Chapter 4. Environmental Consequences

4.A. Introduction

This chapter describes the environmental consequences that would result from implementing the Proposed Action, one of the other action alternatives (Alternatives 1 or 2), or the No Action Alternative for the proposed S-CNF Noxious Weed Management Program. These alternatives were described in detail in *Chapter 2, Alternatives.* Impacts from the Proposed Action, Alternatives 1 and 2, and the No Action Alternative are evaluated and compared in terms of the effects on various resources resulting from the relative scope and intensity of weed treatment actions. The effects of weeds on the various resources also are addressed. The No Action Alternative is discussed first and provides an environmental baseline or benchmark for comparison to the Proposed Action and Alternatives 1 and 2. All issues identified during public scoping for the proposed project that are relevant to this Final EIS were considered in the impact analysis.

The impact analysis follows the same general outline for resources discussed in *Chapter 3, Affected Environment.* It addresses direct, indirect, and cumulative effects on those aspects of the physical, biological, and human environments most likely to be affected by the proposed project. Potential effects on threatened, endangered, and Forest Service sensitive species are described in *Chapter 4, Environmental Consequences*. They are also discussed in detail in a separate Biological Assessment that is submitted for review to the USFWS and the NMFS for federally listed endangered, threatened, and candidate species and in an appendix to this document (Appendix L, Biological Evaluation) for Forest Service sensitive species. S-CNF resources that are unlikely to be affected or only minimally affected are discussed only briefly in this chapter. This focus on potential substantive beneficial and adverse project effects provides a basis for comparing the alternatives and is consistent with CEQ guidelines for implementing the provisions of NEPA. The impact analysis also addresses project-related BMPs and mitigation measures that would be implemented as integral parts of the Proposed Action or one of the alternatives. BMPs and mitigation measures were described in detail in *Chapter 2, Alternatives* and are briefly referenced in this chapter.

The cumulative effects analysis considers the effects of the county weed control programs when combined with the effects of each alternative for the proposed S-CNF Noxious Weed Management Program. These sets of programs are closely related. Four CWMAs have developed weed control plans: Lemhi County CWMA, Custer County CWMA, the Lost Rivers (Butte and Custer Counties) CWMA, and the Continental Divide CWMA (including parts of Lemhi, Butte, Jefferson, and Clark Counties). An additional CWMA for the FCRONRW is being finalized, which will expand coverage in Custer and Lemhi Counties and also include portions of Idaho and Valley Counties.These projects develop cooperative weed control efforts among landowners in the counties, including the S-CNF, which participates in county weed control efforts as a member of the CWMAs. Each alternative described in this Final EIS would potentially be affected by, and affect, the treatment activities and success of the county weed control plans. It is assumed that future levels of weed treatment for each CWMA would be comparable to present levels. The cumulative

effects analysis also considers the potential effects of other ongoing, pervasive actions on the S-CNF, including livestock grazing, impacts from roads and trails, and recreation activities.

In addition, there would be positive cumulative effects in all alternatives from weed treatment activities described in this EIS when combined with the required treatment activities associated with ongoing Forest projects. These effects would vary by alternative and are difficult to quantify, but when both treatment actions are combined, their effectiveness in weed control and eradication would be enhanced.

This chapter concludes with discussions of the following subjects, as required under NEPA: comparison of the effects of the alternatives; probable adverse environmental effects that cannot be avoided; consistency with the S-CNF Forest Plan; possible conflicts with planning policies of other jurisdictions; relationship between short-term use and long-term productivity; and any irreversible and irretrievable commitments of resources that would occur if the Proposed Action or one of the other action alternatives is implemented.

The following assessment of potential impacts assumes that full funding and implementation of each weed treatment alternative will occur each year. It is also assumed for **purposes of analysis** that where one of several different treatment options could be implemented, the option that could potentially have the greatest impact on S-CNF resources would be used to treat weed infestations. These methods were described in *Chapter 2, Alternatives*. Unless used properly, the method generally considered to have the greatest potential for impacts is herbicide applications. These assumptions and approach to analyzing potential effects are believed to provide a worst-case analysis of the upper bounds of effects that could possibly occur on the S-CNF under each alternative. However, during actual program implementation at individual weed infestation sites, these conditions would very likely not occur because of the following reasons:

- Use of the site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy described in *Chapter 2, Alternatives* would not result in worst-case conditions. These site-specific processes are designed to avoid or minimize the potential for adversely affecting S-CNF resources, especially sensitive resources.
- The extensive list of BMPs and mitigation measures described in *Chapter 2, Alternatives* that would be implemented as integral parts of the Proposed Action, other action alternatives or the No Action Alternative would avoid or minimize the potential for worst-case adverse effects to occur.
- Full funding may not be available every year to completely implement the alternative.

4.B. Biological Resources

4.B.1. Vegetation Resources and Noxious Weeds

The effects of weed treatment options on vegetation resources are extremely important. Vegetation resources considered under the Proposed Action and each alternative are: native plant community diversity, and threatened, endangered, and sensitive plant populations. The concerns for vegetation resources are intense because the results of doing nothing to stem the invasion of weeds are likely to be worse in the long term than the most aggressive

treatment strategy. Biodiversity and plant species richness for native vegetation and plant communities, wildlife habitat values, and sensitive species populations are likely to be severely compromised by the unchecked invasion of weeds. Similarly, these same vegetation resources could be compromised by unconstrained weed treatment efforts as well. The following discussion focuses on how these effects may differ among alternatives.

Wildlife habitat associations for S-CNF Species of Focus are based on PVGs. Vegetative group cover types that are currently most impacted by weed invasion will be the focus of most of the weed treatment regimes, no matter which alternative is being considered. These are also the cover types that have the greatest potential for habitat improvement if weed treatment regimes are successful. PVGs with the greatest potential for treatment impacts based on current weed invasion include all the Dry Shrub categories (Wyoming Big Sagebrush/Bluebunch Wheatgrass Cover Types; Threetip Sagebrush/Idaho Fescue/Antelope Bitterbrush Cover Types; Black Sagebrush Cover Types; and Low Sagebrush Cover Types); all of the Dry Grass Categories (Bunchgrass Cover Type and Fescue Grassland Cover Type); the Dry Forest Types (Douglas-fir/Idaho Fescue Cover Type and Ponderosa Pine Grassland Cover Type); and the riparian and woodland categories. The remaining PVGs are expected to experience somewhat less impact from noxious weed treatment. Although the following discussion focuses on how effects to vegetation may differ among alternatives it does not specifically address individual Vegetation Groups because the differences among alternatives is a result of treatment methods and because the need for treatment will remain relatively equivalent for all cover types among alternatives. *Section 3.C.1.c, Plant Management Indicator Species,* describes the plant management indicator species (MIS), how these species were identified as MIS, what they were selected to indicate, and where they occur within the PVGs. For similar reasons as stated above, the potential effects of the treatment options on the individual MIS will not be addressed in this analysis. Although five of the eight MIS were selected to indicate undesirable conditions, only the state-listed noxious weed Canada thistle is considered a target species for treatment. The potential for significant impacts is considered none on non-target grasses and minimal on non-target shrubs (see *Section 4.B.1.b, Vegetation Resources and Noxious Weeds: Proposed Action*). Resultant effects on wildlife associated with the different vegetation groups and cover types are discussed in *Section 4.B.3, Wildlife Resources*.

a. No Action Alternative

Direct and Indirect Effects. There are two important types of direct and indirect effects noxious and invasive weed infestations have on vegetation. First are the effects noxious weeds have on native plant community diversity and integrity when they invade an area. Second are the effects that treatments to remove noxious weeds may have on that same native vegetation.

Under the No Action Alternative, the current level of weed treatment would continue. Direct and indirect effects from noxious weed invasion would be expected to occur at the same or higher levels than currently.

The Forest Service (1999a) discussed the manner and rate at which weed infestations can spread, noting this can be much like the compounding of interest on money. They stated that certain vegetation types such as open grasslands, open river and riparian terraces and benches, and pine grasslands are more susceptible to invasion by spreading weeds than

other vegetation types such as forested slopes, timbered riparian zones, and dense shrub communities. The Forest Service (1999a) estimated the expansion of established noxious weed infestations into susceptible vegetation types on the FCRONRW using an average annual rate of weed spread of 17 percent, with variations between 14 and 24 percent annually depending on the species. Known spread rates for some noxious weed species are: spotted knapweed (24 percent); scotch thistle (16 percent); common tansy, sulphur cinquefoil, Dyer's woad, leafy spurge, and common mullein (14 percent); and rush skeletonweed (14 to 50 percent) (U.S. Forest Service 1999a).

Some of the same assumptions used to estimate weed spread on the FCRONRW were used to estimate future noxious weed spread on the S-CNF under the No Action Alternative. There are presently 66,537 acres of inventoried, known noxious weed infestations on the S-CNF (see Table 2-3, in Chapter 2).

- Annual rates of weed spread are based on acres of existing infestations on the S-CNF, not new starts or new invasions of weeds.
- Effects of major disturbances such as fires, landslides, and timber blow down on the rate of noxious weed spread are not included.
- Annual rates of weed spread under the No Action Alternative would average 17 percent, but could vary from 14 to 24 percent.

Data presented in Table 1-2 (in Chapter 1) indicate how quickly weeds could potentially spread and dominate the S-CNF under the No Action Alternative.

Herbicides and biological control treatments are the major weed control methods that would be used under the No Action Alternative. Under this alternative, the treatment rate of approximately 3,000 to 3,500 acres per year would likely continue. Treatment of noxious weed infestations has the potential to impact native plant communities, sensitive species, and wildlife habitats in a similar manner to the weed infestations. The use of biological controls is based on insect specificity to a given weed species. Ecologically, biological control is considered to have a fairly good track record as far as limiting damage to the target plant and not spreading to native plants (Turner 1985). Biological control use under the No Action Alternative would continue at the present rate and is unlikely to negatively impact native plants.

The treatment method with the greatest potential to negatively affect native vegetation under the No Action Alternative is the use of herbicides. Most herbicides have only limited selectivity and could potentially result in the loss of desirable vegetation that is growing with or near the targeted weeds. Current BMPs under this alternative are in place to ensure that such losses to native vegetation would be minimal. Additional BMPs listed in *Chapter 2, Alternatives* would specifically reduce negative impacts and the risk of losses to sensitive plant populations from noxious weed treatment. Therefore, when these BMPs are followed, there should be little or no direct effects on sensitive species from the treatment of weeds under the No Action Alternative.

There is the potential for minimal impacts to vegetation from off-road chemical treatment activities. Cross-country travel during weed treatment activities could be a limited source of

vegetation disturbance. Off-road travel in riparian habitat conservation areas (RHCAs) is not permitted.

Under the No Action Alternative, the effect of heavily weeded sites on watershed output, particularly on the northern districts of the S-CNF, would continue to be higher than if the weeds were eradicated and the sites were restored to native vegetation. Sites that are heavily infested with weeds tend to have reduced water infiltration and increased runoff when compared to sites with native vegetation (Olson 1999). Higher runoff would mean less soil moisture available for remaining native species. Knapweeds, which are the predominant noxious weed species in the northern region of the S-CNF, are considered by Roche (1988) to be the best regional symptom of desertification, the loss of the productive potential of the land. One of the five indicators for evaluating the susceptibility for desertification is the percent cover of exotic species compared to total cover (Mouat et al. 1993). Over time, reduced infiltration combined with increasing levels of weed litter will make plant seedling survival and natural regeneration of native vegetation less likely. Soil temperature extremes on sites with heavy weed infestations are also likely to occur, compounding the detrimental effects of less soil moisture and more weed litter and noxious weed seeds in the seed bank. Soil temperature fluctuations, caused by lower soil water content, poor soil aggregation, and greater exposure of bare soil to direct sunlight (Jones 1983; Monteith and Unsworth 1990), impact germination rates of native plant species not adapted to such changes. Other potential indirect effects include the potential for some weeds, such as cheatgrass (*Bromus tectorum*), to increase fire frequency. If infested sites are not restored and if weeds continue to expand as predicted under this alternative (Table 1-2), the historic fire cycle may increase on sites with cheatgrass to carry the fire. Other types of weeds may have the potential to increase fire frequency as well because they have the same characteristics of thick, uninterrupted canopy to carry fire and early seasonal drying. If fire frequency or intensity increases beyond the capacity of native vegetation to recuperate, the ecological integrity of the site would be lost. Additional indirect affects from weed treatment could occur on grazing use areas. Grazing use areas that have been treated may be rested from grazing for a period of time if necessary for site restoration purposes. This could indirectly affect vegetation on other use areas if they are grazed more than usual.

The heaviest deterioration to native vegetation under the No Action Alternative would be expected to occur adjacent to present weed populations in shrub-steppe habitats, and in ponderosa pine and dry Douglas-fir forests on the northern Ranger Districts of the S-CNF, particularly after disturbances such as wild fire or logging. Severe levels of deterioration continue under this alternative as desirable native grasses, forbs, and shrubs are replaced by weed species.

BMPs and Mitigation Measures. BMPs and mitigation measures for weed management under the No Action Alternative are designed to avoid or minimize the potential for adverse effects on the S-CNF to native vegetation. These focus on weed prevention and management and on the proper ground-based application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* Examples include compliance of all invasive weed treatment activities with State and Federal laws and agency guidelines and application of all chemicals in accordance with EPA registration label requirements.

Cumulative Effects. Adverse cumulative effects on vegetative resources on the S-CNF under the No Action Alternative may accrue from weed management treatments on

adjacent lands if spray drift from herbicide application on those lands settles on non-target vegetation on the S-CNF. Adjacent lands include the FCRONRW, lands managed by the BLM, and state and private lands within Lemhi, Butte, Custer, and Blaine Counties. CWMAs include coordination with the S-CNF in their management plans, so additional effects on the S-CNF from vegetation treatment outside the S-CNF boundary are unlikely. These CWMAs have met with some success at halting the exponential spread of noxious weeds. Therefore, cumulative beneficial effects on noxious weeds resulting from treatments under the No Action Alternative together with treatments under the three CWMAs would generally be expected to result in some localized eradication, control, and containment of noxious weeds. However, under the No Action Alternative, the spread of weeds on the S-CNF would be expected to continue expanding into native plant communities at approximately the current rate (Table 1-2). This overall effect on noxious weeds and native plant communities would reflect large-scale limitations on being able to eradicate, control, or contain new weeds that have invaded the S-CNF from adjacent lands covered by the CWMAs, or to prevent or reduce the risk of the invasion of adjacent land by weeds presently occurring on the S-CNF. The effects of other ongoing activities on the S-CNF, such as heavy recreational use, livestock grazing, impacts from the construction, maintenance, and use of roads and trails, and possibly wild fires and logging, also may disturb or result in localized reductions in some native plant communities.

Additional adverse cumulative effects on vegetation resources could accrue from livestock grazing sprayed use areas or from recreational pack animal use. Other cumulative effects could occur from disturbance to vegetation caused by logging and other recreational uses. Combinations of localized disturbances with weed treatment may overwhelm the ability of native vegetation to adequately recover, thus providing further opportunities for weed infestation. The potential for these effects to occur is minimal under the No Action Alternative.

b. Proposed Action

Direct and Indirect Effects. The potential for adverse direct and indirect effects on native vegetation, sensitive plant species, and wildlife habitat integrity as a result of noxious weeds on the S-CNF would be expected to decrease under the Proposed Action compared to the No Action Alternative. The Proposed Action would treat much higher acreages of noxious weeds than are presently treated or would be treated under the No Action Alternative. The Proposed Action includes a blend of weed treatment methods, followed by site restoration, where appropriate, as described in *Chapter 2, Alternatives*. This combination of treatment and site restoration is designed to aggressively eradicate, control, and contain weed species on the S-CNF and to restore areas following treatment so that they would have a greater potential to avoid or minimize reinfestation. Under the Proposed Action, the reclamation and restoration of treated sites to native or acceptable vegetation would be a valuable addition to hold sites from reinfestation. Beneficial effects expected to occur with implementation of the Proposed Action are: 1) improve and restore the biodiversity of native vegetation, 2) restore quality habitat for wildlife, and 3) protect the integrity of ecological sites for sensitive plant species.

The Proposed Action has the most treatment options available for the IWM approach. Weed treatment methods that would be used include mechanical, biological, controlled grazing, aerial and ground-based herbicide applications, and combinations of these treatments. For

the Proposed Action, it is estimated (see Table 2-6, in Chapter 2) that annually approximately 100 acres on the S-CNF would receive mechanical treatment, 2,600 acres would receive biological treatment, and 100 acres would receive a combination of mechanical and biological treatments. As mentioned under the No Action Alternative, the release of biological controls on noxious weeds should have no adverse effect on native vegetation or sensitive plant species. The biological controls target specific weeds as a host and would not move into native vegetation. The mechanical and combined mechanical/biological treatment of about 100 acres each of weeds may have some immediate disturbance to native vegetation but there should be little or no long-term adverse effects on native vegetation because of target species selectivity. Possible surface disturbance from controlled grazing, which would be used in separate combinations with herbicides, mechanical treatment, and biological treatment on approximately 100 acres of weeds on the S-CNF under the Proposed Action, would be very minor and localized. The effects of controlled grazing followed by site restoration where appropriate would not adversely affect vegetation resources if grazing were carefully overseen and focused on the weed species. The project operation plan will be the source for specific livestock grazing use objectives and stipulations. If grazing were not carefully controlled, animals could choose to eat any remaining native species of grass and forbs in preference to most weed species, thus further negatively impacting native species.

There is the potential for minimal impacts to vegetation from off-road chemical treatment activities. Cross-country travel during weed treatment activities could be a limited source of vegetation disturbance. Off-road travel in riparian habitat conservation areas (RHCAs) is not permitted.

Under the Proposed Action, a total of approximately 1,300 acres on the S-CNF would be treated each year using a combination of mechanical, biological, and chemical methods. The number of acres treated annually would be less than the existing annual level of weed treatment (3,000 to 3,500 acres) on the S-CNF, where herbicides are the predominant treatment method used. It is unlikely that the combination of mechanical, biological, and chemical treatments followed by restoration where appropriate on 1,300 acres of weeds would adversely affect native vegetation on the S-CNF.

Approximately 13,600 acres of weed infestations on the S-CNF would be treated under the Proposed Action each year using a combination, or one or the other, of aerial and ground-based herbicide application. As noted above, herbicides also would be used in combination with mechanical, biological, and controlled grazing treatments to treat an additional 1,400 acres of noxious weeds on the S-CNF each year. Aerial herbicide application would be the most effective and aggressive treatment method for quickly accessing and treating large weed-infested areas. Treated areas would then be reclaimed and restored where appropriate. Aerial application has the greatest potential to harm native vegetation and sensitive plant species. For this reason, aerial spraying would not be used in areas with large amounts of native vegetation or in areas with populations of sensitive plant species. Areas that would be sprayed by this method would have site clearances completed for sensitive plants and for sites with high-quality native vegetation still intact, so they can be avoided. Many areas, particularly those in the North Fork Ranger District, are currently so heavily infested with knapweed that the benefits from aerial spraying and weed management would greatly enhance the potential for site restoration on a large scale. Protected and

sensitive native vegetation with narrow habitat requirements would especially benefit from improved habitat conditions in adjacent areas.

The potential for native shrub mortality is expected to be minimal where aerial applications are made, likely being limited to partial leaf drop of mature shrubs. However, unprotected seedlings and young plants could experience some mortality. Label application rates for shrubs are generally double that for perennial weedy forbs. In addition, label recommendations for target shrubs include thorough wetting of the entire plant, including the root crown. Such thorough wetting is not expected to occur under aerial applications.

Potential adverse effects from the herbicides used to control noxious weeds, particularly spotted knapweed, on native vegetation are an important consideration. Five herbicides are identified in Appendix C of this Final EIS that can be used to treat spotted knapweed, which is relatively easy to kill with herbicide. They include glyphosate, 2,4-D amine, clopyralid, dicamba, and picloram. All except glyphosate generally do not harm grasses when applied at recommended rates. Glyphosate is a non-selective herbicide so it could potentially kill all vegetation. Of the remaining four herbicides, picloram could potentially cause the greatest impact to native forbs. It has moderate to high persistence in the soil with reported field half-lives from 20 to 300 days and an average field half-life of approximately 90 days (Wauchope et al. 1992). Clopyralid is more selective at targeting knapweed than picloram, in that it mainly affects only legumes and composite species. It is important to note that all of these herbicides are non-selective to a large degree and will kill both native plants and weeds. This would have the effect of opening up more habitat for weed infestation. If non-selective herbicides are applied when knapweeds or other targeted weeds are still green, but native vegetation is completely inactive, there would be less potential for negative impact to native vegetation. Sometimes spraying in early spring or late summer can mimic these conditions as well, but unfortunately herbicides are generally most effective when applied from late May to early June during the peak and most rapid growing period or near peak soil moisture.

The Proposed Action has the potential to be the most detrimental to sensitive plant species because they are by definition not widespread or common. To avoid or minimize this potential, a site-specific implementation process, decision tree, and a minimum tool approach, which were described in *Chapter 2, Alternatives* would require sensitive plant assessments or field surveys prior to implementation of treatment activities. If sensitive plant species are found within a proposed treatment boundary, non-herbicide treatments would be considered as preferred methods. If the continued existence of the sensitive species was undermined by the noxious weed infestation, a herbicide would only be used to remove weeds in that area if it were hand applied to the weeds in order to avoid or minimize risk to sensitive plants.

After treatments have been implemented to remove weeds from a site, filling the open niche with native or approved vegetation through restoration activities where it has been determined necessary would be a crucial part of the Proposed Action. This restoration would consider a full diversity of plants, and it should rely on native plants that would be acclimated to the given site. Site restoration activities, such as seeding, transplanting, and fertilizing, would help ensure that weeds are permanently removed from treated sites. These restoration activities should have no long-term negative impacts on native vegetation or habitat because seeding and transplanting activities would involve only limited soil

disturbance. Fertilizer application rates would follow Forest Service and manufacturer guidelines.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the Proposed Action are designed to avoid or minimize the potential for adverse effects on S-CNF resources including vegetation resources. A total of 59 management practices and mitigation measures address weed prevention and management BMPs and the proper application of herbicides, including 22 measures specifically directed at the proper aerial application of herbicides. All of these measures are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* Examples include: all aerial treatment areas will be assessed or field surveyed for sensitive plants prior to initial spraying; a 300-foot buffer zone flagged, mapped, and reviewed with the pilot will be maintained around sensitive plant populations for aerial herbicide applications; revegetation of any site within the treatment area with substantial soil disturbance or with inadequate native vegetation onsite to naturally reseed the area; equipment will be cleaned before entering S-CNF sites and before leaving weed treatment sites; no chemical will be applied directly to sensitive plant species during spot treatments and a 100-foot buffer will be maintained around known sensitive plant populations during broadcast treatments; and all weeds that are mechanically or hand excavated after flower bud stage will be bagged and properly disposed. In addition, the Proposed Action incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy, which were described in *Chapter 2, Alternatives*. These management tools are designed to consider site-specific resource conditions, including sensitive plant species, that result in the selection of a treatment method that achieves weed management goals with the least impact to S-CNF resources.

Cumulative Effects. Cumulative effects on noxious weeds resulting from treatments under the Proposed Action together with coordinated weed management treatments on adjacent lands through the three CWMAs are likely to be highly beneficial to native plant communities. This benefit should be a direct result of increased success at halting the exponential spread of noxious weeds on the S-CNF through their widespread eradication, containment, and control, together with continued success on adjacent lands. Under the Proposed Action, the spread of weeds on the S-CNF and perhaps on those non-National Forest lands immediately adjacent to the S-CNF would be expected to decline. Potential cumulative adverse effects on native plant communities that were described for the No Action Alternative also may occur under the Proposed Action. These include the potential effects from increased grazing pressure on untreated use areas. Potential disturbance to native vegetation from heavy recreational use, the construction, maintenance, and use of roads and trails, wild fires, and logging could also decrease the ability of native vegetation to overcome the impacts from possible herbicide application, inadvertent herbicide drift, or mechanical weed treatments. These effects, should they occur, would likely be short term and minimal in scope.

c. Alternative 1

Direct and Indirect Effects. The potential for adverse direct and indirect effects on native vegetation, sensitive plant species, and wildlife habitat integrity as a result of noxious weeds on the S-CNF would be expected to decrease under Alternative 1 compared to the No Action Alternative. There would be no aerial spraying of herbicides under this alternative as

compared to the Proposed Action. This would mean that large acreages on the northern S-CNF would be difficult to treat except with biological controls. Herbicide could still be ground sprayed. Ground spraying could be used effectively to surround and contain large acreages, much like containment of wild fires, but treating large acreages with ground spraying would require a longer time frame. With the exception of aerial spraying, Alternative 1 would use the same remaining combination of treatments and site restoration as the Proposed Action: mechanical, biological, controlled grazing, ground-based herbicide applications, and combinations of these treatments. Benefits that improve biodiversity of native vegetation, improve habitat for wildlife, and protect the integrity of ecological sites for sensitive plant species could still be achieved, but it would take much longer than under the Proposed Action but less time than the No Action Alternative. It is likely that Alternative 1 may control the further spread of noxious weeds, but would either do little to eradicate large infestations currently in place or would reduce current infestations at such a slow rate that there would need to be constant efforts to control the spread of weeds from current sites.

For this alternative, weed infestations that could potentially receive aerial spraying under the Proposed Action would instead receive a combination of primarily biological and ground-based herbicide treatments. Other treatment options would remain essentially the same. Both biological control treatments and ground spraying can take longer to control weeds because of either time or possibly labor constraints. Ground-spraying of herbicides could have fewer impacts on native vegetation and sensitive plant species because there are greater possibilities of avoiding such areas with ground-based spraying than aerial spraying. Additionally, there is a higher probability that current, large weed infestations, especially inaccessible infestations, would never be eradicated and restored to native vegetation under Alternative 1.

BMPs and Mitigation Measures. BMPs and mitigation measures for weed management under Alternative 1 are designed to avoid or minimize the potential for adverse effects on the S-CNF to native vegetation. These focus on weed prevention and management and on the proper ground-based application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* The BMPs are the same as the Proposed Action except there will be no aerial herbicide application and therefore less risk than under the Proposed Action of inadvertently adversely affecting native vegetation.

Cumulative Effects. Cumulative benefits of Alternative 1 on vegetative resources on the S-CNF when coupled with coordinated weed management treatments on adjacent lands through the three CWMAs are likely to occur. These benefits would not be expected to occur as rapidly as under the Proposed Action because of the absence of the aerial application of herbicides as a treatment option under Alternative 1, but they would be expected to occur more rapidly than under the No Action Alternative because more acres of weeds would be treated each year. These benefits should be a direct result of increased success at reducing the exponential spread of noxious weeds on the S-CNF, together with continued weed treatment success on adjacent lands. Adverse cumulative effects on vegetation resources associated with other ongoing activities or occurrences on the S-CNF (such as recreation, roads, trails, livestock, wild fires, and logging) and from weed treatment activities that were described for the Proposed Action also would occur under Alternative 1.

d. Alternative 2

Direct and Indirect Effects. The potential for adverse direct and indirect effects on native vegetation, sensitive plant species, and wildlife habitat integrity as a result of noxious weeds on the S-CNF would be expected to be greater than under the Proposed Action, Alternative 1, or the No Action Alternative. This alternative would use neither aerial nor ground-based spraying of herbicides which means that large acreages would have to be treated with mechanical or biological controls. Because fewer treatment methods are available for treating weeds under Alternative 2 and because it is only realistic to control or contain rather than reduce the size of weed infestations under this alternative (see discussion of management objectives for Alternative 2 in *Chapter 2, Alternatives*), it would take longer to achieve lesser levels of weed treatment success than under the Proposed Action or other alternatives. The effectiveness of mechanical and biological treatment options in the eradication, control, or containment of invasive weeds can be delayed from several months to several years while the establishment and expansion of weeds continues. The impacts from mechanical treatment to large acreages could be even more detrimental to native vegetation, especially if mechanical treatment consisted of the use of heavy equipment to mow, plow, or disk large acreages. This type of disturbance removes all vegetation, turns the weed seed bank over in the soil so germination rates are high, and leaves disturbed areas with a fertile place for noxious weed seeds to germinate. It would take much longer than either the Proposed Action, No Action Alternative, or Alternative 1 to reduce or eradicate large weed infestations currently in place, and probably is not possible given the management objectives that were described in *Chapter 2, Alternatives* for this alternative. Alternative 2 may even increase infestations of weeds if restoration seeding, where appropriate, after mechanical treatment either does not occur or is not successful at out-competing weed seeds. Such a slow rate of control would mean a long-term, constant effort to control the spread of weeds from current sites with mechanical means. No herbicide use under Alternative 2 would mean there is no possibility of inadvertently impacting native vegetation, wildlife habitat, or sensitive plant species from chemical drift, but it also means the impact from weed infestation to these same resource categories would be much more likely to occur than under the Proposed Action or other alternatives.

BMPs and Mitigation Measures. BMPs and mitigation measures for weed management under Alternative 2 are designed to avoid or minimize the potential for adverse effects on the S-CNF to native vegetation. The BMPs are the same as the Proposed Action except there will be no herbicide application. Potential adverse impacts from herbicide application would not be a possibility under this alternative.

Cumulative Effects. Some of the same general kinds of beneficial and adverse cumulative effects on vegetation resources that were described for Alternative 1 would occur under Alternative 2. However, it would take longer to achieve a lesser level of weed containment, control, or eradication than under the Proposed Action, Alternative 1, or the No Action Alternative because of the absence of the use of herbicides under Alternative 2. The cumulative success from the coordinated treatments with the CWMAs would be greatly hampered without the use of herbicides. These long-term effects include the expected gradual decline or containment of noxious weeds in some areas and some resultant gradual benefits to native plant communities on the S-CNF. Resultant cumulative benefits to native plant communities would be much less than under the Proposed Action or other

alternatives. Adverse cumulative effects would be similar to those described for the Proposed Action and other alternatives including the potential effects from other ongoing S-CNF activities and occurrences on S-CNF vegetation resources. However, increased and widespread mechanical treatments could exacerbate and compound those impacts to vegetation in areas that are experiencing ongoing surface disturbing activities. There would be no potential for herbicide spray drift on non-target vegetation because chemical treatment would not occur under Alternative 2.

4.B.2. Aquatic Resources

a. No Action Alternative

Direct and Indirect Effects. The No Action Alternative means that there would be no change in current weed management efforts. As a result, the direct effects of noxious weeds on aquatic habitat conditions and threats to aquatic resources on the S-CNF under this alternative would not be significant. However, certain indirect effects would occur. For example, with the expected continued spread of noxious weeds under the No Action Alternative as described in *Section 4.B.1, Vegetation Resources and Noxious Weeds,* of this chapter, there would be an increased potential for short-term and long-term soil erosion and stream sedimentation at weed-infested sites. This can directly and indirectly adversely affect aquatic habitat and associated fish and aquatic invertebrate populations. These adverse effects would likely be greatest in the northern portion of the S-CNF in the North Fork and Salmon-Cobalt Ranger Districts where there are extensive infestations of spotted knapweed.

The Forest Service (1999a; 2001d) noted that the establishment of invasive weeds such as knapweed and sulphur cinquefoil within or adjacent to riparian habitats could increase overland runoff and sediment yield from such habitats, citing studies by Lacey et al. (1989) who reported a three-fold increase in sediment yield and a 50 percent increase in runoff at a knapweed-infested site compared to a non-infested site. Studies on the Lolo National Forest in western Montana showed that a site with 80 percent knapweed cover yielded five times the amount of sediment as sites covered with bunchgrass (Hickenbottom 2000, in U.S. Forest Service 2001c). These same studies estimated that the effects of a 20-minute thunderstorm (100-year event intensity) occurring on 1,648 acres of big game winter range infested with spotted knapweed could produce an additional 160 tons of sediment compared to a weed-free site.

Increased sediment delivery to drainages can directly and indirectly affect aquatic resources through the sedimentation of habitat and increased levels of turbidity and suspended sediment in the water column. Increased sedimentation can cause a reduction or elimination of stream bottom habitat used by aquatic insects such as caddisflies, mayflies, and stoneflies that are important fish foods; a subsequent reduction in aquatic insect abundance and diversity; a reduction in the permeability among interstitial spaces within spawning gravels that inhibits the flow of well-oxygenated water and the removal of metabolic wastes; a subsequent reduction in spawning success, hatching success, and fish production; and a reduction in the interchange of surface and subsurface waters in the hyporheic zone beneath the stream channel (Nelson et al. 1991). Substantially increased sedimentation can eliminate or reduce the depths of pools that provide important year-round cover for juvenile, sub-adult, and adult fish, and may cause the premature siltation of beaver ponds, which often

provide year-round habitat for trout and different life stages of salmon and steelhead. If severe enough, increased sediment loads can cause the erosion and migration of stream channels (Chamberlin et al. 1991), and the subsequent degradation of aquatic and riparian habitat.

Elevated turbidity and suspended sediment levels caused by increased sediment delivery can have sublethal and acute effects on fish. Nelson et al. (1991) reported that suspended sediment concentrations of 1,200 milligrams per liter (mg/L) cause mortalities in underyearling salmonids, while suspended sediment concentrations as low as 100 mg/L up to 1,000 mg/L are sometimes associated with a general reduction in fish activity, impaired feeding, reduced growth, downstream displacement, and decreased resistance to other environmental stressors. (A concentration of 1 mg/L equals 1 part per million or ppm.) Fish and fish food production can be affected by the abrasive effects of very fine sediment on fish embryos and fry and on immature aquatic insects. In addition, very turbid waters can exhibit increased temperatures because of the water's capacity to retain more heat. This can affect those fish and invertebrate species that have the most restrictive cold-water or cool-water thermal requirements.

The potential degradation or loss of riparian habitat from weed infestation can be especially important in smaller drainages because of the many direct and indirect influences riparian habitat has on the quality of aquatic habitat. Murphy and Meehan (1991) reported that riparian habitat can form a protective canopy that provides overhead cover for fish and moderates the extreme effects of air temperatures during summer (helps to cool streams) and winter (helps to insulate streams). Riparian habitat also helps reduce soil erosion and filters sediment before it enters streams, stabilizes streambanks, and allows for the formation of undercut banks that provide cover for fish. In addition, riparian habitat contributes litter (nutrients and food for invertebrates) and woody debris (instream cover) to drainages, and it provides habitat for insects that fall to the water's surface and are consumed by fish (Murphy and Meehan 1991).

Aquatic resources potentially impacted by the direct and indirect effects of increasing weed infestations on the S-CNF include all of the special status, rare, sensitive, introduced, recreational, nongame, and other MIS fish species described in *Section 3.C.2, Aquatic Resources.* Potentially at risk resources also include aquatic invertebrate species, such as pollution-intolerant MIS mayfly and stonefly taxa. The greatest potential for impacts from increased sediment delivery and possibly riparian degradation may be to the anadromous and native resident salmonids, especially protected, sensitive species such as bull trout, westslope cutthroat trout, and the Snake River steelhead, sockeye salmon, and spring/summer chinook salmon. These species have relatively narrow habitat requirements, including the need for clean, cold, well-oxygenated, interconnected water and/or gravels for spawning, egg incubation, rearing, migration, and/or adult success (Bjornn and Reiser 1991). Sensitive amphibians such as the Columbia spotted frog, western toad, and long-toed salamander that are associated with aquatic and riparian habitat on the S-CNF also may be affected by habitat degradation. Site-specific impacts from erosion and sediment delivery would depend on the slope, soil characteristics, precipitation amount and pattern, distance to water, riparian buffer health and extent, and the species and life stages present.

The application of herbicides and other weed treatment methods on the S-CNF would continue under the No Action Alternative at the current treatment rate of approximately

3,000 to 3,500 acres per year. There have been some limited monitoring activities on the S-CNF to assess the impact of current herbicide application methods near aquatic resources. These activities showed that buffer zones were effective for existing application methods and showed no adverse impact on aquatic resources (Rose 2002). Results of monitoring activities on the S-CNF are summarized below.

Monitoring of herbicide applications was implemented on a test basis in the Spring Creek watershed of the S-CNF in 2002 (Rose 2002). This watershed has infestations of spotted knapweed, has been treated with herbicides in the past, and is a candidate for more extensive herbicide treatment beginning in 2003. Monitoring addressed the potential for offsite spray drift using spray cards, and analyzed water quality downstrem of the treatment site. Moisture-sensitive spray cards were placed along two transects perpendicular to the stream prior to sampling. Spray cards were located within the middle reaches of the treatment area, at points 50 feet and 25 feet from the water's edge, and at the near and far streambanks (Rose 2002). Width- and depth-integrated water samples were collected at a well-mixed point on the stream downstream of the treatment area immediately prior to and during treatment operations. Knapweed within the test site was hand sprayed with Weedar 64 (2,4-D amine) in a zone within 50 feet of the stream edge on July 9, 2002, and sprayed using a truck-mounted sprayer in areas outside of the 50-foot buffer zone with Tordon 22K (picloram) on July 10, 2002 (Rose 2002).

Post-spraying observations following herbicide applications in the Spring Creek watershed during 2002 indicated no evidence of spray drift on any spray cards during backpack spraying operations (Rose 2002). Truck operations produced a spray residue on cards located in the middle portions of the treatment area, but no residue was observed on the 50-foot cards, 25-foot cards, or any of the streambank cards. Analysis of water samples showed detectable levels of 2,4-D amine (0.17 microgram per liter) and picloram (0.04 microgram per liter) during backpack spraying, and a detectable level of picloram (0.02 microgram per liter) but not 2,4-D amine during truck spraying (Rose 2002). The monitoring report concluded that a flaw in the study design may have been at least partially responsible for the observed presence of herbicides in water samples collected during treatment operations. The report stated it was quite possible that downstream water samples, which were collected by field personnel wearing waders who had previously entered the sprayed area and then the creek, were contaminated by the coincidental collection of spray cards and downstream water sampling operations (Rose 2002). It is noteworthy that the detected levels of 2,4-D amine and picloram are substantially less than herbicide levels of concern for aquatic species shown in Table 4-1.

Analysis of the effects of herbicide application under the Proposed Action, which would occur over a greater area than the No Action Alternative and is presented in the following text (see *Section 4.B.2.b, Aquatic Resources: Proposed Action*), indicates that aquatic resources would not be impacted under the Proposed Action and supports the conclusion of no adverse effects on aquatic resources from herbicide application under the No Action Alternative. The Proposed Action analysis of herbicides considers several worst-case situations, examining the potential effects of applying different kinds of herbicides at different locations on the S-CNF in watersheds characterized by differing streamflows and soil characteristics (leaching and runoff potential). That analysis concluded that except for the possible accidental spill of a herbicide in a relatively small drainage, there would be no

adverse effects on aquatic resources from the chemical treatment of weeds. Adherence to BMPs and mitigation measures would reduce the likelihood of an accidental spill occurring. The same conclusion applies to the No Action Alternative. Treatment activities would continue to be implemented according to all of the BMPs and mitigation measures described for the No Action Alternative in *Chapter 2, Alternatives*. Therefore, it is unlikely that there would be adverse effects on aquatic resources on the S-CNF from the continued use of these weed treatments and rates under this alternative.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the No Action Alternative are designed to avoid or minimize the potential for adverse effects on S-CNF resources. They focus on weed prevention and management BMPs and the proper ground-based application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* Examples include compliance with all State and Federal laws and agency guidelines during herbicide application; application of herbicides in accordance with EPA registration label requirements and restrictions; no spraying of herbicides when wind velocity exceeds 10 mph, or within 50 feet of open water when wind velocity exceeds 5 mph; and use of label-approved aquatic formulations near open water. A 50-foot no-spray buffer zone will apply for broadcast or 'block' applications and a 15-foot buffer will apply for spot applications along all flowing water streams and ponded water bodies. Reduced buffer zones will be considered when using label-approved aquatic formulations (e.g., aquatic 2,4-D).

Cumulative Effects. Cumulative effects on noxious weeds resulting from treatments under the No Action Alternative combined with treatments under the three CWMAs would generally be expected to result in some localized eradication, control, and containment of noxious weeds. However, under the No Action Alternative, weed infestation on the S-CNF would be expected to continue to increase. This would reflect large-scale limitations on being able to eradicate, control, or contain new weeds that have invaded the S-CNF from adjacent lands covered by the CWMAs, or to prevent or reduce the risk of the invasion of adjacent land by weeds presently occurring on the S-CNF. This cumulative effect could potentially adversely affect aquatic and riparian habitat and a range of protected and other aquatic species through cumulatively increased erosion and sediment delivery to drainages. Adverse cumulative effects on aquatic resources may be greatest in the northern portion of the S-CNF and on adjacent non-National Forest lands because of extensive spotted knapweed infestations.

Additional cumulative effects on aquatic resources associated with other ongoing activities on the S-CNF include the potential for erosion and sediment delivery from road and trail-related construction and maintenance activities, livestock grazing along drainages, and recreational activities adjacent to drainages. Also, cumulative effects on aquatic resources from weed treatment activities potentially include short-term increases in erosion and sediment delivery to drainages caused by mechanical treatments (soil disturbance) and chemical treatments (creation of barren ground caused by weed removal). These areas would be subject to erosion until native vegetation becomes re-established, after which time erosion and sediment delivery should be less than when weeds were present. This would represent an overall long-term cumulative benefit to aquatic habitat and resources. Finally, there is the possibility of herbicide application in adjacent areas (S-CNF and CWMA) and

possible cumulative effects on aquatic resources. However, the CWMA efforts are coordinated with the management agencies to avoid multiple treatments within a defined geographic location. In addition, all such applications would be in accordance with EPA label guidelines, which are designed to protect aquatic organisms.

b. Proposed Action

Direct and Indirect Effects. The potential for adverse direct and indirect effects on aquatic and riparian habitat and species resulting from noxious weeds on the S-CNF would progressively decline under the Proposed Action compared to the No Action Alternative. The Proposed Action includes a blend of weed treatment methods, followed by site restoration, designed to aggressively eradicate, control, and contain weed species on the S-CNF and to reclaim disturbed areas following treatment. The likelihood of increased erosion, surface runoff, and sediment delivery to drainages, possibly resulting in riparian and instream habitat degradation and impacts to aquatic resources, would decline as weed-infested areas are treated and reclaimed. This would result in improved aquatic and riparian habitat conditions and reduced threats to all aquatic species on the S-CNF compared to existing conditions and the No Action Alternative. Benefits may be greatest in the northern portion of the S-CNF where substantial reductions in spotted knapweed infestations could potentially benefit aquatic habitat and numerous aquatic species. Benefits would be especially important to salmonids with narrow habitat requirements of clean, cold, connected, and complex water, such as bull trout, westslope cutthroat trout, and the Snake River steelhead, spring/summer chinook salmon, and sockeye salmon, and could contribute to the recovery and well-being of these protected and/or sensitive species. Riparian benefits would be especially important to amphibians such as the Columbia spotted frog, western toad, and long-toed salamander.

Weed treatment methods that would be used under the Proposed Action include mechanical, biological, controlled grazing, aerial and ground-based herbicide applications, and combinations of these treatments. For purposes of this analysis, it was estimated in *Chapter 2, Alternatives* (see Table 2-6) that each year under the Proposed Action approximately 100 acres on the S-CNF would receive mechanical treatment, 2,600 acres would receive biological treatment, and 100 acres would receive a combination of mechanical and biological treatments. The mechanical treatment of weed sites could result in some localized soil disturbance and possibly increased sedimentation of nearby drainages. However, these effects would be expected to be minor and temporary in duration because of the comparatively few acres of soil disturbance followed by the reclamation and restoration (where appropriate) of treated areas. The release of biological controls on noxious weeds should have no adverse effect on aquatic resources. The biological controls target specific weeds as a host and would not compete for food with aquatic organisms, but they may provide an incidental food source for fish where weed infestations occur near drainages. The combined mechanical/biological treatment of about 100 acres of weeds should have no adverse effects on aquatic habitat or species. Possible surface disturbance from controlled grazing, which would be used in separate combinations with herbicides, mechanical treatment, and biological treatment on approximately 100 acres each of weeds on the S-CNF under the Proposed Action, would be very minor and localized. The effects of controlled grazing, which would be conducted according to stipulations in a project

operation plan, followed by site restoration (where appropriate) would not adversely affect aquatic resources.

A total of approximately 1,300 acres on the S-CNF would be treated each year using a combination of mechanical, biological, and chemical methods. The number of acres treated annually would be less than the existing annual level of weed treatment (3,000 to 3,500 acres) on the S-CNF, where herbicides are the predominant treatment method used. As discussed previously, the limited monitoring studies performed on the S-CNF (Rose 2002) indicate that current weed treatment activities have not adversely impacted aquatic resources on the S-CNF. Therefore, it is unlikely that the combination of mechanical, biological, and chemical treatments and restoration (where appropriate) on 1,300 acres of weeds each year would adversely affect aquatic resources on the S-CNF.

Site restoration activities (where appropriate) following weed treatment, such as seeding, transplanting, and fertilizing, would not adversely affect aquatic habitat or resources. Fertilizer application rates would follow Forest Service and manufacturer guidelines. Any runoff of fertilizers would not be expected to be great enough to enrich streams. Seeding and transplanting activities would involve only limited soil disturbance.

Approximately 13,600 acres of weed infestations on the S-CNF would be treated under the Proposed Action each year using a combination, or one or the other, of aerial and ground-based herbicide applications. As noted above, herbicides also would be used in combination with mechanical, biological, and controlled grazing treatments to treat an additional 1,400 acres of noxious weeds on the S-CNF each year.

Aerial herbicide application would be the most effective and aggressive treatment method for quickly accessing and treating large weed-infested areas. Treated areas would then be reclaimed and restored, where appropriate. As an example, aquatic habitat conditions and resources, particularly those in the North Fork Ranger District where weed infestations (primarily spotted knapweed) are comparatively extensive, would be expected to benefit most from weed management by reducing the potential for soil erosion and sediment delivery to streams. Protected and sensitive aquatic species with narrow habitat requirements that were discussed previously would especially benefit from improved habitat conditions.

Numerous Forest Service NEPA documents prepared for weed management programs on other National Forests in the Intermountain West have examined the potential for adverse effects from the inadvertent introduction of herbicides into aquatic ecosystems. Findings presented in those documents that are applicable to the S-CNF are referenced in this Final EIS. On the S-CNF, spotted knapweed is by far the predominant noxious weed species, comprising approximately 96 percent of the total weed infestations. Five herbicides are identified in Appendix C of this Final EIS that can be used to treat spotted knapweed. They include 2,4-D amine, clopyralid, dicamba, glyphosate, and picloram. Herbicides besides these also could potentially be used to treat spotted knapweed as well as smaller infestations of other weed species. However, the range of toxicities of the five herbicides listed above provides a broad representation of possible adverse effects if herbicides inadvertently enter aquatic ecosystems. One of these herbicides—picloram—represents potentially worst-case conditions for aquatic organisms because of its relatively high toxicity and persistence and mobility in the environment compared to other herbicides. Appendix J

lists various characteristics of these five herbicides as well as the other herbicides discussed in *Section 2.C.1.d, Chemical Treatment,* in *Chapter 2, Alternatives*.

The following examples illustrate the effectiveness of mitigation measures and BMPs, including buffer zones, in the aerial and ground-based application of herbicides to safely and effectively treat noxious weeds in the western United States. For the Mormon Ridge Winter Range Restoration Project on the Lolo National Forest in western Montana, picloram (Tordon 22K) was applied aerially in 1997 to treat noxious weeds on approximately 900 acres (TechLine 1998). This site provides important winter range for elk and deer because of the presence of large bunchgrass, but it had deteriorated due to spotted knapweed and leafy spurge infestations. Picloram was applied aerially at a rate of 1.5 pints per acre (approximately 0.37 pound per acre) using the same types of mitigation measures and BMPs that would be employed in aerial herbicide applications on the S-CNF, including a 300-foot no-treatment buffer to keep herbicides out of all fish-bearing water bodies. (S-CNF mitigation measures and BMPs are described in this Final EIS in *Section 2.D.3 Management Practices and Mitigation Measures,* Appendix A - USDA Forest Service Region 4 Best Management Practices for Weed Prevention and Management, and Appendix E - Aerial Spray Recommendations and Spray Dispersion Model Predictions*)*. Water samples were collected from Mormon Creek prior to, during, 30 minutes after, and 60 minutes after aerial herbicide application (TechLine 1998). Water samples were tested for picloram at a detection level down to 0.01 part per billion (0.01 microgram per liter), which is far below any levels of toxicological significance (see Table 4-1). Picloram was not detected in any of the water samples, indicating the stream protection measures were effective. One year following treatment of the Morman Ridge site, weed production had declined 98 percent from 1,075 pounds per acre to 25 pounds per acre, while grass production had increased 714 percent from 350 pounds per acre to 2,850 pounds per acre (TechLine 1998).

Results of water monitoring studies in association with herbicide applications on the Angeles, Eldorado, Lassen, Sierra, and Stanislaus National Forests in Region 5 of the Forest Service also illustrate the effectiveness of BMPs and buffers when properly implemented (Bakke 2001). Over 140 surface water samples were collected on these Forests during reforestation and noxious weed eradication projects using ground-based applications of glyphosate and triclopyr. Both of these herbicides are proposed for use on the S-CNF. There were no detections of glyphosate in any samples taken after reforestation projects that were not ascribed to contamination. The one project with a detection of glyphosate involved treatment of noxious weeds within the riparian zone. Even here, only one of twelve samples had a detection of glyphosate and that was at a low level of 15 micrograms per liter, which is below any level of concern for human health or aquatic resources (Bakke 2001) (also see Table 4-1). The few positive detections of triclopyr in non-accidental or erroneous applications in water monitoring were all at low levels (highest 2.4 micrograms per liter). These levels are below any aquatic levels of concern. The highest level of triclopyr detected (82 micrograms per liter) was the result of an absence of an untreated buffer on an ephemeral stream, and even this level does not represent a substantial risk of harm to humans or the environment (Bakke 2001).

Herbicides proposed for use on the S-CNF also contain "inert" ingredients, including surfactants, that are not expected to have any significant effect. The dyes and other adjuvants described in *Chapter 2, Alternatives* are described as having little effect on wildlife

populations. Mitigation measures, buffer zones BMPs, and SOPs are expected to minimize adverse impacts, if any, of these other ingredients.

There are reports that many synthetic chemicals released into the environment may disrupt normal endocrine function in a variety of aquatic life and wildlife. Some of the effects observed in animals have been attributed to some persistent organic chemicals such as polychlorinated biphenyls, DDT (dichlorodiphenyltrichloroethane), dioxin, and some pesticides. Adverse effects include abnormal thyroid function and development in fish and birds; decreased fertility in shellfish, fish, birds, and mammals; decreased hatching success in fish, birds, and reptiles; demasculinization and feminization of fish, birds, reptiles, and mammals; defeminization and masculinization of gastropods, fish, and birds; decreased offspring survival; and alteration of immune and behavioral function in birds and mammals. Some argue that these adverse effects may be due to an endocrine disrupting mechanism (EPA 1997). However, the causal link between exposure and endocrine disruption in wildlife is unclear (WHO 2002).

It is unknown whether herbicides have the same effect as DDT and other pesticide compounds. For example, 2,4-D mimics the growth hormone auxin, which in turn causes uncontrolled growth and eventually death in target plant species (Tu et al. 2001). This potential hormone disruption implicates 2,4-D as an endocrine disrupter. A recent study showed that 2,4-D does not influence male-to-female sex reversal in alligators (Guillette et al. 2000). However, little connection has been made between endocrine disruption in other wildlife or human health and herbicide use, primarily because information is not available (Safe et al., 2000). In addition, many other factors disturb wildlife growth, reproduction, and survival. Wildlife can be subject to a number of different stressors (such as habitat loss, competition, food availability, and disease) that may affect the same endocrine markers used to evaluate the effect of endocrine disrupters (Safe et al. 2002; WHO 2002). Thus, the relationship between adverse hormonal effects in wildlife and endocrine disruption remains speculative (WHO 2002).

Herbicides can inadvertently enter aquatic ecosystems through surface runoff, leaching through soils, accidental spills, and wind drift. The potential impact of a herbicide on aquatic organisms depends on the toxicity characteristics and exposure concentration of that herbicide. Table 4-1 presents toxicity levels to aquatic organisms of the five representative herbicides listed above that can be used to treat spotted knapweed. Toxicity levels are presented for four different categories. The 96-hour LC50 level is that concentration of herbicide that is lethal to 50 percent of the test organisms (primarily rainbow trout in the examples) exposed to that concentration for 96 hours. The lower the LC50 value, the more toxic the herbicide. While the 96-hour LC50 value provides a standard for comparing toxicities among herbicides, it is generally considered an unacceptable level of impact or risk to fish populations. Table 4-1 shows no-observed-effect levels (NOELs) or levels that are safe for aquatic organisms (dicamba is the exception in Table 4-1 because no long-term NOEL data on aquatic resources are available for this chemical.

Two other sets of values or criteria are listed in Table 4-1 that are believed by researchers to protect aquatic organisms.

TABLE 4-1
Toxic Levels of Herbicides to Fish (Concentrations in Milligrams per Liter)

Herbicide (test species)	96-hour LC50	LC50 Divided by 10	MATC[1]	NOEL
Picloram[2] (cutthroat trout)	3.5	0.35	0.12	0.29
2,4-D amine (aquatic)[3] (rainbow trout)	420	42	4	10
Glyphosate (aquatic)[4] (rainbow trout)	140	14	0.4	1
Dicamba[5] (rainbow trout)	28	2.8	1.12	No long-term data available
Clopyralid[6] (rainbow trout)	103	10.3	44	23

[1]MATC values from Mayer and Ellersieck (1986).
[2]96-hr LC50 and NOEL values from Woodward (1976, 1979).
[3]96-hr LC50 value from Mayer and Ellersieck (1986) and NOEL value from Syracuse Environmental Research Associates, Inc. (2001).
[4]96-hr LC50 and NOEL values from Syracuse Environmental Research Associates, Inc. (1996).
[5]96-hr LC50 value from Mayer and Ellersieck (1986).
[6]96-hr LC50 and NOEL values from Syracuse Environmental Research Associates, Inc. (1999).

In the first set of criteria, the EPA (EPA 1986) recommends that the 96-hour LC50 value be divided by 10 to set a standard for herbicide concentrations that will protect aquatic organisms (U.S. Forest Service 1999a; 2001d). In the second set of criteria developed by the USFWS (Mayer and Ellersieck 1986), the maximum acceptable toxicant concentration (MATC) represents the acute toxicity value of either rainbow trout or *Daphnia* spp. (a type of water flea), whichever is less, to a specific herbicide divided by 25. The USFWS believes that if herbicide concentrations are equal to or less than the MATC, then all aquatic species will be reasonably protected; certain individuals may still react to the herbicide but the overall population is considered safe (Mayer and Ellersieck 1986). The MATC value is generally lower than the LC50 divided by 10 value. The MATC method is comparable to methods used in risk assessments conducted by the Forest Service and complies with directions outlined in the Forest Service (1995) Handbook.

The LC50 divided by 10 values and the MATC values listed in Table 4-1 are used as criteria in the following assessment to determine the potential for herbicide-related impacts on aquatic organisms on the S-CNF. Both methods have been used in recent NEPA weed management assessment documents prepared by the Forest Service. The LC50 divided by 10 criteria were used for the FCRONRW in central Idaho (U.S. Forest Service 1999a) and the Sandpoint Ranger District in northern Idaho (U.S. Forest Service 2001d). The MATC criteria were used for the Beaverhead-Deerlodge National Forest (U.S. Forest Service 2001a) and the Flathead National Forest (U.S. Forest Service 2000a) in western Montana. Projected values are also compared against NOEL values in the following assessment. NOEL values usually exceed calculated MATC values (see Table 4-1). Appendix J contains detailed information on the characteristics, application rates, and toxicity of all of the herbicides proposed for use on the S-CNF.

To estimate the risk of possible herbicide concentration in streams, it is important to distinguish whether rainfall on a weed treatment site is infiltration-dominated or runoff-dominated. Rainfall typically percolates into the soil on an infiltration-dominated site, but it is more likely to produce overland flow on a runoff-dominated site. Vegetative cover, soil type, degree of surface disturbance and compaction, and land slope determine whether rainfall infiltrates or runs off a site (U.S. Forest Service 2001d, a, c; 1999a). Undisturbed forests and grasslands on the S-CNF are typically associated with infiltration-dominated sites. The overland transport of herbicides applied to smaller weed infestations occurring on this type of landscape would be expected to be minimal. However, many of the weed infestations on the S-CNF are associated with roads, trails, paths, and other areas where the soil has been disturbed and/or compacted. Road prisms, road cuts, and road fills are runoff-dominated features. They enhance runoff by concentrating flows on compacted road surfaces and in ditches, and in some cases by intercepting groundwater flow from cut slopes (Forest Service 2001d, a, c). Compacted, coarse-sized material with low organic matter that is used to create road fill slopes can also contribute to increased runoff. In addition, the Forest Service (1999a; 2001d, a, c) noted that, in general, weed-infested areas could increase overland runoff, citing studies by Lacey et al. (1989) who reported a 50 percent increase in runoff at a knapweed-infested site compared to a non-infested site. In these settings on the S-CNF, the potential for the inadvertent introduction of herbicides to streams would be expected to occur primarily via surface runoff.

Worst-Case Situations: Four worst-case situations involving the use of herbicides on the S-CNF are analyzed in the following text. They include the inadvertent entry of herbicides into aquatic ecosystems through surface runoff (six worst-case scenarios are examined), leaching through soils, accidental spills, and wind drift. These four situations are generally regarded as worst-case examples because of the extensive list of BMPs and mitigation measures described in *Chapter 2, Alternatives* that would be implemented as integral parts of the Proposed Action to avoid or minimize the potential for worst-case adverse effects to occur. For example, BMPs and mitigation measures are included to avoid or minimize the possibility of extreme rain events occurring after herbicide spraying, since such an occurrence could cause a runoff event. In addition, use of the site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy described in *Chapter 2, Alternatives* would not result in worst-case conditions. These site-specific processes are designed to avoid or minimize the potential for adversely affecting S-CNF resources, especially sensitive resources.

Surface Runoff Following Application: Six worst-case scenarios involving surface runoff and the inadvertent entry of herbicides used to treat noxious weeds into drainages are analyzed in the following text. Two of these analyses assume that herbicides are used to treat spotted knapweed in the North Fork HUC 5 of the North Fork Ranger District. The first analysis examines the ground-based application of picloram and the second analysis examines the aerial application of 2,4-D amine. Inventoried infestations of spotted knapweed in this HUC 5 total approximately 24,300 acres and are by far the worst of any weed infestations present in HUC 5s on the S-CNF. The third worst-case scenario analyzed here examines the ground-based application of 2,4-D amine to treat spotted knapweed and Canada thistle in the Lost River Ranger District in the southern portion of the S-CNF. The final three worst-case scenarios are presented under the heading **Low Flow Watersheds.** These analyses examine the effects of herbicide treatment on three comparatively small

drainages associated with 6th order HUCs in the North Fork Ranger District (Hull Creek), Challis Ranger District (Eddy Creek), and Leadore Ranger District (Little Eightmile Creek). Appendix B provides details on the acres and species of weed infestations by Ranger District and HUC 5 on the S-CNF.

Picloram—North Fork Ranger District/North Fork HUC 5: This worst-case analysis involves the ground-based application of picloram to treat 50 acres of spotted knapweed in 1 day during summer. Picloram was selected for analysis because of its relatively high toxicity compared to other herbicides (see Table 4-1), and because of its persistence and mobility in the environment (see Appendix J). The ground-based herbicide treatment of 50 acres in a single day rather than over 1 week is regarded as an aggressive rate of weed treatment. Quartzite is the predominant soil type in the North Fork HUC 5 (see Appendix I) and is one of the more permeable soil types.

The Forest Service (1999a) cited field studies of pesticide spray operations that showed pesticide input to streams varied from non-detectable levels to 6 percent of the amount applied. The Forest Service (2001d) also cited reviews by Rice (1990), which showed that a maximum of 10 percent of picloram applied on a runoff-dominated site could potentially enter a stream in a 6-hour period in the event of rain. By comparison, only 1 percent of picloram applied on an infiltration-dominated site could potentially enter a stream via surface runoff in a 6-hour period in the event of rain. The Forest Service (2001a) reported that with picloram, the risk for contamination is generally greatest with the first storm following herbicide application that results in overland flows. The Forest Service (2001a) also reported that herbicide concentrations in streams generally peak in a 4- to 6-hour period following a runoff-generating event.

At an application rate of 0.50 pound per acre, a total of 25 pounds of picloram would be applied to the 50-acre treatment site. Assuming as a worst case that 10 percent of the applied picloram inadvertently runs off into a nearby drainage over a 6-hour period, that drainage would receive 2.5 pounds of picloram. The major drainage in the North Fork HUC 5 is the North Fork Salmon River. Average monthly flows during late summer/fall when the herbicide could potentially enter the North Fork because of a rainstorm vary from 19 cubic feet per second (cfs) in August to 14 cfs in October (U.S. Forest Service 1998). If 2.5 pounds of picloram enter the North Fork Salmon River over a 6-hour period in October, the resultant concentration would be 0.13 milligram of picloram per liter of river water (0.13 mg/L). This value is less than both the LC50 divided by 10 value (0.35 mg/L) and the NOEL value (0.29 mg/L) for picloram listed in Table 4-1 and essentially the same as the MATC value (0.12 mg/L). In the event of such a worst-case occurrence involving picloram, populations of aquatic life in the North Fork Salmon River, which include the threatened Snake River steelhead, Snake River spring/summer chinook salmon, and bull trout and the sensitive westslope cutthroat trout, would be considered safe according to definitions for these protective criteria. Resultant concentrations in tributaries to the North Fork Salmon River or any other drainage on the S-CNF that receives this same amount of picloram from a runoff-dominated site over a 6-hour period would not exceed the NOEL (0.29 mg/L) level if flows are at least 7 cfs.

Using these same assumptions and an application rate of 1 (rather than 0.50) pound of picloram per acre on a 50-acre runoff-dominated site, the resultant average concentration of picloram in the North Fork Salmon River in October during a 6-hour rainfall event would be

approximately 0.26 mg/L. This value is slightly less than both the LC50 divided by 10 value and the NOEL value, but exceeds the MATC value for picloram (see Table 4-1).

On infiltration-dominated sites where no more than 1 percent of the picloram applied could potentially enter a stream via surface runoff, the resultant average concentration in the North Fork Salmon River would be one-tenth what it would be for drainages receiving input from runoff-dominated sites. For the examples given above over a 50-acre treatment area, the resultant average concentration of picloram in the North Fork Salmon River in October would be 0.013 mg/L when applied at a rate of 0.5 pound per acre and 0.026 when applied at a rate of 1 pound per acre at an infiltration-dominated site. Both of these concentrations would be considerably less than the LC50 divided by 10, the NOEL, and the MATC values for picloram listed in Table 4-1. No adverse effects on populations of aquatic resources would be expected under these conditions.

The predominant soil type in the North Fork HUC 5 is quartzite (88 percent of the total), followed by granitic (5 percent), volcanic (4 percent), and valley bottom (3 percent) soil types (see Appendix I for detailed information on S-CNF HUC 5 soil types). As previously described in discussions of soil characteristics (see *Chapter 3, Section 3.D.3.a, Soils*), quartzite soils are one of the more permeable soil types and would typically be associated with an infiltration-dominated site. The previous worst-case analysis describing picloram concentrations associated with infiltration-dominated sites would therefore seem most applicable to the North Fork HUC 5. However, other site-specific characteristics such as slope, the type and abundance of vegetative cover, and degree of soil compaction also determine whether a treatment site is infiltration-dominated or runoff-dominated. This illustrates the importance of using the site-specific implementation process, decision tree, minimum tool approach, and an adaptive strategy that were described in *Chapter 2, Alternatives* for the Proposed Action when selecting the most appropriate treatment option for a particular weed infestation site to minimize the potential for adverse effects.

2,4-D amine—North Fork Ranger District/North Fork HUC 5: This worst-case analysis involves the aerial application of 2,4-D amine to treat 500 acres of spotted knapweed in 1 day during summer. This analysis is believed to represent a worst-case scenario because of the very large acreage that would be treated in a single day, together with the assumption that a maximum of 10 percent of the applied herbicide on a runoff-dominated site would enter a stream via surface runoff over a 6-hour period. At an application rate of 1 pound of 2,4-D amine per acre, a total of 500 pounds of 2,4-D amine would be applied to the 500-acre treatment site in 1 day. This analysis assumes that 10 percent (50 pounds) of the applied 2,4-D amine runs off and enters the North Fork Salmon River over a 6-hour period in October when the average flow of the North Fork is 14 cfs (U.S. Forest Service 1998a). The resultant average concentration of 2,4-D amine in the North Fork would be 2.7 mg/L. This value is less than the LC50 divided by 10 value (42 mg/L), the MATC value (4 mg/L), and the NOEL value (10 mg/L) for 2,4-D amine, and populations of aquatic resources would be considered safe in the event such a worst-case scenario occurred. Resultant concentrations in tributaries to the North Fork Salmon River or any other drainage on the S-CNF that receives this same amount of 2,4-D amine from a runoff-dominated site over a 6-hour period would not exceed the MATC value if flows are at least 10 cfs.

Using these same assumptions and an application rate of 2 pounds (rather than 1 pound) of 2,4-D amine per acre on runoff-dominated sites, the resultant average concentration of

2,4-D amine in the North Fork Salmon River in October during a 6-hour rainfall event would be approximately 5.3 mg/L. This value is about eight times less than the LC50 divided by 10 value, and about half the NOEL value, but slightly exceeds the MATC value for aquatic life protection (see Table 4-1).

On infiltration-dominated sites where no more than 1 percent of the 2,4-D amine applied could potentially enter a stream via surface runoff, the resultant average concentration in the North Fork Salmon River in October would be approximately one-tenth what it would be if herbicide input was from runoff-dominated sites. Resultant concentrations of 2,4-D amine on infiltration-dominated sites would be 0.27 mg/L when applied at a rate of 1 pound per acre and 0.53 mg/L when applied at a rate of 2 pounds per acre. These values should not represent a risk to aquatic resources based on values listed in Table 4-1. As noted previously, the more permeable quartzite soil type is predominant in this HUC 5.

An additional worst-case scenario involving the potential cumulative effects of 2,4-D amine on the mainstem Salmon River was analyzed. This analysis assumes that 15,000 acres of spotted knapweed in the northern portion of the S-CNF would be treated with herbicide under the Proposed Action in 1 day during summer using 2,4-D amine at an application rate of 1 pound per acre. It is further assumed that 10 percent of the applied 2,4-D amine inadvertently enters the mainstem Salmon River over a 6-hour period because of a rainfall event. Flows in the mainstem Salmon River at Salmon (U.S. Geological Survey gage site 1330250) average 1,236 cfs in August and 1,085 cfs in September. The resultant average concentration of 2,4-D amine in the mainstem Salmon River at a flow of 1,085 cfs would be 1.03 mg/L. This value is about four times less than the MATC value and 10 times less than the NOEL value for 2,4-D amine (see Table 4-1) and would not be expected to adversely affect populations of aquatic resources in the mainstem Salmon River. The MATC value for 2,4-D amine would not be exceeded under these conditions so long as river flow is approximately 280 cfs or greater.

2,4-D amine—Lost River Ranger District/Upper Little Lost HUC 5: This worst-case analysis involves the ground-based application of 2,4-D amine to treat 58 acres of Canada thistle and spotted knapweed in 1 day during summer. These weed infestations are located in the Lost River Ranger District in the Upper Little Lost HUC 5 of the Little Lost HUC 4. The herbicide 2,4-D amine can be used to treat both of these weed species (see Appendix C). This analysis is believed to represent a worst-case scenario, but for the southern portion of the S-CNF rather than the northern portion as in the previous two worst-case scenarios. It assumes that a relatively large acreage of weeds (at least for this portion of the S-CNF) would be treated in a single day within a single HUC 5, and that a maximum of 10 percent of the applied herbicide on a runoff-dominated site would enter a stream via surface runoff over a 6-hour period. At an application rate of 1 pound of 2,4-D amine per acre, a total of 58 pounds of 2,4-D amine would be applied to the 58-acre treatment site in 1 day. This analysis assumes that 10 percent (5.8 pounds) of the applied 2,4-D amine runs off during a rainfall event and enters a headwater tributary to the upper Little Lost River over a 6-hour period. It also is assumed that this event occurs in October during a typical low-flow period when the average tributary flow is only 2 cfs. The resultant average concentration of 2,4-D amine in the headwater tributary would be 2.2 mg/L. This value would be less than the LC50 divided by 10 value (42 mg/L), the MATC value (4 mg/L), and the NOEL value

(10 mg/L) for 2,4-D amine (see Table 4-1), and populations of aquatic resources would be considered safe in the event such a worst-case situation occurred.

On infiltration-dominated sites where no more than 1 percent of the 2,4-D amine could potentially enter a stream via surface runoff, the resultant average concentration of 2,4-D amine in the headwater tributary flowing at 2 cfs would be 0.22 mg/L, or one-tenth what it would be if herbicide input was from a runoff-dominated site. This analysis indicates that for both runoff- and infiltration-dominated sites on the southern S-CNF and in other portions of the S-CNF where weed infestations (and potential herbicide uses) are far less extensive than in the northern S-CNF, populations of aquatic life in the upper Little Lost River drainage would be considered safe according to protective criteria in Table 4-1. These populations include the threatened bull trout.

Soil types in the Upper Little Lost HUC 5 reflect a mixed geology, with sedimentary soils most abundant (45 percent of the total) and lesser amounts of volcanic (29 percent) and quartzite (26 percent) soils present (see Appendix I for details on soil types). As described in *Chapter 3, Section 3.D.3.a, Soils*, sedimentary and volcanic soils generally tend to be less permeable than quartzite soils. This suggests, based on predominant soil characteristics, that weed treatment areas in the Upper Little Lost HUC 5 would tend to be runoff-dominated sites. This and other factors (for example, slope and type and amount of vegetative cover) affecting whether a site is runoff- or infiltration-dominated would be determined as part of the site-specific implementation process in selecting the treatment option that will not cause adverse environmental effects.

Low Flow Watersheds

North Fork Ranger District, North Fork HUC 5, Hull Creek (HUC 170602030502): Hull Creek has a flow of 0.72 cfs and drains 8,419 acres. Spotted knapweed is by far the dominant weed species and is much more abundant in this area of the S-CNF than in other areas. Quartzite soils, which are relatively permeable, are the predominant soil type in this area of the S-CNF. Using the same assumptions for runoff- and infiltration-dominated sites during a rainfall event as in the previous analyses, applying picloram at rates of 0.50 and 1 pound per acre to treat spotted knapweed, and given that flow in Hull Creek is 0.72 cfs, the maximum number of acres that could be treated in 1 day without exceeding the MATC value for picloram (0.12 mg/L, see Table 4-1), which is considered protective of aquatic life, was calculated. These calculations show that on a runoff-dominated site in the Hull Creek watershed, the maximum number of acres that could be treated in 1 day with picloram at application rates of 0.50 and 1 pound per acre without exceeding the MATC value would be approximately 2 acres and 1 acre, respectively. On an infiltration-dominated site, the maximum number of acres that could be treated in 1 day with picloram at application rates of 0.50 and 1 pound per acre without exceeding the MATC value would be approximately 20 acres and 10 acres, respectively.

As an additional analysis, the maximum number of acres of spotted knapweed in the Hull Creek watershed that could be treated in 1 day using 2,4-D amine rather than picloram without exceeding the MATC value for 2,4-D (4 mg/L, see Table 4-1) also was calculated. Application rates of 1 and 2 pounds of 2,4-D per acre were assessed. These calculations show that on a runoff-dominated site, the maximum number of acres that could be treated in 1 day with 2,4-D amine at application rates of 1 and 2 pounds per acre without exceeding

the MATC value, which is considered protective of aquatic life, would be approximately 38 acres and 19 acres, respectively. On an infiltration-dominated site, the maximum number of acres that could be treated in 1 day with 2,4-D amine at application rates of 1 and 2 pounds per acre without exceeding the MATC value would be approximately 380 acres and 190 acres, respectively.

Challis Ranger District, Challis Creek HUC 5, Eddy Creek (HUC 170602010206): Eddy Creek has a flow of 2.51cfs and drains 13,492 acres. A total of 132 acres of spotted knapweed, 5 acres of musk thistle, and 5 acres of leafy spurge have been inventoried in the Challis Creek HUC 5 that contains the Eddy Creek watershed. Volcanic soils, which are among the less permeable soils on the S-CNF, comprise 90 percent of the soil types in the Challis Creek HUC 5. The same type of analysis of picloram and 2,4-D amine as described above for Hull Creek was conducted for Eddy Creek, but using a creek flow of 2.51 cfs. Calculations for picloram show that on a runoff-dominated site in the Eddy Creek watershed, the maximum number of acres that could be treated in 1 day with picloram at application rates of 0.50 and 1 pound per acre without exceeding the MATC value of 0.12 mg/L would be approximately 8 acres and 4 acres, respectively. On an infiltration-dominated site, the maximum number of acres that could be treated in 1 day with picloram at application rates of 0.50 and 1 pound per acre without exceeding the MATC value would be approximately 80 acres and 40 acres, respectively.

Calculations for 2,4-D amine show that on a runoff-dominated site, the maximum number of acres that could be treated in 1 day with 2,4-D amine at application rates of 1 and 2 pounds per acre without exceeding the MATC value of 4 mg/L would be approximately 135 acres and 67 acres, respectively. On an infiltration-dominated site in the Eddy Creek watershed, the maximum number of acres that could be treated in 1 day with 2,4-D amine at application rates of 1 and 2 pounds per acre without exceeding the MATC value would be approximately 1,350 acres and 670 acres, respectively. These data suggest that, if desired and depending on site characteristics determined during the site-specific implementation process, a combination of picloram and 2,4-D amine could be applied at appropriate rates in a single day to treat all of the inventoried weed infestations in the Challis Creek HUC 5 without adversely impacting aquatic resources. Appendix H shows that the threatened bull trout and Snake River spring/summer chinook salmon and the sensitive westslope cutthroat trout occur in the Challis Creek HUC 5.

Leadore Ranger District, Middle Lemhi HUC 5, Little Eightmile Creek (HUC 170602040306): Little Eightmile Creek has a flow of 1.13 cfs and drains 12,534 acres. A total of 197 acres of spotted knapweed, 53 acres of musk thistle, 37 acres of Canada thistle, and 3 acres of leafy spurge have been inventoried in the Middle Lemhi HUC 5 that contains the Little Eightmile Creek watershed. Quartzite is the predominant soil type (63 percent of the total) in the Middle Lemhi HUC 5, followed by lesser amounts of the less permeable volcanic (15 percent) and sedimentary (11 percent) soil types. The same type of analysis of picloram and 2,4-D amine as described above for Hull Creek and Eddy Creek was conducted for Little Eightmile Creek, but using a creek flow of 1.13 cfs. Calculations for picloram show that on a runoff-dominated site in the Little Eightmile Creek watershed, the maximum number of acres that could be treated in 1 day at application rates of 0.50 and 1 pound per acre without exceeding the MATC value of 0.12 mg/L would be approximately 4 acres and 2 acres, respectively. On an infiltration-dominated site, the maximum number of

acres that could be treated in 1 day with picloram at application rates of 0.50 and 1 pound per acre without exceeding the MATC value would be approximately 40 acres and 20 acres, respectively.

Calculations for 2,4-D amine show that on a runoff-dominated site, the maximum number of acres that could be treated in 1 day at application rates of 1 and 2 pounds per acre without exceeding the MATC value of 4 mg/L would be approximately 60 acres and 30 acres, respectively. On an infiltration-dominated site in the Little Eightmile Creek watershed, the maximum number of acres that could be treated in 1 day with 2,4-D amine at application rates of 1 and 2 pounds per acre without exceeding the MATC value would be approximately 600 acres and 300 acres, respectively. These data suggest that if desired, and depending on site-specific characteristics determined during the implementation process, a combination of picloram and 2,4-D amine could be applied at appropriate rates in a single day to treat all or most of the 290 acres of inventoried weed infestations in the Middle Lemhi HUC 5 without adversely impacting aquatic resources. Appendix H shows that the threatened bull trout and Snake River spring/summer chinook salmon and the sensitive westslope cutthroat trout occur in the Middle Lemhi HUC 5.

Leaching

Herbicides can potentially move through soils with rainfall, depending on soil permeability and water-holding capacity. They can subsequently enter groundwater and surface water and potentially adversely affect aquatic resources if their concentrations are high enough. If a soil is coarse and permeable, water can pass through the soil rapidly and carry some of the herbicide with it. If soils retain water in their upper horizons for later use by plants, there will be less opportunity for the water and herbicide to move through the soil and impact aquatic resources (U.S. Forest Service 1999a). The Forest Service (U.S. Forest Service 2001a) noted that a reduced potential for leaching is largely facilitated by plant uptake of the herbicide, natural decomposition, and volatization of active ingredients in the herbicide, and adsorption of the herbicide by soil particles. In their review of forest chemicals, Norris et al. (1991) stated that the "leaching of chemicals through the soil profile is a process of major public concern, but it is the least likely to occur in forest environments." Norris et al. 1991 noted that most chemicals are relatively immobile in soil and that intense leaching can move chemicals a few centimeters to 1 meter in depth, but these distances are short in comparison to distances between treated areas and streams.

The Forest Service (U.S. Forest Service 1999a) cited studies by Watson et al. (1989) on the occurrence of picloram in coarse soils in western Montana following its application at a rate of 1 pound per acre. As noted previously, picloram is a relatively mobile, persistent, and toxic herbicide that can be used to treat spotted knapweed. Picloram concentrations in the upper 5 inches of soil in the western Montana studies ranged from 205 to 366 parts per billion (ppb); the maximum concentration measured at soil depths between 30 and 40 inches was 24 ppb. No picloram was measured in shallow groundwater wells (detection level = 0.5 ppb) (U.S. Forest Service 1999a). A detection level of 0.5 ppb is equivalent to a concentration of 0.0005 mg/L, which is approximately 240 times less than the MATC value for picloram (see Table 4-1) believed by the FWS to be safe for populations of aquatic resources.

The Forest Service (1999a) cited other studies that measured and compared soil concentrations of herbicides less persistent in the environment than picloram. Specific data on soil permeability characteristics were not cited by the Forest Service (1999a). In those studies, Rice et al. (1992) found that clopyralid was never detected at soil depths greater than 10 inches, and after 30 days 2,4-D was never detected at soil depths greater than 2 inches. In those same studies, picloram was detected at soil depths between 10 and 20 inches within 30 days following spraying, but it was not detected (detection level = 10 ppb or 0.01 mg/L) at a soil depth greater than 10 inches 1 or 2 years after spraying (Rice et al. 1992). The Forest Service (1999a) concluded that there is relatively little risk of the deep leaching of picloram, clopyralid, or 2,4-D; they assumed results would be similar for the herbicide dicamba, even though it was not tested, because its persistence and mobility are similar to those of 2,4-D and clopyralid. The Forest Service cited other studies showing there is little probability of carryover of 2,4-D or dicamba in soils from one summer to the following spring because of their short half-lives, and thus limited opportunity for these herbicides to accumulate in the soil and migrate into groundwater. The Forest Service (1999a) stated that even if small amounts of any of these herbicides entered streams or larger rivers on the FCRONRW that the "dilution factor would render the herbicide concentrations to infinitesimal levels."

It is similarly expected that any concentrations of herbicides that may leach through soils and reach surface waters on the S-CNF would not pose a risk to aquatic resources. It is anticipated that picloram application rates on the S-CNF would not exceed approximately 1 pound per acre (the same as in the western Montana studies of coarse, permeable soils by Watson et al. [1989]), and would therefore not occur in soil concentrations great enough to subsequently adversely affect aquatic resources. As noted in the previous discussion on the surface runoff of herbicides, many of the weed infestation sites on the S-CNF—either because of the presence of weeds and their effects on runoff and/or the nature of constructed features weeds are often associated with—are likely runoff-dominated sites rather than infiltration-dominated sites. The likelihood of exposing, much less adversely affecting, aquatic resources to herbicides leached through soils would therefore be very low.

The previous discussion of surface runoff also notes that soil types vary across the S-CNF and can influence the degree to which a weed infestation site is runoff-dominated or infiltration-dominated. For example, soil types associated with locations assessed in the worst-case analyses indicate runoff-dominated conditions in the Upper Little Lost HUC 5 (Lost River Ranger District) and the Challis Creek HUC 5 (Challis Ranger District) and infiltration-dominated conditions in the Middle Lemhi HUC 5 (Leadore Ranger District) and the North Fork HUC 5 (North Fork Ranger District). *Section 3.D.3.a, Soils* in *Chapter 3* generally describes soils characteristics on the S-CNF and notes that on average, all soil types on the S-CNF have moderate amounts of coarse fragments. Appendix I provides information on the percentage abundance of different soil types in each HUC 5 within the S-CNF that can be used to infer soil permeability. Very generally, the most frequently occurring predominant soil types by Ranger District tend to consist of the following: Challis Ranger District (volcanic, sedimentary, and quartzite); Leadore Ranger District (quartzite); Lost River Ranger District (sedimentary); Middle Fork Ranger District (volcanic and quartzite); North Fork Ranger District (quartzite and granitic); Salmon-Cobalt Ranger District (volcanic, quartzite, and granitic); and Yankee Fork Ranger District (volcanic, quartzite, and sedimentary). The predominance of quartzite soils, which are among the

more permeable soil types, in the North Fork HUC 5 where the majority of noxious weeds that have been inventoried on the S-CNF occur illustrates the importance of considering site-specific characteristics before beginning weed treatments.

The site-specific implementation process, decision tree, and minimum tool approach described in *Chapter 2, Alternatives* for the Proposed Action (and Alternatives 1 and 2), together with the Herbicide Leaching Sensitivity Evaluation System presented in Appendix F, are designed to consider soil characteristics such as permeability and leaching potential prior to weed treatment at a particular site in order to avoid or minimize the potential for herbicides to move through soils and impact aquatic resources. In the case of herbicide application, an additional important step in this process is the consideration of different herbicide properties, such as their toxicity to terrestrial and aquatic organisms, persistence and half-life, mobility and sorption to soil particles, water solubility, and other characteristics. Appendix J lists and defines a range of information on herbicide properties and behavioral aspects that can be used to select the most appropriate treatment option given site-specific characteristics. As noted above, the objective of the site-specific process is to evaluate and select a treatment option that will avoid or minimize the potential for herbicides to adversely affect aquatic resources.

Accidental Spills

The Forest Service (U.S. Forest Service 2001a) reports that most groundwater contamination by herbicides derives from point source discharges, such as accidental spills, leaks, storage and handling facilities, improperly discarded containers, or rinsing equipment in loading and handling areas. These discharges can result in localized high concentrations of herbicides. The Forest Service (1999a) discussed results of two studies where picloram was intentionally introduced to streams. In the first study, 2.8 pounds of picloram were introduced to a stream flowing 190 cfs. (By comparison, the North Fork Salmon River averages 140 cfs in June.) Maximum picloram concentration 100 yards downstream from the introduction point 6 minutes later was 14 mg/L. About 3.5 miles downstream, the maximum picloram concentration was 0.005 mg/L, which is less than the MATC (0.12 mg/L) and NOEL (0.29 mg/L) values for picloram (see Table 4-1). In a second study, a picloram concentrate of 6.26 mg/L was metered into a stream for 50 minutes. No picloram was detected (detection level = 0.001 mg/L) beyond about 4 miles downstream. The maximum picloram concentration upstream of this point (2.362 ppm, measured about .25 mile downstream of the introduction point) lasted approximately 1 hour. Based on these studies, the Forest Service (1999a) observed that: 1) herbicide concentrations tend to drop rapidly within a short distance of the spill site, and 2) at any given point in the stream, the elapsed time of exposure to the spilled herbicide should be short.

If the above-referenced picloram concentrations were to occur on the S-CNF, they would be expected to cause at least some mortalities of aquatic resources in the first 3 to 4 miles of stream downstream from the spill. However, concentrations would quickly decline to less than the MATC and NOEL levels farther downstream, and should not adversely affect populations of aquatic resources. If a herbicide spill occurred on the S-CNF, the potential for adversely affecting aquatic resources or significantly jeopardizing a listed fish population would depend on numerous factors, including the spill amount, herbicide toxicity, exposure duration, and receiving water flow. To reduce the risk of this potential occurrence, a number of BMPs and mitigation measures were identified in *Chapter 2, Alternatives* for both the

ground-based and aerial application of herbicides. Examples include defined procedures for mixing, loading, and disposing of herbicides; only mixing herbicides at sites where spills into streams could not occur; properly calibrating, rinsing, and cleaning equipment; having an approved herbicide emergency spill plan and spill containment equipment available during herbicide application; maintaining various-sized, no-treatment/no-spray buffer zones around aquatic resources, depending on the nature of the resource and method of herbicide application; and many others.

Wind Drift

Aerial spraying near aquatic and riparian zones perhaps represents the greatest potential to expose aquatic organisms and amphibians to contaminants either through direct application or wind drift. Risk of contamination during the ground-based application of herbicides is less than during aerial application because application occurs more slowly and applicators are able to recognize potential problems and adjust their application techniques (U.S. Forest Service 2001a). To reduce the risk of the potential for such impacts to occur, a number of BMPs and mitigation measures were identified in *Chapter 2, Alternatives* for both the ground-based and aerial application of herbicides. These include obtaining a weather forecast prior to spraying to ensure no extreme weather events would occur during or soon after spraying that would allow drift or runoff into streams; not spraying when wind velocity exceeds fixed standards and is in a direction that could impact sensitive resources; maintaining various-sized, no-treatment/no-spray buffer zones around aquatic and riparian resources, depending on the nature of the resource and method of herbicide application; using appropriate air speed and aircraft height to reduce wind drift potential; using on-site wind-monitoring devices to determine wind direction and speed; and many others.

BMPs and mitigation measures described in the preceding text and in *Chapter 2, Alternatives* are designed to minimize or avoid the potential for impacts associated with wind drift and inadvertent spraying of aquatic and riparian resources. The BMPs and mitigation measures for the Proposed Action provide specific standards to ensure proper application of herbicides within riparian buffers—areas where amphibians typically occur. These BMPs and mitigation measures should minimize the potential for adverse effects on amphibians, as well as other riparian and aquatic resources. In addition, Appendix E contains aerial spray recommendations and spray dispersion model predictions that provide appropriate examples for possible application on the S-CNF.

Summary

The direct and indirect effects of weed treatment under the Proposed Action would be expected to result in improved habitat conditions and reduced threats for aquatic and riparian resources on the S-CNF. However, short term disturbances may occur and may have a slight negative effect on aquatic resources in specific areas. Weed infestations would progressively decline, reducing the potential for erosion and sediment delivery to drainages and benefiting aquatic resources, particularly in the northern part of the S-CNF. It is unlikely that any of the worst-case situations analyzed in the preceding text, including the northern S-CNF where some weed infestations are severe and the central and southern S-CNF where weed infestations are much less extensive, would occur because of the implementation of BMPs and mitigation measures, and use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy. If worst-case

conditions did occur, the scenarios involving herbicide runoff and leaching of herbicides would not be expected to result in adverse impacts on populations of aquatic resources, including fish, invertebrates, and amphibians. Potential short-term impacts on aquatic and riparian resources could occur if there was an accidental spill of a relatively toxic herbicide in a small drainage. Resultant effects may be localized depending on various factors, including the volume of spill and dilution by the receiving water. Adherence to BMPs and mitigation measures would reduce the likelihood of such a spill occurring, plus they would minimize or avoid the potential occurrence of wind-drift-related impacts on aquatic resources and amphibians. It is noted that the USFWS and NMFS have not prohibited the use of herbicides in weed treatments on the S-CNF in their ESA review of, and concurrence on, Biological Assessments prepared for weed management on the S-CNF.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the Proposed Action are designed to avoid or minimize the potential for adverse effects on S-CNF resources. Numerous examples were presented previously in the discussions of worst-case situations. A total of 59 management practices and mitigation measures address weed prevention and management BMPs and the proper application of herbicides, including 22 measures specifically directed at the proper aerial application of herbicides. All of these measures are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* Examples include compliance with all State and Federal laws and agency manuals, handbooks, and guidelines during herbicide application; application of herbicides in accordance with EPA registration label requirements and restrictions; use of a 50-foot no-spray buffer zone for broadcast or 'block' applications and use of a 15-foot buffer for spot applications along all flowing water streams and ponded water bodies (reduced buffer zones will be considered when using label-approved aquatic formulations [e.g., aquatic 2,4-D]); no spraying of herbicides when wind velocity exceeds 10 mph, or within 50 feet of open water when wind velocity exceeds 5 mph; no spraying of picloram within 100 feet of surface water when wind velocity exceeds 5 mph, and no more than one application of picloram in a treatment area in a year; use of label-approved aquatic formulations near open water; and BMPs and mitigation measures described in the preceding discussions in this section regarding accidental spills of herbicides and wind drift during aerial application. This includes a 300-foot no-treatment buffer zone on all fish-bearing streams, lakes, and ponds and a 100-foot no-treatment buffer zone on non-fish-bearing waters during aerial herbicide application. Also, aerial herbicide application will not occur during periods of inversion. In addition, the Proposed Action incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy, which were described in *Chapter 2, Alternatives*. These management tools are designed to consider site-specific resource conditions that result in the selection of a treatment method that achieves weed management goals with the least impact to S-CNF resources.

Cumulative Effects. Cumulative effects from treatments under the Proposed Action combined with treatments under the three CWMAs would result in benefits to aquatic habitat and resources compared to the No Action Alternative through the widespread eradication, control, and containment of noxious weeds. The CWMAs and the S-CNF weed management program would cumulatively be expected to result in increased levels of weed treatment success. Under the Proposed Action, weed infestation on the S-CNF would progressively decline. This would reflect the eradication, control, and/or containment of

new weeds that have invaded the S-CNF from adjacent lands covered by the CWMAs, and increased success in preventing weeds presently occurring on the S-CNF from invading adjacent lands. This particular benefit may directly contribute to a decline of weeds on adjacent non-National Forest land.

This cumulative effect could potentially benefit aquatic and riparian habitat and a range of protected and other sensitive management indicator species through reduced erosion and sediment delivery to drainages. Beneficial cumulative effects on aquatic resources may be greatest in the northern portion of the S-CNF and on adjacent non-National Forest lands because of extensive spotted knapweed infestations that would be aggressively managed. No adverse downstream cumulative effects on non-National Forest land would be expected from worst-case situations involving herbicide runoff or leaching because of the extremely low concentrations. There is the potential for downstream adverse effects on aquatic and riparian resources if a herbicide spill or wind-drift-related impact occurred close to Forest Service boundaries. Increased flows proceeding downstream would further dilute the herbicide. Weed management BMPs and mitigation measures described previously are designed to prevent or reduce the risk of these types of impacts from occurring.

Additional cumulative effects on aquatic resources associated with other ongoing activities on the S-CNF that were described for the No Action Alternative would also occur under the Proposed Action. These cumulative effects include the potential for erosion and sediment delivery from road and trail-related construction and maintenance activities, livestock grazing along drainages, and recreational activities adjacent to drainages. Also, cumulative effects on aquatic resources from weed treatment activities under the Proposed Action potentially include short-term increases in erosion and sediment delivery to drainages caused by more extensive mechanical treatments (soil disturbance) and chemical treatments (creation of barren ground from weed removal) than under the No Action Alternative. These areas would be subject to erosion until native vegetation becomes re-established, after which time erosion and sediment delivery should be less than when weeds were present and provide correspondingly greater benefits than under the No Action Alternative. This would represent an overall long-term cumulative benefit to aquatic habitat and resources. Finally, there is the possibility of herbicide application in adjacent areas (S-CNF and CWMA) and possible cumulative effects on aquatic resources. However, the CWMA efforts are coordinated with the management agencies to avoid multiple treatments within a defined geographic location. In addition, all such applications would be in accordance with EPA label guidelines, which are designed to protect aquatic organisms.

The Forest Service (2001d) discussed the potential for two additional types of cumulative effects on aquatic organisms in northern Idaho from herbicide application. These are the potential for the bioconcentration of herbicides in aquatic organisms and the possibility of synergistic, combined effects on aquatic organisms when several herbicides are present. For bioconcentration to occur, a pollutant must be present in a high concentration for an extended period of time, the organism must be exposed to the pollutant, and the pollutant must have a high resistance to breakdown or excretion by the organism to allow a sufficient uptake period that would result in an elevated bioconcentration. The Forest Service (2001a) concluded that the risk of bioconcentration would be low because of the relatively small amount and timing of herbicide application. The risk of herbicide bioconcentration in aquatic organisms on the S-CNF also would be expected to be low because of the extremely

low concentrations of herbicides that aquatic organisms would be briefly exposed to during even a worst-case situation. In addition, the herbicides listed in Table 4-1 that could be used to treat spotted knapweed on the S-CNF do not bioaccumulate in fish and/or have very little persistence in the environment (Information Ventures, Inc. 2002).

The Forest Service (2001a) concluded that no synergistic effects from herbicide application would occur. This was because: 1) the EPA currently supports an additive model in predicting synergistic effects, 2) relatively small amounts of herbicides would be applied, and 3) where more than one herbicide is applied the amount of each chemical applied would typically be reduced. This same rationale and conclusion regarding the potential for synergistic effects on aquatic resources also applies to the S-CNF. In addition, because the chances of multiple different herbicide activities taking place in the same drainage on the same day are unlikely, the potential for cumulative synergistic effects on aquatic organisms on the S-CNF would be minimal.

c. Alternative 1

Direct and Indirect Effects. Direct and indirect effects on aquatic habitat and on fish, aquatic invertebrate, and amphibian species under Alternative 1 would generally be similar to those effects described for the Proposed Action, with one important difference. There would be no aerial application of herbicides under Alternative 1, making it a less aggressive weed treatment alternative than the Proposed Action. A combination of primarily biological and ground-based chemical methods rather than aerial herbicide application would be used to treat weed infestations on the S-CNF under Alternative 1. Some weed infestations would be more difficult to access and require more time to treat under Alternative 1 compared to aerial herbicide applications under the Proposed Action. The resulting benefits to aquatic resources resulting from reductions in erosion and sediment delivery from weed-infested areas would still be expected, but to a lesser degree and would take longer to achieve than under the Proposed Action. There would be long-term benefits to protected and sensitive fish species, such as the Snake River steelhead, spring/summer chinook salmon, and sockeye salmon, and to bull trout and westslope cutthroat trout—especially in the northern part of the S-CNF.

Several of the examples of worst-case situations described for the Proposed Action could not occur under Alternative 1 because of differences in treatment techniques. These worst-case situations include the scenario describing runoff of 2,4-D amine aerially applied on 500 acres in a single day, plus possible wind-drift-related impacts on aquatic resources and amphibians in riparian areas from the aerial application of herbicides. The other examples of worst-case situations presented for the Proposed Action regarding the surface runoff of picloram or 2,4-D amine in a single day, leaching of herbicides, and an accidental herbicide spill could potentially occur under Alternative 1. Resultant effects on aquatic resources would be the same as described for the Proposed Action, and would be expected to be negligible or short-term and localized. Also, as noted for the No Action Alternative, the limited monitoring studies performed on the S-CNF (Rose 2002) indicate that current weed treatment activities have not adversely impacted aquatic resources on the S-CNF.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 1 would be the same as for the Proposed Action except for measures dealing with the aerial application of herbicides. These measures are described in

detail in *Section 2.D.3, Management Practices and Mitigation Measures,* and a number of examples were listed in the discussion of BMPs and mitigation measures for the Proposed Action. Alternative 1, like the Proposed Action, also incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy, which were described in *Chapter 2, Alternatives*. These management tools are used to select a site-specific treatment method that achieves weed management goals with the least impact to S-CNF resources present at or near the treatment site.

Cumulative Effects. The same general kinds of beneficial cumulative effects resulting from the successful treatment of noxious weeds on the S-CNF and under the three CWMAs that were described for the Proposed Action would occur under Alternative 1, but they would take longer to achieve and be somewhat less effective because of the absence of the aerial application of herbicides. These long-term effects include the expected decline in noxious weeds and resultant benefits to aquatic and riparian habitat and species on and possibly adjacent to the S-CNF. No adverse downstream cumulative effects on non-National Forest land would be expected from worst-case situations involving herbicide runoff or leaching because of the extremely low concentrations. There is the potential for downstream adverse effects on aquatic resources if a herbicide spill occurred close to Forest Service boundaries, although increased downstream flows would further dilute the herbicide. Weed management BMPs and mitigation measures are designed to prevent or reduce the risk of these types of impacts from occurring. The risks of herbicide bioconcentration and synergistic effects on aquatic organisms under Alternative 1 are expected to be minimal for the same reasons as described for the Proposed Action.

Adverse cumulative effects on aquatic resources associated with other ongoing activities on the S-CNF and from weed treatment activities that were described for the Proposed Action and No Action Alternative would also occur under Alternative 1. These cumulative effects include the potential for erosion and sediment delivery from road and trail-related construction and maintenance activities, livestock grazing along drainages, recreational activities adjacent to drainages, and short-term increases in erosion and sediment delivery to drainages caused by more extensive mechanical treatments (soil disturbance) and chemical treatments (creation of barren ground). Disturbed and barren areas would be subject to erosion until native vegetation becomes re-established, after which time erosion and sediment delivery should be less than when weeds were present and provide correspondingly greater benefits than under the No Action Alternative but less than under the Proposed Action. The possibility of simultaneous herbicide application in adjacent areas (S-CNF and CWMAs)is unlikely since the CWMA efforts are coordinated with the management agencies to avoid multiple treatments within a defined geographic location. In addition, all such applications would be in accordance with EPA label guidelines, which are designed to protect aquatic organisms.

d. Alternative 2

Direct and Indirect Effects. The magnitude of direct and indirect benefits to aquatic resources under Alternative 2 would be expected to be less than under the Proposed Action, Alternative 1, or the No Action Alternative. Weed treatment methods have been identified for all of the inventoried weed infestations on the S-CNF under Alternative 2, but they do not include the ground-based or aerial application of herbicides. Instead, mechanical and biological treatments or their combination would be by far the predominant methods used

to treat weeds on the S-CNF. Because fewer treatment methods are available for treating weeds under Alternative 2 and because it is only realistic to control or contain rather than reduce the size of weed infestations under Alternative 2, it would take longer to achieve lesser levels of weed treatment success than anticipated under the Proposed Action, Alternative 1, or the No Action Alternative. The effectiveness of mechanical and biological treatment options in the eradication, control, or containment of invasive weeds can be delayed from several months to several years while the establishment and expansion of weeds continues. As a result, it also would take longer to realize some benefits to aquatic and riparian resources resulting from reduced erosion and sediment delivery at weed-infested sites to drainages. Increased direct and indirect impacts on aquatic resources would likely occur due to the increase in soil disturbance resulting from mechanical treatment activities. This would be especially true on the northern part of the S-CNF where weed infestations are substantially greater than on any other area of the S-CNF. There would be no potential for any of the worst-case situations involving herbicide application described for the Proposed Action, Alternative 1, or the No Action Alternative to occur under Alternative 2.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 2 are designed to avoid or minimize the potential for adverse effects on S-CNF resources. They focus on weed prevention and management BMPs and are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* Examples presented for the Proposed Action and other alternatives except those directed at the uses of herbicides, also apply to Alternative 2.

Cumulative Effects. The success of the coordinated CWMA programs would be severely hampered under Alternative 2. It would take longer to achieve a lesser level of success because of the absence of the application of herbicides. In some instances, these long-term results may include the expected gradual decline in noxious weeds and some resultant gradual benefits to aquatic and riparian habitat and to fish, aquatic invertebrates, and amphibians on and possibly adjacent to the S-CNF. Adverse cumulative effects under Alternative 2 would be greater than those described for the Proposed Action and other alternatives including sediment delivery from other ongoing S-CNF activities plus the creation of extensive disturbed and barren areas from the mechanical treatment of weeds. Under Alternative 2 there would be no potential for adverse cumulative effects on the S-CNF or adjacent non-National Forest lands from herbicide application, bioconcentration, or possible synergistic interactions, or from the creation of barren areas due to weed removal using herbicides.

4.B.3. Wildlife Resources

a. No Action Alternative

Direct and Indirect Effects. Although the No Action Alternative does not mean there would be no accomplishments or activities relative to weed control, continuing the existing weed management/control activities would not halt the spread of weeds on the S-CNF, particularly on the northern end. Even though there are weed control treatments in this alternative, weed populations would continue to expand, given the widespread nature of the weed populations compared to the acreage treated each year and their projected rate of

spread (see *Section 4.B.1, Vegetation Resources and Noxious Weeds*, for discussion of rate of weed spread).

Impacts from weed control activities on all wildlife species would include very short-term disturbance and displacement during treatment application, usually less than 1 day in duration. These disturbances are most likely to occur in sagebrush/grass plant communities, low-elevation ponderosa pine and Douglas-fir forest, and riparian plant communities, as these are the plant communities that commonly contain significant weed populations. These plant communities are frequently important big game winter range or sage grouse habitat.

All wildlife species would be affected to varying degrees by weed expansion. As weeds expand they displace native plant communities, thereby reducing productivity. Because weed stand plant density and diversity are usually less than the density and diversity of the native plant stand it displaces, hiding cover structure, canopy cover, and height are reduced. This may cause smaller wildlife species to abandon an area. This can reduce the utility of habitats for predators through prey density reduction as native plant foods disappear. Larger herbivores that rely on intact native plant habitats can also be affected through loss of this habitat. Abandonment can also be caused by the loss of food (seeds, forbs, and grasses) as well. Reduction of forage on big game winter range through weed expansion would severely reduce the carrying capacity of the winter range. This would result in big game mortality, particularly during severe winters, when forage is not available in sufficient quantity to support winter herds.

Indirect effects on wildlife would include reduced vegetative cover following treatment applications for a limited time until the newly planted or existing vegetation expands to occupy the sites. This would reduce the quality or utility of the habitat until vegetation recovers and may in fact displace individuals because of lack of cover or forage or both. Recovery time may include one to three growing seasons for grass communities, 2 to 5 years for forb communities, and up to and beyond 15 years for sagebrush and other shrub communities (U.S. Forest Service 2001a).

Except for very short-term disturbance, federally listed threatened, endangered, and candidate (T&E) species would not be directly affected by implementation of this alternative. Bald eagles inhabit riparian zones and low elevation drainages where weeds are present and could be disturbed during application. However, if applications occur outside the nesting period, the disturbance would be short and not significant.

There may be indirect effects through habitat alterations from weed expansion that influence prey species. Effects of weed expansion on ungulate populations would include an initial increase followed by a long-term decrease in the carrion available for bald eagles on winter ranges. Dense riparian stands preferred by the yellow-billed cuckoo do not typically have weed problems, and Canada lynx habitat is usually at higher elevations with low weed density. Grizzly bears and gray wolves roam over large areas and use many habitats, which would allow them to move from areas being disturbed by herbicide application to other habitats. However, as discussed above for big game winter range, weed expansion could greatly reduce the productivity of grass/forb habitats resulting in loss of preferred wolf and potential grizzly bear prey species that depend on that habitat. The preferred prey species

decline could lead to loss of carrying capacity for wolves and potentially grizzly bear, resulting in potential increased predation on domestic livestock to offset the lost prey base.

All sensitive wildlife species, including sage grouse and pygmy rabbits, could be temporarily disturbed during weed treatment procedures. The sagebrush and grass/forb habitats preferred by sage grouse could experience declines in productivity following weed treatment or weed expansion. This could displace the birds into other habitats, which may not be suitable and are already occupied. If sage grouse are present and large blocks of suitable unoccupied habitat are not available for potential dispersal, this would be a significant impact. Pygmy rabbit habitat could also be adversely affected by weed treatments on a short-term basis and by weed expansion on a long-term basis. Townsend's big eared bat, spotted bat, northern goshawk, peregrine falcon, and flammulated owl all occupy habitats that could be impacted by noxious weed expansion. Although the structural habitat components of these species are not likely to be affected, their prey all depend on native plant communities that are being displaced by weeds. Bat species have high energy requirements during certain times of the year and loss of prey could significantly affect the survival of those species. Flammulated owl and northern goshawk would experience carrying capacity declines as their prey bases change in response to weed expansion. This would be particularly adverse during breeding periods.

Effects on Wildlife Source Habitats. The 19 MIS species on the S-CNF would be affected in various ways. All species could be temporarily (less than 24 hours) displaced during treatment application. Adverse impacts would mainly be associated with weed expansion. Bald eagle, peregrine falcon, gray wolf, and grizzly bear (all estimated to be below minimum viable population levels in the two Forest Plans) impacts were discussed above, as were impacts to elk and mule deer on winter range. Vesper sparrow and mountain bluebird would be significantly impacted through weed expansion as they are dependent on cover and forage in shrub-steppe and grass/forb communities. The pygmy nuthatch and brown creeper feed on insects in low elevation forests, which would also decline as weed expansion displaces native plant communities. The continued expansion of weeds into wildlife habitats of the S-CNF could adversely affect the forest's ability to maintain adequate structural diversity of vegetation to ensure habitat for minimum viable populations or target populations of all wildlife species.

The extent of current inventoried weed infestation by PVG is shown in Table 3-5, *Chapter 3, Affected Environment*. These PVGs correspond roughly with wildlife source habitats discussed in Table 3-12, *Chapter 3, Affected Environment.* The North Fork Ranger District has about 57 percent of the inventoried weed-infested land on the entire S-CNF and about 75 percent of the dry forest-ponderosa pine PVG is weed infested. The dry shrub, cool shrub, and dry grass PVGs also have relatively high rates of weed infestation compared to the other vegetation types. These same PVGs are the most susceptible to future weed infestations.

Table 4-2 notes threats to wildlife families for the source habitats occurring on the S-CNF using information from Table 3-5, *Chapter 3, Affected Environment*. Habitat effects include loss and degradation of habitat quality or quantity due to current and potential future weed infestation and, to a lesser extent, increased fire risk. Habitat effects considered in this table would occur over a long term and would be based on the projected rate of spread of weeds and the expected success of control measures under each of the alternatives. Disturbance

effects include displacement of wildlife because of increased human activity during weed treatment and land rehabilitation and would be of short-term duration. Disturbance threats are directly related to the anticipated levels of human activity and the varying sensitivity of different wildlife species to human disturbance. Because there are several species in each wildlife family, disturbance threats indicate impacts to the most sensitive species within the family.

Other potential effects such as mortality from herbicide ingestion have been determined to be insignificant (see discussion under the Proposed Action) and are not addressed in Table 4-2. Note that there is not a direct correlation between the source habitats in Table 4-2 and the PVGs used in Table 3-5, *Chapter 3, Affected Environment*. Information listed in Table 4-2 primarily refers to the lower elevation forests and range lands that are most susceptible to weed infestation. This topic is discussed in greater detail in *Section 4.B.1, Vegetation Resources and Noxious Weeds*. Table 4-2 indicates that under the No Action Alternative, there would be moderate to high short-term disturbance threats and moderate to high long-term habitat threats to wildlife groups

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the No Action Alternative are designed to avoid or minimize the potential for adverse effects on S-CNF resources. They focus on weed prevention and management BMPs and the proper ground-based application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures*. A number of examples of protective BMPs and mitigation measures have been given in previous discussions of other biological resources that also provide protection for wildlife and their habitat. These include compliance with all State and Federal laws and agency guidelines during herbicide application; application of herbicides in accordance with EPA registration label requirements and restrictions; no spraying of herbicides when wind velocity exceeds 10 mph, or within 50 feet of open water when wind velocity exceeds 5 mph; use of label-approved aquatic formulations near open water; use of dyes in riparian areas to provide visual evidence of treated vegetation and proper buffer avoidance; and use of weed specific herbicides on big game winter range to minimize impacts to winter forage. In addition, a 50-foot no-spray buffer zone will apply for broadcast or 'block' applications and a 15-foot buffer will apply for spot applications along all flowing water streams and ponded water bodies. Reduced buffer zones will be considered when using label-approved aquatic formulations (e.g., aquatic 2,4-D).

TABLE 4-2
Relative Threats and Benefits of the Proposed Action and Alternatives on S-CNF Wildlife Source Habitats and Groups

	No Action		Proposed Action		Alternative 1		Alternative 2	
	Long-Term Habitat Threats or Benefit	**Short-Term Disturbance Threats**	**Long-Term Habitat Threats or Benefit**	**Short-Term Disturbance Threats**	**Long-Term Habitat Threats or Benefit**	**Short-Term Disturbance Threats**	**Long-Term Habitat Threats or Benefit**	**Short-Term Disturbance Threats**
Family 1 Low Elevation, Old Forest Family	Moderate to high threat	Moderate	High benefit	Moderate	Moderate benefit	Moderate	High threat	Moderate to high
Pygmy nuthatch								
Family 2 Broad Elevation, Old Forest Family	Moderate to high threat	Moderate	High benefit	Moderate	Moderate benefit	Moderate	High threat	Moderate to high
Northern goshawk (summer), flammulated owl, pine marten, fisher, pileated woodpecker, brown creeper, ruby crowned kinglet, red squirrel, yellow-bellied sapsucker, Boreal owl, great gray owl, three-toed woodpecker								
Family 3 Forest Mosaic Family	Moderate to high threat	Moderate	High benefit	High	Moderate benefit	High	Moderate threat	Moderate to high
Wolverine, lynx								
Family 5 Forest and Range Mosaic Family	Moderate to high threat	Moderate	High benefit	High	Moderate benefit	High	High threat	Moderate to high
Gray wolf, grizzly bear, mountain goat, elk, mule deer, bighorn sheep								
Family 6 Forest, Woodland, Montane Shrub Family	Moderate threat	Moderate	Moderate to high benefit	Moderate	Moderate benefit	Moderate	Moderate threat	Moderate to high
Northern goshawk (winter)								

TABLE 4-2
Relative Threats and Benefits of the Proposed Action and Alternatives on S-CNF Wildlife Source Habitats and Groups

	No Action		Proposed Action		Alternative 1		Alternative 2	
	Long-Term Habitat Threats or Benefit	**Short-Term Disturbance Threats**	**Long-Term Habitat Threats or Benefit**	**Short-Term Disturbance Threats**	**Long-Term Habitat Threats or Benefit**	**Short-Term Disturbance Threats**	**Long-Term Habitat Threats or Benefit**	**Short-Term Disturbance Threats**
Family 7 Forest, Woodland, and Sagebrush Family Bald eagle, harlequin duck, yellow warbler, spotted frog, Townsend's big-eared bat, spotted bat, peregrine falcon	High threat	High	High benefit	Moderate	Moderate benefit	High	High threat	Moderate to high
Family 8 Rangeland and Early- and Late-Seral Forest Family Mountain bluebird	Moderate to high threat	Moderate	High benefit	High	Moderate benefit	High	High threat	Moderate to high
Family 10 Range Mosaic Vesper sparrow, pronghorn	Moderate to high threat	High	High benefit	High	Moderate benefit	High	High threat	Moderate to high
Family 11 Sagebrush Sage grouse and pygmy rabbit	Moderate to high threat	High	High benefit	High	Moderate benefit	High	High threat	Moderate to high

Cumulative Effects. Cumulative effects on noxious weeds resulting from treatments under the No Action Alternative combined with treatments under the three CWMAs would generally be expected to result in some localized eradication, control, and containment of noxious weeds. However, under the No Action Alternative, weed infestation on the S-CNF would be expected to continue to increase. This would reflect large-scale limitations on being able to eradicate, control, or contain new weeds that have invaded the S-CNF from adjacent lands covered by the CWMAs, or to prevent or reduce the risk of the invasion of adjacent land by weeds presently occurring on the S-CNF. This cumulative effect could potentially adversely affect wildlife and their habitat through the cumulative loss of native vegetation communities. Adverse cumulative effects on wildlife and their habitat may be greatest in the northern portion of the S-CNF and on adjacent non-National Forest lands because of extensive spotted knapweed infestations. Cumulative effects from other treatment activities would be minimal. However, there would be some cumulative disturbance of wildlife resulting from other ongoing S-CNF activities, such as recreation, especially in heavily roaded areas.

b. Proposed Action

Direct and Indirect Effects. Direct and indirect impacts to wildlife and their habitat would be less under the Proposed Action than the No Action Alternative. Under the Proposed Action, weeds would be aggressively eradicated, controlled, or contained using a variety of methods, and treatment sites would be restored (where appropriate) to native vegetation following treatment. Loss of native habitat to weed infestations would decrease over time as weed populations are reduced and eliminated. All wildlife species would benefit as native plant communities are restored following weed treatment. Restored plant communities would provide improved forage, hiding cover, and reproductive cover for wildlife as plant density increases, plant canopy cover increases, plant diversity increases, and multi-layered grass/shrub canopies develop compared to the No Action Alternative and existing conditions. Improved conditions would be greatest in the northern part of the S-CNF or other areas where spotted knapweed infestations are extensive. Wildlife species relying on grassland, forb communities, riparian areas, and low elevation pine and fir forests would benefit the most, as these plant communities are the most impacted by weed infestations.

The potential for native shrub mortality was discussed in *Section 4.B.1., Vegetation Resources and Noxious Weeds*, and is expected to be minimal where aerial applications are made, likely being limited to partial leaf drop of mature shrubs. Some mortality of unprotected seedlings and young plants may occur. If mortality to non-target native vegetation should occur, it would only minimally impact dependent insectivores due to the very localized and small area affected.

Big game winter range and actual or potential sage grouse and pygmy rabbit habitat would specifically improve over the long-term through implementation of the Proposed Action. As discussed in *Section 4.B.2.b, Aquatic Resources: Proposed Action*, one year following the aerial herbicide treatment of approximately 900 acres of big game (elk and deer) winter range on the Lolo National Forest in western Montana, weed production (nearly all spotted knapweed) had declined 98 percent from 1,075 pounds per acre to 25 pounds per acre, while grass production had increased 714 percent from 350 pounds per acre to 2,850 pounds per acre (TechLine 1998).

Weed treatment techniques including mechanical, biological, controlled grazing, aerial and ground-based herbicide application, and combinations of these would be implemented under the Proposed Action. As discussed under *Section 4.B.2, Aquatic Resources*, of this chapter, 100 acres of mechanical treatment, 2,600 acres of biological treatment, 300 acres of mechanical/biological/grazing combined treatment, and 1,400 acres of mechanical/biological/chemical/grazing combined treatment would occur annually under the Proposed Action. If any direct adverse effects were to occur, they would be expected to be localized, temporary, and minor relative to the S-CNF acreage or relative to acres currently being treated on the S-CNF each year using chemicals. Beneficial effects would be permanent and occur incrementally over a long period of time, as long as weed-infested areas recover to more natural conditions. In summary, mechanical treatment would have a somewhat longer-term displacement effect on wildlife than chemical treatments, biological control agents only feed on target plants and would have no effect on wildlife, and while strictly controlled grazing would affect habitat by removing some vegetation, the treated area would be too small to have any significant wildlife effect. Chemicals are addressed below.

Restoration of disturbed areas (where appropriate) would not be expected to adversely affect wildlife resources. There would be a short period of time when habitat values on areas being restored would be low, because of low vegetation density. As restored areas mature, effects would be beneficial as wildlife habitat values improve over existing conditions.

The greatest possibility for impacting wildlife from the Proposed Action is through the application of herbicides. Dermal contact or eating contaminated food would be the main methods of impact to wildlife from herbicides. Other weed management program EISs prepared by the Forest Service in the west have examined the impact of herbicide application on wildlife. Findings in those EISs applicable to this Final EIS are referenced herein. Spotted knapweed is the main noxious weed problem on the S-CNF and the herbicides included in this analysis to eradicate spotted knapweed include 2,4-D amine, clopyralid, dicamba, glyphosate, and picloram. These herbicides also contain "inert" ingredients, including surfactants, that are not expected to have any significant effect. The dyes and other adjuvants described in *Chapter 2, Alternatives*, are described as having little effect on wildlife populations. Mitigation measures, buffer zones BMPs, and SOPs are expected to minimize adverse impacts, if any, of these other ingredients.

There are reports that many synthetic chemicals released into the environment may disrupt normal endocrine function in a variety of aquatic life and wildlife. Some of the effects observed in animals have been attributed to some persistent organic chemicals such as polychlorinated biphenyls, DDT (dichlorodiphenyltrichloroethane), dioxin, and some pesticides. Adverse effects include abnormal thyroid function and development in fish and birds; decreased fertility in shellfish, fish, birds, and mammals; decreased hatching success in fish, birds, and reptiles; demasculinization and feminization of fish, birds, reptiles, and mammals; defeminization and masculinization of gastropods, fish, and birds; decreased offspring survival; and alteration of immune and behavioral function in birds and mammals. Some argue that these adverse effects may be due to an endocrine disrupting mechanism (EPA 1997). However, the causal link between exposure and endocrine disruption in wildlife is unclear (WHO 2002).

It is unknown whether herbicides have the same effect as DDT and other pesticide compounds. For example, 2,4-D mimics the growth hormone auxin, which in turn causes uncontrolled growth and eventually death in target plant species (Tu et al. 2001). This potential hormone disruption implicates 2,4-D as an endocrine disrupter. A recent study showed that 2,4-D does not influence male-to-female sex reversal in alligators (Guillette et al. 2000). However, little connection has been made between endocrine disruption in other wildlife or human health and herbicide use, primarily because information is not available (Safe et al., 2000). In addition, many other factors disturb wildlife growth, reproduction, and survival. Wildlife can be subject to a number of different stressors (such as habitat loss, competition, food availability, and disease) that may affect the same endocrine markers used to evaluate the effect of endocrine disrupters (Safe et al. 2002; WHO 2002). Thus, the relationship between adverse hormonal effects in wildlife and endocrine disruption remains speculative (WHO 2002).

Effect of Herbicides on Amphibians: Amphibians are potentially the most sensitive group of wildlife to herbicides because of their permeable skin and complex life cycles. Most amphibian species require moisture or some form of water to complete their life cycle, and most are aquatic in their egg or larval stages. It is unknown if the safety standards (such as buffer zones and application rates) for other kinds of vertebrates are adequate for reptiles and amphibians (Hall and Henry 1992). Carey and Bryant (1995) reviewed the numerous pathways through which amphibians could be affected by chemicals in the environment. They suggest that adult and larval amphibians are not necessarily more sensitive to chemicals than other terrestrial or aquatic vertebrates. However, sublethal effects can manifest as increased susceptibility to disease, increased predation, altered growth rates, or disrupted development. They suggest "endocrine-disrupting toxicants can have effects at tissue levels well below detectable levels," and that "toxicants designated as safe should not be considered to be free of endocrine disrupting effects until proven otherwise." As noted in *Section 4.D.1.b, Human Health and Safety: Proposed Action*, however, there is little available evidence that the herbicides proposed for use on the S-CNF are linked to endocrine disrupting activities in wildlife or humans.

Although amphibian populations have declined in pristine and polluted habitats worldwide, data are insufficient to show that endocrine disrupting compounds caused the decline (WHO 2002). Risk assessments suggest that wildlife, including amphibians, will not be *significantly* affected by herbicides at the expected exposure levels. Also, there will be *buffer zones* around water and wetlands where herbicides will not be applied. This practice will minimize the potential for amphibians to be exposed to herbicides during sensitive developmental stages. Biological and mechanical methods of weed control should have no impact on amphibians. However, during terrestrial stages, amphibians could be trampled or run over by a vehicle or mower, but such events would be rare.

Indirect Herbicide Ingestion by Wildlife: A variety of studies have investigated toxicity of herbicides on wildlife and domestic animals. The LC50s (herbicide concentration lethal to 50 percent of the test organisms) for mallard ducks and quail exceed 10,000 ppm for picloram and dicamba, 4,640 ppm for clopyralid, and 5,000 ppm for 2,4-D (U.S. Forest Service 1984). Deer and cattle feeding studies showed that deer experienced no effects from ingesting 2,4-D-treated foliage with concentrations several times higher than would likely be applied on the S-CNF (Campbell et al. 1981). Cattle fed with picloram-treated hay at concentrations

many times higher than those likely to be used on the S-CNF suffered no lethal effects (Monnig 1988). No effects were observed in heifers fed dicamba at 20,000 ppm in feed (Edson and Sanderson 1965). Monnig (1988) observed that picloram, 2,4-D, and glyphosate are excreted rather rapidly from test animals through the kidneys, and that warm-blooded test animals fed extremely high concentrations of these herbicides had either very low or undetectable concentrations of the test chemical in internal organs. Although not studied, clopyralid effects are likely to be similar to picloram, a close chemical analogue (U.S. Forest Service 2001a, d). Other studies examining black-tailed deer and glyphosate have reported similar results (U.S. Forest Service 2000a).

According to data presented by the U.S. Forest Service (1999a), 2,4-D herbicides have the worst-case LD50s (lethal dose at which 50 percent of test organisms perish) of any of the herbicides analyzed in this Final EIS. The Forest Service further presented data showing that cattle (representative of wild ungulates) and dogs (representative of wild canids) were the most sensitive groups to 2,4-D. Their analysis (U.S. Forest Service 1999a) for elk and canine predators is replicated below to show the probable effects of herbicides on these species on the S-CNF.

Immediately following a typical application rate of 1 pound of herbicide per acre, herbicide concentration on grass and forbs would be about 125 mg/kg or ppm (Monnig 1988). By comparison, concentration of picloram 90 days after application would be approximately 25 ppm (Watson et al. 1989), while concentrations of dicamba, clopyralid, 2,4-D, and glyphosate would be even lower as they break down quicker than picloram. If it is assumed that up to 2 pounds of herbicide (2,4-D) may be applied per acre (grass concentration would equal 250 mg/kg), an application rate that could also be used on the S-CNF, and that the animals feed on the grass immediately after application and only eat contaminated vegetation, then:

Elk: Assuming that an elk (230 kg) eats 16.4 kg/day of forage then the dosage is 250 mg/kg x 16.4 kg/elk x elk/230 kg = 18 mg/kg. Assuming that elk have a LD50 similar to cattle, then the LD50 is 100 mg/kg and the dosage only represents 18 percent of the LD50. Therefore, 2,4-D is fairly non-toxic to elk.

Another herbicide concern is long-term accumulation. Chemicals used on the S-CNF do not bioaccumulate or biomagnify and because they are water soluble, they do not accumulate in fatty tissue and are excreted rapidly (Monnig 1988). According to Monnig (1988), the maximum muscle/organ concentration of the herbicides being analyzed is 0.1 mg/kg. Using this figure the following can be determined for canids.

Canids: If a coyote (23 kg) consumes 5.5 kg of road-kill elk in a day, the dosage is 0.1 mg/kg x 5.5 kg/coyote x coyote/23 kg = 0.02 mg/kg. The LD50 (2,4-D) for dogs is 100 mg/kg, therefore this dosage represents less than 1/400th of the LD50. Herbicides would not be toxic to canids.

Additional examples involving bald eagle (two scenarios) and sage grouse follow that illustrate potential effects of 2,4-D on two avian species with different feeding habits.

Bald eagle: In the first scenario, if a bald eagle (3.2 kg) consumes 0.5 kg of road-kill elk in a single day, the dosage is 0.1 mg/kg x 0.5 kg/bald eagle x bald eagle/3.2 kg = 0.02 mg/kg. In the second scenario, if a bald eagle (3.2 kg) consumes 0.5 kg of road-kill coyote in a single

day that had previously fed on road-kill elk (as described in the above example), the dosage is 0.02 mg/kg x 0.5 kg/bald eagle x bald eagle/3.2 kg = 0.003 mg/kg. The LD50 value of 2,4-D for birds is 500 mg/kg (see Appendix G). The contaminant values of 2,4-D for these two scenarios for bald eagle are both well below the LD50 value.

Sage grouse: If a sage grouse (1.4 kg) consumes 10 percent of its body weight (0.14 kg) in grasses and forbs in a single day, then the dosage is 250 mg/kg x 0.14 kg/sage grouse x sage grouse/1.4 kg = 25 mg/kg. This value is well below (1/20th) the LD50 value of 2,4-D for birds of 500 mg/kg. Birds ingesting insects that were feeding on sprayed foliage would have similar or reduced levels of contaminants due to further dilution from insect body weights.

This analysis, and the fact that the herbicides do not bioaccumulate or biomagnify and are rapidly excreted, would indicate that there would be little or no effects to big game, predators, scavengers, or birds from herbicide application on the S-CNF. There would also be no long-term accumulation from repeated applications.

Dermal exposure test data for rabbits and rats contained in Appendix J indicate that LD50 values for chemicals that could potentially be used on the S-CNF vary from over 2,000 mg/kg for 2,4-D and picloram to over 5,000 mg/kg for glyphosate. These values greatly exceed chemical concentrations on vegetation when the chemical is applied at a rate of 2 pounds per acre (250 mg/kg for 2,4-D) and suggest that there would be limited risk to wildlife from dermal exposure to such vegetation. Analysis presented in *Section 4.D.1, Human Health and Safety*, similarly concludes that for people hiking through an area just sprayed with 2,4-D, the risk from dermal exposure and ingestion of 2,4-D through the skin would be 40 times lower than the EPA's Acceptable Daily Intake (ADI) value for 2,4-D. The ADI is the dose level determined by the EPA to be safe, even if received every day for a lifetime.

Herbicide spills would not present a hazard to wildlife as any spill would be treated as a toxic release, the area would be small, and the presence of humans cleaning up the spill would displace any wildlife in the area before they could consume lethal doses of herbicides.

The implementation of mitigation measures, BMPs, and SOPs described in this Final EIS supports the conclusion that impacts to migrating bird populations, as well as eggs and nestlings, will not be significant. Impacts would not be expected to result in violations of the Migratory Bird Treaty Act, which focuses on direct takings and not on impacting habitat. Furthermore, Executive Order 13186, which defines the responsibilities of Federal agencies to protect migratory birds under the four Migratory Bird Treaties, requires Federal agencies, within the scope of their regular activities, to control the spread and establishment in the wild of exotic animals and plants that may harm migratory birds and their habitat. Controlling the establishment and spread of exotic plants, and thereby improving and protecting existing wildlife habitat, is the objective of this project.

Benefits to wildlife T&E, sensitive, and MIS species under the Proposed Action would be considerably greater than those discussed for the No Action Alternative. All of these species would benefit from the aggressive weed treatment and restoration of habitat (where appropriate) following treatment because of a reduction in the rate of loss of native plant community productivity from weed expansion. The above analysis of herbicide toxicity also

applies to wildlife T&E, sensitive, and MIS species and indicates no adverse effects would result from herbicide application other than possibly brief displacement during application.

Effects on Wildlife Source Habitats and Minimum Viable Populations. The habitat and disturbance threats to wildlife groups under the Proposed Action were presented in Table 4-2. Long-term benefits of this alternative would be high and exceed those of all other alternatives. Expansion of weeds into wildlife habitats of the S-CNF would be slower and control of weeds better than under the No Action Alternative. Therefore, there is less potential for weeds to adversely affect the forest's ability to maintain adequate structural diversity of vegetation to ensure habitat for minimum viable populations or target populations of all wildlife species are met.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the Proposed Action are designed to avoid or minimize the potential for adverse effects on S-CNF resources including wildlife resources. They focus on weed prevention and management BMPs and the proper air- and ground-based application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures* and examples were given in previous resource discussions in this chapter that are also protective of wildlife and their habitat. The Proposed Action, like Alternatives 1 and 2, also includes a site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy that were described in *Chapter 2, Alternatives* to avoid or minimize the potential for adversely affecting wildlife resources, especially sensitive resources and special status wildlife species at individual weed treatment sites.

Cumulative Effects. Cumulative effects of weed treatments under the Proposed Action combined with treatment effects of the three CWMAs would result in long-term benefits to wildlife because of greater levels of weed control and eradication, slower weed population spread, and less total weed-infested acreage compared to the No Action Alternative. This would result in cumulatively improved habitat conditions for wildlife on and off the S-CNF. New weeds that have invaded the S-CNF from adjacent lands would likely be eradicated, and invasion of adjacent lands by weeds presently occurring on the S-CNF would be curtailed as weed populations are controlled or eradicated. This cumulative effect would beneficially affect wildlife, T&E, sensitive, and MIS species and their habitats both on and off the S-CNF. Beneficial cumulative effects on wildlife and their habitat may be greatest in the northern portion of the S-CNF and on adjacent non-National Forest lands because of opportunities for the eradication and control of extensive spotted knapweed infestations.

Treatment activities are closely coordinated with the CWMAs, which would virtually eliminate the potential for treatment overlap for ground and aerial herbicide applications. Since most wildlife species are relatively mobile, there is the potential for birds and animals to enter previously treated areas. However, as the preceding analyses show, any cumulative effects from herbicide ingestion or contact would be minimal. There would be some cumulative disturbance of wildlife from the combined effects of weed treatment and other ongoing S-CNF activities, such as recreation, especially in heavily roaded areas.

c. Alternative 1

Direct and Indirect Effects. Direct and indirect benefits to wildlife would generally be similar to those described for the Proposed Action, but somewhat less pronounced or

widespread and would occur at a slower rate because of no aerial application of herbicides under Alternative 1. A combination of primarily biological treatment and ground-based application of herbicides would be used to treat weed infestations on the S-CNF. This less-aggressive approach would have a somewhat reduced beneficial end result for wildlife resources than the Proposed Action, and it would take longer to achieve widespread positive results. There would be long-term benefits to all wildlife, including T&E, sensitive, and MIS species, from the reduction in size of weed populations and subsequent expansion of native plant communities, resulting in beneficial impacts to wildlife and their habitat from less extensive weed populations. The potential for consumption impacts from herbicides would be the same as described for the Proposed Action. With no aerial application of herbicides, the chance of direct contact is minimal.

Effects on Wildlife Source Habitats and Minimum Viable Populations. The habitat benefits and disturbance threats to wildlife groups under Alternative 1 are presented in Table 4-2. This alternative would provide moderate long-term habitat benefits to wildlife groups, second only to the moderate to high benefits that would occur under the Proposed Action. Expansion of weeds into wildlife habitats of the S-CNF would be slower and control of weeds better than under the No Action Alternative but not as good as under the Proposed Action. Therefore, compared to the Proposed Action, there is greater potential for weeds to adversely affect the forest's ability to maintain adequate structural diversity of vegetation to ensure habitat for minimum viable populations or target populations of all wildlife species are met.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 1 focus on weed prevention and management BMPs and the proper ground-based application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures*, together with site-specific implementation processes (decision tree, minimum tool, adaptive strategy) to avoid or minimize the potential for impacting wildlife resources. Examples of BMPs are the same as described for the No Action Alternative and Proposed Action, except for measures directed at aerial herbicide application.

Cumulative Effects. Cumulative beneficial effects of Alternative 1 combined with the treatment effects from the three CWMAs would be similar to those described in the Proposed Action. However, the effectiveness of the CWMA program could be hampered in the control of large scale or inaccessible weed infestations without the use of aerial application opportunities. Long-term cumulative effects are expected with CWMA efforts to include the continued decline of weed populations and resulting benefits to wildlife on and off the S-CNF.

Cumulative effects from herbicide treatments would be similar to the Proposed Action. Furthermore, no aerial herbicide application under this alternative would eliminate the potential for any cumulative effects from wind drift on wildlife and their habitat. There may be some cumulative but minor disturbance of wildlife from weed treatment and other ongoing S-CNF activities, similar to the Proposed Action.

d. Alternative 2

Direct and Indirect Effects. Although direct effects on wildlife would be reduced under Alternative 2, indirect adverse effects on wildlife would be greater than those expected under the Proposed Action, Alternative 1, or the No Action Alternative. Weed treatment options under Alternative 2 do not include the ground or aerial application of herbicides. Instead, mechanical and biological treatments or their combination would be the main mechanisms for weed control, containment, or perhaps limited localized eradication on the S-CNF based on realistic management goals described for this alternative in *Chapter 2, Alternatives*. While these methods have been shown to be effective, they take a considerably longer period of time to achieve a lower level of weed control than can be achieved using herbicides. The effectiveness of mechanical and biological treatment options in the eradication, control, or containment of invasive weeds can be delayed from several months to several years while the establishment and expansion of weeds continues. Consequently, it would take longer to realize comparatively fewer benefits to wildlife from the containment, control, and limited eradication of weeds. This effect would be most noticeable in the northern part of the S-CNF where by far the largest concentrations of weeds are found. There will likely be an increased potential for wildlife disturbance because of more extensive mechanical treatments. There would be no potential for possible adverse herbicide effects as described under the Proposed Action and Alternative 1 with implementation of Alternative 2.

Effects on Wildlife Source Habitats and Minimum Viable Populations. The habitat and disturbance threats to wildlife groups under Alternative 2 were presented in Table 4-2. This alternative would result in moderate to high short-term disturbance threats, moderate to high long-term habitat threats, and greater impacts on wildlife and habitat than the Proposed Action, Alternative 1, or the No Action Alternative. The continued expansion of weeds into wildlife habitats of the S-CNF could adversely affect the forest's ability to maintain adequate structural diversity of vegetation to ensure habitat for minimum viable populations or target populations of all wildlife species are met. The potential for these adverse effects is highest for Alternative 2.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 2 are designed to avoid or minimize the potential for adverse effects on S-CNF resources, including wildlife resources. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures*, together with site-specific implementation processes referenced previously. They do not include herbicide-related measures since there would be no herbicide application under Alternative 2.

Cumulative Effects. Beneficial cumulative effects of Alternative 2 combined with treatment effects of the three CWMAs would take longer to achieve and would be fewer than under the Proposed Action, Alternative 1, or the No Action Alternative because of no application of herbicides. Cumulative benefits include some expected localized decline, control, or containment of weed populations in some areas and resulting limited benefits to wildlife and their habitat on and off the S-CNF.

Since herbicide use is not included in this alternative, there would be no cumulative effects to wildlife from other past, present, or future herbicide treatments. There will likely be an increased cumulative potential for wildlife disturbance under this alternative from the

effects of more extensive mechanical treatments combined with the effects of other ongoing S-CNF activities. Alternative 2 would not be effective in supporting the goals and objectives of the CWMAs, thus adversely affecting these programs as well.

4.B.4. Ecosystem Function

a. No Action Alternative

Direct and Indirect Effects. Continuance of existing weed management/control activities would not halt the spread of weeds across the S-CNF, particularly on the northern end. Given the widespread nature of the weed populations compared to the acreage treated each year and their projected rate of spread, weed populations would continue to expand even with the weed treatments under this alternative. Ecosystem function would experience little to no impact from treatment of noxious weeds, but ecosystem function would be adversely affected by weed population expansion.

As weed populations expand under this alternative, the hydrologic cycle would be disrupted, as discussed in this chapter under the Aquatic and Soil Resource Sections (*Section 4.B.2, Aquatic Resources* and *Section 4.C.3, Soils, Geology, and Minerals*). Runoff and erosion would increase under weed canopies, compared to native plant communities, which would decrease infiltration on these sites. Plant transpiration from weed communities would be less than transpiration from native plant communities, because of a lower diversity and density of plants in the weed stand. Evaporation of soil moisture would increase from areas occupied by weeds, compared to native plant communities, because of the weed stands generally having a poorly developed canopy and root structure that do not protect the soil from evaporation or promote the infiltration and storage of water.

Carbon and nutrient cycles would be diminished under this alternative. Organic matter production and subsequent deposition onto soils would decrease over time, because of lower plant productivity compared to native plant communities. Lower plant productivity would also reduce the amount of other organic nutrients deposited onto the soil surface. This would reduce the amount of nutrients mineralized over time and further reduce nutrient cycling. This would lower the capability of the S-CNF to contribute to local and regional nutrient and carbon cycles and to continue to support a native, diverse plant community.

As discussed under Wildlife Resources in this chapter (*Section 4.B.2, Aquatic Resources*), weed expansion has a detrimental effect on the food chain, which impacts the food web throughout the S-CNF. This impact can arise through disruption of plant communities (primary productivity) as discussed above or through reduced support for habitat of lower trophic level prey species such as small mammals and birds. Food web stability, structure, and complexity can decline as a result of these effects.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the No Action Alternative are designed to avoid or minimize the potential for adverse effects on S-CNF resources. They focus on weed prevention and management BMPs and the proper ground-based application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* Examples were provided in previous discussions of BMPs and mitigation measures in this chapter.

Cumulative Effects. Cumulative effects of the No Action Alternative combined with the three CWMAs would be expected to adversely affect ecosystem function. The CWMAs and the S-CNF weed management program together have met with some levels of success. However, under the No Action Alternative, weed infestation on the S-CNF would be expected to continue to increase. This would reflect limitations on being able to eradicate, control, or contain new weeds that have invaded the S-CNF from adjacent lands, or to prevent or reduce the risk of invasion of adjacent lands by weeds presently occurring on the S-CNF. This cumulative effect could potentially adversely affect ecosystem function, through disruption of the hydrologic, carbon, and nutrient cycles, as well as food webs, on a regional scale around the S-CNF. Ecosystem functions operate at broad landscape scales and can therefore be impacted from cumulative actions. Adverse cumulative effects may be greatest in the northern portion of the S-CNF and on adjacent non-National Forest lands because of extensive spotted knapweed infestations. Ecosystem function may be cumulatively and minimally affected by other ongoing S-CNF activities such as road and trail impacts, livestock grazing, and recreation activities near drainages. Weed treatment effects would result in some land disturbance and creation of bare surfaces, which would have short-term adverse effects on ecosystem function, but some long-term beneficial effects with the re-establishment of native plants.

b. Proposed Action

Direct and Indirect Effects. Ecosystem function direct and indirect adverse impacts would be less under the Proposed Action than the No Action Alternative. Weeds would be aggressively eradicated, controlled, or contained using a variety of methods, and treatment sites would be restored to native vegetation following treatment under the Proposed Action. Loss of native plant communities to weed infestations would decrease over time as weed populations are reduced and eliminated. As weed populations decline, the hydrologic cycle (where currently altered) would return to operating within normal parameters for the S-CNF. Runoff would decrease, thereby encouraging infiltration of precipitation and subsequent plant transpiration and recharge of aquifers. Plant productivity decline would be less with the Proposed Action as native plant community establishment on eradicated weed sites would restore nutrient and carbon cycles over time. Food web support would be higher under the Proposed Action than other alternatives as weed management is the most aggressive under the Proposed Action.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the Proposed Action are designed to avoid or minimize the potential for adverse effects on S-CNF resources. They focus on weed prevention and management BMPs and the proper ground-based and aerial application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures* and examples are given for the Proposed Action in previous resource discussions in this chapter.

Cumulative Effects. Cumulative effects of the Proposed Action combined with the three CWMAs would result in a net benefit to ecosystem function because of increased higher levels of weed control and eradication, slower weed population spread, and less total weed-infested acreage compared to existing conditions. This would result in an improved hydrologic cycle, nutrient and carbon cycles, and food web support on and off the S-CNF, as new weeds that have invaded the S-CNF from adjacent lands would be eradicated and invasion of adjacent lands by weeds presently occurring on the S-CNF would be curtailed as

populations are controlled or eradicated. This cumulative effect would beneficially affect all ecosystem resources, such as aquatic organisms, wildlife, humans, and plant communities. Beneficial cumulative effects may be greatest in the northern portion of the S-CNF and on adjacent non-National Forest lands because of eradication and control of extensive spotted knapweed infestations. Other cumulative effects on ecosystem function would be similar to those described for the No Action Alternative. They include the continuing effects on ecosystem function from other ongoing S-CNF activities or features (roads, livestock grazing, recreation) and from the short-term disturbance but long-term revegetation of treatment areas.

c. Alternative 1

Direct and Indirect Effects. Direct and indirect effects on ecosystem function would be similar to those described for the Proposed Action, but would occur at a slower pace because of no aerial herbicide application in Alternative 1. A combination of biological treatment and ground-based application of herbicides would be applied to the large blocks of weed infestations on the S-CNF, instead of aerial herbicide application. This less aggressive approach may have similar end results as the Proposed Action, but would take longer to achieve, be less effective in treating weeds and less successful in improving altered conditions in remote, difficult to access locations.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 1 are designed to avoid or minimize the potential for adverse effects on S-CNF resources. They focus on weed prevention and management BMPs and the proper ground-based application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.*

Cumulative Effects. Cumulative beneficial effects on ecosystem function of Alternative 1 combined with the treatment effects from the three CWMAs would be similar to those described in the Proposed Action. These include the expected decline of weed populations with subsequent improvements in hydrologic, nutrient, and carbon cycles and in food web support on and off the S-CNF. However, the effectiveness of the CWMA program could be hampered in the control of large scale or inaccessible weed infestations without the use of aerial application opportunities. No aerial herbicide application under this alternative also would eliminate the potential for any cumulative effects from wind drift on ecosystem function. There may be some cumulative but minor disturbance of ecosystem function from weed treatment and other ongoing S-CNF activities, similar to the Proposed Action.

d. Alternative 2

Direct and Indirect Effects. Direct and indirect adverse effects on ecosystem function would be greater than those described for the Proposed Action, Alternative 1, and the No Action Alternative. Weed treatment methods in Alternative 2 do not consider ground- or air-based application of herbicides. Instead, biological and mechanical treatments would be the main mechanisms for weed control or containment and some eradication on the S-CNF. While these methods have been shown to be effective, they take a considerably longer period of time to achieve the same or lesser levels of control as achieved using herbicides. The effectiveness of mechanical and biological treatment options in the eradication, control, or containment of invasive weeds can be delayed from several months to several years while

the establishment and expansion of weeds continues. Consequently, it would take longer to realize fewer ecosystem benefits under this alternative than the other alternatives. This effect would be most noticeable in the northern part of the S-CNF where the largest concentrations of weeds are found.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 2 are designed to avoid or minimize the potential for adverse effects on S-CNF resources. They focus on weed prevention and management BMPs and the proper application of biological control vectors. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* Examples presented for the Proposed Action and other alternatives except those directed at the use of herbicides also apply to Alternative 2.

Cumulative Effects. Cumulative impacts of Alternative 2 combined with the three CWMA treatment programs and with other ongoing activities on the S-CNF would be similar in nature but would result in fewer beneficial effects and more adverse effects than anticipated under the Proposed Action, Alternative 1, or the No Action Alternative. Ecosystem function would be expected to gradually decline under Alternative 2. The greatly increased use of mechanical weed treatments and associated extensive soil disturbance under Alternative 2 also would contribute to cumulative adverse effects on ecosystem function when combined with other activities occurring on the S-CNF. Implementation of Alternative 2 would not be expected to result in a successful long-term weed treatment program, effective or successful CWMA objectives, or in healthy ecosystem functions on weed-infested areas of the S-CNF.

4.C. Physical Resources

4.C.1. Surface Water

a. No Action Alternative

The direct and indirect adverse effects of noxious weeds on surface water quality and hydrology under the No Action Alternative were discussed in *Section 4.B.2, Aquatic Resources,* of this chapter because surface water affects fish, aquatic invertebrates, and their habitat. Surface water effects are very briefly summarized here. These effects would be expected to be similar to or slightly greater than under existing conditions because of expected increases in weed infestations under the No Action Alternative. The Forest Service (1999a, 2001d) reported that the establishment of invasive weeds such as knapweed and sulphur cinquefoil within or adjacent to riparian habitats could increase overland runoff and sediment yield from such habitats. Lacey et al. (1989) reported a three-fold increase in sediment yield and a 50 percent increase in runoff at a knapweed-infested site compared to a non-infested site. Hickenbottom (2000) reported that a site with 80 percent knapweed cover yielded five times the amount of sediment as a site covered with bunchgrass. Increased sediment delivery to drainages can cause increased levels of turbidity and suspended sediment in the water column and sedimentation of instream habitat. This can adversely affect aquatic resources as described previously in *Section 4.B.2, Aquatic Resources*.

Increased runoff from weed-infested sites may result in local, short-term variations in a stream's hydrograph, but this would not be expected to alter a drainage's seasonal flow regime. The status of 303(d)-designated water bodies on most of the S-CNF would not be

expected to change under the No Action Alternative. However, there could be minor increases in sediment delivery, especially in the more northern portions of the S-CNF, because of expected increases in weed infestations. This may have an effect on achieving or maintaining designated beneficial uses in northern drainages on the S-CNF.

The use of herbicides and other weed treatment methods on the S-CNF would continue under the No Action Alternative at the current treatment rate of approximately 3,000 to 3,500 acres per year. Weed treatment activities would continue to be implemented according to all of the BMPs and mitigation measures described for the No Action Alternative in *Chapter 2, Alternatives*. As discussed previously, what little data that have been gathered on the S-CNF (Rose 2002) indicate that these activities have not impacted surface water quality, hydrology, 303(d)-designated water bodies, or designated beneficial uses on water bodies on the S-CNF and, therefore, they would not be expected to under the No Action Alternative.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the No Action Alternative are designed to avoid or minimize the potential for adverse effects on S-CNF resources, including surface water quality. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures*. Examples aimed at the protection of surface water quality include compliance with restrictions stating no spraying of herbicides when wind velocity exceeds 10 mph, or within 50 feet of open water when wind velocity exceeds 5 mph; use of label-approved aquatic formulations near open water; application of herbicides in accordance with EPA registration label requirements and restrictions; compliance with all State and Federal laws and agency guidelines during herbicide application; and restoration of disturbed and barren treatment areas where appropriate. In addition, a 50-foot no-spray buffer zone will apply for broadcast or 'block' applications and a 15-foot buffer will apply for spot applications along all flowing water streams and ponded water bodies. Reduced buffer zones will be considered when using label-approved aquatic formulations (e.g., aquatic 2,4-D).

Cumulative Effects. As described in *Section 4.B.2, Aquatic Resources,* cumulative effects associated with the No Action Alternative combined with treatments under the three CWMAs could potentially adversely affect water quality through increased erosion and sediment delivery to drainages, resulting from expected increases in weed infestations plus the effects of treating, disturbing, and exposing soil surfaces. Adverse cumulative effects on surface water quality may be greatest in the northern portion of the S-CNF and on adjacent non-National Forest lands because of extensive spotted knapweed infestations. Additional cumulative effects on water quality may result from other ongoing S-CNF activities that potentially contribute sediment to drainages, such as road and trail maintenance and construction, livestock grazing, and recreational activities near drainages.

b. Proposed Action

Direct and Indirect Effects. *Section 4.B.2, Aquatic Resources,* of this chapter contains detailed discussions on the effects of weeds and weed treatments on surface water quality and aquatic resources under the Proposed Action. Much of that assessment addresses the effects of worst-case situations involving herbicide applications, including surface runoff, leaching, wind drift, and accidental spills. In summary, the direct and indirect effects of weed treatment under the Proposed Action would be expected to result in some improvement in

surface water quality on the S-CNF and have a positive effect on achieving or maintaining beneficial uses. Weed infestations would progressively decline, reducing the potential for erosion and sediment delivery to drainages and improving water quality, particularly in the northern part of the S-CNF. It is unlikely that any of the worst-case herbicide situations that were analyzed would occur because of the implementation of BMPs and mitigation measures, and use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy. If worst-case situations did occur, the scenarios involving herbicide runoff and leaching of herbicides would have a very minor effect on surface water quality and would not result in impacts on populations of fish and aquatic invertebrates. Potential short-term impacts on surface water quality could occur if there were an accidental spill of a relatively toxic herbicide in a small drainage. Resultant effects may be localized depending on various factors, including the volume of spill and dilution by the receiving water. Adherence to BMPs and mitigation measures would reduce the likelihood of such a spill occurring. Adherence to BMPs and mitigation measures associated with the aerial application of herbicides would minimize or avoid the potential occurrence of wind-drift-related impacts on surface water quality.

The mechanical treatment of weed sites under the Proposed Action could result in some localized soil disturbance and possibly increased sedimentation of nearby drainages. However, these effects would be expected to be minor and temporary in duration because of the comparatively few acres of soil disturbance, followed by the reclamation and restoration (where appropriate) of treated areas. Site restoration activities, such as seeding, transplanting, and fertilizing, would not adversely affect water quality. Seeding and transplanting activities would involve only limited soil disturbance, and fertilizer application rates would follow Forest Service and manufacturer guidelines. Any runoff of fertilizers would not be expected to be great enough to enrich streams.

BMPs and Mitigation Measures. A total of 59 BMPs and mitigation measures associated with weed management under the Proposed Action are designed to avoid or minimize the potential for adverse effects on S-CNF resources, including water quality. All of these measures are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* A number of examples specifically directed at water quality that were described for the No Action Alternative also apply to the Proposed Action. Examples of several additional measures associated with aerial herbicide application directed at water quality and other resource protection include: obtain a weather report prior to spraying, use proper aircraft speed and height to reduce wind drift potential, and monitor wind speed and direction. In addition, the Proposed Action incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy, which were described in *Chapter 2, Alternatives*. These management tools are designed to consider site-specific resource conditions that result in the selection of a treatment method that achieves weed management goals with the least impact to S-CNF resources.

Cumulative Effects. Cumulative effects of the Proposed Action combined with the three CWMAs would result in increased levels of weed treatment success and the progressive decline of weed infestations. This would potentially benefit surface water quality through reduced erosion and sediment delivery to drainages. Beneficial cumulative effects may be greatest in the northern portion of the S-CNF and on adjacent non-National Forest lands because of extensive spotted knapweed infestations that would be aggressively managed.

No adverse downstream cumulative effects on water quality on non-National Forest land would be expected from worst-case situations involving herbicide runoff or leaching because of the extremely low concentrations. There is the potential for downstream adverse effects on surface water quality if a herbicide spill or wind-drift-related impact occurred close to Forest Service boundaries. Increased flows proceeding downstream would further dilute the herbicide. Weed management BMPs and mitigation measures described previously are designed to prevent or reduce the risk of these types of impacts from occurring. Other cumulative effects would generally be similar to those described for the No Action Alternative, including effects from sediment delivery from other ongoing S-CNF activities and from treating and disturbing/exposing soil surfaces. Long-term benefits through sediment reduction would result from the re-establishment of native vegetation in previously treated, weed-infested areas.

c. Alternative 1

Direct and Indirect Effects. Direct and indirect effects on surface water under Alternative 1 would generally be similar to those effects described for the Proposed Action, except there would be no aerial application of herbicides. Benefits to surface water quality resulting from reductions in erosion and sediment delivery from weed-infested areas would still be expected, but would take longer to achieve and be somewhat less effective than under the Proposed Action.

Several of the examples of worst-case situations associated with the aerial application of herbicides could not occur under Alternative 1 because of differences in treatment techniques. The other examples of worst-case situations regarding the surface runoff of picloram and 2,4-D amine applied in a single day, leaching of herbicides, and an accidental herbicide spill could potentially occur under Alternative 1. Resultant effects on surface water quality would be the same as described for the Proposed Action, and would be expected to be negligible or short-term and localized.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 1 would be the same as for the Proposed Action except for measures dealing with the aerial application of herbicides. Alternative 1, like the Proposed Action, also incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy.

Cumulative Effects. Cumulative beneficial effects of Alternative 1 combined with the treatment effects from the three CWMAs would be similar to those described in the Proposed Action. However, the effectiveness of the CWMA program could be hampered in the control of large scale or inaccessible weed infestations without the use of aerial application opportunities. Long-term cumulative effects are expected with CWMA efforts to include the continued decline of weed populations and resulting benefits to surface water quality on and off the S-CNF. No aerial herbicide application under this alternative also would eliminate the potential for any cumulative effects from wind drift on surface water quality. There may be some cumulative but minor effect on surface water quality from weed treatment and other ongoing S-CNF activities, similar to the Proposed Action.

d. Alternative 2

Direct and Indirect Effects. The magnitude of direct and indirect benefits to surface water quality under Alternative 2 would be expected to be less than under the Proposed Action, Alternative 1, or the No Action Alternative. Because fewer methods would be used to treat weeds under Alternative 2 and because it is only realistic to control or contain rather than reduce the size of weed infestations under Alternative 2, it would take longer to achieve lesser levels of weed treatment success than anticipated under the Proposed Action, Alternative 1, or the No Action Alternative. As a result, it also would take longer to realize some benefits to surface water quality resulting from reduced erosion and sediment delivery at weed-infested sites to drainages. Increased direct and indirect impacts to surface water quality would likely occur due to the increase in soil disturbance resulting from mechanical treatment activities. This would be especially true on the northern part of the S-CNF where weed infestations are substantially greater than on any other area of the S-CNF. The effectiveness of mechanical and biological treatment options in the eradication, control, or containment of invasive weeds can be delayed from several months to several years while the establishment and expansion of weeds continues. There would be no potential for any of the worst-case situations described for herbicides under the other alternatives to occur under Alternative 2.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 2 are designed to avoid or minimize the potential for adverse effects on S-CNF resources, including surface water quality. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* Examples presented for the Proposed Action and other alternatives except for those directed at the use of herbicides, also apply to Alternative 2.

Cumulative Effects. Beneficial cumulative effects of Alternative 2 combined with treatment effects of the three CWMAs would be fewer than under the Proposed Action, Alternative 1, or the No Action Alternative. The success of the coordinated CWMA program would be severely hampered under Alternative 2. It would take longer to achieve a lesser level of success because of the absence of the application of herbicides. In some instances, these long-term results may include the expected gradual decline in noxious weeds and some resultant gradual benefits to surface water quality on and possibly adjacent to the S-CNF. Adverse cumulative effects on surface water quality under Alternative 2 would be greater than those described for the Proposed Action and other alternatives regarding sediment delivery from other ongoing S-CNF activities or features (roads and trails, livestock grazing, recreation near drainages). There would be no potential under Alternative 2 for adverse cumulative effects on the S-CNF or adjacent lands from herbicide application.

4.C.2. Groundwater

a. No Action Alternative

Direct and Indirect Effects. The No Action Alternative would not affect groundwater resources or drinking water quality. Potential effects of the expansion of noxious weeds on water quality would be limited to surface waters, as previously discussed in *Section 4.C.1, Surface Water,* of this chapter and to possibly reduced surface infiltration and correspondingly reduced groundwater storage at weed infestation sites (see discussions of

ecosystem function and soils in this chapter). Herbicides and other weed treatments would continue to be used on the S-CNF at the current treatment rate of approximately 3,000 to 3,500 acres per year. As discussed previously, limited monitoring studies on the S-CNF (Rose 2002) indicate that current weed treatment activities have not adversely impacted resources on the S-CNF. Therefore, they would not be expected to occur or would have negligible impact under the No Action Alternative.

BMPs and Mitigation Measures. Weed treatments would continue to be implemented according to all of the BMPs and mitigation measures described for the No Action Alternative in *Section 2.D.3, Management Practices and Mitigation Measures*. These BMPs and mitigation measures are designed to avoid or minimize the potential for adverse effects on S-CNF resources, including groundwater resources and drinking water quality. Examples of BMPs directed at protecting water quality were listed in the discussion of surface water and include the use of buffers around water bodies, and restricted use of herbicides such as picloram that are persistent and mobile in the environment. Also, no use of chemicals is allowed within 100 feet of any potable water spring development.

Cumulative Effects. The No Action Alternative combined with the effects of the three CWMAs and other ongoing S-CNF activities (recreation, grazing, roads) would not be expected to have a cumulative effect on groundwater resources or drinking water quality on the S-CNF or on adjacent non-National Forest lands through the application of BMPs and mitigation measures.

b. Proposed Action

Direct and Indirect Effects. *Section 4.B.2, Aquatic Resources,* of this chapter discusses the potential for weed treatments to affect groundwater quality (and subsequently surface water and aquatic resources) by the leaching of herbicides through the soil. If the worst-case situation involving leaching of herbicides that was discussed did occur, it would have a very minor or negligible effect on groundwater quality and would not be expected to result in violations of drinking water standards. This conclusion is supported by various reviews and studies briefly summarized in the following text.

The Forest Service (1999a) reviewed studies on the occurrence of picloram (a mobile, persistent herbicide) in coarse soils in western Montana following its application at a rate of 1 pound per acre (Watson et al. 1989). Picloram concentrations in the upper 5 inches of soil in the western Montana studies ranged from 205 to 366 ppb; the maximum concentration measured at soil depths between 30 and 40 inches was 24 ppb. No picloram was measured in shallow groundwater wells (detection level = 0.5 ppb or 0.0005 mg/L) (Forest Service 1999a). In other studies of less-persistent herbicides reviewed by the Forest Service (1999a), clopyralid was never detected at soil depths greater than 10 inches, and after 30 days 2,4-D was never detected at soil depths greater than 2 inches (Rice et al. 1992) . In those same studies, picloram was detected at soil depths between 10 and 20 inches within 30 days following spraying, but it was not detected (detection level = 10 ppb or 0.01 mg/L) at a soil depth greater than 10 inches 1 or 2 years after spraying (Rice et al. 1992). The Forest Service (1999a) concluded that there is relatively little risk of the deep leaching of picloram, clopyralid, or 2,4-D; they assumed results would be similar for the herbicide dicamba, even though it was not tested, because its persistence and mobility are similar to those of 2,4-D and clopyralid. The Forest Service cited other studies (U.S. Forest Service 1984) showing

there is little probability of carryover of 2,4-D or dicamba in soils from one summer to the following spring because of their short half-lives, and thus limited opportunity for these herbicides to accumulate in the soil and migrate into groundwater. In their reviews of forest chemicals, Norris et al. (1991) stated that the "leaching of chemicals through the soil profile is a process of major public concern, but it is the least likely to occur in forest environments."

It is similarly expected that any concentrations of herbicides that may leach through soils and reach groundwaters on the S-CNF would be so low or negligible that they would not pose a risk to drinking water quality. It is anticipated that picloram application rates on the S-CNF would typically range from .5 to 1 pound per acre when treating spotted knapweed sites, the most prevalent weed species (as compared to 1 pound per acre in the western Montana studies), and would therefore be less likely to occur in soil concentrations great enough to subsequently adversely affect groundwater.

BMPs and Mitigation Measures. All of the BMPs and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures* would be implemented under the Proposed Action. These BMPs and mitigation measures are designed to avoid or minimize the potential for adverse effects on S-CNF resources, including groundwater resources and drinking water quality. Examples involving buffers around water bodies, potable springs, and restrictions on the use of mobile, persistent herbicides that were given for the No Action Alternative also apply to the Proposed Action. Other examples given for surface water protection under the Proposed Action regarding the aerial application of herbicides would also contribute to groundwater protection. In addition, the site-specific implementation process, decision tree, and minimum tool approach described in *Chapter 2, Alternatives* and the Herbicide Leaching Sensitivity Evaluation System presented in Appendix F would be used under the Proposed Action (and Alternatives 1 and 2) to consider treatment site characteristics such as soil permeability and leaching potential to avoid or minimize the potential for adverse impacts on groundwater resources.

Cumulative Effects. The Proposed Action combined with the effects of CWMA treatments plus other ongoing S-CNF activities would not be expected to cumulatively affect groundwater resources or drinking water quality on the S-CNF or on adjacent non-National Forest lands through the application of BMPs and mitigation measures.

c. Alternative 1

Direct and Indirect Effects. The potential effect of Alternative 1 on groundwater resources would be the same as described for the Proposed Action. In a worst-case situation, this could include a very minor or negligible effect on groundwater quality that would not be expected to result in violations of drinking water standards.

BMPs and Mitigation Measures. The same BMPs and mitigation measures (except those for aerial herbicide application) and the same site-specific implementation and minimum tool processes that were described for the Proposed Action would be implemented under Alternative 1.

Cumulative Effects. Alternative 1 combined with the effects of CWMA treatments plus other ongoing S-CNF activities (recreation, roads, livestock grazing near drainages) would not be expected to cumulatively affect groundwater resources or drinking water quality on

the S-CNF or on adjacent non-National Forest lands through the application of BMPs and mitigation measures.

d. Alternative 2

Direct and Indirect Effects. Lack of timely and/or successful treatment of weed infestations under Alternative 2 could ultimately affect groundwater quantity due to reduced groundwater recharge. Because herbicides would not be used in this alternative, there would be no potential for a worst-case situation of herbicides leaching into groundwater.

BMPs and Mitigation Measures. The same BMPs and mitigation measures (except those for aerial and ground-based herbicide application) and the same site-specific implementation and minimum tool processes that were described for the Proposed Action would be implemented under Alternative 2.

Cumulative Effects. Alternative 2 together with the combined effects of CWMA treatments and other ongoing S-CNF activities would not be expected to cumulatively impact groundwater resources or drinking water quality on the S-CNF or on adjacent non-National Forest lands.

4.C.3. Soils, Geology, and Minerals

a. No Action Alternative

Direct and Indirect Effects. As described in *Section 4.B, Biological Resources,* of this chapter, weed populations on the S-CNF, particularly in the north, would continue to expand even with the weed control treatments of the No Action Alternative. Soils, geology, and minerals would experience little to no impact from treatment of noxious weeds, but soils would be affected by weed population expansion. There is the potential for minimal impacts to soils from off-road chemical treatment activities. Cross-country travel during treatment activities could be a limited source of soil displacement.

As weed populations expand under the No Action Alternative, soil erosion would be expected to increase. Lacey et al. (1989) found that sediment yield from knapweed-infested sites can increase three times over that found on sites occupied by native vegetation. This could result in a significant increase in sediment yield to streams, particularly in the northern areas of the S-CNF where spotted knapweed has infested more than 29,000 acres. The organic matter content of soils under weeds would decrease over time, because of lower plant productivity compared to native plant communities. This would reduce the capability of soil to support plant growth. As weeds expand under this alternative, progressively larger areas of the S-CNF would have lower soil productivity, which may require fertilization of areas being restored following weed treatment, thereby increasing overall S-CNF weed management costs.

The soil type can influence which weed treatment is appropriate for an area, and soil properties associated with each soil type can lead to indirect effects on other resources from weed treatments. Soil properties that can indirectly affect other resources include those that control water runoff, regulate water infiltration, bind chemicals to the soil, and determine water-holding capacity of the soil. These soil properties would include soil particle size distribution, clay content, and organic matter content. As the percentage of large soil

particles (e.g., gravel, cobble, rock) increases or soil textures become coarser, water infiltration increases and water runoff decreases. As clay content increases, the quantity of water able to infiltrate into the soil decreases and runoff increases. Organic matter and clay particles tend to adsorb herbicide molecules and the greater the percentage of organic matter and clay, the lower the possibility of leaching loss to the groundwater. The resources most likely to be indirectly affected by these soil properties are aquatic resources and water quality. The reader is directed to the previous impact assessments in this chapter for an in-depth discussion of those resources.

The discussion presented for aquatic resources noted that soil types associated with locations assessed in the worst-case analyses indicate runoff-dominated conditions in the Upper Little Lost HUC 5 (Lost River Ranger District) and the Challis Creek HUC 5 (Challis Ranger District) and infiltration-dominated conditions in the Middle Lemhi HUC 5 (Leadore Ranger District) and the North Fork HUC 5 (North Fork Ranger District). Appendix I provides information on the percentage abundance of different soil types in each HUC 5 within the S-CNF that can be used to infer soil permeability. Very generally, the most frequently occurring predominant soil types by Ranger District tend to consist of the following: Challis Ranger District (volcanic, sedimentary, and quartzite); Leadore Ranger District (quartzite); Lost River Ranger District (sedimentary); Middle Fork Ranger District (volcanic and quartzite); North Fork Ranger District (quartzite and granitic); Salmon-Cobalt Ranger District (volcanic, quartzite, and granitic); and Yankee Fork Ranger District (volcanic, quartzite, and sedimentary). The predominance of quartzite soils, which are among the more permeable soil types, in the North Fork HUC 5 where the majority of noxious weeds that have been inventoried on the S-CNF occur illustrates the importance of considering site-specific characteristics before beginning weed treatments.

Soil properties can also influence the type of treatment that may be appropriate on a given site. Soil properties are generally associated with the soil types derived from specific parent material sources. While this information is useful for early planning activities, it is no substitute for on-the-ground soil investigations prior to determining treatment options, but it can alert the planning team to potential constraints. As discussed in *Chapter 3*, *Affected Environment*, soils derived from four parent materials are common on the forest; granite, quartz, sedimentary, and volcanic. Projects located on volcanic or quartz soils can have potential leaching problems due to high rock fragment percentages, where projects located on sedimentary and granitic soils may have lower rock fragment percentages and less leaching potential. However, the expected soil textures (especially for granitics) are the reverse of this. The percentage of fine-grained soil particles can be high in volcanic and sedimentary soils and projects located on those soil types may be susceptible to problems associated with runoff if the fine-textured soil horizons retard infiltration. On the positive side, fine-textured soils tend to adsorb herbicide molecules and reduce leaching potential. Site investigations should be used to verify what soil conditions are present at the project location and then use the Herbicide Leaching Sensitivity Evaluation System in Appendix F and the decision tree in *Chapter 2, Alternatives* to determine the appropriate treatment method. These investigations take into consideration the effects of coarse soil fragments and soil texture in determining leaching potential and whether a treatment site is likely runoff-dominated or infiltration-dominated.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the No Action Alternative are designed to avoid or minimize the potential for adverse effects on S-CNF resources, including soils, geology, and minerals. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* Numerous examples of BMPs and mitigation measures have been presented in discussions of other resources in this chapter that also serve to protect and ensure the proper function of soils.

Cumulative Effects. Cumulative effects of the No Action Alternative combined with the three CWMAs would potentially adversely affect soils, but not geology or minerals, through increased erosion from weed-infested sites and possibly from erosion of disturbed and/or barren weed treatment areas. Adverse cumulative effects on soils may be greatest in the northern portion of the S-CNF and on adjacent non-National Forest lands because of extensive spotted knapweed infestations. Cumulative effects on soil erosion also could result from other ongoing S-CNF activities, such as roads and trail construction and maintenance, livestock grazing, and recreation activities.

b. Proposed Action

Direct and Indirect Effects. Direct and indirect impacts on soils would be less under the Proposed Action than the No Action Alternative. Under the Proposed Action, weeds would be aggressively eradicated, controlled, and/or contained using a variety of methods, with treatment sites restored to native vegetation, where necessary, following treatment. Loss of native habitat to weed infestations would decrease over time as weed populations are reduced and eliminated. Soil erosion would decrease as native plant communities become restored either through natural or artificial processes following weed treatment. Declines in soil productivity would diminish with the Proposed Action as native plant communities become established on eradicated weed sites and restore the nutrient and organic matter balance over time. The effects of eroded soils and sediment delivery on aquatic resources and surface water were discussed previously in this chapter. There is the potential for minimal impacts to soils from off-road chemical treatment activities. Cross-country travel during treatment activities could be a limited source of soil displacement.

As shown in Appendix B, the highest concentrations of weeds are found on the North Fork Ranger District (North Fork, Indianola, Shoup, and Colson Owl HUC 5s) and the Salmon-Cobalt Ranger District (Lower Panther Creek and Lower Camas Creek HUC 5s). The predominant weed species is spotted knapweed. Weed control efforts are likely to concentrate in these areas due to the size of the infestations. Appendix I indicates that quartzite and granitic-derived soils are predominant in the heavily weed-infested North Fork Ranger District HUC 5s and volcanic, granitic, and quartzite-derived soils predominate in the heavily weed-infested Salmon-Cobalt Ranger District HUC 5s. Both the quartzite and granitic soils are susceptible to leaching due to abundant coarse fragments and coarse soil textures. Projects located near streams or near high-water table areas should take this into consideration as per the decision tree (*Chapter 2, Alternatives*). The volcanic soils on the Salmon-Cobalt Ranger District would be most likely to retain herbicides in the soil profile, but surface runoff may be a problem there if clay content is high. The Proposed Action would not affect geology or minerals.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the Proposed Action focus on weed prevention and management BMPs and the proper ground-based and aerial application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures*. The Proposed Action, like Alternatives 1 and 2, also includes site-specific implementation processes that consider soil characteristics such as permeability and leaching potential (see Appendix F) to avoid or minimize the possibility of impacting other S-CNF resources as a result of herbicide application.

Cumulative Effects. Cumulative effects of the Proposed Action combined with the effects of the three treatment CWMAs would result in a benefit to soil resources because of increased levels of weed control and eradication, slower weed population spread, and less total weed-infested acreage compared to existing conditions. This would result in improved soil protection and reduced erosion both on and off the S-CNF. New weeds that have invaded the S-CNF from adjacent lands would be eradicated and invasion of adjacent lands by weeds presently occurring on the S-CNF would be curtailed as populations are controlled or eradicated. This cumulative effect would beneficially affect all resources affected by erosion, such as surface water quality and aquatic organisms. Beneficial cumulative effects on soils and related resources may be greatest in the northern portion of the S-CNF and on adjacent non-National Forest lands because of eradication and control of extensive spotted knapweed infestations. There would be potential short-term cumulative adverse effects from these treatment activities because of mechanical ground disturbance and exposure of barren soils, but long-term benefits would result from the re-establishment of native vegetation. Some adverse cumulative effects on soils also may result from other ongoing S-CNF activities (roads, recreation, livestock grazing) within or adjacent to weed treatment locations.

c. Alternative 1

Direct and Indirect Effects. Direct and indirect benefits to soils would generally be the same as described for the Proposed Action, but would occur at a slower rate and be somewhat less effective and widespread because of no aerial application of herbicides under Alternative 1. A combination of primarily biological treatment and ground-based application of herbicides would be used to treat weed infestations on the S-CNF under Alternative 1. This less aggressive approach would have a similar beneficial end result as the Proposed Action, but it would take longer to achieve. The lack of aerial options in remote, inaccessible areas would result in a less effective, less successful weed treatment program under this alternative than the Proposed Action. There would be long-term benefits to soils from the reduction in size of weed populations and subsequent reduction in erosion. Alternative 1 would not affect geology and minerals.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 1 focus on weed prevention and management BMPs and the proper ground-based application of herbicides. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures*, together with site-specific implementation processes described previously to avoid or minimize the potential for soils-related impacts on other S-CNF resources.

Cumulative Effects. Cumulative beneficial effects of Alternative 1 combined with the treatment effects from the three CWMAs would be similar to those described in the Proposed Action. However, the effectiveness of the CWMA program could be hampered in the control of large scale or inaccessible weed infestations without the use of aerial application opportunities. Long-term cumulative benefits include the expected decline of weed populations with subsequent reduction of erosion on and off the S-CNF. Cumulative adverse effects include soil disturbance/exposure from weed treatment activities and from other ongoing S-CNF activities.

d. Alternative 2

Direct and Indirect Effects. Any direct and indirect benefits to soils under Alternative 2 would be considerably less than those described for the Proposed Action, Alternative 1, or the No Action Alternative. Weed treatment methods under Alternative 2 do not include the ground- or air-based application of herbicides. Instead, mechanical and biological treatments or their combination would be the main mechanisms for weed containment, control, or some eradication on the S-CNF. While these methods have been shown to be effective, they take a considerably longer period of time to perhaps achieve a lesser level of weed control than can be achieved using herbicides. Consequently, it would take longer to realize probably limited benefits to soils under this alternative, especially in the northern part of the S-CNF where the largest concentrations of weeds are found. In addition, the expanded use of mechanical treatments necessary to support eradication and containment goals described for Alternative 2 in *Chapter 2, Alternatives* would result in much greater soil disturbance, exposure, and potentially erosion than under the other alternatives. This direct effect, together with the indirect effects resulting from delays in being able to respond to and reduce weed infestations, would adversely affect other S-CNF resources. Alternative 2 would not affect geology and minerals.

BMPs and Mitigation. BMPs and mitigation measures associated with weed management under Alternative 1 are designed to avoid or minimize the potential for adverse effects on S-CNF resources, including soils, geology, and minerals. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures*, together with site-specific implementation processes described previously except for those processes associated with herbicide application.

Cumulative Effects. Cumulative impacts on soils of Alternative 2 combined with the three CWMA treatment programs and with other ongoing activities on the S-CNF would be similar in nature but would result in fewer beneficial effects and more adverse effects than anticipated under the Proposed Action, Alternative 1, or the No Action Alternative. The greatly increased use of mechanical weed treatments and associated extensive soil disturbance under Alternative 2 also would contribute to cumulative adverse effects on soils when combined with other activities occurring on the S-CNF. Implementation of Alternative 2 would not be expected to result in a successful long-term weed treatment program, effective or successful CWMA objectives, or in healthy soil conditions on weed-infested areas of the S-CNF.

4.C.4. Land Uses and Designations

a. Commercial and Recreation Uses

1) No Action Alternative

Direct and Indirect Effects. The No Action Alternative would have little or no effect on noxious weed invasion. The spread of existing and new noxious weed species would likely continue under the No Action Alternative. These populations would likely spread into adjoining areas not managed by the S-CNF. The impact on resource-based commercial and recreational uses would be significant. Some studies (Hirsch and Leitch 1996) have estimated a loss of $3.95 per wildland acre on other National Forest lands; a similar figure should be expected on the S-CNF. Using Hirsch's and Leitch's loss calculation figure of $3.95 per wildland acre, loss on the S-CNF can be conservatively estimated at $262,964 based on 66,537 acres of inventoried weed infestations. This figure would rise as weed infestations expand, and new species of invaders encroach on the S-CNF. Wildlife is important to many outdoor recreation activities, including consumptive activities such as hunting and fishing, and non-consumptive activities such as wildlife watching and photography. These uses and associated expenditures are described further below. The economic impacts that result from weed-caused changes to wildlands are decreases in wildlife- and recreation-associated expenditures.

Commercial use of native plants on the S-CNF has not been fully documented, but it is likely that commercial gathering of these plants would be directly affected by the continued spread of weeds.

Under the No Action Alternative, invasive weeds would continue to affect commercial and recreational values on the S-CNF—and in the communities that rely on a healthy forest ecosystem. Wildlands provide important habitat for vegetation and wildlife. In turn, wildlife is an important part of many outdoor commercial and recreational activities. Wildlife and outdoor use can be divided into two types: consumptive and non-consumptive. Consumptive use consists of hunting and fishing. Expenditures for consumptive use include the sale of licenses, gasoline, lodging, food, guns and ammunition, and other goods and services (like outfitting and guide fees). Non-consumptive, or recreational, use include photography, wildlife watching, hiking, camping, and white-water rafting. Expenditures for non-consumptive use include fees for guides and outfitters, pack trips, lodging, camping equipment, and public or private land use fees.

As discussed in *Chapter 3* in *Section 3.D.4, Land Uses and Designations,* some 90 percent of travelers return to areas in and around the S-CNF after their initial visit. Hunting and fishing account for more than $340 million a year in the State of Idaho, and much of this occurs in the central mountains of Idaho and the S-CNF. Tourism in central Idaho accounts for an additional $200+ million each year. Tourism supplies more than 600 jobs in Custer County, more than 200 in Lemhi County, and less than 50 in Butte County. As scenic values and wildlife habitat are impacted by noxious weed invasions, a decline in recreational- and commercial-use dollars can be expected.

Direct economic impact is the result of changes in expenditures that affect suppliers of recreational goods and services. The Idaho Department of Agriculture concludes that the state spends more than $300 million each year in attempts to control noxious weeds.

Although Idaho has not conducted a survey to determine the commercial impact of noxious weed infestations on its economy, Hirsch and Leitch (1996) reviewed the impact on Montana's economy. The direct economic impact on wildlife-associated issues in Montana is more the $1.2 million each year, mostly affecting retail trades and business and personal services (Hirsch and Leitch 1996).

Commercial livestock grazing (primarily cattle) also occurs on the S-CNF and surrounding federal lands. Grazing represents a $600 million industry in Idaho. No studies have described the economic impact of noxious weeds on Idaho's rangeland industries; however, Hirsch and Leitch (1996) estimate a loss of $10.73 per rangeland acre to noxious weed invasion in Montana.

Indirect impact may occur through reduced activity in the recreational and commercial use sectors. The anticipated annual economic impact from weed infestations in Montana is more than $2.6 million (Hirsch and Leitch 1996). This loss comes primarily from lost retail trade ($1.3 million), household ($567,000), and business and personal services ($326,000).

BMPs and Mitigation Measures. The No Action Alternative would continue the current weed management strategy on the S-CNF, including weed prevention and BMPs outlined in Appendix A, plus the BMPs and mitigation measures described in *Chapter 2, Alternatives*. Numerous examples of these measures that would be implemented under the No Action Alternative were described in previous discussions of other resources on the S-CNF.

Cumulative Effects. Without a comprehensive weed control strategy on the S-CNF, the cumulative effects of most weed control efforts on the S-CNF together with treatments on the three CWMAs would be minimally successful. As weed infestations become larger on and adjacent to the S-CNF, the cost of control would increase, while the chance of long-term success would diminish. New invaders not successfully treated would likely become established in the ecosystem and, once established, would be difficult to eradicate. As a result, commercial and recreational opportunities within and adjacent to the S-CNF would diminish cumulatively as areas become potentially infested with weed populations. Weed treatment activities, along with other forest activities such as livestock grazing and timber harvest, could further hamper the effectiveness and enjoyment of commercial and recreational uses.

Additionally, opportunities for cooperative efforts with state and county agencies could occur but would be limited. Weed infestations on the S-CNF that were not successfully treated would spread to adjacent lands under other ownership, compromising weed control efforts on those lands. This cumulative effect would compromise the efforts of the CWMAs and exasperate their ability to control infestations on adjacent lands.

It is difficult to assess the negative economic and environmental costs of these cumulative effects on S-CNF resources, or to assign the loss described above to any specific commercial or recreational sector. Rather, these cumulative effects illustrate the profound impact less aggressive weed control activities would have in the future.

2) Proposed Action

Direct and Indirect Effects. The use of herbicides and mechanical, biological, livestock grazing, and combinations of these methods would not result in the total elimination of

noxious weeds from the S-CNF. However, the Proposed Action would strive to eradicate several weed populations, and would effectively reduce the size and rate of spread of other infestations. Sites already dominated by invasive and noxious weeds would not be expected to return to domination under the Proposed Action. In addition, the Proposed Action would likely hinder new noxious weed species from invading a treated site by strengthening native plant populations through natural or artificial restoration efforts, where appropriate.

The full spectrum of weed control actions that would be implemented under the Proposed Action should prevent expansion of weed populations on the S-CNF. Based on the conservative loss estimate described for the No Action Alternative, the Proposed Action would likely result in an impact savings of approximately $262,964. There is a chance that losses from the existing weed population could be recovered, thus increasing the savings.

Commercial and recreational activities on the S-CNF may be affected as access to infested areas is restricted during spraying and other weed treatments. For example, once users become aware that spraying activities will occur, recreational users may be unwilling to use that area. Commercial activities like livestock grazing or hunting may also experience a short-term decline in areas where spraying has occurred. Commercial and recreational use of roads within infested areas may need to be temporarily curtailed as mechanical and herbicide treatments occur. Limited displacement in campgrounds and at trailheads may occur during weed control activities. Weed control efforts like livestock grazing, herbicide application, and other combinations may affect the recreational experience for some users.

BMPs and Mitigation Measures. The BMPs and mitigation efforts described in *Section 2.D.3, Management Practices and Mitigation Measures*, would ensure that herbicides are applied safely and in accordance with EPA regulations. No aerial applications would occur near campgrounds or residences. Weed treatment information would be made available at District offices and information regarding treatment schedules would be made available through such means as notification to permit holders.

Cumulative Effects. The larger expected cumulative beneficial effect of the Proposed Action, combined with the three CWMA treatment programs, is that weed-infested sites on the S-CNF would return to full recreational and commercial use while cooperative weed control efforts with state and county agencies would be enhanced. Weed treatment activities, along with other forest activities such as livestock grazing and timber harvest, could further hamper the effectiveness and enjoyment of commercial and recreational uses.

3) Alternative 1

Direct and Indirect Effects. This alternative would not incorporate aerial spraying activities. As a result, large weed infestations within the S-CNF would be more difficult to control and eradicate. This could lead to unchecked expansion of weed infestations throughout the S-CNF and additional loss of wildland acres. This would also adversely affect recreational and commercial uses on the S-CNF since weed control activities would take longer and be less effective in weed-infested areas.

However, this alternative incorporates the full array of weed treatment options (except for aerial herbicide application) discussed in *Chapter 2, Alternatives*. Implementation of this alternative would result in a short-term loss of some commercial and recreational opportunities as the ground application of herbicides and other methods are used. As the

treatments begin to have some effect, recreational and commercial use opportunities would likely return to pre-treatment levels.

The use of ground-based herbicides and mechanical, livestock grazing, and biological methods would not result in the total elimination of noxious weeds from the S-CNF. While this alternative may not effectively eradicate or control large weed infestations on steep slopes or inaccessible areas, it could be effective in smaller, fragmented patches of weeds. This alternative would eradicate several small weed populations, and would effectively reduce the size and rate of spread of other infestations on the S-CNF. Sites already dominated by invasive and noxious weeds may not return to domination under Alternative 1. In addition, it would likely hinder new noxious weed species from invading a treated site by strengthening native plant populations through natural or artificial restoration efforts where appropriate.

BMPs and Mitigation Measures. This alternative incorporates all BMPs and mitigation measures (except for aerial herbicide application) described for the Proposed Action. Weed treatment information would be made available at District offices and information regarding treatment schedules would be made available through such means as notification to permit holders.

Cumulative Effects. Cumulative effects associated with Alternative 1 and the three CWMAs would be similar to those described for the Proposed Action. However, it would take longer to realize benefits to commercial and recreational uses on the S-CNF, while cooperative weed management efforts and objectives may be compromised if larger weed infestations expand beyond S-CNF boundaries. Weed treatment activities, along with other forest activities such as livestock grazing and timber harvest, could further hamper the effectiveness and enjoyment of commercial and recreational uses.

4) Alternative 2

Direct and Indirect Effects. While Alternative 2 offers a full array of non-chemical weed treatment options, it is expected that treatment would take longer and be less effective than under the Proposed Action, Alternative 1, or the No Action Alternative because it does not include the use of herbicides. The sole use of mechanical, livestock grazing, and biological methods and their combinations would not result in the total elimination of noxious weeds from the S-CNF. This alternative would control some small weed populations, and could effectively reduce the size and rate of spread of other small infestations. However, sites already dominated by invasive and noxious weeds would likely remain dominated by weeds under this alternative. Weed infestations located throughout the S-CNF, and particularly large infestations on the northern portion of the S-CNF, would be virtually impossible and unrealistic to control and eradicate. This would lead to further expansion of weed infestations and additional loss of wildland acres. Commercial and recreational opportunities would also be adversely affected, since weed infestations would remain, and expand, as non-chemical treatments are implemented.

BMPs and Mitigation Measures. This alternative incorporates all BMPs and mitigation measures (except for herbicide application) described for the Proposed Action, and discussed in *Section 2.D.3, Management Practices and Mitigation Measures*. Examples of these measures are presented in previous discussions of other resources on the S-CNF.

Cumulative Effects. Cumulative impacts on land uses of Alternative 2 combined with the three CWMA treatment programs and with other ongoing activities on the S-CNF would be similar in nature but would result in fewer beneficial effects and more adverse effects than anticipated under the Proposed Action, Alternative 1, or the No Action Alternative. The greatly increased use of mechanical weed treatments and associated extensive soil disturbance under Alternative 2 also would contribute to some cumulative adverse effects on land uses when combined with other activities occurring on the S-CNF. Implementation of Alternative 2 would not be expected to result in a successful long-term weed treatment program, effective or successful CWMA objectives, or a full range of land uses on weed-infested areas of the S-CNF.

b. Areas Proposed for Wilderness, Research Natural Areas, and Roadless Areas

1) No Action Alternative

Direct and Indirect Effects. Under the No Action Alternative, current management techniques would continue. Proposed wilderness areas, RNAs, and roadless areas would not be significantly affected by weed infestations. This alternative would likely continue to control infestations in and around these areas with some success. As noted in *Chapter 1, Purpose and Need*, weed invasions continue to spread, despite control and eradication efforts on the S-CNF. Without more aggressive control techniques, a direct effect would be increased vulnerability to expanding noxious weed invasions from infested areas. Such vulnerability is already apparent in the North Fork Ranger District, where infestations have begun to spread into roadless areas. Indirect effects would include loss of habitat, and loss of the rare or unique vegetation features and native biodiversity for which these areas were designated. Effects on these designated resource areas from treatment actions include short-term surface disturbances from mechanical treatments until native vegetation becomes re-established, and limited or temporary restrictions on access to these areas while treatment is occurring and perhaps until shortly after treatment has been completed.

BMPs and Mitigation Measures. The No Action Alternative would continue the current weed management strategy, including weed prevention and BMPs outlined in Appendix A, plus the BMPs and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures*.

Cumulative Effects. Little or no cumulative effects on areas proposed for wilderness, RNAs, or roadless areas would be expected from implementing the No Action Alternative. CWMA activities are generally very limited in these areas as are the other S-CNF activities previously addressed as contributing to cumulative effects.

2) Proposed Action

Direct and Indirect Effects. The Proposed Action would eradicate several weed populations in and around proposed wilderness, RNAs, and roadless areas, and would effectively reduce the size and rate of spread of other infestations. Because of their remote locations, these areas are not normally susceptible to noxious weed invasions. However, some weed infestations occur in RNAs and adjacent to roadless areas, and these populations would be controlled, reduced in size, or possibly eradicated under the Proposed Action. Examples of potentially affected resources include 135,378 acres of roadless areas and the 1,739-acre Allan Mountain RNA in the North Fork HUC 5 of the North Fork Ranger District, which has

extensive spotted knapweed infestations. Detailed information on the location and size of roadless areas and RNAs on the S-CNF is presented in Appendix I. As a result of the Proposed Action implementation, biodiversity and other unique characteristics such as the pristine nature of these and other sensitive areas on the S-CNF would be preserved. Other direct effects of the Proposed Action on these areas could include potential drift from aerial and ground applications of herbicide, and trampling of valuable areas during mechanical treatments in and around an infestation in the RNA or roadless area.

BMPs and Mitigation Measures. The BMPs and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures*, would ensure that herbicides are applied safely and in accordance with EPA regulations. Any aerial treatment areas would be assessed for sensitive plants. Drift-related mitigation measures specific to aerial application would be implemented (e.g., buffer zones, drift reduction techniques, and wind restrictions). Weed treatment information would be made available at District offices and information regarding treatment schedules would be made available through such means as notification to permit holders. In addition, the Proposed Action, as well as Alternatives 1 and 2, incorporate use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy, which were described in *Chapter 2, Alternatives* and referenced in previous resource discussions. These management tools are designed to consider site-specific conditions that result in the selection of a treatment method that achieves weed management goals with the least impact to the unique resources associated with the designated RNAs.

Cumulative Effects. No beneficial or adverse cumulative impacts on areas proposed for wilderness, RNAs, or roadless areas would be expected from the combined effects of implementing the Proposed Action, other ongoing activities on the S-CNF, and CWMA weed treatments on lands adjacent to the S-CNF, since these activities are minor occurrences in these areas.

3) Alternative 1

Direct and Indirect Effects. This alternative would not incorporate aerial spraying activities. As a result, large weed infestations on steep, inaccessible areas most common on the northern part of the S-CNF would be more difficult to control and eradicate. This could lead to expansion of knapweed infestations into roadless areas and RNAs in the North Fork Ranger District and other Ranger Districts, threatening the unique ecological characteristics of the RNAs and altering additional wildland acres associated with roadless areas (see Appendix I for details on resource locations). Other direct effects could mirror those described for the Proposed Action, although the potential risk from aerially applied herbicide drift into these areas would be removed.

BMPs and Mitigation Measures. This alternative incorporates all BMPs and mitigation measures (except for aerial herbicide application), as well as use of the site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy, that were described for the Proposed Action.

Cumulative Effects. No beneficial or adverse cumulative impacts on areas proposed for wilderness, RNAs, or roadless areas would be expected from the combined effects of implementing Alternative 1, other ongoing activities on the S-CNF, and CWMA weed

treatments on lands adjacent to the S-CNF, since these activities are minor occurrences in these areas.

4) Alternative 2

Direct and Indirect Effects. While this alternative offers a full array of non-chemical treatment options, it is anticipated that weed treatment would take longer and be considerably less effective than under the Proposed Action, Alternative 1, or the No Action Alternative. As a result, roadless areas and the unique characteristics of the designated RNAs in the vicinity of weed infestations would be significantly affected by this alternative, since invasions of noxious weeds would continue and existing infestations would expand. Large weed infestations dominating the northern part of the S-CNF would be especially difficult to control or contain in the short term under Alternative 2. It is possible that biological methods would have an effect in containing and controlling weeds, but it may take several decades to achieve management goals. This would lead to expansion of knapweed infestations and continued loss of wildland acres within the roadless areas, along with further alteration of the unique vegetative characteristics of the RNAs in the northern reaches of the S-CNF.

This alternative would not incorporate any herbicide treatments, thus eliminating the potential risk of drift and other possible chemical-related effects on the characteristics of these unique areas. However, the extensive use of mechanical treatments under Alternative 2 and resultant surface disturbances and intrusions into pristine areas to reduce the size and rate of spread of smaller weed infestations may adversely affect the unique characteristics of RNAs and roadless areas.

BMPs and Mitigation Measures. This alternative incorporates all BMPs and mitigation measures (except for herbicide application), as well as use of the site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy, that were described for the Proposed Action and Alternative 1.

Cumulative Effects. No beneficial or adverse cumulative impacts on areas proposed for wilderness, RNAs, or roadless areas would be expected from the combined effects of implementing Alternative 2, other ongoing activities on the S-CNF, and CWMA weed treatments on lands adjacent to the S-CNF, since these activities are minor occurrences in these areas.

c. Wild and Scenic Rivers

1) No Action Alternative

Direct and Indirect Effects. Under the No Action Alternative, invasive weeds would continue to affect commercial and recreational values on the S-CNF and in the communities that rely on and support healthy, wild, and scenic rivers. Stream segments that have been designated as Wild and Scenic, or are eligible for further consideration for Wild and Scenic River designation, would be directly affected by the continuation of current weed management strategies and the presence of noxious weeds under the No Action Alternative. These stream segments are discussed in *Section 3.D.4.d, Wild and Scenic Rivers,* and designated Wild and Scenic River segments are listed in Appendix I. Some eligible segments, like the Yankee Fork and Panther Creek, have served as important transportation and recreation corridors, and have been altered by streamside roads, and by recreational

and commercial activities such as mining, outfitting, camping, and other activities. Under the No Action Alternative, these streams would be susceptible to the continued invasion of noxious weeds, whose introductions are often associated with recreational and commercial activities. Invasive, exotic plants reduce, displace, and/or eliminate native vegetation, which can directly affect wildlife populations, aesthetic qualities, aquatic resources, other ecosystem attributes, and ecosystem function within these river corridors that are characteristics which contribute to their designation or their eligibility for outstandingly remarkable consideration as Wild and Scenic. Other effects on designated or eligible Wild and Scenic River segments from the continued presence of weeds would include loss of habitat, and loss of the outstandingly remarkable features and native biodiversity for which these areas were designated or are eligible for further consideration for designation. Within these areas, it would be desirable to convert the non-native plant populations back to native plant communities, but along some stream segments, weed infestations have become so well established that this would be impossible without more extensive and aggressive weed control efforts than planned under the No Action Alternative. Impacts also may occur through reduced activity in the recreational and commercial use sectors. Economic impact can result from changes in expenditures that affect suppliers of recreational goods and services. As an example, the anticipated annual economic impact from weed infestations in Montana is more than $2.6 million (Hirsch and Leitch 1996). This loss comes primarily from lost retail trade ($1.3 million), household ($567,000), and business and personal service ($326,000).

In addition to these effects, implementation of weed treatments, especially mechanical and chemical treatments, near or adjacent to designated or eligible river segments may adversely impact recreational use or enjoyment of the rivers, either by temporarily limiting access or by temporarily reducing an area's overall qualities. For example, increased water turbidity and reduced river aesthetics may result from runoff over areas disturbed by mechanical treatments and over barren areas prior to their revegetation.

BMPs and Mitigation Measures. The No Action Alternative would continue the current weed management strategy, including weed prevention, BMPs, and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures*. Numerous examples of these measures that would be implemented under the No Action Alternative were described in previous discussions of other resources on the S-CNF.

Cumulative Effects. No beneficial or adverse cumulative impacts on stream segments designated or eligible for further consideration as Wild and Scenic would be expected from the combined effects of implementing the No Action Alternative and CWMA treatments on lands adjacent to the S-CNF. However, some cumulative effects may result from other ongoing activities on the S-CNF where there is a potential to introduce weeds and infest a native plant community. Such an occurrence may be difficult to control, contain, or eradicate given the somewhat limited acres of weeds planned for treatment under the No Action Alternative each year. Several examples discussed above where cumulative effects such as these may occur are the Yankee Fork and Panther Creek, which have served as important transportation and recreation corridors, and have been altered by streamside roads and a variety of recreational and commercial activities (mining, outfitting, camping, etc.). Under these conditions and in other drainages with similar conditions or that receive heavy recreational use, safeguarding the value of a Wild And Scenic River designation or a

segment eligible for designation may eventually be compromised under the No Action Alternative weed treatment program.

2) Proposed Action

Direct and Indirect Effects. The Proposed Action would provide far more benefits to, and far fewer adverse effects on, designated and eligible Wild and Scenic River segments than the No Action Alternative because of the more intensive weed treatment program. The Proposed Action would eradicate several weed populations in eligible Wild and Scenic River segments, and would effectively reduce the size and rate of spread of other infestations. The alternative would also result in a corresponding savings in wildland acreage and contribute to maintaining the overall outstandingly remarkable characteristics of the river corridors that led to their designation or their eligibility for designation as Wild and Scenic. The Proposed Action would also have a greater flexibility than the No Action Alternative for treating new weed infestations associated with other recreational activities on the S-CNF.

Adverse effects from weed treatment would be similar to those described for the No Action Alternative and may temporarily include limitations on use or access along portions of river corridors during treatment activities. Additionally, runoff or drift from herbicide applications and increased sedimentation and river water turbidity from mechanical activities may have direct but very short-term effects on portions of eligible corridors.

BMPs and Mitigation Measures. All of the BMPs and mitigation measures described for the No Action Alternative would be implemented under the Proposed Action. In addition, BMPs and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures* for the Proposed Action would ensure that herbicides are applied safely and in accordance with EPA regulations. Any aerial treatment areas would be assessed for sensitive resources, as described in *Chapter 2, Alternatives*. Drift-related mitigation measures specific to aerial application would be implemented (e.g., buffer zones, drift reduction techniques, wind restrictions). Weed treatment information would be made available at District offices and information regarding treatment schedules would be made available through such means as notification to permit holders. The project operation plan would be the source for specific controlled livestock grazing use objectives and stipulations should this particular treatment option be considered. The Proposed Action also incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy, which were described in *Chapter 2, Alternatives*. These management tools are designed to consider site-specific conditions that result in the selection of a treatment method that achieves weed management goals with the least impact to S-CNF resources, including designated and eligible Wild and Scenic River corridors.

Cumulative Effects. The potential for adverse cumulative impacts on designated or eligible Wild and Scenic River corridors under the Proposed Action would be less than that described for the No Action Alternative. The more aggressive and extensive nature of weed treatments that would occur under the Proposed Action would provide more flexibility in being able to treat new weed infestations associated with other ongoing activities on the S-CNF, such as recreational uses, that may otherwise become established. There would be little or no cumulative effects from activities associated with the three CWMAs as these would be very limited or non-existent within Wild and Scenic River areas.

3) Alternative 1

Direct and Indirect Effects. This alternative would provide benefits similar to those described for the Proposed Action, but they would take longer to achieve and be somewhat less effective or widespread because of the absence of aerial herbicide application under this alternative. Most river corridors that are eligible for further considerations as Wild and Scenic (such as the Yankee Fork and Panther Creek) would not be affected by this variation since they already have roads and access for the ground application of herbicides. Other, steeper corridors have smaller weed infestations that may be adequately controlled by ground-based herbicide application and combinations of treatments. However, where large infestations are located on steep, inaccessible hillsides, weed eradication and control may take longer and be less effective than the Proposed Action, increasing the risk of adverse effects to the outstandingly remarkable eligibility characteristics.

Adverse effects resulting from mechanical, controlled livestock grazing, and chemical treatment would be similar to those described for the Proposed Action, although the potential risk for herbicide drift into sensitive areas from aerial applications would be removed.

BMPs and Mitigation Measures. This alternative incorporates all BMPs and mitigation measures (except for aerial herbicide application), as well as use of the site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy, that were described for the Proposed Action.

Cumulative Effects. The cumulative effects under this alternative would be similar to those described for the Proposed Action.

4) Alternative 2

Direct and Indirect Effects. While this alternative offers a full array of non-chemical treatment options, it is anticipated that weed treatment would take longer and be considerably less effective than under the Proposed Action, Alternative 1, or the No Action Alternative. As a result, designated and eligible Wild and Scenic River corridors in the vicinity of weed infestations would be significantly affected by this alternative, since invasions of noxious weeds would continue and existing infestations would expand, putting these outstandingly remarkable characteristics at risk. Large weed infestations dominating the northern part of the S-CNF would be impossible to control or contain in the short term under Alternative 2. This is especially important since Appendix I shows that the bulk of river corridors (over 12,000 acres) designated as Wild and Scenic on the S-CNF occur in the North Fork Ranger District where spotted knapweed infestations are extensive. It is possible that biological methods would have an effect in containing and controlling weeds, but it would likely take several decades to achieve management goals. This would lead to expansion of knapweed infestations in these areas and additional impacts on designated Wild and Scenic Rivers and on the outstandingly remarkable characteristics identified on those stream segments eligible for further study as Wild and Scenic.

This alternative would not incorporate any herbicide treatments, thus eliminating the potential risk of drift and other possible chemical-related effects on the characteristics of these unique areas. However, the extensive use of mechanical treatments under Alternative 2 and resultant surface disturbances, erosion, and potentially increased

sedimentation and river water turbidity may adversely affect the characteristics of designated and eligible Wild and Scenic Rivers and their corridors.

BMPs and Mitigation Measures. This alternative incorporates all BMPs and mitigation measures (except for herbicide application) described for the Proposed Action, and discussed in *Section 2.D.3, Management Practices and Mitigation Measures*. It also includes use of the site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy, the same as noted for the Proposed Action.

Cumulative Effects. Cumulative effects under Alternative 2 would be similar to those described for the No Action Alternative. However, they would include increased limitations in the flexibility to control, contain, or eradicate potential new infestations of noxious weeds introduced through other ongoing activities, such as various recreational and commercial uses, that occur on the S-CNF. There would be little or no cumulative effects from activities associated with the three CWMAs as these would be very limited or non-existent within Wild and Scenic River areas.

4.C.5. Visual Resources

a. No Action Alternative

Direct and Indirect Effects. Under the No Action Alternative, current weed management techniques would continue. As noted in previous discussions in this document, weed invasions continue to spread, despite control and eradication efforts on the S-CNF. Without more aggressive control techniques, a direct effect would be increased vulnerability of S-CNF resources to expanding noxious weed invasions from infested areas.

For visual resources, noxious weed populations primarily affect views of the immediate foreground and middle ground, rather than the background, except where plant infestations are large enough to impact views of hillsides. Direct effects on visual resources can be both positive and negative. Negative effects of weeds are largely limited to the foreground, where weeds are out of scale, visually out of place, and often associated with land disturbances such as timber harvesting activities and livestock grazing. At the same time, to those unaware that they are looking at noxious weeds, flowering knapweed and other weeds may be an appealing component of the landscape. As a result, it is difficult to quantify the effects of the No Action Alternative on visual resources. However, the No Action Alternative would have a direct effect on the opportunity to view native vegetation and wildlife through the continuing loss of wildland acres. An indirect effect associated with this loss is that the visual appeal native plant populations offer would be reduced. As native plant populations decrease, opportunities for viewing wildlife that rely on these plants would also diminish.

BMPs and Mitigation Measures. The No Action Alternative would continue the current weed management strategy, including BMPs and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures*. Numerous examples were provided in previous resource discussions in this chapter.

Cumulative Effects. There may be some minor cumulative impacts on visual resources under the No Action Alternative if other ongoing S-CNF activities or occurrences (for example, wild fire, road- or trail-related erosion), together with the presence of weeds on the

S-CNF, adversely affect views of the S-CNF. The potential for limited weed treatment success on adjacent lands that are treated under the three CWMAs because of limited success on the S-CNF under the No Action Alternative may result in localized minor cumulative impacts on visual resources at the S-CNF boundary.

b. Proposed Action

Direct and Indirect Effects. The Proposed Action would offer a more fully integrated approach to weed management than any of the other alternatives while maintaining or enhancing visual resources objectives. The long-term expected effect of the success of the Proposed Action is that any weed-infested sites would return to their original state. As native plant populations recover, the natural appearing landscapes would return, and enhanced wildlife on the S-CNF would increase opportunities for viewing natural habitat and wildlife.

The Proposed Action would directly affect the potential visual impact of the anticipated increasing weed populations along roads and hillsides. It would eradicate several weed populations, and would effectively reduce the size and rate of spread of other infestations. Visual quality in treated areas on the S-CNF would improve. During treatment, however, visual opportunities may be temporarily diminished as weed populations die, soil surfaces are exposed and disturbed, and natural vegetation is restored and recovers. This effect is expected to be short-lived, and would be most apparent where there are large weed infestations. Other effects of the Proposed Action on visual resources could include potential trampling of treatment areas during mechanical and livestock grazing treatments in and around an infestation.

BMPs and Mitigation Measures. All BMPs and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures* and discussed in previous sections of this document would be implemented under the Proposed Action to avoid or minimize impacts on S-CNF visual resources. The Proposed Action also incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy that achieves weed management goals with the least impact on S-CNF resources, including visual quality.

Cumulative Effects. No cumulative impacts on S-CNF visual resources would be expected from the combined effects of implementing the Proposed Action, other ongoing activities or occurrences on the S-CNF, and CWMA weed treatments on lands adjacent to the S-CNF. The more aggressive and extensive nature of weed treatments that would occur under the Proposed Action would provide more flexibility in being able to treat weed infestations and prevent or minimize the potential occurrence of cumulative impacts on visual resources.

c. Alternative 1

Direct and Indirect Effects. This alternative would not incorporate aerial spraying activities. As a result, large weed infestations in steep, inaccessible areas would be more difficult and somewhat less effective to control and eradicate. This could lead to expansion of spotted knapweed infestations throughout the S-CNF, and some additional loss of additional wildland acres.

The resulting direct visual impact associated with Alternative 1 would be most apparent where large infestations of weeds occur on steep slopes most prevalent in the northern Ranger Districts of the S-CNF. Ground application of herbicides may have some long-term effects on weed infestations, but control and eradication goals may not be met where access to remote, rugged areas of the S-CNF is often difficult at best. As a result, the vistas of these steep, widely visible slopes would be marred by weed infestations indefinitely. Smaller, more accessible weed populations would be effectively treated, and Alternative 1 would result in control of most populations and eradication of smaller populations. Other direct effects would be the same as described for the Proposed Action; some visual opportunities would be marred during treatment as weeds die, soil surfaces are exposed and disturbed, and native plant populations recover.

BMPs and Mitigation Measures. This alternative incorporates all BMPs and mitigation measures (except for aerial herbicide application) that were described for the Proposed Action and discussed in previous sections of this document.

Cumulative Effects. There may be some potential for cumulative impacts on visual resources under Alternative 1 when combined with the potential effects of other ongoing S-CNF activities and treatment effects under the CWMAs. The nature of the cumulative effect would be similar to that described for the No Action Alternative.

d. Alternative 2

Direct and Indirect Effects. This alternative does not include any herbicide treatment. It is therefore anticipated that weed treatment would take longer and be less effective than under the Proposed Action, Alternative 1, or the No Action Alternative. Large weed infestations on the steep inaccessible areas most prevalent in the northern part of the S-CNF would be impossible to control and contain in the short term. This could lead to expansion of knapweed infestations in these Ranger Districts, and some additional loss of opportunities for viewing the natural landscape. Other large weed infestations could also expand, at least in the short term, since many weed types do not immediately and may never effectively respond to non-chemical treatment.

BMPs and Mitigation Measures. This alternative incorporates all BMPs and mitigation measures (except for herbicide application) described for the Proposed Action, and discussed in *Section 2.D.3, Management Practices and Mitigation Measures*. Like the Proposed Action and Alternative 1, this alternative also includes use of the site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy to minimize impacts on visual resources while achieving weed treatment objectives on the S-CNF.

Cumulative Effects. Potential cumulative impacts on visual resources under Alternative 2 would generally be similar to those described for the No Action Alternative, however, the cumulative effectiveness and weed treatments with the CWMA program would be reduced.

4.C.6. Air Quality and Noise

a. Air Quality

1) No Action Alternative

Direct and Indirect Effects. Under the No Action Alternative, existing weed management treatment techniques would continue, including current levels of herbicide application. An effect on air quality would be potential drift from herbicide spraying onto non-target areas. Spot spraying would result in little drift as applications are made close to the ground's surface. The odor of the chemicals may persist at spray sites for several hours following current ground-based application strategies. Other direct effects on air quality would include dust from spray vehicles and mechanical weed control efforts. Indirect effects on air quality from successful weed treatment would include localized reductions in airborne pollen from weeds and allergens at certain times of the year. However, because the No Action Alternative would continue weed eradication and control efforts at their present level, it is anticipated that pollen levels across the S-CNF would remain at about current levels or increase under this alternative. None of the herbicides approved for use in wildland weed control produce significant airborne by-products. Indirect effects from these activities would be minimal because of the application of BMPs and mitigation measures described in the following text.

BMPs and Mitigation Measures. The No Action Alternative would continue the current weed management strategy, including the use of BMPs and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures*. Because herbicide preparation, use, and application rates would comply with label instructions and Forest Service requirements, there would be no adverse effects on air quality. Examples of protective BMPs and mitigation measures include compliance with all State and Federal laws and agency guidelines during herbicide application; application of herbicides in accordance with EPA registration label requirements and restrictions; no spraying of herbicides when wind velocity exceeds 10 mph; and BMPs and mitigation measures described in the preceding resource discussions in this chapter regarding accidental spills of herbicides, wind drift during herbicide application, and the availability of weed treatment information at District offices. Additional examples of protective BMPs and mitigation measures are presented in *Section 4.D.1, Human Health and Safety*, of this chapter.

Cumulative Effects. Potential cumulative effects on air quality under the No Action Alternative include possible localized increases in dust from mechanical weed treatment and herbicide spray vehicles' activities and from other nearby ongoing S-CNF activities, such as use of roads and trails. Similar cumulative effects may result from nearby weed treatments on adjacent lands under the three CWMAs. Also, some localized odors from herbicide use may persist for several hours if S-CNF and CWMA treatments occur at the same time and in proximity to one another. Since the effects of herbicide application are short term, they will not have cumulative carry-over effects from year to year on air quality.

2) Proposed Action

Direct and Indirect Effects. A potential short-term direct effect on air quality under the Proposed Action would stem from herbicide drift to non-target areas during aerial spraying. Ground-based herbicide application would result in little drift as applications are made

close to the ground's surface. In either case, the odor of the chemicals may persist at spray sites for several hours following ground-based or aerial application. Other direct effects would include increased dust and pollen from vehicles or mechanical treatments.

Short-term mechanical treatments could also include burning weeds with a propane torch. This may lead to a small increase in smoke or haze in the immediate vicinity of the treatment area. None of the herbicides currently registered for wildland weed control are known to produce airborne by-products from burning treated vegetation in amounts that affect air quality. However, spot burning of vegetation treated with chemicals would not be planned within the same season that chemicals are applied. Mechanical treatment of this kind would only be used on small, isolated infestations of weeds, while chemicals would generally be applied on larger, more mature, infestations.

Since the Proposed Action would provide for the greatest level of weed control compared to the other alternatives it would result in the greatest reduction in airborne weed pollen and allergens in the affected area in the long term.

BMPs and Mitigation Measures. The BMPs and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures*, would ensure that herbicides are applied safely and in accordance with EPA regulations. All of the BMPs and mitigation measures previously described for the No Action Alternative and referenced in other sections of this chapter would be implemented under the Proposed Action. Drift-related mitigation measures specific to aerial herbicide application also would be implemented under the Proposed Action (e.g., wider buffer zones than for ground-based herbicide application, no aerial spraying within 300 feet of developed campgrounds or residences, drift reduction techniques, and wind velocity and directional restrictions during aerial application). In addition, weed treatment information would be made available at District offices and information regarding treatment schedules would be made available through such means as notification to permit holders. The Proposed Action also incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy to minimize the potential for air quality impacts while achieving weed treatment objectives.

Cumulative Effects. Cumulative effects on air quality under the Proposed Action from other ongoing S-CNF activities and CWMA treatment activities would be similar to those described for the No Action Alternative. Application of chemical herbicides on adjacent ownerships combined with S-CNF applications would result in the same, short-term effects on air quality caused by chemical odor. This effect may combine to cover a more extensive area if application occurs on adjacent lands at similar times. Since these effects are short term, they would not have carry-over effects from year to year relative to air quality.

3) Alternative 1

Direct and Indirect Effects. The direct effects on air quality of Alternative 1 would be virtually identical to those of the Proposed Action, although the short-term risk of drift from aerial spraying would be removed. However, without aerial spraying, large weed infestations on steep inaccessible slopes would be more difficult and less effective to control and eradicate. This could lead to short-term expansion of spotted knapweed infestations, especially on northern portions of the S-CNF. As a result, airborne weed pollen and allergens would probably increase in those areas.

Smaller, more accessible weed infestations would be effectively treated, and Alternative 1 would result in the control of most weed populations and the eradication of smaller populations, although not as quickly as under the Proposed Action. As a result, localized reductions in levels of airborne weed pollen and allergens would be expected. Other direct effects would be the same as described for the Proposed Action.

BMPs and Mitigation Measures. This alternative includes all BMPs and mitigation measures (except for aerial herbicide application), as well as components of the site-specific implementation process that were described for the Proposed Action.

Cumulative Effects. Cumulative effects on air quality under Alternative 1 would generally be similar to those described for the Proposed Action although there would be a reduced potential for widespread effects when combined with CWMA activities because of no aerial herbicide applications.

4) Alternative 2

Direct and Indirect Effects. Short-term effects on air quality from herbicide application would not occur as no chemical applications would be used under this alternative. However, the more extensive use of mechanical treatments that would occur under Alternative 2 may result in localized increases in dust levels and temporary but repeated instances of air quality degradation. Because it would take longer to achieve a lesser level of weed control or containment under Alternative 2 than the other alternatives temporarily increased dust levels from mechanical treatments at least in localized areas would likely extend over an indefinite period of time. Beneficial effects of reduced weed pollen and allergens on any particular site would occur if weeds are reduced on that site. Individually, these effects may be too small to substantially benefit local air quality.

BMPs and Mitigation Measures. This alternative includes all BMPs and mitigation measures (except for herbicide application) described for the Proposed Action, and discussed in Section 2.D.3, Management Practices and Mitigation Measures. It also includes all components of the site-specific implementation process described for the Proposed Action.

Cumulative Effects. Cumulative effects under this alternative would be similar to those described for the Proposed Action, with two exceptions. There would be a greater potential for cumulative air quality impacts due to increased dust levels but no potential for cumulative herbicide effects since chemicals would not be used under Alternative 2.

b. Noise

1) No Action Alternative

Direct and Indirect Effects. Under the No Action Alternative, existing weed management techniques would continue, including current levels of herbicide application. The only short-term direct effect on noise levels would be from localized mechanical treatments such as mowing and mulching.

BMPs and Mitigation Measures. The No Action Alternative would continue the current weed management strategy, including the BMPs and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures*.

Cumulative Effects. There may be localized, temporary cumulative effects on noise levels associated with the No Action Alternative because of increased noise levels from other ongoing activities on the S-CNF (for example, use of roads, trails, and other recreational activities) and possibly from increased noise levels from nearby mechanical weed treatments that may be occurring on adjacent lands under the three CWMAs.

2) Proposed Action

Direct and Indirect Effects. Short-term direct effects on noise levels under the Proposed Action would result from equipment used in aerial spraying of herbicides and from mechanical treatment efforts such as mowing and mulching. Indirect effects may occur if the frequency or quality of commercial and recreational experiences on the S-CNF are diminished because of increased noise levels during treatment activities.

BMPs and Mitigation Measures. The BMPs and mitigation measures described in *Section 2.D.3, Management Practices and Mitigation Measures*, would be implemented to ensure that noise levels are kept at a minimum during weed treatments. In addition, weed treatment information would be made available at District offices and information regarding treatment schedules would be made available through such means as notification to permit holders.

Cumulative Effects. Cumulative effects on noise under the Proposed Action would be similar to those described for the No Action Alternative, and generally localized to the area of weed infestation and other nearby activities and temporary in nature.

3) Alternative 1

Direct and Indirect Effects. Overhead noise from aerial herbicide applications would not occur under this alternative, thus decreasing the impact on noise levels from weed treatments. With this exception, the direct and indirect effects on noise levels under Alternative 1 would be virtually identical to those of the Proposed Action, and would be short term.

BMPs and Mitigation Measures. This alternative includes all BMPs and mitigation measures (except for aerial herbicide application) as well as the site-specific implementation process described for the Proposed Action.

Cumulative Effects. Cumulative effects on noise would be similar to those described for the No Action Alternative, but they would potentially occur in localized areas over a greater portion of the S-CNF because of larger acreages planned for annual treatment under Alternative 1.

4) Alternative 2

Direct and Indirect Effects. Mechanical weed treatments may cause short-term, direct effects on noise levels within the areas of weed treatment. The use of mechanical treatment methods and noise generated by this treatment technique would be greater under this alternative than any of the other alternatives because of the absence of chemicals as a treatment option. Indirect effects may also occur if some recreational and commercial experiences are affected by a short-term rise in noise levels.

BMPs and Mitigation Measures. This alternative includes all BMPs and mitigation measures (except for herbicide application) described for the Proposed Action, and discussed in *Section 2.D.3, Management Practices and Mitigation Measures*.

Cumulative Effects. Cumulative effects on noise would be similar to those described for Alternative 1, although localized and temporary increases in noise levels may be greater under Alternative 2 because of the more extensive use of mechanical treatments.

4.D. Human and Socioeconomic Resources

4.D.1. Human Health and Safety

a. No Action Alternative

Direct and Indirect Effects. Noxious and invasive non-native weeds are not known to have directly or indirectly affected human health and safety on the S-CNF, and they have not posed significant health threats to a large segment of the population. These same general conditions would be expected in the future, although the continued expansion of noxious weeds on the S-CNF under the No Action Alternative (as discussed in *Section 4.B.1, Vegetation Resources and Noxious Weeds)* may result in an increased potential for minor effects on human health and safety. Examples of potential effects on humans that can be caused by weed species present on the S-CNF, and unique characteristics of several of these species, were described in *Section 3.E.1, Human Health and Safety*. They include minor scrapes and skin irritations from Canada, musk, and other thistle species; sickness from ingesting large amounts of tansy ragwort and St. Johnswort; minor skin irritations from hand-pulling weeds without using gloves; a latex-bearing sap in leafy spurge that can irritate human skin and cause blindness in humans on contact with the eyes; the sap of Russian knapweed contains a known carcinogen; and the sap of spotted knapweed may contain a carcinogen (U.S. Forest Service 2000a; U.S. Forest Service 2001d; Callihan et al. [1991] in U.S. Forest Service 2001a; Niehoff [1997] in U.S. Forest Service 2001d). The potential for some of these effects to occur on the S-CNF would likely increase under the No Action Alternative compared to existing conditions because of expected increases in weed infestations. Increased weed infestations on the S-CNF also would increase the chance of fire within the wildland interface. The resultant degree of risk to human health and safety would depend directly on the successes and failures of the weed treatment program on the S-CNF and indirectly on the successes and failures of the three CWMA treatment programs on adjacent lands. An additional human health-related effect discussed for the No Action Alternative in *Section 4.C.6.a, Air Quality*, of this chapter is the potential for increased levels of airborne weed pollen and allergic reactions.

The ground-based application of herbicides and other weed treatments (biological controls and mechanical methods) on the S-CNF would continue under the No Action Alternative at the current treatment rate of approximately 3,000 to 3,500 acres per year. There have been no data to indicate that any of the weed treatment activities on the S-CNF, including herbicide application, have impacted public or worker health and safety and, therefore, they would not be expected to under the No Action Alternative. There have been no reported instances of herbicide impacts to workers on the S-CNF and no reports of worker health problems. This conclusion is supported by findings for weed management programs on other National

Forests in the Intermountain West that are discussed in detail under the Proposed Action. The Forest Service concluded that based on the best scientific information available and with the implementation of BMPs and mitigation measures, it would be reasonably expected that human health impacts from herbicide applications would range from insignificant and small to none (U.S. Forest Service 1999b; 2000b; 2001a; b; c). The use of biological controls and mechanical methods, as well as site restoration (where appropriate) following treatment, would not be expected to adversely affect human health and safety so long as all equipment used is operated safely and according to the manufacturer's directions. Small amounts of dust may be temporarily raised during some weed treatment/restoration activities, but any effects would be localized and minor.

Other possible effects on workers from treating weeds include cuts, scratches, and skin irritation during the treatment of weeds, as well as sprains and strains from bending or working on uneven ground. The use of boots, long-sleeved shirts, and gloves, as well as strict adherence to Forest Service safety policies, would minimize the risk of injuries or skin irritations to workers. Weed treatments would continue to be implemented according to all of the BMPs and mitigation measures described for the No Action Alternative in *Chapter 2, Alternatives* to avoid or minimize the potential for impacts on human health and safety. Many of these measures focus on the safe and proper application of herbicides, as described below.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the No Action Alternative are designed to avoid or minimize the potential for adverse effects on public health and safety and worker health and safety on the S-CNF. They focus on the proper ground-based application of herbicides and on weed prevention and management BMPs. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures,* and include 23 directives that specifically address precautionary, notification, and other safeguarding measures associated with the ground-based application of herbicides. Examples of some of these measures include the following:

- Apply all chemicals in accordance with EPA registration label requirements and restrictions and/or Forest Service policy, whichever is more restrictive.
- Fill out a Pesticide Application Record on a daily basis detailing the chemical application.
- Treatment areas will be identified on maps available at the Ranger District offices and the Public Lands Office in Salmon, Idaho. The herbicides used, dates of use, and name and phone number to contact for more information will also be available.
- Use a State or Federal licensed applicator to apply or directly supervise herbicide application.
- Follow restrictive location, application methodology, and wind velocity criteria to reduce wind drift potential and the potential for impacts on special concern areas.
- Follow procedures for mixing, loading, and disposing of herbicides (see Appendix B).

- Carry a Herbicide Emergency Spill Plan (see Appendix D) to reduce the risk and potential severity of an accidental spill.
- Carry containment equipment during herbicide application in case of a spill.
- Retain a copy of the material data safety sheets for each herbicide and train personnel on the location and understanding of this information.

Cumulative Effects. Potential cumulative effects include the combined effects of weed treatment under the No Action Alternative together with treatments under the three CWMAs. Expected increases in weed infestations on the S-CNF and possibly on adjacent non-National Forest lands may increase the likelihood on a cumulative basis that some of the adverse effects weed species can have on human health could occur under the No Action Alternative. The potential for such an occurrence may be greatest in the northern portion of the S-CNF and on immediately adjacent non-National Forest lands because of extensive spotted knapweed infestations. Also, the likelihood that weed treatments would continue over a number of years results in a cumulative increase in the possibility that a health-related effect would occur as a result of the actual treatment of weeds (for example, sprains, strains, skin irritations, allergies, cuts, etc.).

There also may be some minor, localized cumulative increases in dust as a result of soil disturbance and exposure during and following treatment prior to re-establishment of native vegetation. There would likely be no cumulative effects on the public or workers from the effects of other ongoing activities or future actions on the S-CNF that are unrelated to weed treatments, such as livestock grazing, roads and trails, and recreation.

b. Proposed Action

Direct and Indirect Effects. The potential for adverse effects on human health and safety caused by the occurrence of noxious weeds on the S-CNF would progressively decline under the Proposed Action compared to the No Action Alternative because of the expected decline in weed populations. Examples of these effects were described under the No Action Alternative. They included scrapes, scratches, cuts, skin irritations, allergies, and other relatively mild effects. The potential for fire within the wildland interface and risk to human health and safety also would be expected to decline as weed populations decline.

Weed treatment methods that would be used under the Proposed Action include mechanical, biological, controlled grazing, aerial and ground-based herbicide applications, and combinations of these treatments. The use of biological controls and controlled grazing would not be expected to adversely affect human health and safety, except possibly for sprains or strains to workers using these treatment methods in very steep or uneven terrain. Risks to workers from using mechanical methods during weed treatment/site restoration would be the same as described for the No Action Alternative, and include the possibility of cuts, scratches, sprains, and strains. The same precautionary measures would be followed while conducting work and operating machinery to ensure worker safety. Any effects from dust raised during weed treatment/site restoration activities would be localized, temporary, and minor.

The application of chemicals would be one of the primary weed treatment methods on the S-CNF under the Proposed Action.

Approximately 13,600 acres of weed infestations on the S-CNF would be treated under the Proposed Action each year using a combination, or one or the other, of aerial and ground-based herbicide applications. Herbicides also would be used in combination with mechanical, biological, and controlled livestock grazing treatments to treat an additional 1,400 acres of noxious weeds on the S-CNF each year. Aerial herbicide application would be the most effective and aggressive treatment method for quickly accessing and treating large weed-infested areas and smaller, isolated areas, but this is often a concern to the public from a human health and safety perspective.

Numerous Forest Service NEPA documents recently prepared for weed management programs on other National Forests in the Intermountain West have addressed this concern by examining the potential direct, indirect, and cumulative effects of various herbicides on human health and safety. Herbicide applications evaluated in those documents include ground-based as well as aerial applications. The Forest Service concluded that based on the best scientific information available and with the implementation of BMPs and mitigation measures, it would be reasonably expected that human health impacts from herbicide applications would range from insignificant and small to none (U.S. Forest Service 2001b; c; d; 1999a; 2000a). Findings presented in those documents that are applicable to the S-CNF are referenced in this Final EIS.

There is a wide variety of opinions within the general population on the value and safety of pesticides, including the herbicides proposed for use on the S-CNF. Many people, especially in rural and agricultural areas, regard pesticides as a necessary part of their business and as a relatively safe tool, if used properly (U.S. Forest Service 2001d). The Northern Region of the Forest Service (Region 1) has analyzed the risk of the use of a number of the herbicides proposed for use on the S-CNF, including 2,4-D, picloram, clopyralid, dicamba, glyphosate, triclopyr, and metsulfuron methyl. This analysis is presented in the following two Risk Assessment documents: *Risk Assessment for Herbicide Use in Forest Service Regions 1, 2, 3, 4, and 10 and on Bonneville Power Administration Sites* (U.S. Forest Service 1992); and *Human Health Risk Assessment for Herbicide Application to Control Noxious Weeds and Poisonous Plants in the Northern Region* (Monnig 1988). Additional studies or research referenced include *EPA Science Advisory Board Report: Assessment of Potential 2,4-D Carcinogenicity-3/91* (EPA 1994); *EPA Risk Assessment Guidelines of 1986-8/87* (EPA 1986); and *EPA RdD/Peer Report of Picloram-9/93* (EPA 1993). These documents are incorporated into this EIS by reference and are included in Forest Service files.

The Forest Service (2001d) discussed the considerable body of laboratory test data that are available on herbicides. Most of these tests have been conducted to meet requirements for EPA registration of these chemicals for use in the U. S. Current Federal regulations allow for conditional registration of herbicides pending the completion of all tests required for final registration as long as no unreasonable adverse effects are found in the interim. The Forest Service (2001d) also noted that this allowance for continued use before all testing of a herbicide is completed concerns some members of the public and has led to charges that "untested" herbicides are allowed on the market. To the contrary, all of the herbicides proposed in this Final EIS for use on the S-CNF are EPA-approved for use according to their label instructions, are conditionally registered, and have been assigned EPA registration numbers.

Appendix J provides information on the characteristics and properties of the herbicides proposed for use on the S-CNF, including their persistence and mobility in soil and water, degradation mechanisms, and toxicity levels to various animals. Information on toxicity levels and toxicity categories comes from results of tests the EPA requires for herbicide registration that must evaluate acute (short-term) and chronic (longer term) exposures of laboratory animals to chemicals. All of these herbicides have been subjected to long-term feeding studies that test for general systemic effects such as kidney and liver damage. In addition, tests on the effects on reproductive systems, mutagenicity (birth defects), carcinogenicity (cancer), and teratogenicity (malformations) have been conducted (U.S. Forest Service 2001d; 1999a).

Table 4-3 lists EPA toxicity categories (danger/poison, warning, caution, none) for various types of harmful acute reactions (oral, dermal, inhalation, eye irritation, and skin irritation). Table 4-4 compares human hazards based on these EPA acute toxicity categories for the herbicides proposed for use on the S-CNF. EPA toxicity categories for acute oral, acute dermal, acute inhalation, and primary skin irritation are rated as "caution" or "none" for all of the herbicides, except picloram ("danger/poison" for inhalation). Acute effects associated with primary eye irritation exceed "caution" levels for six of the herbicides listed in Table 4-4.

Table 4-5 compares the potential for harmful human carcinogenic, teratogenic, reproductive, and mutagenic chronic effects for the herbicides proposed for use on the S-CNF. Data presented in Table 4-5 show that for each of the four human health categories evaluated, the herbicides would either have "no effects" (not considered a hazard to humans) or "unlikely effects" (not considered a hazard to humans at expected exposure levels), with two exceptions. These exceptions are "unknown effects" regarding the carcinogenicity of 2,4-D and picloram, indicating that laboratory tests are inconclusive or further testing is required.

The herbicides identified in these tables also contain "inert" ingredients, including surfactants, that are not expected to have any significant effect. The dyes and other adjuvants described in Chapter 2 are described as having little effect on wildlife populations. Mitigation measures, buffer zones BMPs, and SOPs are expected to minimize adverse impacts, if any, of these other ingredients.

TABLE 4-3
EPA Toxicity Categories for Various Types of Harmful, Acute Reactions

Toxicity Category	Signal Word	Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/L)	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	Severe irritation at 72 hours
III	CAUTION	>500 – 5,000	> 2000 – 20,000	>2.0 – 20	No corneal opacity; irritation reversible within 7 days	Moderate irritation at 72 hours
IV	NONE	>5,000	>20,000	>20	No irritation	Mild or slight irritation at 72 hours

Source: U.S. Forest Service 2001b.

TABLE 4-4
Human Hazards Based on Acute Toxicity Categories for Weed Control Herbicides on the S-CNF

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
Chlorsulfuron	None	Caution	Caution	Caution	None
Clopyralid	Caution	Caution	Caution	Warning	None
Corn Gluten Meal (WOW!®)	None	None	None	None	None
Dicamba	Caution	None	None	Danger-Poison	None
Fosamine	None	None	None	Caution	Caution
Glyphosate	None	None	Caution	Warning	None
Imazapic	None	None	None	Caution	Caution
Metsulfuron Methyl	None	Caution	Caution	Warning	Caution
Pelargonic Acid (Scythe®)	None	None	None	None	None
Picloram	Caution	Caution	Danger-Poison	Caution	None
Sulfometuron Methyl	None	Caution	Caution	None	None
Triclopyr	Caution	Caution	Caution	Caution/Danger	Caution

Sources: EXTOXNET 2002, EPA 2002, Bio-Weed® 2002, U.S. Forest Service 2001a, and U.S. DOE.

TABLE 4-5
Comparison of Harmful Chronic Effects of Herbicides Proposed for Controlling Weeds on the S-CNF

	Potential Chronic Effects			
Herbicide	Carcinogenic	Teratogenic	Reproductive	Mutagenic
2,4-D amine	Unknown	Unlikely	Unlikely	Unlikely
Chlorsulfuron	No Effects	No Effects	No Effects	No Effects
Clopyralid	No Effects	No Effects	No Effects	No Effects
Corn Gluten Meal (WOW!®)	No Effects	No Effects	No Effects	No Effects
Dicamba	No Effects	No Effects	Unlikely	No Effects
Fosamine	No Effects	No Effects	No Effects	No Effects
Glyphosate	No Effects	No Effects	Unlikely	No Effects

TABLE 4-5
Comparison of Harmful Chronic Effects of Herbicides Proposed for Controlling Weeds on the S-CNF

	Potential Chronic Effects			
Herbicide	**Carcinogenic**	**Teratogenic**	**Reproductive**	**Mutagenic**
Imazapic	No Effects	No Effects	No Effects	No Effects
Metsulfuron Methyl	No Effects	No Effects	No Effects	No Effects
Pelargonic Acid (Scythe®)	No Effects	No Effects	No Effects	No Effects
Picloram	Unknown	No Effects	No Effects	Unlikely
Sulfometuron Methyl	No Effects	No Effects	Unlikely	No Effects
Triclopyr	No Effects	No Effects	No Effects	Unlikely

No Effects = No effects have been shown in laboratory tests and it is not considered a hazard to humans.

Unlikely = Inconsistent or isolated effects have been shown in laboratory tests and it is not considered a hazard to humans at expected exposure levels.

Unknown = Laboratory tests are inconclusive or further testing is required.

Sources: EXTOXNET 2002, EPA 2002, Bio-Weed® 2002, U.S. Forest Service 2001a, and U.S. DOE.

The Forest Service (2001d; 2000a; and 1999a) states that the evidence on the carcinogenicity of 2,4-D and picloram is widely debated. Current evidence is mixed, and these compounds seem at most weakly carcinogenic. The Forest Service Project File on the Risk Assessments cited above (U.S. Forest Service 1992; Monnig 1988) contains a letter from Dr. John Graham of the Harvard University School of Public Health stating that the weight of evidence that 2,4-D is a carcinogen is not strong, and even if it is ultimately shown to be carcinogenic, it is unlikely to be a very potent one. In addition, the Science Advisory Board (EPA 1994) at the request of the EPA reviewed 2,4-D and concluded:

> Epidemiologic cohort studies have generally shown no increased risk of cancer, albeit that all of the populations for which specific exposure to 2,4-D have been identified were small, and the follow up period short...The committee concluded that current studies cannot distinguish whether observed risks reported are due to the use of 2,4-D...The Committee concludes that the data are not sufficient to find that there is a cause and effect relationship between the exposure to 2,4-D and Non-Hodgkin's Lymphoma (in U.S. Forest Service 1999a).

Regarding picloram, the EPA Peer Report (EPA 1993) review of this chemical found it to be a "Group E" carcinogen. A "Group E" carcinogen is part of a group "that show no evidence for carcinogenicity in at least two adequate animal tests in different species or in both adequate epidemilogic and animal studies" (in U.S. Forest Service 1999a).

NOELs are available for most types of laboratory toxicity tests, and indicate the highest dose in a particular test that did not result in adverse health impacts to the animal being tested

(U.S. Forest Service 2001d; 1999a). Extrapolating a NOEL from an animal study to humans is an uncertain process. The EPA compensates for this uncertainty by dividing NOELs from animal tests by a safety factor (typically 100) when deciding how much herbicide will be allowed on various foods. This adjusted dose level is referred to as the ADI and is determined by the EPA to be a dose that is safe, even if received every day for a lifetime. The ADI value is usually expressed as milligrams of herbicide allowed per kilogram of body weight. The lower the ADI value, the more toxic the herbicide. Table 4-6 lists the ADIs for herbicides proposed for use on the S-CNF with the comparatively higher acute and chronic toxicity values of the herbicides listed in Tables 4-3 and 4-5. 2,4-D has the lowest ADI value among the herbicides listed in Table 4-6.

TABLE 4-6
ADI mg/kg/day

Herbicide	ADI[1]
Picloram	0.07
2,4-D	0.01 (0.3)[2]
Glyphosate	0.1
Dicamba	0.03
Clopyralid	0.5
Triclopyr	0.025
Metsulfuron Methyl	0.25

[1] From U.S. Forest Service (1992b, in U.S. Forest Service 2001d).
[2] For 2,4-D the World Health Organization has established an ADI of 0.3.

Potential direct effects of herbicide treatment on human health and safety may occur from direct contact with a herbicide, such as when a licensed applicator sprays a herbicide. The Forest Service (2001d) discussed several factors that can affect worker dose level. Weather conditions at the time of herbicide application will affect the level of exposure. Higher winds create more herbicide drift, especially when a high-pressure nozzle is used, which increases the chance of vapors. The BMPs and mitigation measures described in *Chapter 2, Alternatives* include restrictive herbicide application procedures depending on wind velocity and direction. Using appropriate personal protective equipment as required by label can lower the exposure for workers by as much as 68 percent (U.S. Forest Service 1992; in U.S. Forest Service 2001d). This is an especially important factor since most application exposure to herbicides is through the skin and not the lungs (Monnig 1988; in U.S. Forest Service 2001d). Also, the attention and care that a worker uses when mixing, loading, and applying herbicides greatly influences the risk of exposure. To reduce these risks, it is essential that workers receive proper training and certification in mixing, loading, and applying herbicides.

In the Risk Assessments cited above, the Forest Service (in U.S. Forest Service 2001d) has calculated that the 1 day (ADI) dose for workers applying 2,4-D with a backpack sprayer could potentially exceed the EPA's recommended daily dose. However, these risks were determined to be very small because the spraying would only take place a few weeks each

year, as compared to the EPA's ADI values, which assume a lifetime of daily doses. In addition, using all BMPs and mitigation measures listed in *Chapter 2, Alternatives* for the Proposed Action and following the herbicide mixing, loading, and disposal procedures described in Appendix D during weed treatment would reduce the incidence of worker exposure to herbicides. The Forest Service (2000a) also noted that the application rate in pounds of active ingredient per acre is typically below those used in testing and thus adds another margin of safety. This same rationale applies to the aerial application of herbicides, because of the 20 BMPs and mitigation measures listed in *Chapter 2, Alternatives* that are specifically directed at the proper and safe application of herbicides and because of the aerial spray recommendations described in Appendix E of this EIS.

The Forest Service (2001d; 1999a) also acknowledged the possibility of idiosyncratic responses such as hypersensitivity in a small percentage of the population. Such individuals are usually aware of their sensitivities because various natural and synthetic compounds typically trigger them. These persons would not be permitted to work on herbicide spray crews.

Potential indirect effects of herbicide treatment on human health and safety may occur from secondary contact by the public with a herbicide. An example evaluated in three other Forest Service documents (U.S. Forest Service 2001d; 1999a; 2000a), based on findings of the previously referenced Risk Assessments, is when people pick berries (or another wild food) in an area that has been treated with a herbicide. For example, if huckleberry plants occurred on the edge of a spray zone and received spray drift containing 2,4-D, a 150-pound person would have to consume 210 pounds of huckleberries each day for a lifetime to reach the EPA's ADI for 2,4-D listed in Table 4-6 (U.S. Forest Service 2001d). In a worst-case scenario of this example, if huckleberry plants are inadvertently but directly sprayed, a 150-pound person would have to consume a half pound of huckleberries each day for a lifetime in order to reach the EPA's ADI for 2,4-D (U.S. Forest Service 2001d).

The Forest Service (2001d; 2000a) stated for the above example that the likelihood of a person reaching the ADI for 2,4-D is low for several reasons. First, the probability that a person would pick and consume a half pound of huckleberries every day of their life is extremely low. Second, the time period when the plants are unintentionally sprayed and the berries dry up would be generally less than a week, which reduces the likelihood that those berries would be picked. Weed treatment information would be made available at District offices would discourage berry picking at those sites. There is also the likelihood that in many areas of the S-CNF, most spraying of weeds would occur along road ROWs where the occurrence of wild foods such as berries and mushrooms is probably low, although if present they may be picked by the public. In addition, wild foods are typically gathered in small quantities from widely scattered areas, making it unlikely to reach the one-half pound of food level per day every day from the same location (U.S. Forest Service 2001d; 2000a).

The Forest Service (2001d) cited results of the Risk Assessments (U.S. Forest Service 1992; Monnig 1988) on the risk of exposure to people hiking through a recently sprayed area. In this setting, the primary ingestion route for the herbicide would be through the skin. If a hiker walked through an area just sprayed with 2,4-D, the dose of 2,4-D received would be 40 times lower than the EPA's ADI for 2,4-D. In the case of picloram, the dose received in 1 hour by people picking berries in an area recently sprayed with this chemical would be 37 times lower than the EPA's ADI (U.S. Forest Service 2001d).

Human health and safety could potentially be impacted in the event of an accidental herbicide spill. The Forest Service (1999a) reported that an examination of accident records for a 10-year period revealed no major accidents involving herbicide application projects. The Forest Service Northern Region Health Risk Assessment (Monnig 1988, in U.S. Forest Service 1999a) states that spills of concentrate directly onto people could cause acute effects such as nausea, trembling, and headaches, depending on the degree of exposure, time to cleanup, and individual factors. The calculated probability of truck spills involving herbicides, assuming 1,220 weed treatment projects per year, ranged from five accidents every 1,000 years to one accident in 2,400 years. The probability of such an accident involving a drinking water reservoir was conservatively calculated at one accident every 34,000 years (Monnig 1988; in U.S. Forest Service 1999a). To prevent and reduce the risk of the occurrence of accidental herbicide spills on the S-CNF, a number of BMPs and mitigation measures were identified in *Chapter 2, Alternatives* for both the ground-based and aerial application of herbicides. Examples include defined procedures for mixing, loading, and disposing of herbicides; only mixing herbicides at sites where spills into streams could not occur; properly calibrating, rinsing, and cleaning equipment; having an approved herbicide emergency spill plan and spill containment equipment available during herbicide application in the unlikely event a spill did occur; maintaining various-sized, no-treatment/no-spray buffer zones around water bodies, depending on the method of herbicide application; and many others.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under the Proposed Action are designed to avoid or minimize the potential for adverse effects on public health and safety and worker health and safety on the S-CNF. They focus on the proper ground-based and aerial application of herbicides and on weed prevention and management BMPs. They are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures,* and in Procedures for Mixing, Loading, and Disposal of Herbicides and Herbicide Spill Plan for Noxious Weed Control on the SCNF (Appendix D). They include the 23 directives that specifically address precautionary, notification, and other safeguarding measures associated with the ground-based application of herbicides that were described for the No Action Alternative, plus 22 additional measures specifically directed at the proper aerial application of herbicides under the Proposed Action. Examples of these measures were described in the previous discussions of direct and indirect effects on human health for the Proposed Action. In addition, the Proposed Action incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy, which were described in *Chapter 2, Alternatives* and the Herbicide Leaching Sensitivity Evaluation System that is presented in Appendix F. These management tools are designed to consider site-specific resource conditions that result in the selection of a treatment method that achieves weed management goals with the least impact on S-CNF resources. The protection of worker and public health and safety in selecting and implementing a site-specific treatment process has the very highest priority.

Cumulative Effects. Potential cumulative effects would apply to workers and to the public who may be repeatedly exposed to herbicides over an extended period of time. The ADIs listed in Table 4-6 are based on the level of herbicide that would be acceptable each day for a lifetime. As noted in other assessments of herbicide toxicity (U.S. Forest Service 2001d), a person may be exposed to some quantity of herbicide over time, but since spraying would occur for only a few weeks each year, the daily intake would not approach the EPA's ADI

standards. There would probably be no cumulative effects on the public or workers from the effects of other ongoing activities or future actions on the S-CNF that are unrelated to weed treatments, such as roads and trails, recreation, and livestock grazing. The Risk Assessments cited previously (U.S. Forest Service 1992; Monnig 1988) assume that 2,4-D and picloram are carcinogenic, although as discussed previously current evidence on this is mixed. The Risk Assessments also assume that any dose of a carcinogen could cause cancer and that the probability of cancer occurring increases with increasing doses. The estimated probabilities of developing cancer from exposure to 2,4-D or picloram are based on a conservative extrapolation from cancer rates in animals subjected to a given chemical over a lifetime. The Risk Assessments projected that cancer rates would be highest for workers rather than the general public because their doses would be highest. Cancer probabilities of workers would increase by about one in a million after spraying 2,4-D for 193 days or picloram for 17,000 days (Monnig 1988 in U.S. Forest Service 2001d). These estimates were based on a worst-case scenario of a high dose of herbicide with a low amount of worker protection. Given the various forms of BMPs and mitigation measures that are aimed at human health protection, the cumulative impact from herbicide spraying on the S-CNF while complying with all EPA label directions would not be expected to be significant.

Table 4-7 provides some perspective on the estimated cancer risks projected for spraying 2,4-D and picloram versus other activities. For example, one round-trip transcontinental air trip represents an increased risk of cancer from cosmic rays of approximately one in a million. The same level of increased risk is associated with living in Denver, Colorado, for 1.5 months rather than at sea level because of increased cosmic rays, as well as from smoking two cigarettes, or receiving 20 days of natural background radiation. The Forest Service (1999a) reported that cancer risks to members of the general public are 100 to 1,000 times less than the risk to workers when considering exposure to the same herbicide. They continued that risks on this order could not be detected by epidemiology studies as conducted by the National Cancer Institute and that since the average American has about a 1 in 4 chance of developing cancer in his or her lifetime, the cumulative impact from spraying at the rates proposed would not be significant.

There has been an increasing scientific concern and public debate over EDCs and their effect on human and wildlife endocrine systems in the last decade. Ecologists, epidemiologists, endocrinologists, and toxicologists have called attention to the potential hazardous effects that estrogenlike and antiandrogenic chemicals and certain other environmental chemicals may have on human health and ecological well-being. They assert that certain chemicals may disrupt the endocrine system. Because EDCs mimic the effects of some hormonal or reproductive responses, they are often blamed for decreases in fertility, altered sexual characteristics in wildlife, or increases in certain cancers.

The endocrine system is a complex system of regulatory processes. It was originally thought to consist of glands that secreted hormones into the blood stream to specific receptors, producing characteristic actions. Currently, new discoveries have expanded the endocrine system to other chemical regulators such as neurohormones. There are numerous intercellular regulators as well (WHO 2002). Endocrine systems also control metabolism and regulate body processes like kidney function, body temperature, and calcium regulation. Manifestations of endocrine disruption are known to occur in the reproductive system; most

of the existing studies involve observance of EDCs in the reproductive system. However, potential EDCs could interfere with thyroid, cortisol, insulin, and other growth regulators.

The concern over EDCs focuses primarily on synthetic chemical compounds; however, naturally occurring EDCs (such as soy proteins) can also affect hormonal processes (Safe et al. 2000). The World Health Organization (WHO) also recently asserted that it is plausible (though uncertain) that exposure to EDCs could damage certain reproductive and developing systems in humans and wildlife (WHO 2002.) Possible human health effects include breast cancer and endometriosis in women, testicular and prostate cancers in men, abnormal sexual development, reduced male fertility, alteration in pituitary and thyroid gland functions, immune suppression, and neurobehavioral effects.

In addition to potential human health effects, there are also reports that many synthetic chemicals released into the environment may disrupt normal endocrine function in a variety of aquatic life and wildlife. Some of the effects observed in animals have been attributed to some persistent organic chemicals such as polychlorinated biphenyls, DDT (dichlorodiphenyltrichloroethane), dioxin, and some pesticides. Adverse effects include abnormal thyroid function and development in fish and birds; decreased fertility in shellfish, fish, birds, and mammals; decreased hatching success in fish, birds, and reptiles; demasculinization and feminization of fish, birds, reptiles, and mammals; defeminization and masculinization of gastropods, fish, and birds; decreased offspring survival; and alteration of immune and behavioral function in birds and mammals. Some argue that these adverse effects may be due to an endocrine disrupting mechanism (EPA 1997). However, the causal link between exposure and endocrine disruption in wildlife is unclear (WHO 2002).

It is unknown whether herbicides have the same effect as DDT and other pesticide compounds. For example, 2,4-D mimics the growth hormone auxin, which in turn causes uncontrolled growth and eventually death in target plant species (Tu et al. 2001). This potential hormone disruption implicates 2,4-D as an endocrine disrupter. A recent study showed that 2,4-D does not influence male-to-female sex reversal in alligators (Guillette et al. 2000). However, little connection has been made between endocrine disruption in other wildlife or human health and herbicide use, primarily because information is not available (Safe et al., 2000).

The Forest Service (2001d) summarized previous reports on the possible synergistic effects of herbicides. Synergism is when the combined cumulative impact of two or more chemicals exceeds the impacts that would result from adding their individual effects. The previously referenced Risk Assessments considered various possible synergistic effects, including interactions of active and inert ingredients in a herbicide formulation; interactions of herbicides and other chemicals in the environment; and the cumulative effects of herbicide treatments on the S-CNF and other herbicide use the public might be exposed to, such as on adjacent non-National Forest lands from the three CWMAs programs. The Forest Service (2001d) concluded that there are a number of reasons to expect that synergistic or other unusual cumulative interactions would be rare. They cited work by Mullison (1985), Monnig (1988), Forest Service Risk Assessment (1992), and EPA (EPA 1994) on the low teratogenic, mutagenic, and carcinogenic properties of herbicides compared to naturally occurring chemicals in food. They also noted that the low and short-lived doses that would result from spraying these herbicides would be very small compared to many other

chemicals in the environment. Finally, they cited the EPA's *Guidelines for the Health Risk Assessment of Chemicals* that appeared in the Federal Register on September 24, 1986, that a synergistic effect is not expected for these relatively small doses of herbicides. The Forest Service (2001d) cites recent research by Arnold et al. (1996) and a review of this work by Kaiser (1996) on the synergistic effects of four herbicides (three of these have been banned in the U.S.), but concludes that there is not yet sufficient scientific research that the chemicals proposed for use would exhibit synergistic effects.

TABLE 4-7
One-In-One-Million Risks of Cancer Death

Source of Risk	Type and Amount of Exposure
Herbicide Worker[1]	• 2,4-D 193 days • Picloram 17,000 days
Cosmic Rays[2]	• One transcontinental round trip by air: living 1.5 months in Colorado compared to New York • Camping at 15,000 feet over 6 days compared to sea level
Eating and Drinking[2]	• 40 diet sodas (saccharin) • 6 pounds of peanut butter (aflatoxin) • 180 pints of milk (aflatoxin) • 200 gallons of drinking water from Miami or New Orleans • 90 pounds of broiled steak (cancer risk only)
Smoking[2]	• 2 cigarettes
Other—20 days of sea level natural background radiation[2]	• 2.5 months in masonry rather than wood building • 1/7 of a chest x-ray using modern equipment

[1]From Monnig (1988, in U.S. Forest Service 2001d).
[2]From Crouch and Wilson (1982, in U.S. Forest Service 1999a).

The Forest Service cannot absolutely guarantee the absence of a synergistic reaction between the herbicides proposed for use on the S-CNF and other chemicals to which workers or the public might be exposed. However, based on the best scientific information available and assuming the full implementation of all BMPs and mitigation measures identified in *Chapter 2, Alternatives* for the aerial and ground-based application of herbicides under the Proposed Action, it would be reasonably expected that human health impacts from herbicide applications on the S-CNF and immediately adjacent areas would be insignificant.

c. Alternative 1

Direct and Indirect Effects. Direct and indirect effects on human health and safety under Alternative 1 would generally be similar to those effects described for the Proposed Action, with one important difference. There would be no aerial application of herbicides under Alternative 1, making it a less aggressive weed treatment alternative than the Proposed Action. A combination of primarily biological and ground-based chemical methods rather than aerial herbicide application would be used to treat weed infestations on the S-CNF

under Alternative 1. Some weed infestations would be more difficult to access and require more time to treat and likely less effectively under Alternative 1 compared to aerial herbicide applications under the Proposed Action. There also would be a greater chance of physical injuries with increased ground applications in rugged remote country compared to the Proposed Action. There also may be minor long-term benefits to human health and safety with anticipated reductions in the size of weed infestations because of weed treatments and, therefore, reduced potential for scrapes, scratches, cuts, skin irritations, allergies, and other relatively mild effects associated with weed treatment. The potential for fire within the wildland interface and risk to human health and safety also would be reduced under Alternative 1. There would be a reduced potential for herbicide spray drift under Alternative 1, because there would be no aerial application of chemicals. This would reduce the potential for inadvertently impacting forest users possibly hiking or gathering wild foods, although the potential for adverse effects from these actions was described as being very low to unlikely under the Proposed Action.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 1 would be the same as for the Proposed Action, except for measures dealing with the aerial application of herbicides. These measures are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures,* and are designed to avoid or minimize the potential for adverse effects on human health and safety. Alternative 1, like the Proposed Action, also incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy, which were described in *Chapter 2, Alternatives* and a Herbicide Leaching Sensitivity Evaluation System (Appendix F). These management tools are used to select a site-specific treatment method that achieves weed management goals with the least impact to S-CNF resources present at or near the treatment site. As noted for the Proposed Action, protecting worker health and safety and the general public's health and safety would receive the very highest priority when selecting and implementing a site-specific treatment process.

Cumulative Effects. The potential for cumulative effects on human health and safety under Alternative 1 would be essentially the same as described for the Proposed Action, and for the same reasons, although there would be a reduced cumulative effects potential to CWMA workers with no aerial herbicide applications. As noted for the Proposed Action, the Forest Service cannot absolutely guarantee the absence of a cumulative, synergistic reaction between the herbicides proposed for use on the S-CNF and other chemicals to which workers or the public might be exposed. However, based on the best scientific information available and assuming the full implementation of all BMPs and mitigation measures identified in *Chapter 2, Alternatives* for the ground-based application of herbicides under Alternative 1, it would be reasonably expected that human health impacts from herbicide applications on the S-CNF and actions occurring on adjacent areas would be insignificant. There would likely be no cumulative effects on the public or workers from the effects of other ongoing or future activities on the S-CNF that are unrelated to weed treatments.

d. Alternative 2

Direct and Indirect Effects. There would be no potential for herbicide-related effects on worker health and safety or the general public's health and safety under Alternative 2, because herbicides would not be used to treat weeds. Discussions for the Proposed Action concluded that the potential for herbicide-related risk was very low and any effects that may

occur would be insignificant to small. Alternative 2 would completely remove the potential for even only an insignificant herbicide-related impact on human health and safety to occur. Workers using biological controls, mechanical methods, controlled grazing, and site restoration techniques (where appropriate) under Alternative 2 would be subject to the same kinds of effects, such as sprains, strains, cuts, and scratches, as described for the Proposed Action. However, there would be a greater chance for such effects and physical injuries with the increased use of mechanical treatments and on-ground treatments in remote rugged areas under Alternative 2. The potential for fire within the wildland interface and risk to human health and safety as a result of weed infestations would likely be greater under Alternative 2 than under the Proposed Action, Alternative, 1, or the No Action Alternative.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with weed management under Alternative 2 are designed to avoid or minimize the potential for adverse effects on S-CNF resources, with human health and safety receiving the highest priority. They focus on weed prevention and management BMPs and are described in detail in *Section 2.D.3, Management Practices and Mitigation Measures.* Alternative 2, like the Proposed Action, incorporates use of a site-specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy, which were described in *Chapter 2, Alternatives*.

Cumulative Effects. There would be no potential for herbicide-related cumulative, synergistic impacts on human health and safety under Alternative 2 because herbicides would not be used to treat weeds on the S-CNF. Discussions for the Proposed Action and Alternative 1 concluded that the potential for this herbicide-related risk was very low and any effects that may occur would be insignificant. Alternative 2 would completely remove the potential for even only an insignificant herbicide-related impact on human health and safety to occur. There would likely be no cumulative effects on the public or workers from the effects of other ongoing or future activities on the S-CNF unrelated to weed treatments.

4.D.2. Indian Trust Assets/Treaty Rights

As noted in *Chapter 3*, administration of Indian Trust Assets is the responsibility of the federal government. Meetings with the Shoshone-Bannock Tribes have yielded important issues that would potentially be affected by weed management efforts. These are:

- Protection of big game winter range, especially for elk, moose, bighorn sheep, deer, antelope, and mountain goat.
- Protection of small game and mammals.
- Protection of resident indigenous and anadromous fish habitat.
- Access to traditional plant resources, such as, but not limited to, bitteroot, chokecherry, elderberry, current, red twig dogwood (red willow), and lodgepole pine collection areas.
- Unrestricted access for hunting, fishing, and gathering.

S-CNF personnel will consult with the Shoshone-Bannock Tribes, and other Tribes that may have assets within the S-CNF before implementing the selected preferred alternative.

a. No Action Alternative

Direct and Indirect Effects. The No Action Alternative would continue current weed management strategies described in *Chapter 2, Alternatives* but it is not expected to slow the spread of noxious weeds. Given the widespread nature of the noxious weed problem and the relative ineffectiveness of current measures on large infestations, current treatments would not be expected to slow or stop the spread of weed species on the S-CNF.

As noted in prior sections of this chapter, the continued spread of noxious weeds would have adverse direct and indirect effects on native plant communities, potentially including those used by Native American Tribes. Noxious weeds can decrease plant diversity, structure, and function in native plant communities by outcompeting native species for available resources. Big game winter range would also be affected, as weeds continue to spread into these areas. Other Indian Trust wildlife issues (such as big game and wildlife with religious or cultural significance) would be directly affected by loss of cover, forage, and habitat.

Other Trust Assets that would also be directly affected are anadromous fisheries and their habitat, which may experience degradation due to increased sediment delivery to streams from increasing weed infestation. Indirect effects would occur as infested riparian habitat changes to a less diverse plant community. Soil degradation from weed invasions would indirectly affect these Trust resources as water quality declines and sediment increases.

Drift or chemical odor from herbicide applications or noise and dust from mechanical treatments may cause direct adverse effects on Trust Assets or religious sites. Additionally, individual non-target native plants that have cultural importance may be inadvertently killed during mechanical or herbicidal treatment. Inadvertent effects from trampling and the generation of noise and dust during mechanical treatments and from possible herbicide drift may result in some mortality of forbs and a year or more setback in some shrubs, evidenced by leaf loss and berry failure. BMPs described in the following text are designed to prevent the occurrence of adverse effects such as these.

BMPs and Mitigation Measures. BMPs and mitigation measures for this alternative are discussed in *Section 2.D.3, Management Practices and Mitigation Measures*. Any potentially adverse effects on Indian Trust Assets—and corresponding mitigation measures—would be reviewed and coordinated with the Shoshone-Bannock resource technical staff. Tribal staff will be informed and coordinated with on treatment areas, proposed treatment activities, and treatment schedules, prior to treatment, in order to avoid the potential for adversely impacting Indian Trust Assets.

Numerous BMPs designed to prevent or reduce the risk of the occurrence of adverse effects on S-CNF resources were described in previous discussions of the No Action Alternative in this chapter. All of these BMPs are relevant to the protection of Indian Trust Assets. Examples include compliance with all State and Federal laws and agency guidelines during herbicide application; application of herbicides in accordance with EPA registration label requirements and restrictions; compliance with restrictions that have been designated for no-spray buffer zones within all flowing water streams and ponded water bodies; no spraying of herbicides when wind velocity exceeds 10 mph, or within 50 feet of open water when wind velocity exceeds 5 mph; use of label-approved aquatic formulations near open water; evaluate treatment sites and survey, as necessary, for sensitive plant suitability; no

chemical will be applied directly on sensitive plants during spot application; a 100-foot buffer zone will be employed around known populations of sensitive plants during broadcast applications; and weed-specific herbicides, such as Clopyralid, will be used on big game winter range to minimize impacts to winter forage. In addition, prehistoric trails, remnants of historic structures, and other heritage resources including Indian Trust Assets will be protected from disturbance during treatment activities.

Cumulative Effects. Cumulative effects of this alternative on Indian Trust Assets would be similar to the cumulative effects of the No Action Alternative discussed in the vegetation, aquatic, and wildlife resources sections of this chapter. Cumulative effects on noxious weeds resulting from treatments under the No Action Alternative combined with treatments under the three CWMAs would generally be expected to result in some localized eradication, control, and containment of noxious weeds. However, under the No Action Alternative, weed infestation on the S-CNF would be expected to continue to increase. This would reflect large-scale limitations on being able to eradicate, control, or contain new weeds that have invaded the S-CNF from adjacent lands covered by the CWMAs, or to prevent or reduce the risk of the invasion of adjacent land by weeds presently occurring on the S-CNF. This cumulative effect could potentially adversely affect vegetative, aquatic, and wildlife Indian Trust Assets through a number of mechanisms, such as reduced native plant communities, increased sediment delivery to drainages, reduced wildlife habitat, and decreased ecosystem function. Weed treatments on the S-CNF and immediately adjacent lands treated under the CWMAs may also result in some cumulative impacts on Indian Trust Assets from the combined effects of mechanical treatment and possibly herbicide spray drift.

Additional cumulative effects on Indian Trust Assets associated with other ongoing activities on the S-CNF may occur if those activities adversely affect plants, fish, wildlife, or their habitat. Such effects may result from activities that contribute additional sediment to drainages or that result in the loss or disturbance of a resource or its habitat. Examples include potential impacts from the construction, maintenance, and use of roads and trails and possibly livestock grazing and recreation activities near drainages. Livestock grazing and recreation both have the potential to directly and cumulatively affect Indian Trust Assets since both these activities have the potential to disturb plants.

b. Proposed Action

Direct and Indirect Effects. The direct and indirect benefits of the Proposed Action on Indian Trust Assets include those benefits described in the vegetation, aquatic, and wildlife resources section of this chapter that would result from the aggressive treatment and reduction in acres of noxious weeds across the S-CNF. A variety of terrestrial and aquatic plants and animals, including sensitive special status species and their habitats, would benefit. As analyzed in Sections 4.B.2 and 4.B.3, minimal or no adverse impacts to aquatic and wildlife habitat or species would be expected. During weed treatment, access to some Trust Assets may be limited for a short time.

The Proposed Action, like other alternatives described in this chapter, may have some adverse impacts on Indian Trust Assets. There may be short-term adverse effects on Trust Assets from herbicide odor and drift to non-target areas during aerial spraying. Other adverse, short-term effects may stem from chemical odors and drift as ground-based herbicides are applied, the same as described for the No Action Alternative. Noise, dust,

and trampling from mechanical treatments may also affect Trust Assets. Individual non-target plants could be inadvertently killed during treatment, although BMPs and mitigation measures referenced below would be followed to avoid or minimize this potential occurrence. Access for the cultural gathering of plants may be affected, but only for a short time as weed treatment is implemented and briefly thereafter. The experience of Native Americans using Trust Assets may be influenced by the users' knowledge that weed control activities are occurring, or have occurred, on or near Trust lands.

BMPs and Mitigation. The previous resource discussions note the 59 BMPs and mitigation measures that would be implemented under the Proposed Action to avoid or minimize impacts on all S-CNF resources including Indian Trust Assets. In addition, a site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy would be employed at a treatment site to avoid or minimize the potential for impacting Indian Trust Assets. Any potentially adverse effects on Indian Trust Assets—and corresponding mitigation measures—would be reviewed and coordinated with the Shoshone-Bannock resource technical staff. Tribal staff will be informed and coordinated with on treatment areas, proposed treatment activities, and treatment schedules, prior to treatment, in order to avoid the potential for adversely impacting Indian Trust Assets.

Cumulative Effects. Potential cumulative impacts on Indian Trust Assets under the Proposed Action would consist of those effects described in the vegetative, aquatic, and wildlife resources sections of this chapter. Nearly all of these effects would be beneficial as the various weed treatments on the S-CNF, in concert with weed treatments on adjacent lands under the CWMAs, become successful and together result in fewer noxious weeds, improved native plant communities, reduced sediment delivery, increased wildlife habitat, and enhanced ecosystem function. Other ongoing S-CNF activities that were described for the No Action Alternative may also cumulatively impact Indian Trust Assets under the Proposed Action. Livestock grazing and recreation both have the potential to directly affect Indian Trust Assets since both of these activities have the potential to disturb plants.

c. Alternative 1

Direct and Indirect Effects. This alternative would be identical to the Proposed Action, except no aerial herbicide application would occur. As discussed in earlier sections of this chapter, large weed infestations in areas most common on the northern part of the S-CNF may not respond to the treatments described for this alternative, at least not as quickly as with the Proposed Action. These large infestations occur on steep, inaccessible areas where treatment would be more difficult and less effective to implement. As a result, it is possible that weed populations in these areas could continue to adversely affect Indian Trust Assets. Direct and indirect effects on vegetation, aquatic, and wildlife resources that could also adversely affect Trust Assets were discussed earlier in this chapter.

Other effects of Alternative 1 include the potential loss of individual native plants during treatment, chemical odors from ground-based herbicide applications, and noise and dust from mechanical operations. The potential for herbicide drift from aerial spraying would be eliminated, but chemical odors and possible drift from ground-based herbicide application may still affect Indian Trust Assets. The experience of Native Americans using Trust Assets may be affected if the users know that weed control treatments are occurring nearby, or if access to these assets is restricted during treatment.

BMPs and Mitigation Measures. The BMPs and mitigation measures for this alternative are described in *Chapter 2, Alternatives* and include all of those for the Proposed Action, except measures dealing with aerial herbicide application. Any potentially adverse effects on Indian Trust Assets—and corresponding mitigation measures—would be reviewed and coordinated with the Shoshone-Bannock resource technical staff. Tribal staff will be informed and coordinated with on treatment areas, proposed treatment activities, and treatment schedules, prior to treatment, in order to avoid the potential for adversely impacting Indian Trust Assets.

Cumulative Effects. Potential cumulative effects on Indian Trust Assets under Alternative 1 combined with the treatment effects from the three CWMAs would consist of those effects on vegetation, aquatic, and wildlife resources described previously in this chapter. Those effects would be similar to effects described for the Proposed Action, except that cumulative benefits would not be realized as quickly because of the lack of aerial herbicide use under this alternative. Adverse cumulative effects on Trust Assets from other ongoing activities on the S-CNF (for example, recreation activities and livestock grazing) would be similar to those described for the Proposed Action.

d. Alternative 2

Direct and Indirect Effects. This alternative would not incorporate herbicide applications, thus eliminating any potential risks of drift or chemical odor. However, as noted in previous resource discussions, this alternative would have less effect on weed control and expansion since the range of weed treatments is limited. This would result in limited treatment success and fewer benefits to Indian Trust Assets compared to the Proposed Action, Alternative 1, and the No Action Alternative. However, with the continued alteration of native terrestrial and aquatic habitat anticipated under Alternative 2, Trust Assets and Treaty Rights would be adversely impacted. Other treatment effects include noise, dust, smoke, and surface disturbance/trampling of non-target species from mechanical treatments, which would be much more extensive under this alternative than under any of the other alternatives.

BMPs and Mitigation. The BMPs and mitigation measures for this alternative are described in *Chapter 2, Alternatives* and include all of the measures for the Proposed Action except those related to herbicide use. Any potentially adverse effects on Indian Trust Assets—and corresponding mitigation measures—would be reviewed and coordinated with the Shoshone-Bannock resource technical staff. Tribal staff will be informed and coordinated with on treatment areas, proposed treatment activities, and treatment schedules, prior to treatment, in order to avoid the potential for adversely impacting Indian Trust Assets.

Cumulative Effects. Potential cumulative effects on Indian Trust Assets under Alternative 2 would consist of those effects on vegetation, aquatic, and wildlife resources described previously in this chapter. Those effects would be similar to effects described for Alternative 1, except that cumulative benefits would not be realized as quickly because of the lack of aerial herbicide use under this alternative. Adverse cumulative effects on Trust Assets from other ongoing activities on the S-CNF (for example, recreation activities and livestock grazing), as well as the increased use of mechanical treatments under Alternative 2, would be greater than those described for the Proposed Action due to the increase in surface disturbance from mechanical treatment methods.

4.D.3. Environmental Justice

Executive Order 12898 directs agencies to consider patterns of subsistence hunting and fishing when an agency action may affect fish or wildlife. The Proposed Action and alternatives analyzed in this Final EIS would not alter the type of access (motorized versus non-motorized) to treatment areas on the S-CNF and the alternatives would not alter opportunities for subsistence hunting by Native American Tribes.

Neither the Proposed Action or any of the alternatives would alter subsistence rights and fishing by Native American Tribes, and they would not have a disproportionate impact on minority and low-income populations.

4.D.4. Economics

The treatment of noxious weeds is important to the economy of areas surrounding the S-CNF, and the health of the Forest's environment. The loss of wildland and range has direct and indirect economic effects. The methods selected for weed control will also have direct and indirect economic effects.

a. No Action Alternative

Direct and Indirect Effects. The spread of noxious weed species and the establishment and spread of new species would likely continue under the No Action Alternative, as described in *Section 4.B.1, Vegetation Resources and Noxious Weeds,* of this chapter. The continued loss of wildland acres, roughly valued at $3.95 per acre, and rangeland acres, roughly valued at $10.73 per infested acre, would result in direct negative economic impacts to the S-CNF (Hirsch and Leitch 1996) and to adjacent communities. Current loss of wildland acres is nearly $300,000, and would likely increase as additional wildland acres are lost to expanding weed infestations.

The S-CNF and adjacent communities would share the economic impact of these losses since these communities rely on the resources offered by the S-CNF for their livelihood. Direct and indirect effects on vegetation, fisheries, wildlife, and ecosystem function (described earlier in this chapter) would also influence the economic well-being of these adjacent communities. Economic sectors most affected by this alternative would include commercial (grazing, tourist) and recreational uses. The impact of the No Action Alternative on these economic sectors is discussed in detail in *Section 4.C.4, Land Uses and Designations,* of this chapter.

Job opportunities related to current weed management are not a part of this study. As noted earlier in this chapter, job loss related to increasing weed infestations on the S-CNF would likely affect surrounding communities and economic sectors that rely on the resources offered by the S-CNF. Jobs related to weed control efforts would not increase under this alternative.

Indirect economic effects could possibly occur from degradation of water quality and increased cost of sediment control in community water treatment systems if these effects are severe enough. These indirect effects have not been quantified.

Cost effectiveness: The cost effectiveness of this alternative is considered moderate to low because fewer acres would be treated under this alternative, and it would not meet the

weed treatment goals. The estimated annual cost of treating 3,500 acres under this alternative is approximately $843,000 ($241 per acre).

BMPs and Mitigation Measures. BMPs and mitigation measures have not been developed to specifically address economic effects of this alternative.

Cumulative Effects. It is difficult to assess the cumulative impacts or assign general economic loss to various economic sectors as a result of the No Action Alternative when combined with the effects of other ongoing S-CNF activities and the effects of weed treatment under the three CWMAs. Studies similar to the Montana Economic Impact Study (Hirsch and Leitch 1996) have not been performed on Idaho's natural resources, and the cumulative impact cannot be fully defined. However, one possible negative cumulative effect would be the additional costs necessary to treat and control weeds under the three CWMAs if weeds cannot be effectively treated and managed on the S-CNF, as indicated for the No Action Alternative. Wildlands have intangible, non-market benefits, such as healthy, resilient ecosystems. The cumulative economic impacts on these non-market sectors are difficult to assess, although they can be assumed from tourism and recreation data.

b. Proposed Action

Direct and Indirect Effects. The immediate direct effect of the Proposed Action would be to control, contain, and/or eradicate weed populations on the S-CNF. Given the economic cost of the No Action Alternative, a direct effect would be in savings of wildland acres. A conservative estimate would include the savings of currently infested wildland acreage in an amount of $262,964 (see *Section 4.C.4, Land Uses and Designations* of this chapter for calculations).

Other economic effects would include the cost of herbicides and other weed treatments. A rough estimate of the cost of the Proposed Action would depend on the specific type of treatments within a treatment category that are chosen, according to the site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy.

New jobs from these activities may not have a direct impact on the environment, but would directly benefit surrounding communities.

Other impacts would occur where noxious plants begin to die off and native plant populations have not yet recovered. Soil conditions may require some temporary expenditures to prevent or reduce the risk of erosion-related impacts and to hasten the restoration of treatment sites, where appropriate. These impacts should decrease as native plant populations recover.

Cost effectiveness. Each of the control methods used for this alternative have different costs associated with their implementation. This alternative would have high cost effectiveness; treatment methods could be selected to most efficiently and effectively meet the treatment goals. Cost estimates for the treatment methods are described below. Table 4-8 compares the costs for each alternative. Table 2-8 (in Chapter 2) provides detailed cost comparisons among the alternatives.

Mechanical. In the Lolo National Forest, people were actually timed to dig and pull knapweed. Based on that experience, as well as experience in other forests and the S-CNF, estimated costs for mechanical methods are described below:

- *Hand pulling.* One person would take about 48 days (9.7 weeks) to hand pull 1 acre of moderately to densely infested ground on flat terrain to 100 percent elimination of the weeds. Bagging and disposal would take an additional 3 hours a week (or 29 hours for 9 weeks). A seasonal employee to perform the service costs approximately $110/day.

  Math: (1 person x $110/day) x 48.25 days (needed to pull one acre) = $5,307 per acre; 29 hours x $110 = $3,190 for disposal; $5,307 (pulling) + $3,190 (disposal) = $8,497 per acre for one treatment. Administrative costs and travel are not included in this estimate. Hand pulling may not be used in this alternative, but is presented for comparison.

- *Mowing.* A conservative estimate for mowing would be about $300 per acre. Mowing would be feasible on flat to gentle slopes, with no surface rocks, and where road access is nearby. In the largest infested sites where rough, rocky terrain prohibits mowing, mechanical control alone is not economically or physically feasible.

Herbicide Application. The cost of ground application of herbicides varies with the method used. Aerial application provides the most economical and aggressive treatment method for rugged terrain with large infestations. The cost estimates presented below do not include the cost of the herbicides, nor do they consider the economic savings of one treatment per season (with picloram) versus repeat treatments (with 2,4-D).

- *Ground Application*. Costs are derived from the Lolo National Forest *Big Game Winter Range and Burn Area Weed Management EIS*, and are based on spraying one acre.
  - Vehicle (truck): $30 per acre
  - Backpack spraying (includes personnel costs): $125 per acre
  - ATV: $60 per acre
  - Mule or Horseback-mounted sprayer: $65 per acre (based on contract price)

    The effectiveness of ground applications goes down (and cost goes up) where terrain and other factors inhibit the ability to safely complete the task.
- *Aerial application*. At $25 per acre, aerial application is the most economic of the treatment methods, and is the most effective on steep, rugged terrain.

Controlled Grazing. Costs for controlled grazing would be quite variable by contractor, location, and existing facilities. Based on similar projects described in the Lolo and Bitterroot EISs, grazing typically costs about $60 per acre.

Biological Control. Costs associated with biological control are generally based on collection and distribution. The Bitterroot Forest in Montana estimates that biological control agents can cost about $1 per bug. Typically, about 500 bugs are introduced per acre, with an overall cost between $300 to $500 per acre. The Lolo National Forest estimates

biological control costs around $10,000 per year to maintain treatments on about 21,750 acres.

- As noted in *Section 2.D.3, Management Practices and Mitigation Measures,* biological treatment methods generally require years to become effective.

  Estimated annual costs for treating 18,000 acres under this alternative are approximately $3,020,000 ($168 per acre).

BMPs and Mitigation Measures. BMPs and mitigation measures are described in *Section 2.D.3, Management Practices and Mitigation Measures*. It is expected that these measures would help keep environmental and economic costs down through the selection and implementation of a site-specific treatment method that would achieve treatment objectives but have the least overall impact on S-CNF resources, including funds available for weed treatments.

Cumulative Effects. Cumulative economic effects stemming from the Proposed Action would include decreased costs on the S-CNF and potentially on adjacent lands treated under the three CWMAs as eradication efforts become more successful and weed-infested areas decline. The economic impact of infestations spreading beyond S-CNF boundaries would be prevented and/or minimized under the Proposed Action.

c. Alternative 1

Direct and Indirect Effects. Alternative 1 incorporates the same treatment opportunities as the Proposed Action, except for the aerial application of herbicides. The direct economic effects stemming from the cost of this alternative would be essentially the same as the Proposed Action, except the cost of aerial herbicide application would not be included. Instead, weed infestations on steep, inaccessible areas of the S-CNF would be treated using a combination of ground-based methods (herbicide application and biological treatments). As noted in previous discussions, aerial spraying is the most economic and aggressive form of weed control and eradication. Mechanical methods would not be as effective in these areas, and would increase the cost of the project as increased labor is required. Ground-based herbicide application would probably require backpack spraying, another labor-intensive control method. Controlled livestock grazing and biological controls would be less successful in quickly containing, controlling, and/or eradicating large weed infestations.

These weed control opportunities would result in new jobs and have a direct economic benefit on the surrounding communities. This alternative would also cause adverse economic effects if infestations on steep inaccessible areas cannot be contained and expand into uninfested areas and beyond S-CNF boundaries. In other areas of the S-CNF, however, the direct and indirect economic effects would be similar to those described for the Proposed Action.

Cost Effectiveness. This alternative is considered to have moderate to low cost effectiveness because terrain in the largest infested areas would limit the use of more economic treatment measures. Additionally, lower cost measures for rough terrain (e.g., grazing and biological control) generally take years to become effective, and would not meet the treatment goals for the infestation. Estimated annual costs for treating 18,000 acres are approximately $6,850,000 ($381 per acre).

BMPs and Mitigation Measures. BMPs and mitigation measures for this alternative are the same as for the Proposed Action, except for BMPs associated with aerial herbicide application which would not occur with Alternative 1. This alternative also includes use of the site-specific implementation process, decision tree, minimum tool approach, and adaptive strategy to select the most effective and least-impacting treatment method.

Cumulative Effects. Cumulative economic benefits to the S-CNF and adjacent lands associated with Alternative 1 would be similar to those described for the Proposed Action. However, they may take longer to realize because of the absence of aerial herbicide application as a treatment option under this alternative.

d. Alternative 2

Direct and Indirect Effects. Alternative 2 would consist of non-chemical weed treatment methods. These techniques take time and can be labor intensive, thus increasing the potential long-term costs of this alternative.

Because large weed infestations do not quickly respond to non-chemical treatment methods, and some mechanical, biological, or combinations of treatments do not effectively eradicate some species of weeds, weed populations could expand under this alternative. Alternative 2 could prevent or minimize the potential for the expansion of weeds in small infestations, and may even eradicate some species in small infestations. However, this alternative would be comparatively less effective against large weed infestations. In particular, knapweed infestations on some of the steep, inaccessible slopes of the S-CNF will likely expand using only non-chemical treatment methods. The resulting economic effects would then resemble or be worse than those of the No Action Alternative.

Jobs created by the use of mechanical, livestock grazing, and biological methods would have no direct effect on the environment, but would directly benefit the surrounding communities. Adverse economic impacts resulting from not being able to quickly treat larger weed infestations, subsequent water quality degradation, and possibly increased cost of sediment control in community water treatment systems would be similar to those of the No Action Alternative.

Cost effectiveness. This alternative is considered to have low cost effectiveness, based on the necessity for hand-pulling and other non-mechanical methods in rough terrain. The alternative would have minimal effectiveness since less aggressive methods would fail to keep pace with large infestations. The estimated cost of treating 18,000 acres annually under this alternative is approximately $16,370,000 ($909 per acre).

BMPs and Mitigation Measures. BMPs and mitigation measures under this alternative would be identical to those for Alternative 1, except there would be no herbicide use under Alternative 2. This alternative also would include the site-specific implementation process and related components, the same as under Alternative 1.

Cumulative Effects. The cumulative effects of this alternative would be somewhat similar to those of the No Action Alternative. However, it is likely that this alternative would not be as effective on large weed infestations on the S-CNF. As a result, effectiveness of weed control efforts beyond the S-CNF boundary may be minimized, which would cause cumulative

adverse economic impacts to the S-CNF and to adjacent lands where weed treatments are covered by the three CWMAs.

4.E. Cultural Resources

4.E.1. Cultural and Historical Resources and Native American Religious Concerns

a. No Action Alternative

Direct and Indirect Effects. The continued spread of existing noxious weed species and the spread of new species would have no direct effect on non-biotic heritage resources. However, the continued spread of weeds would likely continue to displace native vegetation gathered by local Tribes. The Shoshone-Bannock Tribes have identified several species of native plants—such as bitterroot, chokecherry, elderberry, and currant—that have cultural significance. The traditional use of these plants would continue to be directly affected as weeds begin to displace native plant populations, or as access is affected by continued weed control efforts.

In some areas of the S-CNF, historic vegetation presents a critical element for the setting. For example, much of the original Lewis and Clark Trail remains intact through the S-CNF. The continued presence of noxious weeds along the trail could result in a reduction of the historical integrity of trail and camping sites. Additionally, loss of historically accurate vistas could affect the visual and recreational experience of users studying and attempting to re-create the Lewis and Clark journey.

For some historic sites such as homesteads and mining areas, vegetation is a key element contributing to the integrity of the site, and the continued presence or expansion of weed infestations represents a definite intrusion on the integrity of historic sites.

As discussed in *Section 4.D.2, Indian Trust Assets*, drift or chemical odor from herbicide applications or noise and dust from mechanical treatments may cause indirect adverse affects on Trust Assets or religious sites. Additionally, individual non-target native plants that have cultural importance may be inadvertently killed during mechanical or herbicidal treatment. Inadvertent effects from trampling and the generation of noise and dust during mechanical treatments and from possible herbicide drift may result in some mortality of forbs and a year or more setback in some shrubs, evidenced by leaf loss and berry failure. Surface disturbances from mechanical treatments would have the potential for impacting cultural resources if present at a treatment site. BMPs referenced in the following text are designed to prevent or minimize the potential occurrence of adverse effects such as these.

BMPs and Mitigation Measures. BMPs and mitigation measures are described in *Section 2.D.3, Management Practices and Mitigation Measures*. A BMP specifically directed at cultural resources is the protection of prehistoric trails, remnants of historic structures, and other heritage resources, including Indian Trust Assets, from disturbance during treatment activities. Before the No Action Alternative or any other alternative is implemented, the S-CNF archaeologist would identify areas of concern for historic preservation and Native American issues, and consult with the Idaho SHPO and the Shoshone-Bannock Tribes. Tribal staff will be informed and coordinated with on treatment areas, proposed treatment activities, and treatment schedules, prior to treatment, in order to avoid the potential for

adversely impacting Indian Trust Assets. These entities would continue to be consulted during the implementation of this alternative.

Cumulative Effects. Cumulative effects on cultural resources under the No Action Alternative could include surface-disturbing effects from other CWMA activities along with other ongoing S-CNF activities. Mechanical treatments (or any surface disturbance including the ongoing actions of livestock grazing) could have a high risk of affecting cultural resources.

b. Proposed Action

Direct and Indirect Effects. The Proposed Action incorporates all of the available weed management strategies, and is the most aggressive of the available alternatives. One effect of the Proposed Action on cultural resources would be to control weeds, and to eventually eradicate noxious weeds from many sites on the S-CNF. Because of this, the Proposed Action offers the greatest recovery potential for currently infested historic landscapes (e.g., portions of the Lewis and Clark Trail and historic homesteads) while having a minimal effect on cultural and historic values. Reducing noxious weeds at historic sites would restore and protect the visual quality of historic sites and trails. Additionally, the Proposed Action would control and eradicate weeds that may currently encroach on culturally significant plants.

Types of potential adverse impacts on cultural resources and Indian Trust Assets from mechanical treatments and herbicide application under the Proposed Action would be similar to those described for the No Action Alternative. Some of those effects are also discussed in *Section 4.D.2, Indian Trust Assets*. There would be a greater likelihood of encountering and potentially impacting cultural resources under the Proposed Action because more acres would be treated each year than under the No Action Alternative.

Other impacts include the remote risk that individual native plants would be lost because of chemical, mechanical, and controlled grazing treatments. Access to important cultural sites may be temporarily restricted during weed treatment efforts.

BMPs and Mitigation Measures. BMPs and mitigation measures are described in *Section 2.D.3, Management Practices and Mitigation Measures*. Before the Proposed Action (or any alternative) is implemented, the S-CNF archaeologist would identify areas of concern for historic preservation and Native American issues, and consult with the Idaho SHPO and the Shoshone-Bannock Tribes. Tribal staff will be informed and coordinated with on treatment areas, proposed treatment activities, and treatment schedules, prior to treatment, in order to avoid the potential for adversely impacting Indian Trust Assets. These entities would be consulted during implementation of the Proposed Action, and site-specific treatment strategies using the decision tree, minimum tool approach, and adaptive strategy would be developed accordingly.

Cumulative Effects. Cumulative effects associated with the Proposed Action would be similar to those described for the No Action Alternative but would potentially occur over a broader scale. They would include surface-disturbing effects from other CWMA activities along with other ongoing S-CNF activities. Mechanical treatments (or any surface disturbance including the ongoing actions of livestock grazing) could have a high risk of affecting cultural resources.

c. Alternative 1

Direct and Indirect Effects. This alternative includes all of the available weed treatment methods except aerial spraying. Many of the direct and indirect effects of Alternative 1 would be similar to those described for the Proposed Action. However, large weed infestations in steep, inaccessible areas of the S-CNF may be difficult to eradicate. Ground-based herbicide applications and biological treatments may not be immediately effective on these particular areas containing large infestations. This may result in continued loss of native plant populations in these areas, some of which may have cultural significance.

This alternative would have a direct positive effect on the integrity of portions of the Lewis and Clark Trail that intersect northern reaches of the S-CNF. Also, Alternative 1 would prevent or reduce the risk of the expansion of existing weeds in other sections of the S-CNF, and should prevent or reduce the risk of new expansion of weed populations as well. This would prevent or minimize the potential for any future loss of native plant populations. Types of potential adverse impacts on cultural resources under Alternative 1 from herbicide application and mechanical treatments would generally be similar to those described for the Proposed Action. There would be no potential for herbicide wind drift on non-target species from aerial application under this alternative.

BMPs and Mitigation Measures. BMPs and mitigation measures would be identical to those described for the Proposed Action, except there would be no BMPs for the aerial application of herbicides since this would not occur under Alternative 1. The S-CNF archaeologist would identify areas of concern for historic preservation and Native American issues, and consult with the Idaho SHPO and the Shoshone-Bannock Tribes. Tribal staff will be informed and coordinated with on treatment areas, proposed treatment activities, and treatment schedules, prior to treatment, in order to avoid the potential for adversely impacting Indian Trust Assets. These entities would continue to be consulted during implementation of this alternative.

Cumulative Effects. Cumulative effects on cultural resources associated with Alternative 1 would be generally similar to those described for the Proposed Action. They would include surface-disturbing effects from other CWMA activities along with other ongoing S-CNF activities. Mechanical treatments (or any surface disturbance including the ongoing actions of livestock grazing) could have a high risk of affecting cultural resources.

d. Alternative 2

Direct and Indirect Effects. Many of the effects of Alternative 2 on cultural resources would be similar to those of Alternative 1. However, large weed infestations would take longer to treat and be less effective under this method, since the application of herbicides, which would not be used under this alternative, has been shown to be the quickest method of weed treatment. Potential adverse effects on cultural resources and Indian Trust Assets associated with mechanical treatments and ground disturbance would be greater under this alternative than the other alternatives because of the need to extensively use this particular treatment option under Alternative 2 in the absence of herbicides. Ground-disturbing activities such as these over large areas of the S-CNF could potentially impact cultural resources.

BMPs and Mitigation Measures. BMPs and mitigation measures associated with Alternative 2 are described in *Section 2.D.3, Management Practices and Mitigation Measures*. They are identical to those for the Proposed Action, except for BMPs directed at herbicide application, which would not occur under this alternative. The S-CNF archaeologist would identify areas of concern for historic preservation and Native American issues, and consult with the Idaho SHPO and the Shoshone-Bannock Tribes. Tribal staff will be informed and coordinated with on treatment areas, proposed treatment activities, and treatment schedules, prior to treatment, in order to avoid the potential for adversely impacting Indian Trust Assets. These entities would continue to be consulted during implementation of this alternative.

Cumulative Effects. Types of potential cumulative effects on cultural resources under Alternative 2 would be similar to those described for Alternative 1. However, the magnitude of potential effects would be greater under Alternative 2 because of the greater number of acres that would be treated each year and the increased likelihood of encountering cultural resources and the extensive use of mechanical treatments and ground-disturbing activities that would occur under Alternative 2.

4.E.2. Paleontological Resources

As noted in *Chapter 3* there are no known paleontological resources on the S-CNF, except for limited petrified wood locals. There are no anticipated effects from the Proposed Action or any of the other alternatives on these resources.

4.F. Comparison of Alternatives

Table 4-8 (back of Chapter) summarizes and compares the potential environmental benefits and impacts of the No Action Alternative, Proposed Action, Alternative 1, and Alternative 2 for each resource area previously analyzed in this chapter. Additional information is presented in Table 2-7 (in Chapter 2), which compares and contrasts important features, properties, benefits, and costs among the four alternatives, and in Table 2-8 (in Chapter 2), which provides supporting information and assumptions used to estimate annual costs for each of the treatment options associated with the four alternatives. The Proposed Action, followed by Alternative 1, would be the most effective of the alternatives evaluated in eradicating, controlling, and containing noxious weeds on the S-CNF and in benefiting a broad range of S-CNF resources. The No Action Alternative (No Change from Current Management) would be less effective and Alternative 2 would be the least effective of the alternatives evaluated in treating weeds and in benefiting S-CNF resources because of the comparatively few acres of weeds that would be treated each year (No Action Alternative) and the absence of herbicides as a weed treatment option (Alternative 2).

Potential risks for some S-CNF resources were identified for those alternatives that would use herbicides to treat weeds. These include aerial and ground-based herbicide applications under the Proposed Action and ground-based herbicide applications under Alternative 1 and the No Action Alternative. Such risks would be non-existent under Alternative 2. In all instances involving herbicide and other potential risks, BMPs and mitigation measures would be implemented to avoid or minimize the potential for adverse effects to occur. In addition, the Proposed Action, Alternative 1, and Alternative 2 include the use of a site-

specific implementation process, decision tree, a minimum tool approach, and an adaptive strategy. These management tools are designed to consider site-specific resource conditions that result in the selection of a treatment option that achieves weed management goals with the least impact on S-CNF resources. The protection of worker health and safety and public health and safety in selecting and implementing a site-specific treatment option would receive the very highest priority.

4.G. Probable Environmental Effects that Cannot be Avoided

Some potential environmental risks associated with the use of herbicides that cannot be avoided include possible effects on non-target plant species, possible entry of minute amounts into surface waters, and possible absorption by wildlife and fish. However, the extremely low amounts of herbicide that could potentially come in contact with these resources—together with the implementation of BMPs, mitigation measures, and a site-specific minimum tool process—would not be expected to result in a significant environmental impact under reasonably foreseeable circumstances. This same conclusion applies to human health and safety on the S-CNF. The anticipated continued expansion of noxious weeds on the S-CNF under the No Action Alternative would result in serious unavoidable adverse effects on a broad range of S-CNF resources, as described in detail previously in this chapter. These unavoidable adverse effects from continued weed expansion would be especially severe on the northern S-CNF because of extensive current infestations on that part of the S-CNF.

4.H. Forest Plan Consistency

The Proposed Action, followed by Alternative 1 and then the No Action Alternative, would be the most effective and quickest of the alternatives analyzed in this EIS in achieving various management goals for S-CNF resources. All three of these alternatives would be consistent with the S-CNF Plan. Alternative 2 may only minimally meet or perhaps fail to meet some of the S-CNF management goals, and in the long-term may be inconsistent with the overall S-CNF Plan. Examples of management goals contained in the S-CNF Plan include the following:

- Maintain adequate structural diversity of vegetation to ensure habitat for minimum viable populations or target populations of all wildlife species and to provide representations of the various ecological stages of endemic plant communities.
- Manage aquatic habitat to maintain or enhance the current status of threatened and endangered fish species, meet production goals for anadromous and resident species, and meet state water quality standards.
- Manage water quality and the domestic water supply such that downstream beneficial uses are protected and compliance with state standards is achieved.
- Maintain watershed condition such that downstream beneficial water uses can continue to be supported.

- Maintain wildlife habitat of sufficient quantity and quality to sustain target populations of economically important MIS species.
- Manage for a moderate increase in elk populations and manage threatened and endangered wildlife species habitat to enhance their status.
- Use an integrated approach to manage noxious and invasive weeds while protecting human health and safety; maintaining or enhancing visual resource, air quality, and cultural resource objectives; and preserving the unique characteristics of wild and scenic rivers, wilderness areas, RNAs, and roadless areas.

The Proposed Action would best meet these and other S-CNF Plan management goals. By comparison, Alternative 1, followed by the No Action Alternative, then Alternative 2 would be increasingly less effective than the Proposed Action in meeting S-CNF management goals.

4.I. Possible Conflicts With Planning and Policies of Other Jurisdictions

Neither the Proposed Action nor Alternative 1 would conflict with State and Federal water or air quality regulations, or with USFWS and NMFS service recovery plans for threatened and endangered species. However, the anticipated continued expansion of noxious weeds on the S-CNF under the No Action Alternative and especially under Alternative 2 may threaten recovery of some federally listed species. A Biological Assessment of potential effects of the Proposed Action on Federally listed endangered, threatened, proposed, and candidate species will be completed for the proposed project.

4.J. Relationship Between Short-Term Uses and Long-term Productivity

Neither the Proposed Action nor Alternative 1 would affect the short-term use of commodity-type resources. However, the adverse effects of noxious weed expansion, which would be most likely to occur under the No Action Alternative and Alternative 2, were described for a number of biological and physical resources on the S-CNF previously in this chapter. Related adverse effects on human and socioeconomic resources, including a broad range of commercial and recreational uses that occur on the S-CNF and that support businesses adjacent to the S-CNF, could also result from poor S-CNF health. The Forest Service (1999a) concluded that, for the FCRONRW, the more effective an alternative is at controlling the spread of noxious weeds, the better that alternative is at protecting the natural resources of an area—despite potential minor, short-term impacts on the environment. That same conclusion applies to the S-CNF.

4.K. Irreversible and Irretrievable Commitment of Resources

Implementation of the Proposed Action, Alternatives 1 and 2, and the No Action Alternative would each involve an irretrievable commitment of labor, fossil fuels, and economic

resources to varying degrees. The expected continued expansion of noxious weeds on the S-CNF under the No Action Alternative (No Change from Current Management) and Alternative 2 may irretrievably reduce or eliminate existing plant diversity and associated resource values, including overall ecosystem function.

TABLE 4-8
Comparison of Effects Between Alternatives

Resource Area	No Action Alternative	Proposed Action	Alternative 1	Alternative 2
Biological Resources				
Vegetation Resources and Noxious Weeds	Noxious weeds negatively impact the natural plant communities they invade by reducing plant diversity and species richness, by decreasing the quality of habitat values for wildlife, and by overwhelming sensitive plant populations. Noxious weeds would continue to displace native vegetation at the same or higher rates than currently.	Would use a blend of weed treatment methods and site restoration, designed to aggressively eradicate, control, and contain weeds and to restore areas (where appropriate) following treatment. Expected beneficial effects are: 1) improve and increase the biodiversity of native vegetation, 2) improve quality habitat for wildlife, and 3) protect the integrity of ecological sites for sensitive plant species. Aerial treatment is used to control and eradicate very large infestations in isolated areas with steep slopes and rocky soils.	Benefits described for the Proposed Action could still be achieved, but it would take much longer. The further spread of noxious weeds would be controlled, but little would be done to eradicate large infestations currently in place. There would need to be constant efforts to control the spread of weeds from current sites.	Alternative 2 may, with a large, constant labor outlay, control the further spread of noxious weeds. The reduction in size or elimination of current weed sites would likely not occur and it would take much longer than the Proposed Action, Alternative 1, or the No Action Alternative to see any positive results. No herbicide use would mean there is no possibility of inadvertently impacting native vegetation, wildlife habitat, or sensitive plants from chemical drift.

TABLE 4-8
Comparison of Effects Between Alternatives

Resource Area	No Action Alternative	Proposed Action	Alternative 1	Alternative 2
Aquatic Resources	Increased potential for soil erosion and stream sedimentation at weed-infested sites would continue. This can adversely affect aquatic habitat and associated fish and aquatic invertebrate populations.	Treating and reclaiming weed-infested areas would result in improved aquatic and riparian habitat conditions and reduced threats to all aquatic species. Four worst-case situations involving the use of herbicides include the inadvertent entry of herbicides into aquatic ecosystems through surface runoff, leaching through soils, accidental spills, and wind drift. BMPs and mitigation measures would avoid or minimize these effects.	Similar to the Proposed Action, except that no aerial application of herbicides would take place, making it a less aggressive weed treatment alternative than the Proposed Action. This decreases the chance for wind drift into aquatic systems during application, but increases the time before weeds are eradicated, contained, or controlled and habitat is restored.	Benefits to aquatic resources under Alternative 2 would be less than those for the Proposed Action, Alternative 1, or the No Action Alternative. It would take longer to realize some limited benefits to aquatic and riparian resources resulting from reduced erosion and sediment delivery at successfully treated weed-infested sites to drainages. The increased use of mechanical treatments would result in increased surface disturbance potentially increasing sediment delivery to streams. There would be no potential for any of the worst-case situations involving herbicide application.

TABLE 4-8
Comparison of Effects Between Alternatives

Resource Area	No Action Alternative	Proposed Action	Alternative 1	Alternative 2
Wildlife Resources	All wildlife species would be affected to varying degrees from weed expansion. As weeds expand they displace native plant communities; reduce hiding cover, which may cause smaller wildlife species to abandon an area, in turn displacing predators; and reduce forage on big game winter range. Long-term threats to wildlife would be moderate to high.	Minimal impacts from weed control activities are expected to any wildlife species. Short-term disturbance and displacement is expected during treatment applications; usually less than 1 day. Long-term benefits to all wildlife species would be high as native plant communities are restored following weed treatment.	Long-term benefits to wildlife would be moderate and less than the Proposed Action, and would occur at a slower rate because of no aerial application of herbicides under Alternative 1.	Long-term threats to wildlife would generally be high. Infestations would continue to expand, since this alternative incorporates relatively non-aggressive treatment technologies. The result would be a reduction in available forage for wildlife. Additionally, it would take a longer period of time to achieve the same or lesser levels of weed control than could be achieved using herbicides; rapidly expanding infestations would likely continue to increase in size. Therefore, it would take longer to realize any benefits to wildlife from the control and eradication of weeds.

TABLE 4-8
Comparison of Effects Between Alternatives

Resource Area	No Action Alternative	Proposed Action	Alternative 1	Alternative 2
Ecosystem Function	Ecosystem function would experience little to no impact from treatment of noxious weeds, but ecosystem function would be adversely affected by continued weed population expansion.	Impacts would be less under the Proposed Action than the No Action Alternative. Weeds would be aggressively eradicated, controlled, or contained using a variety of methods, and treatment sites would be restored to native vegetation. Loss of native plant communities would decrease over time as weeds are reduced and eliminated. Long-term eradication in steep and rocky terrain would be most effective with aerial application.	Effects on ecosystem function would generally be similar to those described for the Proposed Action, but would occur at a slower pace because of no aerial herbicide application under Alternative 1. Treatment success and improvements to ecosystem function on infested steep slopes or inaccessible areas would not be as effective or as widespread as under the Proposed Action. Earlier efforts on this terrain have only been marginally successful. There would be negative effects on these areas (e.g., infestations would increase) because these methods alone cannot be effectively used on this terrain.	Direct and indirect adverse effects on ecosystem function would be greater than those described for the Proposed Action, Alternative 1, and the No Action Alternative. The timeframe for implementation and any visible treatment success would be longer, but there would be no risk from herbicide application. Indirect adverse effects would include continued expansion of infestations, especially in steep and rocky terrain where mechanical methods cannot be used.

TABLE 4-8
Comparison of Effects Between Alternatives

Resource Area	No Action Alternative	Proposed Action	Alternative 1	Alternative 2
Physical Resources				
Surface Water	Although increased runoff from weed-infested sites may result in local, short-term variations in a stream's hydrograph, this would not be expected to alter a drainage's seasonal flow regime. The existing use of herbicides would continue at the current rate, limited monitoring indicates these activities have not impacted surface water quality, hydrology, 303(d)-designated water bodies, or designated beneficial uses.	Effects of weed treatment under the Proposed Action would be expected to result in some improvement in surface water quality. Potential short-term impacts on surface water quality could occur if there were an accidental spill of a relatively toxic herbicide in a small drainage. Adherence to BMPs and mitigation measures would reduce the likelihood of such a spill occurring. Aerial applications also would help minimize the threat of spills at or near treatment areas.	Effects on surface water would generally be similar to those effects described for the Proposed Action, except there would be no aerial application of herbicides. Benefits to surface water quality resulting from reductions in erosion and sediment delivery from weed-infested areas would still be expected, but they would take longer to achieve and be less widespread than under the Proposed Action.	The magnitude of direct and indirect benefits to surface water quality would be expected to be less than those for the Proposed Action, Alternative 1, or the No Action Alternative. It also would take longer to realize any benefits to surface water quality resulting from reduced erosion and sediment delivery at weed-infested sites to drainages.
Groundwater	The No Action Alternative would not affect groundwater resources or drinking water quality.	If the worst-case situation involving leaching of herbicides that was discussed did occur, it would have a very minor or negligible effect on groundwater quality and would not be expected to result in violations of drinking water standards.	The potential effect of Alternative 1 on groundwater resources would be the same as described for the Proposed Action.	Alternative 2 would not affect groundwater resources or drinking water quality.
Soils, Geology, and Minerals	Soils, geology, and minerals would experience little to no impact from treatment of noxious weeds, but soil stability and productivity would be affected by weed population expansion.	Declines in soil productivity would diminish with the Proposed Action as native plant communities become established on eradicated weed sites and restore the nutrient and organic matter balance over time.	There would be long-term benefits to soils from the reduction in size of weed populations and subsequent reduction in erosion. Similar to the Proposed Action, Alternative 1 would not affect geology and minerals.	It would take longer to realize any benefits to soils from the control and eradication of weeds. Alternative 2 would not affect geology and minerals. Eradication or control of larger infestations would not occur, thus leaving soils in jeopardy of continued degradation.

TABLE 4-8
Comparison of Effects Between Alternatives

Resource Area	No Action Alternative	Proposed Action	Alternative 1	Alternative 2
Land Uses and Designations	Invasive weeds would continue to affect commercial and recreational values on the S-CNF—and in the communities that rely on a healthy forest ecosystem. There would be a high threat of weed encroachment into roadless areas and risk of impacts to RNA and WSR characteristics.	Commercial and recreational activities may be affected as access to infested areas is restricted during spraying and other weed treatments. However, the Proposed Action would eradicate some weed populations, and would effectively reduce the size and rate of spread of other infestations, which ultimately benefits land use. There would be a low threat of weed encroachment into roadless areas and risk of impacts to RNA and WSR characteristics.	Because this alternative would not incorporate aerial spraying activities, large weed infestations on steep, inaccessible slopes of the S-CNF would be more difficult to control. This could lead to expansion of infestations and some additional loss of wildland acres. This would also affect recreational and commercial uses, since weed control activities would take longer and be less effective in that area. There would be a moderate threat of weed encroachment into roadless areas and risk of impacts to RNA and WSR characteristics.	While this alternative offers a full array of non-chemical weed treatment methods, it is anticipated that treatment would take longer and be less effective than the Proposed Action, Alternative 1, or the No Action Alternative. Commercial and recreational opportunities would be affected, since weed infestations would remain, and likely expand, as non-chemical treatments are implemented. There would be a high threat of weed encroachment into roadless areas and risk of impacts to RNA and WSR characteristics.
Visual Resources	Noxious weed populations primarily affect views of the immediate foreground and middle ground, rather than the background, except where plant infestations are large enough to impact views of hillsides. The opportunity to view native vegetation and wildlife would be reduced.	Visual quality in treated areas would improve. During treatment, however, visual opportunities may be temporarily diminished as weed populations die and natural vegetation is restored and recovers. This effect is expected to be short-lived, and would be most apparent where there are large weed infestations.	The visual impact would be most apparent where large infestations of weeds occur on steep slopes. Ground application of herbicides may have some long-term effects on weed infestations, but control and eradication goals may not be met, with a corresponding effect on visual opportunities. As a result, the vistas of these steep, often inaccessible slopes would be marred by weeds indefinitely.	Some loss of additional opportunities for viewing the natural landscape would occur as non-chemical treatments take time to implement. Other large weed infestations could also expand, since most weed types do not immediately respond to non-chemical treatment. Continued, permanent loss of opportunities may occur as weed infestations begin to spread beyond the capacity to manage expansion and new growth.

TABLE 4-8
Comparison of Effects Between Alternatives

Resource Area	No Action Alternative	Proposed Action	Alternative 1	Alternative 2
Air Quality and Noise	The only effects on air quality would be potential drift from herbicide spraying and some dust from mechanical treatment. Spot spraying would result in little drift. The odor of the chemicals may persist for several hours. Other effects on air quality would include dust from weed control efforts. The only short-term effect on noise levels would be from localized mechanical treatments such as mowing and mulching.	Weed treatments would have the same impacts as described for the No Action Alternative. Since the Proposed Action would provide for the greatest level of weed control, it would contribute the greatest reduction in the amount of airborne weed pollen present in the affected area. The short-term effects on noise levels would stem from aerial herbicide application and mechanical operations.	The direct effects on air quality of Alternative 1 would be virtually identical to those of the Proposed Action, although the short-term risk of drift from aerial spraying would be removed. Overhead noise from aerial herbicide applications would not occur, thus decreasing the impact on noise levels from weed treatments.	Short-term effects on air quality from herbicides would not occur. Beneficial effects of reduced weed pollen on any particular site would occur if weeds are reduced on that site. Individually, these effects may be too small to benefit local air quality. Extensive mechanical weed treatments may cause short-term effects on dust and noise levels within the areas of treatment.
Human and Socioeconomic Resources				
Human Health and Safety	Noxious weeds do not pose a human health and safety risk, except from minor cuts and scrapes and skin irritation from contact with weeds, and allergies from weed pollen. Current ground-based herbicide spraying has not impacted public health and safety and is not expected to cause an impact.	Workers are at risk from cuts, scratches, and skin irritation, and sprains and strains from working on uneven ground. Toxicity studies indicated that worker risks from herbicides would be extremely low. Safety protocols would minimize or eliminate this risk. Risks to the public while collecting wild edible vegetation are virtually non-existent.	Effects would be similar to the Proposed Action, except that the risk of herbicide drift would be reduced because aerial spraying would not be used. Treating steep, inaccessible areas with ground-based treatments increases the risk of worker injury.	Risks from herbicide application would be completely eliminated. However, workers would still be subject to potential sprains, strains, cuts, scratches, and skin irritation from contact with weeds. Increased mechanical treatments increase the risk of injury substantially, especially on steep slopes.

TABLE 4-8
Comparison of Effects Between Alternatives

Resource Area	No Action Alternative	Proposed Action	Alternative 1	Alternative 2
Indian Trust Assets/Treaty Rights	The spread of weeds would likely continue to displace and adversely affect native vegetation gathered by local Tribes. The traditional use of these plants would be further affected as access is affected by continued weed control efforts. Other Trust Assets that could also be directly affected are resident and anadromous fisheries and their habitat, which may experience degradation from increased sediment delivery to streams from weed infestations.	Biological and physical resources would benefit overall, as described above. However, there may be short-term adverse effects from herbicide odor and drift to non-target areas during aerial spraying. Other adverse, short-term effects may stem from chemical odors and drift as ground-based herbicides are applied and from disturbance of resources during mechanical treatment. The cultural gathering of plants may be affected, but only for a short time during treatment. Direct adverse impacts to terrestrial and aquatic habitats and species is expected to be none or minimal. With reduced weed infestations, long term indirect beneficial effects to these habitats is expected benefiting Tribal Treaty Rights.	This alternative would be identical to the Proposed Action, except no aerial herbicide application would occur. The experience of Native Americans using Trust Assets may be affected if the users know that weed control treatments are occurring nearby, or if access to these assets is restricted during and perhaps briefly following treatment. Long-term access to Trust Assets could be affected as weed eradication would take longer to perform under this alternative. Long term beneficial effects to terrestrial and aquatic habitats would be less than the Proposed Action due to less effective treatment options, potentially affecting long term Trust Assets and Treaty Rights.	This alternative would not incorporate herbicide applications, thus eliminating any potential risks of drift or chemical odor. However, this alternative may have a direct effect on weed control and expansion since the range of treatments would be limited, resulting in limited success and benefits compared to the Proposed Action, Alternative 1, and the No Action Alternative. Native American long-term access to Trust Assets would be affected by continued weed expansion expected under this alternative. In addition, with the continued weed expansion, long term effects to terrestrial and aquatic habitats would likely be significant, adversely affecting Trust Assets and Treaty Rights.
Environmental Justice	The No Action Alternative would not alter subsistence rights and fishing by Native American Tribes, and would not disproportionately impact minority and low-income populations.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.

TABLE 4-8
Comparison of Effects Between Alternatives

Resource Area	No Action Alternative	Proposed Action	Alternative 1	Alternative 2
Economics	Adjacent communities would share the economic impact of losses from weed infestations since these communities rely on the forest resources for their livelihood. Effects on vegetation, fisheries, wildlife, and ecosystem function would also influence the economic well-being of these adjacent communities. The land itself has value, the loss of which represents an important economic impact. A conservative estimate of the wildland acreage is approximately $3.95 per acre, with rangeland values at $10.73 per acre. The estimated cost of treating 3,500 acres annually under this alternative is approximately $843,000 ($241 per acre).	Given the economic cost of the No Action Alternative, a direct effect would be in savings of wildland and rangeland acres. A conservative estimate would include the savings of currently infested wildland acreage of approximately $3.95 per acre, with rangeland values of $10.73 per acre. The estimated cost of treating 18,000 acres annually under this alternative is approximately $3,020,000 ($168 per acre).	The economic effects stemming from the cost of this alternative would be essentially the same as the Proposed Action, except the cost of aerial herbicide application would not be included. There would be less acreage affected by wildland and rangeland acreage savings (approximately $3.95 per acre and $10.73 per acre, respectively) with this alternative since treatment in steep, rough terrain would be difficult. The estimated cost of treating 18,000 acres annually under this alternative is approximately $6,850,000 ($381 per acre).	Alternative 2 would consist of non-chemical weed treatment methods. These techniques take time and can be labor intensive, thus increasing the potential long-term costs of this alternative. Wildland and rangeland acreage savings (approximately $3.95 per acre and $10.73 per acre, respectively) would not be realized as non-chemical eradication efforts may not keep pace with infestations. The estimated cost of treating 18,000 acres annually under this alternative is approximately $16,370,000 ($909 per acre)

TABLE 4-8
Comparison of Effects Between Alternatives

Resource Area	No Action Alternative	Proposed Action	Alternative 1	Alternative 2
Cultural Resources				
Cultural and Historical Resources and Native American Religious Concerns	The spread of weeds would likely continue to displace native vegetation gathered by local Tribes. The traditional use of these plants would be affected as access is affected by continued weed control efforts. The continued presence of noxious weeds along the Lewis and Clark Trail could result in a reduction of the historical integrity of trail and camping sites.	Offers the greatest recovery potential for currently infested historic landscapes while having a minimal effect on cultural and historic values. Access to important cultural sites may be temporarily restricted during weed treatment efforts. Native American users' experiences in culturally important or sacred sites may be affected as the users become aware of ongoing treatment activities.	Similar to the Proposed Action.	Similar to Alternative 1. However, large weed infestations may take longer to treat under this method, since the aerial application of herbicide has been shown to be the quickest method of weed treatment. The potential for disturbing cultural resources would be greatest under this alternative because of the planned extensive use of mechanical treatments.
Paleontological Resources	No effects are anticipated from the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.