# CHAPTER 4

# ENVIRONMENTAL CONSEQUENCES

## *INTRODUCTION*

This chapter discloses the direct, indirect and cumulative effects of the alternatives described in Chapter 2. The affected environment and methodology for analysis was addressed in Chapter 3.

## *DIRECT AND INDIRECT EFFECTS*

Direct effects are caused by an action and occur at the same time and place. Indirect effects are caused by an action and occur later in time or farther removed in distance, but are still reasonably foreseeable.

Direct and indirect effects analysis for each alternative and each resource area are based on the description of the alternatives provided in Chapter 2, including the protection measures described under each alternative and under Features Common to All Alternatives section.

Also, every resource assumed that all acres indicated in Chapter 2 would be treated in each of the alternatives. Due to the way the inventory and mapping was done, treatment acres may be less than those indicated. This is mostly caused by areas of light or no weed infestation being included within a weed location “polygon” in the mapped database. The minimum size of a weed polygon is 0.01 acres, where the actual size might be one plant or a small patch.

## *CUMULATIVE EFFECTS*

Cumulative impacts are impacts on the environment that result from the incremental impact of actions when added to other past, present, and reasonably foreseeable future actions. For each resource, an analysis area was identified and used to adequately measure cumulative effects of the proposed alternative. Unless otherwise stated, the cumulative effects area, or the geographic scope, is the treatment area. For temporal scope, the timeframe for project implementation is 15 years and an additional five years past the final implementation year is considered.

### PAST PRESENT AND REASONABLE FORESEEABLE ACTIVITIES

Weed control efforts including aerial and ground application of herbicides will continue on privately-owned and public lands within and adjacent to the Custer National Forest. Government agencies such as the National Park Service, Bureau of Land Management, Gallatin National Forest, Shoshone National Forest, Bighorn National Forest, Black Hills National Forest, Montana Fish Wildlife and Park, Montana State University, Montana and South Dakota Highway Transportation Departments, Montana and South Dakota State Public Lands, local municipalities, Stillwater County, Park County, Carbon County, Sweet Grass County, Powder River County, Rosebud County, and Carter County of Montana, along with Harding County of South Dakota all use herbicides to control weeds adjacent to the Custer National Forest.

Activities that alter vegetation and may potentially act as a weed vector such as wildfires, timber harvesting, fuel reduction, livestock grazing, and recreational uses (hunting, hiking, motorized recreation,

etc.) will continue to dominate the landscape. The reasonably foreseeable and ongoing (previously planned) activities on NFS lands considered in the effects analysis are shown in Tables 4 – 1 and 4 - 2.

The Forest Service has developed prevention and protection measures (environmental design criteria) (Appendix C) that minimize the impacts of these activities on weed spread (FSM 2080). The Best Management Practices for Weed Control is listed in Appendix C.

**TABLE 4 – 1. REASONABLY FORESEEABLE ACTIVITIES[1]**

| Project Name | Type of Project |
|---|---|
| **Beartooth Ranger District** | |
| Beartooth Communications Sites | Facility Management |
| Grizzly Peak Fuel Management | Fuels Management |
| Piney Creek Pool Enhancement | Fisheries Habitat Management |
| Meyers Creek Area Grazing Allotment Planning | Grazing Management |
| Beartooth Front Grazing Allotment Planning | Grazing Management |
| Sage Creek Assessment and Forest Plan Amendment | Grazing Management |
| Big Ice Cave Withdrawal | Land Ownership Management |
| Kalt and Gans Land Exchange | Land Acquisition |
| Stillwater Mining Company, Closure and Post Closure | Minerals Management |
| Jimmy Joe Campground Reconstruction | Recreation Management |
| Beartooth Travel Plan | Road Management |
| East Rosebud Road #2177, Bridge Reconstruction | Road Management |
| Luoma Road Right of Way Permit | Road Management |
| Mickelson Water Pipeline Special Use Re-issuance | Special Use Management |
| Lions Organization Camp Special Use Permit Re-issuance | Special Use Management |
| TCT West Inc. Right of Way Re-issuance | Special Use Management |
| Quad Creek Stream Channel Restoration and FSR #2421 (Glacier Lake Road) Repair and Maintenance | Watershed/Road Management |
| Forest Plant Amendments for Grizzly Bear habitat Conservation for the GYA National Forests | Wildlife Management |
| Northern Rockies Lynx Amendment | Wildlife Management |
| **Ashland Ranger District** | |
| Hanson Prescribed Fire | Fuels Reduction |
| Roundup Prescribed Fire | Fuels Reduction |
| Ten Mile Prescribed Fire | Fuels Reduction |
| Timber Creek Prescribed Fire | Fuels Reduction |
| Whitetail Hazardous Fuels | Fuels Reduction |
| Stag Rock Grazing Allotment Analysis | Grazing Management |
| **Sioux Ranger District** | |
| Slim Buttes Range Analysis | Grazing Management |
| Long Pines Range Analysis | Grazing Management |
| Sioux Oil and Gas Leasing EIS | Minerals Management |
| West River Telephone Special Use Permit Amendment | Special Use Management |
| Verhuist Stockwater Pipeline SU Permit Re-issuance | Special Use Management |

[1] Source: January 2006 Quarterly Schedule of Proposed Actions, Custer National Forest.

**TABLE 4 – 2. ONGOING / UPCOMING ACTIVITIES CONSIDERED IN CUMULATIVE EFFECTS**

| Project Name | Type of Project |
|---|---|
| **Beartooth Ranger District** | |
| Beartooth Aspen Treatment | Wildlife Management |
| Locatable Minerals Development; Stillwater Mine Company operations | Mineral Management |
| Plan of Operations - Stillwater Complex (~ 3 three annually) for locatable minerals | Mineral Management |
| Pryor Mtn reclamation of two. Abandoned uranium mines | Mineral Management |
| Potential gas exploration /development – Line Creek Face (MT/WY) | Mineral Management |
| Adjacent to NFS - Pryor Mtn. Limestone Existing Operations (~ 200 Ac) and potential expansion (~300 Ac) | Mineral Management |
| **Ashland Ranger District** | |
| Powder River Gas Pilot Project (East of District) | Mineral Management |
| **Sioux Ranger District** | |
| Oil and Gas Exploration and Development – N & S Cave Hills, E & W Short Pines and adjacent to these land units | Mineral Management |
| CERCLA – Riley Pass reclamation (~ 300 Ac) | Mineral Management |
| Potential abandoned uranium mine reclamation | Mineral Management |
| Potential Tongue River Railroad (in or adjacent to District) | Mineral Management |
| Potential Energy Development related Power Line Corridors (2) in or adjacent to District | Mineral Management |
| Otter Creek Coal Tract Exploration / Development (~ 11 sections adjacent to District) | Mineral Management |
| **Custer National Forest-Wide** | |
| Fuels Treatments (~ 1200 Ac annually) | Fuels Management |
| Timber Sales | Timber Management |
| Permitted Grazing (~550,000 Ac) | Grazing Management |

## SHORT TERM USE VS. LONG TERM PRODUCTIVITY

Unless otherwise specified, short-term effects are those that occur within three years after treatment. Long-term effects are those that occur after three years from last treatment.

## IRREVERSIBLE / IRRETRIEVABLE

National Environmental Policy Act requires identification of irreversible and irretrievable commitment of resources. These effects are identified in resource areas where they may occur including soils, vegetation, water, and special areas such as Wilderness, inventoried roadless areas, and Research Natural Areas.

## ENVIRONMENTAL JUSTICE

Executive Order 12898 requires federal agencies to incorporate environmental justice into their missions by identifying and addressing high and adverse human health or environmental effects in their programs and policies on minorities and low-income populations and communities. None of the project alternatives would result in disproportionate impacts on minority or low-income populations or communities. Polluting facilities are not being proposed in this analysis. Environmental standards will be applied equitably across the National Forest with the same level of regulatory protection as other groups that may be wealthier, more politically powerful, or of a different race. There will not be inequitable distribution of project impacts as weed treatment can be accomplished across the National Forest regardless of low income or minority populations in the regional area.

### ENERGY REQUIREMENT

None of the alternatives being considered for this project have unusual energy requirements.

### NATIVE AMERICAN TREATY RIGHTS

While the alternatives may have differing impacts on species or their habitat none of the alternatives would alter opportunities for Native American tribes holding treaty rights to hunt and gather.

### ADVERSE EFFECTS THAT CANNOT BE AVOIDED

There are no adverse effects associated with this project identified in the analysis that cannot be avoided. Protection measures listed in Appendix C will be implemented and will mitigate any adverse effects from weed control.

## *VEGETATION*

This section is divided into three main categories (weed species, native plant communities, and rare plants) and will evaluate the effects of the alternatives along with the cumulative effects.

### EFFECTS OF NON-HERBICIDE TREATMENTS COMMON TO ALL ALTERNATIVES

Effectiveness of various non-herbicide treatments by target species are displayed in Appendices F and J.

Mowing would remove most above ground vegetation in treated areas and may damage or kill non-target vegetation. Mowing would mainly decrease the amount of seed production of weeds. Mowing could also weaken root and rhizome systems of creeping perennial weeds.

Tilling would injure top growth and the upper 12 inches of the underground systems of all vegetations within the treatment area. Depending upon the specific site, the moisture situation and the species (target or non-target), this method tends to have limited effectiveness. Tilling can break up the rhizomes of weeds that are creeping perennials, encouraging greater growth. It could also create a seedbed for other weed seed, thus promoting further spread. Reproduction of weeds by seed can be greatly reduced by seeding the site with native species shortly after tilling. The extent and location of tilling activities would be limited by terrain and soil characteristics.

Prescribed burning would suppress competing vegetation. Burning would promote regeneration of some grasses, forbs, and hardwoods, but could destroy some non-sprouting shrubs and other trees. Some noxious weeds such as leafy spurge regenerate rapidly from their root system after a burn and compete with desirable species. The control of such species might thus require burning followed by applying low rates of herbicides.

Sheep and goats have been used to a small degree for leafy spurge control. They tend to only graze on certain biological types of leafy spurge and remove only the top growth. Since the greatest consumption of leafy spurge is about 50%, sheep and goats could also consume some non-target species during the treatment period, depending upon management by the herder. However, if need be, very little non-target vegetation needs to be eaten during this type of spurge treatment.

There are only a few insect which are effective in controlling specific weeds (see Appendix I). No significant detrimental impacts to non-target vegetation would result from the use of insects or pathogens under any alternative due to the state and Federal clearances needed before a release of these agents.

## WEED SPECIES, DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 1 (PROPOSED ACTION)

Under this alternative various pest management practices such as pulling, biological control, and herbicide treatment would be used in combination to control, contain and/or eradicate populations of weed species. Aerial application of herbicides is also provided, thus, larger or remote infestations can be treated in a safe, efficient, and economical manner. The most effective means for control and/or eradication would be chosen depending on the likelihood of long-term effectiveness or resource values at risk. Appendix E, Table E – 1 would generally guide actual treatment priority with emphasis generally being given to new invaders and species having the greatest risk of spread.

This alternative provides for the maximum use of integrated pest management methods. This alternative provides for treatment of 1,500 net infested acres (approximately 14,000 managed gross acres) of noxious weeds, 60 net acres tall larkspur, and 5 net acres for infrastructure maintenance (i.e., paved road shoulder maintenance). See Chapter 2 for specific proposed action. Historic funding levels have allowed for about 600 – 1,200 acres of treatment. A majority of the current weed sites are less than one tenth acre in size and still very manageable. Treating the small satellite populations and keeping those priority weeds in "check" will limit spread into new areas.

Efforts to utilize the most selective herbicide would be considered. This alternative provides for the use of a wide variety of herbicides that have a wide range of plant selectivity. Glyphosate and Diuron is the least selective, affecting most plant species. Clopyralid is the most selective herbicide, affecting only plants in the sunflower (Compositeae), buckwheat (Polygonaceae), nightshade (Solanaceae), and pea (Fabaceae) families. Seven of the thirteen existing Custer Forest weed species are in these families. Dicamba, Picloram, and 2, 4-D-amine are less specific. Monocots (grasses, grass-like plants, lilies, orchids and related families) are tolerant of Dicamba because of rapid metabolism (Sheley and Petrof, 1999); however, when mixed with other herbicides, it may be more lethal to some broad-leaved monocots. Picloram and 2, 4-D appear to be effective on all species except grasses (Poaceae). Conifers have variable response to herbicides, but many are negatively affected by most herbicides.

Currently, all of the Custer National Forest weed species are broad-leaved species. Application rate and extent of coverage, either spot or broadcast, can affect what plant species are impacted by the herbicides. Many of the species can be protected through following label application limits and specified protection measures (see Appendix C). The timing of application and rotation of herbicides may also be important in limiting impacts to non-target native vegetation. This alternative provides for additional herbicide families to choose from that would not be used in Alternatives 2 and 3. Rotating between these family groups of herbicides that are selective in nature will significantly limit potential damage to non-target native plants. Impacts to native plant communities and rare plant species can be greatly reduced while still controlling the weeds on the site.

Aerial application will greatly increase the efficacy of the weed control program on the larger, more remote sites. Weed densities can be greatly reduced through broad scale treatments. Ground crews will have more time to focus on the smaller, scattered infestation, prior to the weeds increasing to the point where control efforts become overwhelming. Aerial treatment is a valuable tool in areas where weeds become established on the steeper slopes or where terrain is a safety concern.

Manual control of areas is anticipated to be less than 5 acres each year on sites that have very few plants, and/or where the plants have already established viable seed before herbicide treatment occurs. Manual methods are very labor intensive and generally effective only on weed species that do not have extensive root systems. For treatment to be effective the site needs to be checked multiple times during the growing season to prevent weeds from going to seed. The site must also be treated yearly until the weeds are eradicated. This method is primarily used where a few plants exist, and in sensitive areas such as adjacent to open water or high water table sites. It is also used where threatened, endangered or sensitive plants species are present and other control methods would harm the rare species.

The biological control program on the Custer National Forest would be expanded to include new sites, when necessary, as a secondary form of control. The effectiveness of other control measures would limit the need for focusing much attention on the use of biological control agents. Coordination with Animal

Plant Health Inspection Service (APHIS) and other affiliations to release and monitor current and new control agents would occur. Use of biological control agents would be focused on sites outlined in Appendix E. The nature of biological control agents is to reduce density and seed production of the target weed, not necessarily to contain or eradicate the species. Multiple biological control agents that work on different parts of the plant tend to be more successful than relying on a single agent. Two weed species, leafy spurge and musk thistle, have biological control agents that are showing promising results in reducing plant density and coverage. A pathogen for houndstongue, not yet available, is looking very promising as an effective control agent.

Cultural control would also be encouraged in cheatgrass (*Bromus techtorum*) communities to encourage re-establishment of native bunchgrass communities. Removing unwanted weeds would involve herbicidal control, possibly seedbed preparation, and seeding.

Kentucky bluegrass, timothy grass, crested wheatgrass, or smooth brome communities are currently considered economically unfeasible to convert back to native communities through cultural methods. However, these communities would be encouraged to be converted back to native systems as native seed sources or techniques become economically feasible.

Under this alternative, various pest management practices such as mowing, pulling, biological control and herbicide treatment would be used in combination to control, contain and/or eradicate populations of invader species. The most effective means for control and/or eradication would be chosen depending on the species and site conditions. See Appendices F and J for treatment effectiveness by species. Also, different approaches would be considered for the different categories of invader species. Key to the effectiveness of this strategy will be knowledge of the distribution and abundance of invaders. See Appendix E for treatment priority criteria.

**Category 1 Species -** Because most of these species exist in extensive, widespread infestations, a great deal of resources would be required to reduce or eradicate populations. For especially hardy species with extensive root systems, eradication of large infestations could prove to be impossible since we do not have the tools or technology to effectively kill all plant parts and prevent re-growth (Sheley and Petroff 1999). Therefore, the key management approach with these species is to control and contain existing populations (keep them from spreading into uninfested areas) and to eradicate new populations in uninfested areas. The IPM approach is to prevent Category 1 species from spreading beyond current infestations. Therefore, Category 1 invaders would not necessarily be eliminated, but infestation spread into uninfested native plant communities would be reduced under this alternative.

**Category 2 Species** - Some infestations of Category 2 species are relatively large, yet they are still geographically limited to only a portion of the Custer National Forest. For this reason containment is the primary goal. If contained, many of these Category 2 species can be eradicated if acted upon immediately thus preventing these new invaders from affecting native plant communities. If eradication is not possible, then control and containment is the goal to at least limit the impacts these species would have on the native ecosystem. Category 2 invaders should therefore be prevented from infesting new areas, and should be eliminated in some existing populations, while the remainder would be contained under this alternative.

**Category 3 Species** - These invaders are the highest priority for control. The discovery of any new populations would prompt immediate eradication action using the most efficient IPM approach. No populations of Category 3 invaders would be allowed to persist under this alternative.

## WEED SPECIES, DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 2 (NO HERBICIDE)

This alternative does not rely on herbicides for controlling weed infestations. Manual, cultural, and biological control methods would be used to control weeds on the Custer National Forest. Only about 10% of the current weed infestations could be treated under this alternative. This alternative would result in 1,340 net infested acres not being treated for the following reasons: (1) there is not an approved biological control agent or very limited effectiveness; (2) the weed patch is too large and can not be hand pulled because of lack of resources; and/or (3) the plant spreads via roots and extensive soil disturbance is not acceptable.

Manual methods of control are very labor intensive and generally effective only on weed species that do not have extensive root systems. Biological control agents would be the primary method used and this tool has had very limited effect on controlling the density of most weed species. At the present time, the Forest has found leafy spurge flea beetle effective in reducing the spurge density on some dry sites. Other biological control agents released on adjacent Forests have not made a noticeable change in weed density. In the future as biological control agents become more abundant and other insects become available, then this may become a more effective tool. Manual methods can be effective in localized sites. However, even with the relatively small amount of weed infestations on the Custer National Forest it is impossible to make any meaningful control effort by the use of manual methods.

Pulling can be effective on new infestations or very small sites with a low plant density. For treatment to be effective the site needs to be checked multiple times during the growing season to prevent the weeds from going to seed. The site must also be treated yearly until the weed is eradicated. Pulling would kill the individual plants that are removed so long as the entire root is taken. Pulling is not effective on species with extensive root systems, like those of leafy spurge or Canada thistle.

Mowing or use of a weed whacker can be used to prevent weed species from going to seed. This is a very long-term control method. If you can keep the weed from producing seed eventually the individual plants may die out. Again this is only for species that reproduce primarily by seed. Weeds with extensive root systems would not be affected. In fact many such species are stimulated to increase their root systems when their tops are cut. Control by mowing is similar to pulling; the site must be retreated multiple times during the growing season to prevent the plant from producing any seeds. The site also must be treated each year or the benefit of the previous year's treatment is lost.

A variety of biological control agents are present on the Custer National Forest. Coordination with Animal Plant Health Inspection Service (APHIS) to release and monitor current and new control agents will continue. Use of biological control is the primary focus for weed control under this alternative. The nature of biological control agents is to reduce the density and seed production of the target weed, not to contain or eradicate the species. At this time most biological agents have not shown significant effects on the majority of weed species. Two weed species, leafy spurge and musk thistle, do have biological agents that are showing promising results in reducing plant density and coverage. Currently no biological control agent has shown an ability to control or reduce the spread of any Custer National Forest weed species.

This alternative provides for 155 acres of treatment with biological agents. Biological control agents could be released on all weed infestations where appropriate, but until such time as they become effective at reducing the density and spread of these weeds no effective control is expected. The risk of weeds taking over a majority of the sites depicted in Chapter 3, Table 3 - 7 becomes more probable.

The threat of herbicides impacting native plant communities is far exceeded by weeds displacing plants under this alternative.

Since the late 1800s, exotic plant species have been spreading across the Pacific Northwest. It is clear when studying distribution records of exotic plant species over time that the number is increasing and that all expand their range once they are established (Rice 1999). In studying these records it is apparent that more species have invaded over time and that all species have increased their range. Based on these historic trends, we expect that these patterns of expansion will continue due to transport of seeds from increasing intercontinental travel and trade, and through continued disturbance on all lands (through agricultural, residential, recreational and commercial developments).

The CNF is no exception to the trend of increasing travel. Recreational and commercial use on the CNF allows the transport of seeds onto sites that are favorable for establishment. Due to the adjacent land ownership patterns within and around the CNF boundaries, weed infestations are likely to continue spreading from non-CNF lands. The number of invader species and their distribution on the CNF will, therefore, only increase if limited action is taken to prevent their introduction or to control their spread.

**Category 1 Species** - Although Category 1 species are already widely distributed on the CNF outside the Absaroka-Beartooth Wilderness, there are still many uninfested areas. Based on past trends of these species, it is reasonable to assume that without some increased methods of control, these areas will

become invaded in the near future, as well. Also, where the density of invaders is currently low infestations will likely increase. The areas identified in the risk assessment for Category 1 species are where these changes are expected to occur. Under the no-action alternative, some treatments would still include using biological control agents, mechanical measures such as hand pulling and mowing, and limited application of herbicides. However, given the widespread nature of species in this category, these measures alone without the increased use of herbicides will have little effect on preventing the introduction and further spread into uninfested areas.

**Category 2 Species** - These species are the most likely to significantly expand to new areas on the CNF in the immediate future if no increased action is taken to control or eradicate populations. This is because these species have already infested a portion of the Forest, and are currently escalating. Some of these Category 2 species have shown highly aggressive tendencies like Salt Cedar that has been found on the Ashland District and is adjacent to the Beartooth District.

**Category 3 Species** – Common crupina has been documented as occurring on the Sioux Ranger District. Species in this category are some of the most highly aggressive exotics known, and are rapidly spreading in our direction. Once these species are established on the CNF, it is expected that they would move rapidly and likely infest areas identified at risk if no action were taken to eradicate new populations.

Measures that do not involve the use of herbicides may prove effective with some newly discovered populations of Category 3 species, particularly if found when infestations are still very small. For others, where non-herbicide control measures have proven to be ineffective, their spread would likely continue.

## WEED SPECIES, DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 3 (NO CHANGE FROM CURRENT MANAGEMENT)

This alternative is the same as current management practices covered by previous NEPA decisions. No additional herbicide treatment would occur outside of those areas identified in the 1987 Custer National Forest Noxious Weeds Control EIS and the 1987 West Fork Rock Creek EA. Alternative 3 would allow treatment of noxious weed species on known infestations (1455 acres) outside of the wilderness using only four herbicides (2, 4-D, picloram, dicamba, and glyphosate). This alternative also allows for manual, cultural, and bioagent treatments. This alternative would not treat infestations within the AB Wilderness Area (about 45 acres) with herbicides because it was not analyzed in the previous environmental analysis. Aerial treatments would not be done under this alternative. Rapid spread of weeds on those sites not previously approved for treatment would occur.

## WEED SPECIES, CUMULATIVE EFFECTS

Invasive weeds are an ongoing battle, especially where eradication is not likely. The odds of having an effective eradication program improve drastically with treating weeds before they become established through seed reserves and/or extensive root networks. The adaptive management approach as designed in Alternative 1 best provides for early detection and eradication.

Biological control is a slow and long-term process, especially in Alternative 2 where it is the primary form of control. While biological control agents have not successfully eradicated any one species on the Custer Forest they have softened the impacts for some species such as leafy spurge.

Alternative 1 would add to efforts ongoing by adjacent counties and ownerships to control weeds surrounding the Custer National Forest. Other landowners, including private and corporate owners, State, and others would benefit from reduced weed populations on the Custer Forest. Actions under these alternatives would allow the Custer Forest to work closer with surrounding landowners, counties, and other land management agencies to be more effective at controlling and containing weed infestations.

Under Alternatives 2 and 3, since the effectiveness of the weed control will be reduced, adjacent land owners will see an increase in weeds spreading from the Forest lands onto their lands over time.

## NATIVE PLANT COMMUNITIES, DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 1 (PROPOSED ACTION)

There is little doubt that measures taken to control weeds will kill some non-target, native plant species. It is important to note that although most weed control activities may kill some individual native plants, the action would be intended to prevent the far greater loss of species diversity and ecosystem processes resulting from further uncontrolled weed infestations. Impacts to plant communities are reduced when control actions are taken at an early stage of invasion. Affects on plant communities increase as weed infestations expand in size and density. The increased impacts come not just from the weeds but also from the control measures. When treatments must be broadcast across an entire area and not specifically focused on the target plant, control measures have a greater potential for negative impacts. This is true for manual, biological, and herbicide treatment methods.

Just as changes in plant diversity or species composition can occur due to invasive plants, changes can also occur due to treatments. Short-term changes in species dominance can lead to long-term shifts in plant community composition and structure. Repeated treatments over time could favor tolerant species, which in turn could shift pollinators available to a community.

DiTomaso (2001) points out that continuous broadcast use of one or a combination of herbicides will often select for tolerant plant species. When broadleaf selective herbicides are used, noxious annual grasses such as cheatgrass may become dominant. Population shifts through repeated use of a single herbicide may also reduce plant diversity and cause nutrient changes. For example, legume species are important components of rangelands, pastures, and wildlands, and are nearly as sensitive to clopyralid as yellow starthistle. Repeated clopyralid use over multiple years may have a long-term detrimental effect on legume populations. Thus, a variety of integrated treatments would most likely avoid adverse impacts to native plant diversity.

Kennedy et al. (1999) summarized studies related to biodiversity and ecosystem functioning. Recent theoretical models predict that decreasing plant diversity leads to lower plant productivity. These models also showed diversity and composition are equally important determinants of ecosystem functioning. Maintaining biodiversity is often one of the primary goals of ecosystem management. Reductions in diversity may destabilize trophic dynamics, alter wildlife populations and change nutrient cycles or decomposition rates (Alpert, et. al., 1997).

Conifer forests are susceptible to changes in ectomycorrhizal fungi. Ubiquitous in most forests, their complex network of fungal hyphae increase the effective rooting area of host trees, often leading to improved nutrient uptake, seedling survival, and growth (Busse et al, 2004). Adverse effects on ectomychorrhizal fungi and on edible mushrooms from herbicide use have not been demonstrated in laboratory studies (ibid.).

Pulling target weeds has little effect on native vegetation. This is due primarily to the very limited area that can be effectively treated by this method and the fact that you are pulling just the target plant. Pulling may affect adjacent plant species due to soil disturbance when removing the entire root system. Significant soil disturbance is rare and generally only seen where weed densities are very high. Mowing may reduce the vigor and reproductive ability of native plant species, which are mixed in with target weeds. As the goal of mowing is to prevent weed species from producing viable seed, timing of the treatment can be used to reduce the impacts to native species. For either of these methods the extent of their use is very limited and the proportion of native plant populations affected would be very small.

Biological control agents are rigorously selected and screened to prevent impacts to non-target species. Not all native species are tested for each new agent. A few biological control agents released prior to the current, more stringent screening protocols, have been found to feed on native plant species. Their impacts have not fully been evaluated. In general, biological control agents are useful in native plant communities because they avoid other non-target vegetation. The Custer National Forest will rely on the updated screening process being followed for biological control agents. None-the-less, because of the remote possibility of effects to native plant species from biological control agents, the Forest will review decisions to release new agents on the Forest.

Use of herbicides has the highest potential to impact native plant communities. Herbicide use will kill non-target plants. The degree of mortality of native species depends on the herbicide used, and the application method, and rate and frequency. As discussed earlier, the herbicides to be used range in their effects on plant species. Clopyralid is one of the most selective and glyphosate is a non-selective herbicide that will kill most plant species including grasses.

Of the proposed application methods, aerial application is most likely to affect non-target native plants. This is because this method indiscriminately applies herbicide to all plants in the treatment area. Also, drift can affect plants outside the treatment area. However, protection measures would be taken to minimize drift. Spot applications with backpack sprayers, truck mounted sprayers or wick applicators focus the herbicide on the target weeds with limited treatment to adjacent non-target vegetation. These methods would affect native species the least.

Under this alternative, Integrated Pest Management strategy methods that would be most effective on controlling invaders, while minimizing impacts on native species would be used. This approach would help decrease the effects of herbicide use. In addition, as only a small portion of the overall infested areas would be treated, the impacts to common native plants are insignificant as they relate to species abundance, distribution, and population viability on the Custer National Forest. Relative speaking, this alternative has the best odds of keeping those potential areas identified in at high risk from becoming weed infested.

This alternative will, in the short term, affect more native plants due to the broadcast application of herbicides by aerial application than the other alternatives. In the long tern this alternative will protect more native plants and plant communities because of the same actions. Being able to treat a large number of infested acres will greatly improve the probability of controlling many of the weed species currently found on the Forest.

## NATIVE PLANT COMMUNITIES, DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 2 (NO HERBICIDE)

Under this alternative, approximately 45% percent or roughly 550,000 acres of the Custer National Forest is naturally susceptible or at high risk to weed invasion in the project area at a much higher rate than if treated under an integrated pest management approach which utilizes herbicides. All native plant community values are at a much higher risk of being de-valued under this alternative. This includes values such as wildlife habitat, ungulate forage, viewsheds for and recreational experience in wild and scenic rivers, wilderness and roadless areas, fire regimes, and ecosystem health and integrity.

The negative affects of weed species introduction have been well documented. A review of the many effects that invasive species impose on native plant and animal communities can be found in Sheley and Petroff (1999). In brief, exotic plant species can decrease plant diversity, structure and function in native plant communities by out competing native species for available resources. Exotics have also been known to displace rare plant species (Thompson *et al*., 1987; Lesica and Shelly, 1996). Some invaders release secondary compounds or allelopathogens that can affect the establishment of native plant species. In addition, some believe that there are situations where the invasion of exotic species is second only to habitat destruction as the most important threat to biodiversity.

These changes in native species composition and structure can have severe impacts on wildlife populations by altering forage availability, reducing cover and eliminating breeding sites. These effects may be felt from invertebrates and soil microbes to the largest ungulate, which depend on native plants for forage.

Invasive weeds can decrease organic matter content and nutrient availability in soils and can increase soil erosion and infiltration. Some species can even increase the salinity of the soil.

Plant communities altered by invasion will not respond to historical disturbance regimes such as fire, insect and pathogens and wind and storm events as they once did. As noted earlier, we conducted a risk assessment on the Custer National Forest, which showed the vulnerability of lands subject to invasion of weeds. The analysis shows about 45% percent or 550,000 acres of the Forest at high risk to weed

infestations. This is a significant portion of the land base. Furthermore, this acreage is not distributed evenly among the vegetation types. The higher elevation moist forest types are the least vulnerable to invasion, yet every acre of the low elevation non-forested communities is at risk. Although there are less acres of non-forest communities than forested, they comprise some of the more unique, species rich communities next to riparian and wetlands. Once converted, these habitats may never be restored to their original condition.

This is not to say that the forest types would not be at significant risk as well. Early successional stages of forest community, those that are most vulnerable to invasion, could be altered to where early forest succession could be impacted. Tree seedlings may have difficulty becoming established, which in turn may alter the future composition and vegetative structure of the forest. These changes in early and mid-serial vegetative structure also affect the frequency and intensity of nature disturbance processes, such as fire and insect infestations.

With Alternative 2 there will be an increase of weed spread, and the consequences described above will occur on the lands identified at risk.

## NATIVE PLANT COMMUNITIES, DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 3 (NO CHANGE FROM CURRENT MANAGEMENT)

Direct and indirect effects of this alternative are similar to Alternative 1 for the previously approved for treatment. The primary difference is all herbicide treatments would be restricted to ground based application. No aerial application of herbicide would be allowed. No herbicide treatment would occur in the AB Wilderness Area. In addition, the only herbicides that would be available for use would be picloram, 2, 4-D, dicamba, and glyphosate. Restricting the use of herbicides would eliminate the option of rotating herbicides due to one of the two options being non-selective.

This alternative would impact fewer native plant species or communities by the application of herbicides. This is because aerial herbicide application would not be allowed. The number of acres that can be treated by ground-based application is limited in extent, due to terrain, personnel, and time constrains. Impacts to native plant communities will come more from the continued spread of weed species than the loss of non-target plants to herbicides. Relatively speaking, this alternative protects the native plant communities better that Alternative 2 but not as good as Alternative 1.

## NATIVE PLANT COMMUNITIES, CUMULATIVE EFFECTS

In addition to the native species that would possibly be impacted under Alternatives 1 and 3, other ongoing actions such as timber harvest, grazing, recreational use, mining and harvest of alternative forest products would also kill native plants. Although non-target plants will be affected from the use of herbicides, there is far greater potential loss of these native species and their habitats if nothing is done

With Alternatives 2 and 3 the trend of increasing infestations on the Custer National Forest are likely to also occur on adjacent private lands used for agriculture, lawns, and commercially developed. These alternatives would compound this problem by making greater acreage on public land available for invasion. Although most infestations do not originate on the Custer National Forest, there are cases where invasions originate on Forest lands and could potentially move out to invade private lands. In many cases, if the Forest Service fails to actively treat weeds then adjacent landowners will do the same.

The same trends of increasing infestation that we expect to occur on CNF lands are even more likely to occur in adjacent private lands. Much more so than public lands, private lands are often converted to agriculture, lawns, golf courses, grazed, pastured, and developed commercially. These are generally the types of sites where invader species are most successful. The no-action alternative would compound this problem by making greater acreage available for invasion. Although most infestations originate from off the CNF and move onto Forest lands, there are cases where invasion originates on Forest lands and could potentially move out to invade private lands.

It is anticipated that there will be new areas disturbed and at risk from weed invasion as a result of fire, and future timber harvest activities on the CNF. The CNF Forest Plan allows for an annual timber harvest of about 3 million board feet of timber. In recent years approximately 3 million board feet have been harvested. It is impossible to reasonably predict future timber harvest levels, but levels would likely be at or less than the allowable sale quantity. Newly harvested areas would be expected to be at some risk for new weed infestation, although the prevention features of this alternative as described in Chapter 2 would reduce the risk. Some of the new harvest areas would be in those vegetation types that are at low risk to weed invasion.

As time passes, acreage harvested since the 1970s will become less susceptible to weed invasion as closed canopy conditions develop. Most weeds found on the CNF do not survive well in closed canopy conditions; with the exception of those on the more open Douglas fir and Ponderosa Pine cover types.

Fewer acres will likely be at risk as a result of post-timber harvest activities in future years. Silvicultural post-harvest treatments used today and predicted for the near future expose far less bare soil than in the past, creating less ground disturbance susceptible to weed invasion.

Travel and recreation are likely to increase in the surrounding lands, which will likely increase the potential for invader weeds to spread both on and off Forest.

## *HUMAN HEALTH*

This issue addresses the concern that weed control may have a detrimental impact on human health. More specifically, the impacts that herbicides (both ground and aerial spraying), mechanical control (i.e. mowing, hand or tool grubbing), seeding, biological, grazing, and burning may have on human health.

### FACTORS AFFECTING HAZARDS ASSOCIATED WITH HERBICIDE

#### Method of Application

How herbicides are applied can have a direct impact on the potential for human health effects. According to the SERA (2003-2004) herbicide risk assessments herbicides applicators are at a higher risk than the general public from herbicide use. Risks associated with backpack, boom, and aerial application of herbicides were estimated to be the highest, due to workers receiving repeated exposures that may remain on the worker's skin for an extended time period.

#### Length of Exposure

The magnitude of a dose that is hazardous to health depends on whether a single dose is given all at once (acute exposure), multiple doses are given over longer periods (chronic exposure), or regularly repeated doses or exposures over periods ranging form several days to months (sub-chronic). The EPA develops reference doses, which are an estimate of a daily dose over a 70-year life span that a human can receive without an appreciable risk of deleterious effects (US EPA, 1989). Reference doses include a "safety factor" where the No Observed Adverse Effect Level (NOAEL) is divided by a factor, usually 100, to account for uncertainty and hypersensitive individuals. The 100-value is derived by including a safety margin of 10 for extrapolating study results from mammals to humans, and an additional safety factor of 10 for variation in population response to a particular compound.

The reference dose is a conservative threshold of toxicity relative to this analysis because it assumes daily exposure over a 70-year life span. Actual worker exposure for herbicide treatments in this project would typically be between 20 to 80 days each year for substantially less than 70 years. The reference dose is also calculated from the NOAEL, assuming humans are 100 times more sensitive than animals to the chemical tests.

### Route of Exposure

Substances tested for acute toxicity are usually administered by pumping a chemical down a tube into an animal's stomach. From this route of exposure, an oral $LD_{50}$ (lethal dose that kills 50 percent of a test population, measured in one milligram of herbicide per kilogram of animal weight) can be estimated. Exposure during chronic testing usually involves placing the chemical in the animal's food, and then measuring the amount of food eaten during each 24-hour period (US EPA, 1996a, b).

Test substances are also applied to the shaved skin of an animal to estimate a dermal $LD_{50.}$ About 10 percent of the animal's body surface is exposed to a chemical covered by a patch for 24 hours. In acute exposure studies, whether by oral or dermal routes, animals are monitored for range of adverse responses for 14 days following dosing (US EPA, 1996c).

Skin acts as a protective barrier to limit and slow down movement of a chemical into the body. Studies of pesticides applied to the skin of humans indicate that for many people, only about 10 percent or less passes into the blood. In contrast, adsorption of chemicals from the small intestine is quicker and more complete than from the skin (Ross et al., 2000).

Required personal protective equipment used by workers during herbicide application (gloves, waterproof boots, long sleeved shirts and pants) is designed to reduce exposure to sensitive areas on the body. Use of personal protective equipment as required by the Forest Service job hazard analysis would protect worker health.

### Herbicide Toxicity – Risk Assessment

Pesticides are not risk-free. The reason EPA allows the use of products with the potential to cause toxicity is that, "when used according to label instructions"; the risks of the pesticide are outweighed by the benefits. Reading and following instructions on labels is the best way to insure personal safety.

The role of risk assessment is to determine if a pesticide is safe for users and the general population when handled and used as prescribed by its label. If not clearly safe, then the process also addresses the question as to whether changes can be made to meet the standards for safety.

The core risk assessment process comprises of the following steps:

- • Hazard identification and Dose-response assessment
- • Exposure assessment
- • Risk characterization

### Hazard Identification and Dose-Response

Hazard identification requires a clear understanding of the chemical's toxic properties, particularly the adverse effects seen after conducting both short- (acute) and long-term (chronic) studies in laboratory animals per EPA standards. Well conducted multi-level feeding studies disclose if, and at what level, changes will occur in each organ of each test species and the nature of any change.

The dose-response assessment is the step that establishes the pattern of affects demonstrated by a pesticide when administered at different dose levels. In acute studies several dose levels are administered and lethality and other effects are monitored. In contrast, among the three or four feeding levels given in chronic studies the highest level(s) must cause clear adverse affects, but not death. Regulators require testing at this level in studies to evaluate carcinogenicity.

The highest pesticide dose that does not cause any observable harm or side effects to experimental animals is known as the No Observable Effect Level (NOEL). The NOEL is typically divided by a safety factor of 100 to I000 to obtain what EPA calls the Reference Dose (RfD). The safety factor is designed to protect sensitive portions of the population and to correct for genetic or species differences due to the extrapolation to humans from animal studies. The RfD is the toxicity level normally used to estimate a level of exposure at or below which no adverse effect is expected to occur even if the agent is ingested daily over an entire lifetime.

Acute toxicity can be a function of the amount of toxicant received, the route of administration, and the type of animal tested. Acute reactions tested include: oral, dermal, and inhalation toxicity; acute delayed neurotoxicity; eye and dermal irritation; and dermal allergic sensitization. Table 4 - 3 identifies the toxicity categories used by the EPA for various types of harmful, acute reactions. Table 4 - 4 displays acute reactions, of the proposed herbicides, in terms of a Signal Word, which is identified in Table 4 - 3.

### TABLE 4 - 3. TOXICITY CATEGORIES FOR HARMFUL, ACUTE REACTIONS

| Toxicity Category | Signal Word | Oral (mg/kg) | Dermal (mg/kg) | Inhalation (mg/kg) | Eye Irritation | Skin Irritation |
|---|---|---|---|---|---|---|
| I | DANGER Poison | 0-50 | 0-200 | 0-0.2 | Corrosive: corneal opacity **not** reversible within 7 days. | Corrosive |
| II | WARNING | >50-500 | >200-2000 | >0.2-2.0 | Corneal opacity reversible within 7 days; irritation persisting for 7 days | Sever irritation at 72 hours |
| III | CAUTION | >500-5000 | >2000-20,000 | >2.0-20 | No Corneal opacity; irritation reversible within 7 days | Moderate irritation at 72 hours |
| IV | NONE | >5000 | >20,000 | >20 | No Irritation | Mild irritation at 72 hours |

### TABLE 4 - 4. HUMAN HAZARDS BASED ON ACUTE TOXICITY CATEGORIES[2]

| Herbicide | Acute Oral Toxicity | Acute Dermal Toxicity | Acute Inhalation | Primary Eye Irritation | Primary Skin Irritation |
|---|---|---|---|---|---|
| 2,4-D Amine | Caution | Caution | Caution | Danger-Poison | Caution |
| 2,4-D Ester | Caution | Caution | Caution | None | Caution |
| Aminopyralid | None | None | None | None | None |
| Clopyralid | Caution | Caution | Caution | Warning | None |
| Chlorsulfuron | None | Caution | Caution | Caution | None |
| Dicamba | Caution | None | None | Danger-Poison | None |
| Diuron | Caution | Caution | None | Caution | None |
| Glysophate | None | None | Caution | Warning | None |
| Hexazinone | Caution | None | None | Danger-Poison | None |
| Imazapic | None | Caution | None | None | Caution |
| Imazapyr | None | Caution | Caution | Caution | Caution |
| Metsulfuron Methyl | None | Caution | Caution | Warning | Caution |
| Picloram | Caution | Caution | None | Caution | None |
| Sulfometuron Methyl | Caution | Caution | Caution | None | None |
| Triclopyr | Caution | Caution | Caution | Caution/Danger | Caution |

Chronic toxicity results from prolonged, repeated, or continuous exposure to a chemical, typically at levels lower than necessary to cause acute toxicity. It often demonstrates a delayed response. Public concerns toward herbicides generally focus on potential chronic toxicity. Sublethal poisoning or exposure may be expressed by any of the following: skin/eye irritation; nervous system disorders; reproduction system disorders; damage to other organ systems (liver, kidney, lungs, etc.); birth defects; mutations; and cancer.

The EPA evaluates carcinogenicity (cancer), teratology (birth defects), reproductive, and mutagenicity (gene mutation) study results of herbicide effects to animals during the herbicide registration and re-registration processes. The study data is used to make inferences relative to human health. From these studies, chronic toxicity of herbicides proposed for use on the Custer National Forest is summarized in Table 4-5.

[2] Forest Service by SERA 1999-2004 at http://www.fs.fed.us/foresthealth/pesticide.shtml, EXTOXNET at http://extoxnet.orst.edu/, Pesticide Information Profiles, Oregon State University, EPA 9/2003, and EPA, 2005.

## TABLE 4 - 5. CHRONIC TOXICITY SUMMARY[3]

| Herbicide Active Ingredient and Chronic Reference Dose | Potential Chronic Effects | | | |
|---|---|---|---|---|
| | Carcinogenic (Cancer) | Teratogenic (Birth Defects) | Reproductive | Mutagenic (Gene Mutation) |
| 2, 4-D (Dichlorophenoxyacetic acid)<br><br>Chronic RfD 0.01 mg/kg/day | EPA re-registration concluded that 2, 4–D is a Group D chemical which is not classifiable as to human carcinogenicity. (EPA Re-registration 2005) | Malformations are likely to occur only at doses that are fetotoxic or maternally toxic. 2,4-D is not teratogenic. (SERA Page 3-13 and EPA Re-registration 2005) | 2,4-D may be subject to additional screening and/or testing to better characterize effects related to endocrine disruption. (EPA Re-registration 2005) | Based on the overall pattern of responses observed in both *in vitro* and *in vivo* genotoxicity tests, 2,4-D is not mutagenic. (EPA Re-registration 2005) |
| Aminopyralid<br><br>Chronic RfD 0.5 mg/kg/day | Aminopyralid is classified as "not likely to be carcinogenic to humans" based on the lack of evidence for carcinogenicity in mice and rats. (EPA 8/10/2005) | There is no quantitative or qualitative evidence of increased susceptibility of developmental toxicity studies. (EPA 8/10/2005) | There is no quantitative or qualitative evidence of increased susceptibility following pre-post-natal exposure. (EPA 8/10/2005) | There is no quantitative or qualitative evidence of increased susceptibility following pre- /post-natal exposure. (EPA 8/10/2005) |
| Chlorsulfuron<br><br>Chronic RfD 0.02 mg/kg/day | No evidence of carcinogenic activity was found in any of the chronic toxicity studies conducted on chlorsulfuron. (SERA Page 3-7) | Chlorsulfuron is not teratogenic, but is embryo toxic at high exposure levels. (SERA Page 3-6) | Does not appear to have significant adverse effects on reproductive function. (SERA Page 3-6) | Not mutagenic, either with or without metabolic activation. (SERA Page 3-7) |
| Clopyralid Methyl<br><br>Chronic RfD 0.15 mg/kg/day | Studies in rats, mice and dogs revealed no evidence of carcinogenic activity has been detected. (SERA Page 3-6) | At doses that cause no signs of maternal toxicity (i.e., doses below about 100 mg/kg/day) no teratogenic effects are apparent. (SERA Page 3-6) | At doses that cause no signs of maternal toxicity (i.e., doses below about 100 mg/kg/day) no reproductive effects are apparent. (SERA Page 3-6) | Clopyralid was found to be is inactive in three different standard bioassays of mutagenicity. (SERA Page 3-6) |
| Dicamba<br><br>Chronic RfD 0.03 mg/kg/day | There are no epidemiology studies or case reports that demonstrate or suggest that exposure to dicamba leads to cancer in humans. (SERA Page 3-9) | Pregnant rats and rabbits indicated no evidence of birth defects. (SERA Page 3-9) | Three multi-generational studies of rats produced no adverse effects on reproduction with doses up to 25 mg/kg/day. (SERA Page 3-9) | Negative in tests for genetic damage. (SERA Page 3-10) |
| Diuron<br><br>Chronic RfD 0.003 mg/kg/day | The Carcinogenicity Peer Review Committee (CPRC) characterized diuron as a "known/likely" human carcinogen, based on urinary bladder carcinomas in rats. (EPA Re-registration EPA 9/30/2003 p. 11) | There is no indication of increased susceptibility to young exposed to diuron in the available studies. In the developmental toxicity study in rabbits, there were no developmental effects at the highest dose tested. (EPA Re-registration EPA 9/30/2003 p. 11) | It is unlikely that diuron will cause reproductive effects in humans at expected levels of exposure. (EPA Re-registration EPA 9/30/2003 p. 12) | Diuron is not mutagenic. Tests have shown that diuron does not produce mutations in animal cells or in bacterial cells. (EPA Re-registration EPA 9/30/2003 p. 11) |
| Glysophate<br><br>Chronic RfD 2mg/kg/day | EPA classified as evidence of non-carcinogenicity for humans. (SERA Page 3-16) | Pregnant rats (up to 3,500 mg/kg/day) and rabbits (up to 350 mg/kg/day) indicated no evidence of birth defects. (SERA Page 3-13) | Multi-generational studies of rats, no adverse effects on fertility or reproduction with doses up to 30 mg/kg/day. (SERA Page 3-13) | No in vivo studies using mammalian species or mammalian cell lines have reported mutagenic activity. (SERA Page 3-17) |
| Hexazinone | Study with rats found no tumors up to 125 mg/kg (highest dose | Pregnant rat study no evidence of birth defects at doses up to 100 | Three-generations of rat study found no evidence of reproductive effects, except | Three of four tests were negative. EPA concluded not a mutagen. (SERA Page |

[3] Page cites are to the individual herbicide reports completed for the Forest Service by SERA 1999, 2003-2004. Each report is located at http://www.fs.fed.us/foresthealth/pesticide.shtml. The Human Health Risk Assessment portion of each herbicide report is located in the Project Record. Other citations come from EPA findings 2003 and 2005.

| Herbicide Active Ingredient and Chronic Reference Dose | Potential Chronic Effects | | | |
|---|---|---|---|---|
| | Carcinogenic (Cancer) | Teratogenic (Birth Defects) | Reproductive | Mutagenic (Gene Mutation) |
| Chronic RfD 0.05 mg/kg/day | tested). EPA will re-evaluate mouse study. (SERA Page 3-4 to 3-5) | mg/kg/day; higher doses did have effects. EPA concludes not teratogen. (SERA Page 3-3) | decreased weight of pups at highest dose (125 mg/kg). EPA requested further information. (SERA Page 3-3) | 3-3) |
| Imazapic<br><br>RfD 0.05 mg/kg/day | EPA classified as not likely to be carcinogenic for humans. (SERA Page 3-5) | Two rat studies showed no signs of teratogenicity at the highest dose tested (i.e., 1000 mg/kg/day). (SERA Page 3-4) | Multi-generational rat study showed no indication of any effect on reproductive performance. (SERA Page 3-5) | Four assays produced negative results for mutagenicity. (SERA Page 3-5) |
| Imazapyr<br><br>Chronic RfD 2.5 mg/kg/day | EPA has categorized imazapyr as Class Evidence of non-carcinogenicity. (SERA Page 3-7) | Five studies show imazapyr does not cause adverse developmental effects. (SERA Page 3-6) | Five studies reveal that imazapyr does not cause adverse reproductive effects. (SERA Page 3-6) | Three studies have shown negative potential for potential mutagenic activity. (SERA Page 3-7) |
| Metsulfuron Methyl<br><br>Chronic RfD 0.25 mg/kg/day | EPA concluded that: “Metsulfuron methyl was not oncogenic in the chronic rat and mouse bioassays. (SERA Page 3-7) | EPA –“The results of a series of studies indicated that there were no teratogenic hazards associated with the use of metsulfuron methyl. (SERA Page 3-6) | EPA-“The results of a series of studies indicated that there were no reproductive, hazards associated with the use of metsulfuron methyl. (SERA Page 3-6) | EPA concluded that “Metsulfuron methyl was not mutagenic in the chronic rat and mouse bioassays. (SERA Page 3-7) |
| Picloram<br><br>Chronic RfD 0.2 mg/kg/day | EPA has categorized picloram as Group E (no evidence of carcinogenicity) based on the lack of carcinogenic activity in rats and mice. (SERA Page 3-8) | Signs of kidney damage were noted at 1000 mg/kg/day. (SERA Page 3-7) | No effects on reproductive performance in studies with 298 to 1,000 mg/kg/day doses. (SERA Page 3-7) | EPA- in reviewing mutagenicity assays determined that “No compelling evidence of a mutagenic effect in relevant biological systems was uncovered”. (SERA Page 3-7) |
| Sulfometuron Methyl<br><br>Chronic RfD 0.02 mg/kg/day | Four studies find that exposure to sulfometuron poses no carcinogenic risk to humans. (SERA Page 3-8) | The No Observable Adverse Effect Level for teratogenic effects is 300 mg/kg/day. (SERA Page 3-7) | No adverse effects on reproductive parameters were observed in rats exposed to dietary sulfometuron methyl at dietary concentrations up to 5000 ppm. (SERA Page 3-8) | Four studies show no mutagenic activity. (SERA Page 3-8) |
| Triclopyr<br><br>Chronic RfD 0.05 mg/kg/day | EPA classified as Group D chemical (not classifiable as to human carcinogenicity) because of marginal response in mice/rats, and the absence of additional support from structural analogs or genotoxicity. (SERA Page 3-9 & EPA Re-registration 1998) | Studies show that teratogenic effects occur only at doses that are maternally toxic. At doses which do not cause maternal toxicity, there is not apparent concern for teratogenic effects. (SERA Page 3-8) | Studies show that reproductive effects occur only at doses that are maternally toxic. At doses which do not cause maternal toxicity, there is not apparent concern for teratogenic effects. (SERA Page 3-8) | Negative in several tests, but weakly positive in a test in rats. (SERA Page 3-10) |

It is important to note that there is much uncertainty and controversy regarding chronic toxicity. For example, the risk analysis completed by EPA makes four primary assumptions: that a carcinogenic substance in animals will have similar potency in humans; that there is a linear relations between dose and carcinogenic response; that the slope of the dose response relationship at low doses can be derived from data at high doses; and it treats all carcinogens, regardless of the mechanism of action, in the same manner (Wilson, 2005). While these assumptions may be valid, they are not proven, and they show some of the complexity associated with risk analysis for chronic toxicity.

There is considerable information on sub-chronic and chronic effects due to exposure to herbicides in controlled animal studies. The information provided in Table 4 - 5 suggests that most the herbicides proposed for use by the Custer National Forest would not result in carcinogenic, mutagenic, teratogenic, neurological or reproductive effects based on anticipated exposure levels to worker and the public when applied under label direction. Table 4- 5, however, indicates that there is some possible concern associated with diuron related to potential carcinogenic effects. However, The EPA addressed these concerns during re-registration through the use of risk protection measures that were added to label direction. It was determined that diuron would not pose unreasonable risk of adverse effects to humans or the environment when used in accordance with labeling required by the 2003 EPA re-registration decision.

**Exposure Assessment**

Exposure assessment includes an estimate of people's potential exposure to a chemical at work, at home, or in their diets and covers periods from acute to lifetime exposures. Levels of exposure are determined by measuring pesticide residues in food, water, ambient air and occupational exposure to applicators and workers. The results of animal metabolism, absorption and elimination studies also are helpful in establishing human exposure levels to pesticides.

A Hazard Quotient (HQ) is the ratio between the estimated dose (the amount of herbicide received from a particular exposure scenario) and the Reference Dose (RfD). A RfD is a dose level determined to be safe by the EPA over a lifetime of daily exposure. When a predicted dose is less than the RfD, then the HQ (estimated dose/RfD) is less than 1, and toxic effects are unlikely for that specific herbicide application. A comparison of herbicide toxicity hazard quotients for workers and the general public, at typical levels of exposure, are shown in Tables 4 - 6 and 4 - 7. Hazard Quotients exceeding 1 are in bold text with a shadowed background.

## TABLE 4 - 6. HERBICIDE TOXICITY HAZARD QUOTIENTS FOR WORKERS[4]

| HERBICIDE | REFERENCE DOSE (RfD)[5] (mg/kg/day) | ACUTE / ACCIDENTAL EXPOSURE[6] | CHRONIC/ LONG TERM EXPOSURE | | |
|---|---|---|---|---|---|
| | Acute/Chronic | Hands, Gloves, Spills –Hands & Legs | Ground Spray (Backpack) | Broadcast Spray (Boom Spray) | Aerial Application |
| 2, 4-D (Dichlorophenoxyacetic acid) | .01/.01 | .1725 | **1.3125** | **2.24** | **1.47** |
| Chlorsulfuron | .25.02 | .00002 | .04 | .06 | .04 |
| Clopyralid | .75/.15 | .0008 | .03 | .05 | .03 |
| Dicamba | 0.1/.045 | .0130 | . 5833 | .9956 | |
| Glyphosate | 2/2 | .001 | .01 | .02 | .01 |
| Hexazinone | .05/.05 | **5.29** | **3.2** | **6.048** | **3.2** |
| Imazapic | .5/.5 | .1 | .003 | .001 | .003 |
| Imazapyr | 2.5/2.5 | .001 | .002 | .004 | .0003 |
| Metsulfuron methyl | .25/.25 | .000008 | .002 | .003 | .002 |
| Picloram | .2/.2 | .005 | .02 | .04 | .03 |
| Sulfometuron methyl | .87/02 | .00003 | .03 | .05 | .03 |
| Triclopyr | 1/.05 | .02 | .3 | .4 | .3 |

Aminopryalid and diuron acute and chronic worker exposure hazards were not shown as part of the above table and will be described narratively below:

**Aminopyralid[7]:** Based on aminopyralid's low toxicity profile, an acute Reference Dose (RfD) for the general population or any of the population sub-groups was not required by EPA.

Based on labeled uses, the occupational exposure is expected to be short- to intermediate-term and no long-term exposure is expected. The application of aminopyralid to control weeds in wheat, rangeland, pastures, non-cropland areas and natural recreation areas is recommended by using broadcast treatment with ground and aerial equipment on wheat and also hand-spray and spot treatments for all other uses.

Based on the available toxicological information, dermal exposures do not result in any adverse systemic effect; therefore, dermal exposures were not included into the estimation of occupational risk to workers. Short- and intermediate-term oral and inhalation exposures are being regulated based on the effects seen in the developmental rabbit toxicity study, which showed a NOAEL of 104 mg/kg/day.

The highest potential exposure was estimated to Mixer-Loaders working on aerial applications of 0.11 lb ae/A, for up to 1200 acres applied per day. The corresponding MOE is 40,000, greatly above the acceptable limit (MOE = 100) (EPA, 8/10/2005 Factsheet).

**Diuron[8]:** Occupational workers can be exposed to a pesticide through mixing, loading, and/or applying a pesticide, or re-entering treated sites. Occupational handlers of diuron include: workers in right-of-way areas or industrial sites, workers in agricultural environments, workers applying paints or stains, workers in ornamental fish and catfish production and workers applying diuron to ornamental plants and trees in nurseries.

According to EPA re-registration of diuron, it is not acutely toxic. No adverse effects attributed to a single exposure were identified in any available study.

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[4] Information for Table 4-6 was taken from SERA(2003-2004) Risk Assessment herbicide worksheets located on the world wide web at http://www.fs.fed.us/foresthealth/pesticide/risk.shtml. Copies of the relevant worksheets are located in the Project Record.
[5] RfDs are set by the EPA.
[6] [1]Typical acute exposure is modeled for four different situations i.e. immersion of hands for duration of one minute, contaminated gloves, spills on hands, and spills on lower leg. The last three are all for a duration of one hour. The value identified in the table is for the category with the highest hazard quotient of the four categories.
[7] EPA, 8/10/2005.
[8] EPA, 9/30/2003

In general, the EPA is concerned when occupational cancer risk estimates exceed 1 x 10-4. The EPA will seek ways to mitigate the risks, to the extent that it is practical and economically feasible, to lower the risks to 1 x 10-6 (one in a million) or less. Five of the assessed scenarios have cancer risks greater than 1 x 10-4 at the highest feasible level of mitigation (private farmer/commercial applicator, typical/max rate) and are of concern by EPA. Twenty-six of the scenarios have cancer risks between 1 x 10-4 and 1 x 10-6 at the highest feasible level of mitigation (private farmer/commercial applicator, typical/max rate).

For occupational cancer risks between 1x10-6 and 1x10-4, EPA carefully evaluates exposure scenarios to seek cost effective ways to reduce cancer risks to the greatest extent feasible, preferably to a risk of 1x10-6 or less. For the scenarios assessed during re-registration, EPA determined that the use of personal protective equipment (PPE) or engineering controls (e.g., closed mixing and loading systems) would further reduce exposure to handlers but for some scenarios, such as mixing/loading and applying with a backpack sprayer, and applying with a rights-of- way sprayer, engineering controls are not available. For other scenarios, such as applying granular formulations with a tractor-drawn spreader, some engineering controls may be available but they are not universally used for this type of application. The EPA encourages the use of engineering controls, in all settings where practical and feasible, and allows for handlers to reduce PPE when engineering controls are used. However, EPA concludes that the risk reduction potential of requiring engineering controls for additional scenarios would not be commensurate with the costs and difficulties associated with implementing the requirement. To address cancer risks to occupational handlers, the registrant has agreed to the several protection measures, which are necessary, reasonable, and cost-effective and are included on the new label.

The EPA re-registration diuron post-application cancer assessment assumes that a worker would contact residues on the day of application for ten or thirty days a year, every year for 35 years. Since it is unlikely that a post-application worker would contact the highest possible residue value for that length of time, this assessment is considered very conservative. Also, less than 5 acres of paved road right-of-way diuron treatment every 2-3 years is reasonably foreseeable under Alternative 1. This amount of treatment is extremely conservative compared to the EPA's exposed worker scenarios.

Post-application cancer risks for private growers were calculated at both the typical application rate and the maximum application rate for each crop grouping. As mentioned previously, the occupational cancer risk assessment is a conservative assessment; therefore, all cancer risks to private growers were less than 1 x 10-4 on the day of treatment and are not of concern to the EPA (EPA, 9/30/2003).

## TABLE 4 - 7. HERBICIDE HAZARD QUOTIENTS FOR THE GENERAL PUBLIC AT TYPICAL LEVELS OF EXPOSURE

| Type of Exposure | * | 2,4-D | Chlorsulfuron | Clopyralid | Dicamba | Glyphosate | Hexazinone | Imazapic | Imazapyr | Metsulfuron methyl | Picloram | Sulfometuron methyl | Triclopyr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ACUTE / ACCIDENTAL EXPOSURE** | | | | | | | | | | | | | |
| Direct spray, entire body | C | **2.6055** | .0003 | .01 | .1986 | .02 | **15.6076738** | .05. | .009 | .0001 | .004 | .0004 | .2 |
| Direct spray, lower legs | W | .2618 | .00003 | .001 | .0200 | .002 | **1.5679460** | .005 | .0009 | .00001 | .0004 | .00004 | .5 |
| Dermal, contaminated vegetation | W | .2988 | .00008 | .0007 | .0171 | .001 | 0.4586713 | .001 | .0005 | .00002 | .0006 | .00002 | .6 |
| Contaminated fruit | W | **1.1760** | .003 | .005 | .2352 | .004 | **7.4640000** | .002 | .002 | .001` | .02 | .0006 | .06 |
| Contaminated water, spill | C | **34.0935** | .02 | .3 | **9.7410** | .7 | **81.8243008** | .2 | .1 | .02 | .4 | .03 | .3 |
| Contaminated water, stream | C | **1.1278** | .002 | .0007 | .0557 | .002 | **1.3533835** | .000008 | .00003 | .00002 | .007 | .000004 | .007 |
| Consumption of fish, general public | M | **10.2349** | .0007 | .01 | .2924 | .008 | **8.1878850** | .0008 | .002 | .00005 | .01 | .002 | .0005 |
| subsistence populations | M | **49.8787** | .003 | .05 | **1.4251** | .04 | **39.9029840** | .004 | .009 | .0002 | .06 | .01 | .002 |
| **CHRONIC/ LONG TERM EXPOSURE** | | | | | | | | | | | | | |
| Contaminated fruit | W | .2609 | .01 | .01 | .0778 | .002. | **3.1407471** | .0002 | .0008 | .0006 | .003 | .004 | .03 |
| Consumption of water | M | .0057 | .00005 | .0005 | .0036 | .00003 | 0.0548571 | .0000001 | .0000005 | .0000007 | .00005 | .000003 | .02 |
| Consumption of fish, general public | M | .0003 | .0000004 | .000002 | .00002 | .00000005 | 0.0011429 | $6x10^{-11}$ | $1x10^{-9}$ | $2x10^{-9}$ | .0000003 | .00000005 | .000006 |
| subsistence populations | M | .0023 | .000003 | .00002 | .00014 | .0000004 | 0.0092571 | $5x10^{-10}$ | .00000001 | .00000002 | .000002 | .0000004 | .00004 |

*C=child, W=woman, M=man

Aminopryalid and diuron acute and chronic exposure assessments to the general public were not shown as part of the above table and will be described narratively below:

**Aminopyralid[9]:** Based on aminopyralid's low toxicity, an acute Reference Dose (RfD) for the general population is not required.

The chronic RfD for aminopyralid is 0.5 mg/kg/day. This value is based on the NOAEL of 50 mg/kg/day in the rat combined chronic toxicity/carcinogenicity study with a 100-fold uncertainty factor to account for interspecies extrapolation (10X) and intraspecies variability (10X). An additional safety factor to protect infants and children is not required, due to the toxicity properties of the material and the conservative nature of the exposure estimates. A chronic exposure analysis was conducted using the tolerance levels for wheat grain and meat commodities and assuming 100% of crops treated with aminopyralid. The estimated exposures to US-population and relevant sensitive sub-population groups were all at least 3 orders of magnitude below the RfD (< 1% RfD).

There are no requested uses for aminopyralid that are considered residential and neither handler nor post-application residential exposures from uses around homes are expected to occur. However, the use on campgrounds and other recreation areas to control vegetation has the potential to result in short-term post-application incidental oral exposures for infants and children via hand-to mouth transfer of residues and ingestion of aminopyralid-contaminated grass and soil. For children with a 15-kg body weight exposed via the hand-to-mouth route, the potential MOE was 150,000. Therefore, post-application exposure via inhalation is not expected to occur.

The source of human exposure results from dietary exposure from food and drinking water, and short term incidental oral exposure, a short term oral exposure of children to treated campgrounds. Aggregating these exposure estimates gives a combined potential level of 0.0033mg/kg/day, for the highest exposed group, children 1-2 years of age. The margin of exposure (MOE) associated with this Tier I exposure estimate is 32,000, greatly above the acceptable limit (MOE = 100). EPA thus concludes that there is reasonable certainty that no harm will come from aggregate exposure to aminopyralid residues (EPA, 8/10/05 Factsheet).

The EPA considered the available data on the risks associated with the proposed use of Aminopyralid and the Triisopropanolammonium salt of Aminopyralid, and information on social, economic, and environmental benefits to be derived from such use. Specifically, the EPA considered the nature and its pattern of use, application methods and rates, and level and extent of potential exposure. Based on these reviews, the EPA was able to make basic health and safety determinations which show that use of Aminopyralid and its Triisopropanolammonium salt during the period of conditional registration will not cause any unreasonable adverse effect on the environment, and that use of the pesticide is, in the public interest. EPA determined that the use of aminopyralid is of significance to the user community, and appropriate labeling, use directions, and other measures have been taken to ensure that use of the pesticides will not result in unreasonable adverse effects to man and the environment (EPA, 11/23/2005 Registration).

**Diuron[10]:** Diuron is not acutely toxic. No adverse effects attributed to a single exposure were identified in any available study. Therefore, EPA did not conduct acute dietary risk assessment.

Based on labeled uses, no intermediate- or long-term residential handlers, or substantial post-application exposures of any duration, are expected. The EPA also concluded that chronic risk of diuron in drinking water is not a concern.

Although estimated exposure to diuron residues in food alone results in a cancer risk estimate of 1.68 x 10-6 for the general population, the EPA believes that this estimate is not of concern based on several protective assumptions in the assessment. The estimates of exposure from food are based largely on field trial data conducted at the maximum application rates (EPA, 9/30/2003 RED, p. 34).

[9] EPA, 11/23/2005 Registration and 2006 Lolo NF Discussion Points for Aminopyralid.
[10] EPA, 9/30/2003 RED

## Risk Characterization

Risk characterization is the process of bringing the hazard identification and exposure assessment results together and determining if probable actual exposures will be safe to individuals who are likely to come into contact with the pesticide in normal use. In the U.S., the EPA calculates a series of safety factors for potentially exposed populations (e.g.- applicators, users, various segments of the general public including children) and will express the result as a safety factor. For example, if a level determined to be safe to a human is 0.I mg/kg of body weight and the analysis used to characterize the risk shows the actual exposure as 0.0002 mg/kg then a safety factor of 400 would result.

The process is quite different if the product being evaluated has demonstrated evidence of being a rodent carcinogen. In this case, though complex, the EPA process is summarized by stating that when assessing risk to humans of potentially carcinogenic products very conservative mathematic models are applied and safety factors are calculated. Because of the inherent uncertainty the safety factors that are calculated always err on the side of human safety.

An additional step, risk management, comes into play when results of risk characterization do not demonstrate adequate safety margins for the product as it is intended for use. In this step alternatives for changing the scope or manner of use and/or protection measures during product use are considered. Risk management relies partly on science, but also considers social, economic and legal parameters before a policy decision is made. A product may not be sanctioned for any use by EPA unless sufficient changes to ensure safety are identified and put in place.

Tables 4 - 6 and 4 - 7 indicate that most of the herbicides included in this analysis do not pose acute (short- term) or chronic (long-term) health risks to workers or the general public, assuming label directions are followed and personnel protective equipment is utilized. However, four herbicides 2, 4-D, dicamba, diuron, and hexazinone models show possibility of chronic effects to workers and acute effects to the general public. Chronic exposure to workers is related to ground (backpack and boom sprayers) and aerial application. Acute exposure to the public is associated with consumption of contained water and fish, and direct application to the entire body. Further risk characterization of these four herbicides follows below.

### *2, 4-D*[11]

***Worker Effects:*** The hazard quotients in both Tables 4 - 6 and 4 - 7 are based on the RfD of 0.01 mg/kg/day, which is derived from EPA. A RfD is an estimate of daily exposure (mg/kg/day) to the human population that is likely to be without risk of deleterious effects during a lifetime. Table 4 - 6 indicates a possible concern involving chronic exposure to 2,4-D for workers involving ground and aerial application. Information in Table 4-7 indicates a concern for the acute exposure of the public through consumption of contaminated water, fruit or fish or a dose covering an entirely naked body.

As discussed on page 3-55 of the SERA (1999) risk assessment for 2,4-D there is no evidence that overt signs of toxicity are plausible at exposures to dose levels less than 1 mg/kg/day of 2,4-D. This assessment is supported by the categorical regression analysis of the animal toxicity data on 2, 4-D. Thus, overt signs of toxicity are not expected to occur in workers involved in ground or aerial applications of 2, 4-D for which central (typical) estimates of the absorbed dose range from 0.013 to 0.022 mg/kg/day. This assessment is consistent with data regarding human experience with the use of 2, 4-D. Even at the upper limits of exposure (i.e., 0.08-0.15 mg/kg/day) there are not likely to be overt signs of toxicity. For workers involved in ground or aerial applications of 2,4-D all of the exposure assessments are based on an application rate of 1 lb a.e. /acre. Nonetheless, even at the highest anticipated application rate of 2 lbs a.e./acre, no overt signs of toxicity would be expected.

The 2, 4-D SERA (1999) risk assessment on page 3-57 states that “the best interpretation of the somewhat complex risk characterization for workers is that 2, 4-D can be applied safely if thorough and effective methods are used to protect workers and minimize exposure. If effective measures of hygiene

[11] SERA (1999) 2, 4-D Risk Assessment pages 3-55, 57, 58, 59, and 3-60.

are not employed, occupational exposure to 2, 4-D could result in adverse but probably not overtly toxic effects.

***General Public:*** Like the worker exposure scenarios, some accidental public exposures are at doses that substantially exceed the RfD (i.e., direct spray, consumption of contaminated water, fish, or fruit shortly after application). These exposures, however, would be relatively short term. In addition many of the exposure scenarios associated with these higher levels of exposure are dominated by *arbitrary uncertainty*. In other words, the amount of exposure is dependent on the magnitude of a spill or some other accidental event. These arbitrary assessments are included in the risk assessment to illustrate the potential consequences of such accidents but the likelihood of such event occurring is probably very low (SERA, 1999, p. 3-57, 58, 59).

The exposures associated with the longer-term consumption of contaminated water are much more plausible and based on modest modeling extrapolations from monitoring studies. Although 2, 4-D is not a highly persistent chemical in water, it is persistent enough that it might contaminate groundwater and surface waters. As illustrated in Table 4-7, however, the plausible levels of longer term (chronic) exposures—based on conservative assumptions—are substantially below a level a concern (SERA, 1999, p. 359).

The SERA (1999) risk assessment analyses of the effects of consuming contaminated vegetation, at the modeled doses are some what conflicted. On the one hand it states that consumption of contaminated fruits may lead to covert health effects. On the other hand the plausibility of the scenario for the longer-term consumption of contaminated vegetation is questionable. First, 2, 4-D is a herbicide. If it is applied at a rate that will effectively kill target vegetation, consumable vegetation is also likely to be damaged to the point that it will not be available for consumption over prolonged periods. Although short-term consumption may occur after an unintentional direct spray, longer-term consumption is unlikely.

The SERA (1999) Risk Assessment, on page 3-60, concludes that "The most reasonable verbal interpretation for these conflicting risk characterizations is that, except for accidental exposures or extremely atypical and perhaps implausible ambient exposures to 2,4-D in vegetation, the risk assessment suggests that the normal use of 2,4-D will not pose any identifiable risk to the general public. "

***EPA 2005 Re-Registration Findings[12]:*** The 2005 EPA re-registration decision considers 2, 4-D dietary (food) risks are less than 100% of the Acute Population Adjusted Dose (aPAD) and Chronic Population Adjusted Dose (cPAD) for all population subgroups and are not of concern.

The EPA also concluded that both the surface water and ground water values are below the drinking water level of concern for acute and chronic exposure, and are not of concern.

An aggregate risk assessment looks at the combined risk from dietary exposure for those chemicals reviewed during the re-registration process, as well as exposures from non-occupational sources (i.e., residential uses). In the preliminary and revised EPA re-registration risk assessments, the estimated acute and short-term exposures exceeded EPA's level of concern. As a result, 2, 4-D registrants agreed to reduce the maximum application rate to turf and residential lawns from 2.0 pounds acid equivalent per acres to 1.5 per application.

Based on current use patterns, occupational handlers (mixers, loaders, and applicators) may be exposed to 2, 4-D during and after normal use. The EPA identified 18 handler scenarios resulting from mixing/loading and applying 2,4-D for crop and non-crop uses. With the exception of mixing/loading wettable powder, all of the short-term and intermediate-term margins of exposure exceed the target of 100 with baseline personal protective equipment (PPE) (i.e., long-sleeved shirt, long pants, shoes plus socks, no respirator) or single layer PPE (i.e., long-sleeved shirt, long pants, shoes plus socks, gloves, no respirator) and are not of concern to EPA. The margins of exposure for handling wettable powder are above 100 with required engineering controls (i.e. water soluble bags).

[12] EPA 6/30/2005

### *Dicamba*

For long term chronic exposure there are no risks apparent to either workers or the public, at typical application rates. Dicamba may be irritating to the eyes and cause mild and transient skin irritation, which are likely to be the most common effects as a consequence of mishandling dicamba. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of dicamba.

The greatest risk of Dicamba appears to be associated with acute or accidental exposure of the public to contaminated water resulting from a spill. Keeping the public away from an accident scene which involved the contaminated of water, until time and dilution can render a spill harmless, is the most likely mitigation for this situation. Subsistence populations may also be at risk from consumption of contaminated water and fish. However, typical subsistence populations (individuals who consume fresh caught fish as a major source of food) do not occur in or near the project area.

***EPA Re-Registration:*** Dicamba is scheduled for EPA re-registration by May of 2006. New findings may be available for disclosure during the Final EIS on this project.

### *Diuron*[13]

***EPA 2003 Re-Registration Findings:*** The EPA's Cancer Assessment Review Committee has classified diuron as "known/likely to be carcinogenic to humans." The lifetime dietary cancer risk estimate is 1.68x10-6 for diuron, representing a borderline exceedance. Generally, EPA is concerned when cancer risk estimates exceed the range of 1x10-6 or one in one million, although this negligible risk standard should not be viewed as a bright line (precision) standard. Residues used in the calculations are from field trials conducted at the highest application rates and from tolerance level residues from certain commodities. In addition, some processing data are still outstanding, which would enable further refinement to the risk assessment. Therefore, the exposure calculation is a conservative estimate and the EPA is not concerned with the dietary cancer risk from diuron use. Although the combined risk slightly exceeds 1 x 10-6, EPA believes that, given the weight of evidence, diuron cancer risk is not of concern. In addition, other risk protection measures outlined in the label will result in lower aggregate risks. (EPA 9/30/2003, p. 95)

EPA determined that the established uses for diuron, with amendments, and risk mitigations to be added to the label changes as specified in the 2003 re-registration decision, met safety standards that there is a reasonable certainty of no harm for the general population. In reaching this determination, EPA considered all available information on the toxicity, use practices, and scenarios, and the environmental behavior of diuron.

An aggregate assessment was conducted for exposures through food, drinking water, and residential uses. The EPA determined that the human health risks from these combined exposures are within acceptable levels. In other words, EPA has concluded that the tolerances for diuron meet safety standards. In reaching this determination, EPA considered the available information on the special sensitivity of infants and children, as well as the chronic and acute food exposure (EPA 9/30/2003).

EPA has determined that worker risks from exposure to diuron in loading, mixing, and application scenarios would be adequately mitigated through the use of the personal protective equipment (PPE) outlined by label:

For post-application risk mitigation, the restricted entry interval for diuron labels remain at 12-hours with the following early entry PPE required: coveralls over long sleeved shirt and long pants, waterproof gloves, chemical resistant footwear plus socks, protective eye wear and chemical resistant headgear for overhead exposures.

Acute risks from drinking water exposures are not of concern. For chronic drinking water risk, drinking water monitoring data were used to determine the estimated environmental concentrations in surface water. These monitoring data confirm that actual concentrations of diuron are substantially less than

[13] EPA 9/30/2003

previous model estimates. Monitoring data show concentrations substantially below the chronic Drinking Water Level of Comparison. Short-term residential exposures to diuron are not of concern. The EPA concluded that the potential cancer risk from residential use is negligible because of the low volume of diuron used in paint and the sporadic, short-term duration of homeowner exposures.

### *Hexazinone*[14]

Hexazinone is of relatively low acute toxicity but is a severe eye irritant. It is not classifiable as to human carcinogencity and does not cause other toxic effects of concern. The dietary risk posed by hexazinone is expected to be minimal. Most tolerances were reassessed and other existing tolerances are considered protective until confirmatory data are available for EPA reassessment. Exposure to workers generally is not expected to pose undue risks, due to hexazinone's overall low acute toxicity. However, based on toxicity concerns regarding primary eye irritation, a 48-hour return entry interval is required under label. (EPA, Re-registration Decision, 9/1994).

The major hazard associated with the use of hexazinone will involve accidental or incidental ocular or respiratory tract exposure. Hexazinone is a severe eye irritant. In addition, respiratory tract irritation was noted in workers applying granular formulations of hexazinone that contained high levels of dust or fine particulates. For workers, the uncertainties in the characterization of risk are dominated by the very wide range of projected exposures. Over the range of plausible application rates, all worker groups may be exposed to hexazinone at levels that exceed the RfD. Although workers using a *belly grinder* may be exposed to much higher levels of hexazinone, compared with other worker groups, the basic characterizations of risks are similar for all worker groups. The effects that are most likely to be observed after exposure to hexazinone are irritation to the eyes, respiratory tract, and skin. In general, irritant effects on the eyes and respiratory tract are likely to be more severe than effects on the skin. Even under the most extreme exposure scenarios, frank systemic effects are not likely to be observed (SERA, pp. 3-31 to 3-32).

In some accidental and extreme exposure scenarios, members of the general public may be exposed to levels of hexazinone above the RfD but still far below the levels projected for workers. While any exposure above the RfD is considered unacceptable by definition, the exposure estimates for the general public are in a range where the occurrence and nature of potential toxic effects cannot be well characterized. For the general public, as for workers, no signs of frank systemic effects are anticipated after accidental exposure to hexazinone (EPA Re-Registration Decision, 9/1994).

EPA's regulatory conclusion is that the use of currently registered products containing hexazinone in accordance with approved labeling will not pose unreasonable risks or adverse effects to humans or the environment (EPA, 1994 RED Facts).

## Synergistic Interactions

Concerns are occasionally raised about potential synergistic interactions of herbicides with other herbicides in the environment or when they are mixed during application (tank mixing). Synergism is a special type of interaction in which the combined impact of two or more herbicides is greater than the impact predicted by adding their individual effects. The Forest Service SERA and EPA Risk Assessments address the possibility of a variety of such interactions. These include the interactions of the active ingredients in an herbicide formulation with its inert ingredients, the interactions of these herbicides with other herbicides in the environment, and the cumulative impacts of spraying as proposed with other herbicide spraying to which the public might be exposed.

No one can guarantee the absence of a synergistic interaction between herbicides and /or other chemicals to which workers or the public might be exposed. Analysis of the infinite number of materials a person may ingest or be exposed to in combination with chemicals is outside the scope of this analysis. The following table shows information relative to synergistic effects.

[14] EPA, 9/1994

## TABLE 4 - 8 CONNECTED ACTIONS – SYNERGISTIC EFFECTS

| Herbicide | Brand Name | Connected Actions |
|---|---|---|
| 2, 4-D[15] | 2,4-D | Herbicide mixtures containing 2,4-D plus triclopyr, dicamba, picloram, or glyphosate are used in Forest Service programs.<br><br>There is some information to suggest that repeated exposure to 2,4-D and other phenoxy herbicides may result in an increased rate of elimination.<br><br>2,4-D is commonly mixed with picloram. There is some indication that co-exposure to 2,4-D and picloram may induce effects not associated with exposure to 2,4-D alone. |
| Aminopyralid | Milestone | There is very little information available on the interaction of aminopyralid with other compounds. |
| Chlorsulfuron[16] | Glean | The manufacturers recommend that chlorsulfuron formulations be mixed with a non-ionic surfactant. According to the product label, Telar (chlorsulfuron) may be applied in combination with other herbicides, such as 2, 4-D or glyphosate. However, there are no animal data to assess whether chlorsulfuron will interact, either synergistically or antagonistically with 2,4-D or any other herbicide. |
| Clopyralid[17] | Transline, | Clopyralid may be applied in combination with other herbicides, particularly in combination with 2, 4-D or 2, 4-D and picloram. There are no data in the literature suggesting that clopyralid will interact, either synergistically or antagonistically with these or other compounds. |
| Dicamba[18] | Banvel, Vanquish | There is no substantial evidence that dicamba will interact with other compounds. |
| Diuron[19] | Diuron 4L, Karmex | An evaluation for a mixture with diuron and chlorsulfuron (a.i.'s in the herbicide Telar DF) was conducted in a diuron risk assessment (BLM, 2005). Data suggests that the addition of chlorsulfuron in a tank mix does not generally result in any additional risks than diuron alone; however, a slight increase in risks to typical terrestrial plant species may occur with the use of the tank mix. |
| Glyphosate[20] | Roundup®, Rodeo, Accord | There is very little information available on the interaction of glyphosate with other compounds. |
| Hexazinone[21] | Velpar | There is very little information available on the interaction of hexazinone with other compounds. Available data suggest that hexazinone may be metabolized by and may induce cytochrome P-450. Thus, it is plausible that the toxicity of hexazinone may be affected by and could affect the toxicity of many other agents. The nature of the potential effect (i.e., synergistic or antagonistic) would depend on the specific compound and perhaps the sequence of exposure. |
| Imazapic[22] | Plateau, Plateau DG | As discussed in Section 3.1.16, the manufacturer of imazapic has recommended tank mixtures of this herbicide with glyphosate. No data are available on the combined toxicity of these two herbicides. Studies have been conducted on mixtures of 2, 4-D and imazapic. While these combinations are more toxic than imazapic alone, there appears to be no basis for asserting that synergistic effects are likely because the toxic action is probably due to 2, 4-D alone. |
| Imazapyr | Arsenal, Chopper, Stalker | Imazapyr may be applied in combination with other herbicides. No data have been encountered in the literature that permits a characterization of the joint action of imazapyr (i.e., synergism, antagonism, or additivity) with most herbicides. |
| Metsulfuron Methyl[23] | Escort® | The manufacturers recommend that metsulfuron methyl formulations be mixed with a surfactant. There is no known published literature or information in the FIFRA files. According to the product label, Escort may be applied in combination with other herbicides. However, there are no animal data to suggest that metsulfuron methyl will interact, either synergistically or antagonistically with any other herbicide. |
| Picloram[24] | Tordon | A commercial formulation of picloram and 2,4-D, Tordon 202C, has been shown to inhibit immune response in mice. |
| Sulfometuron Methyl[25] | Oust XP | The manufacturers recommend that sulfometuron methyl formulations be mixed with a surfactant. There is no known published literature or information in the FIFRA files. According to the product label, Oust may be applied in combination with other herbicides. However, there are no animal data to suggest that sulfometuron methyl will interact, either synergistically or antagonistically with any other herbicide. |
| Triclopyr[26] | Garlon 4 | There is very little information available on the interaction of triclopyr with other compounds. |

[15] USFS, SERA 1999
[16] USFS, SERA 2004
[17] USFS, SERA 2004
[18] USFS, SERA 2004
[19] BLM, 2005
[20] USFS, SERA 2002
[21] USFS, SERA 1999
[22] USFS, SERA 2004
[23] USFS, SERA 2004
[24] USFS, SERA 2003
[25] USFS, SERA 2004

There is some uncertainty in the use of a mix because herbicides may not interact in an additive manner. Risk may be overestimated if the interaction is antagonistic, or risk may underestimate if the interaction is synergistic. In addition, other products may also be included in tank mixes and may contribute to the potential risk.

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 3(c)5(C,D), EPA registers pesticides for use based on a determination that the product *"will perform its intended function without unreasonable adverse effects on the environment, and that when used in accordance with the widespread and commonly recognized practice, the product will not generally cause unreasonable adverse effects on the environment"*. The EPA is aware that tank mixes are part of the *"widespread and commonly recognized practice"* and has not required testing to assess their safety. Supporting the EPA's decision not to require testing are the following: years of experience in agriculture and vegetation management with tank mixing, the absence of a pattern of adverse or unexpected effects on the environment, and a growing body of scientific studies that suggest increased toxicity (synergism) of herbicide mixtures is a rare occurrence. In those rare cases where synergism has been demonstrated in laboratory studies, laboratory exposures were at levels that far exceed the potential exposure that would result from tank mixing for workers, bystanders or the consumer.

Given that the products are used as directed by the label and proper Personal Protective Equipment (PPE) is worn, adverse effects are not likely to occur. Labels for both tank mixed products should be thoroughly reviewed and mixtures with the least potential for negative effects should be selected. Use of the mix should be based on the most restrictive herbicide in the mixture. It should be noted that the herbicide label indicates if a herbicide can be mixed with other herbicides.

**Impurities, Adjuvant and Inert Ingredients in Herbicide Formations**

During commercial synthesis of some pesticides, by products can be produced and carry over into the product eventually formulated for sale. Occasionally byproducts or impurities are considered toxicologically hazardous, and their concentrations must be limited so that potential exposures do not exceed levels of concern.

For most of the herbicides in Table 4-9 there is little information in the published literature on manufacturing impurities in the herbicides. Nonetheless, virtually no chemical synthesis yields a totally pure product. To some extent, concern for impurities in technical grade herbicides is reduced by the fact that the existing toxicity studies on the herbicides were conducted with the technical grade product. Thus, if toxic impurities are present in the technical grade product, the toxic potential of the impurities are likely to be encompassed by the available toxicity studies on the technical grade product. Tables 4-4 and 4-5 provide information on the toxicity of the herbicides contained in Table 4-9.

Literature contains considerable information on the types of inert ingredients and adjuvant present in herbicides proposed for use by the Custer National Forest. Table 4-9 summarizes the information provided by the SERA (1999, 2003-2004) risk assessments for inert material, and adjuvants.

[26] USFS, SERA 2003

## TABLE 4 - 9 SUMMARY OF IMPURITIES, INERT MATERIAL, AND ADJUVANTS

| Herbicide | Brand Name | Impurities, Inert Materials and Adjuvants | Comment[27] |
|---|---|---|---|
| 2, 4-D (Dichlorophenoxyacetic acid) | 2,4-D Amine | monochlorophenoxyactetic acid , 2,6-dichlorophenoxyacetic acid , 2,4,6-trichlorophenoxyacetic acid, and bis(2,4-dichlorophenoxy)-acetic acid. | It is likely that the toxicity of the minor impurities is encompassed by the studies on the technical grade product. SERA, Page 3-30 |
| Aminopyralid | Milestone | Trace amounts of CO2 and NH3. | No major degradates were identified. EPA, 2005 |
| Chlorsulfuron | Glean | Confidential | None of the additives are classified by the U.S. EPA as toxic. SERA, Page 3-8 |
| Clopyralid Methyl | Transline, | isopropyl alcohol, polyglycol, Polyglycol 26-2 | U.S. EPA (2003) identifies ployglycol 26-2 as List 3* inert. Other materials are food additives. SERA, Page 3-8,9 |
| Dicamba | Banvel, Vanquish | Confidential | No apparently hazardous materials have been identified. SERA, Page 3-12. |
| Diuron | Diuron 4L, Karmex | Trace amounts of a manufacturing impurity, 3,3',4,4'-tetrachloroazobenzene, a.k.a. TCAB, which has been shown to be a cytochrome P450 enzyme inducer. | Chronic toxicity/carcinogenicity studies are not available for TCAB. However, since it is assumed that TCAB may have been present in all diuron toxicological test materials, including the test material for the chronic toxicity/carcinogenicity studies, the EPA believes that the risks from exposure to diuron (including carcinogenic potential) have not been underestimated.<br><br>EPA 9/2003 p. 22 |
| Glysophate | Roundup®, Rodeo, Accord, Roundup Pro | nitrosamine, N-nitroglyphosate (NNG), 1,4 Dioxane | The EPA concluded that the NNG content of glyphosate was not toxicologically significant. Page 3-25. Dioxane does not present unquie toxic effects and is likely to be encompassed by the available toxicity data for Roundup. SERA, Page 3-26 |
| Hexazinone | Velpar | ethanol. | Ethanol is a strong eye irritant, and the presence of ethanol may contribute to the irritant effects of Velpar L. Based on the acute toxicity of hexazinone, no adverse effects are anticipated.<br>SERA, Pages 3-8 to 3-10 |
| Imazapic | Plateau, Plateau DG | Confidential | None of the additives are classified by the U.S. EPA as toxic. SERA, Page 3-7 |
| Imazapyr | Arsenal, Chopper, Stalker | Confidential | Inerts and adjuvants have been disclosed to U.S. EPA. Page 3-9 |
| Metsulfuron Methyl | Escort® | sodiumnaphthalene sulfonate-formaldehyde condensate | No plausible basis for asserting that the inerts are present in toxicological amounts. SERA, Page 3-9 |
| Picloram[28] | Tordon | Hexachlorobenzene, Polyglycol 26-2 | Based on the levels of contamination of technical grade picloram with hexachlorobenzene the contamination is not significant in terms of potential systemic toxic effects. Polyglycol is an EPA List 3 inert.. SERA, Pages 3-9,10 |
| Sulfometuron Methyl | Oust XP | Confidential | None of the additives are classified by the U.S. EPA as toxic. SERA, Page 3-10 |
| Triclopyr | Garlon 4 | Ethanol, kerosene | The amount of ethanol is not toxicologically significant in terms of potential toxicity. Kerosene is classified by U.S. EPA as a List 3* Inert. SERA, Page 3-13 |

The SERA and EAP risk assessments, summarized above, indicate that the kind and amount of inert material, and adjuvants included in the different herbicides proposed for use would not likely result in

[27] Page cites are to the individual herbicide reports completed for the Forest Service by SERA (1999,2003-2004). Each report is located at http://www.fs.fed.us/foresthealth/pesticide.shtml. The Human Health Risk Assessment portion of each herbicide report is located in the Project Record.

[28] EPA List 3 – there is insufficient information to categorize this compound as either hazardous (Lists 1 or 2) or non-toxic (List 4).

adverse health effects to workers or the general public. The toxicity assessments (Tables 4 - 4, 4 - 5), which are thought to cover the impurities in the technical grade herbicides, also seem to indicate a lack of health concerns. This assumes that herbicide labels are followed and that correct personal protective equipment is available and used.

**Dyes**

The use of any agent (such as herbicides, dyes, surfactants, or other additives) may pose some level of human risk. The uses of dyes have beneficial consequences in that they can color vegetation, making it less likely for an individual to inadvertently or un-intentionally consume contaminated vegetation. The presence of a dye in herbicide formulations may also make it easier for workers to see when they have been contaminated and allow for prompt remedial action.

Not withstanding these potential benefits, the colorants or other components in the dyes may pose additional risks to humans and wildlife. The assessment of these risks (SERA, 1997) is limited by the proprietary nature of dye formulations. For most of the available dyes, neither the colorants nor adjuvants in the dye formulation are disclosed by the manufacturers. Unless the compound is classified as hazardous by the U.S. EPA, the manufacturer is not required to disclose its identity.

Significant technological advances have been made with respect to dyes available for pesticide applicators. Several water soluble dyes of low toxicity are available, and their use can provide an added level of safety for the workers and the public

**Adjuvants / Surfactants**

Surfactants are also commonly used in herbicide formulations. Surfactants are added to herbicides to improve herbicide mixing and the absorption or permeation of the herbicide into the plant. Like dyes and other inert ingredients, there is often limited information on the types of surfactants used and the toxicity of surfactants, especially since the industry considers the surfactant to play a key role in the effectiveness of the herbicide formulations. Most knowledge of surfactants is kept as proprietary information, and not disclosed. USFS (1997), which assessed the effects of surfactant formulations on the toxicity of glyphosate, reported that toxicity of glyphosate alone was about the same as the toxicity when mixed with surfactant and greater than the toxicity of the surfactant alone. Whether this same pattern would hold true of other herbicides having the same or different surfactants is unknown. If so, the toxicological studies performed on herbicide formulations (which contain the inert ingredients and surfactants) may accurately portray the toxicity and risks posed to humans by the surfactant.

What research there is show that for a surfactant to increase the absorption of another compound, the surfactant must affect the upper layer of the skin. Without some physical effect to the skin, there will be no change in absorption as compared to the other compound alone.

The studies discussed below indicate that in general non-ionic surfactants have less of an effect on the skin, and hence absorption, then anionic or cationic surfactants. Compound specific studies indicate that the alkylphenol ethoxylates generally have little or no effect on absorption of other compounds. In several studies, the addition of a surfactant actually decreased the absorption through the skin. It would appear that, given the data available here, there is little support for the contention that the addition of surfactants to herbicide mixtures would increase the absorption through the skin of these herbicides (Bakke 2002).

Surfactants, by their very nature, are intended to increase the effect of a pesticide by increasing the amount of pesticide that is in contact with the target (by reducing surface tension). This is not synergism, but more accurately is a reflection of increased dose of the herbicide active ingredient into the plant (Bakke 2002).

Although there is not much data in the technical literature, the references included in this paper indicate a lack of synergistic effects between surfactants and pesticides (Bakke 2002).

**Adjuvant Hazards Assessment**

Basic information concerning adjuvants commonly used with herbicides describes hazard information below and is used in conjunction with Forest Service national herbicide risk assessments (Bakke 2002).

Of the adjuvants discussed in the Bakke 2002 assessment, only two carry the Danger signal word [29] (Entry™ II and LI-700®), which is due to the potential effects to the eyes (severely irritating or corrosive). The bulk of the remainder carry the Caution signal word, while several carry the Warning signal word (again because of potential irritant effects to the skin or eyes). None of the adjuvants carry the poison symbol. All of the adjuvants in the assessment are no more than slightly toxic when ingested, inhaled, or absorbed through the skin.

None of the adjuvants contain ingredients found on U.S. EPA's inerts list 1 or 2. This is either based on the identified ingredients, or if these ingredients are not sufficiently identified, by information given by the manufacturers. The assessment of hazards for adjuvants is limited by the proprietary nature of the formulations. Unless the U.S. EPA classifies a compound in the formulation as hazardous, the manufacturer is not required to disclose its identity. At the current time, the disclosure of whether a material is hazardous is based primarily on acute toxicity.

Ammonium, or nitrogen, fertilizers are often added to herbicide mixes in range and row-crop agriculture situations, where the addition of fertilizer works to both enhance herbicidal effects as well as to stimulate the growth of desirable crop or forage plants. Ammonium fertilizers can function as utility adjuvants, because they help prevent the formation of precipitates in the tank mix or on the leaf surface. They also decrease surface tension, increase spreading of the herbicide on the leaf surface, neutralize ionic charges, and increase herbicide penetration into the leaf. Ammonium fertilizers are used primarily with broadleaf-specific herbicides (Tu et. al. 2003).

Ammonium fertilizers used as adjuvants include urea-ammonium nitrates (UAN), ammonium sulfates, ammonium nitrates and ammonium polyphosphates. Although their exact mode of action in herbicide control is unknown, they are often used to enhance the postemergence activity of weakly acidic herbicides, primarily by increasing herbicide absorption. The activity of ammonium fertilizers is strongly herbicide- and species-specific, and is probably dependent on several mechanisms.

Ammonium sulfates are also used to reduce antagonism by hard water ions in spray solutions. Iron, zinc, magnesium, sodium, potassium and calcium ions can react with certain herbicides (such as 2,4-D and glyphosate) to form precipitates or herbicide salts, decreasing the efficacy of those herbicides. Ammonium sulfate prevents the formation of the calcium salt of glyphosate and is recommended in most areas with hard water (Tu et. al. 2003).

Ammonium sulfate is EPA registered as a water conditioner adjuvant and as a herbicide. It can be used as an effective herbicide for tall larkspur control when used alone (see Chapter 3). It is anticipated that the use of this product as an herbicide would generally be through spot treatment of tall larkspur (less than 60 gross acres) in its' granular formulation.

Probable routes of human exposure to ammonium sulfate are inhalation, ingestion, and dermal contact. This product may irritate eyes and skin upon prolonged or repeated contact. There are no carcinogenaic, mutagenic, or teratogenic effects. There is no known effect from chronic exposure to this product. Acute oral toxicity (LD50) is 3000 mg/kg (Rat.) which correlates to very low toxicity for humans or animals. The product itself and its products of degradation are not toxic under normal conditions of use. It will release ammonium ions. Products of biodegradation are nitrogen oxides and sulfur oxides. This agent is a toxic hazard to fish and releases into watercourses and accidental spills are to be avoided. http://www.fertilizerworks.com/html/msds_granamm.html.

[29] Signal words are required on pesticide and registered adjuvant labels, and provide an overall view of the acute toxicity, or effects to eyes or skin, of the product. There are three signal words used by U.S. EPA, Danger, Warning, and Caution, to signify decreasing levels of this toxicity. In addition, the Danger signal word can be accompanied by the skull and crossbones symbol if the product is an acute poison.

The primary summary statement that can be made is that the more common risk factors for the use of adjuvants are through skin or eye exposure. Adjuvants all have various levels of irritancy associated with skin or eye exposure. This points out the need for good industrial hygiene practices while utilizing these products, especially when handling the concentrate, such as during mixing. The use of chemical resistant gloves and goggles, especially while mixing, should be observed.

## UNCERTAINTY

With exception of accidental exposures or exposures under very conservative and somewhat implausible exposure scenarios, workers and the general public should not be exposed to a herbicide at concentrations that result in an adverse health effects. This conclusion is predicated on Forest Service employees and/or contractors wearing appropriate personal protection, applying herbicides in accordance with the label, and implementing the job hazard analysis program. By doing so, possible exposure by contact or through drift would result in potential dose below that determined to be safe by the EPA over a lifetime of daily exposure. It is also predicated on the finding, back by toxicological studies, that a person can be exposed to some amount of a contaminant and not have an adverse effect (i.e. the dose determines the effect).

All of the herbicides proposed for use by the Custer National Forest are registered for use by the EPA and the states of Montana and South Dakota. Registration of these herbicides and Federal regulations adopted to protect workers and the general public has required more scientific information and justification for use of herbicides. Nevertheless, there are many reports in the scientific literature that document associations between herbicide exposure and alterations of the immune system, autoimmune disorders, and increases in the probability of carcinogenesis. Felsot (2001), MCCHB (2001), Popp (1995), and Glover-Kerkvliet (1995) are just a few references that provide information on such effects. The body of literature on herbicide effects raises concerns about additive and synergistic effects of exposure to more than one herbicide, unstudied or unknown consequences of low level chronic exposures, toxicity of inert ingredients, by-products or contaminants of herbicides, and uncertainties about the health effects of sensitive populations. There is also the realization that it is difficult, if not impossible, for government or any scientific agency to fully evaluate a chemical and all the potential combinations of them to ensure that there would not be an adverse effect.

It would be inappropriate to suggest that use of herbicides to control noxious weeds is without risk to workers and the general public. If herbicides are used, there is the possibility of workers and general public exposure, no matter how many protection measures are implemented. All chemical exposure results in some level of health risk, the risk primarily being a function of the dose, or amount a person or organism is exposed to over a period of time.

It is equally inappropriate to conclude that any exposure, regardless of dose, would result in an effect. It is easy to find a report showing a health effect caused by the exposure to a herbicide or any other chemical. The toxicological studies are purposely done using high doses to demonstrate an effect. It is the herbicides that show effects at low levels of exposure or those levels anticipated when in use that should raise concern. With respect to this analysis, the potential dose received by the worker or the public does not approach the exposure levels shown to cause acute or chronic toxicity in the literature. Acute effects occur at doses thousands to tens of thousands of times higher than those estimated for the worker or public for this project. Likewise, chronic effects reportedly occur at doses significantly higher than that expected for the Custer National Forest weed treatment program.

There are simply too many variables (receptor sensitivity, dose received, use of personal protection, etc.) for anyone to predict with 100 percent certainty the potential health risk of herbicide use and exposure. What is known is that through a process of continual review of toxicological data on herbicides, the EPA, using very conservative assumptions, has determined a dose they believe would not result in an adverse health effect for herbicides proposed for use on this project. We know that there are studies which show that exposure to the herbicides proposed for use in high doses can cause deleterious effects. We also know that risk assessments have been completed to determine the estimated dose a worker or person of the general public might be exposed to under varying exposure scenarios. Most important, we know through a comparison of EPA established safe doses and estimated exposures that the estimated dose that people might be exposed to through use of a herbicides would be below that determined to be safe by

the EPA for a lifetime of daily exposure. Therefore, no health effects and risks to workers and the public are anticipated by the use of herbicides by the Custer National Forest.

## HERBICIDE DRIFT

The air serves as a carrier of spray drift. Liquid spray droplets most prone to drift are usually 100 microns or less in diameter and most spray equipment is designed to produce 200 micron droplets. The Forest's restriction of spraying in only low wind periods reduces the chance of airborne herbicides.

Non-target plant loss from volatilization is reported to be negligible with glyphosate. Volatilization will depend on the formulation of 2, 4-D with acids and amines being less volatile than esters which vary from high to low. Any esters used on the Custer National Forest would be of low volatility. The oil soluble amines are considered to be least volatile. Dicamba may volatize from soil surfaces but further study is required to determine the extent of such losses. Picloram volatilization is not considered a problem due to the low vapor pressure of the chemical. Herbicides could be moved out of the target area while adsorbed to dust particles carried by wind. Once in the air, spray droplets are subject to photodecomposition by sunlight.

### Dynamics

Spray drift is largely a function of droplet particle size, release height, and wind speed (Tesk, et. al., 1999). Other factors that control drift, to a lesser degree, include the type of spray nozzle used, the angle of the spray nozzle, and the length of the boom. The largest particles, being the heaviest, would fall to the ground sooner than smaller sizes upon exiting the sprayer. Medium size particles can be carried beyond the sprayer swath (the fan shape spray under a nozzle), but all particles would deposit within a short distance of the release point. The physics of sprayers dictates that there would always be a small percentage of spray droplets small enough to be carried in wind currents to varying distances beyond the target area. Because the small droplets are a minor proportion of the total spray volume, their significance beyond field boundary rapidly declines as they are diluted in increasing volumes of air (Felsot, 2001).

Drift characteristics differ between pesticides. With herbicides proposed in this analysis, it is not critical to coat the entire leaf since some of the product can be absorbed by the plant roots and good efficacy can be achieved by larger droplets on leaves to the target plant. Therefore, herbicide drift can be intentionally reduced by generating larger droplets without reducing efficacy.

Spray nozzle diameter, pressure, amount of water in the tank mixture, and release height of the spray are important controllable determinants of drift potential by virtue of their effect on the spectrum of droplet sizes emitted from the nozzles (Felsot, 2001; Tesk, et. al., 1999). Meteorological conditions such as wind speed and direct, air mass stability, temperature and humidity and herbicide volatility also affect drift.

Commercial drift reduction agents are available that are designed to reduce drift beyond the capabilities of the determinants previously described. These products create larger and more cohesive droplets that are less apt to break into smaller particles as they fall through the air. They reduce the percentage of smaller lighter particles that are the size most apt to drift off the treatment area.

Wind speed increases the concentration of drifting droplets leaving the treated area if the wind is adverse (blowing away from the release point in the treatment area). If the wind is favorable (blowing into the treatment area) drift can be reduced. Numerous studies have shown that over 90 percent of spray droplets land on the target area and about 10 percent or less move off-target, and that the droplets that move off-target most typically deposit within 100 feet of the target area (Felsot, 2001; Yates et al., 1978; Tesk, et. al., 1999).

### Herbicide Drift from Aerial Applications

Drift deposition on surfaces measured downwind from aerial spry sites is typically less than one percent, and often less than 0.1 percent, of on site deposition (Yates et al., 1978; Tesk, et. al., 1999). Drift deposition from ground equipment can be one-tenth of that from aerial application at comparable distances from a spray site (Yates et al., 1978).

Less information is available on the concentrations of herbicides that remain airborne at greater distances from application sites. Robinson and Fox (1978) (USFS, 2005 Gallatin) measured airborne concentrations of herbicides at various distances from aerial spray plots. Under conditions designed to reduce drift, these researchers did not detect airborne levels of herbicides beyond 100 feet downwind of 500 foot wide spray plots (detection limit of 0.1 microgram – there are about 28 million micrograms in an ounce).

These researchers also measured ambient air concentrations of 2,4-D at seven stations in eastern Washington where several million acres of wheat are treated with herbicides annually. Ambient concentrations of non-volatile fractions of 2,4-D typically averaged 0.1 to 0.2 milligrams/cubic meter during periods of heavy application. Imazapic and clopyralid are also non-volatile herbicides, and long-range drift of these compounds may exhibit similar dynamics as the non-volatile fractions of 2,4-D. Therefore, the ambient concentrations of imazapic or clopyralid may be similar to the concentrations measured by Robinson and Fox (USFS, 2005 Gallatin).

Numerous investigations of factors affecting drift from aerial applications are reported in scientific literature (DiTomaso, 1999; Yates *et al*., 1978; Robinson and Fox (1978) (USFS, 2005 Gallatin); Teske et. al., 1999; Teske et al., 2000). Three of the most comprehensive studies are discussed below.

**RAHUFS Drift Estimations**

The 2005 Gallatin NF Weed FEIS cites the 1992 Risk Assessment for Herbicide Use in Forest Service Regions 1, 2, 3, 4 and 10 and on Bonneville Power Administrations Sties (RAHUFS), which discusses spray drift distances downwind of an application site for aerial, back pack, and ground mechanical application equipment. The results of RAHUFS spray drift analysis indicated “low” health risk to the public from ground and aerial applied herbicides. “Low risk” was defined in the study as drift from the herbicides that presents a less than one in a million systemic, reproduction or cancer risk. Spray drift from hand application equipment was found to be negligible.

**AGDRIFT / Felsot Drift Estimations**

Felsot (2001) used the EPA/USDAFS AGDRIFT model to simulate herbicide sprays for several application scenarios, including a truck mounted spray boom set at two heights and a helicopter at two heights. These simulations included crosswinds blowing at ten and six mph. The model output was an estimated amount (percent of that applied) that deposited a defined distance from the edge of a spray swath. A spray deposition curve was developed to calculate a dose that a bystander could potentially receive if standing within the drift zone of an application. The whole body surface area was assumed exposed to drifting spray (highly conservative), and the bystanders were assumed to be an adult weighing 70 kilograms and a child weighing 10 kilograms. Absorption of the depositing dose was assumed to be 10 percent. Calculations were made to determine the percentage of the depositing spray that a child could be exposed to on a daily basis over 70 year life span and be within the EPA safety guidelines as defined by the reference dose (i.e., the “safe dose”). The study estimated that for aerial application, the equivalent safe deposits corresponded to distances from the edge of the spray field of 0 and about 60 feet for clopyralid, picloram, and 2, 4-D. For a ground application, the child would receive a safe dose level of 2, 4-D at 27 feet from the sprayed field edge.

**Mormon Ridge Field Drift Monitoring**

In this study, herbicides were aerially applied with aircraft to the Mormon Ridge winter range in 1997 and 1999. Mormon Ridge presented a difficult treatment scenario in that it is extremely steep, has rolling topography, considerable microclimate variability and aerial application occurred upslope of Mormon Creek, a bull trout –spawning stream. Mormon Creek flows along the bottom of the roughly three miles by ½ to ¾ - mile wide treatment area.

Picloram was aerial applied on Mormon Ridge in 1997. Buffer zones and water quality were monitored and continuous automated water samples collected. Analysis of the water samples (conducted by the Montana Department of Public Health and Human Services Chemistry Lab) indicated no herbicide entered the stream to a detection level of 0.1 parts per billion (USFS, SERA, 1996). The Maximum Contamination

Level as set by the EPA for drinking water is 500 parts per billion. No picloram was detected in Mormon Creek when tested at a level 5,000 times lower than the EPA Maximum Contamination Level. Drift cards were also placed along Mormon Creek to monitor drift. The cards indicated no detectable drift reached the creek.

The Mormon Ridge pilot project area was also aerial treated with picloram three growing seasons after the initial application to control invasive weeds that germinated from the soil seed bank after the herbicide decomposed. Drift cards used during this subsequent treatment did not detect picloram in the riparian aerial spray buffer.

**Spray Drift Summary**

Based on the above information, aerial herbicide applications would have a very short-term localized impact as a result of drift. Most of the drift would settle to within 100-200 feet of the point of release in adverse conditions. Herbicide spray drift from aerial treatments under Alternative 1 would not significantly affect the health of the general public or adversely affect water quality, provided environmental protection measures are implemented to avoid drift toward persons and sensitive resources. Aerial application should be made when there is an organized wind less than 6 mph blowing away from sensitive area. This practice combined with a buffer adjacent to sensitive areas and a drift reduction agent would likely result in no significant offsite drift. Significance in this context refers to concentrations above EPA established RfDs (see Appendix C, Protection Measures).

# HUMAN HEALTH – DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

## HUMAN HEALTH - HERBICIDE TREATMENTS EFFECTS COMMON TO ALTERNATIVES 1 AND 3

This section addresses effects from herbicide treatments common to alternatives 1 and 3. All herbicides listed in this section pertain to Alternative 1, Proposed Action. However, only gyphosate, picloram, 2, 4-D, and dicamba pertain to Alternative 3, Current Management. Chapter 3 outlines referenced literature used to analyze potential human health risks associated with ground and aerial applications of herbicides.

Three levels of analyses were used in the above risk assessment process: 1) a review of toxicity test data (i.e., acute, chronic, and sub-chronic) for herbicides proposed for use to determine dosage that could pose a risk to human health; 2) an estimate of exposure levels to which workers (applicators) and general public may be exposed during treatment operations; and 3) comparison of dose levels to toxicological thresholds developed by EPA to determine potential health risks.

Toxicity test data on laboratory animals is available for herbicides proposed for use in this analysis. Most tests have been conducted under EPA's pesticide registration/re-registration requirements for use in the United States. The EPA uses test data to determine conditions for use of herbicides in the United States.

Label restrictions on herbicides are developed to mitigate, reduce, or eliminate potential risks to humans and the environment. Label information and requirements include: Personal Protective Equipment; User Safety; First Aid; Environmental Hazards; Directions for Use; Storage and Disposal; General Information; Mixing and Application Methods; Approved Uses; Weeds Controlled; and Application Rates. Analysis of herbicide use in this EIS assumes compliance with the product label during handling and application.

A small percentage of the population may have a hypersensitivity to the herbicides proposed for use. These people are generally aware of their sensitivities and would not be allowed to work on herbicide spray crews or in treated areas until either safe re-entry periods, or a period they feel is adequate based on their personal knowledge of their sensitivity, has passed. (Safe re-entry in areas where herbicides have been applied is when the herbicide has dried on the leaf surface).

The potential human health risks for workers and the public from herbicides would be the greatest under Alternatives 1 and 3 due to the amount of area that would be treated with herbicides. While risks to

human health are greatest under this alternative, they would still be below a level considered safe by the EPA for all herbicides proposed for use by the Custer National Forest.

Health risks to workers are greatest for ground application of herbicides. Of those areas treated by backpack, OHV, and truck mounted delivery systems, backpack applications have the greatest potential for worker exposure to herbicides. Potential for public exposure to herbicides under Alternatives 1 and 3 is low since most project areas are remote and away from population centers. Both aerial and ground applications would occur infrequently (i.e. once per year) and neither workers nor the public would receive daily exposures above the EPA reference doses, a dose considered safe by the EPA over a lifetime of daily exposure

Also, once a herbicide dries on the plant there is little risk that the chemical will transfer to people or animals who do not consume the treated vegetation. When applied to vegetation the herbicides are very dilute, below the toxicity level of the chemical.

The more time spent applying herbicides increases the risk of a spill, accident, or mishap. Risk of a herbicide spill or accident is present under Alternatives 1 and 3. In such a case workers may be directly exposed to acute concentrations of a herbicide and the general public may be secondarily exposed to a spill or release should it reach surface or groundwater. The indirect effects in the form of public exposure and disruption would be commensurate with the proximity of the spill area to the public, the amount and concentration of the herbicide, and dilution factors should the herbicide reach water. In both situations the potential effects can be mitigated through such actions as thorough washing, diluting with water, and restricting access to a spill area.

No adverse health effects are anticipated for the workers or the general public based on estimates of exposure, estimates of drift, and the protection measures that would be implemented under this alternative.

## HUMAN HEALTH – NON-HERBICIDE TREATMENT EFFECTS COMMON TO ALL ALTERNATIVES

### Mechanical Treatment

Potential risks to human health from mechanical weed control methods are very low and include emissions from gasoline or diesel powered equipment, burns, allergies, back injuries and skin irritation from direct contact with plants by individuals doing the work. Hypersensitive individuals may be subject to effects from gasoline engine exhaust, gasoline powered weed mowers, and vehicles used for noxious weed control and public use both in and outside the treatment areas.

Some noxious weed species can cause allergies and minor skin irritations in a few individuals. Noxious weeds, such as thistles, cause minor scrapes and irritations, and there are other more serious complications that may result from hand pulling. For example, leafy spurge contains a latex-bearing sap that irritates human skin and rarely causes blindness in humans upon contact with the eye. There have also been claims (not medically supported) that hand pulling of knapweed may result in the formation of tumors on the hands. Highly allergic individuals can have serious complications when exposed to allergens (weeds or pollen), including constriction of the airway and anaphylactic shock, the significance of which should not be underestimated since grassland workers would be working some distance from medical assistance.

Approximately 10 to 15 percent of the U.S. population suffers from allergy symptoms from noxious weed species such as knapweed. Knapweed is a common and powerful allergen that peaks in August. Allergies to weeds such as knapweed may complicate or trigger asthma.

While there is some potential for health effects associated with mechanical treatment of weeds, required personal protective equipment such as gloves, long sleeved shirts, boots and safety glasses along with personal hygiene, would prevent injuries or irritation, and therefore no significant human health effects are anticipated by mechanical removal of weeds.

Operators of machinery (such as tractor mounted mowers) could be injured by losing control of equipment on steep terrain or be coming into contact with flying debris and brush.

Smoke from burning is not expected to significantly affect human health under any alternative. Levels of suspended particulates (a suspected factor in some health problems) are expected to be well below the 150 micrograms per cubic meter (ug/m3) public welfare standard and the 260 ug/m3 public health standard published by EPA.

Workers on burn areas would be exposed to potential injury from the manual treatments they would apply and the conditions under which they would work. Workers who manually ignite burn areas would be exposed to burning materials, which could case physical injuries.

Public safety would not be affected by any method of igniting burn areas. Most burning would occur where the public either would not be present or would be highly visible to those doing the burning. Further, those on or near a burning area would be well aware of impending activities because several hours of active preparation are required before ignition begins. Although prescribed burns might “escape” control and endanger the public, safety measures normally taken to protect firefighters participating in prescribed burning would also protect the public.

To reduce the risks of burn escapes and lingering smoke, the Forest Service has special requirements for planning and implementing prescribed burns. All prescribed burn projects require a Burn Plan, which includes a burning prescription, a description and discussion of fuels, weather, and timing; how to conduct the burn; and safeguards. The safeguards section of the plan addresses all precautions needed to confine the burn to the prescribed area. In addition, the Forest Service has established qualification standards and training requirements for personnel involved in prescribed burning.

### Cultural Treatment

Potential human health risks associated with cultural control methods include exposure to dust and chaff during seeding operations. Allergic reaction can result from exposure of seed and chaff when handling seeds; however, gloves, long sleeved shirts, boots, and other personal protective equipment, as needed, would prevent injuries or irritations. Therefore, no significant human health effects are anticipated by seeding.

Fertilizers are not regulated by FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act). Therefore, toxicity testing and hazard identification is not as extensive as for herbicides. The primary nutrient chemicals are identified, and some constituents that have been identified as potentially hazardous by federal or state regulations are also listed. The exposure reduction practices identified in the herbicide treatment health effects analysis could also be applied to fertilizer handling and applications to reduce risk.

### Biological and Grazing Treatments

Biological treatments have been employed on the Custer NF. Grazing goats and sheep is another control treatment utilized to control weeds. There are now known risks to human health resulting from the use of these biological agents or the grazing of goats and sheep.

## HUMAN HEALTH - NON-HERBICIDE TREATMENT EFFECTS – ALTERNATIVE 2

Under Alternative 2, weeds would continue to spread at a rapid rate in comparison to Alternatives 1 and 3. Increase in weeds can impact individuals affected by allergies and minor skin irritations caused by certain noxious weed species. Some species of noxious weeds, such as thistle and knapweeds, cause minor scrapes and irritations.

Approximately 10 to 15 percent of the U.S. population suffers from allergy symptoms from noxious weed species such as knapweed. Knapweed pollen is a common and powerful allergen that peaks in August and produces strongly positive skin allergy tests. It is a significant allergen in causing allergic rhinitis (USFS, Lolo, 2001). Allergies to airborne seeds may complicate or trigger asthma. It may take up to two

years after getting a person's allergies under control to see a benefit in reduced asthma symptoms. Native plants also contain allergens and affect some individuals.

If noxious weeds spread unchecked, people with allergies, asthma and/or contact dermatitis would have to endure the discomfort caused by these ailments. Indirect effects on human health would increase as invasive weeds spread and affect those persons sensitive to them

There would not be any human exposure to herbicides from on NFS lands under alternative 2 and therefore human health risks are negligible.

## HUMAN HEALTH - CUMULATIVE EFFECTS

Cumulative effects looks at past, present, and reasonably foreseeable activities that may have cumulative effects on human health.

### *Past*

Past factors that may have influenced human health on the Custer National Forest include:

- Drilling, operation, and maintenance of oil and gas wells. An additional threat associated with some of these wells is the presence of hydrogen sulfide, which is a poisonous gas.
- Vehicle accidents on National Forest System Roads.
- Recreational accidents from trips and falls, horse riding, ATVs, insect stings, allergic reactions to plants and insect stings.
- Application of both pesticides and herbicides on NFS lands has likely occurred from the mid 1960's and1970s.
- The use of herbicides on private, state and other federal lands adjacent to NFS lands has probably occurred in a timeframe similar to that of the Forest Service.

There are no readily available statistics on the number of people that may have been affected as a result of the above identified past activities.

### *Present*

Present activates on the Custer National Forest that may have an effect on human health are similar to those of the past. Additional activities include:

- The annual treatment of noxious weeds on the Custer National Forest over the last five years has ranged between 800 and 1200 net acres annually.
- Application of herbicides by adjacent federal, state, and private landowners.
- Use of biological agents i.e. flea beetles for control of leafy spurge.
- Use of mechanical methods i.e. mowing, hand and tool grubbing as a treatment tool.

Currently herbicides are be applied by private, county and federal agencies within the administrative boundaries of the Custer National Forest. In all cases applicators are required be certified for herbicide application. Herbicides are thought in all cases to be applied in accordance with EPA Label directions, including the use of prescribed personal protective equipment.

To date there are no readily available statistics of any adverse health effects being reported as a result of the use of or exposure to herbicides used for treating noxious weeds on the Custer National Forest. It is not known if application of herbicides on adjacent private or federal lands has had an additive effect on human health for people utilizing NFS lands, however, if label instruction were followed this seems unlikely.

There are no known significant health effects associated with the use of biological agents such as flea beetles, grazing of livestock or the use of mechanical methods for treating noxious weeds.

***Reasonably Forseeable***

Future activities will continue to include oil and gas development, recreational use, and the continued treatment of noxious weeds by, private, county, other federal agencies. In addition to these activities the following are reasonably foreseeable:

- Herbicides and biological agents are likely to be the most frequently used treatment methods in the foreseeable future under alternatives 1 and 3. Biological agents are likely to be the most frequently used treatment method under alternative 2.
- Under the proposed action, Alternative 1, various densities of infestations within approximately 15,000 gross acres would be treated over the next ten to fifteen year period under alternatives 1 and 3.
- Between 90 and 95 percent of future treatment acreage would likely be treated with ground based herbicide application and 5 to 10 percent would be aerially applied under alternative 1.
- An unknown amount of herbicide treatment would likely occur on private, state and federal lands adjacent to National Forest System lands.

Based on the results of the SERA (1999, 2003-2004) risk assessments and EPA assessments, ongoing and future activities are not expected to result in the exposure of workers or the general public to herbicide doses that exceed the reference dose (RfD). A RFD is a dose of herbicide determined to be safe by the EPA over a lifetime of daily exposure.

With respect to herbicide applications, the SERA (1999, 2003-2004) risk assessments specifically considered the effect of repeated exposure in that the chronic (long term) RfD is used as an index of acceptable exposure. The daily dose rather than the duration of exposure determines the toxicological response. Consequently, repeated exposure to levels below the toxic threshold should not be associated with cumulative effects. If EPA labels are followed the dose a worker or a person of the general public would be exposed to would be below the RfD. Exceptions to this could include acute exposure through an accidental spill or improper handling of a herbicide. Even in these situations immediate mitigation such as washing, prohibiting use or consumption of contaminated water or vegetable matter can be used to reduce or eliminate potential acute effects.

It is entirely possible past, present, and reasonable foreseeable use of herbicides may have resulted in minor impacts to human health such as rashes or other skin irritations. This may be particularly true for hyper-sensitive individuals, however, there is no cumulative evidence to suggest that the past, present, and projected use of the herbicides on the Custer National Forest, will have a cumulative significant effect on worker or public health. This assumes that EPA labels, personal protect equipment and or label requires for such things as aerial application are complied with.

It is important to note that 2, 4-D and Hexazinone offers some concern as the risk analysis shows that chronic worker exposure to ground and aerial application have hazard quotients above 1 (Table 4-6).

The risk analysis for 2, 4 D is very conservative representing a higher level of application then what the Custer NF normally uses. As discussed in the SERA (1999) risk assessment for 2, 4-D there is no evidence that overt signs of toxicity are plausible at exposures to dose levels less than 1 mg/kg/day of 2,4-D. The risk assessment modeling done for 2, 4-D used .01 mg/kg/day as the Rfd. The risk assessment notes that 2, 4-D can be applied safely if thorough and effective methods are used to protect workers and minimize exposure. The herbicide label provides direction on how to safely apply 2, 4-D and if followed exposure would be at or below the Rfd for 2, 4-D. If effective measures of hygiene are not employed, occupational exposure to 2, 4-D could result in adverse but probably not overtly toxic effects.

Hexazinone is of relatively low acute toxicity but is a severe eye irritant. Exposure to workers generally is not expected to pose undue risks, due to hexazinone's overall low acute toxicity. However, based on toxicity concerns regarding primary eye irritation, a 48-hour return entry interval is required under label. (EPA, Re-registration Decision, 9/1994).

In some accidental and extreme exposure scenarios, members of the general public may be exposed to levels of hexazinone above the RfD but still far below the levels projected for workers. While any exposure

above the RfD is considered unacceptable by definition, the exposure estimates for the general public are in a range where the occurrence and nature of potential toxic effects cannot be well characterized. For the general public, as for workers, no signs of frank systemic effects are anticipated after accidental exposure to hexazinone (EPA Re-Registration Decision, 9/1994).

EPA's regulatory conclusion is that the use of currently registered products containing hexazinone in accordance with approved labeling will not pose unreasonable risks or adverse effects to humans or the environment (EPA, 1994 RED Facts).

The additive impact of Custer National Forest use of aminopyralid relative to the effects of private application of herbicide would be very small. The sites where aminopyralid would be used will be small and non-contiguous across the Forest. Aminopyralid will typically be both broadcast and spot sprayed to direct as much of the herbicide as possible at the target weed. Aminopyralid's environmental fate and toxicological profile allow it to be used in areas where proximity of surface or ground waters constrains the use of other herbicides. Its use will replace the use of more toxic herbicides and herbicides with longer half lives (i.e. will replace 2, 4-D and/or picloram for hawkweeds, thistles, and for some areas of knapweed. Since aminopyralid is used at lower per acre rates (~ ¼ to 1/20 of the acid equivalent rate of previously established standard herbicides such as 2,4-D or picloram) and will be used on the Custer NF to replace other herbicides to a moderate degree, total doses to members of the general public from all sources of herbicides are unlikely to be higher than those estimated in the worst case scenarios described in associated risk assessments incorporated by reference in this analysis (EPA, SERA, and FS Human Health Risk Assessments).

There are no anticipated significant cumulative health effects associated with biological, grazing, mechanical, or seeding treatment of noxious weeds.

**Compliance with the Forest Plan and Other Regulatory Direction**

All alternatives are consistent with Environmental Protection Agency, Occupational Health and Safety Administration, State and Federal water and air quality regulations, and Forest Service regulations (FSM 2080,) regarding pesticide use and worker safety.

A biological assessment of potential effects of the preferred alternative on Threatened and Endangered (T&E) wildlife and plant species is located in the Project Record.

The purposed action is consistent with the February 3, 1999 Executive Order 13112 "to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological and human health impacts that invasive species cause."

Montana and South Dakota noxious weed laws direct County control authorities to make all reasonable efforts to develop and implement a noxious weed program. The lack of adequate weed control under Alternatives 2 and 3 would conflict with these State and County weed control plans and policies. Alternative 1 (Proposed Action) indicates that the Forest Service is committed to the management of noxious and undesirable weeds on the Custer National Forest.

**Incomplete or Unavailable Information**

Incomplete and unavailable information that is relevant to the toxicological tests and endpoints were considered in all EPA and Forest Service Risk Assessments (SERA, 1999-2004). Incomplete and unavailable information relating to individual herbicides is identified in each Herbicide Risk Assessment, prepared for the Forest Service under contract by SERA, Inc., BLM assessments, and in EPA Assessments. Incomplete information discussed in these assessments includes the interactions of the herbicides, associated chemicals, and other naturally-occurring and synthesized substances.

# *SOILS AND GROUND WATER*

## SOILS AND GROUND WATER - DIRECT AND INDIRECT EFFECTS

### Herbicides

Herbicides used under alternatives 1 and 3 vary in their persistence in the environment and in their ability to move through the soil, and can pose an unintentional threat to groundwater quality. This analysis incorporates a hazard rating system known as Relative Aquifer Vulnerability Evaluation (RAVE) and GIS data (soil types, proximity to water, location of weeds) to determine area at risk. See the Soil and Ground Water section in Chapter 3 for a more detailed discussion on the methodology used to analyze this issue. The results from the analysis are presented below.

Table 4 - 10 shows RAVE risk classes for the entire Forest, and Table 4 - 11 proportions classes by major land unit. The RAVE map (map section), shows areas at risk for each District area of the Forest. Table 4-12 depicts areas of existing weeds (from the Custer National Forest Invasive Species Inventory) intersected with the risk areas from the RAVE model.

**TABLE 4 - 10. RAVE RISK CLASSES FOR THE ENTIRE FOREST**

| RAVE Score Class | Acres | Percent |
|---|---|---|
| Low | 23,824 | 1.9 |
| Low to Moderate | 1,222,348 | 95.5 |
| High | 32,819 | 2.6 |
| Unacceptable | 391 | 0.0 |
| Total | 1,279,588 | |

**TABLE 4 - 11. RAVE RISK CLASSES BY RANGER DISTRICT**

| District | RAVE Score Class | Acres | Percent |
|---|---|---|---|
| | | | |
| Beartooth - Beartooths | Low to Moderate | 502,193 | 95.5 |
| Beartooth - Beartooths | High | 23,449 | 4.5 |
| | Total | 525,642 | |
| | | | |
| Beartooth - Pryors | Low | 19,350 | 24.8 |
| Beartooth - Pryors | Low to Moderate | 58,534 | 75.2 |
| | Total | 77,884 | |
| | | | |
| Sioux | Low | 1,934 | 1.1 |
| Sioux | Low to Moderate | 164,174 | 93.4 |
| Sioux | High | 9,369 | 5.3 |
| Sioux | Unacceptable | 391 | 0.2 |
| | Total | 175,868 | |
| | | | |
| Ashland | Low | 2,540 | 0.5 |
| Ashland | Low to Moderate | 497,447 | 99.5 |
| | Total | 499,987 | |

**TABLE 4 -12. % OF EXISTING WEED AREA BY RISK CLASS FOR THE FOREST**

| RAVE Score Class | Acres | Gross Acres of Weeds | Percent RAVE Class with Weeds |
|---|---|---|---|
| Low | 23,824 | 24 | |
| Low to Moderate | 1,222,348 | 10513 | 92% |
| High | 32,819 | 997 | 8% |
| Unacceptable | 391 | 0 | |
| Total | 1,279,588 | | |

Though all the factors discussed above influence rating scores, it appears that depth to groundwater and pesticide leachability account for most of the "High" ratings. No portion of the Pryor Mountains or Ashland District is rated High. All land areas of the Forest have been mapped as part of County Soil Surveys by the NRCS except for the Beartooth area. Even though the NRCS mapped all areas, mapping dates from the 1950's to the 1990's. There is a range of data and data quality that has been populated in the NASIS (National Soil Information System) database for the counties involved. For example, areas of rock outcrop can comprise significant areas of some map unit polygons. There are no data entered for these components.

The entire map unit is populated either with data from other components or is null. Also, not all map units are populated with depth to water table, so depth to groundwater may be highly variable. County soil surveys are not to be used for site specific planning because of variability in soil map unit components but can be used for broad scale applications. The data for the Beartooth area is derived from an ongoing integrated ecological unit inventory. These data are considered draft and will be updated as more work is completed. The same cautions should be considered while looking at the results for the Beartooth District. This RAVE model is designed for a programmatic planning level, and is not appropriate for on-site design. The data used in the model is accurate enough to use on a district level if mapped at that scale. This analysis provides useful "red flag" indicators for applications specialists when in areas designated "High" risk, especially when contemplating broadcast applications.

For the case using a highly-leachable herbicide, almost all of the Custer National Forest falls in the "low to moderate" risk class. Less than three percent falls in the "High" class and less than one percent in the "Unacceptable" class (Table 4 - 10). This indicates that as far as groundwater contamination is concerned, careful use of herbicides on most lands on the Forest is likely a reasonable activity. There are "hot spots" in each Ranger District where special protection measures should be considered (see RAVE map in map section). The Beartooth and Sioux Districts have the most area in this class (Table 4 - 11), primarily due to the high elevation plateaus and rocky glaciated cirque basins on the Beartooth district and because of soil textures and depth to ground water on the Sioux District associated with sedimentary plains geology.

In any of these areas, broadcast use of an alternate herbicide with a lower leachability (see Chapter 3, Table 3 -13 for herbicide leachability) should reduce risk to reasonable levels[30].

The RAVE map (see map section) shows there are some areas that should be reviewed for risks of groundwater contamination from broadcast spraying, based on the potential for contamination through existing weed infestations and potential future contamination if weeds are found in or migrate to those areas. The areas having existing weed infestations in "High" risk areas should have special protection measures designed into all current treatment plans.

Although only a small portion of weed infestations fall into the "High" risk areas (Table 4 - 12), there are some areas of specific concern. Areas having both a significant area in "High" risk and a significant area of weeds in those "High" risk areas should use herbicides that have low leaching potential or special protection measures. Areas of "Low to Moderate" risk can be evaluated at a less intense level. In terms of long term planning, areas having few weeds, but some potential for contamination should include prevention and weed surveys at a higher level than other areas to prevent the establishment of weeds into those areas. For example, the Beartooth Plateau area (see RAVE map in map section) has few weeds at

[30] High-risk areas average a score of around 70. Selecting an alternative herbicide with a low leachability gives a rating factor value of 5 rather than 20 which lowers the average score to 55, well within the "Low to Moderate" risk class (Chapter 3, Table 3 - 13).

present. However because of shallow groundwater and abundant surface water, the area is specified for special protection measures (see Appendix C) as well as increased preventative measures such as travel restrictions or washing guidelines for vehicles.

**Surfactants**

Based on the following studies, it appears that the ability to increase the mobility of other materials throughout the soil profile is a function of the concentration of the surfactant in the soil solution. Surfactants have been used as tools for site amelioration of soil pollution, through their ability to solubilize hydrophobic compounds.

Surfactants applied to the soil, as part of a pesticide application under alternatives 1 and 3, or in subsequent applications, would remain on the soil surface until decomposed unless driven down by water, thereby also diluting the surfactant in the soil/water system.

It appears that biodegradation of pesticides can be affected by surfactants in the soil, however this too is concentration dependent similar to desorption effects. It appears that effects to pesticide biodegradation are through preferential degradation of the surfactant rather than through a toxic action on microorganisms.

Although the potential exists for surfactants to affect the environmental fate of herbicides in soil, any potential effects would be unlikely under normal conditions because of the relatively low concentration of surfactants in the soil/water matrix (Bakke 2002). Localized effects could be seen if a spill occurred on soil, so that concentrations of surfactant approached or exceeded about 1,000 ppm.

**Mechanical**

Under all alternatives, mechanical weed control practices such as tilling could result in slight short-term increases in erosion. The erosion rates would quickly decline as desirable vegetation reoccupies the treated area. No impacts from mechanical treatment would occur under any alternative.

Prescribed burning of weed stands would not create the extremely high fire intensities that cause high losses of soil organic matter, the major source of nitrogen and sulphur in the soil In addition to nitrogen and sulphur, nutrients, such as calcium, potassium, and phosphorous might be lost, resulting in short-term release of nitrogen from the grunt organic matter. Soil productivity could be slightly reduced by the destruction of some soil microorganisms, but impacts would be minor and short-lived because these alternatives would not involve the intense fires that reduce microorganisms most dramatically. Short-term, slight increases in erosion could occur until vegetation reoccupies the treated area.

**General Effects**

Generalizing from the above discussion, it appears that under Alternatives 1 and 3 the Custer Forest has a low to moderate potential for groundwater contamination from foliar-applied herbicides. The areas of higher risk probably can be mitigated with herbicide selection to minimize that contamination potential.

A positive effect of Alternatives 1 and 3 is that weed incidence on the Forest will be reduced. The removal of exotic species is generally beneficial for the soil-part of the ecosystem and there should be beneficial effects here.

Alternative 2 will not use herbicides in areas at risk to ground water contamination so there is no associated risk. However, the weeds will continue to spread under these alternatives and this will eventually lead to a reduction in soil productivity as has been documented in the Gallatin National Forest Weed FEIS (2005), Beaverhead-Deerlodge Noxious Weed Control EIS and in the Helena National Forest Weed EIS (USFS, 2002; USFS; 2003).

## CUMULATIVE EFFECTS TO SOILS AND GROUND WATER

Other foreseeable actions include treatment of weeds by other agencies or by private landowners within these areas at risk to ground water contamination. Although directions on herbicide labels prohibit applying herbicide in areas at risk to ground water contamination, people have not always followed these directions and there is always the risk of an accidental spill in an area with a high water table. However, with this analysis the areas at risk are easily discernable and herbicides that leach rapidly into the soil and aquifer will not be used in these areas. Given the protection measures there is a very low risk of ground water contamination from multiple applications of herbicides (either from multiple application within a watershed or over many years of continuous treatments).

### Irreversible and Irretrievable Commitment of Resources - to Soils and Ground Water

No irreversible or irretrievable commitment of soil or ground water resources is expected to result from any of the alternatives. Protection measures are in effect to control long-term impacts from herbicide treatments: consequently, Alternatives 1 and 3 will not impact these resources. Alternative 2 will not effectively control the spread of weeds so there will be an irreversible loss of soil productivity.

### Consistency with Forest Plan and other Laws, Regulations and Policies to Soils

As each alternative provides some measure of weed control, they are consistent with the Forest Plan standard, which states that management activities would be planned to sustain site productivity. They are consistent with the Soil Conservation and Domestic Allotment Act (16 USC 590), as they limit decreases in soil productivity and suppress sedimentation. These alternatives are also consistent with 43 CRF § 1901 and MCA 76-13-101 which authorize land supervisors to manage vegetation in a way that reduces soil erosion. Additionally, preventing weed propagation is consistent with related public laws outlined in Chapter 2. Alternatives 1 and 3 would be consistent with direction in the Forest Plan and other laws regarding weed control. Alternative 2 would be consistent with direction in the Forest Plan and other laws regarding weed control, but is not a very effective approach.

# *WATER QUALITY, FISHERIES, AND AMPHIBIANS*

Impacts on aquatic organisms, including fish, amphibians, and their habitat, including Management Indicator Species and sensitive species, were analyzed by considering:

- Research results and other literature on individual herbicide characteristics and toxicities for different aquatic species;
- Studies evaluating potential for herbicide entry into surface and groundwater, via different routes (leaching, overland flow, direct application, and drift);
- Results of recent analyses conducted by other National Forests in Region 1;
- Specific protection measures comprising part of each alternative for this EIS;
- Scope of the proposed treatments;
- Treatment methods proposed within alternatives;
- Proximity of proposed treatments to water bodies supporting westslope and Yellowstone cutthroat trout and other sensitive species.

## EFFECTS OF NON-HERBICIDE TREATMENTS TO ALL ALTERNATIVES

The non-herbicide treatments proposed under this alternative will have negligible effects on water resources. Mechanical treatments could result in localized soil disturbance but an increase in sediment to streams would likely be undetectable for several reasons. Disturbed areas would be minimal and localized, and would be reseeded with desirable species after treatment, reducing erosion as roots become established. Cultural treatments (seeding, transplanting, and fertilizing) would not affect fisheries or water quality. Fertilizers would be applied according to Forest Service and manufacturer guidelines.

Runoff nutrient concentrations would not be large enough to measurably enrich streams. Seeding and transplanting would involve limited soil disturbance. Release of biological control agents would have no direct effect on fisheries or surface water quality. These agents would not compete with aquatic insect species since their food base is very specific, nor would they provide more than an incidental food source for fish.

Mechanical treatments such as grazing, burning, and mowing could affect suspended sediments, total dissolved solids, or water temperature. Physical restriction on tilling (such as steep slopes) would prevent significant impacts to water quality. Tilling for weed control on a small scale with streamside buffer strips can benefit water quality. The tilling action breaks the ground surface and allows a greater infiltration rate. Infiltration rates very with soil types and slopes. But terrain restrictions and the scattered nature of weeds do not allow the widespread use of this technique. At the present time, tilling methods have not proved to be effective for the weed species found on the Custer National Forest.

Grazing with sheep or goats to control selected weeds would produce little effect on overall water quality although trampling within the stream channels could degrade water quality. Water quality indicators such as coliform numbers would increase, and in shallow streams might exceed drinking water standards. These exceedance periods, however, would extend no longer than 24 hours after livestock removal.

Burning to control weeds removes top vegetation until the next growing season or fall green up. This removal of vegetation cover would increase the potential of surface runoff and might increase suspended sediment and total dissolved solids levels in the streams until regrowth occurs. The amount of sediment reaching streams is generally proportional to the amount of bare soil in a watershed. The size of the impact from a treatment would depend on the amount of exposed soil, severity of the burn, and distance to the nearest stream.

In summary, the control of noxious weeds using methods described for this alternative would benefit both fish and amphibian habitat conditions by retaining or improving native vegetation both in riparian and upslope areas. The protection measures described above greatly reduce the likelihood that herbicide application will have any negative impacts.

## WATER QUALITY, FISHERIES AND AQUATICS - EFFECTS OF HERBICIDES APPLICABLE TO ALTERNATIVES 1 AND 3

Several Forest Service environmental assessments and environmental impact statements have been conducted in recent years (Gallatin National Forest Weed FEIS (2005), Beaverhead-Deerlodge Noxious Weed Control EIS and in the Helena National Forest Weed EIS (USFS, 2002; USFS; 2003)). Individually or collectively, these analyses looked at the general effects of herbicides on the major fish, amphibians and invertebrates. None of these analyses determined that there would be significant to fisheries and other aquatic life from the proper use of these herbicides.

### Herbicide Toxicity to Amphibians and Fish

Mayer and Ellersieck (1986) reviewed 4,901 acute toxicity tests of over 400 herbicides stored in the database of the US Fish and Wildlife Service, to determine if there were any statistically valid trends that could be used to compare the 66 species studied. They found there is no single species, family or class that, in all cases, is most sensitive to chemicals. They agreed with the conclusions of others, that species best represent themselves and not others, but also observed it was somewhat common that insects were more sensitive to most herbicides than crustaceans, followed by fish, then amphibians (the least sensitive class). Insects and amphibians, however, have been inconsistently studied making it hard to determine any pattern of statistical significance.

A number of herbicides proposed for use on the Custer National Forest show potential for being toxic to amphibians and fish. A general comparison of lethal toxicity levels (LC50) for salmonids and other aquatic species exposed to certain herbicides are provided in the following table. An overview of the effects of the proposed herbicides on aquatic organisms is provided in Table 4 – 13.

## TABLE 4 - 13. EFFECTS OF THE PROPOSED HERBICIDES ON AQUATIC ORGANISMS[31]

| Common Name | Effects to Aquatic Organisms |
|---|---|
| 2,4-D | 2,4-D forms range from being practically nontoxic to highly toxic to fish and aquatic invertebrates. 2,4-D amine salt forms are generally non-toxic to fish. Those compounds most toxic to fish include the 2,4-D ester formulations, N-oleyl-1,3-propylenediamine salt, and the N,N-dimethyl-oleyl-linoleylamine. |
| Aminopyralid | Aminopyralid is practically nontoxic to fish and aquatic invertebrate animals. It does not build up (bioaccumulate) in fish. |
| Chlorsulfuron | Chlorsulfuron is practically nontoxic to most fish and aquatic invertebrate animals. It does not build up (bioaccumulate) in fish. |
| Clopyralid | Clopyralid is of low toxicity to fish and aquatic invertebrate animals. Clopyralid does not build up (bioaccumulate) in fish tissues. |
| Dicamba | Dicamba is slightly toxic to fish and amphibians. It is practically non-toxic to aquatic invertebrates. Dicamba does not accumulate or build up in aquatic animals. Dicamba and its formulations have not been tested for chronic effects in aquatic animals. |
| Diuron | Diuron is moderately toxic to the majority of aquatic animals tested, including rainbow trout. However, it is highly toxic to cutthroat trout and scuds. Diuron is only slightly acutely toxic to fathead minnows. |
| Glyphosate | Glyphosate is no more than slightly toxic to fish, and practically non-toxic to aquatic invertebrate animals. It does not build up (bioaccumulate) in fish. The Accord and Rodeo formulations are practically non-toxic to freshwater fish and aquatic invertebrate animals. The Roundup formulation is moderately to slightly toxic to freshwater fish and aquatic invertebrate animals due to its pre-mixed non-aquatic surfactant. Glyphosate and its formulations have not been tested for chronic effects in aquatic animals. |
| Hexazinone | Hexazinone is practically nontoxic to fish, freshwater invertebrates and mollusks, and is slightly toxic to crustaceans. No toxicity studies have been reported for amphibians. No chronic studies have been reported for aquatic organisms. The liquid and solid carriers in two commercial hexazinone formulations were found to be of extremely low toxicity to fish. |
| Imazapic | Imazapic ranks as a “low risk” herbicide for fish, classed in the same category as 2,4-D, glyphosate, clopyralid, dicamba, and metsulfuron methyl. Neither published literature nor the U.S. EPA files include data regarding the toxicity of imazapic to amphibian species. Aquatic organisms appear to be relatively insensitive to imazapic exposure, relative to both direct toxicity and reproductive effects. |
| Imazapyr | Imazapyr and its formulations are low in toxicity to invertebrates and practically non-toxic to fish. Imazapyr is not expected to accumulate or build up in aquatic animals. Imazapyr and its formulations have not been tested for chronic effects in aquatic animals. |
| Methsulfuron methyl | Metsulfuron methyl is practically nontoxic to fish and aquatic invertebrates. Metsulfuron methyl does not build up (bioaccumulate) in fish. |
| Picloram | Picloram is moderately to slightly toxic to freshwater fish, and slightly toxic to aquatic invertebrate animals; it does not build up in fish. The formulated product is generally less toxic than picloram. Picloram and its formulations have not been tested for chronic effects in aquatic animals. |
| Sulfometuron methyl | Sulfometuron methyl is slightly toxic to fish and aquatic invertebrates. The potential for sulfometuron methyl to build up in fish tissues (bioaccumulate) is low. |
| Triclopyr | Triclopyr is low in toxicity to fish. The ester form of triclopyr, found in Garlon 4, is more toxic, but under normal conditions, it rapidly breaks down in water to a less toxic form. Triclopyr does not accumulate in fish. Triclopyr is slightly toxic to practically non-toxic to invertebrates. Triclopyr and its formulations have not been tested for chronic effects in aquatic animals. |

[31] http://www.fs.fed.us/foresthealth/pesticide/index.shtml and EPA 9/30/2003.

Below is a summary of risk characterization to aquatic species for each herbicide from human health and ecological risk assessment documents prepared for the Forest Service (USFS, SERA 199-2004). These summaries relate the expected direct effects of exposure and ingestion. They do not address the indirect effects of habitat alteration.

**2, 4-D**

Under any foreseeable set of conditions (during Forest Service use), no impact is anticipated in any aquatic species from the general use of 2, 4-D in a watershed.

**Aminopyralid**

Aminopyralid has been shown to be practically non-toxic to fish and aquatic invertebrates. Aminopyralid is slightly toxic to eastern oyster, algae and aquatic vascular plants. Aminopyralid is not expected to bioaccumulate in fish tissue.

There are no acute or chronic risks to non-target endangered or non-endangered fish, birds, wild mammals, terrestrial and aquatic invertebrates, algae or aquatic plants.

**Clopyralid**

The risk characterization for aquatic animals is limited by the relatively few animal and plant species on which data are available compared to the large number of species that could potentially be exposed. This limitation and consequent uncertainty is common to most if not all ecological risk assessments.

The risk assessment for aquatic organisms is relatively simple and unambiguous. Clopyralid appears to have a very low potential to cause any adverse effects in any aquatic species.

**Chlorsulfuron**

The risk characterization for aquatic animals is relatively simple and unambiguous. Chlorsulfuron appears to have a very low potential to cause any adverse effects in aquatic animals. All of the hazard quotients for aquatic animals are extremely low, ranging from $8^{-10}$ (longer term exposures in tolerant invertebrates) to 0.001 (acute exposures to sensitive aquatic invertebrates). At the maximum application rate of 0.25 lbs/acre, the risk characterization is unchanged: the highest hazard quotient 0.001 would be increased to 0.005, below the level of concern by a factor of 200.

**Dicamba**

The risk characterization for aquatic animals is extremely limited by the available toxicity data. For the characterization of risk, NOEC values are not used directly and risks are characterized 50 using LC values. Another very substantial limitation in the risk characterization is that no information is available on the chronic toxicity of dicamba to aquatic animals and the available acute toxicity data do not permit reasonable estimates of toxicity values for chronic toxicity. Within these very serious limitations, there is little basis for asserting that adverse effects in aquatic animals are plausible. This conclusion is consistent with a recent assessment by the U.S. EPA on the impact of dicamba on Pacific anadromous salmonids.

**Diuron**

Diuron is moderately toxic to the majority of aquatic animals tested, including rainbow trout, bluegill sunfish, water flea, striped mullet, sheepshead minnow, Eastern oyster, and brown shrimp. However, it is highly toxic to cutthroat trout and scuds. Diuron is only slightly acutely toxic to fathead minnows. In chronic studies, diuron reduced the number of surviving fathead minnows, the growth and survival of sheepshead minnows, and the growth and reproduction of mysid shrimp.

Acute risk quotients for freshwater fish and invertebrates are relatively low ranging from 0.03 to 2.6; however, limited incident data suggest that diuron may pose an acute risk to fish. Chronic risk quotients for freshwater fish range from 0.3 to 9. Acute and chronic risk quotients for estuarine and marine fish and

invertebrates are low, with the highest risk quotient of 1.3 for chronic risk to marine invertebrates, based on the 12 lb. application rate to rights-of-way.

The protection measures required for labeling under the 2003 EPA re-registration decision serves to decrease risk to non-target species.

**Glyphosate**

The primary hazards to fish appear to be from acute exposures to the more toxic formulations. At the typical application rate of 2 lbs a.e./acre, the hazard quotients for the more toxic formulations at the upper ranges of plausible exposure indicate that the LC50 values for these species will be not reached or exceeded under worst-case conditions. At an application rate of 7 lbs a.e./acre, the acute exposures are estimated to slightly exceed the LC50 value for typical species and exceed the LC50 value for sensitive species by a factor of about 2. In these worst-case scenarios, the exposure estimates are based on a severe rainfall (about 7 inches over a 24 hour period) in an area where runoff is favored – a slope toward a stream immediately adjacent to the application site. This is a standard worst-case scenario used in Forest Service risk assessments to guide the Forest Service in the use of herbicides. This risk characterization strongly suggests that the use of the more toxic formulations near surface water is not prudent.

The use of less toxic formulations results in acute hazard quotients that do not approach a level of concern for any species. Nonetheless, the hazard quotient of 0.08 for sensitive species at an application rate of 2 lbs/acre is based on an LC50 value rather than a NOEC. Thus, the use of glyphosate near bodies of water where sensitive species of fish may be found (i.e., salmonids) should be conducted with substantial care to avoid contamination of surface water. Concern for potential effects on salmonids is augmented by the potential effects of low concentrations of glyphosate on algal populations.

The likelihood of direct acute toxic effects on aquatic invertebrates or longer term direct effects on any fish species seems extremely remote based on central estimates of the hazard quotient and unlikely base on upper ranges of the hazard quotient. The hazard quotient of 0.044 for longer term effects of the more toxic formulations on sensitive fish is based on an estimated NOEC and thus is not, in itself, of substantial concern.

**Hexazinone**

The toxicity of hexazinone to aquatic species is well-characterized. Comparable studies on aquatic algae and aquatic animals clearly indicate that most algal species are much more sensitive to hexazinone, compared with fish and aquatic invertebrates. By analogy to the toxicity of hexazinone to terrestrial plants, it seems likely that aquatic macrophytes also may be very sensitive to the toxic effects of hexazinone. Other than lethality, the most common effect noted on aquatic animals is growth inhibition, which is also the most sensitive effect in experimental mammals. Only one study regarding amphibians was located, and it suggests that amphibians are less sensitive than fish or aquatic invertebrates to hexazinone.

**Imazapic**

Adverse effects in aquatic animals do not appear to be likely. The weight of evidence suggests that no adverse effects in fish or aquatic invertebrates are plausible using typical or worst-case exposure assumptions at the typical application rate of 0.1 lb/acre or the maximum application rate of 0.1875 lb/acre. As in any ecological risk assessment, this risk characterization must be qualified. Imazapic has been tested in only a limited number of species and under conditions that may not well-represent populations of free-ranging nontarget animals. Notwithstanding this limitation, the available data are sufficient to assert that no adverse effects on animals are anticipated based on the information that is available.

**Imazapyr**

Adverse effects in aquatic animals do not appear to be likely. The weight of evidence suggests that no adverse effects in fish or aquatic invertebrates are plausible using typical or worst-case exposure assumptions at the typical application rate of 0.45 lb/acre or the maximum application rate of 1.25 lb/acre. As in any ecological risk assessment, the risk characterization must be qualified. Imazapyr has been

tested in only a limited number of species and under conditions that may not well-represent populations of free-ranging non-target organisms. Notwithstanding this limitation, the available data are sufficient to assert that no adverse effects on animals are anticipated based on the information that is available.

**Metsulfuron Methyl**

The risk characterization for aquatic animals is relatively simple and unambiguous. Metsulfuron methyl appears to have a very low potential to cause any adverse effects in aquatic animals. All of the hazard quotients for aquatic animals are extremely low, with a range in fish from $3^{-10}$ (acute exposures in tolerant fish) to $3^{-5}$ (longer-term exposures to sensitive fish). It should be noted that confidence in this risk characterization is reduced by the lack of chronic toxicity studies in potentially tolerant fish – i.e., bluegill sunfish trout. At the maximum application rate of 0.15 lbs/acre, all of the hazard quotients would be increased by a factor of about 5. However, this difference has no impact on the risk characterization for fish. Hazard quotients in aquatic invertebrates range from $7^{-10}$ (acute exposure in Daphnia) to $7^{-7}$ (acute exposure in Daphnia). Thus, there is no basis for asserting that adverse effects on aquatic animals are likely.

**Picloram**

There is substantial variability in the toxicity of picloram to aquatic species. While this variability adds uncertainty to the dose-response assessment, it has no substantial impact on the risk characterization. None of the hazard indices for fish, aquatic invertebrates, or aquatic plants reach a level of concern. The risk characterization for both terrestrial and aquatic species is limited by the relatively few animal and plant species on which data are available compared to the large number of species that could potentially be exposed. This limitation and consequent uncertainty is common to most if not all ecological risk assessments.

**Sulfometuron Methyl**

Sulfometuron methyl appears to have a very low potential to cause any adverse effects in aquatic animals. All of the hazard quotients for aquatic animals are extremely low, with a range of $2^{-9}$ (lower range for acute exposures in tolerant aquatic invertebrates) to 0.004 (longerterm exposures to amphibians). It should be noted that confidence in this risk characterization is reduced by the lack of chronic toxicity studies in potentially tolerant fish and potentially sensitive aquatic invertebrates and lack of data in amphibians (data only available in a single species). Even with these uncertainties, there is no basis for asserting that adverse effects on aquatic animals are likely.

**Triclopyr**

Both triclopyr and the insecticide chlorpyrifos produce the metabolite 3, 5, 6-trichloro-2-pyridinol (TCP). TCP is similar in toxicity to triclopyr and less toxic than chlorpyrifos. The risk characterization for TCP is considered quantitatively only for fish because toxicity data are available only for fish. At the typical application rate of 1 lb a.e./acre, the worst case hazard quotients are below the level of concern. That the maximum application rate of 10 lbs a.e./acre, the hazard quotients would be a factor of 10 higher and the hazard quotient for longer term exposure would be substantial (hazard quotient = 9). Thus, if triclopyr is applied at higher rates of exposure in areas where surface water contamination is plausible, site-specific modeling and/or environmental monitoring would be useful to ensure and verify that concentrations TCP do reach harmful concentrations. Concentrations of TCP in surface water after the application of triclopyr at 1 lb a.e./acre and chlorpyrifos at 1 lb a.e./acre are well below a level of concern. Thus, the concern for TCP residues in surface water appears to be associated with high application rates of triclopyr rather than applications of triclopyr and chlorpyrifos in the same area.

### Surfactants

Effects on aquatic organisms are driven by the same dose-response principles as any other group of organisms (i.e., dosage thresholds can be determined for various effects). There are interspecies differences, as well as differences within species depending upon age; however the results of studies on the same surfactants are consistent with each other. It does appear that in general, the surfactants used in forestry can affect aquatic organisms at lower doses than for terrestrial organisms (Bakke 2002).

Surfactants are proposed for use with the same protection measures as picloram (see Appendix C). Only those labeled for use in and around water would be used within 50 feet of water, or the edge of subirrigated land, whichever distance is greater, or on high run-off areas. Some surfactants are labeled for use in and around water including: Activate Plus ®, LI-700 ®, Preference ®, R-11 ®, Widespread® and X-77®.

## WATER QUALITY, FISHERIES, AND AMPHIBIANS - DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 1 (PROPOSED ACTION)

### General Effects – Herbicide Application

Potential effects to aquatic organisms from noxious weed management are largely associated with herbicide application on and around streams, lakes or wetlands. Contamination can occur through direct herbicide contact with surface water from either inadvertent application or accidental spill. It may also occur indirectly when herbicides are routed through ditch and irrigation channel networks, routed from adjacent slopes through overland flow, or through contaminated groundwater inflow from herbicides previously leached through soils. Each route of entry results in varied magnitude and duration of contamination.

Aerial spraying near aquatic zones has the most potential to expose aquatic organisms to contaminants, either through direct application or drift. The high potential is due to the inability to target only exact weed locations or completely control drift, both of which can result in unnecessary or inaccurate application of herbicides.

Ground-based application of herbicides may also enter streams directly or through drift. However, the risk of contamination from ground-based equipment is lower because the application is localized and more controlled. Applicators are able to immediately recognize problems and adjust application techniques.

Indirect routing of herbicides to surface waters through overland flow processes is a consideration for some herbicides. Risks vary with the persistence of active ingredients, soil and vegetation characteristics and condition, and the intensity and timing of precipitation events following herbicide application. Overland flow occurs infrequently on most well vegetated forests and rangelands because soil infiltration capacity is generally greater than precipitation. Compacted soil with sparse vegetation typically results in increased potential for surface runoff. The likelihood that an isolated, intense storm would occur right after herbicide application and center itself on a treated area is very low. However, as a risk reduction measure, review of weather forecasts prior to herbicide application is a required protection measure. Using weather forecasts to guide applications should reduce the probability that overland flow would route herbicides to adjacent waterbodies. Based on results from Watson, Rice and Monnig (1989), photo-decay of picloram ranged from 22 to 44 percent within seven days.

Leaching through the soil profile is also a routing mechanism, but generally poses the least risk to aquatic environments. While there are exceptions, most herbicides disappear quickly from both the ground surface and soil. Reduced potential for leaching is largely facilitated by plant uptake of the herbicide, natural decomposition and volatilization of active ingredients, and/or adsorption of the herbicide by soil particles. Most groundwater contamination by herbicides results from point sources such as spills and leaks at storage and handling facilities, improperly discarded containers, or rinsing equipment at inappropriate locations. Point sources are generally discrete, identifiable locations that discharge relatively high local concentrations of herbicides. Such problems can be avoided through proper handling of herbicide containers and application equipment.

Impacts of weed infestations on amphibians have not been adequately evaluated. Maxell (2000) indicated, however, that non-native aquatic and terrestrial weeds can form dense stands that may exclude native amphibians, thus reducing available habitat. Weed management with chemical herbicides have the potential to impact amphibian communities. Many amphibians have vascularization in the epidermis of the skin, which allows easy absorption of toxicants (Maxell 2000). Effects of chemical contamination range from direct mortality to sublethal effects, such as reductions in disease resistance, changes in growth, decreased reproductive ability and morphological abnormalities (Cooke 1981; Hall and Henry 1992; Boyer and Grue 1995; Carey and Bryant 1995).

**Specific Effects – Herbicide Application**

Of the herbicides proposed for use on the Custer National Forest, picloram has the greatest potential to impact aquatic fauna. It persists longer than other herbicides, is slightly to moderately toxic to aquatic organisms, and is currently being used to control weeds on the Forest. Results from the risk analysis described in Chapter 3 are listed in Table 4 - 14. These results are based on herbicide application over the course of one field season. The results assume that the accumulation of persistent herbicides over time will not occur to a significant degree because 1) picloram has a half life of 90 days, and 2) repeat aerial application over consecutive years is highly unlikely.

## TABLE 4 - 14 – SURFACE WATER RISK ANALYSIS (Beartooth District – Picloram Analysis)

| Watershed | | Weed Polygon Areas | | Herbicide (pounds of picloram) | | Streamflow | | Maximum Allowable Annual Treatment | |
|---|---|---|---|---|---|---|---|---|---|
| 6th HUC Number | Acres | Actual infested noxious weed acres | Proposed aerial treatment areas | Applied to land surface at 0.25lb/ac[32] | Routed to surface waters at 0.015 routing coefficient[33] | Estimated low flow (Q95) (cfs) | Estimated concentration of picloram in receiving waters (ppm)[34] | Total acres - all treatment types | Percent of aerial polygon[35] |
| **100700050110** | 42055 | 0 | 0 | 0.0 | 0.0 | 9.0 | 0.000 | 243 | N/A |
| **100700050120** | 18344 | 0 | 0 | 0.0 | 0.0 | 4.3 | 0.000 | 116 | N/A |
| **100700050130** | 14482 | 39 | 0 | 9.8 | 0.1 | 3.5 | 0.031 | 94 | N/A |
| **100700050140*** | 114666 | 84 | 0 | 20.9 | 0.3 | 22.0 | 0.011 | 594 | N/A |
| **100700050150** | 43337 | 4 | 0 | 1.0 | 0.0 | 9.2 | 0.001 | 249 | N/A |
| **100700050160#** | 31710 | 10 | 516 | 47.7 | 0.7 | 7.0 | **0.076** | 189 | 37 |
| **100700050170*#** | 215911 | 206 | 5442 | 527.6 | 7.9 | 38.8 | **0.151** | 1046 | 19 |
| **100700050210** | 35382 | 3 | 0 | 0.8 | 0.0 | 7.7 | 0.001 | 208 | N/A |
| **100700050220*** | 72361 | 11 | 0 | 2.9 | 0.0 | 14.6 | 0.002 | 394 | N/A |
| **100700050230*#** | 92378 | 11 | 0 | 2.9 | 0.0 | 4.6 | 0.007 | 125 | N/A |
| **100700050240#** | 25909 | 4 | 0 | 1.0 | 0.0 | 5.8 | 0.002 | 157 | N/A |
| **100700050310#** | 11770 | 35 | 852 | 83.3 | 1.2 | 2.9 | **0.321** | 78 | 9 |
| **100700050320*#** | 23295 | 41 | 2701 | 246.6 | 3.7 | 42.5 | 0.065 | 1146 | 42 |
| **100700050330#** | 12177 | 3 | 23 | 2.8 | 0.0 | 3.0 | 0.010 | 80 | 100 |
| **100700050340** | 16840 | 0 | 0 | 0.0 | 0.0 | 4.0 | 0.000 | 107 | N/A |
| **100700050410** | 30501 | 0 | 0 | 0.0 | 0.0 | 6.8 | 0.000 | 182 | N/A |
| **100700050420*** | 60280 | 5 | 0 | 1.3 | 0.0 | 12.4 | 0.001 | 335 | N/A |
| **100700050430#** | 17932 | 3 | 0 | 0.8 | 0.0 | 4.2 | 0.002 | 113 | N/A |
| **100700050440#** | 22469 | 10 | 0 | 2.5 | 0.0 | 5.1 | 0.006 | 139 | N/A |
| **100700060101** | 39469 | 0 | 0 | 0.0 | 0.0 | 8.5 | 0.000 | 229 | N/A |
| **100700060104** | 22390 | 0 | 0 | 0.0 | 0.0 | 5.1 | 0.000 | 138 | N/A |
| **100700060105** | 27497 | 0 | 0 | 0.0 | 0.0 | 6.2 | 0.000 | 166 | N/A |
| **100700060107** | 24177 | 0 | 0 | 0.0 | 0.0 | 5.5 | 0.000 | 148 | N/A |
| **100700060511** | 24881 | 13 | 0 | 3.3 | 0.0 | 5.6 | 0.007 | 152 | N/A |
| **100700060601#** | 39543 | 0 | 0 | 0.0 | 0.0 | 8.5 | 0.000 | 230 | N/A |
| **100700060606*#** | 37019 | 3 | 0 | 0.8 | 0.0 | 8.0 | 0.001 | 217 | N/A |
| **100700060607#** | 16700 | 3 | 0 | 0.7 | 0.0 | 3.9 | 0.002 | 106 | N/A |
| **100700060608#** | 28441 | 0 | 0 | 0.0 | 0.0 | 6.3 | 0.000 | 171 | N/A |
| **100700060901#** | 32086 | 7 | 0 | 1.6 | 0.0 | 7.1 | 0.003 | 191 | N/A |
| **100700060902** | 24206 | 1 | 0 | 0.2 | 0.0 | 5.5 | 0.000 | 148 | N/A |
| **100700060903*** | 82414 | 68 | 0 | 34.0 | 0.5 | 16.4 | 0.023 | 443 | N/A |
| **100700060904** | 21136 | 0 | 0 | 0.1 | 0.0 | 4.9 | 0.000 | 131 | N/A |
| **100700060905*** | 43703 | 58 | 0 | 28.9 | 0.4 | 9.3 | 0.035 | 251 | N/A |
| **100700061001#** | 30089 | 4 | 0 | 1.0 | 0.0 | 6.7 | 0.002 | 180 | N/A |
| **100700061002#** | 21694 | 0 | 0 | 0.0 | 0.0 | 5.0 | 0.000 | 134 | N/A |
| **100700061005** | 32363 | 51 | 54 | 17.4 | 0.3 | 7.1 | 0.027 | 192 | 100 |
| **100800100501** | 13739 | 38 | 0 | 9.5 | 0.1 | 3.3 | 0.032 | 89 | N/A |
| **100800100502*#** | 35357 | 40 | 0 | 10.0 | 0.2 | 7.7 | 0.014 | 208 | N/A |

[32] 100% of infested acres and 35% of aerial acres treated. 0.25 lb/ac rate used assuming typical mix with 2,4-D for effective aerial treatment of similar area weeds by local Stillwater and Carbon County aerial application rates.
[33] Assumes 50 percent of the treatment acres are runoff dominant with a routing coefficient of 0.02, and 50 percent are infiltration dominant with a coefficient of 0.01.
[34] Compare values to the 0.075 ppm threshold. Values listed in **bold** exceed this threshold and indicate where surface water risk should be reassessed during aerial contract preparation. The threshold value was derived by taking 1/20 of the 96 hour LC-50 for cutthroat trout (1/20th of 1.5 ppm).
[35] Assumes no ground-based treatment occurs during the same year.

| Watershed | | Weed Polygon Areas | | Herbicide (pounds of picloram) | | Streamflow | | Maximum Allowable Annual Treatment | |
|---|---|---|---|---|---|---|---|---|---|
| 6th HUC Number | Acres | Actual infested noxious weed acres | Proposed aerial treatment areas | Applied to land surface at 0.25lb/ac[32] | Routed to surface waters at 0.015 routing coefficient[33] | Estimated low flow (Q95) (cfs) | Estimated concentration of picloram in receiving waters (ppm)[34] | Total acres - all treatment types | Percent of aerial polygon[35] |
| **100800100503#** | 15650 | 0 | 0 | 0.1 | 0.0 | 3.7 | 0.000 | 100 | N/A |
| **100800100504#** | 20370 | 0 | 0 | 0.0 | 0.0 | 4.7 | 0.000 | 127 | N/A |
| **100800100801#** | 22737 | 0 | 0 | 0.0 | 0.0 | 5.2 | 0.000 | 140 | N/A |
| **100800140401#** | 31025 | 48 | 0 | 12.0 | 0.2 | 6.9 | 0.019 | 185 | N/A |
| **100800140402*#** | 68121 | 50 | 0 | 12.5 | 0.2 | 13.8 | 0.010 | 373 | N/A |
| **100800140403#** | 90333 | 50 | 0 | 12.5 | 0.2 | 17.8 | 0.008 | 480 | N/A |
| **100800140404#** | 129195 | 50 | 0 | 12.6 | 0.2 | 24.5 | 0.006 | 661 | N/A |
| **100800140405#** | 22125 | 0 | 0 | 0.0 | 0.0 | 5.1 | 0.000 | 137 | N/A |
| **100800140502#** | 37344 | 0 | 0 | 0.0 | 0.0 | 8.1 | 0.000 | 218 | N/A |

*All values in these watersheds are corrected to account for cumulative influence of contributing watersheds upstream.
# These watersheds have significant acreage below the Forest boundary. The degree of noxious weed infestation and the amount of herbicide applied on private land is unknown, and therefore not accounted for in the values listed.

These results suggest that ground based application of picloram at 0.25 lb/acre is not likely to exceed safe concentrations in any of the watersheds evaluated. This is mainly due to the low level of weed infested acres within these watersheds, but also due to the relatively high estimated Q95 flow.

These results also suggest that half (those reflected with bold type in the above table) of the six watersheds with proposed aerial application (Beartooth District Stillwater and Dry Creek areas) will likely exceed safe concentrations under the assumption that 35% of the aerial mapped polygon is treated (see Map Section - Beartooth District Alternative One). Aerial applications in these areas under the assessment assumptions would need to limit the treatment acres with picloram as shown in the above table, or use herbicides approved for use near surface water.

However, during contract preparation for aerial application, surface water quality risk with more site-specific information will be re-assessed (see Protection measures, Appendix C). Once the exact treatment areas are delineated in preparation for the contract, treatment acres can be determined for 6$^{th}$ hydrologic unit code (HUC) watersheds potentially affected by aerial application. These delineated areas can be incorporated into the risk assessment to estimate probable herbicide concentrations and allowable treatment acres. If concentrations exceed the recommended safe threshold, treatment acres would need to be reduced to the allowable amount.

Risks to water quality and aquatic biota still exist through accidental drift, accidental spill or misuse of herbicides. Additionally, although the Ashland and Sioux Districts were not incorporated in the risk assessment above, risks still exist to isolated springs and perennial stream segments. Protection measures were developed to address all of these risks. These measures are identified as Protection measures in Appendix C.

By adhering to all label instructions and protection measures (Appendix C), herbicide concentrations in streams are expected to remain at safe levels and therefore negative impacts to sensitive or Management Indicator Species should not occur. This conclusion assumes that project implementation and protection measures described in the EIS are adhered to.

## WATER QUALITY, FISHERIES, AND AMPHIBIANS - DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 2 (NO HERBICIDE)

Effects of the herbicide application under this alternative are non-existent since treatments would be entirely bio-control, cultural, or mechanical. However, if these other treatments are less effective, other indirect effects associated with reduced vegetative cover, and increased surface runoff and sedimentation, may be higher than under Alternative 1.

Other indirect effects can result from alterations in the composition of vegetative ground cover through proliferation or reduction of noxious weeds. On sloped terrain, the possibility of surface runoff and sediment introduction into streams and other waterbodies increases as weeds replace bunchgrasses and other vegetation. If sediment introduction is excessive, fish habitat and amphibian habitat could be negatively affected (Platts, 1991; Maxell, 2000). Instream cover for fish might also change, based on alterations in riparian vegetation along stream margins. Additional effects to fish could include short-term changes in food supply, should aquatic invertebrates be susceptible to low concentrations of herbicides.

## WATER QUALITY, FISHERIES, AND AMPHIBIANS - DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 3 (NO CHANGE FROM CURRENT MANAGEMENT)

Since this alternative does not provide for aerial treatments, significantly less herbicide would be applied across the landscape on the Beartooth District as compared to Alternative 1. Therefore, the risks to water quality and fish from herbicides are reduced from those described for Alternative 1. Application methods under this alternative rely solely on biological and mechanical means. Mechanical treatment has minimal effects in relation to the entire Custer National Forest.

## WATER QUALITY, FISHERIES, AND AMPHIBIANS - CUMULATIVE EFFECTS

Activities considered in the cumulative effects analysis include those directly modifying fish and amphibian habitat as well as those indirectly modifying sediment delivery and routing, and modifying hydrologic regimes. These activities include past road construction and stabilization, vegetation management, grazing, recreation, trail maintenance, and past wildfires (Table 4 - 15).

### TABLE 4 - 15. COMMON ACTIVITIES AND ASSOCIATED LEVELS OF IMPACTS

| Activity | Typical Habitat Alteration or Impact on Aquatic Species | Current Degree of Impact |
|---|---|---|
| Livestock grazing | Bank alteration, stream channel over-widening, sediment introduction | Low to high |
| Timber harvesting | Sediment introduction, reduction of woody debris recruitment potential, modified water temperature regimes | Low to high |
| Road building | Sediment introduction, migration barriers | Moderate to high |
| Recreation (non-fishing) | Sediment introduction, habitat modification | Low |
| Recreational fishing | Hooking and handling mortality; harvest | Low to moderate |
| Water withdrawal | Reduction of instream flows | Low to high |
| Dams | Altered water temperatures, fish migration barriers, altered sediment transportation, altered aquatic communities, altered flow regimes | Low to high |
| Lake fish stocking | Competition/hybridization between introduced species and native species | Moderate to high |
| Noxious weed management | Chemical poisoning of aquatic organisms | Low |

Herbicide application will also occur within some watersheds by county weed control districts and private landowners. The Forest Service projects are directly regulated by the protection measures in this EIS. Although the Forest Service has no direct jurisdiction over weed control methods by counties or private landowners, their herbicide applications are regulated by EPA label requirements. Assuming county and private landowner herbicide applications follow these requirements, measurable direct/indirect effects on water quality and fisheries are not likely. The exception would be in the unlikely event that herbicide applications by all entities coincided in time, space and type of herbicide applied. This is especially true in watersheds where the risk analysis indicates thresholds values are close to being exceeded.

As proposed, Alternatives 1 and 3 are not expected to cumulatively interact with past, current, and reasonably foreseeable actions to negatively impact sensitive amphibian populations. Alternatives 1 and 3 are also not expected to have negative cumulative impacts on sensitive fish populations. Alternative 2 will maintain existing cumulative effects to amphibians and sensitive fish populations.

## BIOLOGICAL EVALUATION DETERMINATION

### Fish and Amphibian Species

Risk of impacting sensitive fish and aquatic life stages of amphibians is directly related to possible herbicide contamination of streams and lakes, and the necessity for water quality conditions to allow individuals throughout all life stages of development and maturation to remain healthy. Risk is indirectly related to effects on aquatic insects, used for food, and riparian and upslope vegetation, necessary to maintain many physical elements of desired habitat characteristics.

Effects to fish and sensitive amphibians from mechanical removal of weeds are considered discountable due to minimal ground disturbance and the limited extent it will occur. Biological control of weeds may have slight beneficial effects. There are no negative impacts associated with biological control.

Susceptibilities to chemical weed treatment are not well defined for amphibian species, as with other aquatic organisms. Their life histories involve both aquatic and terrestrial life stages, making them susceptible to toxicants in both environments. Many amphibians have vascularization in the epidermis of the skin, with little keratinization, simplifying uptake of many toxicants.

Effects on terrestrial life stages of amphibians must be viewed somewhat differently. It is likely that adult or subadult amphibians within riparian zones will come into direct contact with herbicides during or after application. Chemical contamination was reviewed in Cook (1981) and others, (as reported in Maxell 2000). Effects, (although not necessarily from the specific chemicals proposed for use in this document) ranged from mortality to reduced disease resistance, reproductive ability, and morphological abnormalities (Maxell 2000). While amphibians' vulnerability to chemicals is well documented, there is no data that allows us to effectively define what effects might occur from incidental contact with the herbicides proposed for use in this EIS. Many assume that criteria for mammals, birds, and fish will incorporate the protection needed for amphibians (Maxell 2000). For this analysis, it is assumed some risk to individuals may be present but impacts are not predictable.

Within the proposed action alternative, direct contact with herbicides by amphibians will be largely incidental. The broader more continuous coverage of aerial application will not occur in riparian zones, where sensitive amphibians are likely to be found in large numbers. Ground application consists largely of spot application, reducing risk of exposure for high numbers of individuals. Amphibian species can occur in extremely high densities around water bodies, shortly after they metamorphose from tadpoles into young adults. This situation can pose a risk to relatively large number of individuals during ground application in the riparian zones. The occurrence of high concentrations of amphibians will likely be observed during required inspections immediately adjacent to water bodies, prior to ground application. In these cases treatment will be postponed (within the area occupied) until the individuals have adequately dispersed, or weeds can be hand pulled or treated by wick application. Therefore, the proposed action, with these protection measures, is expected to pose little risk to amphibian populations and their habitat.

Based on short exposure times and likely concentration levels that are well below those shown to cause adverse effects to aquatic organisms, it is concluded that risk for adverse effects to sensitive fish and amphibian species in surface waters is low enough to be considered discountable.

Further, many of the cold-water fisheries on the Custer National Forest are located within the Absaroka-Beartooth Wilderness. Therefore, it is expected that the degree of impact on fishes and amphibians in this area would be minimal and would vary little among alternatives. The proposed action, with the protection measures, is expected to pose little risk to fish and amphibian populations and their habitat outside of the Absaroka-Beartooth Wilderness as well. This action may impact individuals, based on the slight risk of a spill, but will not impact populations of sensitive fish and amphibian species on Custer National Forest lands (Table 4 - 16).

### TABLE 4 - 16. BIOLOGICAL EVALUATION FOR SENSITIVE AQUATIC SPECIES

| Species | Determination | Comments |
|---|---|---|
| Northern Red Belly Dace | MIIH | Based on the slight risk of a spill. |
| Sturgeon Chub | MIIH | Based on the slight risk of a spill. |
| Yellowstone Cutthroat | MIIH | Based on the slight risk of a spill. |
| Great Plains Toad | MIIH | Based on the slight risk of a spill. |
| Northern leopard frog | MIIH | Based on the slight risk of a spill. |
| Plains Spadefoot | MIIH | Based on the slight risk of a spill. |
| Western toad | MIIH | Based on the slight risk of a spill. |

MIIH – May Impact Individuals, but will not lead toward listing or loss of viability to the species.

**Monitoring Requirements**

Monitoring for aerial application will consist of detection cards as described in Appendices C and N.

A field inspector will be present during all aerial application to monitor drift using Spray detection cards placed in buffer areas along any stream or lake comprising a sport fishery, or waters important for Threatened, Endangered or Sensitive (TES) aquatic species. Cards will be placed prior to herbicide application and will be sufficient in number and distribution to adequately determine when drift of herbicide into the buffer area exceeds acceptable levels.

**Consistency with Forest Plan and other Laws, Regulations and Policies to Water Quality, Fisheries, and Amphibians**

All alternatives would meet all water quality standards and maintain beneficial uses of surface water and groundwater resources, assuming implementation of protection measures occurs as necessary. Alternatives 1 and 3 would be consistent with direction in the Forest Plan and other laws regarding weed control. Alternative 2 would be consistent with direction in the Forest Plan and other laws regarding weed control, but is not a very effective approach and could allow for increased spread of aquatic weeds.

## *SENSITIVE PLANT SPECIES*

Each alternative was evaluated based on the following criteria: how vulnerable to weed invasion are known populations and their habitat, how will known sites be treated; effectiveness of treatment to stop or reduce the spread of weeds known populations and their habitat; and will the treatment have a detrimental impact on the sensitive plants.

### SENSITIVE PLANTS - EFFECTS OF NON-HERBICIDE TREATMENTS TO ALL ALTERNATIVES

Forest Service policies and protection measures (see Appendix C) give sensitive plant species special attention. Mechanical treatments will avoid or protect known sensitive plant populations and therefore there is very low risk of impacting viability of known populations.

Mechanical and burning control measures could potentially impact unidentified sensitive plant populations. Tilling weeds could impact sensitive plant populations by direct mortality of plants or temporary setback of plant health. Some plant propagules (growing parts) may be retained after tilling and allow some plants to grow back. Burning for weed control could impact some species, especially if fire intensity and severity is extreme enough to kill root crowns, effectively killing the plants. However, many species evolved with fire and can survive, especially if the population occurs in a habitat that is in good to excellent condition and burns are of moderate to low severity/intensity.

When in suitable habitat of listed Sensitive Plants, a survey would precede mechanical treatments that could impact sensitive plant population viability. Populations discovered during these surveys will be avoided or protected in accordance with applicable Forest Service policy (FSM 2670).

### SENSITIVE PLANTS - DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 1

There is little to no vulnerability to weed invasion in the known or potential sites for Barratt's willow (alpine conditions), Musk-root (very rocky), Dakota buckwheat (very shallow soils), and Shoshonea (very shallow, rocky, and exposed soils). There is no threat to Barratt's willow from herbicide treatment in adjacent areas since adjacent areas are generally alpine or subalpine conditions where weeds typically cannot get a foothold. However, there could be a threat from adjacent area herbicide use on Musk root, Dakota buckwheat, Shoshonea, and the remainder of the sensitive plant species. However, with the following protection measures outlined in Appendix C, the risk that herbicides will be accidentally sprayed on sensitive plants is very low:

Based on these features of the proposed action and protection measures outlined in Appendix C, a biological evaluation has been conducted for these sensitive plant species (Table 4 – 17). Analysis presented within this EA serves as documentation of the biological evaluation.

Over time new sensitive plant sites will be discovered and new plants will be added to the sensitive plant list while some may be dropped. Under this alternative, adaptive management allows for treating areas to prevent weed spread into new sensitive plant sites.

## SENSITIVE PLANTS - DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 2 (NO HERBICIDES)

There is little to no vulnerability to weed invasion in the known or potential sites for Barratt's willow (alpine conditions), Musk-root (very rocky), Dakota buckwheat (very shallow soils), and Shoshonea (very shallow, rocky, and exposed soils). The remainder of the sensitive plant species is vulnerable to weed invasion.

With this alternative the known sensitive plant sites cannot be effectively protected from invasive plants with only manual or biological treatments. Not all of the invasive plants infestations, near known sensitive plant populations, can be effectively pulled (i.e., weeds that are rhizomatous such as with Canada thistle and yellow toadflax or populations that are too large for effective treatment) and only some of the weed species currently have effective biocontrol agents. On these sites the invasive plants will continue to spread without the integration of herbicide use

Due to limited funding, hand grubbing can only be implemented on a limited number of acres. Also, grubbing plants that spread via roots requires excavating the soil, which is detrimental to the sensitive plant. Sites where weeds spread is by roots will not be manually treated and weed spread cannot be controlled or contained by hand pulling.

Only Barratt's willow, Musk-root, Dakota buckwheat, and Shoshonea will be protected due to little or no vulnerability from invasion and no effect from herbicides since they are not proposed for use under this alternative.

For the remainder of the sensitive plant species, this alternative will offer very little protection to the known sensitive plant sites and their habitat from invasion from exotic plants. Activities (and lack of herbicide integration) under this alternative will cause a greater loss in these remaining sensitive plant populations and "Will impact individuals or habitat with a consequence that the action may contribute to a trend towards federal listing or cause a loss of viability to the population or species". It is important to note that although the use of herbicides, under Alternatives 1 and 3, may kill some individual plants, there would be a far greater loss of species diversity which would result from further uncontrolled weed infestations.

Over time new sensitive plant sites will be discovered and new plants will be added to the sensitive plant list while some may be dropped. Under this alternative, adaptive management is not considered and does not allow for treating areas to prevent weed spread into new sensitive plant sites:

## SENSITIVE PLANTS - DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 3 (NO CHANGE FROM CURRENT MANAGEMENT)

The risk with this alternative is that herbicides will accidentally be sprayed on sensitive plants. However, the risk is very low with most species due to proximately to current infestations and associated herbicide treatment. Currently, only Beartooth Goldenweed is in close proximity to known weed infestations and has potential for some drift from current spot herbicide treatment.

Over time new sensitive plant sites will be discovered and new plants will be added to the sensitive plant list while some may be dropped. Under this alternative, adaptive management is not considered and does not allow for treating areas to prevent weed spread into new sensitive plant sites as well as in the AB Wilderness Area.

## SENSITIVE PLANTS - CUMULATIVE EFFECTS

The spatial boundary for this analysis is limited to the Custer National Forest and some of the adjacent lands (private and federal). The boundary follows topographic features (such as streams, and ridges), and roads (see the map in project file, rare plants section). These features are physical barriers that allow for more effective weed control.

The temporal boundary includes all known sensitive plant locations that have been identified within the last 10 ten years and all reasonably foreseeable activities that may impact these locations over the next five years.

The following activities are within the spatial and temporal boundaries, and are included in the cumulative effects analysis: weed control effort on land adjacent to the Custer National Forest; and other activities on the Custer National Forest that contribute to the spread of weeds near sensitive plant locations (such as timber harvest, prescribed and natural fires, recreation sites, and grazing).

First, if adjacent landowners do not control their weeds there is a risk that the weeds will spread to the National Forest and impact sensitive plants. Since Alternative 1 is more efficient in controlling the spread of invasive plants, this alternative would be able to respond to this type of situation with a more effective weed control program. Alternatives 2 and 3 would not be able to stop the spread invasive plants, because the tools are less effective (biological control agents are only effective on a few plants and pulling rhizomatous plants is detrimental to sensitive plants) or the location was not included in the 1987 environmental analysis so would not be treated (i.e., the No Action Alternative 3). If the weeds are being controlled on adjacent lands there is slight risk that the herbicides will impact the sensitive plants on the Custer National Forest. Most of the rare plants are more than 50 feet from the boundary and the herbicide is not likely to move this distance (either by drifting or by leaching) at concentrations that are lethal to the sensitive plants. However, there is one species with a known location near National Forest / non-Forest boundaries.

Second, other activities such as timber harvest, prescribed fires, recreation sites, and grazing may impact the spread of invasive plants and inadvertently impact sensitive plants. Prior to implementing all activities a sensitive plant survey and a weed risk assessment would be completed. The activities would be modified to mitigate the impact to the sensitive plants or the risk of spreading weeds. Also, the Best Management Practices for Noxious Weeds (FS Manual 2080) lists activities that will be incorporated into the management of these activities to help prevent the spread of weeds. Alternative 1 is most efficient in controlling the spread of invasive plants. Alternative 2 would not be able to stop the spread of invasive plants, because the tools are less effective (biological control agents are only effective on a few plants and pulling rhizomatous plants is detrimental to sensitive plants). Alternative 3 would be less effective than Alternative 1 since sensitive plant locations and some protection measures, along with allowances for use of other herbicides were not included in the 1987 environmental analyses.

## BIOLOGICAL EVALUATION DETERMINATIONS

Table 4 - 17 provides the determination of effects to sensitive plant species listed for the Custer National Forest that may occur in the analysis area.

### TABLE 4 - 17. EFFECTS DETERMINATIONS TO SENSITIVE PLANT SPECIES

| Species | 1 Proposed Action | 2 No Herb. | 3 No Action | Statement of Rationale |
|---|---|---|---|---|
| *Adoxa moschatellina*<br>Musk-root | MIIH[36] | NI[37] | MIIH | Alternatives 1 and 3: No vulnerability to invasion and low probability of impacting population viability from herbicide with protection measures.<br>Alternative 2: No vulnerability to invasion or herbicide. |
| *Asclepias ovalifolia*<br>Ovalleaf milkweed | MIIH | WIFV[38] | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Astragalus barrii*<br>Barr's milkvetch | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Carex gravida var. gravida* | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population |

[36] MIIH = May impact individuals or habitat but will not likely contribute to a trend towards listing or loss of viability to the population or species
[37] NI – No impact
[38] WIFV = Will impact individuals or habitat with a consequence that the action may contribute to a trend towards federal listing or cause a loss of viability to the population or species

| Species | 1 Proposed Action | 2 No Herb. | 3 No Action | Statement of Rationale |
|---|---|---|---|---|
| Pregnant sedge | | | | viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Cypridium calceolus var. parviflorum* Small Yellow lady's-slipper | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Epipactis gigantea* Giant Helleborine | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Eriogonum visherii* Dakota buckwheat | MIIH | NI | MIIH | Alternatives 1 and 3: No vulnerability to invasion and low probability of impacting population viability from herbicide with protection measures. Alternative 2: No vulnerability to invasion or herbicide. |
| *Gentiana affinis* Prairie gentian | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Gentianopsis simplex* Hiker's Gentian | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Haplopappus subsquarrosus var. subsquarrosus* | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Juncus hallii* Hall's Rush | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Primula incana* Mealy Primrose | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Mertensia ciliata* Mountain bluebells | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Ranunculus jovis* Jove's Buttercup | MIIH | WIFV | MIIH | Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting a trend toward listing. |
| *Salix barrattiana* Barratt's willow | NI | NI | NI | Alternatives 1 and 3: No vulnerability to invasion and no probability of impacts from herbicide. Alternative 2: No vulnerability to invasion or herbicide. |
| *Shoshonea pulvinata* Shoshonea | MIIH | NI | MIIH | Alternatives 1 and 3: No vulnerability to invasion and low probability of impacting population viability from herbicide with protection measures. Alternative 2: No to low vulnerability to invasion or herbicide. |

Effects to Custer National Forest "watch" species, *Lomatium nuttallii*, follow: Alternatives 1 and 3: Low probability of impacting population viability from herbicide with protection measures. Alternative 2: High vulnerability to invasion and impacting population trends.

**Irreversible and Irretrievable Commitment of Resources to Vegetation**

Implementation of Alternatives 1 or 3 with appropriate protection measures and site rehabilitation would result in no irreversible or irretrievable loss of native plant communities. Currently, native plant communities are more at risk from invasion and displacement by invasive weed populations. Implementing Alternatives 2 or 3 could result in irretrievable impacts to native plant communities on some areas if noxious weeds spread from untreated areas and dominate large areas that cannot be treated under existing policies, locations (i.e. the AB Wilderness Area) and methods of weed control. With Alternatives 2 or 3 weeds would continue to proliferate and control measures would not be sufficient to prevent continued expansion of weeds and associated losses in native plant communities.

### Consistency with Forest Plan and other Laws, Regulations and Policies to Vegetation

Alternatives 1 and 3 would be consistent with direction in the Forest Plan and other laws regarding weed control. Alternative 2 would be consistent with direction in the Forest Plan and other laws regarding weed control, but is not a very effective approach.

# *WILDLIFE*

## WILDLIFE - DIRECT AND INDIRECT EFFECTS

Visitors to the Custer National Forest enjoy large and diverse wildlife populations. Dense infestations of noxious weeds have major impacts on ecological conditions that support the existence of wildlife. Noxious weeds reduce wildlife forage, alter thermal and escape cover, change water flow and availability to wildlife, and may reduce territorial space necessary for wildlife survival.

Areas dominated by leafy spurge receive three times less use by deer and four times less use by bison compared with similar uninfested areas. On native bunchgrass sites in Montana, dense spotted knapweed populations reduce available winter forage for elk by 50 to 90 percent. Elk use increased almost four times after dense spotted knapweed infestations were controlled on these sites. On wetlands, invasions of purple loosestrife and saltcedar degrade habitat for furbearing animals and waterfowl. In the intermountain west, medusahead and cheatgrass invasions have increased the frequency of fires and reduced native shrub communities important for wildlife winter habitat (Sheley, et. al., 2005).

There is a concern that weed treatments may impact wildlife by herbicide toxicity, by habitat modification, and by displacement during treatment. For analysis purpose the wildlife species will be divided into three groups for each alternative: Threatened and Endangered Species; Sensitive Species; and Management Indicator Species/Key Species. Protection measures by alternative are found in Appendix C.

## WILDLIFE - EFFECTS OF HERBICIDES APPLICABLE TO ALTERNATIVES 1 AND 3

Several Forest Service environmental assessments and environmental impact statements have been conducted in recent years (USFS Pacific Northwest Region, 2005, USFS Gallatin Weed FEIS, 2005, USFS Beaverhead-Deerlodge, 2002, and USFS Helena, 2003). Individually or collectively, these analyses looked at the general effects of the herbicides (Appendix G) on the major groups of wildlife species. None of these analyses determined that there would be significant effects to wildlife from the proper use of these herbicides, including protection measures outlined in Appendix C.

### Herbicide Toxicity to Terrestrial Mammals and Birds

Exposure of terrestrial animals to herbicides may result from several actions including direct spray application, ingestion of plants or other items that have been sprayed, grooming, and indirect contact with vegetation that has been sprayed or inhalation of spray. Wildlife may become in contact with contaminated vegetation, or ingest contaminated vegetation or prey.

Pesticides have been identified as a major cause of mortality for numerous species. Organophosphorus and carbamate insecticides are currently the chemicals most commonly associated with mass mortality of wildlife, especially migratory birds (Vyas, 1999). The herbicides proposed for use on the Custer National Forest (Appendix G) are made up of different chemical compounds (phenosyaliphatic acids, triazoles, bensoics, and phosphonomethyl).

The effects of many herbicides on mammalian and avian wildlife have not been studied in detail, although most herbicides have been tested on laboratory animals (especially rats, mice, rabbits, and dogs). Findings are then extrapolated to wildlife (USFS - SERA, 1995-2004), which means that conclusions regarding the effects of these chemicals on wildlife are somewhat uncertain. However, risk levels for herbicide use are calculated in a very conservative manner and worst-case exposure scenarios have been studied for most herbicides.

Lethal Dose 50 (LD50) values are used as a measure of toxicity and are defined as the quantity of chemical per unit body weight that would cause lethal effects in 50 percent of a study population with a single dose. Reported LD50 values for herbicides were sometimes highly variable (Table 4-19), reflecting differences among studies such as use of different species or exposure techniques, varying sample sizes, etc. Despite this variability in LD50's, data is sufficient to determine that the herbicides proposed for use under the Proposed Action are generally of low toxicity to mammalian and avian wildlife (Table 4-19).

Exposure to extremely high levels of most herbicides through direct ingestion or spraying during laboratory studies often lead to death or a variety of sub-lethal toxic effects including damage/irritation to the nervous system, kidneys, eyes, skin; inhibition of reproduction; and other problems. However, the doses required to produce such effects were much higher than those wildlife would encounter from application of herbicides in the field even under worst-case scenarios.

In addition to the active ingredients in chemicals used for weed control, commercial herbicide formulations contain various inert ingredients. These ingredients have been placed in four categories by the Environmental Protection Agency according to their toxicity (Moore, 1987). The categories are: 1) inerts of toxicological concern; 2) potentially toxic inerts/high priority for testing; 3) inerts of unknown toxicity; and 4) inerts of minimal concern. The majority of inerts are currently in category 3, indicating that there is a large degree of uncertainty regarding the effects of inert ingredients. Also largely unknown are the possible synerginistic effects of various inert ingredients and pesticides.

The long-term fate of herbicides in the environment is also a concern. Bioaccumulation is the process by which chemicals enter the food chain from the environment, whereas bio-magnification is the increase in concentration of these chemicals from one link in the food chain to the next. Small concentrations of chemicals, from combined effects of these processes, can lead to toxic effects especially for organisms high in the food chain. However, for bio-magnification to occur, the chemical must be long-lived, mobile, and fat-soluble. If a chemical is not long-lived, it will break down before entering the food chain. If it is not mobile, such as when it is bonded to soil, it is unlikely that it could be taken up by an organism. If it is water-soluble rather than fat-soluble, it will be excreted by the organism. The herbicides proposed for use in this project appear to be rapidly excreted (Tatum, 2004, Miller et. al., 2004, USFS, SERA 1995 – 2004) and do not accumulate in tissues. Because of this, these herbicides present a low risk for bio-magnification. Tables 4 – 18 and 4 – 19 outline herbicide toxicity to mammals and birds.

## TABLE 4 – 18. ECOTOXICOLOGICAL CATEGORIES

| Toxicity Category | Mammalian (Acute Oral)* mg/kg | Avian (Acute Oral)* mg/kg | Avian (Dietary)– ppm | Aquatic Organisms‡ ppm |
|---|---|---|---|---|
| very highly toxic | <10 | <10 | <50 | <0.1 |
| highly toxic | 10-50 | 10-50 | 50-500 | 0.1-1 |
| moderately toxic | 51-500 | 51-500 | 501-1000 | >1-10 |
| slightly toxic | 501-2000 | 501-2000 | 1000-5000 | >10-100 |
| practically non-toxic | >2000 | >2000 | >5000 | >100 |

*Reflects dose given to test animals and is based on body weight of the test animal.
-Concentration in the diet. Unrelated to body weight of the test animal. Measure of environmental exposure.
‡Concentration in water. Unrelated to body weight of test animal. Measure of environmental exposure.

## TABLE 4 - 19. MAMMALIAN TOXICITY OF HERBICIDES[39]

| Chemical name (common brand names) | Mammalian toxicity (LD50 in mg/kg body weight) | Avian Toxicity (LD50 in mg/kg body weight) | Risk Assessment |
|---|---|---|---|
| 2,4-D (amine form)<br><br>(Hi-Dep, Weedar 64, Weed RHAP A-4D, Weed RHAP A) | [1]moderate (639 >5,000)<br><br>[2]low /moderate (100-1800) | [1]low/moderate (472->2,000)<br><br>[2]low/moderate (300-5,000) | Good data for mammals and birds; birds somewhat less sensitive than mammals; exposure not expected to cause observable adverse signs of toxicity but may lead to eye or skin irritation; exposure at higher than expected levels also affects kidneys, nervous system, and thyroid and may lead to vomiting, diarrhea, and muscle twitches. |
| Aminopyralid[40] | very slightly toxic | Low/moderate | There are no acute or chronic risks to non-target endangered |

[39] Unless otherwise posted, data are from *Human Health and Ecological Risk Assessments* (ERA), Syracuse Environmental Research Associates, Inc. (http://www.fs.fed.us/foresthealth/pesticide/risk.htm)
[40] EPA 2005

| Chemical name (common brand names) | Mammalian toxicity (LD50 in mg/kg body weight) | Avian Toxicity (LD50 in mg/kg body weight) | Risk Assessment |
|---|---|---|---|
| (Milestone) | (>5000) | (>2250 - >5556) | or non-endangered birds, wild mammals, and terrestrial invertebrates. |
| Chlorsulfuron (Telar) | 1nearly nontoxic (<5,000)<br>3very slightly toxic (5,545) | 1nearly nontoxic (<5,000)<br><br>3very slightly toxic (>5,000) | Most data are from experimental mammals, there is some uncertainty about extrapolating conclusions to wildlife; potential for adverse effects to mammals and birds appears to be remote. |
| Clopyralid<br><br>(Stinger, Reclaim, Transline) | 1low (none given)<br><br>2low (>3,000-5,000) | 1low (none given)<br><br>2low (1,465) | Well studied in experimental mammals but not birds or other wildlife; potential for adverse effects to mammals and birds appears to be remote, given available data. |
| Dicamba<br><br>(Banvel, Banex, Trooper) | 1slightly toxic (566-3,000)<br><br>2low (600->3,000) | 1nearly nontoxic (673-2,000)<br><br>2low (none given) | Most data are from experimental mammals, there is some uncertainty about extrapolating conclusions to wildlife; toxic effects unlikely for application rates at or above those normally used. |
| Diuron[41] | Low (2,900) | Practically nontoxic (9000) | The highest calculated avian acute risk quotient based on a single application of diuron at 12 lbs a.i./A to rights-of-way. The acute levels of concern are exceeded for birds feeding on short grass, tall grass and broadleaf plants and insects. However, levels of concern are not exceeded if risk quotients are calculated using mean estimated exposure concentrations based on mean residues from Hoerger and Kenega 1972 as modified by Fletcher et al. 1994.<br><br>Chronic avian toxicity data is not currently available for diuron.<br><br>The acute and chronic levels of concern for mammals is only exceeded for 15 gram mammals feeding on short grass following a 12 lb a.i./A application of diuron to rights-of-way.<br><br>Diuron is practically non-toxic to honeybees and risk to non-target insects is expected to be minimal. |
| Glyphosate<br><br>(Roundup, Rodeo, Accord) | 1nearly nontoxic (none given)<br>2low (1,500->5,000) | 1nearly nontoxic (3,850)<br><br>2low (1,500->5,000) | Good data on mammalian and avian wildlife; toxic effects very unlikely even at highest allowable application rates. |
| Hexazinone<br><br>(Velpar, Velpar ULW, Velpar L, Pronone 10G) | 1nearly nontoxic (none given)<br><br>2low (none given) | 1nearly nontoxic (3,850)<br><br>2low (2,258) | Most data are from experimental mammals, there is some uncertainty about extrapolating conclusions to wildlife; available data indicate it is unlikely to cause adverse effects to terrestrial species; ingestion of crystals by birds immediately after application may cause reproductive effects or overt signs of toxicity. |
| Imazapic | 2low (none given) | 2low (none given) | Most data are from experimental mammals, there is some uncertainty about extrapolating conclusions to wildlife; larger mammals affected more than smaller, however adverse effects to mammals or birds are unlikely under typical or worst-case cases of exposure. |
| Imazapyr<br><br>(Arsenal, Chopper, Contain) | 1nearly nontoxic (4,800-5,000)<br><br>2low (none given) | 1nearly nontoxic (<2,150)<br><br>2low (none given) | Most data are from experimental animals, there is some uncertainty about extrapolating conclusions to wildlife; little data on toxic levels; sufficient data are available to conclude that adverse effects to terrestrial species are unlikely under typical or worst-case cases of exposure. |
| Metsulfuron methyl<br><br>(Escort, Ally) | 1nearly nontoxic (none given)<br><br>2low (>2,000) | 1nearly nontoxic (<2,150)<br><br>2low (>2,000) | Most data are from experimental mammals, there is some uncertainty about extrapolating conclusions to wildlife; sufficient data are available to conclude that adverse effects to terrestrial species are unlikely under typical or worst-case cases of exposure; may cause weight loss at sub-lethal doses. |
| Picloram<br><br>(Tordon, Grazon, Access, Pathway) | 1low (<950-8,200)<br><br>2low (3,000-5,000) | 1nearly nontoxic (<2,000)<br><br>2low (>2,000) | Most data are from experimental mammals, there is some uncertainty about extrapolating conclusions to wildlife; adverse effects to mammals or birds are unlikely under typical or worst-case cases of exposure. |

[41] EPA, 9/30/2003, p. 71

| Chemical name (common brand names) | Mammalian toxicity (LD50 in mg/kg body weight) | Avian Toxicity (LD50 in mg/kg body weight) | Risk Assessment |
|---|---|---|---|
| Sulfometuron methyl<br><br>(Oust) | [1]low (<5,000 *ppm*)<br><br>[2]low (none given) | [1]low (<5,620 *ppm*)<br><br>[2]low (none given) | Very limited data on birds; observable effects to most mammals & birds not expected; possible reproductive effects to some species although evidence is not conclusive. |
| Triclopyr<br><br>(Garlon, Grazon) | [1]slightly toxic (310-713)<br>[2]low (none given) | [1]very low (1,698)<br><br>[2]low (none given) | Good data for birds and mammals; application rates at or above those normally used not expected to affect terrestrial animals. |

Below is a summary of risk characterization to terrestrial species for each herbicide from human health and ecological risk assessment documents prepared for the Forest Service (SERA 1999-2004) and EPA. These summaries relate the expected direct effects of exposure and ingestion. They do not address the indirect effects of habitat alteration.

**2, 4-D**

Except for accidental exposure scenarios, there is relatively little indication that 2,4-D applications are likely to cause any adverse effects in terrestrial animals. For small mammals, a reasonable verbal interpretation of the direct spray scenarios is that signs of frank toxicity are unlikely but subclinical effects could result in some species. The direct spray scenario for the bee is less ambiguous: some populations of bees subject to a direct spray could evidence substantial mortality. An major consideration in all of the direct spray scenarios involves interception of the 2,4-D by vegetation. This would tend to reduce the level of exposure but the magnitude of the reduction would depend on the proportion of the 2,4-D that is intercepted prior to contacting the animal. While this cannot be well quantified in general, it may account for the failure of some field studies to note toxicity in bees after the application of 2,4-D.

Neither of the drinking water scenarios led to hazard quotients that reach a level of concern. For the longer-term drinking water scenario, the anticipated exposures are far below a level of concern. As in the characterization of risk for potential human health effects, both the acute and longer term exposures of a small mammal to vegetation contaminated with 2,4-D are of some concern. Nonetheless, given the conservative nature of the exposure assumptions as well as the marginal nature of the hazard quotients - i.e., 0.5 to 2 - it seems reasonable to assert that, at least in some and perhaps most instances, actual exposures would be below and sometimes far below a level of concern. Nonetheless, if contaminated vegetation is the sole diet of the animal, some subclinical toxic effects could occur. No frank signs of toxicity, however, are likely.

A very conservative multi-route exposure scenario supports a concern for potential although perhaps isolated effects on terrestrial vertebrates. The dose-response assessment on which this hazard characterization is based is most clearly relevant to mammalian species. However, because the dose-response assessment encompasses more sensitive species - i.e., larger mammals - and the exposure assessment is based on a smaller mammal, the assessment is inherently conservative.

Although the data on avian species are not as extensive as those for mammals, acute toxicity studies in birds suggest that avian species are somewhat less sensitive than mammals. In addition, the available studies on the effects of 2, 4-D on avian eggs suggest that no effects would be anticipated from a direct spray of avian eggs at application rates of up to 10 lb/acre, a rate that is far in excess of those anticipated by the Forest Service.

**Aminopyralid**

Aminopyralid has been shown to be practically non-toxic to birds, honeybees, and earthworms. There are no acute or chronic risks to non-target endangered or non-endangered birds, wild mammals, and terrestrial invertebrates.

### Clopyralid

No adverse effects are anticipated in terrestrial or aquatic animals from the use of clopyralid in Forest Service programs at the typical application rate of 0.35 lb a.e./acre. The same qualitative assessment holds for the maximum application rate of 0.5 lb a.e./acre except for the large bird feeding exclusively on contaminated vegetation over a 90 day period. Other more plausible scenarios – i.e., the longer term consumption of vegetation contaminated by drift or the longer term consumption of contaminated water or fish – yield hazard quotients that are in the range of 0.00005 to 0.02, far below a level of concern.

The risk characterization for both terrestrial and aquatic animals is limited by the relatively few animal and plant species on which data are available compared to the large number of species that could potentially be exposed. This limitation and consequent uncertainty is common to most if not all ecological risk assessments.

### Chlorsulfuron

Just as there is little reason to doubt that adverse effects on some plant species are plausible, there is no clear basis for suggesting that effects on terrestrial or aquatic animals are likely or would be substantial. Adverse effects in mammals, birds, terrestrial insects, and microorganisms are not likely using typical or worst-case exposure assumptions at the typical application rate of 0.056 lb a.e./acre or the maximum application rate of 0.25 lb a.e./acre. One study has suggested that latent/sublethal chlorsulfuron toxicity to one plant species could result in adverse reproductive effects in one species of beetle that consumes the leaves of the affected plant. This appears to be a highly specific plant-insect interaction and this effect has not been noted in subsequent studies by the same group of investigators using other plant-insect pairs. As with the human health risk assessment, this characterization of risk must be qualified. Chlorsulfuron has been tested in only a limited number of species and under conditions that may not well-represent populations of free-ranging nontarget species. Notwithstanding this limitation, the available data are sufficient to assert that no adverse effects are anticipated in terrestrial animals.

### Dicamba

For terrestrial vertebrates, some acute exposure scenarios but no chronic exposure scenarios exceed the level of concern but only at the highest application rate. At the typical application rate of 0.3 lb/acre, no adverse effects on mammals or birds are plausible for either acute or chronic exposures. At the highest application rate of 2 lb/acre, adverse reproductive effects are plausible in acute exposure scenarios involving mammals and birds consuming contaminated vegetation or contaminated insects. In chronic exposure scenarios at an application rate 2 lb/acre, the hazard quotients associated with the consumption of contaminated vegetation are below the level of concern by factors of 5 to over 16,000. There is little basis for asserting that adverse effects would be expected in terrestrial insects or soil microorganisms. The very limited data in insects suggest that no lethal effects are likely in a direct spray. There are no data on sublethal effects in insects. At the highest application rate, transient effects might be seen in some populations of soil microorganisms.

### Diuron

Diuron is slightly toxic to bobwhite quail and practically nontoxic to mallard duck on an acute oral basis. It is practically nontoxic to bobwhite quail and slightly toxic to mallard duck on a subacute dietary basis. Diuron is relative nontoxic to both honey bees and laboratory rats (acute basis). In a 2-generation rat reproduction study, diuron caused pup body weight loss. Avian reproduction information is not available.

In general, most acute risk quotients for terrestrial wildlife were below the most conservative EPA level of concern. However, direct spray of the pollinating insect resulted in elevated risk quotients at both the typical and maximum application rates. In addition, at the maximum application rate, risk was also predicted for the pollinating insect from indirect contact with foliage impacted by direct spray. These are highly conservative scenarios assuming that the insect absorbs 100% of the herbicide after application with no herbicide degradation or limitations to uptake by the insect. Therefore, these scenarios may overestimate risk to the insect.

Risk quotients for acute ingestion scenarios were below the most conservative level of concern when herbicide is applied at the typical application rate, but above the level of concern in all cases at the maximum application rate. Risk quotients for chronic ingestion scenarios were above the associated level of concern of 1.0 for three receptors (the small and large mammalian herbivores and the large mammalian carnivore) when herbicide is applied at the typical application rate. At the maximum application rate, elevated risk quotients were predicted for all evaluated scenarios. This evaluation indicates that direct spray impacts may pose a risk to insects, birds, and mammals, primarily when the maximum application rate is used.

EPA's ecological risk assessment shows minimal exceedance of the levels of concern for acute risk to birds. Chronic risk to birds could not be calculated due to a lack of chronic avian toxicity data; these data are required.

Chronic RQs for very small mammals (15 grams) range from 0.1 to 9.2; all other mammalian RQs are below levels of concern.

The protection measures required for labeling under the 2003 EPA re-registration decision serves to decrease risk to non-target species.

The EPA developed a Endangered Species Protection Program to identify pesticides whose use may cause adverse impacts on endangered and threatened species, and to implement protection measures that address these impacts. EPA did not require specific label language at the 2003 re-registration time relative to threatened and endangered species. The general risk mitigation required through the 2003 EPA re-registration decision will serve to protect listed species of potential concern until such time as the EPA refines its risk assessment for birds, mammals, aquatic species and plants from the uses of diuron.

**Glyphosate**

The current risk assessment for glyphosate generally supports the conclusions reached by U.S. EPA: Based on the current data, it has been determined that effects to birds, mammals, fish and invertebrates are minimal. At the typical application rate of 2 lbs a.e./acre, none of the hazard quotients for acute or chronic scenarios reach a level of concern even at the upper ranges of exposure for terrestrial organisms. For the application rate of 7 lbs a.e./acre, central estimates of the hazard quotients somewhat exceed the level of concern for the direct spray of a honey bee. That the upper range of the hazard quotients, the level of concern is exceeded modestly in acute scenarios for a large mammal consuming contaminated vegetation and a small bird consuming insects. In the chronic exposure scenarios, the hazard quotient for a large bird consuming contaminated vegetation on site exceeds the level of concern by a factor of about 3. As with all longer term exposure scenarios involving the consumption of contaminated vegetation, the plausibility of this exposure scenario is limited because damage to the treated vegetation – i.e., vegetation directly sprayed at the highest application rate – would reduce and perhaps eliminate the possibility of any animal actually consuming this vegetation over a prolonged period.

**Hexazinone**

Effects on terrestrial species is based primarily on the available data on experimental mammals. Although the limited data available on the toxicity of hexazinone to wildlife species and the observations from the available field studies do not suggest a cause for substantial concern, field studies are not usually designed to detect effects on nontarget species.

As summarized in the human health risk assessment, hexazinone has a low order of acute toxicity to mammals. As noted in the hazard identification for ecological effects there is relatively little information regarding the toxicity of hexazinone to other terrestrial animals. The information on birds suggests that the acute and subchronic lethal potency of hexazinone to birds and mammals is similar.

For nontarget terrestrial species, the approach will be similar to that taken in the human health risk assessment, except that uncertainty factors will not be used because data are available on nontarget species.

**Imazapic**

Adverse effects in terrestrial animals do not appear to be likely. The weight of evidence suggests that no adverse effects in mammals, birds, fish, and terrestrial or aquatic invertebrates are plausible using typical or worst-case exposure assumptions at the typical application rate of 0.1 lb/acre or the maximum application rate of 0.1875 lb/acre. As in any ecological risk assessment, this risk characterization must be qualified. Imazapic has been tested in only a limited number of species and under conditions that may not well-represent populations of free-ranging nontarget animals. Notwithstanding this limitation, the available data are sufficient to assert that no adverse effects on animals are anticipated based on the information that is available.

**Imazapyr**

Adverse effects in terrestrial animals do not appear to be likely. The weight of evidence suggests that no adverse effects in mammals, birds, fish, and terrestrial or aquatic invertebrates are plausible using typical or worst-case exposure assumptions at the typical application rate of 0.45 lb/acre or the maximum application rate of 1.25 lb/acre. As in any ecological risk assessment, the risk characterization must be qualified. Imazapyr has been tested in only a limited number of species and under conditions that may not well-represent populations of free-ranging non-target organisms. Notwithstanding this limitation, the available data are sufficient to assert that no adverse effects on animals are anticipated based on the information that is available.

**Metsulfuron Methyl**

Just as there is little reason to doubt that adverse effects on some plant species are plausible, there is no clear basis for suggesting that effects on terrestrial or aquatic animals are likely or would be substantial. Adverse effects in mammals, birds, terrestrial insects, and microorganisms are not likely using typical or worst-case exposure assumptions at the typical application rate of 0.03 lb a.e./acre or the maximum application rate of 0.15 lb a.e./acre. This characterization of risk, however, must be qualified. Metsulfuron methyl has been tested in only a limited number of species and under conditions that may not well-represent populations of free-ranging nontarget species. Notwithstanding this limitation, the available data are sufficient to assert that no adverse effects are anticipated in terrestrial animals.

**Picloram**

The potential for adverse effects on other terrestrial nontarget animal species appears to be remote. The weight of evidence suggests that no adverse effects in terrestrial animals are plausible using typical or even very conservative worst case exposure assumptions.

**Sulfometuron Methyl**

There is no clear basis for suggesting that effects on terrestrial animals are likely or would be substantial. Adverse effects in mammals, birds, terrestrial insects, and microorganisms are not likely using typical or worst-case exposure assumptions at the typical application rate of 0.045 lb a.e./acre. The hazard quotients associated with the upper range for chronic consumption of vegetation by a large mammal (hazard quotient = 0.2) or large bird (hazard quotient = 0.3) feeding exclusively on treated vegetation slightly exceeds the level of concern of 0.1 associated with the maximum application rate of 0.38 lb a.e./acre. As with the human health risk assessment, this characterization of risk must be qualified. Sulfometuron methyl has been tested in only a limited number of species and under conditions that may not well-represent populations of free-ranging non-target species. Notwithstanding this limitation, the available data are sufficient to assert that no adverse effects are anticipated in terrestrial animals.

**Triclopyr**

For terrestrial mammals, the central estimates of hazard quotients do not exceed the level of concern for any exposure scenarios. At the upper range of exposures, the hazard quotients exceed the level of concern for large mammals and large birds consuming contaminated vegetation exclusively at the application site. At higher application rates, concern for exposure scenarios involving the consumption of

contaminated vegetation is augmented substantially. At the maximum application rate of 10 lbs a.e./acre, the central estimate of the hazard quotient exceed the level of concern for several acute exposure scenarios: the direct spray of a small mammal assuming 100% absorption, a large mammal consuming contaminated vegetation, and a small bird consuming contaminated insects. The central estimates of the hazard quotients for the chronic consumption of vegetation is exceeded for a large mammal and a large bird and the upper range on the hazard quotients are also increased by a factor of 10: i.e., to 60 for a large mammal and 50 for a large bird. This risk assessment is consistent with the risk characterization given by U.S. EPA indicating that contaminated vegetation is primary concern in the used of triclopyr and that high application rates will exceed the level of concern for both birds and mammals in longer term exposure scenarios.

### Adjuvants / Surfactants

Based on a review of the current research, it would appear that adjuvants / surfactants have the potential to affect terrestrial insects. However, as is true with many toxicity issues, it would appear that any effect is dose related. The research does indicate that the silicone-based surfactants, because of their very effective spreading ability, may represent a risk of lethality through the physical effect of drowning, rather than through any toxicological effects. Silicone surfactants are typically used at relatively low rates and are not applied at high spray volumes because they are very effective surfactants. Hence it is unlikely that insects would be exposed to rates of application that could cause the effects noted in these studies. Other surfactants, which are less effective at reducing surface tension, can also cause the drowning effect. But as with the silicones, exposures have to be high, to the point of being unrealistically high, for such effects (Bakke 2002).

When considering the need for relatively high doses for a lethal effect, combined with the fact that individuals, not colonies or nests of invertebrates, may be affected, there is little chance that the surfactants could cause widespread effects to terrestrial invertebrates under normal operating conditions. Spills or accidents could result in concentrations sufficiently high to cause effects, depending upon the surfactant (Bakke 2002).

Use of ammonium sulfate (fertilizer adjuvant), when used as an herbicide on tall larkspur, will be done by spot treatment and used away from water per label instructions. Minimal effects to non-target organisms might occur, but generally only if an accidental spill occurred.

## THREATENED / ENDANGERED SPECIES

### Direct and Indirect Effects – Grizzly Bear

### Grizzly Bear - Herbicide Toxicity, Alternative 1 (Proposed Action), Direct and Indirect Effects

This alternative proposes more acres of herbicide treatment than all other alternatives. Grizzly bears would be likely to occasionally contact herbicides by ingesting plants that had been sprayed and by dermal absorption following contact with sprayed plants. There is also a very small chance that grizzly bears could be directly sprayed with herbicide during aerial application. However, the toxicity of herbicides proposed for use is low, as are the chances of grizzly bears receiving doses great enough to cause toxic effects. However, this must be qualified by the fact that there is uncertainty regarding the toxicity of some herbicides and inert ingredients.

### Grizzly Bear - Habitat Modification, Alternative 1 (Proposed Action), Direct and Indirect Effects

Compared to the No Change from Current Action - Alternative 3, more vegetation would be treated with herbicides. Therefore, there would be a larger short-term loss of forage resulting from mortality of non-target plants in treatment areas. However, native vegetation would begin to recover and provide forage within two to three years of herbicide treatment (Rice et al. 1997). Long-term impacts to grizzly bear spring foraging opportunities as weeds out-compete native vegetation would be lower than under the Alternative 3 (No Change from Current Action), because the acreage of untreated weed infestations would be smaller.

Grazing by goats and sheep in grizzly bear habitat to favor the growth of native plants would be used under this alternative. Grizzly bears could be attracted to and prey upon these animals. This could result in the conditioning of grizzly bears to livestock as food, and lead to conflicts with livestock on adjacent grazing allotments resulting in management removals of grizzly bears. However, goats and sheep would be used in localized areas. Bands of sheep and goats would be much smaller than those typically associated with commercial livestock grazing. Additionally, protection measures would be applied to lessen the chances of depredation conflicts developing. Herders and guard dogs would be used to monitor herds, and would immediately report any depredations. Electric fencing would be used to contain sheep and goats at night. Camps would be subject to the food storage order and herders required to dispose of any sheep or goat carcasses to prevent attracting bears. Sheep and goats would be removed from the Forest if grizzly bear depredations were to occur. Application of the above protection measures would ensure compliance with applicable Custer Forest Plan grizzly bear standards and guidelines. Use of goats and sheep for weed control under this alternative would also be in compliance with standards from the Final Conservation Strategy for Grizzly Bears in the Yellowstone Area (IGBC 2003) because grazing would be temporary and occur outside of any existing allotment, no new allotment would be created, and no animal months would be allocated.

**Grizzly Bear - Disturbance and Displacement, Alternative 1 (Proposed Action), Direct and Indirect Effects**

The potential for disturbance or displacement of grizzly bears would be great since more weeds would be treated with ground based applications and there would be an additional chance of displacing bears with aerial spraying. No aerial spraying is currently proposed within grizzly bear core habitat, although the need for this activity may arise in the future. Aerial spraying of a weed population would occur once per year, and would be completed in several hours or less. Protection measures would be applied to allow only 8 hours of aerial spraying within core habitat per Bear Management Sub-unit per year in order to limit disturbance within this important habitat. This would be consistent with core habitat management direction from Forest Plan and the Conservation Strategy, because there would be no reduction in core habitat and there would be no reoccurring low-level helicopter flights over core habitat.

**Grizzly Bear - Herbicide Toxicity, Habitat Modification, and Disturbance and Displacement, Alternative 2 (No Herbicides), Direct and Indirect Effects**

There would be no toxic effects to grizzly bears under this alternative because no herbicides would be used.

Under this alternative there would be no short-term loss of grizzly bear forage resulting from non-target plants killed by herbicides, because no herbicides would be used. Instead, the long-term availability of native forage plants would be reduced as they are out-competed by weeds.

The effects of sheep and goat grazing for weed management on grizzly bears would be similar under all alternatives. Their effects are described in detail under Alternative 1.

Disturbance and displacement of grizzly bears under this alternative would be minimal. Mechanical and herbicide treatments require the most human activity and have the most potential to cause disturbance. No herbicide treatment and very limited amounts of mechanical treatment would be used under this alternative.

**Grizzly Bear - Herbicide toxicity, Habitat Modification, and Disturbance and Displacement, Alternative 3 (No Change from Current Management), Direct and Indirect Effects**

Grizzly bears would be likely to occasionally contact herbicides by ingesting plants that had been sprayed and by dermal absorption following contact with sprayed plants. The toxicity of herbicides proposed for use is low, along with the chances of grizzly bears receiving doses great enough to cause toxic effects. However, this must be qualified by the fact that there is uncertainty regarding the toxicity of some herbicides and inert ingredients.

Under this alternative, grizzly bear habitat would be treated with herbicides each year. These areas would have reduced foraging capacity for grizzly bears because non-target plants would be killed by broad-spectrum herbicides until native vegetation began recovering within 2-3 years of herbicide treatment (Rice et al. 1997). Weed infestations are most likely to occur in association with roads or other human developments, while grizzly bears tend to avoid those same disturbances (IGBC 1998). Despite this potential spatial separation, it is highly likely that grizzly bears use areas with weed infestations to some degree. However, many weed infestations would not be treated, and they would continue to spread and displace native forage plants (especially in lower-elevation sagebrush/grassland habitat types). Grizzly bears forage in these areas primarily during spring or early summer when green plants are emerging but higher-elevation habitats are still snow-covered (USFWS 1993). The long-term availability of spring forage for grizzly bears would be somewhat reduced by the continued spread of weeds. Other important grizzly bear habitat includes avalanche chutes, high elevation meadows, and whitebark pine stands that would be largely unaffected since they are at low risk for weed infestations. The effects of sheep and goat grazing for weed management on grizzly bears would be similar under all alternatives. Their effects are described in detail under Alternative 1.

It is likely that grizzly bears would occasionally be displaced as a result of weed treatment activities. However, activities such as herbicide spraying and grubbing would be of short duration in any given spot, so any displacement would be localized and last only a few days. Bears could resume use of treated areas shortly thereafter.

**Cumulative Effects – Grizzly Bear**

**Grizzly Bear – Alternative 1 (Proposed Action) – Cumulative Effects**

Cumulative effects to grizzly bears resulting from herbicide use in this alternative would be similar to those described under Alternative 3 (No Action), because the herbicides proposed for use are rapidly excreted and do not bio-accumulate. Weed control activities would not alter access values and impacts to grizzly bear core habitat from aerial spraying would be mitigated, therefore any disturbance to grizzly bears resulting from this alternative would not contribute to cumulative effects on grizzly bears. This alternative would have a greater probability of containing the spread of weeds than the others and would have the least cumulative effects on grizzly bear foraging opportunities.

**Grizzly bear – Alternative 2 (No Herbicides) – Cumulative Effects**

No herbicides would be used, so there would be no cumulative toxic effects. Weed control activities would not impact core areas or alter other access values, so any disturbance to grizzly bears resulting from this alternative would have discountable cumulative effects. This alternative would have a lower probability of containing the spread of weeds than all others and would do the least to preserve grizzly bear foraging opportunities. It would therefore have more cumulative effects than other alternatives.

**Grizzly bear – Alternative 3 (No Change from Current Management) – Cumulative Effects**

Cumulative effects to grizzly bears were analyzed for the two Bear Management Subunits on the Custer National Forest (Boulder Slough #1 and Lamar #1), because Bear Management Subunits are approximately the average size of a female grizzly bear's home range and contain all necessary seasonal habitat components. The temporal bounds for the analysis were the past 10 years and 15 years into the future, because weed infestations have changed rapidly and it is difficult to predict how their spread beyond that timeframe would affect grizzly bear habitat.

Weed control with herbicides is an activity that has been occurring for years in the analysis area, and undoubtedly will continue for many years into the future. Private landowners, county governments, and other state and federal agencies all use herbicides to control weeds. However, this use has been compatible with grizzly bear recovery and is expected to continue to be so. The herbicides proposed for use are water-soluble and do not bio-magnify, so cumulative toxic effects to grizzly bears resulting from these processes would not occur.

A large variety of human activities occur in the analysis area, many of which may disturb or displace grizzly bears. Grizzly bear access management in the recovery zone is designed to balance these effects by providing core habitat characterized by a low level of human activity that could cause disturbance to bears. The analysis area was 110,500 acres, and all but approximately 1,200 acres of this was secure habitat. The amount of secure habitat in these Bear Management Subunits was deemed adequate, because at least that much was present in 1998 when the grizzly bear population achieved recovery goals (IGBS 2003). Aerial spraying in core habitat could temporarily displace grizzly bears from localized areas. However, cumulative effects resulting from such actions would be discountable, due to their short duration and localized nature. Adjacent areas of core habitat would continue to be managed to provide secure grizzly bear habitat.

Threats to several major grizzly bear food sources in the analysis area have been documented. The long-term persistence of whitebark pine trees, whose nuts provide a critical seasonal food source for grizzly bears (Felicetti et al. 2003), is threatened by blister rust, mountain pine beetle attack, and climate change (Tomback et al. 2001). Increased development of private lands may decrease habitat availability for ungulate populations, which are more important to bears in the Yellowstone area than to other grizzly populations (IGBC 2003).

Bears may be forced to rely more on herbaceous vegetation if these food sources decline in the future. Weeds have not been implicated as a major threat to grizzly bear forage, but the potential does exist for this to become more of an issue in the future if weeds spread into core habitat and other areas with low access densities that are preferred grizzly bear habitat. Although there is uncertainty regarding the ultimate impacts of weeds on grizzly bear foraging opportunities in the analysis area over the long-term, it is likely that over the next 15 years weeds would not have a major impact due to the broad diets of bears and the current low amount of weed infestation in the most important bear habitats. Forest Service projects such as timber sales and prescribed fires, road maintenance, recreational activities and vehicle use, special use permits (both recreation events and non-recreation), livestock grazing, and summer home residence may contribute to the spread of weeds. Recently adopted Best Management Practices (Forest Service Manual 2080) for preventing weed spread are incorporated as protection measures in project plans, which would help limit weed spread from Forest Service actions. Therefore, even though this alternative would be insufficient to contain the spread of most weed infestations, cumulative impacts to grizzly bear foraging opportunities would be low.

### Direct and Indirect Effects – Gray Wolf

#### Gray Wolf - Herbicide Toxicity, Alternative 1 (Proposed Action), Direct and Indirect Effects

Wolves would be likely to occasionally contact herbicides by dermal absorption following contact with sprayed plants. There is also a very small chance that they could be directly sprayed with herbicide during aerial application. However, the toxicity of herbicides proposed for use is low (Table 3-14). Although there is uncertainty involved with the toxicity of some herbicides and inert ingredients, the chances of wolves receiving doses great enough to cause toxic effects are very low.

#### Gray Wolf - Habitat Modification, Alternative 1 (Proposed Action), Direct and Indirect Effects

Under this alternative, fewer acres of weed infestations would go untreated compared to all other alternatives. Elk populations, which are the primary prey for wolves, are not currently limited by weed infestations so short-term effects on wolves would be similar to the Alternative 3 (No Change from Current Action). The long term effects of weed infestations on elk populations are uncertain, but this alternative would do the most to maintain forage for the prey populations that wolves are dependent on.

As with grizzly bears, the use of sheep and goats for weed management could lead to possible conflicts with wolves. Wolf depredation can be a problem when commercial sheep grazing operations are located in proximity to areas occupied by wolves (USFWS 1987). This could lead to conditioning of wolves to livestock as food, and lead to conflicts with livestock on adjacent grazing allotments resulting in management removals of wolves. However, the grazing use proposed in this alternative differs from typical commercial grazing operations in several key ways that would reduce the likelihood of this occurring.

Goats and sheep would be used in localized areas. Bands of sheep and goats would be much smaller than those typically associated with commercial livestock grazing. Additionally, protection measures would be applied to lessen the chances of depredation conflicts developing. Herders and guard dogs would be used to monitor herds, and would immediately report any losses of their stock. Herders would be required to immediately dispose of any sheep or goat carcasses to prevent attracting wolves, receive training from the U.S. Fish and Wildlife Service or other authorized organization in the use of hazing techniques to prevent depredations by wolves, and to implement those techniques when wolves are known to be in proximity to domestic sheep or goats being used for weed control. Electric fencing would be used to contain sheep and goats at night. Sheep and goats would be removed from the Forest if wolf depredations were to occur. Despite such precautions, wolves have preyed upon domestic sheep being used for weed control in the Yellowstone area (Bangs 2003) with resulting management removal of a wolf, and there is potential for this to occur on the Forest if goats or sheep are used.

**Gray Wolf - Disturbance and Displacement, Alternative 1 (Proposed Action), Direct and Indirect Effects**

Wolves could be displaced by activities such as ground-based herbicide spraying. However, activities would be of relatively short duration during daylight hours, so disturbance or displacement would be very temporary and affect only localized areas. Aerial spraying would be more likely to disturb or displace wolves than ground spraying, but the additive disturbance of this treatment on wolves would be discountable due to the short duration and localized nature of aerial spraying. Based on wolf protection measures, weed treatment activities would not disturb wolf denning because no ground-based or aerial spraying would occur within ½ mile of a known den site from April 1 thru June 30 (J. Trapp, MT Fish, Wildlife, and Parks, personal communication on 04/29/05).

**Gray Wolf - Herbicide Toxicity, Habitat Modification, and Disturbance and Displacement, Alternative 2 (No Herbicides), Direct and Indirect Effects**

There would be no toxic effects to gray wolves under this alternative because no herbicides would be used.

The effects of sheep and goat grazing for weed management on wolves would be similar under all alternatives. Their effects are described in detail under Alternative 1.

Long-term negative impacts to elk forage and ultimately the prey base for wolves would be uncertain, but potentially greater for this alternative than all others because the treatments proposed would be the least likely to contain the spread of weeds.

Although weed management activities would vary among alternatives, they would have similar displacement and disturbance effects on wolves. These effects are described in detail in Alternative 1, and are expected to be discountable due to their short duration and localized nature.

**Gray Wolf - Herbicide Toxicity, Habitat Modification, and Disturbance and Displacement, Alternative 3 (No Change from Current Management), Direct and Indirect Effects**

Wolves would occasionally come into contact with herbicides through dermal absorption following contact with treated vegetation. Due to the low toxicity of herbicides proposed for use and the low doses expected with dermal absorption, toxic effects to wolves would be extremely unlikely even with the uncertainty involved regarding the toxicity of some herbicides and inert ingredients.

The acreage of weed treatment would be insufficient to contain the spread of weeds. Elk winter ranges are generally in low-to-mid elevation rangelands that have a high risk for infestation by weeds. Degradation of elk winter ranges on the Forest due to weed infestation would likely lead to lower populations of prey for wolves. The effects of sheep and goat grazing for weed management on wolves would be similar under all alternatives. Their effects are described in detail under Alternative 1.

Although weed management activities would vary among alternatives, they would have similar displacement and disturbance effects on wolves. These effects are described in detail in Alternative 1, and are expected to be discountable due to their short duration and localized nature.

**Cumulative Effects – Gray Wolf**

**Gray Wolf – Alternative 1 (Proposed Action) – Cumulative Effects**

Cumulative effects to wolves resulting from herbicide use in this alternative would be similar to those described under Alternative 3 (No Action), because of the low potential for herbicides proposed for use to bio-magnify. Weed control activities would not impact dens, and any disturbance to wolves resulting from this alternative would have discountable cumulative effects. This alternative would have the greatest probability of containing the spread of weeds, and would do the most to preserve elk and deer populations that provide the forage base for wolves. It would have the least cumulative effects on wolves.

**Gray Wolf – Alternative 2 (No Herbicides) – Cumulative Effects**

No herbicides would be used, so there would be no cumulative toxic effects. The potential for disturbance and displacement would be lowest under this alternative, and would have discountable cumulative effects. This alternative would be more likely to contribute to cumulative effects on wolves than Alternative 3 (No Action), because it would be less likely to contain the spread of weeds in elk habitat over the next 15 years and lower elk populations could result.

**Gray Wolf – Alternative 3 (No Change from Current Management) – Cumulative Effects**

Cumulative effects to gray wolves were analyzed for the Absaroka Elk Management Unit (EMU), which contains all seasonal ranges for elk on the Custer National Forest within known wolf distribution. EMU's were delineated in the Statewide Elk Management Plan for Montana as a collection of hunting districts that share similar ecological conditions and encompass the yearlong range of major elk populations (Youmans 1992). They were used because elk populations are the primary factor determining wolf distribution on the Forest. The temporal bounds for the analysis were the past 10 years and 15 years into the future. Because weed infestations have changed rapidly and it is difficult to predict how they will spread beyond that timeframe, it will also be difficult to predict how weeds would affect wolves and their prey.

Weed control with herbicides is an activity that has been occurring for years in the analysis area, and undoubtedly will continue for many years into the future. Private landowners, county governments, and other state and federal agencies all use herbicides to control weeds. However, this use has been compatible with wolf recovery and is expected to continue to be so in the future. The herbicides proposed for use are water-soluble and do not bio-magnify, so cumulative toxic effects to wolves under this alternative would not occur.

A large variety of human activities occur in the analysis area. Isolated cases of disturbance to wolf dens from human activity have occurred in the past (Smith 1998), but have not affected wolf recovery. Disturbance or displacement of wolves under this alternative would be infrequent and have discountable cumulative effects to wolves.

Elk populations, which provide the bulk of the forage base for wolves in the analysis area, are generally robust. Private land development is probably the main threat to elk populations, but public land winter range is also available. The quality of public lands winter ranges may become more important in the future, as private lands winter ranges are lost to development. The continued spread of weeds on elk winter ranges could decrease forage availability and ultimately elk populations within the next 15 years. This alternative could contribute to cumulative effects on wolves because it may not be sufficient to contain the spread of weeds in important elk habitat, and lower elk populations could result.

Other Forest Service projects such as timber sales and prescribed fires, road maintenance, recreational activities and vehicle use, special use permits (both recreation events and non-recreation), livestock grazing, and summer home residence may contribute to the spread of weeds in winter range areas. Recently adopted Best Management Practices (Forest Service Manual 2080) for preventing weed spread

are incorporated as protection measures in project plans, which would help limit weed spread from Forest Service actions.

### Direct and Indirect Effects – Bald Eagle

#### Bald Eagle - Herbicide Toxicity, Alternative 1 (Proposed Action), Direct and Indirect Effects

Since bald eagles are not currently known to nest on the Forest they would be highly unlikely to come into contact with herbicides on the Forest. Foraging bald eagles from off-forest nest locations could possibly come into contact with treated areas. This section will discuss the potential affects on bald eagles from adjacent lands or if nests are found on the Forest in the future. No aerial spraying would be allowed within 800 meters if an active bald eagle nest was located, which would prevent the direct spraying of adult birds or chicks on their nests. The chances of bald eagles being directly sprayed would otherwise be very remote. The amount of herbicide absorbed would be very low, and toxic effects would be unlikely due to the low toxicity of herbicides proposed for use. However, this must be qualified by the fact that there is uncertainty regarding the toxicity of some herbicides and inert ingredients. The herbicides proposed for use do not appear to bio-accumulate or bio-magnify, so the probability of toxic effects to eagles resulting from them eating contaminated prey would also be very low.

#### Bald Eagle - Habitat Modification, Alternative 1 (Proposed Action), Direct and Indirect Effects

Weed infestations and treatments proposed under this alternative would have little affect upon potential bald eagle habitat. Weeds have not affected the aquatic systems that support the major fish populations on the Forest, Mystic, West Rosebud, and East Rosebud Lakes that in turn would provide the majority of forage for breeding bald eagles on the Forest. Fish populations in the major water bodies that would be the most important to bald eagles would not be affected by herbicide use because protection measures would be applied to protect aquatic species (see Fisheries/Amphibians specialist's report) and the large volume of water in these lakes would dilute any herbicides that entered the system to non-toxic levels.

#### Bald Eagle - Disturbance And Displacement, Alternative 1 (Proposed Action), Direct and Indirect Effects

Because of the high potential for disturbance to nesting eagles from aerial spraying, protection measures would be applied preventing aerial spraying within zones I or II (less than 800 meters) of bald eagle nests. Ground-based human activities associated with the project would not be allowed within zone I (less than 400 meters) of an active nest, except along roadways open to public motorized use where disturbance already occurs. These measures would be in compliance with recommendations for bald eagle nesting territory management (Greater Yellowstone Bald Eagle Working Group 1996) and would effectively prevent disturbance of nesting eagles. Project activities could otherwise lead to the occasional disturbance and displacement of foraging eagles, but these effects would normally be discountable due to the localized nature of treatments and the availability of alternative foraging locations.

#### Bald Eagle - Herbicide Toxicity, Habitat Modification, and Disturbance and Displacement, Alternative 2 (No Herbicides), Direct and Indirect Effects

There would be no toxic effects to bald eagles under this alternative because no herbicides would be used.

Impacts to bald eagle habitat would be very similar under all alternatives. The effects are described in detail under Alternative 1. The only difference is that elk populations could be lower under this alternative, possibly leading to reduced availability of carrion for eagles.

The potential for disturbance or displacement of foraging bald eagles would be very low because biocontrol would be the treatment method affecting the most acres. Little human activity is associated with biocontrol. Mechanical and herbicide treatments require the most human activity and have the most potential to cause disturbance. No herbicide treatment and very limited amounts of mechanical treatment would be used under this alternative.

**Bald Eagle - Herbicide Toxicity, Habitat Modification, and Disturbance and Displacement, Alternative 3(No Change from Current Management), Direct and Indirect Effects**

The effects of this alternative would similar to those described in Alternative 1, except that there would be a lower chance of bald eagles contacting herbicides due to the lower number of acres proposed for treatment.

Impacts to bald eagle habitat would be very similar under all alternatives. The effects are described in detail under Alternative 1. The difference is that elk populations could be lower under this alternative, possibly leading to reduced availability of carrion for eagles.

The potential for disturbance and displacement of bald eagles would be lower than under Alternative 1, because no aerial spraying would occur and fewer acres would be treated using ground-based activities. Bald eagles could be disturbed or displaced by weed control activities, especially by ground-based herbicide spraying near active nests. The same protection measures would apply to ground-based weed management activities to prevent disturbance of nesting eagles.

**Cumulative Effects – Bald Eagle**

**Bald Eagle – Alternative 1 (Proposed Action) – Cumulative Effects**

Cumulative effects to eagles resulting from herbicide use in this alternative would be similar to those described under Alternative 3 (No Action), because the herbicides proposed for use are rapidly excreted and do not bio-accumulate. Cumulative impacts of disturbance to foraging eagles resulting from this alternative would be slightly greater than under the No Action Alternative. However, these effects would be very slight due to the short duration and localized nature of the proposed treatments. As for the No Action Alternative, there would be no cumulative effects to bald eagle forage or their habitat.

**Bald Eagle – Alternative 2 (No Herbicides) – Cumulative Effects**

No herbicides would be used, so there would be no cumulative toxic effects. The potential for disturbance and displacement of eagles would be minimal under this alternative, and would have discountable cumulative effects because alternate foraging areas would still be available. This alternative would have no direct or indirect effect upon the forage base for eagles or their habitat, and would not have any cumulative effect.

**Bald Eagle – Alternative 3 (No Change from Current Management) – Cumulative Effects**

The analysis area for bald eagles was the Beartooth Mountains portion of the Beartooth Ranger District because this area would be the most likely location on the forest for future nesting bald eagles. The temporal bounds for the analysis were the past 10 years and 15 years into the future, because weed infestations have changed rapidly and it is difficult to predict how their spread beyond that timeframe would affect eagles.

Weed control with herbicides is an activity that has been occurring for years in the analysis area, and undoubtedly will continue for many years into the future. Private landowners, county governments, and other state and federal agencies all use herbicides to control weeds. Other pesticides including organophosphates and carbamates are also in use and have caused bald eagle mortalities on the Gallatin National Forest which is adjacent to the Custer National Forest in the Beartooth Mountains (Greater Yellowstone Bald Eagle Working Group 1996). However, the herbicides proposed for use are water-soluble and do not bio-magnify. Therefore, no toxic cumulative effects to bald eagles are expected under this alternative.

A large variety of human activities occur in the analysis area. The human population in the analysis area is growing rapidly. The potential for disturbance and displacement of eagles has therefore also increased. Although private land eagle habitat may be affected more, recreational use of public lands will also continue to cause disturbance problems for eagles in the future. Disturbance to nesting bald eagles would largely be mitigated under this alternative. There would be some cumulative effects to foraging bald

eagles that were displaced due to weed control activities under this alternative, because birds would be displaced to other areas that would likely have human activities such as fishing and boating. They could also be discouraged from foraging in these areas. Recreational activities are currently not high enough to prevent bald eagles from finding adequate forage, but could increase to that level within the next 15 years. However, the disturbance and displacement of foraging eagles resulting from this alternative would be discountable because of effective protection measures, and the localized, short duration nature of activities.

This alternative would have no direct or indirect effect upon the forage base for eagles or their habitat, and would therefore not have any cumulative effect.

## Sensitive Species

### Sensitive Species - Herbicide Toxicity, Alternative 1 (Proposed Action), Direct and Indirect Effects

The probability would be greater for this alternative than for all other alternatives that sensitive species including the peregrine falcon, northern goshawk, Baird's sparrow, blue-gray gnatcatcher, burrowing owl, greater sage grouse loggerhead shrike, long-earred myotis, long-legged myotis, pallid bat, spotted bat, and Townsend's big-eared bat would contact herbicides. The only expected overlap between wolverine habitat and treatment areas would be on big-game winter ranges. However, wolverines would not be expected to contact herbicides because they use big game winter ranges while carrion is available during the winter and early spring, before herbicides would be used. Black-tailed and white-tailed prairie dog colonies located on the Forest are presently weed free. Toxic effects to sensitive species due to the use of herbicides under this alternative are unlikely. Species such as the peregrine falcon, northern goshawk, Baird's sparrow, blue-gray gnatcatcher, burrowing owl, greater sage grouse, loggerhead shrike, long-earred myotis, long-legged myotis, pallid bat, spotted bat, and Townsend's big-eared bat could occasionally ingest prey that had been sprayed with herbicides because they forage in areas that may receive treatment with herbicide. The herbicides proposed for use have not been found to bio-accumulate or bio-magnify. The toxicity of herbicides proposed for use is low (Table 3-14), as is the chance of these species receiving doses great enough to cause toxic effects. However, this must be qualified by the fact that there is uncertainty regarding the toxicity of some herbicides and inert ingredients.

### Sensitive Species - Habitat Modification, Alternative 1 (Proposed Action), Direct and Indirect Effects

The short-term impacts of herbicides on vegetation could cause localized decreases in the abundance of prey species for peregrine falcon, northern goshawk, Baird's sparrow, blue-gray gnatcatcher, burrowing owl, greater sage grouse, loggerhead shrike, long-earred myotis, long-legged myotis, pallid bat, spotted bat, and Townsend's big-eared bat. These impacts would be more widespread than those under Alternative 3 (No Change from Current Action), due to the much larger area proposed for treatment. However, populations of these prey species depend on native vegetation and would begin recovering in treated areas within 2-3 years of herbicide treatment (Rice *et al*., 1997). This alternative would result in more acres of weed infestation successfully treated compared to the Alternative 3, and the long-term availability of forage for these species would be improved.

### Sensitive Species – Disturbance and Displacement, Alternative 1 (Proposed Action), Direct and Indirect Effects

The probability of disturbance and displacement of sensitive species under this alternative would be slightly larger than for all other alternatives, due to the use of aerial spraying. The effects would be temporary and localized due to the short duration of aerial spraying. Breeding activities of sensitive species would not be affected because weed control would generally not occur in close proximity to expected nesting and breeding areas for species that are sensitive to disturbance such as peregrine falcons and goshawks. Aerial spraying would not occur within one mile of known peregrine nests and within ¼ of goshawk nests. With protection measures that prohibit aerial spraying less than one mile of an active peregrine falcon nest from April 1-August 15 and within ¼ mile of an active goshawk nest from April 1 to August 15, this alternative would be consistent with management recommendations for this species

because other weed management activities would be within the scope of activities that historically occurred.

**Sensitive Species - Herbicide Toxicity, Habitat Modification, and Disturbance and Displacement, Alternative 2 (No Herbicides), Direct and Indirect Effects**

There would be no toxic effects to sensitive species under this alternative because no herbicides would be used.

The short-term impacts of weed treatment on forage availability for peregrine falcon, northern goshawk, Baird's sparrow, blue-gray gnatcatcher, burrowing owl, greater sage grouse, loggerhead shrike, long-earred myotis, long-legged myotis, pallid bat, spotted bat, and Townsend's big-eared bat would be less than under all other alternatives because biocontrol using species-specific agents rather than broad-spectrum herbicides that kill a variety of plants would be the most widespread treatment method. Long-term negative effects of this alternative to sensitive species habitat would be greater than those expected under the Alternative 3 (No Action), because weed treatments would be less likely to contain the spread of weeds.

The potential for disturbance or displacement of sensitive species would be very low because biological control would be the treatment method affecting the most acres. Little human activity is associated with biological control.

**Sensitive Species - Herbicide Toxicity, Habitat Modification, and Disturbance and Displacement, Alternative 3 (No Change from Current Management), Direct and Indirect Effects**

The effects of this alternative would similar to those described in Alternative 1, except that there would be a lower chance of sensitive species contacting herbicides due to the lower number of acres proposed for treatment and the lack of aerial spraying.

The short-term effects of this alternative upon sensitive species habitat would be similar to those described under Alternative 1, except they would be less widespread due to the much smaller area proposed for treatment. Over the long term, forage availability for these species would decline because the amount of acreage treated would be insufficient to limit the spread of weed infestations.

The probability of disturbance and displacement of sensitive species under this alternative would be smaller than under Alternative 1, due to the lower number of acres proposed for treatment and the lack of aerial spraying. Some disturbance and displacement of sensitive species could still result from weed treatments, but the effects would be temporary and localized. As described in Alternative 1, protection measures would be applied to prevent disturbance to breeding goshawks.

**Sensitive Species - Cumulative Effects**

**Sensitive Species - Cumulative Effects - Alternative 1 (Proposed Action)**

Cumulative effects to sensitive species resulting from herbicide use in this alternative would be similar to those described under Alternative 3 (No Action), because the herbicides proposed for use are rapidly excreted and do not bio-accumulate. Cumulative effects resulting from disturbance would be slightly greater than other alternatives due to the larger area of treatment proposed, but would still have minimal impacts. This alternative would have the greatest probability of containing the spread of weeds, and would do the most to maintain suitable native vegetation that provides habitat for sensitive species. Cumulative impacts on sensitive species habitat over the next 15 years would be lowest under this alternative.

**Sensitive Species - Cumulative Effects - Alternative 2 (No Herbicides)**

No herbicides would be used, so there would be no cumulative toxic effects. Disturbance from weed treatment activities proposed under this alternative would have the least cumulative effects on sensitive species because it would involve the fewest activities with the potential to cause disturbance. This alternative would contribute more to cumulative effects on sensitive species habitat than all other

alternatives because it would be the least likely to contain the spread of weeds and continued habitat degradation would result over the next 15 years.

**Sensitive Species - Cumulative Effects - Alternative 3 (No Change from Current Management)**

The analysis area for sensitive species was Beartooth, Ashland and Sioux Ranger Districts. This area was chosen because it is a large area that provides a full variety of the habitats available to the wolverine, peregrine falcon, northern goshawk, Baird's sparrow, blue-gray gnatcatcher, burrowing owl, greater sage grouse, loggerhead shrike, long-earred myotis, long-legged myotis, pallid bat, spotted bat, Townsend's big-eared bat, black-tailed prairie dog and white-tailed prairie dog in southeast Montana. The temporal bounds for the analysis were the past 10 years and 15 years into the future, because weed infestations have changed rapidly and it is difficult to predict how their spread beyond that timeframe would affect sensitive species habitat.

Weed control with herbicides is an activity that has been occurring for years in the analysis area, and undoubtedly will continue for many years into the future. Private landowners, county governments, and other state and federal agencies all use herbicides to control weeds. However, the herbicides proposed for use are water-soluble and do not bio-accumulate. Although they may occasionally contact herbicides, no toxic cumulative effects to the wolverine, peregrine falcon, northern goshawk, Baird's sparrow, blue-gray gnatcatcher, burrowing owl, greater sage grouse, loggerhead shrike, long-earred myotis, long-legged myotis, pallid bat, spotted bat, Townsend's big-eared bat, black-tailed prairie dog and white-tailed prairie dog are expected under this alternative.

The continued spread of weeds on other public and private lands would lead to loss of native vegetation that supports prey populations for the wolverine, peregrine falcon, northern goshawk, Baird's sparrow, blue-gray gnatcatcher, burrowing owl, greater sage grouse, loggerhead shrike, long-earred myotis, long-legged myotis, pallid bat, spotted bat, Townsend's big-eared bat, black-tailed prairie dog and whit-tailed prairie dog. Forest Service projects such as timber sales and prescribed fires, road maintenance, recreational activities and vehicle use, special use permits (both recreation events and non-recreation), livestock grazing, and summer home residence may contribute to the spread of weeds. Recently adopted Best Management Practices (Forest Service Manual 2080) for preventing weed spread are incorporated as protection measures in project plans, which would help limit weed spread from Forest Service actions. This alternative would contribute somewhat to cumulative effects on these species because it would be insufficient to contain most weed infestations and continued habitat degradation would result, although the degree to which populations of sensitive species would be impacted is difficult to predict.

Disturbance from human activities has been identified as a problem for some sensitive species, such as the western big-eared bat (Reel et al. 1989). Although a variety of sensitive species are subject to disturbance from human activities, the impacts of these effects are unknown. Disturbance from weed treatment activities proposed under this alternative would have very low cumulative effects on sensitive species due to the very small area that would be treated compared to the large area subject to disturbance by other human activities.

## Management Indicator Species / Key Species

**Management Indicator Species / Key Species - Herbicide Toxicity, Alternative 1 (Proposed Action), Direct and Indirect Effects**

The chances of MIS/Key Species, goshawk, white-tailed deer, ruffed grouse, western kingbird, Bullock's oriole, yellow warbler, ovenbird, spotted towhee, Brewer's sparrow, sharp-tailed grouse, elk, golden eagle, merlin, mule deer, bighorn sheep, and pronghorn antelope, contacting herbicides would be greater under this alternative than for all other alternatives, because this alternative proposed the most herbicide use. Most herbicide use would occur in habitats occupied by MIS/Key Species, and they would be likely to occasionally ingest sprayed vegetation or prey species (insects) that had been sprayed. There would be a small additional risk of MIS/Key Species being directly sprayed during aerial herbicide application. The toxicity of herbicides proposed for use is low, as are the chances of MIS/Key Species receiving doses great enough to cause toxic effects. However, this must be qualified by the fact that there is uncertainty regarding the toxicity of some herbicides and inert ingredients.

**Management Indicator Species / Key Species - Habitat Modification, Alternative 1 (Proposed Action), Direct and Indirect Effects**

This alternative would involve the greatest short-term impacts but also the most long-term benefits to MIS/Key Species populations, because this alternative proposed the most acreage of weed treatment. Forage and habitat availability would temporarily decrease in areas treated with herbicides, but would begin recovering within two to three years of herbicide treatment (Rice et al. 1997). Over the long term, fewer acres of weeds would go untreated under this alternative than for all others.

**Management Indicator Species / Key Species - Disturbance and Displacement, Alternative 1 (Proposed Action), Direct and Indirect Effects**

The probability of disturbance and displacement of MIS/Key Species under this alternative would be slightly larger due to the use of aerial spraying. The effects would still be temporary and localized due to the short duration of aerial spraying.

**Management Indicator Species / Key Species - Herbicide Toxicity, Habitat Modification, and Disturbance and Displacement, Alternative 2 (No Herbicides), Direct and Indirect Effects**

There would be no toxic effects to MIS / Key Species under this alternative because no herbicides would be used.

The short-term effects to MIS/Key Species habitat would be less than under all other alternatives because biocontrol using species-specific agents rather than broad-spectrum herbicides that kill a variety of plants would be the most widespread treatment method. Long-term negative impacts to MIS/Key Species habitat would be greater for this alternative than all others, because the treatments proposed would be the least likely to contain the spread of weeds.

The potential for disturbance or displacement of MIS/Key Species would be very low because biological control would be the treatment method affecting the most acres. Little human activity is associated with biological control.

**Management Indicator Species / Key Species, Herbicide Toxicity, Habitat Modification, and Disturbance and Displacement, Alternative 3 (No Change from Current Management), Direct and Indirect Effects**

The chances of MIS/Key Species contacting herbicide would be lower than under Alternative 1, because the number of acres treated would be lower. The chances of MIS/Key Species experiencing toxic effects if they did contact herbicides are low, and are described in detail under Alternative 1.

Under this alternative, there would be a smaller short-term loss of MIS/Key Species forage in areas treated with herbicides until native vegetation began recovering within 2-3 years of herbicide treatment (Rice et al. 1997) compared to Alternative 1. Degradation of MIS/Key Species habitat on the Forest would likely lead to lower long-term MIS/Key Species populations compared to Alternative 1, because the treatments proposed would less effective at containing the spread of weeds.

Some disturbance and displacement of MIS/Key Species would be expected to result from weed treatments. These effects would be temporary and localized, and adjacent areas would normally contain suitable habitat for displaced animals.

## Management Indicator Species / Key Species - Cumulative Effects

**Management Indicator Species / Key Species, Cumulative Effects - Alternative 1 (Proposed Action)**

Cumulative effects to MIS/Key Species resulting from herbicide use in this alternative would be similar to those described under Alternative 3 (No Action), because the herbicides proposed for use are rapidly excreted and do not bio-accumulate. Cumulative effects resulting from disturbance would be slightly

greater than other alternatives due to the larger area of treatment proposed, but would still have minimal impacts. This alternative would have the greatest probability of containing the spread of weeds, and would do the most to maintain quality MIS/Key Species habitat within the analysis area. Cumulative impacts on MIS/Key Species habitats over the next 15 years would be lowest under this alternative.

**Management Indicator Species / Key Species, Cumulative Effects - Alternative 2 (No Herbicides)**

No herbicides would be used, so there would be no cumulative toxic effects. The potential for disturbance and displacement of MIS/Key Species would be minimal and contribute the least towards cumulative effects on MIS/Key Species compared to all other alternatives. This alternative would contribute more towards cumulative effects on MIS/Key Species habitat than all other alternatives because it would be the least likely to contain the spread of weeds in MIS/Key Species habitats.

**Management Indicator Species / Key Species, Cumulative Effects - Alternative 3 (No Change from Current Management)**

The analysis area for MIS/Key Species was the Beartooth, Ashland and Sioux Ranger Districts. This area was chosen because it is a large area that provides a full variety of the habitats available to the MIS/Key Species on the Custer National Forest. The temporal bounds for the analysis were the past 10 years and 15 years into the future, because weed infestations have changed rapidly and it is difficult to predict how weed spread beyond that timeframe would affect MIS/Key Species habitat.

Weed control with herbicides is an activity that has been occurring for years in the analysis area, and undoubtedly will continue for many years into the future. Private landowners, county governments, and other state and federal agencies all use herbicides to control weeds. However, toxic effects to MIS/Key Species associated with this use have not been identified. The herbicides proposed for use are water-soluble and do not bio-accumulate, so cumulative toxic effects to MIS/Key Species resulting from bio-accumulation under this alternative would not occur.

A large variety of human activities occur in the analysis area, many of which have the potential to disturb or displace MIS/Key Species. Disturbance from weed treatment activities proposed under this alternative would have very low cumulative effects on MIS/Key Species due to the small number of acres that would be treated compared to the large area subject to disturbance by other human activities.

MIS/Key Species populations are generally robust in the analysis area. Private land development is probably the main threat. The quality of MIS/Key Species habitat available in public lands may become more important in the future as private lands are lost to development. Forest Service projects such as timber sales and prescribed fires, road maintenance, recreational activities and vehicle use, special use permits (both recreation events and non-recreation), livestock grazing, and summer home residence may contribute to the spread of weeds. The continued spread of weeds on MIS/Key Species habitats will likely decrease habitat availability and ultimately MIS/Key Species populations in the future. Recently adopted Best Management Practices (Forest Service Manual 2080) for preventing weed spread are incorporated as protection measures in project plans, which would help limit weed spread from Forest Service actions. The continued spread of weeds on MIS/Key Species habitats could contribute to cumulative effects on MIS/Key Species.

## SUMMARY OF EFFECTS ON WILDLIFE

Table 4 – 20 summarizes the potential risk of toxic effects to wildlife by alternative.

### TABLE 4 - 20. POTENTIAL RISK OF TOXIC EFFECTS TO WILDLIFE

| | Alt. 1-Proposed Action | Alt. 2–No herbicides | Alt. 3-No Action |
|---|---|---|---|
| Grizzly Bear | Low[42] | None | Low |
| Gray Wolf | Low | None | Low |

[42] Low risk means that animals may contact herbicides but are unlikely to experience toxic effects due to the low toxicity of herbicides proposed for use. No risk means that animals would not contact herbicide.

| | Alt. 1-Proposed Action | Alt. 2–No herbicides | Alt. 3-No Action |
|---|---|---|---|
| Bald Eagle | Low | None | Low |
| Sensitive Species[43] | Low | None | Low |
| MIS/Key Species[44] | Low | None | Low |

Table 4 – 21 summarizes the potential effects weed management alternatives on wildlife habitat under each of the alternatives. Effects were a combination of short-term impacts of the treatments versus the long-term impacts of invasive weeds.

### TABLE 4 - 21. POTENTIAL EFFECTS ON WILDLIFE HABITAT BY ALTERNATIVE

| | Alt. 1-Proposed Action | Alt. 2–No herbicides | Alt. 3-No Action |
|---|---|---|---|
| Grizzly Bear | Low | Moderate | Moderate |
| Gray Wolf | Low | High | Moderate |
| Bald Eagle | None | None | None |
| Sensitive Species | Low | Moderate | Moderate |
| MIS/Key Species | Low | High | Moderate |

Table 4 – 22 summarizes the potential disturbance and displacement effects on wildlife under each of the alternatives.

### TABLE 4 - 22. POTENTIAL DISTURBANCE / DISPLACEMENT EFFECTS ON WILDLIFE

| | Alt. 1-Proposed Action | Alt. 2–No herbicides | Alt. 3-No Action |
|---|---|---|---|
| Grizzly Bear | Moderate | Low | Low |
| Gray Wolf | Low | Low | Low |
| Bald Eagle | Moderate | Low | Low |
| Sensitive Species | Moderate | Low | Low |
| MIS/Key Species | Moderate | Low | Low |

**Consistency with Forest Plan and other Laws, Regulations and Policies - Wildlife**

The Custer Forest Plan (USFS, 1986) contains a Forest-wide standard stating that “the Forest has the responsibility to manage the land to maintain at least viable populations of existing native and desirable non-native vertebrate species, promote the conservation of federally listed threatened and endangered species and coordinate and cooperate with appropriate state, federal and private agencies in the management of habitats for major interest species.” Additionally, the Forest Plan (USFS, 1986) identified a list of Management Indicator Species as directed by the National Forest Management Act. Alternative 1 would best meet the intent of these standards and objectives by doing the most to maintain native vegetation that is a critical habitat component for most wildlife. Alternatives 1 and 3 would be consistent with direction in the Forest Plan and other laws regarding weed control. Alternative 2 would be consistent with direction in the Forest Plan and other laws regarding weed control, but is not a very effective approach and has a more likelihood of altering habitats for wildlife in the long-term.

All alternatives would be consistent with the Migratory Bird Treaty Act, the Final Conservation Strategy for Grizzly Bears within the Greater Yellowstone Area (IGBC, 2003), the Lynx Conservation Assessment and Strategy (2000) and , the State’s conservation plans for prairie dogs and sage grouse, and the Greater Yellowstone Bald Eagle Management Plan (Greater Yellowstone Bald Eagle Working Group, 1996). A Biological Assessment discussing effects of the Preferred Alternative will be prepared and submitted to the U.S. Fish & Wildlife Service to comply with the Endangered Species Act.

[43] Wolverine, peregrine falcon, northern goshawk, Baird’s sparrow, blue-gray gnatcatcher, burrowing owl, greater sage grouse, loggerhead shrike, long-earred myotis, long-legged myotis, pallid bat, spotted bat, Townsend’s big-eared bat, black-tailed prairie dog and white-tailed prairie dog.

[44] Goshawk, white-tailed deer, ruffed grouse, western kingbird, Bullock’s oriole, yellow warbler, ovenbird, spotted towhee, Brewer’s sparrow, sharp-tailed grouse, elk, golden eagle, merlin, mule deer, bighorn sheep, and pronghorn antelope.

# *WILDERNESS, RECOMMENDED WILDERNESS, AND INVENTORIED ROADLESS AREAS*

## WILDERNESS AND INVENTORIED ROADLESS AREAS - DIRECT AND INDIRECT EFFECTS, ALTERNATIVE 1 (PROPOSED ACTION)

Weeds in Wilderness would not be treated with aerial applications of herbicides in this alternative (or any alternative considered in this decision).

Aerial applications could be considered in roadless lands. The activity would be of short duration, less than one day.

### Natural Integrity and Apparent Naturalness

Where weed treatment is effective, there will be short-term evidence including dead or wilting plants and areas of disturbed soils where plants have been pulled up or grubbed out. Where plants are dead or dying, and spraying was marked with dye, some people may recognize the weeds were sprayed, which may not appear natural.

This alternative would be the most aggressive and effective alternative in controlling weeds in Wilderness, recommended wilderness, and roadless areas, because of the multi-faceted treatment options (including herbicides), and the larger number of acres treated. This alternative would create the most improvements in natural integrity by restoring native vegetation to weed infested sites.

In the AB Wilderness, approximately 45 acres of herbicide treatment could occur initially. The effects on natural integrity would be an overall improvement of these areas as invading noxious weeds are excluded from wildlands and replaced with native plants (see the vegetation section). Apparent naturalness of treatment areas will improve as the evidence of noxious weeds decreases and is replaced with native vegetation. See the effects discussions under vegetation, wildlife and fish, and watershed for an estimate of the direct effects to these resources.

Herbicide treatment would decrease establishment and expansion of aggressive species in wildland areas, and reduce weed related impacts. The visual impact of spraying would be temporary and on most sites only last a few hours or less. Dying and wilting weed plants following herbicide treatment could be apparent. However, this appearance would be short-lived as surrounding vegetation would screen dead plants or blend in with native vegetation, as it grows dormant. Some desirable native vegetation could also be killed along with the weeds depending on the type of herbicide used.

Biological control with insects would only be used on large established weed patches, and would not be noticeable. Some people may notice areas where weeds were pulled, but it would likely not affect the apparent naturalness of the areas.

### Remoteness and Solitude

Aerial spraying would not occur in Wilderness areas. Aerial spraying of herbicides within Inventoried Roadless areas would reduce feelings of remoteness and solitude during the one day within each area required to accomplish this work. Public traffic would be limited to these areas during spraying which would help mitigate any effect to the sense of remoteness or solitude. The public may encounter weed crews during hand spraying operations in Wilderness, recommended wilderness, or roadless areas, which may affect some people's sense of remoteness, and their opportunity for solitude. This effect would be very short term (typically only several days), and backcountry crews treating weeds would be small (typically 1-4 people).

The use of biological controls would not affect remoteness or solitude. Where weeds are pulled by hand, or chopped/grubbed recreationists may happen upon a work crew and have a reduced feeling of solitude. Treating large infestations with mechanical treatments would require larger crews and longer stays than

treating with herbicides, which may have a greater effect on the sense of remoteness and opportunities for solitude. Again, impacts would be short term, with crews being in one area typically no longer than a week.

### Primitive Recreation Opportunities

With aerial herbicide application, treated areas would be closed to public use until it is safe for them to enter these areas, thus restricting the overall recreational opportunity during this time. Treatment would most likely occur during spring through fall. The public would be kept out of treatment areas for approximately 24-48 hours at a time, reducing opportunities for recreation during those periods.

Mechanical or biological treatments, because of their limited extent and minor impacts, will not impact opportunities for primitive recreation.

In all applications a “minimum tool analysis” would be used to determine the treatment option which would have the least impact on Wilderness values while effectively controlling the weeds which may include a combination of herbicides, biological, or mechanical treatments. See Appendix E for an example of a minimum tool decision tree.

## WILDERNESS AND INVENTORIED ROADLESS AREAS - DIRECT AND INDIRECT EFFECTS, ALTERNATIVE 2 (NO HERBICIDE)

In this Alternative, no herbicide would be used, resulting in more acres being treated with biological controls. The effectiveness of both treatment types will be compromised because herbicides would not be used to suppress the established weeds.
The deliberate introduction and establishment of natural weed enemies (biological controls) are designed to reduce the plant’s competitive or reproductive capacities. Its purpose is generally not eradication, but rather a reduction in densities and rate of spread kept at an acceptable level. It has been argued that introduction of an exotic insect into a Wilderness setting is a human manipulation of a natural process.

Biological controls have a different magnitude of effect on the resource than do encroaching weeds. The weeds affect everything in a naturally functioning system from wildlife populations, to water runoff patterns. The exotic insects only directly affect the host weed species. This method is most effective on dense weed infestations over large areas, and would thus have limited effectiveness in the Absaroka Beartooth Area where target species are localized and in small patches.

### Natural Integrity and Apparent Naturalness

This alternative has the potential to have the largest negative effect on naturally functioning ecosystems, and apparent naturalness in Wilderness and roadless lands. Weeds would only be treated with mechanical or biological controls in this alternative, both of which have limited applications for some species. Weeds would eventually occupy all suitable habitats, significantly changing the natural integrity of these lands and their apparent naturalness. See the vegetation section for a thorough discussion of uncontrolled weed population direct effects on the ecosystem, and the discussion under Alternative 2.

### Remoteness and Opportunities for Solitude

Effects to remoteness and solitude under this alternative would be limited to backcountry recreationists encountering weed control crews who were primarily treating weeds with mechanical methods. The effect would be short term and isolated. Recreationists would not encounter any weed spraying crews, nor aerial applications in this alternative. Treating large infestations with mechanical treatments would require larger crews and longer stays than treating with herbicides, which may have a greater effect on the sense of remoteness and opportunities for solitude by increasing chances for encounters. Again, impacts would be short term, with crews in one area typically no longer than one week.

## WILDERNESS AND INVENTORIED ROADLESS AREAS - DIRECT AND INDIRECT EFFECTS, ALTERNATIVE 3 (NO CHANGE FROM CURRENT MANAGEMENT)

Noxious weed control in Wilderness is currently only accomplished by hand grubbing and pulling. Hand control projects have focused on pulling only small patches of houndstongue and spotted knapweed. The Forest currently has no blanket authority to use herbicides for weed control in Wilderness. Typically, less than two acres are treated per year in Wilderness using hand control methods (pulling, grubbing and packing out weeds). Under this alternative approximately 45 acres of current infestations would likely not be treated because they were not covered under previous NEPA decisions for use of herbicides.

Focused information and education programs, hand control projects, strict controls on weed free feed requirements for recreational livestock have all had limited success in controlling the advancement of noxious weed infestations in Wilderness. Monitoring over the last several decades proves that weed populations are expanding despite these efforts at education and hand eradication.

Other Wilderness Area NEPA decisions have allowed chemical and biological control methods. Little or no weed control efforts using herbicides, hand control methods, and biological controls are occurring in the roadless portions of the Forest.

### Natural Integrity and Apparent Naturalness

Expanding weed populations negatively affect the natural integrity of a landscape by displacing native vegetation. This species composition change has a ripple effect throughout the ecosystem. As a weed monoculture develops natural diversity of plant species is drastically reduced resulting in a direct effect to natural integrity. Weed invasions increase erosion, reduce water quality, and effect indigenous wildlife.

Under the No Action Alternative noxious weeds would spread at varying rates depending on the weed species, competing vegetation, disturbance history, and presence of vectors (water, recreationists, animals and vehicles). Under this alternative, it is likely that noxious weeds would eventually infest most suitable habitats within Wilderness, including sites that are presently weed-free. In roadless lands, spread would also go largely unchecked, though there is currently limited authority for herbicide control outside of Wilderness. Unchecked spread of noxious weeds would result in the unavoidable deterioration of the natural condition of the Wilderness and adjoining land diminishing the recreational experience and wildland values. Backcountry travelers who are knowledgeable about plant communities would be aware of the changing landscape, and would not meet their expectations for experiencing an intact ecosystem. The intent of the Wilderness Act is to maintain natural integrity and preserve naturally functioning ecosystems; that would not be realized with this alternative.

### Remoteness and Solitude

Effects to remoteness and solitude under this alternative would be limited to backcountry recreationists encountering weed control crews who were primarily treating weeds with mechanical methods. In some cases recreationists may encounter crews applying herbicides using stock or trail vehicles outside of Wilderness, which could influence a user’s sense of remoteness or solitude. These effects would be short term, limited to a few days in the summer. There would be no long term effects to remoteness or opportunities for solitude using either hand control methods, or limited chemical treatments outside of Wilderness.

## WILDERNESS AND ROADLESS AREAS - CUMULATIVE EFFECTS

Several reasonably foreseeable past, present, and future activities could contribute to cumulative effects to natural integrity, apparent naturalness, opportunities for solitude and remoteness in Wilderness, recommended wilderness, and roadless areas. The analysis area for this discussion is the entire Custer National Forest. Effects are similar in all alternatives. Differences in cumulative effects between alternatives are more an issue of magnitude tied primarily to opportunities for solitude, than presence or absence of effect.

Increasing recreation pressure from all sorts of users including hikers, horseback riders, mountain bikers, and off-highway vehicle enthusiasts contribute to a decreased sense of solitude. These same users are potential vectors for spreading weeds in the Wilderness, recommended wilderness, and roadless areas and affecting natural integrity.

Management of fire also has potential cumulative effects on the natural integrity of these areas. Fire creates ready seedbeds for weeds to become established. Over 22% of the Custer National Forest has experienced recent wildfires, including areas within the AB Wilderness, recommended wilderness, and roadless areas. These areas are ripe for expanding weed infestations.

**Irreversible and Irretrievable Commitment of Resources**

Under Alternatives 2 and 3, once weeds become well established in Wilderness and Inventoried Roadless Areas, eradication would probably never occur, resulting in an irreversible loss of natural integrity and apparent naturalness.

**Consistency with Forest Plan and other Laws, Regulations and Policies**

All alternatives are consistent with management direction found in the Forest Plan, the Wilderness Act, and proposed Roadless Area Conservation Rule. All alternatives are consistent with FSM 21009.14 (13.4) for pesticide use in wilderness areas as long as the Regional Forester approves the annual pesticide use plan. Alternatives 1 and 3 would be consistent with direction in the Forest Plan and other laws regarding weed control. Alternative 2 would be consistent with direction in the Forest Plan and other laws regarding weed control, but is not a very effective approach and has a higher probability of increasing weed infestations within Wilderness, recommended wilderness, and roadless areas.

## *WILD AND SCENIC RIVERS*

### WILD AND SCENIC RIVERS - DIRECT AND INDIRECT EFFECTS, ALTERNATIVE 1 (PROPOSED ACTION)

There would be no substantial direct effects in Alternative 1 to the outstandingly remarkable attributes that make these rivers eligible for inclusion in the system.

Noxious weeds are present along all of these streams. Weeds are often spread with water as the vector. These established weed populations are difficult to treat effectively within close proximity to water. To date, only hand pulling treatments have been used. Under this Alternative, weeds within 50 feet of these rivers could be treated with herbicides that are approved for aquatic applications. .

Indirectly, the effective treatment of weeds along these corridors would improve scenery, and protect fish and wildlife values by restoring the native vegetation component.

### WILD AND SCENIC RIVERS - DIRECT AND INDIRECT EFFECTS, ALTERNATIVE 2 (NO HERBICIDES) AND ALTERNATIVE 3 (NO CHANGE FROM CURRENT MANAGEMENT)

The effects for Alternatives 2 and 3 would be the same. Under the No Action Alternative 3, no aquatic approved herbicides are currently being used to treat weeds along the river corridor, as would be the case in Alternative 2 – no herbicides at all.

There would be no direct effects to the outstandingly remarkable features of these rivers in either alternative. See the fish and wildlife sections for detailed descriptions of direct effects. Indirectly, the lack of aggressive weed control may affect the natural appearance (scenery) of these corridors, as weeds occupy all suitable habitats. The presence of weeds could have a negative effect on the experience of some recreationists who expect a natural environment without the presence of exotic plant species.

Weeds can also increase sediment level, thus effecting fish populations. Also, weeds can decrease forage quality, thus displace wildlife in the river corridor.

### WILD AND SCENIC RIVERS - CUMULATIVE EFFECTS

For all alternatives, there is likely to be some cumulative effects within the river corridors as recreation use increases. Increasing recreation use would likely increase the spread of weeds, which would affect the values of scenery, and potentially increase soil erosion which could affect the fishery and wildlife values.

#### Consistency with Forest Plan and other Laws, Regulations and Policies

All Alternatives are consistent with the goals and objectives of the Custer Forest Plan for eligible river segments to protect and maintain their potential classification. Alternatives 1 and 3 would be consistent with direction in the Forest Plan and other laws regarding weed control. Alternative 2 would be consistent with direction in the Forest Plan and other laws regarding weed control, but is not a very effective approach and has a higher probability of increasing weed infestations within wild and scenic river areas.

## *RESEARCH NATURAL AREAS*

Research Natural Areas (RNA) are designated areas representing major, natural timber types or other plant communities in an unmodified condition. Weeds and the control of weeds may have a detrimental impact on RNAs. At present, there are no known weed infestations on designated or candidate RNAs. Weed establishment is highly unlikely in the Line Creek Plateau RNA due to its alpine setting. Lost Water Canyon and Poker Jim have suitable habitat that is vulnerable to weed invasion.

### RNAS - DIRECT AND INDIRECT EFFECTS, ALTERNATIVES 1 (PROPOSED ACTION)

This alternative proposes to treat weeds that pose a threat to the plant communities within the RNA. Aerial application is excluded from the RNA (see Appendix C -Environmental Protection Measures). However, if any ground treatment with herbicide is planned within a RNA, concurrence must be obtained through the Research Station Director and Forest Supervisor.

The overall goal of RNA management is to maintain the full suite of ecological processes associated with the natural communities and conditions for which the RNA is designed to protect. Until recently, the primary course of action was to leave RNAs alone. However, with the emphasis on ecosystem management, more attention is being placed on restoration of natural processes such as fire, and control of invasive alien species, which alter the composition, and functioning of natural communities (Natural Heritage Program 2004). Weed treatments would protect the natural ecological composition of the RNA, and protect their identified values for research or special interest. Since weeds have been located adjacent to RNAs, effective treatment of those areas would help protect RNAs by helping to eliminate establishment of noxious and invasive weeds within them.

Proposed adaptive management activities include the identification and treatment of weeds that may enter RNAs through natural sources (e.g. wind, wildlife, fire). Following identified protection measures (Appendix C), effects from treatment of new locations would be the same as those already identified. If future additional treatment is needed within the RNAs, concurrence of the Research Station Director and the Forest Supervisor will ensure that herbicide use is consistent with FSM and Forest Plan direction.

### RNAS - DIRECT AND INDIRECT EFFECTS, ALTERNATIVE 2 (NO HERBICIDES)

Biological control could be used when effective agents are available, however the weeds would always be present (biological control agents never eradicate their host). Effective biological control agents are only available for a few weed species. Mechanical pulling of small patches of non-rhizomatous weeds would be implemented where practical. The majority of the most aggressive weed species spread via their roots so pulling is not an effective method of control unless all of the roots are removed and the patch is very small. Also, extensive ground disturbance within the RNAs is not appropriate because of the damage to the

resource that is being protected. Under Alternative 2 most weeds would continue to encroach into these areas. This alternative would not provide opportunities to prevent the introduction of noxious weeds.

### RNAS - DIRECT AND INDIRECT EFFECTS, ALTERNATIVE 3 (NO CHANGE FROM CURRENT MANAGEMENT)

Under this alternative, there would be limited effectiveness to treat weeds with a full array of tools and herbicides in RNAs. Weeds would continue to expand and diminish the unique plant values within and adjacent to these areas.

### RNAS - CUMULATIVE EFFECTS

Under all alternatives, there are no past, present, or reasonably foreseeable actions that, along with the proposed activities within the RNAs, would cumulatively increase the risk of noxious weed spread, with the exception of wildfire. Cumulative effects may occur when weed-spreading activities occur next to RNAs. Under Alternative 1 effective treatments of weeds would maintain the ecological integrity and research value of the areas. Under Alternatives 2 and 3, the long-term lack of effective treatment of potentially new infestations, along with the likelihood that weeds would eventually spread from outside the RNAs into them, poses a risk to both the research value and biological diversity of RNAs.

#### Consistency with Laws and Policies – Research Natural Areas

All of the alternatives are consistent with the Forest Plan. All alternatives are consistent with direction in the Establishment Records by proposing specific control against target organisms, and by taking measures to control or eradicate these populations. Alternatives 1 and 3 would be consistent with direction in the Forest Plan and other laws regarding weed control. Alternative 2 would be consistent with direction in the Forest Plan and other laws regarding weed control, but is not a very effective approach and has a higher probability of increasing weed infestations within Research Natural Areas.

## *RECREATION*

### RECREATION - DIRECT AND INDIRECT EFFECTS - ALTERNATIVES 1 (PROPOSED ACTION)

Direct and indirect effects on recreation resulting from implementation would include short-term (one to seven days) encounters with herbicide treatment crews, short-term odors from some herbicides, and visual impacts from wilting plants. Additional effects resulting from these alternatives would be the protection of adjacent non-infested areas and preservation of intact plant communities, which would enhance the recreation experience. Concern over herbicides may cause some Forest users to choose to recreation in areas that have not been recently treated with herbicides. All weed treatment activities would be conducted in compliance with Travel Plan regulations, which allow for administrative use, unless otherwise prohibited by special order or other designation orders. When cross-country motorized travel is necessary to facilitate weed control, there will be short-term visual impacts in the form of tracks created by laying down grasses. In dry years, these tracks could remain visible throughout the season. While in wetter years the tracks could be erased, by rains and re-growth, before the fall.

All known weed infestations in dispersed sites, permitted use sites, special use sites, rental cabin sites, summer home sites and campgrounds could be treated in this alternative. Signs will be posted in recreational areas notifying the public of the herbicide used and stating the safe re-entry period as specified on the herbicide label (usually when the herbicide is dry on the plant surface).

Under this Alternative, herbicide treatments would decrease established and expansions of aggressive weed species into non-infested areas and reduce weed-related impacts on recreation. The visual impact of spraying would be temporary and on most sites only last a few hours. Dying and wilting plants following herbicide treatment would be apparent. However, this appearance would be short-lived as surrounding vegetation would screen dead plants or blend with native vegetation, as it grows dormant.

Long-term improvements include an overall reduction of stiff plant stalks and sharp or bristled seeds, and increase in the variety and amount of native flora. Treating invasive weeds would be an improvement in the overall quality of the recreational sites. Areas with aerial treatment are not near recreation sites or trails so this activity will not have an impact on recreational users.

### RECREATION - DIRECT AND INDIRECT EFFECTS - ALTERNATIVE 2 (NO HERBICIDES) AND ALTERNATIVE 3 (NO CHANGE FROM CURRENT MANAGEMENT)

Under Alternative 2 No Herbicides would be used to treat the weeds so only small infestations would be pulled. Most of the weed patches would not be treated or control would be limited to biological control insects (which have minimal effectiveness). Consequently the long-term impact of limited weed control will be a substantial increase in weed density throughout most recreation sites, which will spread into adjacent areas.

Under Alternative 3 No Change from Current Management, most recreation sites are currently being treated with herbicides and this would continue. Under the Forest Service Manual (1950, 31b.5.a), the chief of the Forest Service has excluded the action of applying registered herbicides in campgrounds or recreation sites from NEPA requirement of a decision document and of a project file (Fed Register Vol. 57, 1992). To comply with the herbicide labels the sites treated in recreational areas will be signed to notify the public of a safe re-entry period (usual when the herbicide has dried on the plant).

### RECREATION - CUMULATIVE EFFECTS

Cumulative effects from activities described at the beginning of this chapter would continue to impact recreation, affecting the location where and times when people can recreate at various locations across the Custer National Forest without being displaced by herbicide applications. Effects on recreation under any of the alternatives would be minor and short-term (one to seven days). While visitor displacement is the most likely direct effect of weed treatment, short-term (one to three years) visual impacts from cross-country motorized travel for the purpose of herbicide application are also possible. Also, an aggressive weed control program (as in Alternative 1) will maintain the native plants and current visual quality of native plant communities. While the less aggressive weed control alternatives (2 and 3) will continue to see an increase in weed species and a decrease in native plants resulting in a diminished visual quality for the landscape.

#### Consistency with Forest Plan and other laws and Policies – Recreation

Alternatives 1 and 3 would be consistent with direction in the Forest Plan and other laws regarding weed control. Alternative 2 would be consistent with direction in the Forest Plan and other laws regarding weed control, but is not a very effective approach and has a higher probability of increasing weed infestations within recreational areas. Effects from herbicide treatments will be of short duration, less than one day. Areas inside campgrounds and other developed recreation sites that are treated with herbicides will be posted to notify for public safety.

## *HERITAGE*

### HERITAGE - ALTERNATIVE 1 (PROPOSED ACTION)

Heritage resources are nonrenewable resources easily damaged by ground-disturbing activities. Although some artifacts are susceptible to damage from heavy equipment use, ground disturbance, or burning, it is the provenience of artifacts and features, or their horizontal and vertical location in relation to each other and to the soil deposits that is most important. Disturbance or movement of features and artifacts in relationship to each other disturbs or destroys the context of the information inherent in the site. Impacts from weed control activities could lessen the value of heritage resources by destroying important scientific data and diminishing the physical setting of sites. Heritage resources can be diminished by any change in their historical, architectural, archaeological, cultural character or ecological setting. Under the NHPA, an

impact is considered significant if it results in an adverse effect to a heritage resource that is on or eligible for the National Register of Historic Places. An adverse effect would occur if a management activity alters the characteristics of a historic property that qualifies for inclusion on the National Register of Historic Places (NRHP).

**Archaeological Resources**: Mechanical, manual, grazing and burning treatments have the highest potential for ground disturbance to archaeological sites. Mechanical digging, mowing or tilling pose the greatest threat. Mechanical and burning control measures could potentially disturb or destroy unidentified heritage resources on or near the ground surface. The potential for damage would vary with the amount of ground disturbance and burning under each alternative. Tilling weeds could damage artifacts and disrupt relative positions of cultural materials. Mixing organic matter in archeological sites could contaminate carbon 14 dating samples, making them unreliable for scientific analysis. Uncovering sites could increase the possibility of illegal artifact collecting.

Burning for weed control could destroy combustible cultural materials and damage stone and ceramic artifacts. The circumstance may occur, however, that burning could aid in the discovery and recovery of significant cultural resources, as seen at the cultural inventory following a wildfire in the Brewer, Kraft Springs, Stag Rock, Tobin, during 2000 and 2002.

Manually digging or pulling weeds could cause surface disturbance and displacement of buried archaeological materials. Sheep or goat grazing could cause trampling of artifacts and disturbance to features. Prescribed burning could affect sites with fire-sensitive materials. Herbicides and surfactants could impact the analytical potential of perishable materials such as wood and datable materials, although these effects have not been studied and the overall effect is not likely to be adverse.

In general, herbicides do not have the resident time that would affect chemical structure of surface archaeological remains. Biological methods would not be expected to damage sites, wooden beams or historic structures, since these herbivorous insects have a high degree of target host specificity.

Removal of weeds by any method could expose bare soil and increase soil erosion for a short time (typically a year or less), which could cause minor disturbance or damage to archaeological site features. While the adverse effects described for archaeological resources could potentially occur, there is a low risk of adverse impacts occurring. These effects would primarily be mitigated by avoidance of significant sites.

If it is predicted that adverse effects to archaeological resources cannot be avoided, the Forest would consult with the SHPO and other interested parties including tribes, concerning the steps to be taken to mitigate adverse effects. In addition, monitoring would be used to ensure that protection measures are followed and adequately protected heritage resources. If damage to an archaeological site is discovered during implementation, the activity would be immediately halted and SHPO notified about the resolution of adverse effects.

**Ethnographic Resources**: Effects on ethnographic resources, including traditional cultural properties, are difficult to estimate because traditional communities are sometimes unwilling to provide location data as well as information on the nature of impacts. However, some traditional gathering locations have been identified on the Custer National Forest. In some instances the mere presence of Forest Service workers or contractors in the area of a traditional cultural property can be an effect. Protection measures to alleviate auditory, visual, or other impacts on traditional cultural places require continuing consultation and coordination with traditional communities and flexibility in implementation.

Drift or chemical odor from herbicide applications or noise and dust from mechanical treatments may cause short-term adverse effects on traditional or religious sites. Protection measures that would minimize this impact include: using methods that reduce herbicide spray drift, posting signs during treatment activities, using direct hand application of herbicides onto target plants (avoiding surrounding plants), and consulting with tribes.

Tribes are concerned about exposure to or residue from herbicides during gathering, processing and consuming of gathered plant materials grown in or near lands where herbicides may have been applied.

Herbicides found in or on plants are called residues. Before a new herbicide can be sold for use in an agricultural setting, it has to be registered for agricultural use by the US Environmental Protection Agency (EPA). The registration process involves a careful consideration by EPA of possible health effects from the pesticide. The manufacturer of each new pesticide is required to submit scientific data to EPA that help evaluate the risk of health effects from its use. EPA reviews the submitted data and other available studies to determine if the pesticide is likely to affect human health or the environment. All the uses that have been approved by EPA are mentioned on the pesticide label.

There are a relatively small number of papers published on the subject of pesticide determination in medicinal plants and their final preparations (Zuin, et. al, 2000). Some reasons may be due to the complexity of the chemicals as well as the tedious and long analytical procedures. Most of the published papers are acquired with difficulty due to their limited access (periodicals of restricted circulation and/or in a wide variety of languages). In some of them, the scientific name of the medicinal plant investigated is not given.

Some studies have been done on herbicides used in commercially cultivated medicinal plant fields. One study tested more than 60 herbicides in a long-term study in order to develop chemical killing methods to control weeds in several medicinal plant fields (Zuin, et. al., 2000). The authors concluded that the utilization of those herbicides led to a considerable reduction in weed cover and a reduced manual work needed for weed control. The study also concluded that the use of chemicals did not result in any herbage yield reduction or morphological variation and did not influence the production of essential oils or the respective active principles.[45]

Although the plant materials in a treated area are dead, dying, chlorotic, brittle or deformed, (and hence are undesirable and very unlikely to be selected for ornamentals, medicine, or food) monitoring and consultation will occur where conflicts are known. If weed infestations threaten known special plant gathering areas (USDI, BLM and MT DNRC, 2002; USDA, Forest Service, 1996 and USDI, NPS, 1994), tribal consultation would be employed to adaptively add any new protection measures that might be needed to minimize effects to the plant population(s) in question and still meet project objectives (i.e., changes in weed treatment timing, application methods, treatment priority). Protection measures and adaptive management measures (Appendices C and E) would be employed.

Protection measures would be effective in avoiding impacts to fire sensitive areas of traditional concern when those areas are identified through additional consultation with traditional and tribal communities. Burning practices would be developed to reduce threats to traditionally used plant species or account for traditional practices in an area. Sometimes burning effects have been known to have a positive effect on plants by reducing competition from other plants and providing a temporary flush of nutrients. For all treatment activities, monitoring will ensure that site treatment recommendations are followed and adequate to protect heritage resources.

Invasive weeds can crowd out plants traditionally gathered for food, dress, or ceremonial purposes and can influence wildlife and fish habitat ecology. Treatment type or timing could interfere with traditional plant gathering by tribes utilizing areas of the Custer National Forest.

Curly cup gumweed (*Grindelia squarrosa*) and Broom Snakeweed (*Gutierresia sarothrae*), and Yellow Sweet Clover (*Melilotus officinalis*) are known to occur in isolated low elevation areas on or adjacent to the Forest, but are not typically priority plants for IPM treatment. All other documented species are a desired native component to the desired condition of overall plant community health and diversity.

Although the plant materials in a treated area are dead, dying, chlorotic, brittle or deformed, (and hence may be undesirable and very unlikely to be selected for ornamentals, medicine, or food) monitoring and consultation will occur where conflicts are known. If weed infestations threaten known special plant gathering areas (USDI, BLM and MT DNRC, 2002; USDA, Forest Service, 1996 and USDI, NPS, 1994), tribal consultation would be employed to adaptively add any new protection measures that might be needed to minimize effects to the plant population(s) in question and still meet project objectives (i.e.,

[45] Active principle is a constituent of a drug, usually an alkaloid or glycoside, on which the characteristic therapeutic action of the substance largely depends.

changes in weed treatment timing, application methods, treatment priority). Protection measures and adaptive management measures (Appendices C and E) would be employed.

Protection measures (Appendix C) would be expected to greatly limit the risk of adverse impact to plants that have cultural importance. Given the protection measures (Appendix C), effects to heritage resources associated with weed removal are estimated to be minor. While there may be short-term removal of important plants, measures require re-establishment of desired vegetation, which would compensate for the short-term reduction in the species.

### HERITAGE - ALTERNATIVE 2 (NO HERBICIDE)

Weeds would continue to spread more rapidly as compared to the other two alternatives and over a shorter amount of time would likely reduce or endanger native plant species used traditionally.

Under this alternative, the greater reliance on mechanical, manual, grazing, and burning methods would slightly increase the exposure to risk where archaeological sites could be damaged by ground-disturbing treatments. There would be no potential impacts from spraying herbicides under this no herbicide alternative. It eliminates the potential health risks to those who collect and use traditional plants. Otherwise, effects to both archaeological and ethnographic resources would be the same as described for Alternative 1.

### HERITAGE - ALTERNATIVE 3 (NO ACTION – CURRENT MANAGEMENT)

Effects to both archaeological and ethnographic resources would be the same as described for Alternative 1, but with fewer protection measures and weed spread vulnerability. This alternative would also place more vulnerability to weed spread in the AB Wilderness area, as well as other areas of difficult access. Treatment methods would be fewer relative to the types of species specific and more environmentally friendly herbicides available for use, but would not be authorized for use under this alternative. Because of the likelihood of more weed spread, plant gathering areas could be placed in greater jeopardy by weeds out-competing traditionally used plants.

## *SOCIAL AND ECONOMIC*

### SOCIAL AND ECONOMIC – DIRECT AND INDIRECT EFFECTS – ALTERNATIVES 1 AND 3 (PROPOSED ACTION & CURRENT MANAGEMENT)

**Economic Aspects.** The appropriated funded weed treatment program on the Custer National Forest in 2006 was $130,000, in which a total of 1200 acres were treated. The present program level is not keeping up to the current rate of spread. Therefore, the losses will continue to increase annually as well as continue to threaten adjacent lands, but not as significantly as they would under Alternative 2.

There is an estimated displacement of 430 AUMs (Animal Unit Month) by noxious weeds on the Custer National Forest. These losses are reflected in reductions of revenues to the Federal government as well as a more local loss to the agricultural and livestock industries. The cost to the industry would equal ~$60,000 annually[46]. This scenario assumes that the level of noxious weeds will remain constant.

Federal payments to counties through PILT (based on acreage) or Secure Rural Schools and Community Self-Determination Act (based on an average of previous years' payments) would not be impacted under Alternatives 1 and 3.

[46] The Forest rangelands usually offer an average five month season of use, and by assuming a loss of 430 AUMs, it can be determined that equates to 86 cow/calf pairs. With the assumption of a 500 pound calf at market time and given the 2004 price of $138 per 100 pounds (cwt), the cost to the industry would equal ~$60,000 annually.

**Lifestyle Aspects.** Diverse native viewsheds would be essentially maintained. Public land enjoyment through general recreational camping, fishing, hunting would continue. Fish and wildlife habitat needed for quality fishing and hunting would be maintained.

**Partnerships and Collaboration in Weed Management.** Alternatives 1 and 3 encourage partnerships.

## SOCIAL AND ECONOMIC – DIRECT AND INDIRECT EFFECTS – ALTERNATIVE 2 (NO HERBICIDE)

Over time, the exponential spread of weeds that would occur under Alternative 2 (estimated at 8-12% increase annually) would drastically affect the economy of the primary agricultural component of this area (including county revenues), lifestyles, and partnerships.

**Economic Aspects.** The economic effects of weeds spreading are often difficult as the costs are often hidden and the effects tend to be cumulative.

The population in and adjacent to the Custer National Forest is predominantly rural. The business patterns of the zone of counties are agricultural oriented. The economic effects of spreading noxious weed infestations could have severe impacts on the livelihood of these counties' residents. Under current economic conditions of decreasing land values and decreasing livestock market values, rural areas such as these are being economically threatened. The impact of weed infestations on the private land is an additional hardship, let alone the decrease in the productivity of Federal lands. This decrease of goods and services from the natural environment causes a significant impact on the areas' economic well-being, and the economic stability of these areas becomes somewhat strained. This is evident throughout the country as people move from rural-agricultural setting to urban communities which offer greater economic stability.

Leafy spurge alone results in $129 million annual economic loss to the livestock industry in Montana, Wyoming, and the Dakotas (Partners Against Weeds, BLM). Weeds reduce forage for livestock, cost the industry millions of dollars; and, in some cases render public lands and family ranches useless for grazing. Often times, weed infestations will significantly lower land values in surrounding areas. Noxious weeds may not have a major effect on land values in many parts of Montana and South Dakota because buyers may be "paying for the view", but real estate licensees are seeing more potential buyers scrutinize weed infestation and management practices before closing. On production-oriented land, noxious weeds are usually considered in land appraisals. In one analysis, the presence of a noxious weed that reduces carrying capacity by 60% lowered the value of the land from the original $220 to $100 per acre.

Currently, all weeds cost farmers over $100 million each year in expenses and crop production losses in Montana alone. Degraded wildlife habitat also reduces wildlife-associated recreational expenditures in most states. Their secondary impact on the economy is unknown, but likely ranges between $200 and $300 million each year (Sheley, et. al., 2005).

Spotted knapweed and leafy spurge rank as one of the largest weed problems on rangeland in Montana and South Dakota. They reduce livestock and big game forage, damages wildlife habitat and can double the amount of soil erosion from sites where they invade rangeland.

Without the use of herbicide within the project area, the weed rate of spread is projected to increase 10% annually as well as continue to threaten adjacent lands. This equates to a potential loss in carrying capacity of an estimated 50 additional AUMs displaced annually. This, in addition to current estimated loss of 430 AUMs, would equate to $67,000 lost in year 1 with a projected 10 year loss to the livestock industry at $133,000. These losses are reflected in reductions of revenues to the Federal government as well as a more local loss to the agricultural and livestock industries.

In addition to the projected loss to the livestock industry, a loss in wildlife habitat and big game animals can also be expected. Deer and elk are not known to use knapweed to any significant extent. A heavily infested knapweed stand should generally be considered out of production as big game range and result in economic loss.

Noxious weeds have a substantial impact on the economy and may cause job losses. Economic losses caused by leafy spurge and spotted knapweed have been calculated for Montana and South Dakota. Nearly 4.5 million acres of South Dakota are infested with noxious weeds. Statewide losses from noxious weeds exceed $80 million annually (SDSU, Wrage, et.al.). The cost of leafy spurge to grazing lands and wildlands in the upper Great Plains including states of Montana, North and South Dakota, and Wyoming is estimated at $129.5 million and represents a potential loss of 1,433 jobs. Spotted knapweed in Montana alone costs an estimated $42 million, money that could support 518 full time jobs in the state. If spotted knapweed invaded 34 million vulnerable acres in Montana, loss to the livestock industry alone is estimated at $155 million (MWMP, 2001). Knapweed impact is not limited to grazing land. Forested areas and forest productivity can also be affected.

Leafy spurge is considered the most persistent noxious weed. It has a wide habitat suitability, prolific reproduction capabilities, and strong competitive ability and is difficult to control. Loss of hay and beef cattle production is estimated at $7 million in North Dakota due to both the reduced forage production from leafy spurge competition and to cattle avoiding leafy spurge infested areas (Lym and Messersmith 1985). Forage availability for wildlife is similarly limited.

Other listed weeds produce somewhat similar effects on rangeland as the two species listed above. The economic impacts of these weeds are a direct correlation between loss of carrying capacity, loss of habitat, and acres infested.

Federal payments to counties through PILT (based on acreage) or Secure Rural Schools and Community Self-Determination Act (based on an average of previous years' payments) would not be impacted under Alternative 2.

**Lifestyle Aspects.** Viewsheds would be altered from a diverse landscape to patches of monocultures of invasive weeds. Fish and wildlife habitat needed for quality hunting and fishing would become displaced with invasive weeds. Public land enjoyment through general recreational camping, fishing, hunting would be lessened as annoying sticky / thorny weeds invade areas or recreational areas invaded by monocultures of weedy vegetative lifeforms.

**Partnerships and Collaboration in Weed Management.** Alternative 2 does not encourage partnerships and would erode existing and future partnerships with municipalities, adjacent landowners, and others.