agricultural land. In fact, eight of the 13 counties in the plan area have a higher percentage of agricultural land than the state and all but Jefferson, Lewis and Clark, and Powell have a higher percentage than the nation. There are 6,786 farms in the primary area with 2,063 of those farms being classified as Beef Cattle Ranch and Farms (NASS 2014).

The counties in the plan area rely on forage produced on NFS lands for approximately 4%–6% of the total forage base of their respective counties. This percentage is similar to that of other places in the west, as expressed below (excerpted from Skags 2008):

> *"The USFS has estimated that less than 10% of total national forage consumption by domestic livestock is provided by public lands (USDA–USFS, 1989b). Torell, Fowler, Kincaid, and Hawkes (1996) estimated that 15% of the nation's beef cows and 44% of the sheep and lambs were produced on public land ranches, that approximately 5% of the nation's grazing capacity comes from BLM and USFS lands, and that 4% of the forage for the nation's beef cow herd is supplied by these lands. While neither the overall national beef cow herd nor the national beef supply is greatly dependent upon public rangelands, many individual ranching operations in the inter–mountain West are almost 100% dependent upon total annual or seasonal forage provided by publicly–owned rangelands. Torell, Fowler, Kincaid and Hawkes (1996) also concluded that 41%*

of beef cows in the eleven western states grazed on federal lands for part of the year, and that 19% of the total annual forage demand in the region was met from federal land."

An analysis of the economic contribution of programs on the Forests indicates that the grazing programs contribute approximately 258 jobs and $3.4 million in labor income to the 13-county primary plan area; see the section in Chapter 5 entitled "Helena and Lewis & Clark National Forest's Contributions to the Analysis Area Economy" for more information on the contribution of HLC NFs programs to jobs and income in the plan area. For more information on the importance of agriculture to the 13-county area, see the section entitled "Economic Conditions and Trends" in Chapter 5 of the assessment.

Effects from Forest Management Actions

The extent of available forage as a component of multiple use (range) could be affected by several future management actions initiated by the Forests. The intensity, duration, and timing of livestock grazing could notably affect resource conditions, including forage plant health and sustainability, riparian condition and function, and soil productivity and stability. The administration of livestock grazing by the Forests to ensure the maintenance of resource conditions will continue. Management standards and constraints governing permitted livestock grazing are expected to become more stringent to comply with sensitive species requirements and water quality standards.

Conifer canopy closure, conifer/shrub encroachment into grasslands, and the spread of invasive weeds all have the ability to notably reduce available forage for livestock. The degree to which future management actions address each of these ecological processes will in turn influence the potential loss or increase in available forage. Fire and physical manipulation of the tree overstory, may have potential effects of maintaining or increasing forage productivity for browsing and grazing ungulates. Development of rotation grazing systems versus season long grazing can have very positive effects on establishment of desired native vegetation. Treatment of invasive weeds can allow desired natural plant communities to flourish.

Permitted livestock numbers may decline slightly over the next 10–20 years within the plan area, due to more stringent management constraints and due to loss of forage brought about by conifer canopy closure, invasive weed spread, and encroachment of conifers into grassland communities.

Comments Received

Comments to the scoping notice were received and analyzed for relevance to this project as follows:

- Forest Plan should determine grazing levels. This is addressed at the grazing allotment level during Allotment Management Plan development, not in the Forest Plan.
- Forest Plan should guide livestock management. This is addressed at the appropriate scale in the assessment and will be addressed further in the Environmental Impact Statement (EIS).
- Forest Plan should improve range condition. The Forest Plan will address this further in the EIS.
- Forest Plan should address progress towards goals and objectives. Agreed and has been addressed and will be addressed further in the EIS.
- Forest Plan should determine suitability and capability. Agreed. An analysis to determine this has been completed.
- Forest Plan should address impacts from grazing. This will be addressed in the EIS.

Information Needs

A more thorough analysis of the herbaceous composition and trend data will need to be made at the individual grazing allotment level, when allotment management plans are developed. This will allow for site specific

management practices to be examined and put in place to ensure desired community attributes are achieved. Further, additional data analysis utilizing measurements gathered on nonforested plots on FIA and FIA Intensified Grid Plots will be possible in the short term. This data will be used to generate statistical estimates of conditions relative to the key ecosystem characteristics identified to represent rangeland health.

Timber Products

Use and development of natural resources on the Helena and Lewis and Clark National Forests and surrounding lands played an essential role in the economy and growth of the area over the past 150 years, since the early settlement of the area by European-origin Americans. The harvest of trees for a variety of uses has occurred. Mining for gold and other minerals boomed in the late 1800's, and associated tree cutting that occurred for fuelwood, mine timbers, and railways was extensive in many accessible drainages. Harvest became associated with a demand for pulpwood during World War II and to support numerous small mills that operated in the area (USDA Forest Service 1986a). The original mission of the Forest Service focused on protecting water and timber (Kline et al. 2012), and timber harvest continues to be an important use. Under the Millennium Ecosystem Assessment (MEA) classification system, provisioning services include all tangible products from ecosystems that humans make use of for nutrition, materials, and energy. These products can be traded and consumed or used directly (Haines-Young and Potschin 2010). Timber harvested on NFS lands on the HLC NFs provides a variety of wood products, such as sawlogs, veneer logs, and house logs, as well as logs used for pulpwood, posts and poles, firewood, furniture, and energy.

Information Sources

- Forest Service Cut and Sold reports from the Timber Sale Accountability (TSA) database
- Management activity data queried from the FACTS database

Geographic Scale

The HLC NFs plan area includes the entire Helena National Forest (HNF) and Lewis & Clark National Forest (LCNF). The HLC NFs are located across thirteen primary Montana counties which are grouped into four analysis zones (North, Central, East, and West). In addition, another seven counties are considered secondary plan areas which contain infrastructure and/or communities which utilize timber coming off of the HLC NFs, as shown in Table 6.6. Many of these counties contain suitable lands and/or receive timber products from other National Forests or private lands. Suitable acres from the HLC NFs plan area represent relatively small proportions of counties. The amount of suitable acres is greatest in the east county group. Please refer to map 19 in appendix A, 1986 Forest Plans Suitable Timber Lands.

Table 6.6 Counties affected by HLC NFs timber projection

County Group	Total Approx. Acres	Approx. Suitable HLC NFs Acres	% of County in Suitable HLC NFsLands
North (Glacier, Pondera, Teton)	4,458,524	17,932	0.40%
Central (Cascade, Choteau)	4,289,995	161,069	3.75%
East (Fergus, Judith Basin, Meagher, Wheatland)	6,424,014	570,727	8.88%
West (Broadwater, Jefferson, Lewis and Clark, Powell)	5,582,771	276,250	0.47%
Secondary (Missoula, Deer Lodge, Gallatin, Park, Golden Valley, Sweetgrass, Yellowstone)	9,272,985	17,707	0.19%

Current Condition, Trends and Drivers

Timber Products

The outcomes of treatments for timber production are summarized by estimating the volume of wood products sold. The existing 1986 HNF Forest Plan estimated the long-term sustained yield capacity (LTSYC) to be 21.3 million board feet (MMBF) per year based on an assumption that timber production is maximized on suitable acres. The Plan identified an allowable sale quantity (ASQ) of 15 million board feet per year from suitable lands for the first 9 decades, increasing to 21 by decade 11. ASQ is the total output of timber and other wood products anticipated in the plan period and takes into account the fiscal capability of the forest and consistency with land management goals and objectives. For the LCNF, the existing Forest Plan identified a long-term sustained yield capacity (LTSYC) of 20.5 MMBF and an ASQ of 12 MMBF per year of timber harvest from suitable lands for the first several decades, increasing to 20 by decade 6.

Reports from the Timber Sale Accounting system provide summaries of the timber products sold each year since 1980, in thousand board feet (MBF). While the Figure 6.2 displays MBF, volume is expressed in million board feet (MMBF) in the narrative and tables.

Figure 6.2 displays the trend in total volume of timber products sold on each Forest from 1980 to 2013. "Timber products" include *sawtimber, pulp, poles, posts*, and *nonsaw* material. Amounts for 1983 and 1987 are incomplete due to data gaps. The largest combined volumes sold occurred in 1980 and 1992 at over 30 MMBF. Beginning in 1990, volume sold began a general downward trend, with pulses ranging from less than 1 MMBF to over 20 MMBF per year. Volume from the HNF was lower than previous decades but somewhat stable through the 2000's due to post-fire salvage projects. On the LCNF, relatively little volume has been sold since 2000. Volumes sold on the HNF increased from 2009 to 2011 due in large part to post-mountain pine beetle activities. This trend is expected to continue on both Forests in the short term until beetle-killed timber no longer has merchantable value.

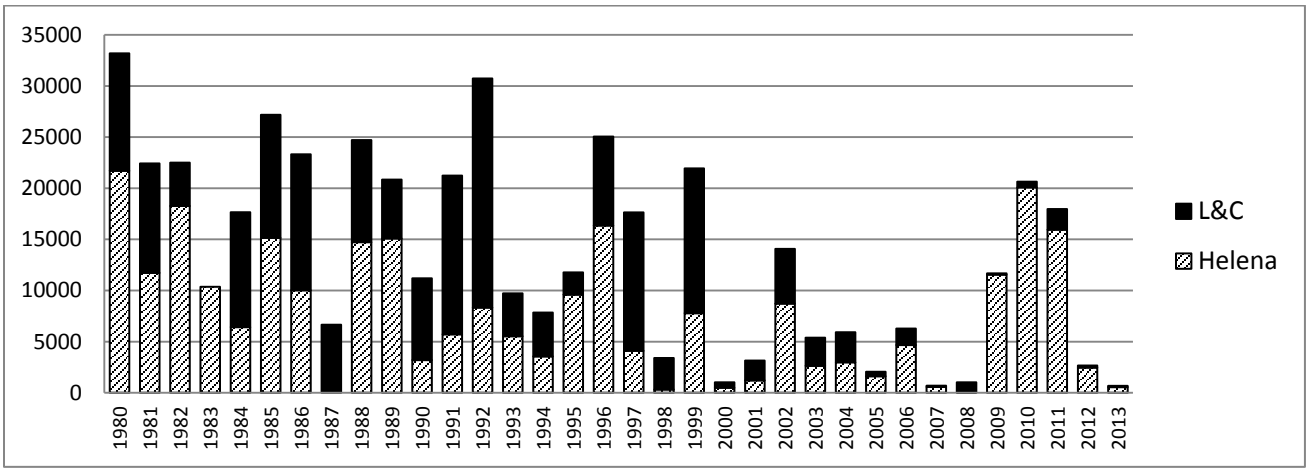

Figure 6.2 Total volume (MBF) sold by forest, 1980-2014 (excluding fuelwood)

Trends in average yearly timber product volume sold have generally declined by decade (Table 6.7). The HNF experienced a drop in timber products sold in the 1990's, and then remained somewhat steady after 2000. The LCNF produced steady amounts through the 1990's and then decreased substantially after 2000. Since 1980, the average volume timber products sold yearly from the HLC NFs has declined over 30%.

Table 6.7 Average volume timber products sold/year, MMBF, by decade

Decade	Helena NF Average	Lewis & Clark NF Average	HLC NFs Total Average
1980-1989*	13.7	9.5	23.2
1990-1999	6.5	9.6	16
2000-2013[+]	5.7	1.5	7.2

*9 years included in the average due to 1 year of missing data for each Forest

[+]13 years included in the average

Over the 27 year period since the existing Forest Plans were signed (1986 to 2013) an average of 12.2 MMBF of timber products was sold per year across the HLC NFs (plus an average 4.5 MMBF/year of fuelwood). The highest volume produced in a single year on the HNF after 1986 occurred in 2010 (20 MMBF) while the highest on the LCNF occurred in 1992 (over 22 MMBF).

The average timber product volume sold per year has been less than the ASQ provided in the 1986 Forest Plans. Fuelwood is not included in Table 6.7, but is included in Table 6.8 to account for the overall volume produced. Please refer to the section below for a detailed summary of fuelwood. Overall the HLC NFs have produced on average about 10 MMBF per year less than the ASQ.

Table 6.8 ASQ (1986 Forest Plans) and average volume/year MMBF sold timber products + fuelwood 1986-2013

Forest	ASQ[1] (1986 Plans)	Average Volume Sold 1986-2013	Difference
Helena	15	8.6	- 6.4
Lewis & Clark	12	8.0	- 4
HLC NFs Overall	27*	16.7	- 10.3

[1]ASQ is assigned by Forest; the ASQ's for the Helena and Lewis & Clark are added together for this summary.

Figure 6.3 shows volume sold by type from 1980 to 2013. Sawtimber made up the majority of volume until 2009. Since 2009, the HNF sold primarily nonsaw material; most of this was mountain pine beetle-killed lodgepole pine. Post and poles have made up a relatively small but consistent proportion of volume sold on the HLC NFs. Little to no sawtimber has been sold since 2009 on either Forest.

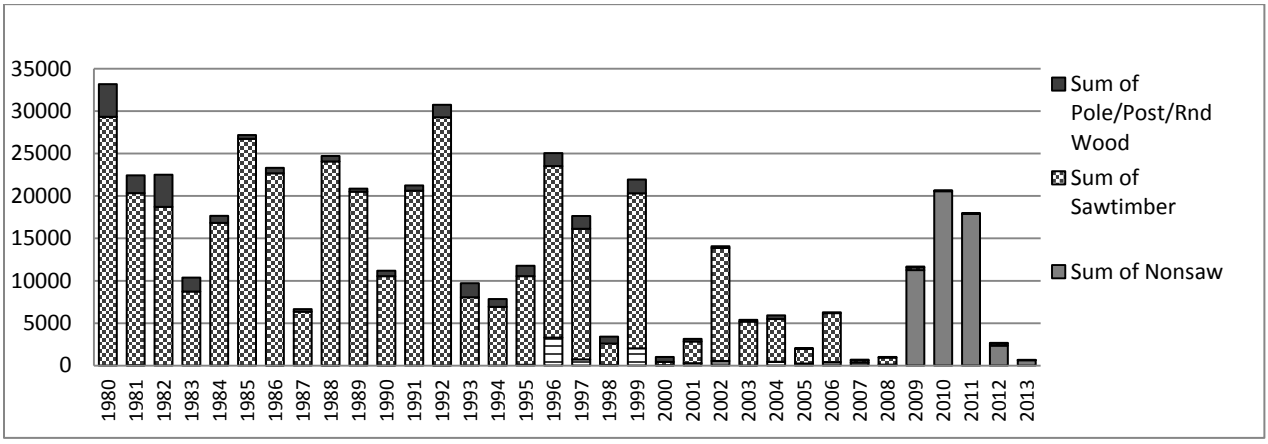

Figure 6.3 Volume (MBF) of forest products sold by type on the HLC NFs 1980-2013

Figure 6.4 shows sawtimber volume sold by tree species. The primary species utilized for sawtimber is lodgepole pine (69%); this is the most common species on the HLC NFs and dominates the most productive and accessible landscapes. (Note: For several reporting years a small amount of volume was categorized as "pine"– this is likely to have been lodgepole and the two are grouped together). Lodgepole is valuable for a variety of timber products and has been favored as a timber species due to the ease with which it regenerates. Douglas-fir is the second most prevalent sawtimber species sold (17%). The remainder of sawtimber sold (14%) is made up of relatively small amounts of ponderosa pine, subalpine fir, Engelmann spruce, and other miscellaneous species.

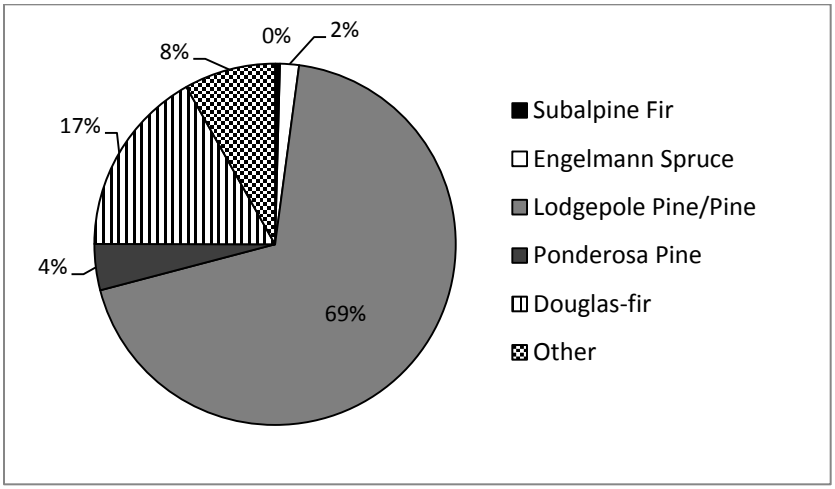

Figure 6.4 Sawtimber volume sold 1980-2013 by species on the HLC NFs

Non-Timber Products: Fuelwood and Christmas Trees

The primary non-timber products sold on the HLC NFs are personal use fuelwood and Christmas trees. Other products, such as mushrooms and boughs, have been permitted as free personal use in small quantities but not on a consistent basis.

Figure 6.5 shows the volume of fuelwood sold from 1980 to 2013, and Table 6.9 shows the average MMBF per year by decade. For the most part, fuelwood is sold for personal use. With the exception of remarkably high volume sold by the LCNF in 1984, for the most part fuelwood volume has accounted for between 2 and 10 MMBF/year. Cutting and removing dead trees for firewood has been a consistent use by the public of the timber resource on the HLC NFs. Average volumes by decade were somewhat higher in the 1980's, dipping slightly in the 1990's, and rising again in the 2000's. The rise since 2007 is likely attributable to abundant dead trees being available following the large-scale mountain pine beetle outbreak. Fuelwood use has been maintained between an average of about 2 and 4 MMBF per year on each Forest since 1980. Over the 27 period since the 1986 Forest Plans were signed, an average of 4.5 MMBF per year of fuelwood has been sold across the HLC Nfs. The HNF averaged about 2.1 MMBF/year and the LCNF 2.4 MMBF/year during this period.

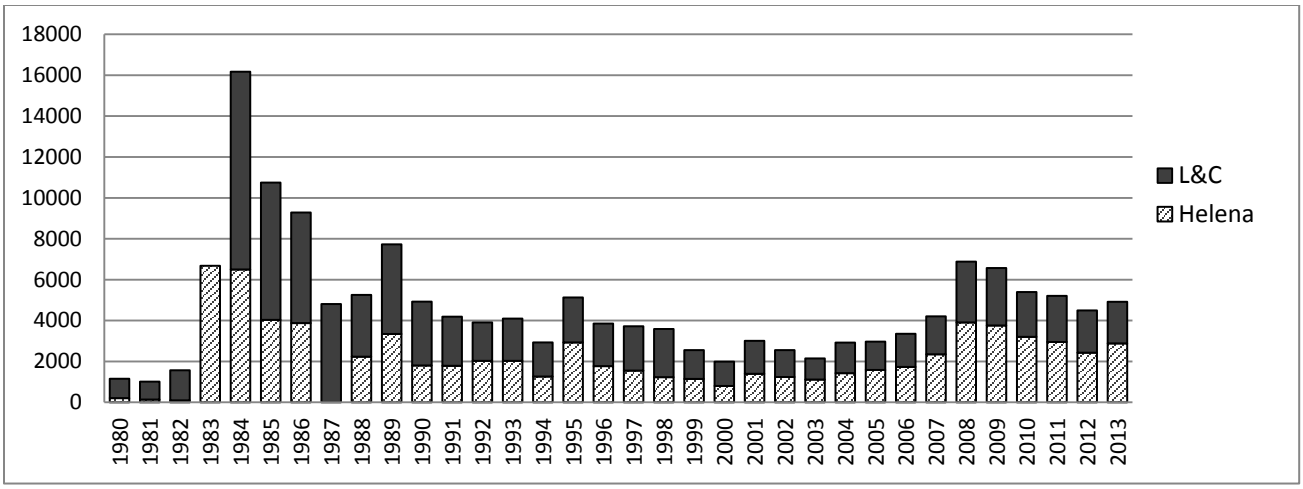

Figure 6.5 Volume (MBF) fuelwood sold 1980-2013 by forest

Table 6.9 Average volume fuelwood sold/year, MMBF, by decade

Decade	Helena NF	Lewis & Clark NF	HLC NFs Total
1980-1989*	3.0	4.1	7.2
1990-1999	1.8	2.1	3.9
2000-2013+	3.0	2.6	5.7

*9 years included in the average due to 1 year of missing data for each Forest

+13 years included in the average

Christmas trees are also a consistent and popular personal use product sold by the HLC NFs. The product sold is tracked by quantity rather than volume. Figure 6.6 shows that prior to 2000 the LCNF sold a higher amount of Christmas trees than the HNF, as high as about 17,000 at its maximum in 1993. Since 2000 both Forests have been relatively stable in the quantity sold, combined to be between 4,000 and 5,000 trees per year.

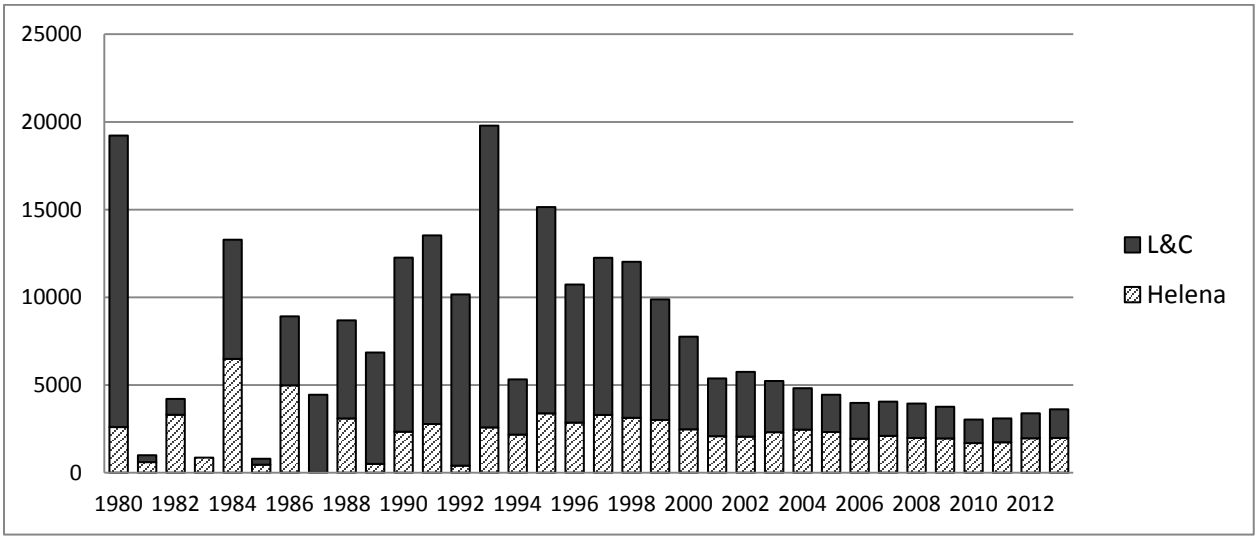

Figure 6.6 Christmas trees sold (Quantity) 1980-2013 by forest

Trends driving the supply and demand for timber

The period of 2007 to 2011 represents the worst operating environment experienced by the North American and Montana forest products industry since the Great Depression. It involved a two-year recession from 2007 to 2009, the related financial crisis, and a housing collapse with the lowest levels of new home construction since the Second World War (Keegan et al. 2012). Low prices for lumber and other wood products have accompanied this broad economic downturn. As of August 2012, there has been only a small increase in U.S. housing construction. Modest upticks are expected in domestic lumber markets if U.S. home building recovers and global demand continues to increase. Given continued difficult conditions, additional mill closures are possible. However, with slightly over half of capacity utilized in recent years—versus a historic level of over 80 percent during good markets—the industry would be expected to process substantially more timber when markets improve, provided adequate timber supply is available.

Consumption of manufactured wood products is projected to show only modest growth through 2060, while the consumption of wood for fuel is expected to increase substantially. How this trend affects the area surrounding the Forest depends on factors such as the price difference between wood fuel and fossil fuels; technological changes; and changes in regulations or incentives (Skog 2012).

The current Forest Plans allowable sale quantity (ASQ) is 15 and 12 MMBF average annual timber harvest for the HNF and LCNF respectively. The ASQ is the *maximum* level of harvest consistent with the current forest plan's standards and guidelines. The annual timber volume offered per year averaged 8.6 and 8.0 MMBF respectively over the period 1986 through 2013 and has declined over time. This actual amount of timber offered is influenced by a variety of factors, including site-specific environmental analyses, public involvement on project proposals, choice of harvest methods, and effects of administrative appeals and litigation. In addition, actual levels are limited by the budget the HLC NFs receive for that purpose, and workforce capacity needed to prepare sales and the associated environmental analyses. Forest Service funding and workforce capacity to support the timber sale program is not expected to increase in the immediate future.

Forest Service Management Actions Affecting or Affected By Timber Production

Under the current Forest Plans (1986), roughly 19% of the approximately 2.8 million acres of National Forest System (NFS) lands in the HLC NFs are considered suitable for timber production. The HNF has a higher proportion of suitable acres relative to its overall landbase. The larger LCNF contains slightly more suitable acres, but these represent only about 15% of the landbase in large part due to the amount of wilderness and wilderness study areas on the Forest. Areas considered suitable for timber management are those lands where management of forest stands for timber products is legally and technically feasible, will not cause irreversible damage to other resources, and is compatible with the area's desired conditions and objectives.

Table 6.10 Lands suitable for timber production in current forest plans

Forest	Suitable Forest Land*	Total NFS Lands*	Percent Suitable
Helena	251,600*	975,100*	26%
Lewis & Clark	282,307*	1,843,397*	15%
HLC NFs Total	533,907*	2,818,497*	19%

*Acres in the 1986 Forest Plans. Current acres differ based on land exchanges that occurred after 1986.

The proportion of suitable acres varies by geographic area (GA), as shown in Table 6.11. The Little Belts and Divide GA's contain the most suitable acres.

Table 6.11 Lands suitable for timber production in current forest plans by geographic area

Geographic Area	Suitable Forest Land*	Total Acres	Percent Suitable
Big Belts	72,578	451,946	16%
Castles	46,715	79,862	58%
Crazies	34,437	70,036	49%
Divide	111,934	232,891	48%
Highwoods	28,201	44,495	63%
Little Belts	531,422	900,961	59%
Rocky Mountain Range	44,094	782,987	6%
Snowies	84,207	121,897	69%
Upper Blackfoot	90,047	348,185	26%
Elkhorns	0	175,259	0%

*Acres in the 1986 Forest Plans. Current acres differ based on land exchanges that occurred after 1986.

In addition, since the 1986 Forest Plans, Inventoried Roadless Areas (IRA's) have been identified where management opportunities are limited by policy. Currently, roughly 1.5 million acres across the HLC NFs are designated as IRA (52% of the landbase); these acres overlap with proposed and wilderness study areas but not wilderness. These areas also overlap some areas considered suitable for timber management in the 1986 Plans. Wilderness covers about 21% of the HLC NFs. Wilderness, wilderness study, proposed wilderness, and roadless designations together represent roughly 73% of the HLC NFs landbase.

Management activities have been recorded in activity tracking databases, currently known as the Forest Activity Tracking System (FACTS), as early as the 1940's and 1950's when harvesting on NFS lands became more prevalent and accurate record keeping began. Treatment types are grouped into three categories:

- Harvest
- Stand Improvement and Reforestation
- Fire/Fuels

The majority of harvest has occurred on lands currently identified as suitable for timber production, as shown in Table 6.12. Other lands and management areas allow timber harvest for reasons such as salvage or wildlife habitat improvement provided resource values associated with the lands are not detrimentally affected.

Table 6.12 Harvest occurring on lands suitable for timber production in current forest plans

Forest	Percent of Harvest on Suitable Lands
Helena	85%
Lewis & Clark	97%
HLC NFs Total	91%

Treatment types are interrelated and multiple activities occur on the same acre. For example, a harvest is often followed by prescribed burning and planting. Therefore, acres reported are greater than the footprint of managed area. Total acres are reported for each activity, followed by an assessment of the management footprint.

Timber Harvest

Timber harvest is a tool used not only to provide timber products and contribute to the local economy but also to achieve multiple resource objectives. These include reducing insect or disease impacts, improving wildlife habitat, increasing tree growth, improving timber productivity, lowering fuels and fire risk, and altering vegetation conditions to enhance forest resilience. Three main types of timber harvest are displayed: even-aged

regeneration harvest (such as clearcutting, shelterwood, and seed-tree cuts); uneven-aged regeneration harvest (such as group selection and single-tree selection); and intermediate harvest (such as commercial thins and improvement cutting). Chapter 2, Terrestrial Ecosystems discusses each of these types in further detail.

Table 6.13 shows the trend of harvest from the 1940's to 2013. Roughly 138,649 acres of harvest have been recorded on the HLC NFs. The greatest amount of harvest occurred in the 1960's and 1990's; over 30,000 acres were harvested in each of these periods. Regeneration harvests were the most common, representing over 75% of harvest type prior to 1990. This is in large part due to the primary timber species on suitable lands, lodgepole pine, being biologically suited to even-aged systems because of its natural stand-replacing disturbance regeneration strategy. Nevertheless, there has been a shift proportionately to more intermediate harvests recently, trending toward 30% in the 1990's and 2000's, and nearly 70% since 2010. Regeneration harvests that have occurred since 2000 have been largely related to post-fire and insect salvage projects which removed dead trees. Total harvest acres have declined sharply since 2000.

Table 6.13 Harvest by type and decade for the HLC NFs

Decade	Acres of Even-Aged Regeneration Harvest	Acres of Uneven-Aged Regeneration Harvest	Acres of Intermediate Harvest	Total Acres
1940-1959	7,641	361	268	8,270
1960-1969	33,367	2,132	1,284	36,783
1970-1979	21,434	757	2,028	24,219
1980-1989	18,392	854	4,279	23,525
1990-1999	20,385	1,943	8,447	30,775
2000-2009	7,566	494	2,620	10,680
2010-2013	1,281	65	3,051	4,397
Total	110,066	6,605	21,977	138,649

Regeneration harvesting, which removes most existing trees and establishes a new forest of seedlings, is an important tool to increase structural diversity across landscapes and establish early successional communities. The reduction in this harvest has reduced this affect. Intermediate harvesting modifies the composition and structure of existing forests without establishing a new age class; the result of these harvests often include improved growth and productivity and establishment of structures desirable for objectives such as forest resiliency, watershed values, and wildlife habitat improvement.

Though economic conditions and oscillating timber values are partially responsible for the peaks and valleys in timber harvest levels, insect or disease epidemics and wildfires are prominent ecological factors that have influenced harvest trends. Salvage of fire-killed trees after large, stand-replacement fires in 2000, 2003 and 2007 were largely responsible for the peak in harvested acres in the mid-2000s. Hazard tree removal following the recent mountain pine beetle outbreak is in large part attributable to harvest levels since 2009.

Stand Improvement and Reforestation

Site productivity, forest density, and to a lesser extent forest composition directly affect growth rates and the potential size class of trees. Site productivity may be fixed, but density and composition can be altered. Reforestation and timber stand improvement treatments, specifically planting and thinning of young sapling stands, are designed to lower tree densities, alter species compositions, and improve growth and health. The reforestation activities summarized also include the certification of natural regeneration, where no planting was needed but the success of natural regeneration was deliberately monitored relative to prescription objectives.

As shown in Table 6.14, stand improvement and reforestation acres exceed the amount of harvested acres. This is because in recent decades reforestation has been conducted on suitable sites impacted by natural disturbances, primarily wildfire, where no harvest was done but where the establishment of adequate stocking was needed per the National Forest Management Act (NFMA). The success of post-harvest reforestation is tracked and discussed in detail in the Ecosystem Drivers section. Only 1% of regeneration harvests recorded in the activity database have a current reforestation failure recorded.

Table 6.14 Stand improvement and reforestation activities by decade for the HLC NFs plan area

Decade	Acres of Stand Improvement	Acres of Reforestation	Total Acres
1940-1959	0	2,135	2,135
1960-1969	1,596	8,543	10,139
1970-1979	10,137	28,873	39,010
1980-1989	14,804	41,938	56,742
1990-1999	11,883	33,799	45,682
2000-2009	1,266	21,751	23,017
2010-2013	19	6,201	6,220
Total	39,705	143,240	182,945

Fire and Fuel Treatments

Fire and fuel treatments, such as prescribed burning or slashing and piling of fuels, are also methods with which the Forest Service alters forest conditions. Historically, these activities occurred in association with commercial timber harvest. Burning was done to reduce activity fuels and prepare sites for planting. Therefore, the trend in these activities somewhat mirrored harvest levels prior to the 1980's. Since then, increasingly fire and fuel treatments are utilized as stand-alone methods to alter forest structure and composition for multiple objectives such as hazardous fuel reduction, forest resilience enhancement, and wildlife habitat improvement and can occur across a wide range of management areas. When they do occur in the suitable land base, fire and fuel treatments include objectives to provide for appropriate timber production and stocking levels. Please refer to chapter 2, Terrestrial Ecosystems for more information regarding fire and fuel treatments.

Total Footprint of Harvest

The footprint of harvest is slightly less than the total acres harvested because of multiple activities may be reported on the same acre. Figure 6.7 shows the results of an analysis done to depict more closely the actual footprint of land affected by harvest by eliminating duplicate activities in the same stand. The footprint of harvest recorded in FACTS across the HLC NFs from 1940 to 2014 totals about 125,360 acres, or 4% of the administrative area. Landscapes which have had more harvest, such as the Little Belts, tend to be those with gentle topography, high accessibility and treatment feasibility, are in proximity to urban areas, support productive forests, and/or have a high proportion of area considered suitable for timber production. Conversely, landscapes with fewer treated acres, such as the Crazy Mountains, have been less affected because of rugged topography, remoteness, wilderness or roadless designations, small landscape size, and/or less productive vegetation types. Please refer to chapter 2, Terrestrial Ecosystems for more information regarding the effects of treatment on landscape patch and pattern dynamics. Further, that section discusses the additional footprint where fire and fuels activities have impacted vegetation outside of the areas affected by harvest.

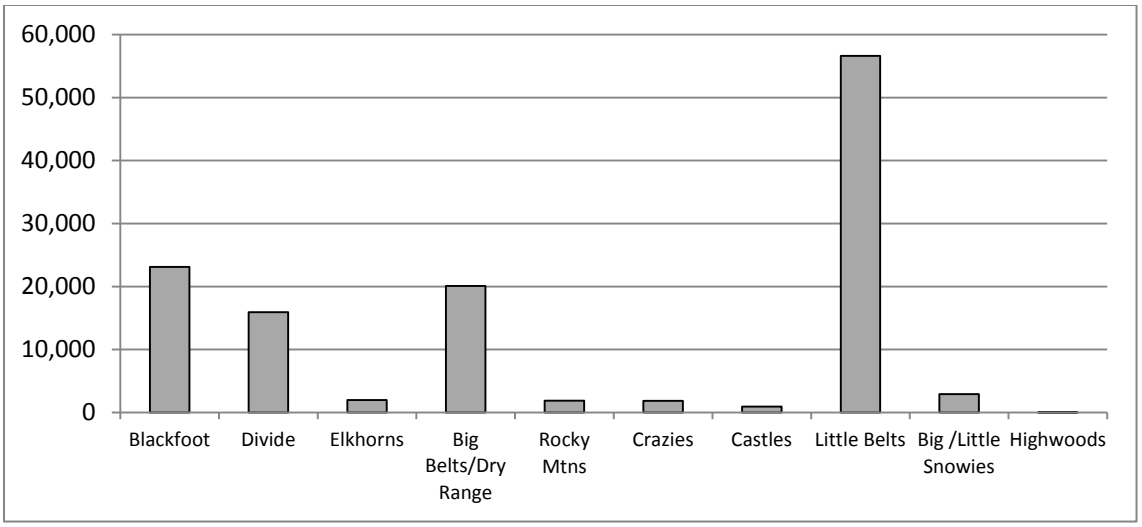

Figure 6.7 Footprint of harvest activities - Acres by geographic area, 1940-2014 (FACTS)

Stability or Resiliency of Ecosystems that Currently Maintain Timber Production

The ecosystems that provide forest products are subject to an array of natural and anthropogenic influences, as described in detail in chapter2, Terrestrial Ecosystems. Natural disturbances such as wildfire, windthrow, insects, and disease function across the landscape to kill trees and regenerate new age classes. Climate conditions greatly affect forest growth, establishment, and resiliency to those natural disturbances. Human interventions, most notably fire suppression and forest management such as timber harvest and planting, have also altered forest conditions.

Stand replacing fires were common on the HLC NFs during the last dry warm/period in the late 1800's. These disturbances along with early forest practices around the turn of the last century, which included cutting trees to support the mining and railroad industries, coincided with a moist relatively moist climate condition suitable for tree establishment and growth. In general, dense forest cover established quickly in the early 1900's in burned or cut-over areas. The moist conditions that prevailed during most of the next century also limited the potential for wildfires and insect outbreaks. These factors created conditions less conducive to burning, which along with forest management policies contributed to decades of successful fire suppression. Thus, relatively extensive continuous forests of the same age and density developed. These forests were susceptible to drought stress when the climate shifted into the current warm/dry period in the 1980's. The buildup of fuels that has resulted in some areas from a variety of causes combined with warm/dry conditions has generally resulted in more large wildfires. Further, these factors also in part served to fuel a recent mountain pine beetle outbreak which has affected most pine forests across the HLC NFs since 2007. Interrelated processes such as these which affect vegetation in turn affect the quantity and type of timber products are available.

Since 1980 approximately 576,155 acres (or about 20%) of the HLC NFs have been burned by wildfire. Of this, about 55,400 acres burned in areas considered suitable for timber production in the 1986 Forest Plans, representing about 10% of the total suitable base. Thus, while most wildfires have occurred in unsuitable areas, timber production has been affected to an extent. The effects of fires vary widely, and data to summarize severity are not readily available for all past fires. Where stand-replacing effects occurred, forests were returned to an early successional seedling stage of development, and it will be at least 50-60 years before the trees reach a size where commercial timber harvest may be feasible. Salvage of fire-killed trees occurred within a few years of some fires to remove trees before they lost economic value, representing a small percentage of each fire area.

Many pine-dominated forests have been recently impacted by the mountain pine beetle outbreak. At the peak of the outbreak in 2009, over 900,000 acres across the HLC NFs were infested, over 400,000 of which were on the suitable timber base as defined in the 1986 Forest Plans (about 75% of the total suitable base). It is important to note that the aerial detection surveys upon which infested acres are estimated are not flown on all areas, and tend to be more focused in managed areas than in non-managed areas such as wilderness. Further, the level of mortality can vary widely on any given acre. Regardless of these uncertainties, it is clear that a substantial amount of the suitable base has been impacted by this disturbance event. Mortality was most extensive in mature lodgepole pine forests. In areas where the sawtimber component was substantially impacted, the availability of lodgepole products will be greatly reduced for the next few decades once the short window of opportunity for salvage has passed until new forests grow to a merchantable size. Please refer to chapter 2, Terrestrial Ecosystems for more information regarding the influences of natural disturbances on vegetation composition, structure, function, and connectivity.

Generally, the trend of homogeneous forest conditions that developed over the last century has resulted in "pulse" periods of product availability. Over time, promoting the development of a more diverse mosaic of forest conditions may lead to increased resiliency and a more stable timber product output capability.

Influence of Non-NFS Lands or Other Conditions

In addition to the impacts of natural conditions such as disturbance regimes and climate, other factors impact timber production on the HLC NFs.

Forest growth rates directly influence potential timber production over time, as well as the value of the timber as influenced by tree size. Site productivity is generally considered fixed, and is based upon biophysical site attributes such as topography, soil type, and climate. On the HLC NFs, site productivity in terms of tree growth is estimated to be between 20 and 84 cubic feet per acre per year on suitable lands with average rotation ages ranging from 95 to 150, depending on the species and site (USDA Forest Service 1986a and 1986b).

Recent concerns regarding the potential impact of wildland fire to or from adjacent lands has been a driver of treatments to reduce hazardous fuels particularly in wildland urban interface (WUI) areas. The National Wildfire Coordinating Group defines hazardous fuel as a fuel complex defined by kind, arrangement, volume, condition, and location that presents a threat of ignition and resistance to control. In some cases, hazardous fuel reduction treatments are not designed to enhance or maximize timber productivity even in suitable areas.

Forest conditions on adjacent non-national forest system lands can limit harvesting opportunities on NFS lands, in order to provide for multiple resource requirements such as watershed or wildlife habitat. Harvest activities on BLM, State, or private ownership would result in forest structure conditions and are taken cumulatively into account when assessing the environmental impacts of treatments on nearby NFS lands. A substantial proportion of the counties influenced by the timber produced on the HLC NFs are made up of other ownerships.

Other regulatory agencies, such as the U.S. Fish and Wildlife Service, may also provide direction that limits management activities to protect threatened and endangered species, meeting their responsibility under the Endangered Species Act. Similarly, additional resource regulations and policies influence treatments to improve timber production or provide timber products from suitable lands.

Importance to People in the Broader Landscape

The Socioeconomic Conditions and Trends chapter of this assessment (Chapter 5) provides a great deal of information on the economic importance of the timber sector to the plan area including sections on the timber sector, wildland dependence, federal land payments to states, assessing the economic contribution of major industries in the HLC NFs plan area, and HLC NFs' contributions to the plan area economy. Below are some highlights from those sections:

- In 1998, there were 32 active primary wood products facilities in the 13-county plan area. However, by 2009, this number had dropped to 16.
- In 2012, the amount of timber-related employment in the primary plan area was very small, with the largest amount occurring in the western area (Broadwater, Jefferson, Lewis and Clark, and Powell Counties), which derived a higher percentage of its employment (2.2 percent or 594 jobs) from timber-related industries than either the state (1 percent) or the nation (0.7 percent).
- The only two counties in the primary plan area that had any substantial amount of timber-related employment in 2012 were Broadwater County, where timber-related employment accounted for 22.5 percent of private employment (178 jobs) and Powell County, where it accounted for 23.7 percent (243 jobs). The 178 timber-related jobs in Broadwater County in 2012 occurred mainly in sawmills (143) and other wood product manufacturing (31 jobs). In Powell County, most employment was associated with growing and harvesting, which accounted for 95 of the 243 timber-related jobs.
- Wildland dependency (percent of total county labor income derived from wildland-related industries) declined from 2000 to 2010. For Broadwater and Powell Counties, this drop in dependency was primarily due to a decline in dependence on timber. However, in 2010, both counties still met the 15 percent criterion for wildland dependency, at 33.7 percent for Broadwater County, and 19.3 percent for Powell County.
- From 1991 to 2000, Lewis and Clark County ranked 6th in the state in terms of revenue sharing payments and Powell County ranked 8th, with average payments of $502,000 and $481,000 respectively. Jefferson, Meagher and Judith Basin had average payments of more than $100,000. However, of the 5 counties receiving more than $100,000 in payments, Judith Basin funds were entirely due to activities on the HLC NFs, while the other counties also received money from activities on other NFs within their boundaries. The remaining 8 counties in the 13-county area received payments lower than $100,000 on average.
- After 2001, all counties in the plan area switched to receiving Secure Rural School Act payments in lieu of 25-percent fund payments For the 13-county primary plan area, Powell County (5th in the state in terms of average payments) had the highest average payment at just under $1 million. Lewis and Clark County ranked 9th in the state, having an average SRSA payment of $716 thousand. Other plan area counties receiving more than $250,000, on average, from 2000 to 2012 included Meagher, Jefferson, and Judith Basin. Chouteau County had the lowest average SRSA payment of the 13 counties, at $19,000.
- Overall, federal land payments make up approximately 4.4 percent of the total county general revenue in the 13-county plan area. Judith Basin is the most dependent on federal land payments, with nearly 10 percent of the county's general revenue coming from federal land payments. Cascade County is the least dependent on these payments with federal land payments making up less than one percent of the county's general revenue.
- Economic analysis indicated that 1,318 of the 13-county area's 137,883 jobs were driven by the timber industry in 2010 – these are jobs directly related to timber activities, purchasing of supplies and services as inputs to the timber industry, and spending of employees of both the timber industry and its suppliers in the local economy. Eleven percent of these jobs (154) are associated with the timber program of the HLC NFs.

Information Needs

Timber harvest modeling utilizing the most recent vegetation data available which incorporates the effects of recent disturbances, and includes calibrations relative to future climate conditions, contemporary land management designations, and policies or regulations affecting vegetation management is necessary to gain a clear understanding of potential future timber production levels on the HLC NFs.

Watershed

Protecting the nation's water supply has always been an important part of the Forest Service's mission, and managing the forests for watershed purposes is recognized as an essential multiple use. Water supply is also important from an ecosystem services perspective, as stated in Smith et al. 2011:

> *"Fresh water is one of the most valuable ecosystem services provided by forests. Forested land absorbs rain, recharges underground aquifers, cools and cleanses water, and sustains watershed stability and resilience (USDA Forest Service 2000). Water provided by forests supports vegetation, supplies fresh drinking water, sustains agricultural production, enables power generation, and creates habitat for aquatic species with subsequent economic, recreational, and cultural benefits (Postel and Carpenter 1997)."*

Forests and other mature ecosystems generally improve water quality in a watershed (Brauman et al. 2000). Two-thirds of the nation's clean water supply comes from precipitation that is filtered through forests and ends up in streams. Root systems stabilize soils and allow water to filter through various layers of soil before entering groundwater. Through this process, toxins, nutrients, sediment, and other substances can be filtered from the water (Hanson et al. 2010).

A substantial amount of information on water resources and water quality can be found in chapter 3 - Watershed, Aquatic, Soil and Air resources of this assessment. Below is a brief summary of that information as it relates to the multiple uses of water.

Current Conditions, Trends, and Drivers

Municipal Water Supply

The 1986 Forest Plans identified portions of 3 HUC level 6 watersheds as Municipal Water Supplies: Tenmile Creek, Belt Creek-Carpenter Creek, and North Fork Smith River-Trout Creek. These watersheds provide drinking water to four cities or towns by either a reservoir or water diversion or by a spring or well. The city of Helena uses Ten Mile Creek as its main source of municipal water. The city of East Helena uses McClellan Creek (not identified in 1986 FP), the town of White Sulphur Springs uses Willow Creek (part of NF Smith River-Trout Creek HUC6) and the town of Neihart has O'Brien Creek and Shorty Creek (both within Belt Creek-Carpenter Creek HUC6). Please see map 20 in appendix A, Index of National Forest Watersheds that are Important to Surface Drinking Water.

Impaired Streams

According to the State 303(d) list, fifty five stream segments within the plan area are not meeting water quality standards. Thirty-five are listed for mining related impacts, and the remaining twenty are listed for grazing or habitat quality issues. TMDLs (Total Maximum Daily Load) assessments have been prepared and are being implemented for several sub-basins in the plan area, including those in the Divide, Elkhorn, and Upper Blackfoot GAs. Please see the water quality section of the watershed, aquatic, soil and air resources chapter and also map 15 in appendix A, Streams Listed on the State 303(d) List for Water Quality Impairment. In addition, the streams with mining related issues are also discussed in the minerals and geology section of this assessment.

Forests to Faucets

The Forests to Faucets project (Weidner and Todd 2011) assessed the lands across the United States that are most important to surface drinking water sources. The project also identified forested areas important to the protection of drinking water and areas where drinking water supplies might be threatened by development, insects and diseases and wildland fire. The project is centered on three core objectives:

- Assess subwatersheds across the United States to identify those most important to surface drinking water.

- Identify forested areas that protect drinking water in these subwatersheds.
- Identify forested areas where future increases in housing density, insects and disease, and wildland fire may affect surface drinking water in the future.

Each of the index's are calculated for watersheds across the nation and the index scores rank the relative importance from least, 0, to most, 100.

Importance of FS lands to surface drinking water

The Forests to Faucets project indicated the majority of watersheds within the plan area have low importance for delivery of drinking water from surface waters originating on the Forest (see map 20 in appendix A, Index of Helena and Lewis & Clark NFs Watersheds that are Important to Surface Drinking Water). There are several that do have higher importance. Table 6.15 displays the mean value for this index as well as the subwatersheds with the 10 highest index scores. The 10 highest index score subwatersheds are concentrated in the Rocky Mountain Range Geographic Area.

Table 6.15 Subwatersheds with the highest index scores for National Forest importance to surface drinking

Geographic Area	HUC6	Name	Index Score
ALL	ALL	Mean Value All HLC NFs	14.97
Little Belts	100301030801	Upper Tenderfoot Creek	61.38
Divide	100301011401	Upper Tenmile Creek	60.80
Little Belts	100301030903	Upper Deep Creek	60.30
Rocky Mountain Range	100301040207	Lower West Fork South Fork Sun River	54.81
Rocky Mountain Range	100301040208	Lower South Fork Sun River	53.68
Rocky Mountain Range	100301040101	Open Creek	53.40
Rocky Mountain Range	100301040204	Middle South Fork Sun River	53.10
Rocky Mountain Range	100301040203	Upper South Fork Sun River	53.07
Little Belts	100301030401	Sheep Creek Headwaters	52.46
Rocky Mountain Range	100301040205	Ahorn Creek	52.29

Wildland Fire Threat to Drinking Water

Forests to Faucets indicated overall that surface drinking water from forested lands within the project also have a low index for threat from wildland fire (see map 21 in appendix A, Index of Wildland Fire Threats to Forest Watersheds that are Important to Surface Drinking Water). Table 6.16 displays the mean value for this index as well as the subwatersheds with the 10 highest index scores. The 10 highest index score subwatersheds are concentrated in the Rocky Mountain Range GA. Upper Tenmile Creek, the municipal watershed for the city of Helena, has the highest index of all (see chapter 2, Terrestrial Ecosystem for additional information regarding wildfire disturbance regimes on the HLC NFs). The Tenmile South Vegetation Management project is in planning now and would treat a large portion of the watershed, which would reduce the risk for wildland fire.

Table 6.16 Subwatersheds with the highest index scores for wildland fire threats to forests important to surface drinking water

Geographic Area	HUC6	Name	Index Score
	ALL	Mean Value All HLC NFs	16.99
Divide	100301011401	Upper Tenmile Creek	74.40
Little Belts	100301030903	Upper Deep Creek	58.74
Rocky Mountain Range	100301040207	Lower West Fork South Fork Sun River	53.78
Rocky Mountain Range	100301040208	Lower South Fork Sun River	53.68
Rocky Mountain Range	100301040204	Middle South Fork Sun River	53.10
Rocky Mountain Range	100301040101	Open Creek	52.70
Rocky Mountain Range	100301040203	Upper South Fork Sun River	52.26
Rocky Mountain Range	100301040205	Ahorn Creek	51.16
Rocky Mountain Range	100301040402	Hannan Gulch	50.15
Little Belts	100301030904	Lower Deep Creek	49.64

Insect and Disease Threat to Drinking Water

Forests to Faucets indicated overall that surface drinking water from forested lands within the project have minimal threat from insect and disease (see map 22 in appendix A, Index of Insect and Disease Threats to Forest Watersheds That are Important to Surface Drinking Water). Table 6.17 displays the mean value for this index as well as the subwatersheds with the 10 highest index scores. The 10 highest index score subwatersheds are concentrated in the Little Belts and Rocky Mountain Range GAs. Upper Tenmile Creek, the municipal watershed for the city of Helena, has the highest index of all (see chapter 2, Terrestrial Ecosystem for additional information regarding insect and disease disturbance regimes on the HLC NFs). The Tenmile South Vegetation Management project is in planning now and would treat a large portion of the watershed, which would reduce the risk for wildland fire.

Table 6.17 Subwatersheds with the highest index scores for insect and disease threats to forests important to surface drinking water

Geographic Area	HUC6	Name	Index Score
	ALL	Mean Value All HLC NFs	3.34
Divide	100301011401	Upper Tenmile Creek	56.84
Little Belts	100301030403	Moose Creek	44.04
Rocky Mountain Range	100301040101	Open Creek	35.91
Little Belts	100301030903	Upper Deep Creek	35.39
Little Belts	100301030801	Upper Tenderfoot Creek	33.92
Castles	100301030203	Cottonwood Creek	28.40
Little Belts	100301030404	Middle Sheep Creek	27.80
Rocky Mountain Range	100301040204	Middle South Fork Sun River	27.33
Big Belts	100301011604	Upper Trout Creek	26.92
Elkhorns	100301010702	Upper Crow Creek	25.54

Influence of Development Threat from Non–NFS Lands or Conditions

The Forests to Faucets project indicated that lands within the Forest have minimal threats from future increases in housing density and development (see map 23 in appendix A, Index of Development Threats to Forest Watersheds that are Important to Surface Drinking Water). Table 6.18 displays the mean value for this index as well as the subwatersheds with the 10 highest index scores. The ten highest index scores are not concentrated in any one GA, but the highest index scores are within the Divide and Big Belt GAs.

Table 6.18 Subwatersheds with the highest index score for development threats

Geographic Area	HUC6	Name	Index Score
	ALL	Mean Value All HLC NFs	0.91
Big Belts	100301011204	Magpie Creek	30.40
Divide	100301011402	Middle Tenmile Creek	28.80
Divide	100301011309	Last Chance Gulch	17.45
Rocky Mountain Range	100301020103	Falls Creek	15.78
Upper Blackfoot	100301020103	Falls Creek	15.78
Elkhorns	100301011303	Warm Springs Creek	13.34
Elkhorns	100301011307	McClellan Creek	13.31
Divide	100301011308	Middle Prickley Pear Creek	10.71
Elkhorns	100301011308	Middle Prickley Pear Creek	10.71
Rocky Mountain Range	100301040402	Hannan Gulch	10.03

Rapid development in the urban interface has increased concerns about wildfire risk (Jones et al. 2009). Management to reduce fire risk within this interface may influence water quality in some parts of the plan area, but this effect is likely to be small.

Fish and Wildlife

Consumption of and activities associated with wildlife and fish are an important multiple use of the Forests. As an ecosystem service, fish and wildlife provide a variety of benefits to the public:

- Fish and wildlife are consumed as food, making them an important provisioning service provided by the Forests.
- Fish and wildlife have numerous recreational and cultural uses. They are hunted for sport, viewed by recreationists, and are an important cultural resource for the Tribe.
- People also hold a variety of non-use values for wildlife and fish. These may include existence value (people value the fact that wildlife and fish exist, even if they are never seen), bequest value (even people who do not use wildlife or fish recognize that future generations may value and use this resource), or option value (people recognize that certain fish or wildlife species that are not used now may have important uses in the future).

Fish

The ecosystems that help maintain fish populations are described in detail in chapter 3 - Watershed, Aquatic, Soil and Air Resources of this assessment. These ecosystems extend well beyond NFS lands, and the ability of several adjacent and downstream rivers to support trout populations is heavily influenced by surface and subsurface flows originating on NFS lands. Without these cool-temperature flows, most of these river and stream segments wouldn't be adequate salmonid (trout, char, whitefish) habitat. Those that may still support salmonid species would have greatly reduced populations. Waters from NFS lands also support warm-water fishing activities by

increasing the quantity of habitat, however, these fish are less dependent on the ecosystem service of thermal regulation.

This support of downstream areas is an especially important socio-economic factor in this plan area. Several high-use and world renowned trout fisheries lie adjacent to and between forest system lands in this plan area. These include sections of; the Missouri River, the Smith River, the Sun River, Belt Creek, the Blackfoot River, and the Little Blackfoot River. These waters account for over 335,000 days of salmonid based, angler-use per year (Montana Fish, Wildlife, and Parks 2012b, Montana Fish, Wildlife, and Parks 2015). Participation by non-resident anglers makes up about one-third of these angler days (Montana Fish, Wildlife and Parks 2012a). Table 6.19 displays the latest available use data for these rivers and streams that rely heavily on water discharge from plan area lands.

Table 6.19 Summary of angler use relying on waters from the plan area.

Water Body Name	Total Angler Days	Resident Angler Days	Non-resident Angler Days
Smith River Sec 01	4,395	2,931	1,464
Smith River Sec 02	14,645	8,674	5,971
Smith River Sec 03	3,963	2,415	1,548
Missouri River Sec 08	55,805	43,014	12,791
Missouri River Sec 09	170,850	99,906	70,944
Missouri River Sec 10	39,987	30,001	9,986
Missouri River Sec 10b	14,591	11,272	3,319
Sun River Sec 01	4,326	2,911	1,415
Sun River Sec 02	9,107	7,842	1,265
Dearborn River	2,819	1,540	1,279
Belt Creek	11,105	9,168	1,937
*Blackfoot River Sec 01	16,470	12,285	4,185
*Blackfoot River Sec 02	11,570	7,686	3,884
*Blackfoot River Sec 03	5,283	2,788	2,495
*Blackfoot River Sec 04	6,032	3,913	2,119
*Little Blackfoot River Sec 01	6,201	4,779	1,422
Sum of Angler Days	**377,149**	**251,125**	**126,024**
Est. Salmonid Angler Days (based on MTFWP Survey data showing 89.3% average for rivers in these basins)	**336,794**	**224,255**	**112,539**

*Data is for 2011 angling year, all other records are for 2014

Non-resident stream anglers spent an average of $646.23 per angler day in 2014 to participate with resident stream anglers spending an average of $83.40 per angler day (Montana Fish, Wildlife, and Parks 2015). Thus, these waters account for approximately $18,702,867 of expenditures from resident anglers and $72,726,078 from non-resident anglers.

Lakes and reservoirs in these basins account for more than 175,000 additional salmonid based, angler days (Montana Fish, Wildlife and Parks 2012a). About one-seventh of this participation is by non-resident anglers. Non-resident lake anglers spent an average of $379.33 per angler day in 2014 with resident stream anglers spending an average of $87.35 per angler day (Lewis and King 2014). This accounts for approximately $13,102,500 of expenditures by resident anglers and $9,483,250 by non-resident anglers.

Accounting for angler days within the NFS lands of this plan area is difficult. Montana Fish, Wildlife, and Parks does not breakdown angling participation data and estimates by land ownership. Most of the higher use rate streams span forest boundaries. Some popular reservoirs also have varying proportions of NFS lands on their shorelines. Lower use-rate streams are grouped into an "undesignated waters" category. Many, but not all of these are smaller mountain streams on NFS lands.

There are streams and river segments where most of the use reported in angler surveys by Montana Fish Wildlife and Parks can reasonably be attributed to NFS lands in this plan area. These are mostly contained within NFS lands or are mostly accessible on NFS lands. An incomplete list of these has been compiled by the fisheries specialists. Undesignated waters were not added and many waters with less than 100 angler days were left-out for expediency. More streams on the west-side of the divide were missed as 2014 was not yet available for these. For several of the more popular streams in this portion of the planning unit, 2011 use data was used as a substitute. The total angler days that was accounted for in this methodology was still approximately 99,000. About 23,000 of these days were by non-resident anglers. These numbers are likely 10-25 percent high for this subset of waters as some use is on non-NFS lands. Use on Hauser and Holter Reservoirs was not pro-rated for ownership and added to this set. Table 6.20 displays the higher-use waters in this dataset.

Table 6.20 High use waters in the HLC NFs plan area

Water Body Name	Total Angler Days	Resident Angler Days	Non-resident Angler Days
Smith River Sec 02	14,645	8,674	5,971
Missouri River Sec 10	39,987	30,001	9,986
Missouri River Sec 10b	14,591	11,272	3,319
Sheep Creek	1,139	793	346
Gibson Reservoir	1,248	1,248	0
Wood Lake	1,664	1,664	0
N Fk Sun River	1,775	1,775	0
*Nevada Creek	1,285	1,054	231
*Little Blackfoot River Sec 02	1,940	1,758	182
Sum of Angler Days	**78,274**	**58,239**	**20,035**

*Data is for 2011 angling year, all other records represent 2014 angling year

Influence of non-NFS Lands or Conditions

The Montana Department of Fish, Wildlife, and Parks manages fish populations both on and off the Forests. This agency sets limits on the number of fish harvested, species harvested, harvest seasons, and gear types for game fish on the Forests. Non-NFS lands within the drainage basins of this plan area tend to produce effects that degrade habitat quality for salmonid fishes. These effects include; loss of water discharge, increased sediment yields, and warmer flows. For most basin areas lying east of the divide, salmonid distribution stops after streams and rivers leave the inter-mountain valley areas that get discharge from NFS lands. Thus, NFS lands in this plan area are usually buffering effects from non-NFS lands.

Fish from NFS lands also provide uses other than angling and harvest. For some people, the knowledge that native fish are present in the ecosystem has and important intrinsic value. For these people, this is true regardless of whether they are seen, fished for, caught, considered a game fish, or otherwise assigned a human value; people value these fish simply because they are part of the natural ecosystem.

Native fish are an integral part of the culture, history, and tradition of the Blackfoot Nation, and other Native American people groups. National Forest lands are critical for the viability of bull trout in the Blackfoot River Sub-basin. The NFS lands in this plan area contain an important portion of the remaining genetic diversity of westslope cutthroat trout. Without the genetic diversity represented in these populations, westslope cutthroat trout

would likely be listed as a threatened species for at least the Missouri River drainage portion of its range. This is a great economic cost that is so-far being avoided by contributions from this plan area.

Effects from Forest Management Actions

Please see the Watershed, aquatic, soil and air resources chapter of this assessment for more information.

Wildlife

Introduction

The wide array of species and exceptionally varied habitats that exist in the scattered and divergent landscapes of the Helena and Lewis and Clark National Forests provide opportunities for a wide variety of recreational opportunities involving wildlife within the plan area. Hunting and trapping are important to Montanans and others in many ways: as traditional activities going back several generations, as an important cultural activity for the tribes in the area, as a means of subsistence, as income through sale of pelts or through outfitting and guiding, as a connection to nature, to name a few. Hunting brings people to Montana from other states and countries as well, providing income in many communities. Wildlife viewing is considered a non-consumptive recreational activity, which is briefly discussed in this section. People also hold a variety of non-use values for wildlife, which are discussed in the "Inspiration and Nonuse Value" section of this chapter.

Geographic Scale

Wildlife and habitat management occur at many scales, dependent on the species. Although some species, such as elk, are managed at the scale of Elk Management Units, others are managed at the scale of the Herd Unit or Hunting District. Summarizing hunting and trapping information across the plan area is a challenging task because it encompasses a large and varied portion of Montana, in discrete units separated by dozens of miles. Because hunting effort and outcome is reported by Montana Fish, Wildlife, and Parks by Region and Hunting District, we chose that scale for displaying and discussing hunting. Trapping and bird hunting are displayed by region and county, as that is the way the information is reported. Hunting Districts vary by species: although deer, elk and lion share districts, separate HDs are delineated by MTFWP for antelope, bighorn sheep, mountain goats, black bears, and moose. Wolf hunting and trapping occurs and is reported by Wolf Management Unit, and trapping is managed and reported by Trapping Districts that correspond to MTFWP Regions. Upland bird hunting is managed and reported by MTFWP Region.

Current Conditions, Trends, and Drivers, and Stressors

Current conditions, trends, drivers and stressors vary by species and by area, and are summarized below. Please also refer to the Terrestrial Wildlife section, "Species of Public Interest" for more detailed information about some species.

The stability or resiliency of the ecosystems or key characteristics of ecosystems that currently maintain the wildlife and habitats

Wildlife use of ecosystems and their components varies by species and by season. Some information about ecosystems and habitats used by wildlife, and the status and trends of those systems, is available in the Terrestrial Ecosystems and Terrestrial Wildlife sections. The Terrestrial Wildlife section includes a table that references species habitats to vegetation types and components, as well as their stressors and trends, that are discussed in more detail in the Terrestrial Vegetation section. In this section, species' requirements are discussed broadly and in general terms.

Big Game

Big game species include elk, mule deer, white-tailed deer, bighorn sheep, mountain goat, and black bear. Most big game species vary their use of habitat by season, with some using markedly different habitat types or ecosystems in different seasons, and making lengthy migrations between winter and summer ranges.

Elk typically summer in higher elevation areas providing good forage (grasses, forbs, and occasional browse) and thermal cover, often on National Forest land. Winter habitat for elk usually occurs at lower elevation in forests intermingled with shrubfields and meadows, or on private, usually agricultural lands. Elk are habitat generalists; movement patterns, migration routes, and locations of both summer and winter ranges may change over time in response to forest management activities as well as to natural occurrences such as fire, drought, or insect infestations. Winter habitat may be less stable and resilient than summer habitat, because it occurs at lower elevation on private lands where competition with livestock, or permanent changes such as conversion to cropland or private development may occur.

Mule deer and white-tailed deer both occur throughout the plan area. Mule deer generally use higher elevation areas largely on NFS lands, but most winter ranges occur on lower-elevation open forests or shrubfields that may occur partly or entirely off NFS lands. White-tailed deer occur at lower elevations, often in denser forest and riparian areas. Wintering areas for both mule deer and white-tailed deer often occur on non-NFS lands, often private lands adjoining or near to public lands where they summer. Both species of deer are somewhat general in habitat use and therefore able to respond to changes in habitats caused by management activities or natural occurrences. Winter ranges that occur on private land may be less stable over time than those on public land, due to competition with livestock or the potential for permanent changes such as conversion to cropland, or private development. There has been an overall trend toward reduction of winter range statewide, particularly for mule deer, due to these influences.

Bighorn sheep occur throughout the Rocky Mountain Range, and in the Elkhorns GA and the north end of the Big Belts GA, with possible occasional occurrences along the eastern edge of the Upper Blackfoot GA. Bighorn sheep occur in ‘metapopulations’: small, semi-isolated herd groups that experience very little intermingling and therefore limited opportunity for genetic interchange or for re-population where a herd may have been reduced or eliminated. Connectivity among bighorn sheep metapopulations has generally been maintained within units of NFS land, but may be disrupted among or between units, by highways or other human development. Bighorn sheep require escape terrain, including steep open slopes or cliffs that are adjacent to open, grassy foraging areas. These specific requirements mean that bighorn sheep habitat is more limited than that of other big game species, and therefore potentially more vulnerable to certain changes. Where grasslands are encroached by conifer growth due to fire exclusion or lack of similar disturbance, sheep habitat may be restricted. Bighorn sheep are extremely vulnerable to diseases transmitted by domestic sheep and goats; therefore the proximity of bighorn sheep habitats to domestic sheep and goat allotments and grazing areas will impact the value and stability of those areas to bighorns.

Mountain goats occur in the Rocky Mountain Range and Upper Blackfoot GAs, which are part of their historic distribution, and in the Big Belts, Elkhorns, Crazies, Highwoods, and Snowies GAs, where they exist as introduced populations. Mountain goats prefer high, rugged, and rocky upper mountains and peaks with diet varying according to seasonal availability. Mountain goats use a relatively narrow set of steep, high elevation habitats, which may make them vulnerable to habitat changes, including those related to climate change. Mountain goats on the Rocky Mountain Range GA are contiguous with the population on the Flathead National Forest, and may be connected to mountain goat populations in Glacier National Park. Populations in the other GAs within the plan area are individually isolated by large expanses of unsuitable low elevation land.

Moose are distributed in all GAs within the plan area except the Highwoods GA. They may occur at relatively lower densities in the eastern GAs. Moose may make long distance movements across landscapes relatively devoid of suitable habitat, allowing demographic and genetic interchange among populations. Moose use a variety of forest types where cover and browse are present, requiring thermal cover in summer because they are particularly vulnerable to heat stress. Moose may use clearcuts, recently burned areas, or other areas where forest canopy has been disrupted or removed, and shrub species used for forage are abundant. Mature conifer or aspen forest habitat types may be important, however, in providing forage and both thermal and hiding cover. Moose

foraging habitat may have increased in some portions of the plan area due to increased wildfires, but there have been declines in the moose population in Montana and elsewhere in recent years. The causes of these declines are not yet well understood.

Black bears are found throughout the plan area. Black bears tend to use forested habitats and feed on a wide variety of plant and animal species as those are available. They are habitat generalists, although they may be somewhat vulnerable to disturbances, such as large, stand-replacing fires, that remove large areas of cover and forage. As these areas recover they may increase in value to black bears, depending on the presence of forage and adequate cover.

Furbearers and Wolves

Furbearers are animals generally trapped for the value of their pelts, and include marten, bobcat, beaver, and others. These species occupy very different habitats that vary in their stability or resiliency. Marten rely on mature, closed canopy forest, which is vulnerable to fire, disease and insects. Bobcat are generalists, using many different habitats where enough cover is presence for concealment while hunting, and where small mammal prey species are available. Beaver occur in association with forested streams and wetlands. Beaver are unique in the impact they have on their habitat, altering hydrology in ways that increases stability of water flows and promotes growth of willow and aspen, which are among their preferred forage species. Wolves require only adequate distribution and availability of prey species, which include elk, moose, both species of deer, and smaller mammals as available. Therefore wolves do not rely on specific habitats, and are affected indirectly by the stability and resiliency of habitats that support their prey.

Forest Service Management Actions Affecting or Affected by Wildlife and Habitats

Harvest of timber for commercial or other purposes may result in the loss of thermal or hiding cover, and in areas of heavy snowfall results in deep snow interfering with foraging opportunities by removing canopy that intercepts snow. Conversely, certain harvest activities may increase production of forb and browse species used by big game, and may increase abundance and productivity of berry-producing shrubs used by bears.

Fire exclusion, particularly on winter ranges, may result in loss of shrubfields used by elk, mule deer, and moose. Conifer encroachment resulting from lack of fire may reduce grasslands used by bighorn sheep for foraging, and may reduce visibility, thereby reducing the likelihood that sheep will use those areas. Use of fire (both naturally occurring and prescribed fire) as a management action may improve the abundance and palatability of grass, forb, and shrub species used by big game, and may reduce conifer encroachment. Fire may remove dense forest used by black bears, but may also increase abundance and productivity of some foods used by bears.

Roads providing access onto NFS lands also provide access for hunters and trappers, but increase the potential for human-wildlife encounters that can result in illegal mortality or, in the case of bears, human-bear conflicts that increase risk of mortality to bears. The potential for roads to impact wildlife depends heavily on the spatial pattern of open roads relative to specific wildlife habitats, as well as on the season and type of use allowed. Recent and ongoing travel management planning and decisions in the plan area have considered potential impacts to wildlife species, and generally reduced open road mileage where potential negative impacts may occur.

Recreation management has the potential to impact wildlife by the specific locations where recreation activities or sites occur, and by where specific activities are allowed or encouraged. Limitations on certain types of activity, such as snowmobiling on big game winter ranges or in key spring bear habitats, can benefit wildlife populations by reducing disturbance and displacement to less favorable habitats.

Influence of Non-NFS Lands or Other Conditions on Wildlife and Habitats

Big game winter habitat quantity and quality has generally decreased in Montana, due to increased residential and industrial subdivision, which generally occurs to a greater degree where NFS lands are in proximity to population

centers. Fire exclusion has also caused changes in winter ranges on non-NFS lands and in the Wildland-Urban Interface (WUI), by altering vegetation. In some portions of the plan area, conversion of native grassland to agriculture has either removed winter range, or created areas of seasonal wildlife concentration, such as on irrigated alfalfa fields. Residential development in deer winter range can also increase conflict and therefore potential mortality to deer when they become nuisances, feeding on ornamental plants, gardens, etc. These activiies have the potential to eventually impact big game populations if not appropriately managed.

Increased residential development in proximity to NFS lands increases risk of mortality to bears, because bears may be drawn to food and attractants (garbage, bird feeders, pet food, livestock food, apple trees, chickens, etc.) associated with those residences. Bears exploring those attractants or exploiting those food sources may become food-conditioned and habituated to humans, increasing the likelihood of conflict or property damage, and consequently increasing risk of mortality to those bears. In some areas, residential developments have the potential to become population 'sinks', where ongoing mortality can impact the bear population.

There are eight state-owned Wildlife Management Areas (WMAs) adjacent to portions of the plan area. These WMAs are managed primarily as wildlife winter range, and help to offset some of the influence of private land development on big game winter range. Coordination between MTFWP and the Forest Service regarding management across boundaries where these WMAs occur varies.

Importance to People in the Broader Landscape

In 2005, a cooperative study sponsored by Montana Fish, Wildlife & Parks and The U.S. Forest Service Northern Region was completed that looked at the relationship between fish and wildlife conservation and economic prosperity in Montana (MTFWP 2005). This study highlighted the importance of wildlife-related activities to residents of Montana, as well as those visiting the state. Though the report stated that participation in hunting is declining slightly nationally, the percent of Montana's population participating in wildlife-related activities (hunting, fishing, wildlife viewing, bird watching) was substantially higher than for the nation or for the Rocky Mountain Region of the west (the states of Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah, Wyoming) (Swanson 2005).

The importance of hunting in the 13-county HLC NFs plan area is apparent from statistics gathered by Montana Fish, Wildlife and Parks (MTFWP 2014). The following sets of tables provide information on big game hunting, trapping, and bird hunting in the plan area. In most cases the information is presented by MFWS Region and Hunting District, for those hunting districts that have HLC NFs land within them. These statistics are not the hunting and trapping that occurs only on NF land, as that was not available. These statistics are only meant to convey the amount of hunting and fishing that occur in the general area of the HLC NFs as an indicator of the importance of hunting and trapping to the public. The majority of the hunting and trapping that occurs in proximity to the HLC NFs occurs in Region 4 (see map 24 in appendix A, Montana Fish, Wildlife, and Parks Wildlife Administrative Boundaries). Region 4 includes the counties of Cascade, Chouteau, Fergus, Glacier, Judith Basin, Liberty, Meagher, Petroleum, Pondera, Teton, and Toole as well as parts of Lewis and Clark County (9 of the 17 counties in the plan area).

Big Game

Moose

Table 6.21 provides statistics on moose hunting on the hunting districts with HLC NF land. The hunting districts included are as follows (by MFWS Region): Region 2 – 215, 280, 293; Region 3 – 303, 335, 380, and 390; Region 4 – 415, 494, and 496. HDs 343 and 441 also contain HLC NF land but no information was available for these districts. Approximately 10 percent of the moose hunting in the state occurs on these districts. The largest amount of moose hunting occurs in the Region 3 districts connected to the HLC NFs, with an average of 15 moose harvested annually from 2011 to 2013. The districts with HLC NF land account for around 15 percent of

the animals harvested in Region 2, 10 percent of those harvested in Region 3, and all of the animals harvested in Region 4. The vast majority of moose hunting is done by state residents.

Table 6.21 Moose hunting - average annual number of hunters, hunting days, and animals harvested on MFWS hunting districts containing some HLC NFs land, 2011 to 2013

	Hunters	Days	Animals Harvested
Region 2 - Districts 215, 280, and 293	0	0	0
Nonresident	0	3	1
Resident	6	68	4
Total for above districts	6	70	4
Percent of Region 2 activity	14.9%	12.0%	15.1%
Region 3 - Districts 303, 335, 380, and 390			
Nonresident	0	0	0
Resident	16	159	15
Total for above districts	16	159	15
Percent of Region 3 activity	9.1%	9.4%	10.2%
Region 4 - Districts 415, 494, 496			
Nonresident	0	0	0
Resident	11	138	8
Total for above districts	11	138	8
Percent of Region 4 activity	100.0%	89.6%	100.0%
Percent of State activity	9.3%	9.0%	9.8%

Big Horn Sheep

Table 6.22 provides statistics on bighorn sheep hunting on the hunting districts with HLC NF land. The hunting districts included are as follows (by MFWS Region): Region 4 -421, 422, 423, 424, 441, and 455. HDs 380 and 381also contain HLC NF land, but no information was available for these districts. Similar to moose, approximately 10 percent of the bighorn sheep hunting in the state of Montana occurs on districts containing some HLC NF land. Approximately 18 bighorn sheep were harvested annually on these districts between 2011 and 2013, which accounted for approximately 43 percent of the animals harvested in Region 4.

Table 6.22 Bighorn sheep hunting - average annual number of hunters, hunting days, and animals harvested on MFWS hunting districts containing some HLC NFs land, 2011 to 2013

	Hunters	Days	Animals Harvested
Region 4 - Districts 421, 422, 423, 424, 441, 455			
Nonresident	2	8	2
Resident	19	175	17
Total for above districts	21	183	18

	Hunters	Days	Animals Harvested
Percent of Region 4 activity			
Nonresident	62.5%	76.7%	62.5%
Resident	39.9%	53.2%	41.3%
Total	41.1%	53.9%	42.6%
Percent of State Activity			
Nonresident	3.6%	2.3%	11.6%
Resident	6.2%	8.7%	9.5%
Total	5.9%	7.8%	9.7%

Mountain Goats

Table 6.23 provides statistics on mountain goat hunting on the hunting districts with HLC NF land. The hunting districts included are as follows (by MFWS Region): Region 3 – 313; Region 4 – 414, 415, 442, 451, and 460. HDs 280 and 380 also contain HLC NF land, but no information was available for these districts. Approximately one third of the mountain goat hunting in the state occurred on these districts annually from 2011 to 2013. The majority of that occurred in MFWS Region 3, which accounted for 59 animals harvested and 365 hunting days. However, the districts with HLC NFs land only accounted for 36 percent of the animals harvested in Region 3, while hunting on the districts containing HLC NFs land in Region 4 accounted for three quarters of the hunting in that region.

Table 6.23 Mountain goat hunting - average annual number of hunters, hunting days, and animals harvested on MTFWP districts containing some HLC NFs land, 2011 to 2013

	Hunters	Days	Animals Harvested
Region 3 - Districts 313			
Nonresident	7	27	6
Resident	68	339	53
Total for above districts	75	366	59
Percent of Region 3 activity	34.7%	31.4%	36.1%
Region 4 - Districts 414, 415, 442, 451, and 460			
Nonresident	0	0	0
Resident	11	55	9
Total for above districts	11	55	9
Percent of Region 4 activity	78.6%	88.7%	77.8%
Percent of State activity	32.2%	27.8%	34.5%

Deer

Table 6.24 provides statistics on deer hunting on the hunting districts with HLC NFs land. The hunting districts included are as follows (by MFWS Region): Region 2 - 215, 280, 281,293, and 298; Region 3 - 318, 335, 339, 343, 380, 390, 391, and 392; Region 4 - 411, 413, 415, 416, 418, 420, 422, 423, 424, 432, 441, 442, 445, 446, 447, 448, 449, 452, 454, and 455; Region 5 - 511, 530, 540, and 580. Deer hunting occurring on districts containing HLC NFs land accounted for around 16.5 percent of animals harvested in the state and nearly one quarter of hunting days. Most of this occurred in Region 4, where 7,765 deer were harvested off of these districts annually, which accounted for nearly all of the animals harvested in Region 4 but only around half of the hunting activity. For the other 3 Regions, hunting on the districts containing HLC NFs land accounted for a much smaller percentage of activity on those districts.

Table 6.24 Deer hunting - average annual number of hunters, hunting days, and animals harvested on MTFWP districts containing some HLC NFs land, 2011 and 2013 (no data for 2012 was available)

	Hunters	Days	Animals Harvested
Region 2 - Districts 215, 280, 281,293, and 298			
Nonresident	440	2,776	94
Resident	3,999	27,460	770
Total for above districts	4,440	30,236	865
Percent of Region 2 activity	30.3%	24.1%	11.3%
Region 3 - Districts 318, 335, 339, 343, 380, 390, 391, and 392			
Nonresident	455	2,664	242
Resident	5,942	41,725	2,363
Total for above districts	6,397	44,388	2,604
Percent of Region 3 activity	30.9%	28.5%	16.9%
Region 4 - Districts 411, 413, 415, 416, 418, 420, 422, 423, 424, 432, 441, 442, 445, 446, 447, 448, 449, 452, 454, and 455			
Nonresident	2,974	16,711	1,405
Resident	14,663	78,592	6,272
Total for above districts	17,639	95,301	7,675
Percent of Region 4 activity	92.9%	84.3%	47.5%
Region 5 - Districts 511, 530, 540, and 580			
Nonresident	923	5,010	672
Resident	3,410	15,784	1,783
Total for above districts	4,332	20,794	2,456
Percent of Region 5 activity	34.8%	30.3%	20.8%
Percent of State activity	22.1%	25.4%	16.5%

Elk

Table 6.25 provides statistics on elk hunting on the hunting districts with HLC NFs land. The hunting districts included are as follows (by MFWS Region): Region 2 - 215, 280, 281,293, and 298; Region 3 - 318, 335, 339, 343, 380, 390, 391, and 392; Region 4 - 413, 420, 430, 440, 441, 444, 450, 455, 470, 490, and 491; Region 5 - 511, 530, 540, and 580. Elk hunting occurring on districts containing HLC NFs land accounted for nearly one-third of the elk hunting activity in the state. The largest amount of the hunting occurred in Region 4, where 3,078 elk were harvested off of these districts annually, which accounted for around three quarters of the animals harvested in Region 4. For the other 3 Regions, hunting on the districts containing HLC NFs land accounted for a much smaller percentage of activity on those districts.

Table 6.25 Elk hunting - average annual number of hunters, hunting days, and animals harvested on districts containing some HLC NFs land, 2011 and 2013 (data for 2012 was not available)

	Hunters	Days	Animals Harvested
Region 2 - Districts 215, 280, 281,293, and 298			
Nonresident	647	4,343	112
Resident	6,187	43,809	885
Total for above districts	6,833	48,152	996
Percent of Region 2 activity	29.8%	23.5%	29.6%
Region 3 - Districts 318, 335, 339, 343, 380, 390, 391, and 392			
Nonresident	918	6,046	224
Resident	11,548	83,751	1,804
Total for above districts	12,466	89,796	2,028
Percent of Region 3 activity	30.1%	27.3%	23.1%
Region 4 - Districts 413, 420, 430, 440, 441, 444, 450, 455, 470, 490, and 491			
Nonresident	2,672	16,591	747
Resident	13,083	75,168	2,333
Total for above districts	15,752	91,758	3,078
Percent of Region 4 activity	86.0%	74.2%	73.2%
Region 5 - Districts 511, 530, 540, and 580			
Nonresident	562	3,218	178
Resident	2,418	13,236	476
Total for above districts	2,980	16,454	654
Percent of Region 5 activity	39.0%	34.3%	37.1%
Percent of State activity	36.7%	27.2%	32.3%

Antelope

Table 6.26 provides statistics on antelope hunting on the hunting districts with s NF land. The hunting districts included are as follows (by MFWS Region): Region 2 - 215; Region 3 - 371, 380, 381, and 390; Region 4 - 411, 413, 415, 416, 418, 420, 422, 423, 424, 432, 441, 442, 445, 446, 447, 448, 449, 452, 454, and 455; Region 5 - 511, 530, 540, and 580. Antelope hunting occurring on districts containing HLC NFs land accounted for one quarter of antelope hunting activity in the state. The largest amount of the hunting occurred in Region 4, where 1,361 antelope were harvested off of these districts annually, which accounted for around two thirds of the animals harvested in Region 4. For the other 3 Regions, hunting on the districts containing HLC NFs land accounted for a much smaller percentage of activity on those districts.

Table 6.26 Antelope hunting - average annual number of hunters, hunting days, and animals harvested on districts containing some HLC NFs land, 2011 and 2012 (no information available for 2013)

	Hunters	Days	Animals Harvested
Region 2 - District 215			
Nonresident	4	6	2
Resident	35	139	27
Total for above districts	39	144	29
Percent of Region 2 activity	83.7%	83.2%	90.5%
Region 3 - Districts 371, 380, 381, and 390			
Nonresident	17	64	8
Resident	585	2,695	287
Total for above districts	601	2,759	294
Percent of Region 3 activity	18.8%	23.4%	10.4%
Region 4 - Districts 413, 420, 430, 440, 441, 444, 450, 455, 470, 490, and 491			
Nonresident	137	524	119
Resident	1,948	6,666	1,244
Total for above districts	2,084	7,187	1,361
Percent of Region 4 activity	84.1%	80.8%	66.2%
Region 5 - Districts 511, 530, 540, and 580			
Nonresident	182	568	140
Resident	1,280	3,609	811
Total for above districts	1,462	4,177	952
Percent of Region 5 activity	47.9%	42.9%	36.7%
Percent of State activity	24.3%	23.6%	25.3%

Black Bears

Table 6.27 provides statistics on black bear hunting on the hunting districts with HLC NFs land. The hunting districts included are as follows: 280, 300, 301, 411, 410, 440, 450, and 580. The numbers are not broken down by Region because the same district numbers occurred in more than one region. Black bear hunting on districts with HLC NFs land accounted for around 18 percent of animals harvested in the state in 2013. The majority of these were male bears.

Table 6.27 Black bear hunting - animals harvested on districts containing some HLC NFs land, 2013

HDs 280, 300, 301, 411, 420, 440, 450, and 580	Female	Male
Nonresident	7	16
Resident	92	164
Percent of state total	19.3%	18.3%

Mountain Lions

Table 6.28 provides statistics on mountain lion hunting on the hunting districts with HLC NFs land. The hunting districts included are as follows (by MFWS Region): Region 2 - 212, 215, 280, 281, 284, 290, 291, 292, 293, and 298; Region 3 - 318, 335, 339, 343, 388, 390, 391, and 392; Region 4 - 400, 401, 403, 405, 406, 411, 412, 413,415, 416, 418, 420, 422, 423, 424, 425, 432, 441, 442, 445, 446, 447, 448, 449, 452, 454, 455, 471; Region 5 - 511, 530, 540, 580, 590. Mountain lion hunting on the districts containing HLC NFs land accounted for around a quarter of the mountain lions harvested in the state in 2013. The largest amount of mountain lion hunting occurred in Region 4, where 67 animals were harvested in 2013, with the split between females and males being 28 and 39, respectively, which accounted for around 83 percent of the animals harvested in Region 4. . For the other 3 Regions, hunting on the districts containing HLC NFs land accounted for a much smaller percentage of activity on those districts.

Table 6.28 Mountain lion hunting – number of animals harvested on districts containing some HLC NFs land, 2013

Mountain Lion hunting - average annual number of hunters, hunting days, and animals harvested on districts containing some HLC NFs land, 2011 and 2013*		
	Females	Males
Region 2 - Districts 212, 215, 280, 281, 284, 290, 291, 292, 293, and 298		
Nonresident	0	1
Resident	0	5
Total for above districts	0	6
Percent of Region 2 activity	0.0%	8.3%
Region 3 - Districts 318, 335, 339, 343, 388, 390, 391, and 392		
Nonresident	0	4
Resident	8	11
Total for above districts	8	15
Percent of Region 3 activity	24.2%	24.6%
Region 4 - Districts 400, 401, 403, 405, 406, 411, 412, 413,415, 416, 418, 420, 422, 423, 424, 425, 432, 441, 442, 445, 446, 447, 448, 449, 452, 454, 455, 471		
Nonresident	5	10
Resident	23	29
Total for above districts	28	39

Mountain Lion hunting - average annual number of hunters, hunting days, and animals harvested on districts containing some HLC NFs land, 2011 and 2013*		
Percent of Region 4 activity	82.4%	83.0%
Region 5 - Districts 511, 530, 540, 580, 590.		
Nonresident	0	1
Resident	9	11
Total for above districts	9	12
Percent of Region 5 activity	56.3%	60.0%
Percent of State activity	21.1%	23.5%

Furbearers

Table 6.29 provides information on trapping in counties contained in the HLC NFs plan area. Trapping information is provided by MTFWP by trapping district, which equates to the MTFWP regions and by county. For Region 4, the counties in the HLC NFs plan area account for the vast majority of trapping in that region. For the other Regions, HLC NFs plan area counties account for much less of the trapping in those regions. Trapping in counties in the HLC NFs plan area account for approximately one quarter of all animals trapped in the state in 2010. Beavers, coyotes, and muskrats trapped in the plan area counties account for around one quarter of animals trapped in the state. For otters and skunks, the percentages are much higher, at 42 and 53 percent, respectively, of the state total. Muskrats account for the largest number of animals trapped in the area at 4,603, followed by coyotes at 2,249. Table 6.30 provides information on pelt prices for some of the furbearing species. These prices range from a low of $1.67 per pelt for muskrats up to a high of $589 for bobcat.

Table 6.29 Number of animals trapped on districts in HLC NFs plan area counties, 2010

	All species	Bobcat	Beaver	Badger	Coyote	Martin	Mink	Muskrat	Otter	Raccoon	Fox	Skunk	Weasel
Region 2 HLC NF Counties													
Powell	1,044	32	143	0	364	11	3	267	40	16	86	81	0
Percent of trapping district total	19.2%	26.1%	17.3%	0.0%	55.1%	2.0%	1.8%	13.5%	83.3%	5.7%	22.9%	27.5%	0
Region 3 HLC NF Counties													
Broadwater	39	19	40	0	0	0	3	0	0	13	0	0	0
Jefferson	237	35	84	3	13	0	16	499	5	43	5	5	0
Total plan area	276	54	124	3	13	0	19	499	5	57	5	5	0
Percent of trapping district total	3.8%	30.8%	12.9%	6.7%	2.9%	0	10.8%	11.2%	22.2%	15.8%	3.2%	2.0%	0
Region 4 HLC NF Counties													
Cascade	3,940	16	342	43	561	0	11	348	5	105	76	2,427	5
Chouteau	405	5	27	0	332	0	0	0	0	3	3	35	0
Fergus	1,216	35	324	5	375	0	16	321	0	97	40	3	0
Judith Basin	224	57	38	0	54	0	0	54	0	11	5	5	0
Lewis and Clark	771	49	140	0	108	0	16	305	0	78	27	40	8
Meagher	94	0	8	0	86	0	0	0	0	0	0	0	0
Pondera	2,120	0	11	0	0	0	11	2,093	0	5	0	0	0
Teton	920	11	5	0	181	0	0	717	0	0	3	3	0
Total plan area	9,690	173	895	49	1,696	0	54	3,838	5	299	154	2,513	13
Percent of trapping district total	85.6%	86.5%	66.0%	75.0%	96.2%	0	41.7%	81.9%	100.0%	80.4%	95.0%	97.9%	1
Region 5 HLC NF Counties													
Wheatland	394	11	92	24	175	0	0	0	0	0	35	0	0
Percent of trapping district totat	8.0%	3.0%	12.9%	50.0%	15.4%	0	0.0%	0.0%	0.0%	0.0%	15.1%	0.0%	0
Percent of state total	24.8%	16.8%	23.0%	12.4%	26.5%	0.8%	9.9%	24.9%	42.2%	11.6%	19.8%	65.4%	2.8%

Table 6.30 Pelt prices

Species	Pelt Price from beginning of reporting period to 2013
Beaver	$14.95- 30.91
Otter	$30.01-112.58
Muskrat	$1.67-11.51
Mink	$9.31-29.05
Bobcat	$81.75-589.08
Marten	$15.01-84.70
Fisher	$28.62-145.30
Wolverine	$200.01-$235.74

Game Birds

Table 6.31 provides information on upland bird hunting in counties contained in the HLC NFs plan area. Upland gamebirds consist of the following species: Pheasant, Hungarian Partridge, Chukar Partridge, Sharptail Grouse, Sage Grouse, Ruffled Grouse, Blue Grouse, and Spruce Grouse. Upland bird hunting is managed and reported by MTFWP Region. Upland bird hunting in the counties contained in the HLC NFs plan area accounts for about 30 percent of the upland bird hunting in the state. For those districts containing HLC NFs lands, the largest number of birds harvested occurred in Region 4, at 77,886 birds in 2007. Cascade, Chouteau, Fergus, and Teton Counties had the most activity, with more than 10,000 birds harvested in each of those counties in 2010.

Table 6.31 Upland bird hunting in counties in the HLC NFs plan area, 2007

County	Hunters			Harvest		
	Resident	Nonresident	Total	Resident	Nonresident	Total
Region 2 HLC NF Counties						
Powell	301	30	331	1,390	51	1,441
Percent of Region 2 Total	10.6%	17.0%	11.0%	9.7%	8.5%	9.6%
Region 3 HLC NF Counties						
Broadwater	949	54	1,003	5,022	429	5,451
Jefferson	437	20	457	1,531	58	1,589
Percent of Region 3 Total	32.6%	12.2%	30.0%	27.5%	13.4%	25.6%
Region 4 HLC NF Counties						
Cascade	1,856	335	2,190	13,031	2,197	15,228
Choteau	1,536	298	1,834	11,922	2,346	14,268
Fergus	1,329	568	1,897	10,879	4,814	15,693
Glacier	89	14	103	395	85	479
Judith_Basin	428	95	522	4,087	980	5,067
Lewis_and_Clark	761	98	859	3,659	369	4,028
Meagher	451	74	525	2,588	456	3,045
Pondera	1,250	169	1,419	7,253	1,089	8,341
Teton	1,621	247	1,867	10,104	1,633	11,737

County	Hunters			Harvest		
	Resident	Nonresident	Total	Resident	Nonresident	Total
Percent of Region 4 Total	100.0%	89.9%	98.1%	90.4%	83.0%	89.0%
Region 5 HLC NF Counties						
Wheatland	254	41	294	935	183	1,117
Percent of Region 5 Total	6.7%	5.4%	6.5%	4.0%	5.0%	3.9%
Percent of State Total	39.5%	24.9%	36.3%	30.9%	19.8%	28.3%

Economic Value of Hunting and Wildlife-related Activities

A recent survey by MTFWP provides estimates of resident and nonresident hunter and angler expenditures in Montana (FWP 2015). This survey estimated that resident hunters spend from $69.52 per day (waterfowl hunting) up to $229.67 per day (mountain goat hunting) on trip-related expenditures. Nonresident hunters spend from $362.52 per day (pheasant, grouse, and partridge hunting) up to $1,188.20 per day (mountain goat hunting). It was estimated that hunters in Montana spend around $348 million annually in the state for trip-related expenditures.

Round 2 (data collected from 2005 to 2009) of the National Visitor Use Monitoring survey done on the HLC NFs indicated that 20.5 percent of all visitors to the Forests participated in hunting and for 19.6 percent of HLC NFs visitors, hunting was the primary activity that they engaged in during their trip to the forest, making it the number one activity on the forest. Viewing wildlife also had a high participation rate, with 28.1 percent of visitors saying that they participated in viewing wildlife. However, only 1.6 percent said it was their primary activity on the forest. The economic contribution analysis conducted for this assessment (see section entitled “Helena and Lewis and Clark NFs’ Contributions to the Analysis Area Economy”) indicates that approximately 136 jobs and $3.9 million dollars of labor income are associated with non-local fish and wildlife-related visits to the forest.

While economic contribution analysis, such as that discussed above, looks at the impact of natural-resource based activities on jobs and income in the local economy, other types of economic analysis are designed to look at the demand for a good or service and the value that individuals place on a given resource. These studies often estimate the average value (usually referred to as the net economic benefit) of different types of resource to people. As part of the Montana Challenge, Duffield (2003) looked at studies that had been done in Montana related to the average value of hunting and fishing and other wildlife related activities. Table 6.32 shows the estimated values provided in that report for different types of hunting experiences after they have been adjusted for inflation to reflect 2012 dollars. These studies show elk hunting trips to be almost twice as valuable as deer hunting trips but the difference nearly disappears when looking at the value per day, versus value per trip. More substantial is the difference in value for hunting moose and Bighorn sheep, compared to the more common species. Hunting moose is more than twice as valuable as hunting deer or elk (when put on a per day basis).

Table 6.32 Relative values for Montana hunting by species targeted, adjusted to 2012$

Species	Year of Study	Value per Trip	Value per Day
Deer	1986	197	101
Elk	1985	346	123
Waterfowl	1989	278	147
Moose	1993	809	269

Source: Duffield 2003 (Note: Values found in Duffield 2003 have been updated to adjust for inflation)

Energy and Minerals

Energy and minerals are discussed in chapter 9 – Renewable and Nonrenewable Energy and Minerals.

Ecosystem Services

Wood for Fuel

Please see the timber products subsection in the Multiple Use section of this chapter.

Clean Air

Clean air is an important environmental benefit provided by forests. Clean air is necessary for all life on Earth, and air pollution has been associated with a range of adverse health and environmental effects. Trees absorb and sequester air pollutants such as carbon dioxide (CO_2) through photosynthesis and produce oxygen for people and animals to breathe. Trees also play an important role in capturing air pollutants deemed hazardous to human health: ground-level ozone (O_3), particulate matter (PM), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) as documented by Nowak et al. (2014). The pollutants come from dust, pollen, smoke, ash, motor vehicles, and industrial sources such as power plants.

The Environmental Protection Agency (EPA) establishes national ambient air quality standards and the Montana Department of Environmental Quality (MT DEQ) manages these standards within the state of Montana. MT DEQ, along with select counties, monitors for air pollution and provides reports summarizing air quality data. Please refer to the Air Quality section of Chapter 3 for more information.

Cultural and Historical Resources

The term “cultural services” refers to the intangible benefits people receive from ecosystems, including nonmaterial spiritual, religious, inspirational, and educational experiences (Kandziora et al. 2013). Under the MEA classification (MEA 2003), cultural and heritage values are included as a “cultural service”. For this planning effort, cultural and heritage values are the cultural and historic uses and resources in the plan area. The four direct cultural/heritage values of the plan area are heritage tourism, interpretation, education, and public partnership programs. In addition, culturally important plant and fungi species are also ecosystem services. For information on these values, refer to the Chapter 11 – Cultural and Heritage Resources and Uses.

Aesthetics

See Chapter 7, Recreation Settings, Opportunities, Access, and Scenic Character and the section on natural amenities in Chapter 5, Social and Economic Conditions and Trends.

Inspiration and Non-use Values

The term “cultural services” refers to the intangible benefits people receive from ecosystems, including nonmaterial spiritual, religious, inspirational, and educational experiences (Kandziora et al. 2013). It can also include what are generally termed “non-use values.” Nonusers are individuals who may never visit or use a natural resource but are nevertheless affected by changes in its status. Expression of their preferences for the state of these resources is called nonuse value (also often termed passive-use values or intrinsic value). (Harpman et al.1994). These may include existence value (people value the fact that the resource exists, even if they never see it or use it), bequest value (people value that future generations may value and use this resource), or option value (people recognize that certain resources that are not used now may have important uses in the future).

This section will focus primarily on two of the cultural services that were identified as key ecosystem services, both of which fall generally under the heading of “inspiration”. These are solitude and spiritual experiences. Non-use values were acknowledged as important but were not identified as a key ecosystem service so they will only be briefly discussed at the end of this section.

Solitude

Solitude is commonly defined as an escape or complete isolation from all other people or situation in which you are alone usually because you want to be. It is generally perceived as a positive experience whereas loneliness is a negative experience. There has been some research on the topic of solitude as it relates to wilderness (Hollenhorst 1994 and Hammitt, 1994), although one can have solitude outside of designated wilderness. Some components to solitude are remoteness, naturalness and removal from human intrusions. In an era where people are able to easily be connected to the outside world, solitude is an important element for some users.

Although solitude is a personal experience and your personal attitude about solitude play a large role in how you experience solitude, generally, the more primitive setting you are in, the more solitude you may experience. One way to look at opportunity for solitude is using the recreation opportunity spectrum (ROS) which is a framework to describe different settings across the landscape and attributes associated with those settings. The social setting attribute in ROS discusses the probability of solitude; two ROS classes, primitive and semi-primitive non-motorized have a high probability of solitude.

About 16% of the plan area is in the primitive class, which on the Forests is designated wilderness. The social setting for primitive is that the user would have a very high probability of solitude, closeness to nature, self-reliance, high challenge and risk with little evidence of people.

Another ROS category the also provides recreation visitors with a high probability to experience solitude is semi-primitive non-motorized (SPNM). The social setting for SPNM is a high probability of solitude, closeness to nature, self-reliance, high to moderate challenge and risk with some evidence of others. The percent of the plan area in the semi-primitive non-motorized class during the summer is about 36%. During the winter months when snow covers the ground, settings with SPNM decrease to 28%. This is due to the fact that over the snow vehicles can access areas that are unavailable in the summer months. See Recreation Settings and Opportunity Section for more detailed discussion.

Spiritual Experiences

Arthur Carhart once said “Perhaps the rebuilding of the body and spirit is the greatest service derivable from our forests, for what worth are material things if we lose the character and quality of people that are the soul of America.”

Opportunities for spiritual experiences and spiritual renewal exist throughout the HLC NFs. The plan area offers many opportunities for visitors to connect with nature by offering many different recreational opportunities and settings. The Forest is home to three exceptional wilderness areas, the Bob Marshall, the Scapegoat and the Gates of the Mountains. The vastness of these landscapes provides excellent opportunities for solitude and spiritual renewal. However, one does not have to be within wilderness to attain a spiritual connection or to receive spiritual renewal while recreating in the outdoors. Camping trips to favorite campgrounds or dispersed sites, nature hikes along trails, OHV rides on forested ridgetops, or fishing trips with family members can also bring about a sense of connectedness to the environment, escape from modern life, and a renewal of mind and spirit.

According to Heintzmans (2010), today spirituality is often defined as “a way of being and experiencing that comes about through awareness of a transcendent dimension and that is characterized by certain identifiable values in regard to self, others, nature, life, and whatever one considers to be Ultimate” (Elkins et al., 1988, p.10). Spiritual renewal is a personal journey with many different variables that are hard to define or describe. Many people who explore the outdoors or even by viewing scenery, describe a deep connection to the land and renewal in their life.

Although we don’t have specific studies for the HLC NFs Forest, studies show how interested wilderness and park visitors are in the spiritual dimension of their visit. In Canada’s Prince Albert National Park, about 46% of

backcountry visitors felt that the opportunity to reflect on spiritual values was important in their decision to visit the backcountry (Brayley & Fox, 1998). The spiritual value of wilderness was acknowledged by 69% of wilderness users in California's Eldorado National Forest (Trainor & Norgaard, 1999). Studies at Ontario Provincial Parks found that 53% of campers and 58% of day visitors indicated that introspection/spirituality added to their satisfaction with park experience (Heintzman, 1998, 2002). These studies suggested that a majority of people who visit park and wilderness areas seek spiritual outcomes; however, spiritual outcomes may not be the most valued outcomes. For example, Behan, Richards, and Lee's (2001) survey of visitors to an Arizona wildland recreation setting discovered that 11% of participants cited spiritual benefits as the most valued benefit.

Non-use Values

In his seminal article on the values of natural resources, Krutilla (1967) describes several types of values that people hold for natural resources. In that article, Krutilla observes that, "There are many persons who obtain satisfaction from the mere knowledge that part of the wilderness of North America remains, even though they would be appalled by the prospect of being exposed to it." Others have pointed out people may value natural resources because of sympathy towards animals or people (they feel altruistic towards those that do "use" the natural environment), feelings of environmental responsibility, or because they desire to have the natural environment around for future generations (Harpman et al 1994; Boyle and Bishop 1987; Madariaga and McConnell 1987).

The literature emphasizes that nonuse value is most likely to be greater where the resource in question is unique and/or where adverse impacts are irreversible, when the resource is regionally, nationally, or internationally important; and/or when endangered species and their habitats are involved (Harpman et al 1994).

Some studies have found that use values exceed nonuse values while others have found the opposite. Some examples of such studies are listed below. Note that all of the dollar values shown are in nominal dollars (they have not been adjusted for inflation). They are provided to serve as a comparison of use values and nonuse values.

- Boyle and Bishop (1987) examined the value of maintaining and restoring bald eagle habitat in Wisconsin and estimated use values of $47 to $57 per household per year and non-use values of approximately $18 to $28 per household per year.
- Olsen et al. (1991) measured the value of doubling the Columbia River Basin salmon and steelhead fish runs. Use values were estimated at $47.64 per household per year, while nonuse values were estimated at $26.52 per household per year.
- Sanders et al. (1990) estimated the total value of preserving fifteen wild and scenic rivers in Colorado. They reported that Colorado residents expressed a use value of $19.16 and a nonuse value of $81.96 per household per year.
- Duffield (1992) measured the value of wolf recovery in Yellowstone National Park and estimated use values of $5.48 per household per year and nonuse values of $17.39 per household per year.
- Haefele et al. (1992) looked at the value of protection programs (against insects and air pollution) for spruce-fir forests in the southern Appalachians. They found use values ranging from $1.48 to $7.58 and nonuse values ranging from $15.93 to $50.75 (all per household per year).

Research and Education

Introduction

"Find out in advance what the public will stand for; if it is right and they won't stand for it, postpone it and educate them." –Gifford Pinchot

The Forest Service has recognized its role and responsibility to educate people about the management and conservation of their National Forest System lands and resources since its creation. It is just as important today as

it was in 1905 to increase knowledge among adults and youth on forests and natural resources through a variety of programs, services and materials. The Forest Service manual (FSM 1623, FSM 2390) provides national, regional, and forest direction on the management and delivery of community outreach, conservation education, and interpretive programs and efforts. Further program direction is given through the multiple agency strategic plans and/or initiatives that are primarily focused on education and outreach within the agency.

The Helena and Lewis & Clark National Forests have two of the most prominent conservation education, interpretation, and community outreach programs in the Northern Region. Although the Lewis & Clark National Forest hosts numerous outdoor activities across the Forest, including Winter Trails Day and More Kids in the Woods, a large number of its conservation education, interpretative and community outreach programs are based out of the Lewis & Clark Interpretive Center.

Helena National Forest

The Helena NF has led the Region in implementation of multiple science and place-based educational opportunities and service learning projects, all of which meet the common core educational standards for the State of Montana. The Forest's community outreach and conservation education programs take place on National Forest system lands, and depend on the partnerships of multiple other organizations, agencies, schools and volunteers. The Forest's goals, objectives and priority work for its community outreach, interpretive, volunteer, and conservation education programs are outlined in its "2012-2015 Community Outreach and Conservation Education Strategy."

Montana Discovery Foundation

The unique partnership between the Helena National Forest and the Montana Discovery Foundation—a non-profit organization that compliments the agency's conservation education goals—has allowed the Forest to connect people to the outdoors through quality educational and recreational opportunities across the Forest for more than 15 years. Each year, the Helena National Forest, Montana Discovery Foundation and many other organizations, agencies and partners reach 7,500 people through more than 100 programs that are implemented by staff and volunteers.

Some of the sustainable programs that are made possible through the partnership with Montana Discovery Foundation and other partners include: Youth Forest Monitoring Program, A Forest for Every Classroom, Snowschool, monthly moonlight hikes, citizen science and monitoring projects, student-led vegetation inventory project(s), various fishing days and historical/cultural themed programs, and the numerous programs—International Migratory Bird Day, Celebrating Wildflowers, and Adopt-a-Species to list a few—included in our larger Community Naturalist program.

Youth Forest Monitoring Program

The Youth Forest Monitoring Program (YFMP) started in 1996, and has grown over 18 years to include student crews stationed out of Helena, Lincoln and Deerlodge. YFMP is an intensive seven-week internship program for high school students, where participants learn forest ecology concepts and field data collection protocols for monitoring streams, soils, vegetation, recreation areas and wildlife populations. At the end of the internship, students present their data collection and analysis findings and recommendations to Forest Service specialists, community members and media during a community-wide meeting. Throughout their time in YFMP, under the supervision and guidance of their field instructor(s), students explore forest ecology, discover a variety of natural resource careers, take part in stewardship projects and ultimately supplement ongoing forest health analysis through strong citizen-led forest monitoring. At the end of their internship, students receive a stipend for their summer work. In a 2013 YFMP participant questionnaire, over 55% of students responding have pursued degrees in natural resources, and over 39% of these students have worked seasonal or full-time jobs with the Forest Service. In addition, 96% of students responding felt they made a positive difference on their forest lands. This

indicates YFMP students are more likely to be involved in planning for their local landscapes, and are more vested in their community.

Forest for Every Classroom

Along with the numerous youth-focused programs, the Helena National Forest and its partners hosted Montana's first replication of Region 9's "A Forest for Every Classroom" (FFEC) year-long professional development program for formal and non-formal educators that is focused on place-based education with strong strands of civic engagement and service learning. Teachers who participate in FFEC develop their own curriculum that increases student literacy skills and fosters student understanding of and appreciation for the forested lands in their communities. The curricula integrate hands-on study of natural and cultural resources of the local community, addressing concepts in ecology, sense of place, land management/stewardship, and civics. At the heart of the FFEC program is the belief that students who are immersed in the interdisciplinary study of their own "place" are more eager to learn and be involved in the stewardship of their communities and public lands. Together the Helena National Forest, Montana Discovery Foundation, Montana Fish, Wildlife and Parks hosted the core FFEC program from 2009-2012, and have since focused on alumni events for the 48 educators who successfully completed the program.

Outdoor Explorers Mentoring Program

Helena's Outdoor Explorers Mentoring Program (OEMP) aims to foster life-long engagement with nature and communities, and provide stepping stones to inspire the next generation of natural resource professionals by connecting underserved youth with the wild places in their backyard through intergenerational place-based outdoor adventures and service learning project. The program reaches underserved youth— 6-14 year olds, of whom 63% are living at or below poverty level, 25% have an incarcerated parent, 75% are from single parent households—in the Helena and surrounding areas. To-date the OEMP program partners have hosted more than 20 programs for a total of nearly 350 Big Brother Big Sister "matches" over past two years. Through a challenge cost-share agreement, the program is funded for three consecutive years; program partners are committed to maintaining this program beyond the three years and will seek other funding sources when necessary.

Veterans Opportunities

Currently the Helena National Forest, Montana Discovery Foundation, and Fort Harrison Veterans Affairs are working together to provide volunteer and educational opportunities to Montana veterans who are, or have been, enrolled in post-traumatic stress disorder (PTSD) rehabilitation programs at Fort Harrison, as part of a new program called "The Force of Nature." The purpose of The Force of Nature program is to provide quality volunteer and educational programs and activities to Montana veterans who are working to re-engage themselves into their communities. Since the program's inception in 2011, about 50 veterans have participated in more than 15 weekend programs and volunteer activities, including wildlife tracking workshops, wildlife monitoring and surveys, trail maintenance and improvements, facility improvements, noxious weeds inventory, and powerline inventory and monitoring. The Force of Nature program is incorporated into the veterans' six week PTSD rehabilitation program, and is offered as an extended program once they complete their therapy. After their experience in The Force of Nature, about 10% of the veterans have become regular volunteers at their local Forest Service office.

The Helena National Forest has other unique programs and partnerships that help reach under-served youth and veterans who suffer from post-traumatic stress disorder (PTSD). Although these two programs are relatively new additions to the CO/CE program, the Forest continues to explore ways to make these ongoing sustainable programs for years to come.

Lewis and Clark National Forest

Lewis and Clark outreach programs reach approximately 55,000 – 57,000 people each year. The Lewis and Clark National Forest provides numerous programs throughout the year that include prepared education presentations,

exhibits and programs at the Lewis and Clark Interpretive Center, special events, community events, summer camps, outreach to new airmen at Malmstrom Air Force Base, and seasonal or one-time opportunities. Many of these programs are accomplished through working with partners. The range of these contacts includes youth, family, and adult focused events; all with the goal of fulfilling the Forest's education objectives and connecting people to their Forest and recreational opportunities.

Lewis and Clark National Historic Trail Interpretive Center

The idea of the Lewis and Clark National Historic Trail Interpretive Center was conceived of in the early 1980's during a series of community visioning sessions. During that time frame Montana Governor Ted Schwinden offered land at Giant Springs State Park for a building site. In October of 1984 Congress established the Center and named the USDA Forest Service as the agency to plan, build, and manage the facility. President Reagan signed Public Law 100-552, establishing the center. Following a 15 year period of planning, fundraising, and construction, the center opened in May of 1998. Approximately half of the construction cost (roughly three million dollars) of building the center came from community fundraising. Today the center is open 334 days a year, offering approximately 2,700 day programs each year. The programs are typically interpretative and are presented by the staff with alternating educational films telling the story of the Lewis and Clark Expedition. Special evening programs are also provided throughout the year. Examples of these programs include: a Winter Film Festival, Starparty Extravaganza (416 attendees in 2014), the annual anniversary celebration (203 attendees in 2014), Sunday Sampler in coordination with other museums - (800 attendees in 2014), support for Lewis and Clark Festival which is annually put on by the Lewis and Clark Foundation – (4700 attendees in 2014), the October Voices in the Shadows programs, (251 attendees in 2014), approximately 10 Friday evening summer Riverside Voices programs, one-time events such as this year's 50th Anniversary of the Wilderness Act (140 attendees), the Christmas with Lewis and Clark concert by the Shamrockers (140 attendees at the December 2014 concert), approximately 48 education programs for individual schools (1,675 students and 167 teachers/chaperones in 2014), 18 "More Kids in the Woods" winter ecology day-long classes for all Great Falls 6th" graders, and 10 days of the Field Investigations program for all Great Falls public school 7th graders with each one of these programs serving 750 – 800 students annually.

The Lewis and Clark Interpretive Center works closely with a number of other agencies, groups, and organizations including: the Lewis and Clark Foundation, the Lewis and Clark Honor Guard, the Portage Route Chapter of the Lewis and Clark Trail Heritage Foundation, the Great Falls Museum Consortium, and the National Weather Service. Additionally, a high functioning volunteer organization contributes over 10,000 hours of mission critical service annually.

School Programs

The Forest staff also provides school programs throughout the year for kids from preschool to high school. These may vary from year to year based on requests from the school but have included winter ecology snowshoe hikes, Smokey Bear presentations, judging entries at a state regional science fair and providing winners with a special interpretive snowshoe hike, hosting a table at the Great Falls School System's annual STEAM event, mentoring an envirothon team, providing field trip experiences on the LCNF, making classroom presentations, providing a fire prevention/ecology and a trail-based conservation program in Lewistown, and providing job shadowing experiences for kids interested in natural resource careers.

Malmstrom Air Force Base

With the Malmstrom Air Force Base sited in Great Falls, many airmen from across the country, often from urban backgrounds, are interested in recreation opportunities on the LCNF. The Forest provides approximately 25 briefings annually at the base's First Term Airmen Class and participates as opportunities arise at several other special events on the base each year. Over the course of a year forest personnel are able to speak with an estimated 600 airmen.

Special Events

The LCNF aggressively capitalizes on one-time special opportunities to reach out to our communities. Such events include the 2014 50th anniversary of the Wilderness Act, and the National Christmas Tree events that took place in 7 different communities on the LCNF as it traveled through Montana on its way to Washington DC.

The Forest, as a member of Get Fit Great Falls, participates in putting on the annual June National Trails Day and leads the annual Winter Trails Day events and has also assisted with the Great Falls Kids Fishing Day. The Forest has often participated in community events or programs that attract forest users. These events have included sportsmen shows, Earth Day celebrations, and special events at Cabela's in Billings.

Each summer an estimated 6,000 visitors stop at the Forest's booth in the Nature's Den building at the Montana State Fair. The booth typically provides information on current forest issues, fire prevention, and travel plan rules, as well as providing hands on activities for kids, and a venue for adults to ask questions they may have regarding recreation opportunities on the Forest. The Forest also responds to requests to provide programs for summer camps and participation in community events.

Regulating Services – Flood control, erosion, control, and carbon sequestration

Regulating services are "the benefits people obtain due to the regulation of natural processes such as water purification and erosion control. These are the less tangible benefits people gain from ecosystems when abiotic and biotic factors are controlled and/or modified (Haines-Young and Potschin, 2010) and consequently they are not widely acknowledged by humans" (Kandziora et al. 2013).

Three regulating services were chosen as "key" ecosystem services provided by the HLC NFs – flood control, erosion control, and climate regulation/carbon sequestration.

Flood Protection

Flood protection is an important regulating ecosystem service provided by National Forests. Large trees, for instance, break up heavy rainfall. Organic soils and established root systems assist in absorbing water, while permeable soils allow surface water to soak in and recharge groundwater resources.

Flood protection is an important regulating ecosystem service provided by the Helena and Lewis & Clark National Forests. This service is provided through the maintenance of properly functioning watersheds characterized by effective ground cover and healthy, permeable soils with well-developed root systems to maximize infiltration and regulate streamflow.

Geographic Scale

Management activities can have measurable effects on streamflow at the watershed and subwatershed scales. The management of the Helena and Lewis & Clark National Forests focuses on the inherent capacity of watersheds to regulate flows instead of engineered solutions.

Conditions, Trends, and Drivers

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. 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". The results are displayed in Table 6.34. In summary, 103 were rated as Class 1-functioning properly, 159 were rated as Class 2- functioning at risk, and 34 were rated as Class 3-impaired. The most notable drivers of the ratings in the plan area were roads, grazing, and mining.

Table 6.33 Number of 6th level watersheds by geographic area rated in each category under the WCF

	Class 1 Functioning Properly	Class 2 Functioning at Risk	Class 3 Impaired Function	Grand Total
Big Belt Mountains GA	3	35	7	45
Castle Mountains GA	2	9	1	12
Crazy Mountains GA	5	5		10
Divide GA	1	13	14	28
Elkhorn Mountains GA	1	18	2	21
Highwood Mountains GA	3	4		7
Little Belt Mountains GA	21	39	4	64
Rocky Mountain Range GA	40	13	1	54
Snowy Mountains GA	15	3		18
Upper Blackfoot GA	12	20	5	37
Grand Total	103	159	34	296*

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

Intensive forest harvest and associated road construction have the potential to effect watershed processes. Changes in water yield and peak flows have been observed after forest harvest, but contemporary forest management has little or no effect on floods greater than a 6 year recurrence interval (Grant et al. 2008). In other words, as precipitation and/or snowmelt events get larger, the relative degree of forest management influence becomes smaller.

Urbanization and agricultural development can all influence drainage efficiency. Dam operations complicate the interpretation of direct effects of forest management on peak flows in these subbasins. Natural disturbances such as stand-replacing wildfires, insects and disease can also alter hydrologic processes (Grant et al. 2008).

Forest harvest has been utilized experimentally to increase water yield, particularly in areas where precipitation exceeds potential evapotranspiration. These increases are often small and short-lived and are less effective when water is most needed. Increasing harvest frequency to create detectable changes in water yield is difficult (Jones et al. 2009). These difficulties are further complicated by management constraints and multiple use/sustained yield guidelines (Kattelman et al. 1983).

Influence of non–NFS Lands or Conditions

Rapid development in the urban interface has increased concerns about wildfire risk (Jones et al. 2009). Management to reduce wildfire risk within this interface may influence stream flow in some parts of the plan area, but this effect is likely to be small.

Half of the subwatersheds assessed for the Watershed Condition Framework on the HLC NFs lack majority Forest Service ownership. Management activities and future development within these lands adjacent to the plan area could potentially affect flood protection services provided by the National Forest.

Importance to People in the Plan area and the Broader Landscape

Because flood-related damage to homes, commercial buildings, farms and public infrastructure is costly, the Forest's ability to reduce flood risk and severity is a socially beneficial service. In addition, floods can cause damage to the following ecosystem services:

- Water quality (floods can damage diversion and filtration structures; in addition, a temporary impairment of water quality can occur when sediment transport is high during high flows)
- Fish and wildlife (floods can create and maintain complex aquatic habitats, temporarily displace fish, damage fish habitat, and damage infrastructure that can increase the damage to fish habitat)

- Cultural/heritage values (these values can be lost if floods damage stream-adjacent structures or resources)
- Aesthetics (these values can be temporarily impaired by logjams, damage to infrastructure, reduced access to areas, and changes to viewsheds)
- Recreation opportunities (these can be reduced temporarily or permanently when floods damage roads and bridges, cutting off access to recreation areas)
- Landslide protection (floods can trigger debris torrents, exacerbating the flood damage and increasing damage to fish and wildlife services)

Information Needs

A better understanding of the direct and indirect water yield responses to climate change is needed for potential mitigation and adaptation of the flood protection service provided by the HLC NFs. Direct effects include changes in temperature, precipitation regimes and precipiation patterns. Indirect effects include changes to the frequency and severity of both wildfires and insect/disease epidemics.

Erosion Control

Soil stabilization and erosion control are important regulating services. Regulating services are "the benefits people obtain due to the regulation of natural processes such as water purification and erosion control. These are the less tangible benefits people gain from ecosystems when abiotic and biotic factors are controlled and/or modified (Haines-Young and Potschin, 2010) and consequently they are not widely acknowledged by humans" (Kandziora et al. 2013).

In a recent publication, Smith et al. (2011) explain the importance of erosion control as a regulating service:

> *The article articulated the importance of these services by highlighting erosion's costs to natural and human-made systems. They explained that "downstream costs [of erosion] may include disrupted or lower quality water supplies; siltation that impairs drainage and maintenance of navigable river channels harbors, and irrigation systems; increased frequency and severity of floods; and decreased potential for hydroelectric power as reservoirs fill with silt". The integrity of forest soils and vegetation has considerable impact on hydrology, aquatic habitats, and economic uses of water supplies and waterways.*

Conditions, Trends, and Drivers

The "Soils" section of the Watershed, aquatic, soil and air resources chapter of the assessment contains substantial information on the conditions, trends, and drivers of soil in the plan area.

Ecosystems and Soil Stabilization

Soil is flexible (it can be dug) and stable (it can withstand wind and water erosion). Soil also provides valuable long-term storage options, protecting archeological treasures and landfilling garbage generated by humans. Inherent soil properties, such as soil texture and particle size distribution, play a major role in physical stability. The need for structural support can conflict with other soil uses. For example, soil compaction may be desirable under roads and houses, but it can be devastating for the plants growing nearby. Soil has a porous structure to allow passage of air and water, withstand erosive forces, and provide a medium for plant roots. Soils also provide anchoring support for human structures, such as buildings and roads, and protect archeological treasures. The conflict—stability and support versus plant growth capabilities—is constant when forest management decisions involve roads, skid trails, recreation trails, and forest productivity. The main forest impacts to structure and stability are mass wasting, erosion, and loss of organic matter.

Importance to People in the Plan area and the Broader Landscape

Costs associated with erosion and landslides include reduced soil productivity, damaged roads and structures, filled ditches and reservoirs, reduced water quality, and harm to fish populations.

Effects from Forest Service Management Actions

In 2010, the FSM Chapter 2550, Soil Management, was amended at the national level. The emphasis of soil management was changed from disturbance tracking to an approach focusing on long-term soil quality and ecological function. The objectives of the national direction are 1) to maintain or restore soil quality on NFS lands and 2) to manage resource uses and soil resources on NFS lands to sustain ecological processes and function so that desired ecosystem services are provided in perpetuity.

FSM 2550 identifies six soil functions: soil biology, soil hydrology, nutrient cycling, carbon storage, soil stability and support, and filtering and buffering. Soil is the foundation of the ecosystem; in order to provide multiple uses and ecosystem services in perpetuity, these six soil functions need to be active.

Land use practices such as grazing, logging, and mining have been occurring on the Forests since they were established. These past forest practices have caused several impacts to soil functions. In present-day forest management, soil restoration is included in the majority of projects in order to meet the desired productivity for the land. The soil functions are intertwined, so discussing them separately is difficult. A few impacts can impair the majority of soil functions; these impacts are compaction, erosion, and loss of organic matter. As discussed in section soil section of the assessment, past activities have caused many of these impacts. While these impacts have not been eliminated, the Forest Service has substantially decreased these types of effects through the use of current management practices. This reduction of impacts, coupled with soil restoration activities, is expected to increase the capacity of the soils to provide multiple uses and ecosystem services in perpetuity.

Carbon/climate

Please refer chapter 4, Climate Change and Baseline Assessment of Carbon Stocks.

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