United States
Department of
Agriculture

Forest Service

Fire and Aviation Management
Washington, DC

Nationwide Aerial Application of Fire Retardant on National Forest System Land

Final Environmental Impact Statement

October 2011

Cover photo by Kreig Rasmussen, Fishlake National Forest, 2005.

List of Tables

List of Figures

Abstract

Nationwide Aerial Application of Fire Retardant

Final Environmental Impact Statement

Lead Agency: U.S. Department of Agriculture (USDA), Forest Service

Cooperating Agency: U.S. Department of the Interior (USDI), Bureau of Land Management

Responsible Official: Thomas Tidwell, Chief, USDA Forest Service

For Information Contact: Glen Stein, Fire and Aviation Management, USDA Forest Service, gstein@fs.fed.us, (208) 869-5405

Abstract: The USDA Forest Service is proposing to continue the aerial application of fire retardant on National Forest System lands in response to the July 2010 direction from the U.S. District Court for the District of Montana requiring the Agency to issue a decision no later than December 31, 2011. This final environmental impact statement discloses the environmental and economic effects of the proposed action. The purpose of the proposed action is to address the need for the continued use of aerially applied fire retardant as a firefighting tool because it reduces fire intensities and rates of spread and increases the ability to safely fight wildland fires with ground-based forces. The Forest Service provides standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire.

Twenty-seven comments were received in response to the notice of intent to prepare an environmental impact statement. Fifty-three comments were received in response to the draft environmental impact statement. The Agency considered three alternatives in detail, including the proposed action, which were developed in response to the comments received and issues identified. Alternative 1 No Aerial Application of Fire Retardant) is the no-action alternative; Alternative 2 (Continued Aerial Application of Fire Retardant Under the 2000 *Guidelines*, Including the 2008 Reasonable and Prudent Alternatives) is the proposed action; and Alternative 3 (Continued Aerial Application of Fire Retardant, Using Aerial Application of Fire Retardant Direction and Adopting the 2008 Reasonable and Prudent Alternatives) is the preferred alternative. The final environmental impact statement describes the effects of each alternative with respect to the purpose and need and significant issues. The final environmental impact statement is available online at http://www.fs.fed.us/fire/retardant.

Under 40 CFR 1506.10(b)(2) this final environmental impact statement is available for consideration by the Chief of the Forest Service for a minimum of 30 days before the Agency will record a decision.

Summary

Summary

On July 27, 2010, the United States District Court for the District of Montana invalidated the Forest Service's 2008 decision to continue using the 2000 *Guidelines for Aerial Application of Retardants and Foams in Aquatic Environments* and adopt the 2008 Reasonable and Prudent Alternatives (Appendix A) identified by the U.S. Fish and Wildlife Service (FWS) and the National Oceanographic and Atmospheric Administration (NOAA) Fisheries, holding that the 2000 Guidelines were developed in violation of the National Environmental Planning Act (NEPA) and the Endangered Species Act (ESA). The district court vacated the 2008 decision, and remanded it to the USDA, FWS, and NOAA Fisheries for further proceedings (Forest Service Employees for Environmental Ethics vs. Forest Service, 726 F.Supp.2d 1195 (US District Court, Montana 2010) .

On August 27, 2010, a notice of intent was published in the *Federal Register* announcing the intention of the Forest Service to prepare an EIS and initiate a 45-day scoping period. As a result of this notice, 27 comment letters were received by October 12, 2010.

A notice of availability was posted in the *Federal Register* on May 13, 2011, for the draft EIS titled *Nationwide Aerial Application of Fire Retardant Project, Proposing to Continue the Aerial Application of Fire Retardant on National Forest System Lands*. This began the 45-day comment period, which ended on June 27, 2011. The Forest Service received 53 comment letters from individuals, representatives of businesses, special interest groups, tribal governments, and Federal and State agencies.

Comments received during the commenting periods and concerns collected during the tribal and stakeholder meetings, webinars, and conference calls were analyzed and synthesized. The additional engagement process confirmed that the issues the Forest Service had identified remained valid. However, substantive comments were used to clarify the purpose and need, adjust Alternative 3, and correct and strengthen the analysis for the final EIS. The Forest Service response to comments can be found in Appendix Q.

Purpose and Need for Action

High fire intensities and rates of spread inhibit the ability to safely fight wildland fires with ground-based forces. In addition, remote locations and rugged topography make access difficult and often delay the deployment of ground forces for fire suppression efforts.

- The Forest Service needs an effective tool for wildland firefighting that can:
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity.
- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations, thus controlling fires while they are smaller and less dangerous and damaging.
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

Aerially applied fire retardant can help accomplish each of the above objectives. However, because aerially applied fire retardant can have adverse effects on some sensitive resources, the Forest Service must provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire.

Public Involvement

To supplement the comments received during scoping and the draft environmental impact statement commenting period and to determine if greater public outreach was warranted, the Forest Service entered into an interagency agreement with the U.S. Institute for Environmental Conflict Resolution (US Institute) to conduct a stakeholder assessment. The US Institute contracted with EnviroIssues, a facilitation and public outreach company based in Seattle, to develop and implement the assessment.

Agency decision makers worked directly with tribal leadership at local levels (e.g., Forest Service regions, national forests and grasslands, and districts) through official government-to-government consultation. To complement the official government-to-government consultations, the Forest Service provided two virtual national tribal listening sessions via webinar in April and July 2011 exclusively for tribal members.

The Forest Service selected four communities for community listening sessions. These listening sessions were open to the general public. The communities were selected based on their past and future potential to be affected by the use of aerial fire retardant on wildfires and their geographic diversity. Community listening sessions were held in Ocala, Florida, on May 24, 2011; Santa Barbara, California, on June 7, 2011; Wenatchee, Washington, on June 9, 2011; and Tucson, Arizona, on June 15, 2011.

In addition to the community listening sessions, a national community listening session was held via webinar on June 16, 2011, for those who were unable to attend an on-site meeting. A second national stakeholder update session via webinar was held October 12, 2011.

Lastly, on April 28 and June 22, the US Institute convened a virtual non-Agency discussion group via a webinar to engage representatives from specific organizations and interest groups in a discussion about their concerns regarding the aerial application of fire retardant and the EIS process. Most of those who participated in these two webinars also attended other engagement events (e.g., technical listening sessions, the science panel, and community listening sessions).

A science panel, a series of technical listening sessions, and an interagency discussion group were designed to engage people with these interests with in-depth understanding about aerial fire retardant use in firefighting operations and its potential impacts on the natural environment, cultural resources, and sacred sites.

In addition to the many informal and ad-hoc discussions that Forest Service officials had with their interagency firefighting partners, a formal discussion group was formed to share thoughts about the analysis in the draft environmental impact statement and the need for coordination of fire fighting activities. The group was convened by the US Institute and met virtually via webinar on April 26, 2011.

The Forest Service formally consulted with the U.S. Fish and Wildlife Service and NOAA Fisheries, as required by Section 7 of the Endangered Species Act.

Issues

Issues serve to highlight effects or unintended consequences that may occur under the alternatives and provide the opportunity, during the analysis, to mitigate adverse effects and compare trade-offs to inform the decision maker and the public. Issues are best identified early in the process to help determine the scope of the actions, alternatives, and effects to consider. However, because of the iterative nature of the NEPA process, additional issues may surface and be considered at any time.

The Council on Environmental Quality regulations refers to issues as they relate to environmental impact statements. 40 CFR 1500.4 states:

- *Agencies shall reduce excessive paperwork by:*
    - *(c) Discussing only briefly issues other than significant ones.*
    - *(g) Using the scoping process not only to identify significant environmental issues deserving of study, but also to deemphasize insignificant issues, narrowing the scope of the environmental impact statement process accordingly.*

- *As part of the scoping process the lead agency shall:*
    - *(40 CFR 1501.7(a)(2)) Determine the scope and the significant issues to be analyzed in depth in the environmental impact statement.*
    - *Identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (1506.3), narrowing the discussion of these issues in the statement to a brief presentation of why they will not have a significant effect on the human environment or providing a reference to their coverage elsewhere. (40 CFR 1501.7(a)(3)).*

After reviewing historical documents including the 2007 environmental assessment (EA), the comments received during scoping, and the additional stakeholder engagements, the following issues were identified as significant and were used to develop Alternative 3. The evaluation of issues (comment analysis) is documented in the project record.

Quantitative and qualitative indicators are listed to help track how the alternatives respond to the issues.

1. *Water quality:* In certain rare situations, when fire retardant comes in contact with water the fire retardant chemicals can temporarily alter the water quality and may be toxic to aquatic organisms. Fire retardant could reach water through misapplications or through leaching and erosion.

   Indicators:

- Contamination of water with fire retardant from accidental drop - Potential for accidental application of fire retardant into water.

- Contamination of drinking water from fire retardant - Potential for drinking water contamination from fire retardant.

- Leaching or erosion of soil and nutrients into streams and waterways - Acres affected by fire retardant.

2. *Human Health and Safety*: Because fire retardant contains numerous chemicals, there is concern by some as to their safety to humans. In addition, firefighting is an inherently risky activity and it is important to manage that risk and keep firefighter and public safety as the highest priority.

Indicators:

- Known human health issues.

- Protection of human life and public safety.

3. *Impacts on threatened and endangered species:* Consultation with the FWS and NOAA Fisheries conducted on the 2007 EA resulted in 65 determinations that the use of aerially delivered fire retardant as proposed by the Forest Service may jeopardize the continued existence of 65 species listed under the ESA. As a result, the FWS and NOAA Fisheries provided the Forest Service with reasonable and prudent alternatives to address these determinations. On July 27, 2010, the Federal District Court in Montana ruled that the reasonable and prudent alternatives did not adequately address the possible effects on these species and also that effects on ESA listed terrestrial species were not addressed by the Forest Service.

Indicator:

- Impact on federally listed species - Number of species and critical habitat affected.

4. *Cultural Resources:* Cultural resources, such as petroglyphs, historic structures, traditional Native American gathering areas, and sacred sites, may be affected by the aerial application of fire retardant.

Indicator:

- Potential for effects to cultural resources.

There were numerous issues raised during scoping that were not considered significant for the purposes of this EIS, however, the Interdisciplinary Team recognized their importance and they were used to help shape the effects analysis in Chapter 3. Briefly, these issues included:

- The cost compared to benefits of using fire retardant relative to environmental risks.
- The potential for displacement of native plant communities by fire retardant use.
- The potential for increases in invasive plants and aquatic organisms due to the use of fire retardant.
- Changes in soil chemistry as a result of applying fire retardant.
- Concern for the viability of Forest Service-listed sensitive species populations.

Proposed Action and Alternatives

Alternative 1 (No Action): No Aerial Application of Fire Retardant

Under this alternative, the Forest Service would discontinue the aerial application of fire retardant for fires occurring on National Forest System (NFS) lands. Aerial application of water would continue to be available for use by incident commanders as a fire suppression tool. This alternative would not prohibit the aerial application of fire retardant on lands owned or administered by the States, private ownerships, or other Federal agencies. Other jurisdictions would make their own decisions regarding the use of aerially applied fire retardant on lands that they manage.

Alternative 2 (Proposed Action): Continued Aerial Application of Fire Retardant Under the 2000 Guidelines, Including the 2008 Reasonable and Prudent Alternatives

Under this alternative, the Forest Service would continue aerial application of retardant and permanently adopt the 2000 *Guidelines for Aerial Delivery of Retardant or Foam Near Waterways* (Appendix A). This alternative adopts the 2008 Reasonable and Prudent Alternatives as identified by U.S. Fish and Wildlife Service (FWS) and National Oceanic and Atmospheric Administration (NOAA) Fisheries (Appendix A). Table 1 in Chapter 2 includes a list of the components included in Alternative 2.

These guidelines include:

- 300-foot buffers on either side of waterways where aerially delivered fire retardant will not be applied.

Deviations from these guidelines are acceptable under the following circumstances:

- When alternative line construction tactics are not available due to terrain constraints, congested area, life and property concerns, or lack of ground personnel, it is acceptable to anchor the foam or retardant application to the waterway. When anchoring a retardant or foam line to a waterway, the most accurate method of delivery will be used to minimize placement of retardant or foam in the waterway (e.g., a helicopter rather than a heavy airtanker); or
- When it is determined by the unit administrator that life or property is threatened and the use of retardant or foam can be reasonably expected to alleviate the threat; or
- When it is determined by the unit administrator that potential damage to natural resources outweighs possible loss of aquatic life.

Also included are provisions for complying with the emergency Section 7 consultation procedures of the Endangered Species Act (ESA) with respect to aquatic species (Appendix A).

Alternative 3 (Preferred Alternative): Continued Aerial Application of Fire Retardant, Using Aerial Application of Fire Retardant Direction and Adopting the 2008 Reasonable and Prudent Alternatives

Aerial Application of Fire Retardant Direction replaces the 2000 *Guidelines for Aerial Delivery of Retardant of Foam Near Waterways* (Appendix A) to better respond to water quality, ESA, cultural resource and tribal issues. To ensure that this direction also considers human health and safety, one exception is provided:

Aerial delivery into waterways or avoidance areas may occur when human life or public safety is threatened and the use of retardant can be reasonably expected to alleviate the threat.

The direction also includes implementing the 2008 Reasonable and Prudent Alternatives (Appendix A).

Alternative 3 consists of the following components:

- Aircraft Operational Guidance,
- Avoidance Area Mapping Requirements,
- Annual Coordination, and
- Reporting and Monitoring Requirements.

Aircraft Operational Guidance

Operational guidance ensures that retardant drops are not made within the 300-foot buffers of either side of waterways or avoidance areas for threatened, endangered, proposed, candidate, or sensitive (TEPCS) species.

Whenever practical, as determined by the fire incident commander, the Forest Service will use water, other suppressants, or less toxic approved fire retardants in areas occupied by TEPCS species or their designated critical habitats. Some species and habitats require that only water be used to protect their habitat and populations; these habitats and populations have been mapped as avoidance areas. Incident commanders and pilots are required to avoid aerial application of fire retardant in avoidance areas for TEPCS species or within the 300-foot buffers on either side of waterways.

These guidelines do not require helicopter or airtanker pilots to fly in a manner that endangers their aircraft or other aircraft or structures, or that compromises the safety of ground personnel or the public.

- **Operational guidance to ensure retardant drops are not made within 300-foot buffers on either side of waterways or avoidance areas for TEPCS species:**

Medium/Heavy Airtankers, Single Engine Airtankers, and Helicopters: When approaching mapped avoidance areas for TEPCS species waterways, or riparian vegetation visible to the pilot, the pilot will terminate the application of retardant approximately 300 feet before reaching the mapped avoidance area or waterway. When flying over a mapped avoidance area waterway, or riparian vegetation, the pilot will wait 1 (one) second after crossing the far border of an avoidance area or bank of a waterway before applying retardant. Pilots will make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant within the 300-foot buffer zone or avoidance area

- **Protection of cultural resources, including historic properties, traditional cultural resources, and sacred sites:**

These resources cannot be mapped using a national protocol or addressed with a standard prescription that would apply to all instances. Therefore, they will be given case-by-case consideration when ordering the aerial application of fire retardant. As necessary, incident commanders will consider the effects of aerial applications on known or suspected historic properties, any identified traditional cultural resources, and sacred sites. Cultural resources specialists, archaeologists, and tribal liaisons will assist in the consideration of effects and alternatives for protection.

Avoidance Areas Mapping Requirements

Identified avoidance areas are:

- **Aquatic Avoidance Areas:**
    - Mapped waterways with a 300-foot buffer including perennial streams, intermittent streams, lakes, ponds, identified springs, reservoirs, and vernal pools.
    - Buffer areas may be adjusted for local conditions and coordinated with the FWS and NOAA Fisheries local offices.

- **Terrestrial Avoidance Areas:**
    - May be used to avoid impacts on one or more federally listed threatened, endangered, or proposed plant or animal species or critical habitat where aerial application of fire retardant may affect habitat and/or populations.
    - May be used to avoid impacts on any Forest Service terrestrial sensitive or candidate species where aerial application of fire retardant may result in a trend toward federal listing under ESA or a loss of viability on the planning unit.

The following protocols are for a standardized national map template of avoidance areas for TEPCS species.

- Use FWS and NOAA Fisheries-designated critical habitat layers, when available.
- Use National Hydrography Dataset for mapping water bodies to create aquatic avoidance areas.
- Use FWS, NOAA Fisheries, and Forest Service species population and designated critical habitat information for occupied sites.
- All national forests and grasslands that have affected TEPCS species will complete and update maps, as necessary, in cooperation with local FWS and NOAA Fisheries offices.
- Update maps annually in cooperation with FWS and NOAA Fisheries to reflect changes during the year on additional species or changes made for designated critical habitat.
- A national map template for all revisions will be maintained by U.S. Forest Service Geospatial Service and Technology Center, Salt Lake City, Utah.

Annual Coordination

The Forest Service will annually coordinate with FWS and NOAA Fisheries local offices to ensure that any updates that are needed for fire retardant avoidance areas on NFS lands are mapped using the most up-to-date information.

- The Forest Service will coordinate with aviation managers and pilots on avoidance area mapping and aircraft operational direction and will coordinate with all personnel involved in fire suppression activities.

Reporting and Monitoring Requirements

The Forest Service will report all misapplications of aerially applied fire retardant into avoidance areas. A report of misapplication requires notification by the forest to FWS, and NOAA fisheries as appropriate to determine if there are any necessary future mitigation measures or reinitiation of consultation when there has been an adverse impact to a listed species or its designated critical habitat. Depending on the severity of the adverse effect, an appropriate restriction on future aerial application of retardant may be necessary for the area reported.

To determine if under-reporting misapplications of fire retardant drops is occurring, the Forest Service will annually monitor 5 percent of all fires that are less than 300 acres in size and where aerial fire retardant had been used and aquatic or terrestrial avoidance areas exist.

Monitoring of misapplications of fire retardant will be outlined within an Implementation Handbook for the Reporting and Monitoring of Misapplications of Aerially Applied Fire Retardant. The monitoring components that are reported annually through forests and national TES-species staff for coordination with other agencies will:

- Determine the amount of follow-up monitoring necessary as dictated by the extent of the impacts to species or habitats identified during assessment of the misapplication.
- Be conducted in coordination with local Forest Service/FWS/NOAA/USGS offices and appropriate State agencies.
- Determine the type of recovery or restoration of species or habitats if needed.
- Determine the appropriate contingency measures for protection of TEPCS species from aerially applied fire retardant.
- Determine if additional assessment of cumulative effects for some species would need to be coordinated with certain agencies.

If a retardant drop occurs on a cultural resource, a traditional cultural property, or a sacred site, then the site condition will be assessed by a qualified archaeologist and reported to the State Historic Preservation Officer and if appropriate, tribal representatives including the Tribal Historic Preservation Officer. If the affected resource is a sacred site, or a traditional cultural property, then tribal notification and consultation will be required as part of the determination of effects If the effect is found to be adverse, then the agency will consult with the tribe to determine an appropriate course of action to mitigate or resolve the adverse effect.

Existing monitoring and reporting forms will be updated, as needed, for use in the reporting and monitoring process.

Major Conclusions of the Environmental Impact Statement

Fire Retardant Use in Wildland Fire Management

The effects analysis for wildland fire management is based on several factors including retardant effectiveness, use of fire retardant during all types (size class) of wildland fires, exposure of incident responders, partnerships and political/public consequences, air quality and public and firefighter safety. These factors were evaluated relative to the three alternatives with the following consequences. Under Alternative 1, which proposes to eliminate aerial delivery of fire retardant on NFS lands, it is expected that there would be significantly reduced effectiveness of aerial resources (primarily air tankers) in fighting wildfires, which can lead to more acres burned, potential for an increase in the loss of structures, increased exposure of incident responders to fireline hazards, inconsistent use of fire retardant among partners and cooperators with the potential for increased losses of critical infrastructure, failure to meet public expectations, and decreased air quality Under Alternative 2, which proposes to continue the existing status of aerial delivered fire retardant on NFS lands, for the most part, there would be no substantial effects in any specific area of concern. Although Alternative 3 would allow for the use of retardant, it is uncertain how significant the impact of national standard mapping protocols for TESPC will be on its use. Currently, Forest Service units may have avoidance areas mapped along waterways based on implementation of the 2008 Reasonable and Prudent Alternatives and, depending on the extent of mapping and the identification of additional avoidance areas under Alternative 3, there could be increased limitations and restrictions as to where fire retardant could be applied, with the potential subsequent loss of critical public infrastructure. More restrictions in the use of fire retardant could lead to the reduced effectiveness of fire operations and increased risk and hazard to firefighters and the public; however, such consequences would not be as significant as those under Alternative 1.

Soils

Under Alternative 1, there would be no direct, indirect, or cumulative effects on soils from the aerial application of fire retardant. Effects on forest soils from the aerial application of fire retardant under Alternatives 2 or 3 resemble a fertilizing response. For nutrient-poor soils (sandy, with low organic matter content), the addition of nitrogen and phosphorus could improve soil productivity in the short term. For already productive soils (clay, with high organic matter content), the additional nutrients could have an acidifying effect and reduce soil pH, making some nutrients unavailable. An indirect effect of fire retardant application is an increase in vegetative growth and potential change in vegetative community structure and composition. Leaching of nitrogen into streams and water bodies could occur in areas of coarse textured soils and for drops occurring within the water body influence zone. The persistence of effects will depend on vegetation type and post-application weather patterns (Adams and Simmons 1999).

Hydrology

Fire retardant in water can have adverse impacts on water quality and can have an impact on defined beneficial uses of water Generally, impacts are short-term, as dilution occurs when the affected water moves downstream. Eutrophication can occur where fire retardant affects small bodies of water that do not have the ability to quickly dilute the impacted water

Alternative 1 does not allow aerial use of fire retardant and therefore, there would be no direct, indirect, or cumulative effects on water quality under this alternative. Alternative 2 would have occasional impacts either due to the exceptions or from misapplication of fire retardant into water It is estimated that 0.25 percent of fire retardant drops impact water or the 300-foot buffer under this alternative. Alternative 3 would have a slight drop in the percentage of drops affecting water as there are fewer exceptions under this alternative.

Aquatic Vertebrates and Invertebrates

There are 86 threatened, endangered, and proposed fish species and 67 threatened, endangered, and proposed crustaceans and mollusks. At the Forest Service sensitive-species level, there are 166 sensitive fish species, 90 sensitive crustaceans and mollusks. Macroinvertebrates are a key food source for fish, mollusk, and crustacean species and the loss of numbers and populations will affect the viability of the food web.

There would be no direct or cumulative effects from the aerial delivery of fire retardant on aquatic vertebrates and invertebrates under Alternative 1. Indirect effects could include more use of water as a fire retardant tool because fire retardant in not available for use. That increase is unquantifiable at this point and not considered a a level that would cause de-watering of waterbodies and cause effects to aquatic species.

The direct, indirect, or cumulative effects on aquatic vertebrates and invertebrates are the same for both Alternatives 2 and 3. Current avoidance areas are 300 foot buffers on all waterways, that does not change for Alternative 2 or 3. Alternative 3 allows local national forests and grasslands to increase buffers for aquatic organisms, at the national scale we are unable to quantify what those changes might be.

If an exception is invoked or a misapplication occurs and fire retardant enters a waterway, direct effects include lethal and sublethal effects on aquatic species. These could include mortality of organisms, change in abundance and composition of aquatic communities, or adverse impacts to habitat.

Increased monitoring of retardant drops under Alternative 3 will help address missing information on the frequency of misapplications.

Indirectly, there is the chance of increased nutrients if there is the invocation of an exception or a misapplication. There is the risk of eutrophication to waterways (as discussed in the Hydrology section). There may be a change in macroinvertebrate abundance and species composition, which are food resources for aquatic vertebrates. Additionally, the influx of nutrients may favor the influx of non-native aquatic invasive species, and many of these species are strong competitors, opportunistic, and adversely affect the native aquatic communities.

Determinations under the ESA for the federally listed aquatic species are summarized as 21 no effect, 18 not likely to adversely affect, and 118 likely to adversely affect. Designated Critical Habitat Determinations are 10 no effect, 15 not likely to adversely effect and 72 likely to adversely effect.

Sensitive species determinations are made for Alternative 3 and summarized as 68 no impact and 188 may impact, not likely to contribute towards Federal listing.

Plant Species and Habitats

There are currently 169 federally listed plant species, 24 designated critical habitats, 2,537 Forest Service sensitive plant species, and 10 candidate species on NFS lands. Very little is known about fire retardant effects on plant species and their habitats; available literature suggests that effects are likely to be short-term in duration. Based on records of past fire retardant use, we estimate that future aerial fire retardant application would impact only a small proportion of NFS lands annually (0.002 percent). Exact locations, timing, and need of application in the future are unknown. Because these variables cannot be defined before fire retardant use, we use a conservative analysis that considers potential effects on botanical resources including federally listed, Forest Service listed sensitive species, and native plant communities. If fire retardant is not applied to these species or resources, the potential effects would not occur. Our analysis considers historical fire retardant use, species-specific habitats, species distribution, and local conditions or knowledge related to possible fire retardant use in the future.

Alternative 1 would result in no effects on federally listed species or designated critical habitats or Forest Service listed or Federal candidate species or plant communities from the aerial application of fire retardant because none would be applied. Because of the potential for increased fire size, fire intensity, and ground suppression activities, variable effects (beneficial or negative) could occur. The extent of an effect would depend on site-specific conditions of the fire and the location.

Alternative 2 may result in the potential for more species (Federal and Forest Service listed) and designated critical habitats to be adversely affected because fewer species than under Alternative 3 are protected in avoidance areas. Effects associated with potential fire retardant application for federally listed species include: 64 species not affected, 105 species and 9 designated critical habitats likely to be adversely affected, 14 designated critical habitats not likely to be adversely affected, and 1 critical habitat not affected.

Under Alternative 2, no avoidance areas for sensitive or candidate plant species are designated, unless they occupy areas where waterway buffers are presently identified. Potential effects associated with fire retardant application for Forest Service sensitive and candidate species include:

- 1,874 sensitive and seven candidate species that may be adversely affected by fire retardant but would not likely result in a loss of viability in the planning area nor cause a trend toward Federal listing.
- 223 sensitive and three candidate species that are likely to result in a trend toward Federal listing or a loss of viability in the planning area.
- 440 sensitive species that would not be affected because they either occur on forests or grasslands that do not use fire retardant or occur in habitats where fire retardant would not be used.

Alternative 3 designates fire retardant avoidance areas for Forest Service sensitive and candidate plant species in addition to those for federally listed species. As a result, there would potentially be fewer species and designated critical habitats that would be likely to be adversely affected. Effects associated with the potential for fire retardant application for federally listed species include: 64 species not affected, 49 species likely to be adversely affected, 56 species and 23 designated critical habitats not likely to be adversely affected, and one remaining designated critical habitat not affected.

Under Alternative 3 there are 223 sensitive species and three candidates identified for avoidance mapping. Avoidance mapping would provide protection from adverse effects except in the event of a misapplication. As a result, there are 2,097 sensitive species and 10 candidate species that could experience some adverse effects if fire retardant were to be applied, but effects would not result in a loss of viability on the planning unit or cause a trend toward federal listing. No impacts on 440 sensitive species would occur because they either occur on forests that do not use fire retardant or in habitats where fire retardant would not be used.

Effects on native plant communities are expected to be variable and based on site-specific conditions. An increase in vegetative growth as a result of added nutrients (nitrogen and phosphorus) from fire retardant may illicit a beneficial impact in some native plant communities. Fire retardant may also result in changes to plant community structure or composition, depending on which species respond favorably to nutrient additions. The magnitude and direction of potential change is highly site-specific and influenced by numerous factors other than fire retardant application. Non-native invasive species may increase in some areas where fire retardant is applied (Alternatives 2 and 3). Increases may also occur under Alternative 1 as a result of disturbance from more ground-based fire suppression. Treatment of non-native invasive species would be implemented based on local site-specific conditions and national regional-, or forest- or grassland- approved plans.

Wildlife Species and Habitats

Under all three alternatives, there is a potential direct effect on animals resulting from disturbance associated with low-flying aircraft and the breaking off of tree tops/vegetation by water under Alternative 1 or from fire retardant under Alternatives 2 and 3.

Under Alternative 1, the only impacts on wildlife species would be from disturbance from low-flying aircraft over nest sites or, where species may be present, the very low potential for directly hitting a species with a water drop. The amount of disturbance may be potentially higher under this alternative than under Alternatives 2 or 3 because water is expected to be less effective than fire retardant. There would be no other direct, indirect, or cumulative impacts on wildlife species or habitats.

Alternative 2 has the same impact on species from disturbance from low-flying aircraft as Alternative 3. This alternative would provide protection from applying fire retardants into waterways and for a very few of the listed T&E species (the three species with jeopardy determination from the FWS 2008 Biological Opinion), but it does not provide protection for any of the other TEPCS species that may be affected by the aerial application of fire retardant. It is expected that impacts from the direct application of fire retardant on species will have very low potential to occur, because of the mobility of most species.

Implementation of Alternative 2 may result in the potential for more TEP species that are likely to be adversely affected because fewer species are protected from fire retardant application. Effects associated with potential retardant application for TEP species include: 43 species not affected, 62 species and 28 designated critical habitats that may be affected or are likely to be adversely affected; 3 species whose existence may be in jeopardy or trend toward extinction. No sensitive or candidate species are provided avoidance areas to protect them from fire retardant effects Effects associated with potential retardant application for Forest Service sensitive and candidate species include: 437 species where retardant application may adversely impact individuals or habitats but they are not likely to have loss of viability in the planning area or trend toward Federal listing. There are 27 sensitive and nine candidate species where application of retardant would adversely impact individuals or habitats resulting in a loss of viability in the planning area or trend toward Federal listing without protection from avoidance area designation. No impacts are expected on 74 sensitive species because they either occur on forests or grasslands that do not use fire retardant or occur in habitats where fire retardant would not be used.

Implementation of Alternative 3 would designate more fire retardant avoidance areas and thus the potential for fewer TEP species that are likely to be adversely affected. Effects associated with the potential for fire retardant application for TEP species include: 43 species not affected, 12 species that may be affected or will likely be adversely affected, and 50 species and 28 designated critical habitats that may be affected or will not likely to be adversely affected. There are 32 species and 18 critical habitats identified for avoidance area mapping. There are 27 sensitive species and nine candidate species identified for fire retardant avoidance mapping to ensure that fire retardant would not affect individuals resulting in a loss of viability in the planning area or a trending toward Federal listing. These avoidance areas would be protected from adverse effects except in the event of a misapplication. As a result, there are potentially 437 sensitive or candidate species that, if fire retardant were to be applied, may experience some adverse impacts but this would not result in a loss of viability in the planning unit or cause a trend towards Federal listing. No impacts are expected on 74 sensitive or candidate species because they either occur on forests or grasslands that do not use fire retardant or occur in habitats where fire retardant would not be used.

Alternative 3 has the same impact on species from disturbance from low-flying aircraft as Alternative 2. This alternative proposes more protections for sensitive terrestrial species than Alternative 2, and has more protections for T&E species. One exception (for human life and safety) is allowed under this alternative; thus, it is expected to have fewer impacts on habitats and species than Alternative 2, which allows for three exceptions. In addition, Alternative 3 proposes monitoring of areas were fire retardant drops have been used within a watershed to determine if adverse impacts on any terrestrial species are occurring. If aerial application of fire retardant has occurred within a watershed and has a significant impact on a species or a portion of that species' population (or habitat then the area may have certain thresholds of impacts associated with it to restrict the future use of fire retardant for a specific period of time depending on the species affected, reproductive needs, life-cycle requirements, how the fire retardant affects the critical life phases, and other factors.

Under Alternatives 2 and 3, it is possible that terrestrial species with limited mobility could be directly affected from the aerial application of fire retardant. The indirect effects of the use of the aerial application of fire retardant may include the coating or covering of vegetation and food sources consumed by species. Ingestion of retardant on vegetation or insects by a species depends on the amount of fire retardant used (coverage by vegetation/eco-region type), timing of ingestion after application, and the ability of an animal to avoid feeding on chemicals.

The use of proposed avoidance area mapping may help to minimize direct and indirect impacts caused from the aerial delivery of fire retardant in the vicinity of the TES species populations that may be affected during a critical period of their life cycle, such as nesting, if the predominate fire season coincides with this life-cycle period.

Direct and indirect impacts from the implementation of Alternatives 2 and 3 are not expected to impede the long-term recovery of a species or the conservation value of its critical habitat. Implementation of the proposed action would allow essential features of critical habitat to remain functional because long-term retardants are not likely to have lasting effects on terrestrial ecosystems. Additionally, Alternatives 2 and 3 will prevent wildfires from becoming potentially much larger and consuming most or the entire critical habitat of a species. Lastly, mitigation measures in avoidance mapping for habitat and populations, the establishment of trigger points for restricting the use of retardants within watersheds where fire retardant previously has caused adverse effects to a species or population, and yearly operations planning should all help to reduce impacts on species and habitats.

Social and Economic Considerations

Annual Agency-wide compliance costs associated with avoidance area mapping, assessments, consultations, and monitoring are estimated to be only slightly higher for Alternative 3 ($1.4 million) than Alternative 2 ($1.0 million). Compliance costs are relatively small compared to estimated costs for applying retardant ($24 to $36 million per year; similar to Alternatives 2 and 3). Combined annual costs for compliance and retardant use are small percentages of total average annual suppression costs for 2000 to 2010 ($917 million per year). There are no compliance or retardant costs under Alternative 1; however, other suppression costs (e.g., for substitute tools and tactics) and the probability for changes in size and/or characteristics of wildland fires are expected to be greater under Alternative 1. Suppression cost efficiency is therefore projected to be lower under Alternative 1 than Alternatives 2 and 3, recognizing that this action does not change fire suppression objectives (e.g., protection of health safety, and values-at-risk). There may be potential for slight increases in the probability for changes in size and/or characteristics of wildland fires under Alternative 3 compared to Alternative 2 for some forest units, depending in part on the extent of avoidance area mapped for different units. As a consequence, it is concluded that suppression cost efficiency under Alternative 3 is similar to or slightly lower than Alternative 2 (see summary of fire operation indicators for additional details about suppression efficiency).

Public Health and Safety

Under Alternative 1, not applying aerial fire retardant will likely have no effect in remote areas on human health However, when fires occur on NFS land near developed communities, smoke from fires may have a greater impact on human health than fire retardant applied during firefighting operations. Respiratory problems aggravated by smoke inhalation have the potential to affect many more people directly, resulting in respiratory distress, bronchial infections, and hospitalizations; and indirectly, as access to NFS lands, outdoor recreation, and employment may be restricted.

The human health effects of Alternatives 2 and 3 are likely to be minimal: primarily skin irritations based on records of past incidents. The use of fire retardant has the potential to reduce smoke concentrations in some areas more than the use of water only; however, the greater influence on smoke concentrations is likely to be the presence of wind sufficient to disperse the smoke. There is some potential for application of fire retardant on private property, including gardens and pets. Cleaning property and pets contacted by fire retardant is unlikely to have health effects, although consumption of garden produce coated with fire retardant is not advised even after removing the fire retardant.

Cultural Resources

As there would be no aerial delivery of fire retardant under Alternative 1, there would be no direct, indirect, or cumulative effects on cultural resources associated with this alternative. Under Alternatives 2 and 3, cultural resources, including traditional cultural properties, sacred sites, and historic properties, may be affected by the aerial application of fire retardant. The effects include direct visual impacts on historic properties caused by the color and persistence of color associated with the application of fire retardant, the direct physical impacts caused by the chemical composition of fire retardant (deterioration of artifacts and residues, and exfoliation of rock surfaces), and the indirect effects on the human environment when fire retardant is applied to sacred sites or native foods.

Scenery Management

Under Alternative 1 there would be no direct, indirect, or cumulative effects on scenic resources from the aerial application of fire retardant. The application of aerial fire retardant under Alternatives 2 and 3 may have a temporary impact on scenic resources on NFS lands. Colored fire retardant can temporarily stain surfaces a reddish color. The duration of this impact varies and depends on the site conditions (soils, vegetation, and other physical characteristics) and on weather events (rain and snowfall) following the application. The visibility of the residual fire retardant will last longest in rocky areas and where little precipitation occurs. Areas composed of more porous surfaces and receiving more frequent precipitation will have shorter duration impacts. Most commonly, the effect on scenic resources is short-lived and of minimal consequence. As the shift is made to the use of fire retardant with fugitive colorant, which fades quickly, the effects on scenic resources would diminish.

Wilderness

Under Alternative 1, there would be no effects on wilderness characteristics from the use of aerially applied fire retardant.

The effects on wilderness characteristics would be the same under both Alternatives 2 and 3, because there are no differences between these alternatives in the presence of wilderness. Fire retardant introduces chemicals into the environment that locally will affect nutrient loads, nutrient cycling, growth rates, and potentially some toxicity issues. The presence of fire retardant dye creates an unnatural appearance, which is another indicator of the effects of man and civilization. While fire retardant is not a structure or installation, the presence of the dye trace can result in visible presence of the fire retardant in wilderness. Fire suppression activities, including the application of retardant, are unlikely to adversely affect human use and visitation because most active fire suppression areas are closed to human use. Fire retardant drops may adversely affect cultural resources, historic structures, and other features in wilderness. Effects include coloration, application damage, and small changes in nutrient loading. The number and degree of current and projected fire retardant drops are not sufficient to have long-lasting effect on wilderness character.

Air Quality

With no aerial delivery of fire retardant there would be no direct impact on air quality associated with this alternative. Although it is likely under this alternative that more acres would burn in wildfires therefore indirect and cumulative effects on air quality are likely to increase. Any increase in the potential for larger, longer duration fires due to a ban on the use of fire retardant would likely result in increased public exposure to the serious health hazards caused by high levels of air pollutants in wildfire smoke. These wildfire smoke impacts can rise to levels considered hazardous by EPA as measured by air regulatory agencies (EPA, states, tribes and local authorities) as well as by FLM agencies).

It is reasonable to expect that more NAAQS exceedances will occur from the extra smoke and more state resources will be tied up with the time and expense needed to deal with the implications. States could find themselves dealing with new non-attainment areas and/or efforts to document and exclude data through the time-consuming and expensive Exceptional Events process. In addition, fire fighters are likely to experience increased exposure to smoke.

There would be no measurable direct, indirect, or cumulative effects from the aerial delivery of fire retardant on air quality under either Alternatives 2 or 3. The retardant remains in the air less than a minute, and is typically in the path of the fire which is well removed from areas accessible to the public.

Chapter 1. Purpose and Need for Action

Chapter 1. Purpose and Need for Action

1.1 Document Structure

The Forest Service has prepared this final environmental impact statement (final EIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal laws and regulations. This EIS discloses the direct, indirect, and cumulative environmental impacts that would likely result from the proposed action and alternatives. The document is organized into four chapters:

Chapter 1. Purpose and Need for Action: The chapter includes information on the history of the project proposal, the purpose of and need for the project, and the Agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.

Chapter 2. Alternatives, Including the Proposed Action: This chapter provides a more detailed description of the Agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation measures. This chapter also includes alternatives that were given consideration but not analyzed in detail. Finally, this chapter provides a summary table of the environmental consequences associated with each alternative.

Chapter 3. Affected Environment and Environmental Consequences: This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource area, beginning with the affected environment followed by the environmental consequences.

Chapter 4. Consultation and Coordination: This chapter provides a list of preparers, agencies, tribes, organizations, businesses, and individuals who contributed to the development of the EIS.

Appendices: The appendices provide additional detailed information to support the analysis presented in the EIS.

Glossary: The glossary provides definitions for words and terms used in the EIS.

Index: The index provides page numbers by document topics.

Related documentation, including additional detailed analysis of project-area resources, may be found in the project planning record located at the National Interagency Fire Center in Boise, Idaho.

1.2 Project Background

In 2004, the Forest Service Employees for Environmental Ethics filed a lawsuit against the Forest Service alleging that the application of fire retardant required the Forest Service to prepare an environmental analysis (EA) pursuant to NEPA, and consult with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA).

On October 24, 2005, the United States district court for the District of Montana held that the Forest Service's failure to conduct an EA on the use of long-term chemical fire retardant on National Forest System (NFS) land violated NEPA, and the Agency's failure to consult on this program violated the ESA.

On July 28, 2006, the Forest Service published a notice of proposed action to conduct an environmental analysis and prepare an EA to determine whether the continued nationwide aerial application of fire retardant using the 2000 *Guidelines for Aerial Application of Retardants and Foams in Aquatic Environments* (Appendix A) to fight fires on NFS lands would result in any significant environmental impacts within the meaning of NEPA.

In October 2007, the Forest Service issued an EA and decision notice and finding of no significant impact (DN/FONSI) titled *Aerial Application of Fire Retardant*. In February 2008, the Forest Service amended the DN/FONSI by incorporating the reasonable and prudent alternatives proposed by the FWS and NMFS identified during the Section 7 consultation process as prescribed by the ESA.

On April 2, 2008, the Forest Service Employees for Environmental Ethics again filed a lawsuit against the Forest Service alleging that the EA prepared by the Forest Service pursuant to NEPA and the consultation with the FWS and the NMFS under ESA were inadequate.

On July 27, 2010, the U.S. District Court for the District of Montana issued a decision in Forest Service Employees for Environmental Ethics v. United States Forest Service, 08-43 (D. Mont.) that invalidated the Forest Service's decision based on violations of NEPA. The court also held that the FWS and NMFS Section 7 consultation with the Forest Service violated the ESA. The court directed the Forest Service and the FWS and NMFS to cure these NEPA and ESA violations, and for the Forest Service to issue a new decision no later than December 31, 2011.

1.3 Fire Retardant Background

Large fixed-wing airtankers have played an increasingly important role in firefighting since the mid 1950s when aircraft were first used to deliver fire retardant. Although research as early as the 1930s looked toward improving the effectiveness of water as a forest fire-extinguishing agent, the use of fire retardants did not begin until the 1950s. Since the 1950s, various chemical formulations have been used. In recent decades the focus has been on improving formulations to consider their environmental impacts, while maintaining or improving their firefighting effectiveness.

Fire retardant, which is approximately 85 percent water and 15 percent fertilizer salts, thickening agents, coloring agents, and other ingredients such as corrosion inhibitors and stabilizers, slows the rate of fire spread by cooling and coating the fuels, depleting the fire of oxygen, and slowing the rate of fuel combustion with inorganic salts that change how the fire burns. Fire retardant is typically applied to fuels in front of an advancing fire, not directly onto the fire. When determined to be an appropriate suppression tactic, fire retardant may be applied to any type of landscape experiencing wildfire from low-lying desert ecosystems to oak woodlands and into alpine forests. Most fire retardant is applied in the Western United States; it is rarely used in the Northeast and only occasionally used in the Midwest. Fire retardant is periodically used in the Southeast, depending on the severity of the fire season.

Most fire retardant delivery occurs on ridge tops and adjacent to human-caused or natural fire breaks such as roads, meadows, old fire scars, and rock outcrops. Occasionally, retardant is applied adjacent to aquatic environments that are being used as a natural fire break. Applying retardant adjacent to these human-caused or natural fire breaks enhances the effectiveness of fire breaks by widening the fire break. Retardant delivery to aquatic systems is limited because aquatic habitats are relatively small linear or polygon shapes and because pilots have been instructed to avoid known bodies of water and maintain communication with resource advisors, scouts, and others through the incident commander on a fire, as stated in *2000 Guidelines for Aerial Delivery of Retardant or Foam Near Waterways* (Appendix A). Fire retardant may also be applied if firefighters, public safety, or structures are threatened and the use of fire retardant is expected to alleviate the threat.

1.4 Purpose of and Need for Action

High fire intensities and rates of spread inhibit the ability to safely fight wildland fires with ground-based forces. In addition, remote locations and rugged topography make access difficult and often delay the deployment of ground forces for fire suppression efforts.

The Forest Service needs an effective tool for wildland firefighting that can:

- Reduce the spread and intensity of fires to increase firefighter and public safety.
- Reduce the exposure of firefighters and the public to risky and dangerous situations during fire activity.
- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations, thus, controlling fires while they are smaller and less dangerous and damaging.
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeters quickly, which is one of the primary tactics to minimize fire size until ground crews can reinforce the line.

Aerially applied fire retardant can help accomplish each of the above objectives. However, because aerially applied fire retardant can have adverse effects on some sensitive resources, the Forest Service must provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire.

1.5 Scope

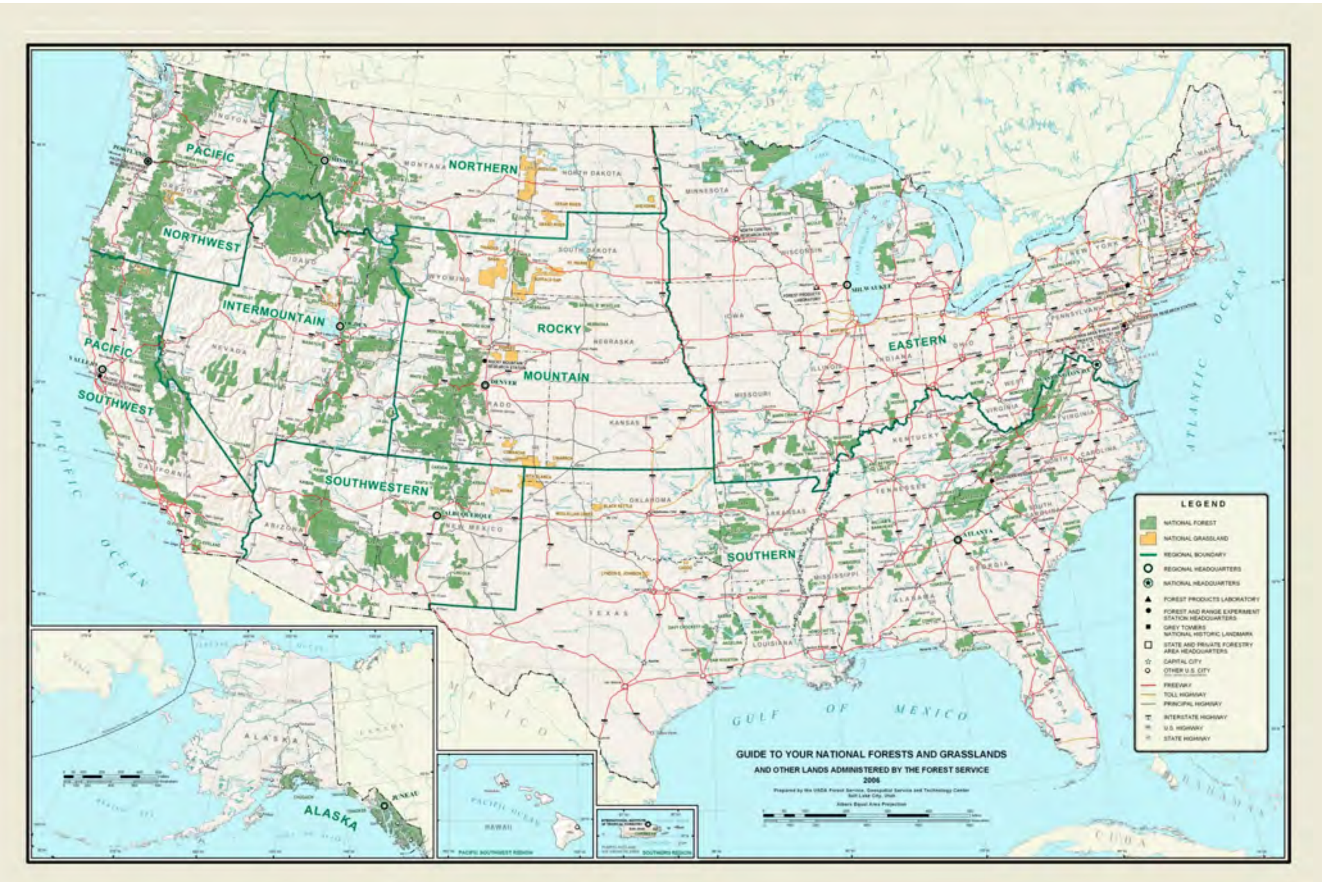
Environmental effects have been analyzed on a nationwide, programmatic scale. Programmatic analysis is appropriate because the time and place where fire retardant may be used is unpredictable, and because site-specific analysis, as is typically done at the project scale, is not possible under emergency fire situations.

The proposed action and alternatives are limited to NFS lands, which comprise approximately 193 million acres (Figure 1 'Map of National Forest System lands.'). NFS lands include lands near aquatic environments or terrestrial environments containing federally listed threatened endangered proposed and candidate species or Forest Service listed sensitive species. The intent of the action is to provide management direction to minimize impact on humans and the environment. Land management plan amendments would not be required under any of the alternatives. It is not anticipated that any future analysis under NEPA will be required to implement this program.

Fire managers use complex and varied site-specific criteria and real-time adaptive management as they choreograph specific tactics on the ground. Programmatic management direction, as proposed in this EIS, is analyzed for the range of conditions across the country but specific outcomes in specific areas is unknown. The exclusion areas and other measures that arose from ESA consultation and the analysis herein respond to the uncertainty of the time and place of fire retardant use. Local, forest-level, and regional land managers may refine these measures, as necessary, in the future.

The information averages and estimates contained in this analysis are derived from the most accurate, readily available data. Quantifications are limited and vary because this analysis is national in scope. The Biological Assessments prepared provide detailed analysis on each species listed under the ESA that occur on NFS lands and the Biological Evaluations provide detailed analysis on each species listed by the Forest Service as sensitive.

Figure 1 Map of National Forest System lands.



1.6 Proposed Action

The Forest Service proposes to continue aerial application of retardant and permanently adopt the 2000 *Guidelines for Aerial Delivery of Retardant or Foam Near Waterways* (Appendix A). This alternative adopts the 2008 Reasonable and Prudent Alternatives as identified by U.S. Fish and Wildlife Service (FWS) and National Oceanic and Atmospheric Administration (NOAA) Fisheries (Appendix A). For a detailed description of the proposed action see Alternative 2 in chapter 2 of this document.

1.7 Decision Framework

The deciding official for this proposal is the Chief of the U.S. Forest Service. Based on the final EIS and information contained in the project record, the Chief will decide whether the Forest Service will continue to use aerially delivered fire retardant as a fire suppression tool, and if so, the parameters under which it can be used. The decision involves balancing effectiveness in meeting the purpose and need for fire retardant use against its potential adverse effects under each alternative.

1.8 Public Involvement

On August 27, 2010, a notice of intent was published in the *Federal Register* announcing the intention of the Forest Service to prepare an EIS and initiate a 45-day scoping period. Scoping is defined in the NEPA regulations at 40 CFR 1501.7, as "…an early and open process for determining the scope of issues to be addressed…." As a result of this notice, 27 comment letters were received by October 12, 2010. Letters were received from individuals, representatives of businesses, special interest groups, tribal governments, and Federal and State agencies. The letters were reviewed for issues and comments on the proposed action. Comments received during the scoping comment period are part of the project record located at the National Interagency Fire Center in Boise, Idaho.

A notice of availability was posted in the *Federal Register* on May 13, 2011, for the draft EIS titled *Nationwide Aerial Application of Fire Retardant Project, Proposing to Continue the Aerial Application of Fire Retardant on National Forest System Lands*. This began the 45-day comment period, which ended on June 27, 2011. The Forest Service received 53 comment letters from individuals, representatives of businesses, special interest groups, tribal governments, and Federal and State agencies; these comments were received by email and via the U.S. Postal Service.

To supplement the comments received during scoping and the draft EIS commenting periods and to determine if greater public outreach was warranted, the Forest Service entered into an interagency agreement with the U.S. Institute for Environmental Conflict Resolution (US Institute) to conduct a stakeholder assessment. The US Institute contracted with EnviroIssues, a facilitation and public outreach company based in Seattle.

An Assessment Design Team was convened, consisting of representatives of the Forest Service, the U.S. Fish and Wildlife Service (FWS)(invited, but did not actively participate), NOAA Fisheries, Forest Service Employees for Environmental Ethics (plaintiffs in the 2010 lawsuit), National Tribal Environmental Council, and the US Institute. The Assessment Design Team was asked to review and comment on the interview methodology, interview questions, and the initial list of potential interviewees. A total of 24 stakeholder interviews were conducted in November and December 2010 that reflected a wide spectrum of stakeholder expertise and interests.

A summary of the assessment findings was prepared, and included their process recommendations based on these findings. A draft of this report was presented to the US Institute, the Forest Service, and other members of the Assessment Design Team in Tucson, Arizona, on January 7, 2011. The only Assessment Design Team member who was not an employee of either the US Institute or the Forest Service who participated in the January 7 meeting was Andy Stahl, Forest Service Employees for Environmental Ethics. Mr. Stahl participated via conference call. After incorporating the feedback from this meeting, the report, *Assessment: USDA Forest Service Aerial Fire Retardant Application; January 2011* (*Assessment*), was finalized and delivered. The *Assessment* identified and recommended six objectives for tribal and stakeholder engagement, along with recommendations on mechanisms for giving and receiving information.

Throughout the commenting period, the Forest Service provided a variety of engagement opportunities based on the objectives identified in the *Assessment*. The collaborative activities were targeted to engage tribal, public, science/technical, and agency interests. A description of these activities and outcomes are posted to the Forest Service fire retardant website at http://www.fs.fed.us/fire/retardant/index.html. A summary is provided below.

Comments received during the commenting periods and concerns collected during the tribal and stakeholder meetings, webinars, and conference calls were analyzed and synthesized. The additional engagement process confirmed that the issues the Forest Service had identified remained valid. However, substantive comments were used to clarify the purpose and need, adjust Alternative 3, and correct and strengthen the analysis for the final EIS. The Forest Service response to comments can be found in Appendix Q.

TRIBAL: Agency decision makers worked directly with tribal leadership at local levels (e.g., Forest Service regions, forests, and districts) through official government-to-government consultation. To complement the official government-to-government consultations, the Forest Service provided two virtual national tribal listening sessions, exclusively for tribal members, via a webinar in April and July 2011.

Some who participated in the national tribal listening sessions also participated in the official consultations, while others who participated were tribal experts and other tribal staff who identified unique tribal and cultural considerations. Additionally, an invitation was issued to tribal members to participate in a virtual national stakeholder listening session via a webinar on October 12, 2011. Tribes do not consider themselves stakeholders but were invited to listen and participate in the national stakeholder listening session based upon a recommendation from participants in the July national tribal listening session. The Agency also held a technical listening session to engage tribal members and representatives on a technical level. The technical listening session was held on April 12, 2011, in conjunction with the Intertribal Timber Council spring meeting in Albuquerque, New Mexico.

PUBLIC: Based on the recommendations contained in the *Assessment*, the Forest Service selected four communities for community public listening sessions. The communities were selected based on their past and future potential to be affected by the use of aerial application fire retardant on wildfires and also on their geographic diversity. Community listening sessions were held in Ocala, Florida, on May 24, 2011; Santa Barbara, California, on June 7, 2011; Wenatchee, Washington, on June 9, 2011; and Tucson, Arizona, on June 15, 2011.

In addition to the community listening sessions, a national community listening session was held via webinar on June 16, 2011, for those who were unable to attend an on-site meeting. A second national stakeholder listening session webinar was held October 12, 2011.

Lastly, on April 28 and June 22, the US Institute convened a virtual non-Agency discussion group via a webinar to engage representatives from specific organizations and interest groups in a discussion about their concerns regarding the aerial application of fire retardant and the EIS process. Most of those who participated in these two webinars also attended other engagement events (e.g., technical listening sessions, the science panel, and community listening sessions).

SCIENCE/TECHNICAL: One of the needs identified for specific focus in the *Assessment* was the need to engage technical and science-based stakeholders possessing in-depth understanding about aerial fire retardant use in firefighting operations and its potential impacts to the natural environment, cultural resources and sacred sites. A science panel, a series of technical listening sessions, and an Interagency Discussion Group were designed to engage people with these interests.

On May 17, 2011, the US Institute convened a science panel composed of five experts in aquatic biota, wildlife, fire management, soils, and cultural resources/sacred sites in Boise, Idaho, to share their thoughts and discuss the analysis contained in the draft EIS. At the science panel, the public had the opportunity to dialog with and ask questions of the experts. The science panel was streamed live via the Internet and a link to the recording of this session is posted to the project website at http://www.fs.fed.us/fire/retardant/index.html.

In addition to the science panel, three technical listening sessions were conducted. The first was held on April 12, 2011, in Albuquerque, New Mexico, to gather technical input from tribal members and representatives at the Intertribal Timber Council. The second technical listening session was held in Boise, Idaho (home of the National Interagency Fire Center) on May 17, 2011, to gather input from fire managers and fire operations technical experts. The third technical listening session, held in Missoula, Montana, on May 26, 2011, provided interdisciplinary dialog about the resource effects as identified in the draft EIS.

AGENCY: The *Assessment* identified the importance of collaboration with interagency partners recognizing that fighting fire is an inherently interagency task. In addition to the many informal and ad-hoc discussions that Forest Service officials had with their interagency firefighting partners, a formal discussion group was formed to share thoughts about the analysis in the draft EIS and the need for coordination of firefighting activities. The group was convened by the US Institute and met virtually via a webinar on April 26, 2011.

The Forest Service formally consulted with the FWS and NOAA Fisheries, as required by Section 7 of the ESA.

These engagement activities provided a variety of forums for tribal members and representatives and stakeholders representing a broad spectrum of expertise and interest to share thoughts, concerns, and information. The results of the dialog were considered in development of the final EIS and helped to inform the Chief of the Forest Service as the decision maker in the action. Summaries from each tribal and stakeholder engagement event supported by the US Institute and EnviroIssues are available on the project website at http://www.fs.fed.us/fire/retardant/eis_info.html.

1.9 Issues

Issues serve to highlight effects or unintended consequences that may occur under the alternatives and provide the opportunity, during the analysis, to mitigate adverse effects and compare trade-offs to inform the decision maker and the public. Issues are best identified early in the process to help determine the scope of the actions, alternatives, and effects to consider. However, because of the iterative nature of the NEPA process, additional issues may surface and be considered at any time.

The Council on Environmental Quality regulations refer to issues as they relate to environmental impact statements. 40 CFR 1500.4 states:

- *Agencies shall reduce excessive paperwork by:*

    (c) Discussing only briefly issues other than significant ones.

    (g) Using the scoping process not only to identify significant environmental issues deserving of study, but also to deemphasize insignificant issues, narrowing the scope of the environmental impact statement process accordingly.

- *As part of the scoping process the lead agency shall:*
    - *(40 CFR 1501.7(a)(2)) Determine the scope and the significant issues to be analyzed in depth in the environmental impact statement.*
    - *Identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (1506.3), narrowing the discussion of these issues in the statement to a brief presentation of why they will not have a significant effect on the human environment or providing a reference to their coverage elsewhere. (40 CFR 1501.7(a)(3)).*

After reviewing historical documents including the 2007 Aerial Application of Fire Retardant Environmental Assessment (EA), the comments received during scoping, and the additional stakeholder engagements, the following issues were identified as significant and were used to develop Alternative 3. The evaluation of issues (comment analysis) is documented in the project record.

Quantitative and qualitative indicators are listed to help track how the alternatives respond to the issues.

1. *Water quality:* In certain rare situations, when fire retardant comes in contact with water the fire retardant chemicals can temporarily alter the water quality and may be toxic to aquatic organisms. Fire retardant could reach water through misapplications or through leaching and erosion.

    Indicators:

    Contamination of water with fire retardant from accidental drop - Potential for accidental application of fire retardant into water.

    Contamination of drinking water from fire retardant - Potential for drinking water contamination from fire retardant.

    Leaching or erosion of soil and nutrients into streams and waterways - Acres affected by fire retardant.

2. *Human health and safety*: Because fire retardant contains numerous chemicals, there is concern by some as to their safety to humans. In addition, firefighting is an inherently risky activity and it is important to manage that risk and keep firefighter and public safety as the highest priority.

    Indicators:

    Known human health issues.

    Protection of human life and public safety.

3. *Impacts on threatened and endangered species:* Consultation with the FWS and NOAA Fisheries conducted on the 2007 EA resulted in 65 determinations that the use of aerially delivered fire retardant as proposed by the Forest Service may jeopardize the continued existence of 65 species listed under the ESA. As a result, the FWS and NOAA Fisheries provided the Forest Service with reasonable and prudent alternatives to address these determinations. On July 27, 2010, the Federal District Court in Montana ruled that the reasonable and prudent alternatives did not adequately address the possible effects on these species and also that effects on ESA listed terrestrial species were not addressed by the Forest Service (US District Court, Montana 2010).

Indicator:

Impact on federally listed species - Number of species and critical habitat affected.

4. *Cultural resources:* Cultural resources, such as petroglyphs, historic structures, traditional Native American gathering areas, and sacred sites, may be affected by the aerial application of fire retardant.

Indicator:

Potential for effects on cultural resources.

There were numerous issues raised during scoping that were not considered significant for the purposes of this EIS; however, the interdisciplinary team recognized their importance and these issues were used to help shape the effects analysis in Chapter 3. Briefly, these issues include:

- The costs compared to benefits of using fire retardant relative to environmental risks.
- The potential for displacement of native plant communities by retardant use.
- The potential for increases in invasive plants and aquatic organisms due to the use of fire retardant.
- Changes in soil chemistry as a result of applying fire retardant.
- Concern for the viability of Forest Service-listed sensitive species populations.

Chapter 2. Alternatives, Including the Proposed Action

Chapter 2. Alternatives, Including the Proposed Action

This chapter discusses the alternatives considered in detail in this EIS, displays the comparisons among those alternatives, and presents the alternatives considered but eliminated from detailed consideration, along with the reasons for elimination of these alternatives.

2.1 Alternatives Considered in Detail

2.1.1 Alternative 1: No Aerial Application of Fire Retardant (No Action)

Under this alternative, the Forest Service would discontinue the aerial application of fire retardant for fires occurring on National Forest System (NFS) lands. Aerial application of water would continue to be available for use by incident commanders as a fire suppression tool. This alternative would not prohibit the aerial application of fire retardant on lands owned or administered by the States, private ownerships, or other Federal agencies. Other jurisdictions would make their own decisions regarding the use of aerially applied retardant on lands that they manage.

2.1.2 Alternative 2: Continued Aerial Application of Fire Retardant Under the 2000 Guidelines, Including the 2008 Reasonable and Prudent Alternatives (Proposed Action)

Under this alternative, the Forest Service would continue aerial application of retardant and permanently adopt the 2000 *Guidelines for Aerial Delivery of Retardant or Foam Near Waterways* (Appendix A). This alternative adopts the 2008 Reasonable and Prudent Alternatives as identified by the U.S. Fish and Wildlife Service (FWS) and National Oceanic and Atmospheric Administration (NOAA) Fisheries (Appendix A). Table 1 'Comparison of Alternatives by Components' includes a list of the components included in Alternative 2.

These guidelines include:

- 300-foot buffers on either side of waterways where aerially delivered fire retardant will not be applied.

Deviations from these guidelines are acceptable under the following circumstances:

- When alternative line construction tactics are not available due to terrain constraints, congested area, life and property concerns, or lack of ground personnel, it is acceptable to anchor the foam or retardant application to the waterway. When anchoring a retardant or foam line to a waterway, the most accurate method of delivery will be used to minimize placement of retardant or foam in the waterway (e.g., a helicopter rather than a heavy airtanker); or
- When it is determined by the unit administrator that life or property is threatened and the use of retardant or foam can be reasonably expected to alleviate the threat; or
- When it is determined by the unit administrator that potential damage to natural resources outweighs possible loss of aquatic life.

Also included are provisions for complying with the emergency Section 7 consultation procedures of the Endangered Species Act (ESA) with respect to aquatic species (Appendix A).

2.1.3 Alternative 3: Continued Aerial Application of Fire Retardant, Using Aerial Application of Fire Retardant Direction and Adopting the 2008 Reasonable and Prudent Alternatives (Preferred Alternative)

Aerial Application of Fire Retardant Direction replaces the 2000 *Guidelines for Aerial Delivery of Retardant of Foam Near Waterways* (Appendix A) to better respond to water quality, ESA, cultural resource, and tribal issues. To ensure that this direction also considers human health and safety, one exception is provided:

Aerial delivery into waterways or avoidance areas may occur when human life or public safety is threatened and the use of retardant can be reasonably expected to alleviate the threat.

The direction also includes implementing the 2008 Reasonable and Prudent Alternatives (Appendix A).

Alternative 3 consists of the following components:

- Aircraft Operational Guidance,
- Avoidance Area Mapping Requirements,
- Annual Coordination, and
- Reporting and Monitoring Requirements.

Aircraft Operational Guidance

Operational guidance ensures that retardant drops are not made within the 300-foot buffers of either side of waterways or avoidance areas for threatened, endangered, proposed, candidate, or sensitive (TEPCS) species.

Whenever practical, as determined by the fire incident commander, the Forest Service will use water, other suppressants, or less toxic approved fire retardants in areas occupied by TEPCS species or their designated critical habitats. Some species and habitats require that only water be used to protect their habitat and populations; these habitats and populations have been mapped as avoidance areas. Incident commanders and pilots are required to avoid aerial application of fire retardant in avoidance areas for TEPCS species or within the 300-foot buffers on either side of waterways.

These guidelines do not require helicopter or airtanker pilots to fly in a manner thatendangers their aircraft or other aircraft or structures, or that compromises the safety of ground personnel or the public.

- **Operational guidance to ensure retardant drops are not made within 300-foot buffers on either side of waterways or avoidance areas for TEPCS species:**

Medium/Heavy Airtankers, Single Engine Airtankers, and Helicopters: When approaching mapped avoidance areas for TEPCS species waterways, or riparian vegetation visible to the pilot, the pilot will terminate the application of retardant approximately 300 feet before reaching the mapped avoidance area or waterway. When flying over a mapped avoidance area waterway, or riparian vegetation, the pilot will wait 1 (one) second after crossing the far border of an avoidance area or bank of a waterway before applying retardant. Pilots will make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant within the 300-foot buffer zone or avoidance area

- **Protection of cultural resources, including historic properties, traditional cultural resources, and sacred sites:**

These resources cannot be mapped using a national protocol or addressed with a standard prescription that would apply to all instances. Therefore, they will be given case-by-case consideration when ordering the aerial application of fire retardant. As necessary, incident commanders will consider the effects of aerial applications on known or suspected historic properties, any identified traditional cultural resources, and sacred sites. Cultural resources specialists, archaeologists, and tribal liaisons will assist in the consideration of effects and alternatives for protection.

Avoidance Areas Mapping Requirements

Identified avoidance areas are:

- **Aquatic Avoidance Areas:**
    - Mapped waterways with a 300-foot buffer including perennial streams, intermittent streams, lakes, ponds, identified springs, reservoirs, and vernal pools.
    - Buffer areas may be adjusted for local conditions and coordinated with the FWS and NOAA Fisheries local offices.

- **Terrestrial Avoidance Areas:**
    - May be used to avoid impacts on one or more federally listed threatened, endangered, or proposed plant or animal species or critical habitat where aerial application of fire retardant may affect habitat and/or populations.
    - May be used to avoid impacts on any Forest Service terrestrial sensitive or candidate species where aerial application of fire retardant may result in a trend toward federal listing under ESA or a loss of viability on the planning unit.

The following protocols are for a standardized national map template of avoidance areas for TEPCS species.

- Use FWS and NOAA Fisheries-designated critical habitat layers, when available.
- Use National Hydrography Dataset for mapping water bodies to create aquatic avoidance areas.
- Use FWS, NOAA Fisheries, and Forest Service species population and designated critical habitat information for occupied sites.
- All forests and grasslands that have affected TEPCS species will complete and update maps, as necessary, in cooperation with local FWS and NOAA Fisheries Service offices.
- Update maps annually in cooperation with FWS and NOAA Fisheries to reflect changes during the year on additional species or changes made for designated critical habitat.
- A national map template for all revisions will be maintained by U.S. Forest Service Geospatial Service and Technology Center, Salt Lake City, Utah.

Annual Coordination

The Forest Service will annually coordinate with FWS and NOAA Fisheries local offices to ensure that any updates that are needed for fire retardant avoidance areas on NFS lands are mapped using the most up-to-date information.

- The Forest Service will coordinate with aviation managers and pilots on avoidance area mapping and aircraft operational direction and will coordinate with all personnel involved in fire suppression activities.

Reporting and Monitoring Requirements

The Forest Service will report all misapplications of aerially applied fire retardant into avoidance areas. A report of misapplication requires notification by the forest to FWS, and NOAA fisheries as appropriate to determine if there are any necessary future mitigation measures or reinitiation of consultation when there has been an adverse impact to a listed species or its designated critical habitat. Depending on the severity of the adverse effect, an appropriate restriction on future aerial application of retardant may be necessary for the area reported.

To determine if under-reporting misapplications of fire retardant drops is occurring, the Forest Service will annually monitor 5 percent of all fires that are less than 300 acres in size and where aerial fire retardant had been used and aquatic or terrestrial avoidance areas exist.

Monitoring of misapplications of fire retardant will be outlined within an Implementation Handbook for the Reporting and Monitoring of Misapplications of Aerially Applied Fire Retardant. The monitoring components that are reported annually through forests and national TES-species staff for coordination with other agencies will:

- Determine the amount of follow-up monitoring necessary as dictated by the extent of the impacts to species or habitats identified during assessment of the misapplication.
- Be conducted in coordination with local Forest Service/FWS/NOAA/USGS offices and appropriate State agencies.
- Determine the type of recovery or restoration of species or habitats if needed.
- Determine the appropriate contingency measures for protection of TEPCS species from aerially applied fire retardant.
- Determine if additional assessment of cumulative effects for some species would need to be coordinated with certain agencies.

If a retardant drop occurs on a cultural resource, a traditional cultural property, or a sacred site, then the site condition will be assessed by a qualified archaeologist and reported to the State Historic Preservation Officer and if appropriate tribal representatives including the Tribal Historic Preservation Officer. If the affected resource is a sacred site, or a traditional cultural property, then tribal notification and consultation will be required as part of the determination of effects If the effect is found to be adverse, then the agency will consult with the tribe to determine an appropriate course of action to mitigate or resolve the adverse effect.

Existing monitoring and reporting forms will be updated, as needed, for use in the reporting and monitoring process.

2.2 Comparison of Alternatives by Components

Table 1 'Comparison of Alternatives by Components' provides a comparison of the alternatives by components.

Table 1 Comparison of Alternatives by Components

Components	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction (Preferred Alternative)
Aerial delivery of retardant	No	Yes	Yes
Exceptions for retardant use	N/A	Three exceptions: For protection of life and property, when alternative line construction tactics are unavailable, and when damage to natural resources outweighs loss of aquatic life.	One exception: For protection of human life or public safety.
Aircraft operational guidance	None	*2000 Guidelines for Aerial Delivery of Retardant or Foam* (Appendix A): 300-foot buffer on all waterways and threatened and endangered T&E terrestrial plant and animal species, as identified in the 2008 RPAs.	New Aerial Application of Fire Retardant Direction: 300-foot buffers on all waterways, riparian vegetation visible to pilots, terrestrial avoidance areas, and other resources (e.g., cultural).
Avoidance area mapping	None	Terrestrial species for T&E jeopardy species only from 2008 Biological Opinions, 300-feet buffers on all waterways.	Terrestrial T&E species and some sensitive species, 300-feet or more buffers on all waterways.
		Aquatic: 153 federally listed aquatic species, 157 Forest Service sensitive aquatic species.	Aquatic: 153 federally listed aquatic species, 157 Forest Service sensitive aquatic species.
		Plants: 20 federally listed species, 14 designated critical habitats.	Plants: 84 federally listed species, 21 designated critical habitats, 223 Forest Service sensitive species, 3 candidate species.
		Wildlife: 3 federally listed species, 3 designated critical habitats.	Wildlife: 32 federally listed species, 18 designated critical habitats, 36 Forest Service sensitive species, including candidate species.
		Aquatic avoidance areas: approximately 30% of NFS lands.	Aquatic avoidance areas: approximately 30% of NFS lands.

Components	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction (Preferred Alternative)
		Terrestrial avoidance areas: approximately 0.0025% of NFS lands.	Terrestrial avoidance areas: approximately 0.8% of NFS lands.
Annual coordination with regulatory agencies and other agencies and cooperators	None related to retardant use	Pre-season coordination, 2008 Reasonable and Prudent Alternatives, update and review of avoidance area maps for terrestrial plant and animal species identified within the 2008 Biological Opinion, and 300-foot buffers on waterways.	New Aerial Application of Fire Retardant Direction; annual training briefings, as needed; coordination meetings, as needed.
Monitoring	None	Misapplication into waterways, T&E species associated with 2008 Biological Opinions, or if needed during emergency consultation process.	1. Monitoring of misapplications that occur in avoidance areas on any fire, which may include implementation of trigger points that restrict retardant use if adverse impacts are identified. 2. Monitoring of 5% of all fires <300 acres where aerial retardant was applied.
Reporting	None	All misapplications into waterways and any affected threatened endangered or sensitive species.	1. All misapplications into waterways and any affected TEPCS species. 2. 5% of small fires and on all large fires.
Protection of cultural resources	N/A	No	Yes for sacred sites, traditional use areas, etc.
Protection for Forest Service sensitive species	N/A	No for terrestrial plant and animal species. Yes, for Aquatic species with standard 300-foot buffer on all waterways.	Yes, for those terrestrial plant and animal species identified that may trend towards listing or loss of viability on the planning unit. Additional buffers for waterways can be applied at the local level for aquatic species.
Use of emergency consultation regulations (50 CFR 402.05)	No	Yes	No – Re-initiation process developed for exceeding incidental take, new chemicals, new information, species, etc.

Components	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction (Preferred Alternative)
			Review of Biological Assessment (BA) would occur at 5 years, and 10 years for adequacy of analysis or incorporation of additional information relevant to determination process.
Aerial delivery of retardant	No	Yes	Yes
Exceptions for retardant use	N/A	Three exceptions: For protection of life and property, when alternative line construction tactics are unavailable, and when damage to natural resources outweighs loss of aquatic life.	One exception: For protection of human life or public safety.
Aircraft operational guidance	None	*2000 Guidelines for Aerial Delivery of Retardant or Foam* (Appendix A): 300-foot buffer on all waterways and threatened and endangered T&E terrestrial plant and animal species, as identified in the 2008 RPAs.	New Aerial Application of Fire Retardant Direction: 300-foot buffers on all waterways, riparian vegetation visible to pilots, terrestrial avoidance areas, and other resources (e.g., cultural).
Avoidance area mapping	None	Terrestrial species for T&E jeopardy species only from 2008 Biological Opinions, 300-feet buffers on all waterways.	Terrestrial T&E species and some sensitive species, 300-feet or more buffers on all waterways.
		Aquatic: 153 federally listed aquatic species, 157 Forest Service sensitive aquatic species.	Aquatic: 153 federally listed aquatic species, 157 Forest Service sensitive aquatic species.
		Plants: 20 federally listed species, 14 designated critical habitats.	Plants: 84 federally listed species, 21 designated critical habitats, 223 Forest Service sensitive species, 3 candidate species.
		Wildlife: 3 federally listed species, 3 designated critical habitats.	Wildlife: 32 federally listed species, 18 designated critical habitats, 36 Forest Service sensitive species, including candidate species.

Components	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction (Preferred Alternative)
		Aquatic avoidance areas: approximately 30% of NFS lands.	Aquatic avoidance areas: approximately 30% of NFS lands.
		Terrestrial avoidance areas: approximately 0.0025% of NFS lands.	Terrestrial avoidance areas: approximately 0.8% of NFS lands.
Annual coordination with regulatory agencies and other agencies and cooperators	None related to retardant use	Pre-season coordination, 2008 Reasonable and Prudent Alternatives, update and review of avoidance area maps for terrestrial plant and animal species identified within the 2008 Biological Opinion, and 300-foot buffers on waterways.	New Aerial Application of Fire Retardant Direction; annual training briefings, as needed; coordination meetings, as needed.
Monitoring	None	Misapplication into waterways, T&E species associated with 2008 Biological Opinions, or if needed during emergency consultation process.	3. Monitoring of misapplications that occur in avoidance areas on any fire, which may include implementation of trigger points that restrict retardant use if adverse impacts are identified. 4. Monitoring of 5% of all fires <300 acres where aerial retardant was applied.
Reporting	None	All misapplications into waterways and any affected threatened endangered or sensitive species.	3. All misapplications into waterways and any affected TEPCS species. 4. 5% of small fires and on all large fires.
Protection of cultural resources	N/A	No	Yes for sacred sites, traditional use areas, etc.
Protection for Forest Service sensitive species	N/A	No for terrestrial plant and animal species. Yes, for Aquatic species with standard 300-foot buffer on all waterways.	Yes, for those terrestrial plant and animal species identified that may trend towards listing or loss of viability on the planning unit. Additional buffers for waterways can be applied at the local level for aquatic species.

Components	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction (Preferred Alternative)
Use of emergency consultation regulations (50 CFR 402.05)	No	Yes	No – Re-initiation process developed for exceeding incidental take, new chemicals, new information, species, etc. Review of Biological Assessment (BA) would occur at 5 years, and 10 years for adequacy of analysis or incorporation of additional information relevant to determination process.

2.3 Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate reasonable alternatives and to briefly discuss the reasons for eliminating alternatives that were not developed in detail (40 CFR 1502.14)[1]. People who commented during scoping and on the draft EIS suggested a number of alternatives that reflect their values and preferred management options. These alternatives examined but not evaluated in detail fit into three primary categories:

- Additional restrictions based on locations
- Additional restrictions based on criteria
- Additional limitations on type of application

These alternatives were reviewed and weighed by the deciding official during the course of the process. Therefore, they contribute to the range of reasonable alternatives and a reasoned choice, even though they were eliminated from detailed study.

In addition to these specific alternatives several comments suggested that certain alternatives should be selected with modifications (Response to Comments Public Concerns numbers 5, 6, and 8). These specific modifications have also been considered but eliminated from detailed study.

Alternative 4: Allow Use of Fire Retardant in an Unrestricted Manner

While this alternative would maintain the ability to rapidly reduce wildfire intensities while slowing the spread of wildfire and protecting firefighters, it would not meet the Purpose and Need of this action to protect aquatic and terrestrial environments from aerially applied fire retardant. In addition, it would not respond to the issues of threatened and endangered species, water quality, and cultural resource protection.

1 General criteria for eliminating requests for additional management direction from detailed study included: 1. Management direction would not meet the purpose and need; 2. Management direction is not within the authority of the Forest Service; 3. Management direction is conjectural in nature or not supported by scientific evidence; 4. Management direction is already reflected in an alternative or does not contain a magnitude of change that provides a sharply different approach; or 5. Management direction does not pertain to Aerial Retardant EIS.

Alternative 5: Prohibit Aerial Application of Retardant in Areas Within One-Quarter Mile of Waterways, in Wilderness and Wilderness Study Areas, and in Other Withdrawn Land Allocation Areas

This alternative was not considered for detailed analysis because a GIS analysis of this alternative using two sample national forests (the Boise and San Bernardino National Forests) (kppendix K) showed that prohibition of retardant use, as described, would remove more than 90 percent of the NFS land area from fire retardant use. Because of operational considerations, the remaining land area would be unavailable for the use of aerially delivered fire retardant. Therefore, we have determined that this alternative would be so similar to the Alternative 1 that it does not warrant further consideration as a stand-alone alternative.

Alternative 6: Use Only Water for Aerial Suppression of Fires

This alternative was not considered for detailed analysis because Alternative 1 addresses no aerial application of fire retardant; however, it does consider the aerial application of water. As discussed in the Fire Retardant Use in Wildland Fire Management section in Chapter 3, water is 50 percent less effective than wet retardant and is ineffective once it dries, while retardant remains effective when dry. Additionally, most of the water drifts and evaporates before reaching the ground due to air turbulence caused by the aircraft, wind, and other factors.

Alternative 7: Restrict the Use of Retardant to Those Exceptional Situations in Which the Benefits Far Outweigh the Risks

This alternative was not considered for detailed analysis because the alternatives analyzed in detail adequately address this concern. It is not possible to develop detailed site-specific guidance for evaluating and weighing various risks and effectiveness of fire retardant necessary to satisfy Alternative 7 because too many factors are involved that vary across incidents. A primary benefit of aerial application of fire retardant is that it enables firefighters to contain fires more quickly and more safely, thus, reducing property damage and threats to human safety by reducing fire intensity and rate of spread under certain fuel and fire behavior conditions.

Alternative 3 facilitates efficient decisions about the aerial application of fire retardant by: 1) placing restrictions on fire retardant use to minimize risks to aquatic terrestrial and plant life, in addition to cultural resources and sites; and 2) still allowing for the use of fire retardant as one of a number of tools to help maximize the effectiveness of suppression efforts for those incidents where decisions have been made to suppress or contain fire. As such, Alternative 3 is designed to help identify those situations where the benefits of using fire retardant (that is, facilitating suppression to help achieve suppression objectives and goals) outweigh the potential risks.

Alternative 8: Use Retardant Only Where Proven Safe and Effective

This alternative was not considered for detailed analysis because the alternatives analyzed in detail adequately address this concern. Laboratory experiments (Gimenez et al. 2004; Plucinski et al. 2007; USDA Forest Service Standard Burn Test (ongoing) and firefighter experience (appendix O) have shown that aerial application of fire retardant is an effective tool for reducing fire intensity and rate of spread in certain fuel types and fire behavior conditions, thus, enabling firefighters to contain fires more quickly and safely to protect life and property. The alternatives analyzed in detail consider a reasonable range of options to constrain the use of aerial applications of fire retardant to provide acceptable levels of protection to resources that are sensitive to potential adverse effects from retardant, while retaining sufficient flexibility for firefighters to use aerial application of retardant as an effective tool, when appropriate.

Proponents of this alternative suggest that further potential environmental damage could be avoided if the use of fire retardant was further constrained by a national standard that would allow its use only when some level of effectiveness is guaranteed. The evaluation of when and where the use of retardant will be effective requires a very site-specific evaluation of fuel and fire behavior conditions by experienced on-site firefighters. An alternative could not be designed where fire retardant could be used only if it were proven effective because fire starts are unpredictable and fire characteristics are extremely variable. Fires of any size can have a wide range of characteristics based on weather, terrain, fuel types and amounts, and many other factors. Fire retardant has not been, and will not be used indiscriminately. Instead, fire retardant is used when there is a reasonable belief on the part of experienced on-site firefighters that it will be effective in a particular site-specific situation. Many reasons exist to discourage any overuse of retardant, including cost and limited availability. Firefighters use sound professional judgment in deciding where and when the aerial application of fire retardant is expected to be an effective firefighting tool.

Alternative 9: Do Not Use Retardant Until a New, Less Toxic Retardant is Developed

This alternative was not considered in detail because, regardless of the alternative selected, the Forest Service may continue to pursue less toxic formulations and improved delivery systems, make future decisions on changes to the fire retardant program, and evaluate improved delivery system capabilities. Appendix J describes the Agency's policy regarding suppression chemicals and delivery systems. For example, retardants containing sodium ferrocyanide are no longer used by Federal agencies. The environmental analysis in this document and subsequent decision would not prohibit a future decision on the use of new products. New products proposed for use in fire suppression are evaluated using a separate process. For information on qualifying a product for use as a fire retardant, see the evaluation criteria described on the Forest Service Fire website at http://www.fs.fed.us/rm/fire/wfcs/index.htm#qpl.

Alternative 10: Increase the Size of Protections for Waterways and Increase Protection for Some Specially Designated Areas

The Forest Service considered an alternative that would have increased protections to waterways to 600 feet on each side and protections to some specially designated areas, such as designated wilderness and inventoried roadless areas (IRAs).

In regard to waterways, the Forest Service discussed this option with FWS and NOAA Fisheries. Generally application outside the 300-foot buffer is unlikely to have a measurable impact on stream water quality (Crouch et al. 2006). Intrusions into the buffer but at least 3 meters from water are unlikely to have a high impact on water because of uptake by vegetation and adherence of phosphorus to soils (Norris et al. 1978). Areas with steep slopes, coarse-textured soils, and little vegetation cover will have greater potential for movement of fire retardant to water and associated negative impacts (Napper 2011). Based on these discussions and these findings it was decided that the need for increased protections was best determined at the local-unit level in conjunction with discussions with the local FSW office rather than a national one-size-fits-all buffer.

The Forest Service also determined that there were no additional values in IRAs that were not already protected under Alternatives 2 or 3. The effects of aerial application of fire retardant in designated Wilderness were considered in all alternatives. The effects of not using fire retardant near waterways, in Wilderness, and other specially designated areas were considered in Alternative 1.

2.4 Comparison of Alternatives by Effects

This section provides a summary of the effects of implementing each alternative considered in detail. Information in Table 2 'Comparison of Alternatives by Effects' is focused on effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 2 Comparison of Alternatives by Effects

Effect	Indicator	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction, Preferred Alternative
Human health	Known health issues	None from retardant may be some increase in smoke in the air that may cause respiratory problems.	Some minor skin irritation may occur when retardant comes in direct contact with skin.	Same as under Alternative 2.
Human life and public safety	Protection of human life and public safety	N/A	Includes an exception allowing for use of aerially delivered fire retardant to protect life and property.	Includes an exception allowing for use of aerially delivered fire retardant to protect human life or safety.
Impact on all federally listed species	# of species and critical habitat affected	No species or critical habitat directly affected by the use of aerially delivered fire retardant since no fire retardant used.	More potential for risk of impacts from aerially applied retardant than under Alternative 3 due to 3 exceptions under Alternative 3.	Less potential for impacts from aerially applied retardant than Alternative 2 due to only one exception for human safety, but more than Alternative 1.
	Toxicity	No toxicity to wildlife and aquatic species, no changes in plant or wildlife habitat.	More risk than under Alternative 1.	More species protected by additional avoidance area mapping and additional monitoring requirements.

Effect	Indicator	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction, Preferred Alternative
		Could be positive or negative effects on species or habitats due to the increased potential for smaller fires to become larger fires or increases in ground suppression actions. More use of water suppression activities that may impact federally listed aquatic species or habitats.	For ESA plant species: 64 no effect, 105 likely to be adversely affected. For designated critical habitats plants: 9 likely to be adversely affected, 14 not likely to be adversely affected, 1 no effect.	For ESA plant species: 64 no effect, 49 likely to be adversely affected, 56 not likely to be adversely affected. For designated critical plant habitats: 23 not likely to be adversely affected, 1 no effect.
		Potential for more disturbances to occur to wildlife species under this alternative than under Alternatives 2 and 3 due to potential for more aerial use of water.	For ESA wildlife species: 43 no effect, 62 likely to be adversely affected, including 28 critical habitats.	For ESA wildlife species: 43 no effect, 12 likely to be adversely affected, 50 not likely to be adversely affected. For wildlife designated critical habitats: 22 no effect and 6 likely to be adversely affected.
			For ESA aquatic species: 21 no effect, 18 not likely to be adversely affected, 118 likely to be adversely affected. For designated critical habitat aquatic species: 10 no effect, 15 not likely to be adversely affected, 72 likely to be adversely affected.	For ESA aquatic species: 21 no effect, 18 not likely to be adversely affected, 118 likely to be adversely affected. For designated critical habitat aquatic species: 10 no effect, 15 not likely to be adversely affected, 72 likely to be adversely affected.

Effect	Indicator	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction, Preferred Alternative
Cultural resources	Potential for effects	No impact from fire retardant; may be some impact from larger fires.	Some potential for effects such as deterioration, staining, or deterioration of protein residues.	Some potential; however, less than under Alternative 2 due to additional requirements for the protection of cultural resources.
Potential for Misapplications of Fire Retardant into Avoidance Areas	Relative potential or probability	None	Lower probability than Alternative 3 because fewer avoidance areas are mapped.	Higher probability than Alternative 2 because more avoidance areas are mapped.
Impacts on all wildlife species/habitat, includes TEPCS	Relative amount of impact from retardant	Fewer impacts than under Alternatives 2 or 3 because only water is used.	More impacts expected than under Alternative 3 due to fewer protections. Fewer impacts than under Alternatives 2 or 3 because only water is used.	Less impact expected than under Alternative 2 due to more protections. More impacts than under Alternative 1.
	Disturbance from low flying aircraft	Expect more disturbance than under Alternatives 2 and 3 due to more drops needed to suppress fires.	Expect less disturbance than under Alternative 1 and the same as under Alternative 3.	Expect less disturbance than Alternative 1 and the same as under Alternative 2.
	Toxicity	No toxicity due to no fire retardant being used.	Higher potential for toxicity than Alternative 3 due to less avoidance areas.	Lower toxicity than Alternative 2 due to more avoidance areas.
	Potential for larger fires to affect habitat	Higher potential for larger fires than under Alternatives 2 and 3 because water is less effective at fire suppression than aerially delivered fire retardant.	Lower potential for larger fires than under Alternatives 1 and 3 due to exception to anchor within protected areas; most effective at fire suppression.	Lower potential for larger fires than under Alternative 1 but higher than Alternative 2 because only one exception, which may provide less suppression effectiveness.

Effect	Indicator	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction, Preferred Alternative
Impacts to native plant communities	Relative amount of impact from retardant	No impact from fire retardant.	Could result in 2,358 to 4,715 acres annually (~ 0.002 percent) of NFS lands affected by fire retardant.	Could potentially be less than under Alternative 2 because of more avoidance area mapping.
	Phytotoxicity	No impact from fire retardant; potential impact from more intense fires.	Some minor short-term effects on some plant species sensitive to retardant effects when applied during active growing period.	Some minor short-term effects on some plant species sensitive to retardant effects or applied during active growing period.
	Vegetation diversity	No impact from retardant; could potentially result in site-specific beneficial or negative) effects on plant community diversity on more acres of native plant communities under Alternatives 2 or 3 because of potential for larger fires and more acres burned.	Could potentially result in site-specific beneficial or negative) effects on plant community diversity on 2,358 to 4,715 acres annually.	Could potentially result in fewer site-specific beneficial or negative) effects on plant community diversity associated with retardant application compared to Alternative 2; however, potential for more intense fires may cause negative effects where they occur.
Impacts to all Forest Service sensitive species	# species affected	No species or habitats directly affected from the use of aerially applied fire retardant since no fire retardant is used.	More potential for risk of impacts from aerially applied fire retardant than under Alternative 3 because the three exceptions allow more flexibility in the use of aerial application of fire retardant; more than under Alternative 1	Less potential for impacts from aerially applied fire retardant than under Alternative 2 due to only one exception for human safety; more than Alternative 1.

Effect	Indicator	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction, Preferred Alternative
		No toxicity to wildlife or aquatic species, no changes to plant and wildlife habitat	No protections provided for any terrestrial plant and animal sensitive species.	Includes protections for some terrestrial plant and animal sensitive species as identified by local Forest Service units with avoidance area mapping and reporting of misapplications into avoidance areas and additional monitoring requirements.
		Could be positive or negative effects on species or habitats depending on the increased potential for smaller fires to become larger fires or increases in ground suppression actions.	Aquatic sensitive species are protected by 300-foot buffers on waterways.	Additional buffers can be applied to 300-foot standard buffers on waterways.
		More use of water suppression activities that may affect sensitive species or habitats.	Reporting required for misapplications in all waterways.	
			For plant species: 440 no impacts, 223 likely to result in a trend toward Federal listing or a trend toward loss of viability on the planning unit, 1874 may affect individuals or habitat but not likely to trend toward Federal listing or loss of viability on the planning unit.	For plant species: 440 no impacts, 2097 may impact individuals or habitat but not likely to trend toward Federal listing or loss of viability on the planning unit.

Effect	Indicator	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction, Preferred Alternative
			For wildlife species: 74 no impacts, 36 likely to result in trend toward Federal listing or loss of viability on the planning unit, 437 with may affect individuals or habitat but not likely to result in trend towards Federal listing or loss of viability.	For wildlife species: 74 no impacts, 471 may affect individuals or habitat but not likely to result in trend toward Federal listing or loss of viability on the planning unit.
			For aquatic species: 68 no impacts, 188 may affect individuals or habitat but not likely to result in trend towards Federal listing or loss of viability.	For aquatic species: 68 no impacts, 188 may affect individuals or habitat but not likely to result in trend forward Federal listing or loss of viability.
Impacts to aquatic resources	Risk of misapplication and toxic effects to aquatic organisms	None	More than Alternative 3 due to more flexibility in use of retardant with three exceptions. Misapplication probability is 0.42% if retardant is used in the fire season.	Less than Alternative 2 due to only one exception. Misapplication probability is 0.42% if retardant is used in the fire season.
Potential for invasive species to increase due to fertilizing effect of retardant (both aquatic and terrestrial	Increase in establishment or competitive advantage	None from aerially applied retardant supplying additional nutrients. May be an increase and spread due to an increase in fire sizes or ground suppression activities.	Could increase slightly as a result of fertilizing effects of fire retardant.	Could increase slightly as a result of fertilizing effects of fire retardant. Species could also increase and spread because of the potential for fires to be more intense as a result of avoidance mapping requiring different fire fighting strategies and need for additional ground suppression but much less area compared to Alternative 1.

Effect	Indicator	Alternative 1 – No Retardant	Alternative 2 – Current Use	Alternative 3 – New Direction, Preferred Alternative
Contamination of water with fire retardant from accidental drop	Potential for accidental application of fire retardant into water	None	Low due to avoidance mapping of all waterways.	Low due to avoidance mapping of all waterways.
Contamination of drinking water from fire retardant	Potential for drinking water contamination from fire retardant	None	Low due to avoidance mapping of all waterways but higher than under Alternative 3 due to more exceptions.	Slightly lower than under Alternative 2 due to fewer exceptions.
Fertilizing effects of retardants on soil productivity	Acres affected by retardant	None	Could result in 2,358 to 4,715 acres annually (~ 0.002 percent) of NFS lands to be affected by retardant.	Less than under Alternative 2 due to more acres included in avoidance mapping.
Leaching or erosion of soil and nutrients into streams and waterways	Number of retardant drops within 300-foot buffer	None	Slightly higher than Alternative 3 because of more exceptions, more than under Alternative 1.	Lower than under Alternative 2 because of fewer exceptions, more than Alternative 1.
Effects on wilderness characteristics	Change to wilderness character	None	Some potential for short-term effects.	Some potential for short-term effects.
Effects on air quality	Meets local and State air quality standards	Yes; however, may be an increase in smoke in the air from larger fires.	Yes, less effect from larger fires than under Alternative 1.	Yes, less effect from larger fires than under Alternative 1.
Visual quality	Changes to visual quality	None; however, there may be more acres burned and the ability to protect areas of high value visuals may be reduced.	Some short-term effects due to colorant; use of fugitive colorant in the future will shorten or eliminate this effect. Less effect from larger fires than under Alternative 1.	Some short-term effects due to colorant; use of fugitive colorant in the future will shorten or eliminate this effect. Less effect from larger fires than Alternative 1.

Chapter 3. Affected Environment and Environmental Consequences

Chapter 3. Affected Environment and Environmental Consequences

This chapter provides an overview of the affected environment including specific resource components that would be affected by the alternatives to establish a baseline for analysis. Additionally, this chapter presents the scientific and analytic basis for a comparison of the alternatives and describes the probable effects of each alternative on selected environmental resources. Resource specialist reports, biological assessments, and evaluations contained in the project record describe the affected environment and species-specific impacts in detail and include the broad scale analyses of the environmental effects of the alternatives.

The analysis in this final EIS focuses on the effects of aerial fire retardant. Aerial drops of fire retardants occur when and where wildland fires occur; therefore, the exact placement and number of drops depends on future fire events, which are unknown. Information on fires and fire retardant use was collected from 2000 through 2010 and used as baseline data for the existing condition. Information on fire retardant intrusions into water was limited to 2008 to 2010 because more complete information was collected for these years compared to earlier data. The averages, estimates, and other information contained in the EIS and the project record are derived from the most accurate, readily available data.

Actions that may contribute to cumulative effects include:

- The use of fertilizers on private timberland and agricultural lands. Fertilization is uncommon on National Forest System (NFS) lands and unlikely to add to nutrients in areas where fire retardant has been used. However, the private forest industry can and often does use fertilizers on some forests.
- The use of fire retardant by other Federal and State firefighting agencies under the *2000 Guidelines for Aerial Delivery of Retardant or Foam Including the 2008 Reasonable and Prudent Alternatives* (Appendix A). Although data are not available to predict quantities of fire retardant applied, it is assumed that percentages of land base affected would be similar to those on NFS lands (0.002 percent of the land base affected annually).
- The use of fire and fire retardant on other land ownerships in the same area and at the same time as fire retardant is used on NFS land; however ,amounts and locations are unknown.
- The use of all other Federal and State fire suppression tools.
- Results of fire providing nutrient availability to non-native invasive species (NNIS).

The following assumptions also apply:

- Fire retardant formulations will likely continue to be nitrogen- and phosphorus-based; therefore, current affects are for expected future applications.
- The extent of effects is low because of the small amount of area affected by fire retardant each year, which is distributed widely across the United States. The impact of any one drop is likely to be minor and thus, would represent a minor contribution to cumulative effects
- Policy, direction, and local treatment and eradication of NNIS for Forest Service projects will continue.

Thus, cumulative effects to resources are unlikely but theoretically possible where fire retardant is applied under these scenarios.

3.1 Fire Retardant Use in Wildland Fire Management

This section provides an overview of the operational use of aerially applied fire retardant and the fire retardant use background, including the evaluation process for fire retardants. Additionally, this section presents the basis for a comparison of the alternatives and describes the probable effects of each alternative on selected wildland fire management elements. The averages, estimates, and other information contained in this section and the project record are derived from the most accurate, readily available data. Because this environmental impact statement is national in scope, the predicted impacts may vary according to site-specific factors.

3.1.1 Affected Environment

Fire Retardant Operational Use

The use of aircraft (fixed- and rotor-wing) for the delivery of fire retardant is one of many suppression tools used by fire managers. Long-term fire retardant contains a chemical that alters the combustion process and causes cooling and smothering/insulating of fuels. Fire retardant effectiveness is reduced over time but decreases the fire's rate of spread until rinsed off of the fuels, usually by precipitation.

The decision to call for aerially applied retardant is largely driven by fire intensity and behavior, availability of other resources, and the need to buy time for ground resources to arrive on-scene. Fire retardant can be delivered by aircraft to the incident swiftly, regardless of ground access issues. The general expectations of operational managers on the ground for fire retardant actions are as follows (Appendix O):

- Slows the rate of spread and lowers intensity;
- Reduces spotting by coating available fuels in front of the fire;
- Allows time for ground resources to gain access to the area to
- construct fireline; and
- In very light fuels, such as grass and light brush, and under the right circumstances, can actually serve as the fireline and prevent further spread.

Fire retardant is delivered by airtankers, single engine airtankers (SEATS), and helicopters, and fills an essential link in the overall suppression strategy. The main principle in the use of aerially delivered fire retardant is to use it early and in sufficient quantity, apply it from an effective altitude with a minimum time lapse as practical between drops, and build a contiguous fireline with fire retardant.

Retardant application to build fireline.

Aircraft and Operational Risk

Wildland firefighting is inherently risky. Nationwide, wildland firefighter fatalities have occurred at a rate of approximately 20 per year over the past decade (U.S. Fire Administration 2010). Aircraft accidents are among the leading causes of firefighting deaths (National Wildfire Coordinating Group 2007). During the past decade, aviation fatalities have averaged 3.7 per year, with most of these fatalities occurring on large wildland fires (National Wildfire Coordinating Group 2007, Large-Cost Fire Independent Review Panel 2009).

The Forest Service and the interagency fire community work hard at identifying the causal factors behind any fatality or accident, regardless of whether it occurs from an aircraft accident or other cause. The primary means by which we prevent accidents in all wildland fire operations is through aggressive risk management. The Forest Service acknowledges that while the ideal level of risk is zero, a hazard-free work environment is not a reasonable or achievable goal in fire operations. Risk management is intended to minimize the number of injuries or fatalities experienced by wildland firefighters.

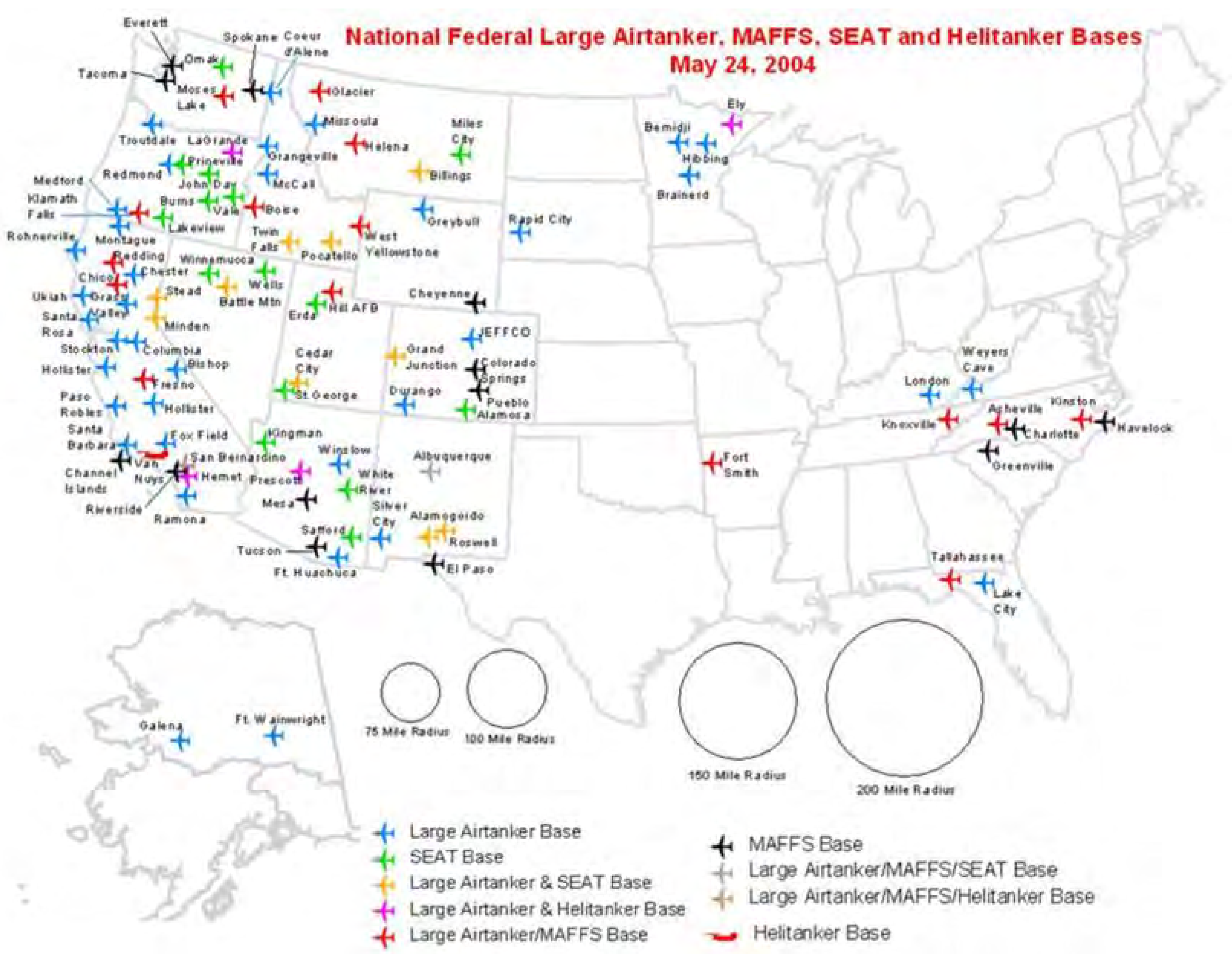
The Forest Service has also adopted the Safety Management System (SMS) as the foundation to our aviation safety program. The intent of SMS is to improve the aviation culture by increasing hazard identification, reducing risk-taking behavior, learning from mistakes, and correcting procedures before a mishap occurs rather than after an accident National Wildfire Coordinating Group 2011).

The focus on aircraft accidents has led to an increase in required maintenance and, for large airtankers, a continued airworthiness program (CAP) and operational service life (OSL) standards have been implemented. The OSL requirements have been added to the large airtanker contracts in order to provide additional inspection and maintenance requirements to help mitigate potential accidents. As a result of the CAP and OSL, the large airtanker fleet has been reduced by approximately 50 percent since implementation. Additional safety and maintenance requirements have also been added to the contracts for both SEATs and helicopters.

Aircraft and Fire Retardant Use

Fire retardant is normally stored and mixed at an airtanker base or, in some instances, on site near a fire incident (Figure 2 'National Federal large airtanker, MAFFS, SEAT, and helitanker bases, May 24 2004'). Containment and treatment systems are required for fire retardant loading pits, mixing and pump areas, storage tanks, areas where fire retardant deliveries are received, aircraft maintenance areas, and where loaded airtankers are staged for dispatch (National Interagency Aviation Council 2009). When fire retardant is mixed at the incident site (portable retardant base), precautions include establishing reload sites to manage fire retardant in portable tanks (National Interagency Fire Center 2007b).

Figure 2 National Federal large airtanker, MAFFS, SEAT, and helitanker bases, May 24 2004



Airtanker types are distinguished by their retardant load: (PMS 410-1 Fireline Handbook):

- Type 1 – 3,000 gallons

- Type 2 – 1,800–2,999 gallons
- Type 3 – 800–1,799 gallons
- Type 4 – 799 gallons (SEATS)

Helicopters can deliver retardant either with a bucket (usually on a longline) or with a “fixed tank,”referred to as a “helitanker.” These are usually heavy-lift, or type 1, helicopters. Occasionally, type 2 helicopters will drop retardant, and on rare occasions, type 3 helicopters can do so. Supplying helicopters with fire retardant is the primary reason for setting up “portable retardant bases.” Helicopters are also distinguished by their loads:

- Type 1 – 700–2,500 gallons
- Type 2 – 300–699 gallons
- Type 3 – 100–299 gallons

Helitankers (type 1) – have a fixed tank and carry a minimum of 1,100 gallons.

Retardant aircraft are used in conjunction with other resources, most often in the building and holding of firelines. Retardant is most effective with support from ground resources, but can be used to hold a fire for long duration or even stop the fire if the overall conditions favor this. In addition, fire retardants are used in situations where the operational tactic is to slow or influence the forward rate of spread because effective fireline building may be impossible.

Retardant application in conjunction with ground resources.

Assigning Aircraft to Fire Incidents

Incident commanders, fire managers, and line officers evaluate the appropriate response of fire retardant delivery aircraft to ensure that their use will be effective in meeting incident strategies, that the aerial application of fire retardant is the right tool for the job, and that the exposure to the risks of fighting the fire is commensurate with the values being protected. There are currently only 11 to 17 large airtankers under contract by the Forest Service, and not every incident can take advantage of them when there is competition for large airtankers. Fire leadership prioritizes type 1 and 2 incidents daily to ensure that large airtankers and other national shared resources are provided to incidents with the highest priority needs. Once an airtanker is assigned to an incident, there is no guarantee as to how long it will remain on that incident. During busy times, higher priority incidents can arise, and the tanker can be diverted accordingly.

Upon identifying an unplanned ignition, an initial size-up and assessment is completed to determine how the fire will be suppressed (Incident Response Pocket Guide [IRPG]). If the decision is made to use aerially applied fire retardant, the application of fire retardant will be positioned such that it will be the most effective at the time of ignition discovery. Natural ignition fires typically occur in the afternoon and early evening hours, which are usually in the heat of the day and have the lowest humidity levels. Using fire retardant at that time is critical to assist in slowing the spread and intensity of the fire.

Fire managers frequently use retardant to stabilize small remote fires (type 4–5 incidents) before these fires mature into larger, long-duration incidents. Retardant aircraft are vital to extended attack fires (type 3) for high values at risk, which includes wildland–urban interface areas. Fighting fires in these areas often places firefighters at the greatest risk due to the complexity of dealing with both natural fuels and structures in the fire environment. Type 1 and 2 incident management teams (IMTs) rely on airtankers to assist in the success of managing and suppressing these complex, large-scale fires. See Appendix O of the FEIS for professional firefighter input to a set of questions focusing on the use and effectiveness of fire retardant.

Retardant application to assist in minimizing fire spread.

Data derived from the Aviation Business System indicates approximately 90 million gallons of fire retardant (approximately 36,148 drops) were aerially applied to National Forest System (NFS) lands in the 2000–2010 decade. It is estimated that the average area of NFS lands that have fire retardant applied is between 2,358 and 4,715 acres annually, which is approximately 0.002 percent of the total NFS landbase. Forest Service Regions 3, 5, and 6 apply higher amounts of fire retardant compared to other regions (Figure 3 'Gallons of aerially applied fire retardant by Forest Service region, 2000–2010' and Figure 4 'Number of fire retardant drops by Forest Service region, 2000–2010'). See Appendix C for aerially applied fire retardant use nationally and by individual forest.

Figure 3 Gallons of aerially applied fire retardant by Forest Service region, 2000–2010

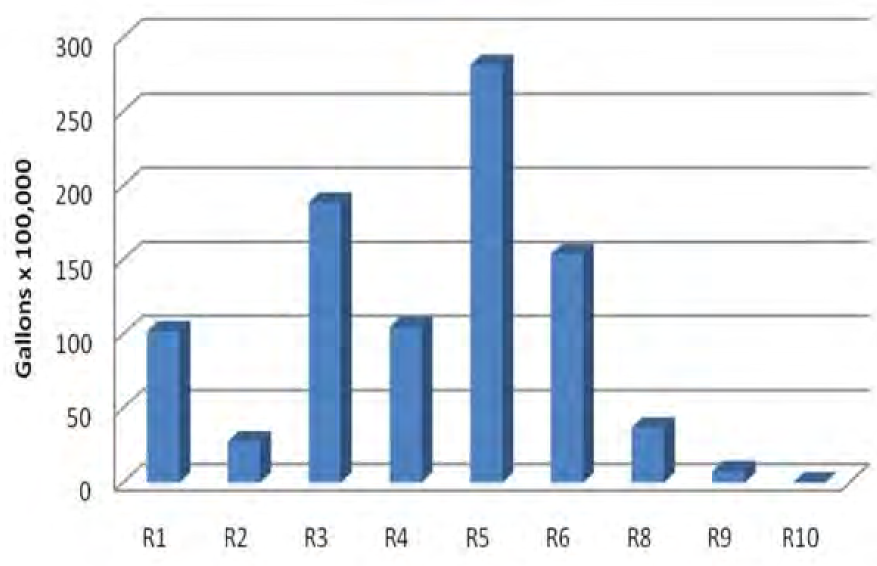
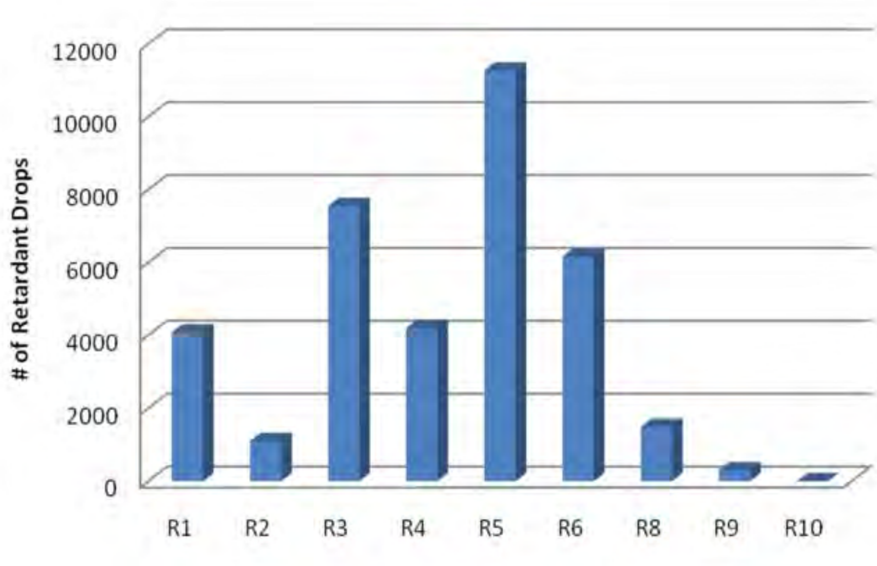


Figure 4 Number of fire retardant drops by Forest Service region, 2000–2010



Applying Retardant

Fuel is one of the three necessary elements for fire (the others being oxygen, and heat) that can be significantly affected by wildland fire retardant chemicals. Fire retardants interact with fuel and work by fuel coating, fuel combustion modification, and fuel cooling.

Fire retardant aerial application factors include fuel type, application rates, delivery systems, effectiveness of on-scene resources, winds, proximity to sensitive areas, and other firefighting tactics. Fire retardant coverage level is a unit of measure used to describe the thickness of fire retardant on the ground and is expressed in gallons per 100 square feet (gpc). Aerial application rates range between 1 and 8 gpc, with the majority of applications being between 4 and 8 gpc (Johnson 2010). Usually, the width and length of a fire retardant drop swath varies based on the type of aircraft used for delivery, drop height, and surface wind speed and direction. An average drop is 50 to 75 feet wide by up to 800 feet long. Depending on firefighting tactics, fire retardant drops might be strung together, creating a continuous path of fire retardant on the ground or used to create a barrier in combination with other naturally occurring barriers to the advancement of fires (e.g.., ridgetops, roads, waterways, and old burn scars).There are general guidelines for coverage levels according to fuel type, and suggested coverage levels are intended to be used as reference points only. Feedback from crews on the ground is essential in determining the effectiveness of fire retardant drops and whether the subsequent coverage should be lighter or heavier.

Fire scientists (Rothermel and Philpot 1974) used several fuelbed burn tests to develop a mathematical model to help predict fire retardant coverage levels (Table 3 'Coverage Level, Fuel models, and Flow Rate Range for Fire Retardant Drops'). The coverage levels range from 0.5 to greater than 8. This is translated into line-building capacity, which is the primary tactic for the potential stopping of an advancing fire. The mathematical model outputs were validated with the Operational Retardant Effectiveness (ORE) Study.

Table 3 Coverage Level, Fuel models, and Flow Rate Range for Fire Retardant Drops

Coverage Level ($gal/100ft^2$)	Fuel Models			Flow Rate Range (gal/sec)
	NFDRS[1]	NFFL FB[2]	Description	
1	A,L,S	1	Annual Perennial Western Grasses, Tundra	100–150
2	C	2	Conifer with Grass, Shortneedle Closed	151–250
	H,R	8	Conifer, Summer Hardwood.	
	E,P,U	9	Longneedle Conifer, Fall Hardwood.	
3	T	2	Sagebrush with Grass	251–400
	N	3	Sawgrass	
	F	5	Intermediate Brush (green)	
	K	11	Light Slash	
4	G	10	Shortneedle Conifer (heavy dead litter)	401–600
6	O	4	Southern Rough	601–800
	F,Q	6	Intermed. Brush (cured), Black Spruce	
Greater	B,O	4	California Mixed Chaparral; High	Greater than 800

Coverage Level (gal/100ft²)	Fuel Models			Flow Rate Range
	NFDRS[1]	NFFL FB[2]	Description	(gal/sec)
Than 6			Pocosin	
	J	12	Medium Slash	
	I	13	Heavy Slash	

1. National Fire Danger Rating System Fuel Models
2. Northern Forest Fire Laboratory Fuel Models (Anderson 1982)

Retardant application at coverage level 2.

Long-Term Fire Retardant—Background

Large, fixed-wing airtankers have played an increasingly important role in firefighting since the mid-1950s, when aircraft were first used to deliver fire retardant. Although research as early as the 1930s looked towards improving the effectiveness of water as a forest fire extinguishing agent, use of fire retardants did not materialize until the 1950s.

Throughout this time, various fire retardant chemical formulations have been used, but the focus in recent decades has been on improving the formulation to be more environmentally friendly while maintaining or improving its current effectiveness.

Fire retardant, which is approximately 85 percent water, slows the rate of fire spread by cooling and coating the fuels, robbing the fire of oxygen, and slowing the rate of fuel combustion with inorganic salts that change how the fire burns. Fire retardant is typically applied to fuels in front of an advancing fire, not directly to the fire. When determined to be an appropriate suppression tactic, fire retardant may be applied aerially to any type of landscape experiencing wildfire from low-lying desert ecosystems to oak woodlands and into alpine forests. Most fire retardant is applied in the Western United States; it is rarely used in the Northeast and only occasionally used in the Midwest. Fire retardant is periodically used in the Southeast depending on the severity of the fire season.

Most aerial fire retardant delivery occurs on ridge tops and adjacent to human-caused or natural fire breaks, such as roads, meadows, old fire scars, and rock outcrops. Occasionally, fire retardant is applied adjacent to aquatic environments that are being used as a natural fire break. Applying fire retardant adjacent to these human-built or natural fire breaks enhances the effectiveness of the fire breaks by widening the break, which is especially important when applying fire retardant adjacent to aquatic environments. Since 2000, fire retardant delivery to aquatic systems is limited because aquatic habitats are relatively small, linear or polygon shapes and because pilots have been instructed to avoid known bodies of water and maintain communication with resource advisors, scouts, and others through the incident commander on a fire incident, as stated in *Guidelines for Aerial Delivery of Retardant or Foam Near Waterways* (2000 *Guidelines*) (Appendix A). Under these guidelines, fire retardant may also be aerially applied if firefighters, public safety, or property are threatened and the use of fire retardant is expected to alleviate the threat.

As fire retardant is a standard tool for fire managers to use in fire management operations, it is imperative that any product used meets stringent requirements in order to ensure safety is met for equipment, people, and the environment. Current fire retardant formulations in use today are primarily inorganic fertilizers, the active compound being ammonia polyphosphates (USDA Forest Service 2007 [amendments inserted into text May 17, 2010]; see Appendix L). Although retardant is approximately 85 percent water, the ammonia compounds constitute about 60 to 90 percent of the remainder of the product. The other ingredients include thickeners, such as guar gum; suspending agents, such as clay; dyes; and corrosion inhibitors (Johnson and Sanders 1977, Pattle Delamore Partners 1996). The ammonia salt causes the solution to adhere to vegetation and other surfaces; this stickiness makes the solution effective in retarding the advance of fire (Johansen and Dieterich 1971). Corrosion inhibitors are needed to minimize the deterioration of fire retardant tank structures and aircraft, which contributes to flight safety (Raybould et al. 1995). Previous retardant formulas contained sodium ferrocyanide[2] as a corrosion inhibitor. It was found that, under certain conditions, sodium ferrocyanide poses greater toxicity to aquatic species and aquatic environments than fire retardant solutions without this agent. Due to this finding, the Forest Service amended the specification to no longer allow this ingredient in any formula.

A full understanding about how retardant chemical components interacted with various elements of the environment was generally lacking during early use of the materials (pre-1990s). Over the past two decades, wildland firefighting agencies have conducted more monitoring and review of the environmental and safety aspects of retardant use

2 Sodium ferrocyanide is a complex cyanide in which cyanide ions are bound to metal ions, such a ferrous iron. The odorless, yellow powder has a slightly toxic hazard rating in Dangerous Properties of Industrial Materials (ERM-New England, Inc. 1987). It has low toxicity to humans, and the Food and Drug Administration has approved it for use as an anti-caking agent in table salt (Food and Drug Administration 2000).

(Labat Environmental April 2007, Labat-Anderson 1994, Carmichael 1992, Finger 1997, Krehbiel 1992, Van Meter and Hardy 1975). Due to fish kills that occurred when retardant containing sodium ferrocyanide accidentally entered streams and lakes during fire incidents (Carmichael 1992; Krehbiel 1992; Norris and others 1991), the Forest Service contracted with the Columbia Environmental Research Center (CERC) of the U.S. Geological Survey (USGS) to perform additional research on the chemical reaction of sodium ferrocyanide in water solutions exposed to ultraviolet radiation as it pertained to retardant use.

The Columbia Environmental Research Center (CERC) report (Little and Calfee 2000) spurred a review of procedures used by the Forest Service, Bureau of Land Management (BLM), National Park Service (NPS), and Fish and Wildlife Service (FWS) during aerial firefighting. As a result of these studies, the *Guidelines for Aerial Delivery of Retardant or Foam near Waterways* (Appendix A) were established as interim guidelines in April 2000. Due to the potential increased toxicity, the Forest Service has not accepted for contract or purchased retardants that contain sodium ferrocyanide since 2005 (U.S. Forest Service 2000, 2002). The Forest Service has discontinued the use of retardants containing sodium ferrocyanide since the 2007 fire season.

Besides the ongoing work with outside agencies and environmental entities, the Forest Service's wildland fire chemical program includes a specification review and revision process. This is applied to all categories of wildland fire chemicals. The current specification was established in 2007 and includes a move away from products that contain ammonia sulfate salts to products with inorganic phosphate salts only. Products with inorganic phosphate salts reduce the level of ammonia from 3.1 percent to 2.2 percent, an overall reduction of 33 percent ammonia content in the retardants. This change not only decreases the toxicity to aquatic organisms, it also provides for increased effectiveness on both flaming and flowing combustion and decreased corrosion to magnesium and steel.

The evaluation process for any product is funded by the company that is seeking to have a product on the qualified products list (QPL). The Forest Service does not use any wildland fire retardant chemical that has not been through the evaluation and placed on the QPL. The initial request from a company or manufacturer for the Forest Service to evaluate a product results in a review of the formula's ingredients and quantities used in the product, identification of the source of supply for each ingredient, and copies of the Material Safety Data Sheets (MSDS) for the product for each ingredient used to prepare the fire retardant. This is done to assure the product does not contain ingredients meeting the criteria for chemicals of concern (which is checked against our list of unacceptable ingredients as contained in the specification National Toxicology Program (NTP) Annual Report of Carcinogens, International Agency for Research on Cancer (IARC) Monographs for Potential Carcinogens, Comprehensive Environmental Response, Compensation and the Liability Act (CERCLA) List of Extremely Hazardous Substances and Their Threshold Planning Quantities in order to determine if there are any ingredients that could pose a threat to either the environment or human populations. If this review identifies an ingredient of potential concern, a risk assessment is conducted by a third party before proceeding with a full evaluation.

The fire retardant specification includes requirements for effectiveness, safety and environmental protection, materials protection, stability, and physical properties. The Forest Service developed unique test methods or identified standard test methods for each requirement in the evaluation process.

The Forest Service establishes formal national retardant contracts in order to ensure that only products on the QPL are purchased and applied to NFS lands. These contracts are also used by other Federal and land management agencies through their authorities and policies.

Burn test of retardant during the evaluation process.

All of the requirements for fire retardant properties are important and necessary; however, the effectiveness of fire retardant has been questioned. Studies have been conducted surrounding the effectiveness and the delivery of fire retardant (Gimenez et al. 2004; Plucinski et al. 2007; USDA Forest Service Standard Burn Test).

One such study attempted to determine how much chemical or fire retardant is needed in a given fire suppression job and to relate those amounts to fuel and fire behavior characteristics. The Operational Retardant Effectiveness Study (ORE) began in 1983 and collected data through 1988. Specific to fire retardant effectiveness the study sought answers in quantitative terms that could lend themselves to more in-depth analysis to fill knowledge gaps. Study areas concentrated on relating effective fire retardant coverage and fuel and fire characteristics, tailoring chemical or fire retardant to the need, optimizing tank and gating system performance, and developing adequate use guidelines for airtanker selection, allocation, deployment, and real-time use. The study validated the airtanker performance guides and fire retardant coverage level charts as well as the value of using gum-thickened fire retardant to minimize evaporation and drift during use under operational conditions. The study provided additional recommendations to operations procedures in order to maximize the effectiveness of fire retardant (George 1985).

Data show that long-term fire retardant applications show a reduction in fire spread and intensity of about 39 to 45 percent when compared to water when the fuels are still wet from application. When the water has evaporated, the fuels treated with fire retardant still show a reduction in spread and intensity of 0.53 to 0.57, or a reduction of greater than 50 percent compared to untreated fuels. Data for water-treated fuels show no reduction in spread or intensity (0 reduction factor) after they have dried (USDA Forest Service n.d.).

Using this comparison is a simplistic approach given that water is a fire suppressant and is primarily useful for direct attack through placement on or very near the open flaming front. Fire retardants work from the onset of their application where, in contact with heat, pyrolysis begins. During this process, a greater amount of water and other non-combustibles are produced at the expense of flammable products. Water acts as a cooling mechanism to suppress fire by absorbing heat. When water evaporates, it has no suppression effect on fire spread or fire behavior, whereas fire retardant will remain effective after water evaporation.

3.1.2 Current Implementation of the 2000 Guidelines

Fire Retardant Application Guidelines

The Forest Service is currently operating under the 2000 *Guidelines* (Appendix A). These guidelines allow the aerial application of fire retardant to NFS lands but prohibit their use within a 300-foot buffer of a waterway (and in water with exceptions. The reasonable and prudent alternatives (RPAs) (Appendix B) adopted by the Forest Service, as a result of consultation with the FWS and National Oceanic and Atmospheric Administration (NOAA) Fisheries in 2007 and 2008, restrict the use of aerially applied retardant within the habitat of threatened and endangered species identified through the regulatory agencies' processes and listed in their biological opinions.

The Forest Service implemented the RPAs through direction to the field in March of 2008 as well as instructing the field that the 2000 *Guidelines* were to be applied. Based on this new direction, the national forests which contained listed species identified in the biological opinions with jeopardy opinions were required to develop related maps or provide direction to firefighting resources. The national forests are now required to brief the incident commander(s)(IC) where limitations exist in the use of aerially applied fire retardant. The agency administrator/IC does still have the ability to invoke the exceptions under the 2000 *Guidelines* if needed. In addition, the agency administrator incorporates any restrictions for the use of aerially applied fire retardant in the delegation of authority letter given to the IC.

If fire retardant is applied aerially within the waterway buffer or habitat of an identified threatened and endangered (T&E) species, reporting is mandatory and emergency consultation may be necessary. In addition, depending on the effects to species, subsequent monitoring may be required.

Fire operations entities adjusted their tactics in 2000 as part of the development of the 2000 *Guidelines*. In addition, national forests worked with ICs to provide appropriate guidance as to where to avoid the use of aerially applied fire retardant, and this guidance is often documented in the delegation of authority letter given to ICs by the line officer, and direction is sent to aviation resources so that they were aware of the requirements. Policy, manuals, handbooks, and training materials have all been updated to include the 2000 *Guidelines* and the T&E species habitat limitations.

Retardant application to assist in the protection of property.

The upward reporting requirements were formalized as a direct result of the acceptance of the RPAs. This acceptance also included the requirement to report where retardant was misapplied to the habitat of a T&E species. Since the implementation of the guidelines in 2000 and the addition of the RPAs in 2008, 48 reports have been submitted (38 from 2008 to 2010) with 5 citing use of exceptions to the guidelines.

3.1.3 Environmental Consequences

Alternative 1—No Action

Direct and Indirect Effects

Under this alternative, there would be no long-term fire retardant aerially delivered on NFS lands. Ground-based application of fire retardant, foams, water enhancers (gels), and water (including aerial application of water only) would continue to be available for use by ICs as suppression tools. This alternative would not prohibit the aerial application of fire retardant on lands owned or administered by State, private, or other Federal entities.

Reduced Effectiveness

Removing aerial application of fire retardant as a fire suppression tool will reduce the overall effectiveness of aerial fire suppression resources. Fire retardant has been shown to be up to 50 percent more effective than plain water as a suppressant in reducing fire spread and intensity (USDA Forest Service n.d.). Water does not have the "staying power" of fire retardant on the vegetation as it evaporates very quickly and has little or no effect in slowing the rate of fire spread or fire spotting potential under conditions of low relative humidity and high temperature. Aerial delivery resources would continue to be used, although they would deliver water only to assist with the tactics for managing the fire.

The reduced effectiveness of aerial resources may place firefighters in more hazardous situations requiring the assistance of aerial resources. With reduced effectiveness, firefighters may not be able to tactically engage the fire on the ground through perimeter control or direct attack as in the past. Firefighters would be required to back away from known effective fire control barriers and anchor points otherwise defensible with the use of fire retardant and choose a more ground-defensible barrier (natural or man-made). This could increase the acreage burned as the retarding effect provided by fire retardant would no longer exist. During significant fire events with dense smoke plumes, a potential consequence of initial attack (IA) tactics limited because fire retardant cannot be used, safety impacts from decreased visibility could also be an issue.

Greater Exposure of Ground Personnel

Aerially applied fire retardant is primarily used to slow the fire's rate of spread until adequate ground resources can arrive. Due to water's decreased residence time and effectiveness in checking fire spread, the fire size may be greater by the time ground resources arrive. The ability to use aerially applied fire retardant to assist in the control of small, remote fires in steep terrain with poor access would be lost as well. Competition for increased number of requests for aerial drops of water on a fire may limit the number of fires that typically receive aerial support in the initial stages. The result could be larger fires at containment and more fires progressing to extended, long-term, or large-fire status. This could be most notable for units that utilize SEATs as a standard component of their normal IA response (common practice in rangeland fuel types) as water serves only as a fire suppressant whereas fire retardant has both suppressant (in it's water component) and retarding effects. In addition, without the use of fire retardant (which affords firefighters valuable response time), the positioning of both aerial and ground resources in close proximity to high fire danger areas will become even more critical than in the past. The current Forest Service 10-year IA success rate is approximately 98 percent, which could potentially be affected under this alternative.

Aerially applied fire retardant is used to provide additional safety and increased effectiveness to firefighters during suppression actions. In rare occasions, the retarding properties of fire retardant also allow for the pretreatment of areas prior to the ignition of prescribed fires. Land managers might also use this tactic where a prescribed fire is near the wildland urban interface in order to provide additional firebreak protection. Firefighters are also taught to request fire retardant drops if they are in a situation that becomes more hazardous, where the safety zone is compromised, or when their designated escape route has been removed. Over the past decades, aerially applied fire retardant was used to provide firefighters response time and escape support during entrapments.

Increased Air Operations

The consequence of aerial deliver of water alone instead of more effective fire retardants will be that fire control efforts will require more drops to assist with perimeter management on the ground. This increase of the number of flights would increase exposure for flight crews of both fixed-wing and rotor-wing aircraft to hazardous conditions. The 10-year average annual flight hours for large airtankers is 5,831; for SEATs, it is 845 hours; and for helicopters, it is 39,928 hours. Helicopters have the highest frequency rate of accidents over this 10-year period, an average of 2.9 accidents per year. Increased demand for aerial support could potentially lead to an increase in accidents simply due to increased flight hours. Another outcome could be increased aircraft congestion in the confined airspace, which again creates more hazard exposure and potential for mishap.

Additional water-dropping aircraft (helicopters, airtankers, SEATs, and scoopers) would be in demand to make up for the lack of long-term fire retardant functionality. However, the availability of aircraft in certain categories (types 1, 2, and 3 helicopters; large airtankers; and water scoopers) has been declining in recent years, reducing the capability to minimize fire impacts. At the same time, additional aerial supervision aircraft would be necessary to coordinate the increase in tactical aircraft flights as would additional personnel, such as aircraft managers, aerial supervisors, dispatchers, and aircraft support personnel. All these factors, plus the higher use rates associated with call-when-needed/rental aircraft, will contribute to higher overall aviation and fire costs.

Increased Ground Operations

There will be a demand for additional ground suppression resources, including engines, crews, helitack, dozers, and smokejumpers in order to mitigate initial attack capability lost with the elimination of aerially applied, long-term fire retardant, thus increasing ground crew exposure to hazards and risks from the fire environment.

A lowered probability of success for tactical actions could be expected in areas accustomed to fixed-wing delivery of fire retardant on initial attack and especially in areas with remote access. Areas that have traditionally depended more on water delivered from rotor-wing aircraft may not have the same issue.

The current interagency nature of fire management today relies on consistent direction, standard training, and standard operations in order to minimize and mitigate risks. Assuming that the other agencies continue the use of aerially applied fire retardant, there is potential for increased confusion among firefighting resources as to tactics, which can compromise their safety as well as the safety of aerial resources.

Conflicting Fire Suppression Requirements

States are usually mandated by State law to suppress all wildfires at the smallest possible size. If the Forest Service has lost the capability of using aerially applied fire retardant and a fire spreads to lands under State jurisdiction, cooperative relationships could be compromised, as well as the potential for additional losses to critical infrastructure for communities as well as private property.

Federal fire policy clearly articulates that all aspects of fire management will be done on an interagency basis to "Promote an interagency approach to managing fires on an ecosystem basis" (USDA Forest Service 2009). In addition, if this alternative were selected, it would require that Master Cooperative Agreements and Annual Operating Plans were modified collaboratively with cooperators in order to clearly articulate policies, guidelines, and standard operating procedures with regard to aerial resources and the use of fire retardant. Clarification and revision would be necessary and must be clear where the Forest Service protects other Federal and non-Federal lands, and where other cooperators may be involved in protecting NFS lands.

Unmet Public Expectation

Over the past 50 years, aerially delivered fire retardant has become one of the most important tactical tools for wildland firefighters and has set the stage for public expectations regarding fire response. Input from professional wildland firefighters identified how effective the use of fire retardant is in slowing the growth of fire and impacting the combustibility of fuel (Appendix O). In fire-prone areas, utilizing all fire suppression tools and tactics available—including fire retardant—contributes to overall fire management. Eliminating the fire retardant tool can impact efficiency and timeliness in containing fires and result in a greater loss to natural resources, watersheds, and public and private property.

Cumulative Effects

Presently, 98 percent of wildland fires are kept under 300 acres and rely on the use of aerially applied fire retardant to contain them. Without aerially applied fire retardant to slow the growth of more isolated fires, potential exists for some of these fires to grow larger before firefighters can safely fight the fires (Henderson and Lund 2011).

Backing away from known effective control barriers and anchor points that are typically used in conjunction with the use of aerially applied fire retardant and using less desirable countermeasures (using indirect attack tactics and strategies) would likely increase the area burned before containment. During significant fire events with dense smoke plumes, safety impacts from decreased visibility can also be an issue, which can be a direct result from limited IA tactics when fire retardant cannot be utilized.

In summary, the loss of both natural resources and private property would increase under Alternative 1. Because of the difference in the effectiveness of water on fire behavior compared to fire retardant, there would be:

- Greater risk of small fires becoming large fires and fires moving into populated areas;
- Potential increase in loss of public infrastructure, including utilities corridors, communication sites, and transportation systems;
- Increase in the cost of fighting fires; and
- Inconsistencies between agency fire policies if the Forest Service is the only agency that does not use aerially applied fire retardant to fight fires, which puts both firefighters and the public at greater risk.

Alternative 2—Proposed Action

Direct and Indirect Effects

Because the Forest Service would continue to use aerially applied fire retardant under this alternative, it is expected that the initial attack success will maintain about 98 percent, similar to previous years.

Exposure and risk considerations related to fire retardant would remain the same as over the last decade. There would be no significant changes in policies and guidelines for using aerially delivered fire retardant, change in political sensitivities, relationships with cooperators and partners, or issues regarding use of fire retardant.

Under this alternative, the potential for misapplication of aerially delivered fire retardant into waterways, within the 300-foot buffer, and in the habitat of TEPCS species is possible. In addition, fire retardant could be aerially applied in these same areas with the use of the exceptions allowed under the 2000 *Guidelines*. If fire retardant enters these areas either through a misapplication or as a result of the exceptions, reporting is required and potential initiation of emergency consultation pursuant to regulations at 50 CFR 402.05 implementing section 7 of the Endangered Species Act of 1973, as amended, exists. As part of the emergency consultation, the Forest Service may need to conduct subsequent monitoring, which could include measures to prevent or compensate for population declines due to the aerial application of fire retardant. For areas where aerially applied fire retardant was applied to terrestrial plants and has resulted in an increase in invasive species, there is the potential to have to remove all non-native plant species from the affected area. This requirement was implemented with the acceptance of the RPAs from the FWS in 2008 (Appendix B).

The implementation of monitoring requires personnel to be assigned and funds committed in order implement a monitoring plan. The plan could require additional mitigation measures to the impacted area. Due to this, additional emphasis has been placed on the appropriate use of retardant in initial attack responses as well as large fires.

Through fire operations planning, initial attack priorities are established and the appropriate firefighting resources are assigned. If fires escape initial attack, a risk-informed initial strategy is developed that considers exposure to incident responders, values-at-risk, stakeholder engagement, and impacts on the lands. This risk assessment would include any potential limitations to the use of aerially applied fire retardant due to waterways or the presence of TEPCS species. This process further refines the tactics used in response, which can contribute to minimizing the potential for accidental aerial application of fire retardant.

Cumulative Effects

Because there would be no change from current protocols in the aerial delivery of fire retardant, there are no change in current cumulative effects.

Alternative 3

Direct and Indirect Effects

In general, this alternative will be similar to Alternative 2. Additional avoidance areas would be established due to the addition of federally listed threatened endangered or proposed terrestrial plant or animal species or critical habitat and candidate species and Forest Service sensitive species where aerial application of fire retardant may adversely affect habitat and/or populations. An additional change is to the exceptions from the 2000 *Guidelines*: exceptions are allowed only for the protection of life or safety (public and firefighter). This could potentially increase the loss of private and public property and infrastructure investments within national forests and allow fire spread to communities. Agency administrators will need to work closely with incident commanders in identifying areas of potential safety concern that could compromise public or firefighter safety. In these cases, the exception to aerial application of fire retardant may be invoked. There will be an increase to the mapping requirement and the consultation needed at the beginning and throughout operations. The avoidance area mapping requirement for TEPCS could result in more area required for aerial avoidance area for fire retardant. This means that consultation with local regulatory agencies, national forest or unit biologists, agency administrators, and Fire and Aviation Management representatives would be completed prior to the fire season.

Preseason readiness reviews would require the measures above in strategies for preplanned dispatch for initial attack response, cooperator agreements, and any meetings where response to fires is a topic. Such venues will provide direct means of communicating the intent of these guidelines and promote a standard practice in reviewing the avoidance maps annually to ensure that they contain the most up-to-date information.

National standards (in the way of a template) for mapping avoidance areas will require coordination annually at sub-geographic levels. Firefighters, aviators, and cooperators will be required to understand the tactical limitations of aerial application of fire retardant within the pre-identified avoidance areas.

Under this alternative, fire retardant cannot be used to anchor fires into waterways, steep terrain, or areas of limited accessibility if located within pre-indentified avoidance areas. This could lower the probability of success for areas accustomed to the assistance of fixed-wing fire retardant application under high fire danger conditions and cause a decrease in the rates of initial attack success and increase the acres burned in those areas, based on comments from wildland fire professionals regarding effectiveness (Appendix O).

The potential for larger, longer-duration fires translates to increased exposure to risks for firefighters, aerial resources, and the public. This potential is greater than that in Alternative 2 but much less than in Alternative 1.

Firefighter and public safety is always the first and highest priority in fighting fires (FSM 5100). The introduction of increased restrictions on where fire retardant can be applied aerially may have the potential to introduce unintended consequences to safety. Firefighting training, direction, and requirements are generally standardized across all Federal wildland firefighting agencies and most States; implementing a potentially more complex mapping system for ground and aerial resources only on fires on NFS lands could lead to confusion and inconsistencies with partners and cooperators. Changes in protection priorities and protocols between the Forest Service and cooperators has the potential to cause confusion for incident commanders and agency administrators when developing intent and priorities, particularly under unified command situations. This could increase risks to some extent.

If significant additional areas are identified for avoidance the overarching benefit of aerial application of fire retardant would be lost within those areas, potentially increasing the demand for additional ground and aerial firefighting resources in order to mitigate this impact. This could lead to increased hazard exposure to ground resources and pilots and a higher cost to fighting the fires.

Limiting the aerial delivery of fire retardant could generate a perception that the Forest Service is not fighting a fire that requires aggressive action to manage the spread and minimize negative impacts from the fire.

Cumulative Effects

Eliminating the use of aerial applied fire retardant in avoidance areas could lead to an increase in acres burned, destruction of other wildlife habitat and vegetation, impacting watershed conditions (including waterways), increasing the potential for soil movement (landslides) due to rainfall, raising smoke particulate levels in airsheds due to longer-duration fires, and an increase in the cost to suppress fires.

3.2 Soils

This section addresses the potential for fire retardant to change soil chemical properties, leach through the soil and enter streams and waterways, increase vegetative growth, and change vegetative community composition under the proposed action and alternatives. The fate of fire retardant application and its subsequent effect on soil productivity varies with application rates, vegetation types, fuel models, and inherent soil properties. Fire retardant formulations in use today are primarily inorganic fertilizers, the active compound being ammonia polyphosphates (Henderson and Lund 2011). As with any nutrient addition to the soil there is a chemical response that may affect soil fertility. Because soil properties are unique and vary by ecoregion, a soil risk rating identifies the soil condition (physical, chemical and biological properties) that affects the movement, uptake, and response of the soil to the fire retardant. See appendix H for soil risk ratings.

3.2.1 Affected Environment

The potentially affected environment is limited to NFS lands, approximately 193 million acres. The estimated area of fire retardant application across all NFS lands is between 2,538 and 4,715 acres annually (0.002 percent of total Forest Service land base). Soils across NFS lands vary based on climate, parent material topography, and living organisms present. Forest Service land managers are charged with the task of ensuring that soil quality and productivity is maintained. Soil physical, chemical and biological properties are used to describe existing conditions as they affect soil quality and sustainability (USDA Forest Service 2010). The application of aerial fire retardant across diverse soils and ecosystems may affect soil condition through physical, chemical and biological changes from the fertilizing effects of fire retardants or through leaching of nutrients from soils into streams and waterways.

Soils contain both nitrogen and phosphorus. The amount of soil nitrogen and phosphorus varies and is related to physical and chemical properties including texture, clay content, soil structure, organic matter content, nutrient availability, and soil pH (Certini 2005, Neary et al. 2005).

Site-specific soil property information is available through the State Soil Geographic (STATSGO) database, Soil Survey Geographic (SSURGO) database, or from individual forest soil resource inventories. These surveys provide information on physical, chemical, and biological properties of soils. The STATSGO database is the U.S. General Soil Map and provides coverage for the entire United States at a coarser scale than what is commonly available from individual forest or grassland soil resource inventories.

Soil quality and productivity vary throughout NFS lands. Management activities include forest management, grazing, recreation, access and travel management, prescribed fire, and other disturbances. Each management activity has the potential to affect soil physical, chemical and biological properties by modifying vegetative cover, increasing soil compaction and erosion, changing soil hydrologic properties, and changing soil nutrient status by the addition or removal of nutrients. Soil contamination occurs from contaminant sources, including abandoned mines, illegal dumping, drug labs, spills, atmospheric deposition, and other factors. Each National Forest manages activities to reduce potential adverse impacts on soil resources by using regional soil quality standards to maintain and protect soil productivity. The Forest Service Watershed Condition Classification requires each forest to evaluate soil condition on a watershed scale and evaluate indicators for soil productivity, soil erosion, and soil contamination (Potyondy and Geier 2010).

In order to understand how fire retardants can affect soils, it is important to look at nitrogen and phosphorous sources and principal mechanisms of movement from soils to plants or from soils to waterways. Nitrogen constitutes about 78 percent of the earth's atmosphere. The primary pathways by which nitrogen enters soils are:

- Organic material added from litterfall, root death, faunal remains, etc.
- Atmospheric deposition;
- Biological fixation (by certain plants and soil microorganisms);
- Synthetic fertilizers; and
- Organic fertilizers and manures.

Soil microorganisms decompose organic material, producing ammonium or nitrate forms of nitrogen that can be used by plants.

Total nitrogen content of soils ranges from less than 0.02 percent in subsoils to more than 2.5 percent in peat soils (Tisdale et al. 1985). Brady (1984) identifies three major forms of nitrogen in mineral soils: organic nitrogen associated with the soil humus, ammonium nitrogen that is fixed by certain clay minerals, and soluble inorganic ammonium and nitrate compounds. The amount of soluble nitrogen available to plants can be as little as 1 to 2 percent of the total nitrogen in the soil The largest pool of nitrogen is in the organic form and tightly held by clay minerals in the subsoil.

Phosphorus is critical for many reactions that maintain plants and animals. Phosphorus is immobile in the soil and is tightly bound to soil particles. Phosphorus, like nitrogen, is found in two different forms in soil inorganic and organic Organic forms are in humus and other organic material. Phosphorus in organic materials is released through the mineralization process involving soil organisms. Microbial activity is highly dependent on soil moisture and temperature. Inorganic phosphorus is negatively charged in most soils and reacts with positively charged iron, aluminum, and calcium ions to form insoluble substances. Both positively charged iron and aluminum ions are typically found in forest soils, and when these ions react, the phosphorus is considered fixed and not available for plant growth. Soil phosphorus is most available for plant uptake at pH values of 6 to 7. When the soil pH is below 6, aluminum phosphates fixes the phosphorus. Alternatively, at pH levels above 7, positively charged calcium ions fixes the phosphorus again making it unavailable to plants. The addition of more phosphorus to the soil may not increase the plant uptake of phosphorus. Other soil properties that reduce the solubility of phosphorus include organic matter content, soil texture, and the cation exchange capacity of the soil Because phosphorus is immobile, it can enter streams and waterways only through a misapplication or from post-fire erosion where phosphorus-laden sediment enters a waterway.

3.2.2 Environmental Consequences

General Effects of Fire Retardant on Soils

The primary effect on soils from fire retardant is a fertilizing response. For nutrient-poor soils (sandy, low organic matter content), the addition of nitrogen and phosphorus could improve soil productivity in the short term. For already productive soils (clay, high organic matter content), the additional nutrients could have an acidifying affect and reduce soil pH, making some nutrients unavailable. An indirect effect of fire retardant application is an increase in vegetative growth and potential change in vegetative community composition. Leaching of nitrogen into streams and waterways could occur in areas of coarse-textured soils and for drops occurring within the waterway influence zone. The persistence of effects will depend on vegetation type and post-application weather patterns (Adams and Simmons 1999).

Soil response to long-term fire retardants varies with soil quality, vegetation, application rates, and environmental conditions (temperature, biological activity, and precipitation) during and after the application (see soil report risk chart, Appendix H).

Other direct effects include the potential for nutrient leaching. Because phosphorus is not mobile in the soil the only transport mechanism would be associated with erosion of soil particles that had been coated from a fire retardant drop. Nitrogen leaching potential is higher in coarse-textured soils because there is less clay and organic matter to bind the fertilizer. Leaching of nitrogen into streams and waterways could occur in areas of coarse-textured soils when fire retardant drops occur within the waterway influence zone.

The following studies show how variability of the soil response. A test of Phos-Chek application on mixed grass prairie wetland ecosystem soils shows a fertilizing response with increased herbaceous biomass but decreased species diversity (Poulton et al. 1997). Other studies showed Phos-Chek degrading rapidly in soils with high organic content, suggesting that long-term effects are unlikely (Little and Calfee 2002). Diammonium phosphate fire retardant application on herbaceous biomass in California oak-savanna rangeland had increased vegetative response the first year, but the response was not significant the second season (Larson and Duncan 1982).

Research on two study sites in heathland areas of Victoria, Australia (Hopmans and Bickford 2003) demonstrated the effect of fire retardants on sandy, coarse-textured soils with low accumulations of organic matter. Phos-ChekD 75 R was applied at rates typically used for fire control. The effect of the applications decreased the soil surface pH by 0.5 units. The change in pH was still evident after 12 months. The soil salinity response varied between the two test sites with little to no change at one site compared to a significant increase in the soil salinity on a soil with low background electrical conductivity. The duration of the change in salinity of the surface soil was less than 6 months. Observed levels of plant available nitrogen increased from three-fold at one site to nearly ten-fold at another site. The increase in plant-available nitrogen rapidly declined to background levels after 12 months. Similarly, a significant increase (five-fold) in plant-available phosphorus was found in the surface soil after 12 months.

Persistence of fire retardants and their availability to the environment varies depending on fire retardant concentration and soil quality. Little and Caffee (2002) studied the toxicity to aquatic species and persistence of chemicals in fire retardants using different substrates in weathering studies. Toxicity was much lower on soils with high organic content. Conversely, soils with low organic matter or coarse, sandy soils showed significantly higher mortality to aquatic species. Other factors that come into play include soil moisture, temperature, and diurnal temperature changes, which affect microbial processes. Research conducted in Australia identified soil pH, organic matter content, and clay content as important factors affecting fate and persistence of the fertilizer (NRE 2000).

A test of fire retardant effects on prairie and mountain soils resulted in an increase in biomass, mostly grasses, during the first growing season (Larson and Newton 1996).

Indirect effects on vegetation include: increased biomass production, plant vigor, fertilizer burn, and shifts in species composition. The degree of the response depends on annual and seasonal changes to rainfall, temperature, and microbial activity.

Studies of the effect of fertilizers (nitrogen and phosphorus) on vegetation growth and plant community composition can help to explain how plants use the fertilizers in fire retardants. According to a study by Leishman and Thompson (2005), the invasion of exotic plants is more successful on low quality soils where nutrients, especially phosphorus, have been added.

In Australia, phosphorus fertilizer applied for 3 years on nutrient-poor sandy soils was retained in the ecosystem for at least 2 decades (Heddle and Specht 1975). The long-term study showed the heath vegetation changed towards an herbaceous sward in response to the phosphorus fertilizer 22 years after application.

Conversely, studies conducted in Australia demonstrated little change in vegetative growth response from one application of Phos-Chek (Bell 2003). These studies indicate a potential for increased vegetative growth is often a quick, short-term response to the application of the fertilizers. However, changes in vegetative community composition through the addition of nitrogen and phosphorus application resulted from repeated applications over many years, which is not typical of aerial fire retardant applications.

Alternative 1—No Action

Direct and Indirect Effects

In the absence of aerially applied fire retardants, the effect of fire on soils must be most prominently considered. Fires can result in the loss of nitrogen in a gaseous form (N_2). More nitrogen is lost during hot fires than cool fires. A flush of nitrogen availability occurs following a fire, because fire oxidizes organically-bound nitrogen to the nitrate form, which is available to plants and also susceptible to leaching. Nitrogen availability decreases to pre-fire levels after a few years (Certini 2005). Fires also convert the organic pool of soil phosphorus to orthophosphate, which is readily available to plants (DeBano et al. 1998). Soil erosion and nutrient leaching into streams and waterways is a common post-fire response (Neary et al. 2005). The fire size and soil burn severity would determine how many acres are affected.

Without the aerial application of fire retardant, any indirect effects from fire retardants on soil would be from ground-based applications, which would most likely occur on limited acreage. The effects of the ground-based applications on soil would most likely be masked by the chemical and physical effects associated with the wildfire.

Nationwide, the average annual initial attack success rate is 98 percent (Henderson and Lund 2011). Firefighting strategies improve with the aerial application of fire retardant because it helps slow the rate of spread. Without this tool, initial attack success rates may be reduced, and in some cases, fire size could increase, resulting in more acres burning at a high soil burn severity rating. If more acres burn, there could be additional costs in burned area emergency response (BAER) assessment and potential treatments to reduce the post-fire threat to life, property, and cultural and natural resources due to flooding, landslides, and loss of infrastructure. Without the use of aerially applied fire retardants, other firefighting strategies may be used in suitable locations, which could cause greater soil disturbance and erosion and reduce soil quality and productivity (Ingalsbee 2004, Backer et al. 2004).

Cumulative Effects

No cumulative effects on the soil physical, chemical, or biological properties would occur because no fire retardants would be applied.

Alternative 2—Proposed Action

Direct and Indirect Effects

Under this alternative, the acres affected by aerially applied fire retardant would be similar to the 10-year average and vary accordingly by ecoregions and Forest Service region. An estimated 2,358 to 4,715 acres annually (0.002 percent of the total Forest Service land base) may receive aerial fire retardant application. It is difficult to identify which soil types may be affected, but it is realistic to expect many soil types to potentially be treated. Some soil types are more susceptible to fire spread due to characteristics that contribute to drought (e.g., coarse texture) or because they are located in dry climates, while wet soils in cool climates are less likely to experience fire.

Effects on forest soils from fire retardant resemble a fertilizing response. For nutrient-poor soils (sandy, low organic matter content), the addition of nitrogen and phosphorus could improve soil productivity in the short term. For already productive soils (clay, high organic matter content), the additional nutrients could have an acidifying affect and reduce soil pH making some nutrients unavailable. An indirect effect of fire retardant application is an increase in vegetative growth and potential change in vegetative community structure and composition. Leaching of nitrogen into streams and waterways could occur in areas of coarse textured soils and for drops occurring within the waterway influence zone. The persistence of effects will depend on vegetation type and post-application weather patterns (Adams and Simmons 1999).

Cumulative Effects

The impacts on soil condition (physical, chemical and biological properties) resulting from the incremental impact of the action added to past, present, and reasonably foreseeable future actions are expected to be minor based on the following points:

- Aerial fire retardant application rates are based on fire behavior fuel models and fuel descriptions, and fire retardant is applied in front of an advancing fire. Fuel models are important to soils because they provide information on the amount and size class of live and dead vegetation available to intercept the fire retardant. When fire retardant is dropped on grass or brush, it has a greater live plant surface area to adhere to before coming in contact with the soil. For horizontally placed litter and slash, fire retardant movement to the soil is influenced by the depth and continuity of the material (Tome and Borrego 2002). Of the fire retardant applied aerially, only a small percentage reaches the soil surface.
- Fire retardant formulations will likely continue to be nitrogen- and phosphorus-based; therefore, similar effects are expected, although concentrations of salts may change.
- The area subject to aerial fire retardant application covers a very small proportion of land base nationally.

Alternative 3

Direct and Indirect Effects

Under this alternative, the acres affected by aerially applied fire retardant would be similar to the 10-year average and vary accordingly by ecoregions and Forest Service region. An estimated 2,358 to 4,715 acres annually (0.002 percent of the total Forest Service land base) may receive aerial fire retardant application. It is difficult to identify which soil types may be affected, but it is realistic to expect many soil types to potentially be treated. Some soil types are more susceptible to fire spread due to characteristics that contribute to drought (e.g., coarse texture) or because they are located in dry climates, while wet soils in cool climates are less likely to experience fire.

Effects on forest soils from fire retardant resemble a fertilizing response. For nutrient-poor soils (sandy, low organic matter content), the addition of nitrogen and phosphorus could improve soil productivity in the short term. For already productive soils (clay, high organic matter content), the additional nutrients could have an acidifying affect and reduce soil pH making some nutrients unavailable. An indirect effect of fire retardant application is an increase in vegetative growth and potential change in vegetative community structure and composition. Leaching of nitrogen into streams and waterways could occur in areas of coarse textured soils and for drops occurring within the waterway influence zone. The persistence of effects will depend on vegetation type and post-application weather patterns (Adams and Simmons 1999).

Cumulative Effects

The impacts on soil condition (physical, chemical and biological properties) resulting from the incremental impact of the action added to past, present, and reasonably foreseeable future actions are expected to be minor based on points presented under Alternative 2.

Summary of Effects

Table 4 'Summary of Effects on Soils' summarizes the direct effects of the no-action and action alternatives on soil resources.

Table 4 Summary of Effects on Soils

Effect	Indicator	Alt. 1 No Action	Alt. 2 Proposed Action	Alt. 3 Preferred Action
Fertilizing effects of retardants on soil productivity	Acres affected by retardant	None	Expect 2,358-4,715 acres annually or 0.002 percent of the total land base to be affected by retardant	Less than Alternative 2 due to more acres being included in avoidance mapping
Leaching or erosion of soil and nutrients into streams and water bodies	Number of retardant drops within 300-foot buffer	None	Remain at current levels due to allowable exceptions in fire retardant use	Lower than Alternative 2 due to fewer exceptions in fire retardant use

3.3 Hydrology

This section addresses the conditions of water resources and riparian areas within National Forest System (NFS) lands and the effects of using aerial fire retardant on these areas by alternative.

Elk find a safety zone in the East Fork, Bitterroot River, Montana
Photo by John McColgan, August 2000.

3.3.1 Regulatory Framework

This section discusses direction for protection of water resources according to the Federal Water Pollution Control Act of 1948, expanded and reorganized in 1972 (Federal Water Pollution Control Amendments of 1972) and commonly known as the Clean Water Act (CWA). Major amendments occurred in 1977 and 1987. The objective of the CWA is to restore and maintain the chemical, physical and biological integrity of the Nation's waters. CWA Section 303(d) directed the States to list water quality-limited waterways (303(d) listed streams) and develop total daily maximum loads (TDML) to control the non-point source pollutant causing loss of beneficial uses.

The Safe Drinking Water Act (SDWA) was established to protect the quality of drinking water in the U.S. This law focuses on all waters actually or potentially designed for drinking use, whether from above ground or underground sources. The 1996 SDWA amendments require the identification and management of source water protection areas for public water systems.

The Forest Service has a determination from the Environmental Protection Agency (EPA) that a National Pollutant Discharge Elimination System (NPDES) permit is not necessary for aerial delivery of fire retardant. Forest Service direction (see Appendix R) created a 300-foot buffer zone on either side of any surface water for fire retardant application as our strategy to protect waterways is to avoid them. Pilots operating in compliance with these guidelines would not be discharging fire retardant into waters of the U.S. Therefore, an NPDES permit would not be required (EPA letter from Susan Bromm, project record).

The objectives of the National Forest Management Act (1976) ensure that forest planning and management activities provide for the conservation and sustained yield of soil and water resources.

Forest Service Manual 2500-2503 policy requires that all management activities minimize short-term impacts on the soil and water resources and maintain or enhance long-term productivity, water quantity, and water quality.

2000 Guidelines requires a 300-foot buffer for streams and other waterways with the use of aerially applied long-term fire retardant.

3.3.2 Affected Environment

The affected environment is limited to national forests and grasslands—approximately 193 million acres—and adjacent lands downstream. While most long-term fire retardant nationwide is used in the Western United States, all Forest Service regions except Region 10 (Alaska) have used aerially applied fire retardant in the past 11 years. Puerto Rico is part of Region 8 and has not used fire retardant in the past 11 years (Appendix P).

Surface Water

There are approximately 277,006 miles of perennial streams and 640,843 miles of intermittent or ephemeral streams on NFS lands in Regions 1-9 (Table 5 'Miles of Stream and Acres Within 300 Feet of Streams, by Region.* Source: Forest Service GIS'). Because no aerially applied fire retardant was used from 2000 through 2010 in Alaska or Puerto Rico, they are not included in the tables below.

Table 5 Miles of Stream and Acres Within 300 Feet of Streams, by Region.* Source: Forest Service GIS

Forest Service Region	Perennial (miles)	Intermittent and ephemeral (miles)	Total miles of stream	Acres within 300 feet of any stream type
1	41,680	55,820	97,500	7,090,919
2	29,258	128,715	157,973	11,488,961
3	6,881	82,381	89,262	6,491,813
4	41,782	74,120	115,902	8,429,242
5	30,097	127,581	157,678	11,467,525
6	55,172	91,487	146,660	10,666,148
8	44,467	52,125	96,592	7,024,837
9	27,669	28,612	56,281	4,093,197
Totals	277,006	640,843	917,849	66,752,642

*Numbers may be high due to overlapping acres on stream buffers.

Surface water resources include rivers, streams, lakes, ponds, reservoirs, wetlands, and other water features identified in Table 6 'Acres of Lakes, Wetlands, Other Water Features and Acres within 300 foot buffer.* Source Forest Service GIS' There are 2,236,702 acres of reservoirs, ponds, and lakes. Most of the lakes, ponds, and wetlands are in Forest Service Regions 8 and 9. Region 3, in the Southwest, has the fewest lakes, wetlands, and other water features.

Table 6 Acres of Lakes, Wetlands, Other Water Features and Acres within 300 foot buffer.* Source Forest Service GIS

Region	Estuary	Ice Mass	Lake/Pond	Playa	Reservoir	Wetlands (Swamp, Marsh)	Total Acres	Acres within 300-foot buffer
1	0	6,949	210,724	4	62	33,495	251,233	616,398
2	0	12,292	114,855	461	2,546	27,274	157,428	765,023
3	0	0	49,907	550	1,404	6,838	58,698	257,483
4	0	4,824	174,423	1,624	3,435	34,615	218,922	693,646
5	0	6,381	220,617	2,876	303	17,267	247,444	545,126
6	133	48,618	171,876	49	82	44,119	264,877	633,446
8	0	0	408,947	3	823	592,967	1,002,739	2,087,621
9	0	0	873,242	15	3,461	533,012	1,409,729	2,894,462
Totals	133	79,065	2,224,590	5,584	12,114	1,289,585	3,611,072	8,493,203

*Numbers may be high due to overlapping acres on stream buffers.

Groundwater

Groundwater is found as unconfined shallow aquifers and as deeper aquifers with a confining layer above. Groundwater within shallow unconfined aquifers with unconsolidated sediments is more susceptible to contamination due to greater connection with surface water Groundwater resources under NFS lands have not been assessed at a national or regional scale (Sedell et al. 2000). However, it can be assumed that NFS lands act as recharge areas for aquifers, some used for drinking, watering livestock, or irrigation.

Municipal Watersheds and Source Water Protection Areas

A municipal supply watershed is one that serves a public water system as defined in Public Law 93-523 (Safe Drinking Water Act) or as defined in State safe drinking water regulations. The 1996 Safe Drinking Water Act amendments require the identification and management of source water protection areas for public water systems. States are required to develop source water assessments for public drinking water supplies including both surface and groundwater sources. These watersheds are usually in rural settings and do not involve industrial contaminant sources.

Overall, 18 percent of the nation's water supply comes from land managed by the Forest Service. In the Western United States, more than half the water originates on NFS land (Furniss et al. 2010, Brown et al. 2008). The water from forested land is generally of higher quality than water from urban or agricultural lands (Furniss et al. 2010, Dissmeyer 2000, Brown et al. 2008). An estimated 3,400 public drinking water systems are located in watersheds containing NFS lands (USDA Forest Service 2000, Brown et al. 2008). In addition to public water systems, private residences sometimes use springs and streams on or adjacent to NFS land for domestic water supplies.

Water Quality

Water quality standards are established to protect beneficial uses of a State's waters. Beneficial uses are assigned by each State for water quality. A general definition for water supplying beneficial uses is water that is drinkable, swimmable, and fishable.

Beneficial uses include:

- Domestic water supply;
- Fishing;
- Industrial water supply;
- Boating;
- Irrigation;
- Water contact recreation;
- Livestock watering; and
- Aesthetic quality.

Water Quality Impairment

The five primary causes of water quality impairment on NFS lands are, in descending order of importance: high temperatures, excessive sediment loads, habitat modification, excessive mercury content, and excessive metal loads (Carlson 2009, Kimbell and Brown 2009).

Streams on Forest Service-managed land tend to have good water quality compared to streams in agricultural areas or urban areas; nitrogen and phosphorus are not common pollutants of National Forest System land.

Streams draining agricultural lands in the United States average about nine times greater concentrations of nitrate and phosphate than streams draining forested areas (Binkley et al. 1999). The major contaminants in these areas are from livestock and fertilizers. The concentration of nitrate (N), which is particularly important for water quality, averages 0.23 mg (N)/L (the same as parts per million) for very large forested watersheds in the United States, compared with 3.2 mg (N)/L for streams in large agricultural watersheds (Omernik 1976).

Forest streams typically contain 8 to 12 mg/l of oxygen (Brown and Binkley 1994). High loading of organic matter and nutrients (such as nitrogen or phosphorus), combined with sediment and increased water temperature, can deplete dissolved oxygen particularly in small streams (Ringler and Hall 1975). Nitrogen and phosphorus are the primary causes of eutrophication and resulting algal blooms. Chronic symptoms of over enrichment include low dissolved oxygen, fish kills, cloudy murky water and depletion of desirable flora and fauna.

Nutrient concentrations in streams in agricultural areas are directly related to land use and associated fertilizer applications and human and animal wastes in upstream watersheds. Total nitrogen concentrations were higher in agricultural streams than in streams draining urban, mixed land use, or undeveloped areas, with a median concentration of about 4 mg/L—about six times greater than background concentrations (Dubrovsky 2010).

Total phosphorus concentrations were also highest in streams in agricultural and urban areas, with a median concentration of about 0.25 mg/L—about six times greater than background concentrations (Dubrovsky 2010).

Susceptibility of aquifers to contamination relates to geology, depth to groundwater, infiltration rates, and solubility of contaminants. The shallow unconfined aquifers are at greater risk from surface contamination due to rapid infiltration from the surface to the water table. Groundwater-residence times can range from days to tens of thousands of years or more.

A nationwide study by the U.S. Geological Service found that contaminants occur most frequently in shallow groundwater in agricultural and urban areas (Dubrovsky et al. 2010, Dubrovsky and Hamilton 2010). This study found that 7 percent of the private wells surveyed were contaminated with nitrogen; approximately 3 percent of public systems were contaminated. The lower levels for public systems were in part due to greater depths of wells, longer travel times, and locations with fewer nutrient sources (Dubrovsky et al. 2010, Dubrovsky and Hamilton 2010). Other nutrients in groundwater were not higher than background levels. Groundwater typically is not vulnerable to contamination by nutrients, such as phosphorus, that attach to soils (Dubrovsky et al. 2010).

Fire Retardant Drops Affecting Water

Forty-two drops of aerially applied fire retardant have occurred into water or the 300-foot buffer within the past 3 years (Table 7 'Intrusions Into Water or Buffers by Region.'). Of these, 32 were at least partially into water and 10 were within the 300-foot buffer required for waterways under the 2000 Guidelines but did not directly hit a stream or other waterway. The majority of the intrusions were accidental, and the five exceptions were all in Forest Service Region 5 (California). Regions 4, 5, and 6 have documented the majority of intrusions into water (see Table 7 'Intrusions Into Water or Buffers by Region.'). Using an 11-year average of 3,286 aerial drops of fire retardant per year, approximately 0.4 percent of the fire retardant drops affect water or the area within the 300-foot buffer.

Table 7 Intrusions Into Water or Buffers by Region.

Year	Region	Drops	Accidental	Exceptions	Water	Buffer only
2008	R4	3	3		3	
	R5	3	2	1	1	2
	R6	6	6		5	1
2008 Total		**12**	**11**	**1**	**9**	**3**
2009	R4	2	2		2	
	R5	5	3	2	4	1
	R6	4	4		3	1
2009 Total		**11**	**9**	**2**	**9**	**2**

Year	Region	Drops	Accidental	Exceptions	Water	Buffer only
2010	R3	2	2		2	
	R4	8	8		8	
	R5	5	3	2	2	3
	R6	4	4		2	2
2010 Total		**19**	**17**	**2**	**14**	**5**
Grand Total		**42**	**37**	**5**	**32**	**10**

Desired Condition

Surface water quality standards are established by States and Tribes and then approved by EPA under Section 303 of the CWA. This process ensures that all States meet at least minimal national water quality protection requirements, although States can choose to establish more stringent standards than required nationally but cannot go below national standards. Surface water quality standards include water quality criteria to protect designated beneficial uses of surface waters (e.g., aquatic life uses, drinking water irrigation, primary contact recreation, etc.). Specific criteria by pollutant (ammonia, total phosphorus, total nitrogen, chlorophyll a, and water clarity by ecoregion) are listed on the EPA website. Nitrogen and phosphorus levels in surface water quality standards are generally more stringent than those in the national primary drinking water regulations (NPDWRs or primary standards), although they vary from State to State.

EPA water quality recommendations for ammonia affecting freshwater organisms is dependent on pH, temperature and life-stage (USDI Environmental Protection Agency 2009). Currently, most States have only a narrative standard to control the amount of nitrogen and phosphorus allowed in surface waters (e.g., statements that prohibit "discharges that create conditions which produce undesirable aquatic life"). However, such narrative standards are often ambiguous regarding the concentration of nutrients allowed in surface waters, making it more difficult to implement or enforce a narrative standard. EPA has been encouraging States and Tribes to establish numeric surface water quality standards for nutrients (see http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/memo_nitrogen_framework.pdf—accessed 7/26/2011). Efforts are underway by EPA and the States to tighten allowable nutrient levels in surface waters (e.g., total nitrogen levels as low as 0.13 mg/L and total phosphorus levels as low as 0.006 mg/L) (personal communication between Carol Thornton, Forest Service hydrologist, and Potts 2001). These standards are more stringent than typical drinking water standards.

NPDWRs (Table 8 'National Primary Drinking Water Standards.') are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. Nitrate standards are set primarily for the protection of infants (USDI Environmental Protection Agency 2010).

Table 8 National Primary Drinking Water Standards.

Contaminant	MCLG1 (mg/L)[2]	MCL or TT1 (mg/L)[2]
Nitrate	10	10
Nitrite	1	1
Phosphorus	No national freshwater standard [1]	N/A

1. These standards are dependent on State regulations.

National secondary drinking water regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply with them. However, States may choose to adopt them as enforceable standards.

The presence of phosphorus in drinking water is not considered a human health hazard, and no Federal drinking water quality standards are established for phosphorus. Nevertheless, phosphorus can affect the water's color and odor and indicate the presence of other organic pollution. Furthermore, because phosphorus can accelerate the growth of algae and aquatic vegetation, it contributes to the eutrophication and associated deterioration of municipal water supplies (Dissmeyer 2000).

3.3.3 Environmental Consequences

Methodology

Environmental effects have been analyzed on a nationwide, broad scale. The analysis is based on a review of current literature for the effects of aerially applied fire retardants on water resources and the fire retardant risk assessments. Additional information on the Forest Service present use of aerially applied fire retardants was provided by the Forest Service Fire and Aviation program and Forest Service GIS specialists.

Incomplete and Unavailable Information

As aerial application of fire retardants occur when and where wildfires occur, the exact placement and number of drops depends on future fires and cannot be known ahead of time. Information on fires and fire retardant use was collected from 2000 through 2010 and used as baseline data for the existing condition. Information on intrusions into water was limited to 2008–2010 as more complete information was collected for these years than in previous years.

Spatial and Temporal Context for Effects Analysis

The potentially affected environment (and analysis area) for direct and indirect effects is limited to NFS lands, approximately 193 million acres, and the lands directly downstream. The area of greatest interest for direct and indirect effects occur where aerial use of fire retardant is applied to water or within the 300-foot avoidance buffer required for waterways under the 2000 guidance.

For this analysis, short-term effects are those that last for 1 to 5 years. Long-term effects are those that continue after this time period.

Impacts on the surrounding and downstream lands are also considered for cumulative effects, which can occur where fire retardant affects water over a large area in conjunction with other effects or where multiple intrusions into water occurs within the same area over several years' time.

General Effects of Aerially Applied Fire Retardant on Water Resources

A primary issue for this analysis is the potential for aerially applied fire retardant to enter streams and impact aquatic species and the water quality of domestic water sources. Surface water and groundwaters on and adjacent to NFS lands are susceptible to contamination from aerially applied fire retardant through direct application (either mishaps or by decision), spill, drift, leaching, and runoff (containing both eroded soil and water see the Routes for Fire Retardant to Impact Water section below for more details. The likelihood and significance of this contamination is influenced by wind, riparian vegetation, type of stream, pH of water soils, rainfall, fires in the area, and fire behavior.

Commonly used long-term fire retardants are mixtures of diammonium sulphate, diammonium phosphate, monoammonium phosphate, gum thickeners, an iron oxide coloring agent, and preservatives. Long-term fire retardants typically consist of fertilizer salts that are mixed with water to ensure uniform dispersion. Even after the water has evaporated, the retardant remains effective until removed by rain or erosion. The ammonium salts form a combustion barrier after the evaporation of the water carrier. Their effectiveness depends on the amount of retardant per unit surface area, the type of vegetation on which the retardant is applied, and fire behavior. The ammonium salts chemically combine with cellulose as the fuels are heated, effectively blocking access to the fuel (Hamilton et al. 1998). The active ingredients of the fire retardant break down into the nutrients phosphorus and nitrogen.

Routes for Fire Retardant to Impact Water

The routes for aerial fire retardant to get into water include: direct application (either by misapplication, spills during transport, or by decision), drift, runoff during storm events, and leaching through soils. Each of these methods is discussed below.

Direct Application

Fire retardant can directly enter water through aerial application into water from either misapplication or from the decision to apply to streams under an exception to guidance. Spills into water during transport can also occur. The effects of fire retardant on water quality depend on the size of the stream or waterway, the amount of fire retardant that directly enters the water and how quickly dilution of the fire retardant occurs. The aerial application of fire retardant perpendicular to and across a stream introduces less retardant into the stream than an application into the stream parallel to the stream channel.

Several characteristics of the application site determine the initial concentration of retardant in the stream. Narrow, deep streams exhibit a much lower initial concentration (therefore, a smaller mortality zone for aquatic species) than shallow, wide streams given equivalent flow properties (Norris and Webb 1989). Streams with dense overstory vegetation are less affected by retardant because the vegetation intercepts much of the retardant (Norris et al. 1978). Where less overstory vegetation exists, more retardant directly enters the water.

The chemical form of ammonia in water consists of two forms or species, the more abundant of which is the ammonium ion (NH_4^+) and the less abundant of which is NH_3(the more toxic form); the ratio of these species in a given aqueous solution depends on both pH and temperature. In this study, the principal chemical species in the stream during the first 24 hours after application were ammonia nitrogen as the gas NH_3 and the cation NH_4^+ and total phosphorus. Un-ionized ammonia (NH_3) is of primary importance because of its potential toxic effects on aquatic species. The amount of NH_3 relative to NH_4^+ is dependent primarily on pH of the water (Trussel 1972). As the pH increases, the proportion of ammonia nitrogen present as NH_3 increases and the toxicity to aquatic organisms increases.

A 1978 study by Norris et al. assessed the concentration of fire retardant and its byproducts following aerial application to streams as well as dilution and changes in concentration over time. Tests using 1,000 gallons of fire retardant applied across four streams occurred in Idaho, Oregon, and California. One result showed no immediate increase in NH_3 concentrations where retardant was applied parallel to the stream (Norris et al. 1978). Results for aerial application of fire retardant directly into water showed maximum concentrations of NH_3(un-ionized ammonia) ranging from 0.02 to 0.32 mg/L approximately 150 feet downstream from the application point at time intervals between 2 and 22 minutes after application (Norris et al. 1978). This concentration is under the 10 mg/L drinking water standard.

Time-to-dilution to 1 percent of maximum concentration at 150 feet downstream ranged from 10 minutes to almost 4 hours. Sampling over all the sites at various time intervals from 10 minutes to 4 hours after application showed a reduction in concentration from 4 to 29 percent at 650 feet downstream of the application points, and 1 to 3 percent at 2,600 feet downstream. The differences in concentrations were due to factors of velocity and mixing turbulence of the stream flows. Some retardant settled on the stream bottom and acted as a continuous source of nitrogen and phosphorus until the nutrients went into solution and were diluted and carried downstream.

The principal chemical compounds immediately after direct stream application were ammonium nitrogen and total phosphorus. However, in all cases, the principal remaining compounds after 24 hours were nitrate NO_3^-) and soluble nitrogen, both transformation products of ammonium polyphosphates and with very low toxicity (Norris et al. 1991). Soluble nitrogen and phosphorus are readily taken up by aquatic plants and are of primary interest for nutrient enrichment and possible eutrophication. Soluble nitrogen in stream water following severe wildfire events has been shown to be as high as 35 times that of comparable and adjacent unburned watersheds (Tiedemann et al. 1978), probably as a result of increased nitrification and reduced uptake from burned vegetation.

After 24 hours, nitrate (NO_3^-) and soluble organic nitrogen are the primary retardant components in the stream. These are transformation products of the diammonium phosphate in the retardant mixture (Norris and Webb 1989).

In the past 11 years, three spills (unrelated to aerial application during a fire) into water or riparian areas have been reported, one on NFS land. In 2002, on a fire in Oregon (but not on NFS land), four bags of retardant fell off a truck and one-and-a-half bags of concentrate mixed into the affected creek water before containment occurred. In 2005, a spill occurred during fire retardant mixing. In 2010, there was an accident on BLM-administered land where a plane experiencing mechanical problems jettisoned a full load (3,000 gallons) of fire retardant over a dry vernal pool.

Spills during transportation both on the ground and in aerial accidents have occurred in the past and will likely occur in the future. A transportation and handling plan is required for moving and using fire retardant. This plan addresses spill prevention and containment. Special precautions are promoted to contain potential spills during air tanker operations on the ground. Retardant loading pits must have containment and treatment systems to handle leaks, spills, and/or wash-down water used to wash aircraft that may contain metals from the aircraft, fuel hydraulic fluid, and oils National Wildfire Coordinating Group 2007). As of 2011, liquid bulk tankers are sealed to prevent leaks or spills (Transportation and Emergency Response Procedures, ICL Performance LP).

Drift

How much aerially applied fire retardant drifts from it's release path depends on the height of the drop, speed of the drop, flow rate, and wind direction and speed. Fire retardant formulations generally include a gum thickening agent to raise the viscosity to between 100 cps and 1800 cps to reduce drift (USDA Forest Service 2005). These products create larger and more cohesive droplets that are less apt to break into small particles that are more prone to drift. Fire retardant mixtures containing clay have particles in the range of 2–3 mm, whereas guar gum-thickened retardant solutions have particles that vary between approximately 3.5 mm and 5 mm depending on the type of gum in the mixture (Gimenez et al. 2004). This is a much larger droplet size when compared to micrometer-range droplets in aerially applied herbicides, and aerially applied fire retardant is, therefore, less susceptible to drift than aerially applied herbicides.

In drop tests for fire retardant with gum thickening agents, testing was conducted with crosswind speeds of 1 to 13 mph. Drops from elevations of approximately 100 to 300 feet resulted in the center of the retardant drop drifting from 0 to 70 feet (Thornton 2011). Generally, fire retardant is used at low wind speeds for more precise placement of the retardant and to ensure adequate coverage levels. However, aerial application is allowed in winds up to 30 mph (Fireline Handbook). With higher wind, there is more potential for drift of the fire retardant, which also lowers the efficiency of the drop. Pilots are instructed to make adjustments for conditions such as wind to avoid inadvertent application of fire retardant within any 300-foot buffer.

Flight condition guidelines:

Aerial supervision personnel must carefully evaluate flight hazards and conditions (visibility, wind, thunder cells, turbulence, and terrain) to ensure that operations can be conducted in a safe and effective manner. The following policies and guidelines are designed to do this:

a) *Visibility*—Regardless of time of day, when poor visibility precludes safe operations, flights will be suspended. It is recommended that incident aircraft fly with landing and strobe lights on at all times. It is required that lead planes fly with landing/impulse and strobe lights on at all times. Regular position reporting is critical in marginal visibility conditions.

b) *Wind Conditions*—Moderate to high winds and turbulent conditions affect flight safety and water/fire retardant drop effectiveness. The following guidelines should be considered in making the decision to continue or suspend operations. A number of factors—including terrain, fuel type, target location, resources at risk, and cross-winds—must be considered.

i) *Heavy airtanker drops* –Generally ineffective in winds over 20–25 kts.

ii) *SEAT operations* –Generally ineffective in wind over 15–20 kts. Operations shall be suspended when sustained winds are 30 kts or the gust spread is 15 kts.

iii) *Helitanker drops* – Generally ineffective in winds over 25–30 kts.

iv) *Helicopter operations* – Capability to fly in excessive wind conditions varies considerably with weight class (type) of the helicopter and degree of turbulence. If the helicopter flight manual or the helicopter operator's policy does not set limits, the following shall be used, but may be further restricted at the pilot's or air operations personnel's discretion. Limits are as follows:

(1) Above 500 ft AGL: All helicopter types: constant winds up to 50 kts.

(2) Below 500 ft AGL:

(a) *Type 3 helicopters* –Steady winds shall not exceed 30 kts or a maximum gust spread of 15 knots.

(b) *Type 2 and 1 helicopters* –Steady winds shall not exceed 40 kts or a maximum gust spread of 15 kts.

c) *Thunderstorm* –Evaluate "thunderstorm activity" and flight safety. Consider delaying operations or reassigning resources to safe operation areas. Suspend flight operations when lightning is present.

Runoff and Leaching

Runoff and leaching both result from precipitation events after aerial application. *Run-off* occurs when overland flow carries water and soil directly to waterways. *Leaching* occurs when water moves through soil dissolving and removing minerals. The effects of run-off and leaching on nitrogen and phosphorus levels in nearby waterways was tested in the Norris et al. (1978) study. After 1,000 gallons of mixed fire retardant were applied parallel to and within 3 meters of a stream in Oregon, there was no immediate measured increase in NH_3 concentrations where retardant was applied parallel to the stream (Norris et al. 1978). During a year-long monitoring after application of the fire retardant to ground near the stream, measured soluble nitrogen forms and phosphorus levels in stream water were similar to the untreated, control watersheds (Norris et al. 1978, 1991).

Post-fire water quality monitoring for streams near four wildfires showed that aerial application of fire retardant near streams but not into the stream had minimal effects on surface water quality (Crouch et al. 2006). Ammonia and phosphorus were found in streams in burned areas where fire retardant was not used from the burning of wood and other organics due to direct effects from the fire at concentrations similar to those found in areas where fire retardant was aerially applied.

The potential for nitrogen leaching is higher in coarse-textured soils with less clay and organic matter to bind the fertilizer (Napper 2011). These soils are also more prone to erosion. In more fine-textured soils, clays and organic matter tend to bind the fertilizer. Leaching of phosphorus from areas without vegetation is higher than where vegetation is available to uptake the nutrient (Pappa et al. 2006).

In soil nitrogen is converted by microbial processes to forms used by plants (Norris et al. 1978). Some of the nitrogen stays in a form that is typically volatilized and lost to the atmosphere.

Phosphorus is tightly bound to soil particles and is unlikely to accumulate in waterways in significant amounts unless there is a rapid rate of soil erosion (Norris et al. 1978). Soils with high clay content strongly attract phosphorus. Erosion of soils (particularly fine soils) could carry phosphorus to water on soil particles. Once it reaches water phosphorus is quickly taken up by aquatic organisms, especially algae (Neary et al. 2005). Polyphosphates are readily soluble in soil water and sequester minerals. In soils, polyphosphates promote vegetative growth by steady hydrolysis—conversion to and spread as orthophosphates—which are taken up by plants.

Runoff of phosphorus from areas applied with retardant is usually in very low concentrations (Labat-Anderson, Inc. 1996): so low, in fact, that, if the limiting nutrient in a waterway is phosphorus (which is typical in the Western United States), the risk for eutrophication of streams in these areas is very small. In the less-likely event that nitrogen is the limiting factor, then an accidental drop or run-off from treated ground may cause an increase in aquatic plant biomass.

Dilution by flow or tributary inflow is generally less prominent in lakes than in streams. Dilution is partially a function of lake size, but dilution could be rapid in small lakes with large water-inflow areas. Decreases in nutrient concentration in lakes, ponds, and other lentic (still) water bodies are a function of chemical and biological degradation processes. The primary pathways fire retardant to enter lakes and other water bodies would be from direct application, drift, or runoff.

Where fire retardant was applied at different rates to constructed seasonal wetlands during the dry season, water quality was degraded for at least 2 years afterward (Angeler and Moreno 2006). The changes in water quality included higher nutrient content, higher electroconductivity, higher turbidity, lower oxygen, and changes to the pH (Angeler and Moreno 2006). The nutrient surplus increased phytoplankton growth, causing lower oxygen levels and higher turbidity found with eutrophication. This environment was similar to the Mediterranean environment of southern California. Changes to water quality were greatest with the highest contamination rates.

While contamination of groundwater by fertilizers is well-studied, effects of fire retardant on groundwater have not been studied because of the comparatively small amount of aerially applied fire retardant used per year and scattered nature of application. From fertilizer studies, it is known that shallow groundwater with coarse overlying sediments and low amounts of vegetative matter is most likely to become contaminated. Much of the shallow groundwater would be associated with riparian areas along streams and would be within the 300-foot buffer. Losing reaches of streams act as recharge areas for shallow groundwater. There is potential for some contamination of groundwater from these areas where intrusions occurred.

Alternative 1—No Action

Direct and Indirect Effects

Because there would be no aerial use of fire retardant, there would be no pathways for aerial fire retardant to impact water quality.

Presently, 98 percent of fires are kept under 300 acres and 98 percent of retardant used is in initial attack situations on these smaller fires. Without aerially applied fire retardant to slow the growth of more isolated fires, potential exists for some of these fires to grow larger before firefighters can safely fight the fires (Henderson and Lund 2011). With more large fires, there is more potential for impacts on water quality from fires. The most adverse effects of fires on water quality include increased suspended sediment and turbidity, increased water temperature, and increased nutrients (Landsberg and Tiedemann 2000). These water quality impacts could negatively affect the functioning of water supply systems if they occurred within municipal watersheds and source water protection areas.

Alternative 2—Proposed Action

Direct and Indirect Effects

The effect from aerial use of fire retardant on water resources would be similar to that discussed under the section General Effects of Fire Retardant on Water Resources above. The potential for measurable effects from leaching of fire retardant from outside the 300-foot buffer on surface water is low, as discussed.

Intrusions (either misapplication or by decision) of aerial fire retardant into water are the most likely cause of detrimental effects.

Approximately 30 percent of the land base in the NFS lies within the 300-foot protective buffer for water and would therefore be mapped as avoidance areas. In the past 3 years, 42 reported intrusions of fire retardant into water or the buffer on NFS lands have occurred. Using an 11-year average of 3,286 drops per year, approximately 0.4 percent of aerially applied fire retardant drops affect water or the area within the 300-foot buffer. It is expected that, under this alternative, a similar number of accidents would occur. All listed exceptions to the 2000 guidelines could still occur under this alternative. In the past 3 years, there have been five exceptions that affected water or the area within the 300-foot buffer. Therefore, about 12 percent of the intrusions that affected water were made under exceptions to the 2000 guidelines, versus the 88% that are misapplications. Under this alternative, a similar number of exceptions would be expected to occur, primarily in Forest Service Region 5.

Many site-specific factors may influence the seriousness of an accidental or intentional fire retardant application within the buffer. If an accident should occur in which aerially applied fire retardant contaminates a smaller stream, there is a high likelihood of the accident negatively affecting water quality in the short-term. The distance downstream affected depends on the size of the stream as well as the amount of fire retardant contacting water (discussed in more detail under the section General Effects of Fire Retardant on Water Resources above). Effects on streams are short-term because dilution occurs as the retardant moves downstream. Contamination of larger streams would be diluted more quickly because of the larger flow.

Application outside the buffer is unlikely to have a measurable impact on stream water quality (Crouch et al. 2006). Intrusions into the buffer but at least 3 m from water are unlikely to have a high impact on water because of uptake by vegetation and adherence of phosphorus to soils (Norris et al. 1978). Areas with steep slopes, coarse-textured soils, and little vegetation cover will have greater potential for movement of fire retardant to water and associated negative impacts (Napper 2011).

Where retardant is dropped on vernal pools or other small water bodies, there is likely to be negative effects on water quality for at least 2 years because of the lack of flow to dilute the retardant, as occurs in streams (Angeler and Moreno 2006); eutrophication would likely occur. Larger lakes are less likely to experience negative effects because dilutions of the fire retardant would occur more quickly owing to the larger volume of water Soils that are poorly drained and have high organic carbon content tend to favor denitrification of nitrate to nitrogen gases, so less nitrogen is available to move into water (Dubrovsky 2010). Wetland soils have these characteristics, as do many of the soils in the southern United States.

All waterways are mapped as avoidance areas. Public water supplies protected by source water protection areas tend to be on larger streams and waterways. These are easier for pilots to see and avoid than the small streams that are more frequently documented in intrusion reports. If an intrusion should occur, it is likely that dilution would quickly bring water quality back to EPA drinking water standards. As surface water standards (State standards) can be stricter than drinking water standards, there is higher potential that misapplication into water may cause local exceedences of water quality standards.

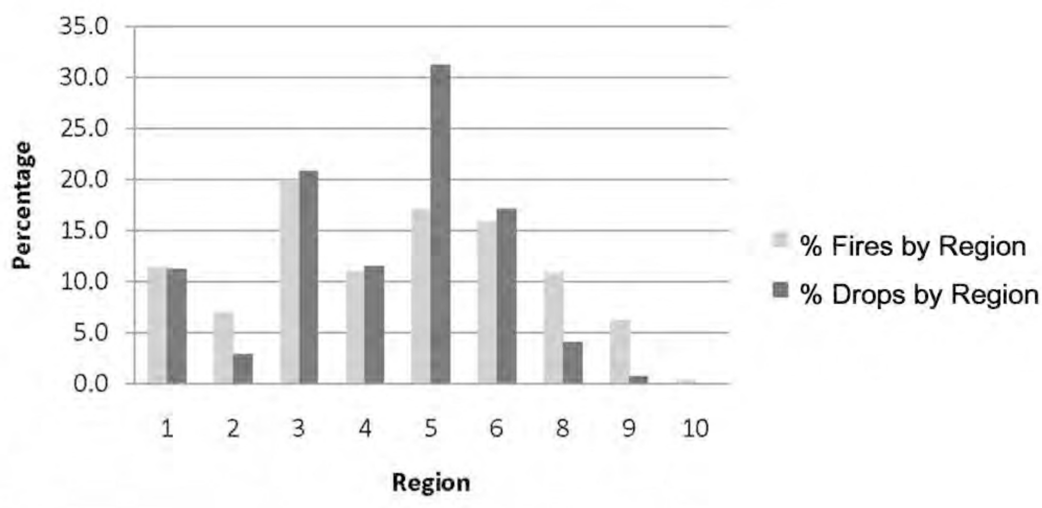
Much of the shallow groundwater recharge areas would be protected by the 300-foot buffer on surface water The groundwater that has been contaminated with agricultural fertilizers is in areas that have repeated fire retardant treatments of large areas of land (millions of acres). In contrast, the Forest Service uses aerially applied fire retardant on an average of between 2,000 and 5,000 acres a year, scattered throughout the country. Given that the amounts of nitrogen and phosphorus used in fire retardant are very small compared to agricultural use, are scattered throughout the landscape and that spatial application changes year to year, the likelihood of any aquifer being contaminated is low.

Risk by Region

Figure 5 'Comparison of percentage of fires versus percentage retardant drops by region' compares the percentage of fires that occur in each region (out of all fires on NFS lands) to the percentage of fire retardant used by each region (on all NFS lands) for the years 2000-2010. For example, 17 percent of the fires on all NFS lands occur in Region 5; however, Region 5 uses 30 percent of the total fire retardant used on all NFS lands.

Forest Service Regions 3, 4, 5, and 6 all have more than 10 percent of the fires occurring on NFS land and use at least 10 percent of the fire retardant (Table 9 'Fires and Retardant Use by Forest Service Region, 2000–2010', Figure 5 'Comparison of percentage of fires versus percentage retardant drops by region').

Figure 5 Comparison of percentage of fires versus percentage retardant drops by region



These regions would all be considered higher risk for intrusions due to the number of fires and the amount of fire retardant used in the past 11 years. All except Region 1 have had documented intrusions within the past 3 years. Regions 2 and 8 would be considered lower risk as they have 7–11 percent of the fires but only use 3-4 percent of the fire retardant. Region 9 has approximately 6 percent of the fires but uses less than 1 percent of the fire retardant and would also be considered at low risk.

Region 10 consists of two national forests—the Chugach and Tongass—that are considered coastal rain forests. While precipitation is expected to decrease in the southwestern United States, it is expected to increase over the rest of the United States and Canada (Field et al. 2007). In Alaska, some forested areas have seen a combination of warmer temperatures and increased insect infestations (Field et al. 2007), and this trend will likely continue. While the warming trend will likely continue, no large changes would be expected from what is presently occurring over the next 10 to 15 years. NFS land in Alaska would still be low risk for misapplications for the next 10 to 15 years as there is no history of fire retardant use on NFS lands in the last 10 years, even with the warming trend that is presently occurring. Lightning is an uncommon occurrence in these forests, and when it does occur, it is usually accompanied by rain. This, combined with the fact that Region 10 has not used fire retardant on NFS land in the past 11 years, makes the region at extremely low risk for an intrusion of fire retardant into water from national forest use of fire retardant in this region.

Table 9 Fires and Retardant Use by Forest Service Region, 2000–2010

Forest Service Region	Number of Fires 2000-2010	# Retardant Drops 2000-2010 (11yrs)	Total Gallons 2000-2010 (11yrs)	Average # Retardant Drops per year	Average gallons/yr	% of Total Fires	% Retardant used by each region
01	10,703	4,082	10,203,789	371	927,617	11	11.3
02	6,591	1,101	2,753,524	100	250,320	7.1	3.0
03	18,597	7,550	18,875,476	686	1,715,952	20.0	20.9

Forest Service Region	Number of Fires 2000-2010	# Retardant Drops 2000-2010 (11yrs)	Total Gallons 2000-2010 (11yrs)	Average # Retardant Drops per year	Average gallons/yr	% of Total Fires	% Retardant used by each region
04	10,234	4,197	10,493,664	382	953,969	11.0	11.6
05	15,884	11,266	28,165,743	1,024	2,560,522	17.0	31.2
06	14,834	6,165	15,411,352	560	1,401,032	15.9	17.1
08	10,165	1,487	3,716,469	135	337,861	10.9	4.1
09	5,835	300	749,790	27	68,163	6.3	0.8
10	359	0	0	0	-	0.4	0.0
Totals	93,202	36,148	90,369,807	3,286	8,215,437	100.0	100.0

Alternative 3

Direct and Indirect Effects

The impacts of this alternative are similar to Alternative 2, but the likelihood of accidental contact of the aerially applied fire retardant to water would be somewhat lower due to the standardized mapping of water resources, in which water resources are identified to fire personnel before the need for use of fire retardant occurs. The exception for protection of property would not be used under this alternative, and the decision to anchor fireline to a waterway would not occur except when human life was threatened. There have been five exceptions that affected water in the past 3 years, all in Region 5, out of a total of 13 intrusions in this region; therefore, approximately 38 percent of the intrusions in Region 5 were exceptions. This number would likely be smaller under this alternative as there are fewer exceptions allowed under this alternative. Overall, 12 percent of the intrusions into water or the 300-foot buffers were exceptions. Because of the changes in exceptions, it is likely that there would be fewer intrusions under this alternative, particularly in Region 5.

Risk by Region

Risk by region would be the same as discussed under Alternative 2 above.

Cumulative Effects

The effects of fire management activities on water resources can be cumulative. A cumulative impact results from the incremental effect of an action when combined with other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

All actions on land outside of land managed by the Forest Service are the same under all alternatives.

Past and present actions on all management areas, private or Government, still affect water resources. Actions include those from agriculture, past and present livestock grazing, logging, mining, roads, buildings, subsequent fires, firefighting, and invasive plants and treatment of these plants. These actions can increase sediment input to streams, raise water temperatures where shading is reduced, and add nutrients or pollutants to waterways. Waste-water treatment plants can add high amounts of nutrients to streams in urban areas. As populations increase, it would be expected that impacts from urbanization would increase. Overall, nutrient content on Forest Service land (which are usually at comparatively high elevations in the watershed) is low when compared to large agriculture and urban areas. As the impact from use of fire retardant to water from the effects of the nutrients (nitrogen and phosphorus) has been discussed above, cumulative effects involving the contribution of other activities that add nutrients to water in the rural watersheds where Forest Service lands occur are the focus of this discussion.

The following activities may contribute to cumulative effects of nutrients on water quality:

- Livestock grazing;
- Use of fertilizers on private timberland and agricultural lands;
- Other State and Federal agencies applying aerial fire retardant; and
- Effects of fire on nutrient availability to streams and waterways.

Other fire suppression tools will continue to be used. Although other fire suppression activities, such as fireline construction, are associated with fires and fire suppression, the relevant contribution to cumulative effects addressed here focus on aerially applied retardant only. These include the area and quantities of retardant use.

Alternative 1—No Action

As there are no direct or indirect effects from aerial application of fire retardant, there are no cumulative effects Without the use of aerially applied fire retardant, there may be increased potential for some fires to be more intense or to become larger, resulting in greater potential for severe environmental impacts, including increased nutrients in streams where larger fires occur. There is no data to quantify this impact at this time.

Alternative 2—Proposed Action

Cumulative effects are unlikely for Alternative 2 because: 1) mapped avoidance areas protect waterways from direct and indirect effects, and 2) the small amount of area affected by fire retardant use during each year, spread widely as it is across the United States.

However, cumulative effects could occur (though are unlikely) under certain scenarios. Fire can add to local nutrient levels, and these nutrients can affect streams or lakes. Where fire retardant has affected a stream and fire has added available nitrogen and phosphorus by burning vegetation, there is potential for cumulative effects from nutrients to streams from both pathways. For streams, this effect is likely to be short-term because of the movement of the nutrients downstream and the dilution occurring along the way. For an area with small ponds and lakes without large inflows, eutrophication could occur. The combined effects of fire and retardant could cause eutrophication lasting several years.

Fertilization efforts are uncommon on NFS land and unlikely to add to nutrients in areas where fire retardant has been used. However, the private forest industry can and often does use fertilizers within the same watersheds. In addition, fire and fire retardant can be used on other ownerships in the same watershed and at the same time as retardant is used on NFS land. Cumulative effects are unlikely but theoretically possible where accidental intrusions into water occur under these scenarios. As discussed earlier, water quality analysis on a national scale has shown that forested areas tend to have lower nutrient levels and better water quality than other lands (Dubrovsky and Hamilton 2010, Dubrovsky et al. 2010). As fire retardant use would likely continue to occur at the present levels, this scenario is likely to continue.

Alternative 3

While direct and indirect effects under Alternative 3 may be slightly lower than under Alternative 2 due to consistent mapping of buffers and fewer use exceptions, these changes would be minor when looked at cumulatively. Therefore, cumulative impacts are similar to those discussed under Alternative 2 above.

Summary of Effects

Impacts by alternative are shown in Table 10 'Comparison of Potential Impacts by Alternative':

Table 10 Comparison of Potential Impacts by Alternative

Effect	Indicator	Alternative 1	Alternative 2	Alternative 3
Contamination of water with fire retardant from accidental drop	Potential for accidental application of fire retardant into water	None	Low due to avoidance mapping of all waterways	Low due to avoidance mapping of all waterways
Exceptions contaminating water	Potential for exceptions	None	Slightly higher than Alternative 3 due to more exceptions (3)	Lower due to fewer exceptions (1)
Contamination of drinking water from fire retardant	Potential for drinking water contamination from fire retardant	None	Low due to avoidance mapping of all waterways but higher than Alternative 3 due to more exceptions (3)	Slightly lower than Alternative 2 due to fewer exceptions (1)

3.4 Aquatic Vertebrates and Invertebrates

3.4.1 Affected Environment

The potentially affected environment (and analysis area) is limited to National Forest System land, approximately 193 million acres, and will extend beyond National Forest System land to areas downstream. While most long-term fire retardant is used in the Western United States, all Forest Service regions except Region 10 (Alaska) have used fire retardant in the past 11 years.

This analysis covers aquatic organisms, including vertebrates and invertebrates. There are 86 threatened endangered and proposed fish species and 67 threatened endangered and proposed crustaceans and mollusks. At the Forest Service sensitive species level, there are 166 sensitive fish species, 90 sensitive crustaceans and mollusks. Regions 3, 5, and 8 have the highest number of threatened endangered and sensitive species nationally. Macroinvertebrates are a key food source for fish, mollusk and crustacean species and the loss of numbers and populations will affect the viability of the food web and are discussed in general effects

Studies show that fire retardant is toxic to aquatic invertebrates and vertebrates and will result in direct and indirect effects to populations and habitat.

Of primary importance for aquatic species is the approximately 30 percent of the Forest Service regions that are within 300 feet of a stream. Regions 1-9 have used fire retardant within the past 11 years. Region 10 is not included in this analysis because they have not used aerial fire retardant application in the past 10 years and are not expected to use it in the foreseeable future.

3.4.2 Environmental Consequences

General Effects on Aquatic Vertebrates and Invertebrates, Including Habitats

The following is a discussion of the general effects with supporting studies of fire retardant and toxicity to aquatic vertebrates and invertebrates. See the hydrology section of Chapter 3 for a discussion of chemical responses of fire retardant in water

This section discusses the impacts on fish and aquatic invertebrates mortality from the five chemical formulations of retardant currently in use. Two of the retardant formulations are being phased out. Fish mortality depends on species, life stage and other environmental factors and on the specific retardant product. Table 1 lists the retardants discussed in this report. Toxicity is measured as the LC50. This is the concentration of product in water that results in the death of 50 percent of the aquatic test specimens within a specified time frame, 96 hours in this case. *It is important to remember when comparing values, that the lower the LC50 value, the greater the toxicity.*

Fish Response to Retardant Toxicity

Toxicity studies are not available for all aquatic species analyzed, this section summarizes the available information, mostly on salmonid fish species (Table 11 'Summary of Toxicity Studies Conducted on Fish'). The magnitude of mortality and the distance over which it occurs will vary with characteristics of the application, the site, and quantity of streamflow. Other factors, such as water chemistry and sunlight, can also affect toxicity of some of the retardants.

Table 11 Summary of Toxicity Studies Conducted on Fish

Species	Retardant	96 hour LC50 (mg/L)
Rainbow Trout	Phos Chek 259	94-250
Rainbow Trout	Phos Chek 259-F	168
Rainbow Trout	Phos Chek D75R**	142-194
Rainbow Trout	Phos Chek D75-F**	184-271
Rainbow Trout	Phos Chek D75-F**	170-280
Chinook Salmon	Phos Chek D75-F**	170-280
Coho Salmon	Phos Chek 259	94-250
Shortnose Sturgeon	Un-Ionized ammonia*	.37-.58
Rainbow Trout	Un-Ionized ammonia*	.20

*Un-ionized ammonia is one of the major ingredients of all fire retardants and the most toxic form to fish (Fontenot et al. 1998).

**These fire retardants are being phased out and are no longer being manufactured; current stocks will be applied during fire season 2011, and no application of these product is expected in the future, starting with fire season 2012 (Henderson and Lund 2011).

Backer et al. (2004) found the response of fish to fire retardants could be more significant than their response to fire. Fish response does not only depend on the amount of retardant to hit the water and variables within the stream, but also on interactive effects among the various ingredients in the retardant or on the interaction of retardant effects coupled with the effects of the nearby fire to the stream. Johnson and Sanders (1977) found that most mortality of rainbow trout individuals occurs in the first 24 hours of exposure to retardant.

The most toxic portion of the long-term retardants is ammonia (McDonald et al. 1995). Un-ionized ammonia is more toxic to aquatic organisms than total ammonia (MacDonald et al. 1995, Poulton et al. 1997). Rainbow trout are twice as sensitive to un-ionized ammonia as shortnose sturgeon. Nitrates and nitrites could also contribute to the toxicity of retardants. Norris et al. (1983) stated that the some of the factors fish mortality from fire retardant include free ammonia, in certain instances un-ionized ammonia.

Water hardness (the levels of calcium carbonate, CaCO3) influences toxicity of retardants for some species of fish and not others. The toxicity of Phos Chek D75-F was increased in soft water (twice as toxic) compared to hard water for juvenile rainbow trout and is shown in Table 12 'Toxicity Levels of Long-Term Retardant Concentrates to Rainbow Trout' (McDonald et al. 1995, Poulton et al. 1997). Gaikowski et al. (1996) tested various early life stages of fish and found that in hard water, all early stages were affected the same, and in soft water, there were only minor differences in tolerance. In studies by Buhl and Hamilton (1998), there was no difference in the responses of chinook salmon to Phos Chek D75-F in hard or soft water. Poulton et al. (1993) likewise found no significant difference in the response of coho salmon to Phos Chek D75-F in hard and soft water.

Water hardness varies throughout the country and would affect the toxicity of the fire retardant to fish species dependent on the location. For example: water hardness on National Forest System lands in Arizona range from 96–150 mg/L near the Coronado National Forest to 580–1,200 mg/L near the Kaibab National Forest (USDI Geological Survey 2008).

The Forest Service has worked with the U.S. Geological Service (USGS) to develop a fish toxicity test for all retardants currently in use and is summarized in Table 4. This work focused on determining the relative sensitivity of fish species and life stages of fish to wildland fire chemicals. Juvenile rainbow trout were found to be among the most sensitive of this group of aquatic species and as sensitive as the threatened or endangered species that had been studied. The reported values are for the product concentrates. Mix ratios (the content and formulations of the retardant) must be considered in addition to the LC50 when estimating toxicity in the field. It is assumed that Phos Chek 259, studied by Johnson and Sanders (1977), is comparable to the Phos Chek brands 259-F and 259-R, as seems to be indicated by Buhl and Hamilton's (2000) research.

Table 12 Toxicity Levels of Long-Term Retardant Concentrates to Rainbow Trout

Product	96h LC50	
	Soft Water	Hard Water
Phos Chek G75 F,D75-R*	1,775 mg/L	472 mg/L
Phos Chek G 75 W,D75-F*	1,558 mg/L	467 mg/L
Phos Chek 259-F	148 mg/L	168 mg/L
Phos Chek LC-95A-R,W,AF	435 mg/L	960 mg/L
Phos Chek P100-F	1494 mg/L	1932 mg/L

*These retardants are being phased out and are no longer being manufactured; current stocks will be applied during fire season 2011, and no application of these product is expected in the future, starting with fire season 2012 (Henderson and Lund 2011).

Macroinvertebrates and Crustaceans Response to Retardant Toxicity

Macroinvertebrates are a key food source for fish, mollusk, and crustacean species and the loss of numbers and population will affect the viability of the food web. As long as there is depressed individual and species abundance, fish that depend on those macroinvertebrates as a food source will not recolonize. When fire retardant enters the water and ammonia concentrations increase quickly, macroinvertebrates exhibit highly variable responses.

The EPA (USDI Environmental Protection Agency1986) reported that macroinvertebrates are more tolerant to ammonia (the primary component of retardants) than fish. Adams and Simmons (1999) reported that mayflies and stoneflies in Australia were not affected by Phos Chek D75-F. McDonald et al. (1997) reported that D75-F 96-hr LC50 for *Hyalella azteca (an* amphipod crustacean) was 53 mg/L in soft water and 394 mg/L in hard water.

In a study in Arizona, mayflies (*Epeorus* (Iron) *albertae*) were consistently more sensitive to Phos-Chek D75-F than stoneflies (*Hesperoperla pacifica*) (Poulton et al. 1997). The LC50 for mayflies exposed to Phos-Chek D75-F for 3 hours was 1,033 mg/L (Poulton et al. 1997). This concentration is similar to the field concentration that would result from drift or run-off but is almost 10 times lower than the concentration expected if an accidental drop occurred. Mayflies were less sensitive to Phos-Chek D75-F when compared to trout or fathead minnows (Poulton et al. 1997).

Phos-Chek D75-F exposures to mayflies, stoneflies, trout, *Daphnia*, and fathead minnows indicated that mayflies and stoneflies were much less sensitive to Phos-Chek when compared to the trout (Poulton et al. 1997).

Most toxicity studies for macroinvertebrates have been conducted with Phos-chek D75-F. This formulation is only one of the five formulations being used by the Forest Service and will be phased out over the next two years. There is a need for further studies of the effects to macroinvertebrates from all fire retardant formulations. Nitrates and nitrites could contribute to the toxicity of retardants but did not appear to influence the toxicity of Phos-Chek D75-F to daphnids. McDonald et al. (1996, 1997) found that nitrate-nitrogen concentrations in the Phos-Chek toxicity tests were 75-160 times less than those reported to be toxic to freshwater invertebrates. Nitrite-nitrogen concentrations in a Phos-Chek D75-F toxicity study on crayfish were also 30 times less than the crayfish 96-hour LC50 (Gutzmer and Tomasso 1985).

Macroinvertebrate species may respond to disturbance (retardant concentrations) by allowing themselves to enter the water column and “drifting” away from the disturbance. Drift of Ephemeroptera, Plecoptera, and Trichoptera during the first Phos-Chek D75-F exposure period returned to zero at the lower dose but did not return to zero in the second exposure at the higher dose (Poulton et al. 1997). The rate of Phos-Chek degradation in-stream was accelerated in areas with elevated organic matter (Poulton et al. 1997). Half-life for long-term fire retardants in-stream was 14 to 22 days. Overall, Poulton et al. (1997) determined that Phos-Chek D75-F is not highly mobile. These timeframes affect the ability of the macroinvertebrates ability to recolonize an waterbody where retardant has been applied.

Given these results and the unknown toxicity of the other Phos-Chek formulations, adverse effects are likely to result from 660 mg/L Phos-Chek D75-F in stream systems (Poulton et al. 1997). This dose was comparable to the concentration expected from a surface run-off event.

Mollusks Response to Retardant Toxicity

Although there are no data to quantify the toxic effects of fire retardant chemicals on freshwater mussels, there are data on the toxicity of ammonia, which is the likely toxic component of Phos Chek retardants. Augspurger et al. (2003) developed protective water quality ammonia limits for freshwater mussels, ranging from 0.3 to1.0 mg/L total ammonia at pH 8 at 25C. Toxicity would result from increased un-ionized and total ammonia levels and would depend on the organic level of the soil the proximity of the application, the amount that enters the water column, the concentration of the fire retardant, and the volume and velocity of the stream.

Additional studies of ammonia toxicity on freshwater mussels were conducted by Wang et al. (2007a and 2007b). Acute toxicity levels of ammonia for mussels (EC50s) were >13 mg total ammonia (Wang et al. 2007a). Chronic toxicity may occur depending on the persistence of the fire retardant in the environment. Chronic toxicity levels were 0.37 to 1.2 mg total ammonia for survival and from 0.37 to 0.67 mg total ammonia for growth (Wang et al

2007b). There are many variables that factor into the toxicity level of the fire retardant to the mussels. Although mussels can close their valves to potentially avoid some toxic exposure nothing is known about this behavior with respect to Phos Chek chemicals.

In general, growth was frequently a more sensitive endpoint compared to survival and juvenile mussels are more sensitive to ammonia that other organisms (Newton and Bartsch 2007).

Sub-Lethal Effects on Aquatic Species

Toxicity of the retardants are not the only effects to aquatic species. There is the potential for sublethal effects from short-term or transient exposures to retardant. We expect that the extent of the sublethal impacts will extend downstream much farther than the 6.2 miles (the distance shown where lethal impacts could occur), because ammonia concentrations below lethal limits will persist further downstream than the extent of lethal concentrations. The Forest Service is currently working with USGS on a study to further refine the knowledge of sublethal effects

Laboratory studies show that rainbow trout exposed to NH_3 levels over 0.1 mg/l developed skin, eye, and gill damage. Other reactions to sub-lethal levels of ammonia are reduced hatching success; reduced growth rate; impaired development; injury to gill tissue, liver, and kidneys; and the development of hyperplasia (an abnormal increase in the number of cells in an organ or a tissue). Hyperplasia in fingerling salmonids can result from exposure of ammonia levels as low as 0.002 mg/l for 6 weeks. Considering the research in California (Norris et al. 1978) that showed detectable levels of ammonia for an entire year following retardant introduction, it is possible that hyperplasia could be a concern for listed salmonids. The presence of ammonia in the water can also lead to suppression of normal ammonia excretion and a buildup of ammonia on the gills. Fire retardants may also inhibit the upstream movement of spawning salmon (Wells et al. 2004).

Ecological Considerations for Retardant Toxicity

Responses of organisms tested in controlled laboratory systems do not necessarily provide reasonable predictors of organisms' responses to similar chemicals in the wild, although in most cases this is the only data available to conduct an evaluation. Reaction to various substances establishes a starting point around which to predict the response under various scenarios.

The conditions simulated in a laboratory test are unlikely to resemble "worst case field conditions." In laboratory tests, species are generally isolated from confounding factors so that researchers are able to isolate the species responses to the chemical (or stressor) under study. Lab studies do not replicate typical environmental conditions where intraspecific (within species) or interspecific (between species) competition for food or shelter occurs. Water velocities, water temperature, and dissolved oxygen (DO) are not representative of fluctuating conditions in a natural aquatic environment, particularly during a wildfire) and generally, there are no other chemical stressors present.

While there has been a fair amount of research conducted in laboratory environments, the response of aquatic species to an accidental fire retardant drop in the natural environment with additional stressors, such as low DO, ash, increased water temperatures, and other conditions expected as the result of the nearby fire, has not been studied. Most aquatic species are particularly sensitive to elevated temperatures and are not tolerant of water with low disolved oxygen (DO). Warm water holds less oxygen and water with low DO will occur during a wildfire. There have been several studies done on the interactive effects of ammonia and DO, all showing the LC50s of rainbow trout to fall dramatically when DO is low. Alabaster et al. (1983) showed that at 10 ppm DO, rainbow trout die at concentrations of un-ionized ammonia of 0.2 mg/l, but when the DO fell to 3.5ppm, the lethal concentration of un-ionized ammonia was only 0.08 mg/l. Thurston et al. (1981) showed that when DO dropped from 8.5 ppm to 5 ppm, rainbow trout became 30 percent less tolerant of ammonia.

Gresswell (1999) showed that smoke in the air is absorbed by water and increases the ammonia concentrations in rivers even without an accidental application of retardant. Crouch et al. (2006) showed that in burning watersheds, prior to treatment with retardants, there is increased ammonia, phosphorous, and total cyanide. When there is a greater background level of ammonia during a fire, the ammonia levels created by an accidental drop are higher than experienced in a controlled setting. The stream chemistry would take more dilution to reach non-toxic levels.

Retardant components beyond ammonia can have sublethal effects to aquatic organisms. Ash and guar gum have both been identified as respiratory inhibitors in the water Ash has been identified as the cause of fish kills during wildfires and volcanic eruptions (Newcombe and Jensen 1996), while guar gum is an ingredient in fire retardants and would further exacerbate the effects of increased ammonia concentrations. Buhl and Hamilton (1998) stated, "these results indicate that although ammonia is a major toxic component in D75-F, other components in the formulation may have had a significant influence on the toxicity of D75-F to Chinook salmon".

Drift caused by wind and air speeds from all retardant drops, including an accidental retardant drop, within the 300-foot buffer (but outside of a waterway) should be considered. Several environmental factors such as wind speed and direction, amount of retardant dropped from the aircraft, topography, the type of waterway (pond vs. stream), and dilution should be considered when analyzing the level of toxicity in a waterway. Discussion of how drift occurs is described in the Hydrology Section of this FEIS.

General Indirect Effects

Fire retardants have negative indirect impacts to many aquatic species analyzed for this program. Many rivers are impaired according to the EPA 303(d) water quality standards by excess nutrients. Fire retardants are nitrogen based and when they hit the water and break down, the retardants eventually become nitrogenous nutrients adding to the already high nutrient load. Eutrophication (when excess nutrients create a high vegetation and low oxygen environment) can reduce the habitat quality and quantity for aquatic vertebrates and invertebrates.

The application of nutrients into these waters could lead to shifts in phytoplankton composition or provide a competitive advantage to organisms that are not naturally suited for those waters and poor conditions for species analyzed in this analysis.

The influx of nutrient may also favor the introduction or spread of aquatic invasive species. Indirect effects to non-native aquatic invasive species from increased nitrogen from fire retardants could result in increases in density of non-native invasive species if present where retardant is applied; many of these species are good competitors and opportunistic and negatively affect the native species abundance and stream composition.

Alternative 1—No Action

No direct, indirect, or cumulative effects would occur to any aquatic federally listed species, designated critical habitats, or Forest Service listed sensitive species from the application of fire retardant because none would be applied.

Without the use of fire retardant, the probability of a wildland fire becoming larger and burning more acreage is higher and may increase the need for additional ground suppression resources including engine crews, handcrews, helitack and dozers (Henderson and Lund 2011). Without the use of aerial fire retardant, there may be increased potential for some fires to be more intense, resulting in greater potential for increased sedimentation and water yields where these intense types of fires may occur. Increased use of ground suppression resources may also result in more impacts to aquatic species and habitats. As a result, there is the potential for species and habitats to be negatively impacted. The effects of other fire suppression activities are not the focus of this analysis but are mentioned here to provide context.

The effects of fire on aquatic species and their habitats, in particular, will depend on the intensity of the fire, prior watershed conditions, and ability of local aquatic communities to repopulate, which depends on life history patterns and overlapping generations. Local conditions may create situations where increased temperatures caused fish mortality (Neary et al. 2005) or isolated populations were extirpated as a result of the fire and suppression activities (Dunham et al. 2003).

Water use for fire suppression is not at levels that would cause water depletion and adversely affect aquatic species or environments. Pumps are equipped with screens to prevent removal of fish from streams and removal of most other aquatic organisms. Wash methods are implemented for equipment that is in contact with water to prevent the spread of aquatic invasive species. waterways for drafting of water are pre-selected by resource personnel to avoid areas with TES species and habitats.

Allowing fires to burn through fire adapted ecosystems may also result in beneficial effects on species and their habitats, particularly where fire has been suppressed historically. Local land management resource plans identify areas where fire could be beneficial and the use or non-use of aerial fire retardant is implemented locally to address local needs. Because of the scope of this analysis and the various types of ecosystems considered, variable effects could occur given local factors. In general, aquatic ecosystems are not adversely affected by wildfire.

Cumulative Effects

As there are no direct or indirect effects from aerial use of fire retardant, there are no cumulative effects Without the use of aerial fire retardant, there may be increased potential for some fires to be more intense or to become larger, resulting in greater potential effects in streams where larger fires occur. There is no data to quantify this impact at this time.

Alternative 2—Proposed Action

Under this alternative, the Forest Service would continue aerial application of retardant under the 2000 Guidelines for Aerial Delivery of Retardant, with the adoption of the 2008 Reasonable and Prudent Alternatives (RPA) as identified by US Fish and Wildlife Service and NOAA Fisheries (Appendices A and B). This alternative allows three exceptions allowing for retardant use in the guidelines (refer to Chapter 2, Alternatives).

This alternative identifies avoidance areas to protect aquatic species and habitat. They are defined as:

- All waterbodies with a 300-foot buffer; this includes perennial streams, intermittent streams, lakes, ponds, identified springs, reservoirs, and vernal pools.

Direct and Indirect Effects

Mapping of buffers on all waterways are competed as directed under the 2000 Guidelines for Aerial Delivery of Retardant. The potential for retardant being applied to these TES species and critical habitat does exist from invoking of an exception (three for this alternative) or a misapplication of retardant delivered to a waterbody.

Misapplication Data Analysis

Even though the Forest Service does not intend to drop fire retardant in waterways, there have been instances where misapplications do occur. We have recorded those incidents, and the data for aquatic habitats are summarized in Table 13 'Recorded Misapplication Aerial Fire Retardant Drops in Aquatic Habitats or Buffer Areas'

Table 13 Recorded Misapplication Aerial Fire Retardant Drops in Aquatic Habitats or Buffer Areas

Year	Drops direct to water	Drops within 300 ft buffer	Total drops to water and buffer	Total drops	Total drops to water and buffers / total drops (%)
2008	9	3	12		
2009	9	2	11		
2010	14	5	19		
Totals (3 yrs)	32	10	42	9,858*	0.42

* This figure is the sum of an annual average of drops for 3 years. See Table 9 for more information concerning total drops.

The acceptable level of certainty for this broad scale analysis is a 99.99 percent confidence to differentiate the Endangered Species Act (ESA) effects determinations. Currently the Forest Service is 99.58 percent confident that a single application of fire retardant will not reach the water within the 300-foot buffers.

The calculation for the probability of a misapplication is:

Probability = 1 – (1-(1/t))^n

t= the likelihood of an event (for 2008-2010 – 42/9853)

n= number of application events

The probability for fire retardant intrusions is 0.42% if there is only a single application during a fire season. The current frequency of misapplications is rare and at the extreme ends of their respective curves. Therefore increasing buffer sizes does not correlate with a linear reduction in the misapplication rate. (Kahn 2011, personal communication)

This analysis assumes that all misapplications within the 300 foot buffers will enter waterways and affect aquatic species. As discussed in the hydrology section not all misapplications recorded to date have delivered retardant to waterways.

There are a number of cases where fish mortality has been documented in recent years due to misapplication of fire retardant to streams so it is prudent to analyze the effects of those events.

The following assumptions relate to the ESA effects determination found in Appendix F. These are considered direct effects to aquatic species for Alternative 2 when an exception is invoked (3 possible reasons for this alternative) or misapplications occur.

- Determinations are made over the range of the species and designated critical habitat.
- When fire retardant enters waterways and aquatic populations are present, there will be adverse effects to those populations. Many of the listed species have small isolated populations and if a retardant application either by invoking the exceptions or misapplication occurs, it could have adverse effects on the species and habitat.
- Any TES species or designated critical habitat where any retardant has been used within the range of the species during the last 10 years would have a Likely to Adversely Affect determination for those species (based on the average of 10 years of data), unless otherwise determined at the local forest- or grassland-level.
- If the TES species or designated critical habitat has a very low likelihood of occurring on any Forest/Grassland then the determination is Not Likely to Adversely Affect (NLAA), unless otherwise determined at the local forest- or grassland-level.
- If retardant is not used on any Forest/Grassland or designated critical habitat within the range of the TES species then the determination is No Effect (NE).
- Because the effects to the TES listed species would also affect the habitat the determinations where a species has designated critical habitat mirror the determinations made for the species.

Under alternative 2 there are a total of 90 federally listed fish species, 166 Forest Service sensitive fish species, 67 federally listed aquatic invertebrate species, 90 Forest Service sensitive aquatic invertebrate species, that could be affected by the use of aerially applied fire retardant.

Determinations for the federally listed aquatic species are summarized as 21 No Effect, 18 Not Likely to Adversely Affect and 118 Likely to Adversely Affect. For a complete review of species distribution and baseline habitat information for federally listed species please refer to the Biological Assessment. For a complete listing of Forest Service listed sensitive/candidate species and results of the national screening process and species specific impact determinations please refer to the Biological Evaluation.

Indirectly, there is the chance of increased nutrients if there is the invocation of an exception (three exceptions under Alternative 2) or a misapplication occurs. This may cause a concern where many waters are already nutrient-rich. There could be a change in macroinvertebrate abundance and species composition, which are food resources for aquatic vertebrates and would then effect their abundance and composition. Additionally, the influx of nutrients may favor non-native aquatic invasive species and many of these species are strong competitors and opportunistic and adversely affect the native aquatic communities.

Sensitive species are not provided specific mapped avoidance areas under Alternative 2. However, the effects on sensitive species are likely to be similar to federally listed endangered and threatened species because of the 300-foot buffer for all streams and other water bodies. There is potential for retardant being applied to these species, because of exception to the guidelines and the risk of misapplications. Effects to sensitive species are displayed in the Biological Evaluation.

Direct impacts to the freshwater mussels project include the potential to kill or injure mussels from an accidental drop into mussel habitat An accidental drop could result in both acute and chronic toxicity. Acute toxicity could occur if ambient concentrations of ammonia exceeded 0.3 to1.0 mg/L total ammonia at pH 8 at 25C within mussel habitat

Indirect impacts to federally listed mussels may include altering nutrient and food base that the mussels are dependent upon.

The amount of water used is not at a level to cause any water depletion issues of water bodies or adverse effects to listed species. In addition, standards are in place for all pumps to have screens to prevent fish kills. As discussed in Chapter 2, the stations must be 300 feet from waterways and do not pose a high risk for spill.

Cumulative Effects

The cumulative impacts on aquatic communities resulting from the incremental impact of the action added to past, present, and reasonably foreseeable future actions are expected to be minor and short-term.

The added effects of the use of aerially applied fire retardant are minimal and only occur if a exception is invoked (3 possible exceptions) or a misapplication occurs and delivers retardant to a waterbody. If one does occur it could impact a portion of a waterbody or cause an impact to populations of aquatic species.

Application of actions and assumptions for cumulative effects described in the past, present and foreseeable activities relevant to cumulative effects section above in this section, and in the introduction section of Chapter 3. Although there is the potential for aerial fire retardant to be applied to federally listed species and Forest Service listed sensitive species under this alternative from invoking and exception or a misapplication of retardant, the re-application to these same locations in the future is highly improbable due to the fact that fire and use of retardant would not occur due to low fuel loads. In other words, once a fire burns an area, it is highly improbable to burn at the same intensity, again, to cause the Forest Service to drop more retardant in that area. Wildland fire could have an additive effect to nutrient increases from retardant application, but little information is available on this subject. Cumulative effects resulting in changes in aquatic communities are expected to be minor.

Alternative 3

Under Alternative 3 to protect federally listed threatened, endangered, and proposed species, national forests and national grasslands that apply fire retardant using aircraft will the implementation of the following direction (further described in Chapter 2):

- Aircraft Operational Guidance,

- Avoidance Area Mapping Requirements,
- Annual Coordination, and
- Reporting and Monitoring Requirements.

Aquatic Avoidance Area:

- All waterbodies with a 300-foot buffer; this includes perennial streams, intermittent streams, lakes, ponds, identified springs, reservoirs, and vernal pools. *Buffer areas may be adjusted for local conditions and coordinated with the U.S. Fish and Wildlife Service (USFWS) and NOAA Fisheries offices.*

Direct and Indirect Effects

Alternative 3 direct and indirect effects are the same as those described in Alternative 2. In addition, Alternative 3 provides the opportunity for a Forest or Grassland to invoke larger stream buffers to address local conditions (in addition to the existing 300 foot buffers). There is potential for additional acres to mapped as avoidance areas for aquatic species.

Because waterways are already mapped in Alternative 2, Forest Service sensitive species trending towards Federal listing and federally listed species and designated critical habitat would receive the same protection as Alternative 2. Effects on Forest Service sensitive species and federally listed species and designated critical habitat would be similar to those described in Alternative 2.

The potential for retardant being applied to these species does exist from invoking the one remaining exception (protection of life) or a misapplication of retardant (see misapplication data analysis for alternative 2). However the loss of two exceptions for applying retardant should reduce the likelihood of retardant delivery to waterways and the adverse effects to aquatic species.

Under this alternative the pre-indentified avoidance areas could potentially lower the probability of success for areas accustomed to fixed wing retardant assistance under high fire danger conditions and cause a decrease in the initial attack success rate and minimizing acres burned in those areas based on effectiveness comments from wildland fire professionals (Appendix O). The potential for larger, longer duration fires translates to the potential for more ground firefighting and aerial resources such as water in these areas. This increase is potentially greater than Alternative 2 but much less than Alternative 1. With this alternative similar effects as those described in alternative 1 but at a much smaller scale of impact.

In addition, Alternative 3 proposes monitoring of areas were retardant drops have been used within a watershed to determine if adverse impacts are occurring. If aerial application of fire retardant has occurred within a watershed and has a significant impact on a species or a portion of that species' population (or habitat then the area may have certain thresholds of impacts associated with it to restrict the future use of fire retardant for a specific period of time depending on the species affected, reproductive needs, life-cycle requirements, how the fire retardant impacts the critical life phases, and other factors.

In summary, the establishment of trigger points for restricting the use of retardants within watersheds where retardant previously has caused adverse effects to a species or population, and yearly operations planning should all help to reduce impacts on aquatic species and habitats.

Cumulative Effects

With mapping of waterways already in place cumulative effects to aquatic species and habitat would be the same as those described in Alternative 2.

Under this alternative the pre-indentified avoidance areas could potentially lower the probability of success for areas accustomed to fixed wing retardant assistance under high fire danger conditions and cause a decrease in the initial attack success rate and minimizing acres burned in those areas based on effectiveness comments from wildland fire professionals (Appendix O). The potential for larger, longer duration fires translates to the potential for more ground firefighting and aerial resources such as water in these areas. This increase is potentially greater than Alternative 2 but much less than Alternative 1. With this alternative similar cumulative effects as those described in alternative 1 but at a much smaller scale of impact.

Summary of Effects

Table 14 Summary of Effects by Alternative

Effects	Indicator	Alternative 1	Alternative 2	Alternative 3
Impact to all federally listed and Forest Service listed sensitive aquatic species	# species and critical habitat impacted	No species or critical habitat impacted from the use of fire retardant. Could be positive or negative effects to species or habitats depending on the increased potential for smaller fires to become larger fires or increases in ground suppression actions. More use of water suppression activities that may impact	Federally listed Species: 21 No Effect 18 Not Likely to Adversely Effect 118 Likely to Adversely Effect Designated Critical Habitat: 10 No Effect 15 Not Likely to Adversely Effect 72 Likely to Adversely Effect More potential for risk of impacts from aerially applied retardant that Alternative 3 because the 3 exceptions allow more discretion in the use.	Federally listed Species and Critical Habitat: Same as alternative 2. Less potential for impacts from aerially applied retardant than Alternative 2 due to only one exception for human safety. Could be positive or negative effects to species or habitats depending on the increased potential for smaller fires to become larger fires or increases in ground suppression actions.

Effects	Indicator	Alternative 1	Alternative 2	Alternative 3
		federally listed species or habitats.		

3.5 Plant Species and Habitats

This section focuses on the effects of aerially applied fire retardant on plants and plant communities, including noxious and non-native invasive plants. The first part analyzes the effects on federally listed threatened endangered proposed and candidate species, associated designated critical habitats, and Forest Service sensitive plant species (collectively, TEPCS). The second part evaluates impacts associated with aerial retardant application and non-native invasive plant species . Both sections address impacts to native plant communities as it relates the implementation of each alternative. Because of the national scale of effects associated with these alternatives, most are general and qualitative in nature.

The analyses and results presented represent biological findings of the Forest Service. The U.S. Fish and Wildlife Service will review these biological findings and provide a biological opinion for those species protected under the ESA.

3.5.1 Affected Environment: Federally Listed Threatened, Endangered, Proposed, Candidate, and Forest Service Sensitive Plant (TEPCS) Species

Federally listed plant species: pedate checker-mallow (left), photo by Scott Eliason, USDA Forest Service; Munz's onion (right), photo by Mark W. Skinner, USDA Forest Service.

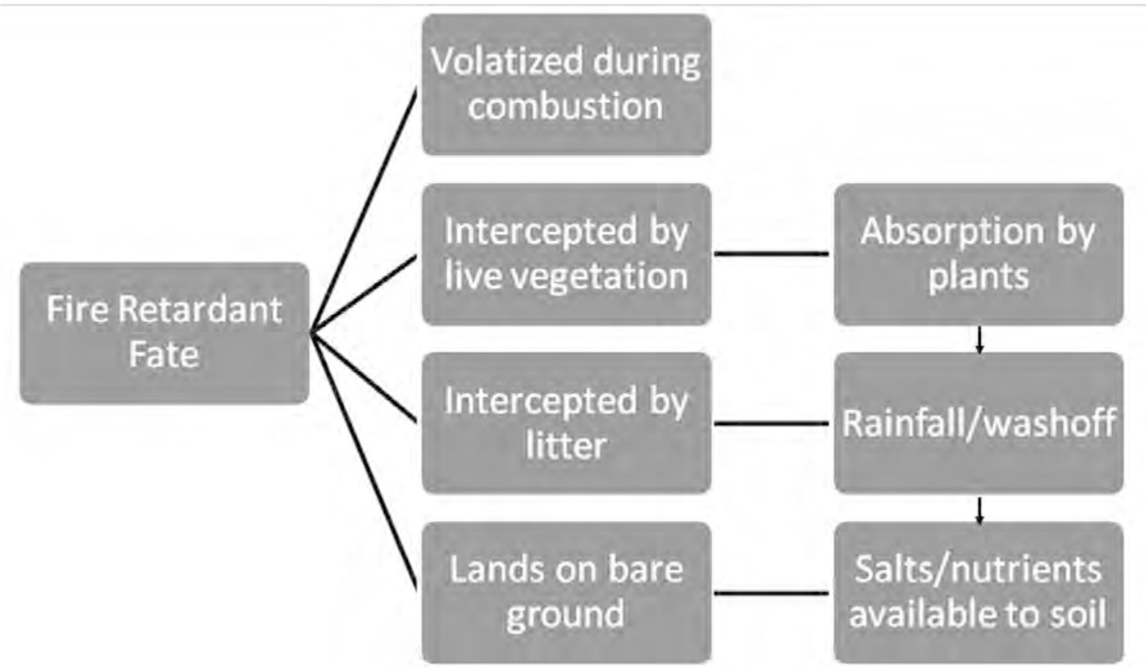
Aerially applied fire retardant on National Forest System (NFS) lands (approximately 193 million acres) can occur on various types of vegetation including, but not limited to, annual and perennial grasslands, conifer forests, summer and fall hardwood forests, sagebrush with grass, intermediate brush, southern rough vegetation, and mixed chaparral. As a result of these various types of diverse vegetation types, numerous federally listed and forest service sensitive plant species occur in these areas. Plant species considered within this analysis include grasses, forbs, shrubs, mosses, lichens, and other species that occur in numerous types of habitats across NFS lands. Of these species, 169 federally listed plant species, 24 designated critical habitats, 10 candidate species and 2,537 Forest Service listed sensitive plant species may have the potential to be impacted by aerial delivery of fire retardant. Species lists for federally listed and Forest Service listed sensitive species can be found in the Biological Assessment and the Biological Evaluation.

3.5.2 Environmental Consequences: Federally Listed Threatened, Endangered, Proposed, Candidate, and Forest Service Sensitive Plant Species

Fire retardant which adheres to vegetation and other surfaces is composed of ammonium sulphate or ammonium phosphate salts, thickeners, dyes and corrosion inhibitors, making it effective in reducing the advance of a fire. The retardant slurry acts as a barrier in front of a fire, and, as the fire burns into the areas coated with retardant, the salts are converted to sulphuric and phosphoric acids with the release of sulphur dioxide, ammonia, and nitrogen oxides. This reaction suppresses the flaming combustion of fuels (Chandler et al. 1983). If aerially applied retardant is used as a method of control, the vegetation and soils in the area may be burned to some extent in some cases, and in other cases vegetation and ground may be covered with retardant and unburned. Please refer to fire section within this final EIS and Appendices J, L and M for a complete discussion of retardant use tactics, retardant presently approved for use on Forest Service lands, and effectiveness of retardant use.

Effects on individual plant species or plant communities depend upon various factors, including what happen to the retardant after application, species specific characteristics, habitats, soil types, and timing of retardant application (active growing season vs. dormant season). Figure 6 'Fate of aerially applied fire retardant' below illustrates pathways of where aerially applied retardant can go once it is applied from aircraft; effects of other fire suppression tools are not considered in detail in this analysis.

Figure 6 Fate of aerially applied fire retardant



General Effects of Fire Retardant on Plants and Plant Communities

Very little is known about the effect of retardant on plants and their associated plant communities. Most studies evaluating impacts are short-term (2 to 3 years) and represent a limited number of ecosystems. Results of these studies indicate that there is the potential for phytotoxic effects such as leaf burning, and defoliation and changes to plant diversity, including increases in non-native invasive species (NNIS) associated with the fertilizing effect of retardants. Reported effects to plants and their associated plant communities in these studies using various retardant formulations, imply nitrogen and phosphorus components within retardant contribute to effects and certain species may be more susceptible to an impact. No direct or indirect effects to plants or plant communities have been associated with the other constituents of retardants (xanthan thickeners, guar gums, fugitive colorants, attapulgus clay, iron oxide, or performance additives).

Susceptibility of an impact may include numerous site specific factors and a variety of unknown interactions between species and their respective local environments. Site specific characteristics potentially contributing to susceptibility could include: proximity to and species specific characteristics of nearby non-native invasive weed population, certain soil conditions, timing of retardant application (active growth period or dormant) in additions to other unknown factors.

The studies summarized below provide the best available science and the basis for the effects analysis for the alternatives considered.

Phytotoxicity

Phytotoxic effects such as leaf curling, leaf burning, tip and shoot die back, complete plant death or decrease in potential for germination are effects that potentially may occur to some species under some conditions. Studies reporting these types of effects are very limited to a few species under certain specific conditions.

In a California foothill annual non-native grassland wildfire, native legumes were shown to decrease in abundance for 2 years after the application of PhosChek XA fire retardant (Larson and Duncan 1982). PhosChek XA contains the highest levels of nitrogen and phosphorus and is no longer used by the Forest Service (Johnson 2011). Although the exact amount of retardant applied in this study is unclear, most of the currently used retardants have lower amounts of nitrogen, except for PhosChek 259 retardant, which is only used in helicopter delivery systems that consistently are more accurate in the placement of retardant.

Widespread short-term effects (leaf death in tree, shrub, and ground cover species) from retardant containing ammonium sulfate and a polysaccharide have been reported in an Australian eucalyptus forest (Bradstock et al. 1987). Leaf death occurred within a week after treatment and continued for many months in both overstory and understory species. While the overstory recovered rapidly, decreased cover in many understory species persisted at 1 year post application. The results of the associated greenhouse experiments reported in this study indicate that the ammonium sulfate component was the retardant ingredient responsible for foliar damage and that foliar washing did not minimize the adverse effects. PhosChek D75 is the only retardant that currently has ammonium sulfate within the formulation, and this retardant is being phased out and will not be used by the Forest Service in the future (Johnson 2010).

Shoot and whole plant death on individual plants were recorded on heathland plant species in Australia after experimental application of PhosChek D75R (Bell 2003, Bell et al. 2005). Depending on the application rate (1.2 to 3.7 GPC), adverse effects to plant species varied. Little change in the visual estimates of percent foliar cover between treated and untreated areas were observed and application of retardant to undisturbed heathland vegetation did not appear to significantly change species composition or projected foliage cover of the major life forms of native vegetation (herbs, mosses, grasses and sedges, woody shrubs).

No phytotoxic effects were observed in field studies examining effects of retardant (PhosChek G75-F) in a North Dakota mixed-grass prairie (Larson and Newton 1996), or a in Great Basin shrub-steppe vegetation (Larson et al. 1999).

Monitoring the potential phytotoxic effects from a misapplication of retardant (Phoschek P100) on *Eriogonum ovalifolium* var. *vineum* (Cushenbury buckwheat) a federally listed plant species on the San Bernardino National Forest in southern California indicate no foliar burn, phytotoxicity, or mortality to individuals 4 months after application (Eliason 2010a). No impacts to critical habitat to this species or *Lesquerella kingii* subsp. *bernardina* (San Bernardino Mountains bladderpod), were documented with ongoing monitoring in upcoming season to fully evaluate effects (Eliason 2010b).

Results of studies indicate that there is a possibility of phytotoxic effects to species that are more sensitive to retardant or to species that occur in an environment that is more susceptible to impacts. Literature also suggests little or no direct impact 1 to 2 years post retardant application on the species evaluated. It is expected that available propagule seedbank sources or other propagule sources nearby would provide long-term revegetation potential for commonly occurring species that might be impacted in the short term. Based on these results and the small percentage of land expected to have fire retardant applied to it annually (0.04 percent or less by any individual forest and less than 0.0025 percent nationwide), direct impacts are expected to be minor and short-term.

Vegetation Diversity

Fire retardants can serve as a source of plant nutrients (specifically, nitrogen and phosphorus) in the soil whether applied directly to the ground as a retardant or deposited on the ground via rainfall or after being chemically altered during a fire. Individual and plant community responses from changes in nutrient availability are extremely complex and highly site specific. Additionally, *changes in availability of nitrogen and phosphorus in the soil as a result of fire itself may mask effects of retardant application* (Napper 2011). The persistence of nitrogen and phosphorus from fire retardant applications and its availability to plants varies depending on retardant concentration and soil quality (Napper 2011). Plant available nitrogen was shown to be short-term (12 months), yet plant available phosphorus was found in the surface soil after 12 months (Hopmans and Bickford 2003). Persistence in the soil and related plant nutrient availability is variable and prediction of short- or long-term availability of nutrient in the soil and associated vegetation responses is highly site-specific. Please refer to Soils section of this EIS for a complete discussion of soil nutrients and retardants.

Larson et al. (1999) suggest that the effects of ammonium-based retardants on plant and plant communities might be similar to the effects shown in fertilizer studies. If so, the impact to soil quality through the fertilizing effects of retardants could increase the vegetative response and change vegetative community composition. Increases in nutrient inputs might encourage the growth of some plant species, including NNIS, and give them a competitive advantage that would result in changes in community composition and species diversity (Tilman 1987, Wilson and Shay 1990, Bell 2003, Larson and Newton 1996).

The effects of Phos Chek D75 application on species diversity was evaluated in a North Dakota grassland community (Larson and Newton 1996) and in a shrub steppe area in the Great Basin in Nevada (Larson et al. 1999). Community characteristics, including species richness, evenness, diversity, and number of stems of woody and herbaceous plants were measured. The results of these studies indicate the following:

- In a North Dakota prairie ecosystem, species richness was reduced in plots exposed to retardant whether the area was burned or unburned. All plots were dominated by the Kentucky bluegrass (*Poa pratensis),* which gained a competitive advantage from retardant application and crowded out other species.
- In a Great Basin shrub steppe ecosystem, species richness declined the first year,with depression in species richness was most pronounced in the riparian corridors. No impacts to species richness were observed after 1 year.

Overall, the vegetative community response from retardant was less than from burning alone. Larson et al. (1999) suggest that even if fire retardant increases growth rates of non-native plants for a few post-fire years, the impacts from fire being allowed to burn unchecked may be more detrimental. In both studies, the authors note that each study was short-term, and that results of the long-term ecological responses during several growing seasons are necessary to evaluate effects

In another study, Phos Chek XA, a retardant no longer used by the Forest Service, applied to a California grassland produced almost twice the yield of forage in the first year after application in both burned and unburned areas, and growth continued into the second year after application in a retardant-treated unburned area (Larson and Duncan 1982). The increases in biomass or quality of forage could attract more herbivores and browsers to retardant application sites (Larson and Duncan 1982).

In 1997, aerially applied retardant (Phoschek D75) applied to the Mount Jumbo Fire near Missoula, MT resulted in increased density and biomass of annual plants including cheat grass (*Bromus tectorum*) and tumble mustard (*Sisymbrium altissimum*) in an area already impacted by NNIS due to urban use (Calloway 2010). Bell et al. (2005) also recorded enhanced weed invasion in an Australian heathland ecosystem, particularly in areas receiving high concentrations of retardant (Phos Chek D75R).

Nutrient additions, in the form of aerially applied fire retardant applications in native plant communities, may have the potential to increase dominance of NNIS and decrease diversity of plant communities. Understanding and predicting this potential for invasion is complex and may be influenced by numerous factors, such as the number of propagules, the characteristics of the invading species, the susceptibility of the environment to invasion (Williamson and Fitter 1996, Williamson 1996, Lonsdale 1999), and various soil qualities (Napper 2010). For instance, Leishman and Thomson 2005 and Dassonville et al. 2008 show that invasive exotic species might be better competitors than other vegetative communities on nutrient poor sites that have received an increase in nutrients. Yet, Kalkhan et al. (2007) showed nutrient rich soils in Rocky Mountain National Park were more vulnerable to exotic species invasion than less fertile soils. In this study, nitrogen was positively linked to exotic plant species richness. In fertilizer studies conducted in Australia (Heddle and Specht 1975) on nutrient poor sandy soils, phosphorus fertilizer applied for 3 years was retained in the ecosystem for at least 2 decades. Heedle and Specht also studied heath vegetation for more than 22 years and found change towards a herbaceous grassy area (sward) in response to application of phosphorus fertilizer.

These studies indicate a potential for increased vegetative growth and change in vegetative community composition as a result of the addition of nitrogen and phosphorus, but the magnitude and direction of the change is strongly site-specific. From a broad-scale perspective, because the amount of retardant applied per forest, per region, or nationwide and associated potential for impact is small (less than 0.0025 percent annually across National Forest System lands), potential impacts to or changes in plant diversity are expected to be minor from a spatial perspective. Because each forest implements forest-wide and species-specific NNIS treatment strategies (implemented under separate actions at the regional or forest level) in combination with other NNIS treatments associated for larger fires (burned area emergency recovery programs), the potential impacts from increases of NNIS would be expected to be short-term (3 to 15 years). These impacts, however, do not preclude impacts to individual species, especially threatened and endangered plant species, designated critical habitat areas, sensitive species that trend towards listing, and plant species that are considered "narrow endemics." Impacts to threatened and endangered species habitats by invasive species are one of the threats facing many species nationwide (Pimentel et al. 2005, Wilcove and Chen 1998). Treatment of NNIS and protection of federally listed species, associated critical habitats, and Forest Service sensitive species will continue on each forest as directed by national policy and regional and forest level direction (see Biological Evaluation and Botany Report).

Pollinators

Impacts of fire retardant to plant specific pollinators are not currently documented in the scientific literature. Although ants are not significant plant pollinators (NBII 2011), data suggests no effects to major surface dwelling ant species and some effects to minor species (Seyour and Collett 2008). Evidence from the same study further suggest retardant application when combined with prevailing climatic conditions may lead to foliage mortality, litter accumulation and weed invasion leading to potential creation of habitat less suitable for species. Although some of these same effects to pollinator habitat may occur in certain areas under certain conditions, the amount of NFS lands impacted by aerially applied retardant is small and impacts from fire itself may be far greater in comparison. Also refer to the wildlife report for impacts to invertebrates (butterflies and beetles) for additional information.

Methodology

Environmental effects have been analyzed on a nationwide, broad scale, and the information and estimates contained in this analysis are derived from the most accurate, readily available data. Methodology used to determine effects include:

Historical Fire and Aerial Fire Retardant Application Data

Fire retardant drops by each national forest over the past decade have been quantified and provide estimates of future retardant applications. Data are presented in Appendix C.

Species Occurrences and General Habitat Requirements

Surveys and inventories for federally listed and U.S. Forest Service sensitive species have been conducted for many years by various individuals, organizations, and government agencies including but not limited to the Forest Service, U.S. Fish and Wildlife Service, universities, and State wildlife and natural resource agencies. Additionally, all Forest Service NEPA proposed projects require analysis of impacts to and in some cases monitoring of federally listed and regional forester's sensitive plant species. Results of these activities provide occurrence and habitat information providing baseline information for effects analysis.

Components of the Alternatives Providing Plant Protection

- Preseason coordination, and training, related to aerial application of retardant
- Reporting of misapplications and monitoring of effects to species from retardant as required under Alternatives 2 and 3 (see Chapter 2 for full description of alternatives).
- Avoidance areas (no retardant application areas) established to protect Threatened, Endangered Proposed, Candidate and Forest Service sensitive (TEPCS) species from adverse effects as needed, based on species and local conditions, including 300-foot protection buffers for all water bodies.

Screening Process to Determine Potential Impacts

National screens (Appendix E) were developed and used to identify species that potentially could be impacted from future retardant applications. These screens were used to determine impacts to Forest Service sensitive plant species and for use in consultation with U.S Fish and Wildlife Service for Federally listed plant species.

Spatial and Temporal Context for Effects

The spatial extent of this analysis includes all National Forest System lands (approximately 193 million acres). The temporal extent for cumulative effects analysis is the next 10 to 20 years. This time frame encompasses the time period in which aerially applied fire retardant could reasonably expected to potentially have an impact. Most studies associated with the effects of fire retardant to plants are 1 to 2 years in length, indicating that additional longer-term studies should be conducted in the future to fully evaluate effects There are some other studies of similar chemicals applied to native vegetation (fertilizer studies) indicating a potential effect after 22 years, under certain environmental conditions; this temporal extent is conservative with respect to actual retardant impacts.

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects

Numerous human and natural actions, past, present, and reasonably foreseeable are likely to or potentially may cause, negative or positive impacts to federally listed or Forest Service sensitive species viability or habitats. Activities such as habitat restoration and rehabilitation projects, habitat destruction from land development, recreational activities, climate change, encroachment of NNIS, grazing, timber harvesting, road building, mining, etc, all may have the potential to impact botanical resources. NFS land have Land Resource Management Plan guidance that provides for protection and restoration of threatened endangered sensitive species and habitats and in some forests natural communities. For the purposes of this analysis, actions, activities, and effects similar to those of aerially applied retardant, for instance application of fertlilzers or nutrients, are considered in the cumulative effects analysis (see Chapter 3 Introduction section).

Alternative 1—No Action

No direct, indirect, or cumulative effects would occur to any federally listed species, designated critical habitats, Forest Service listed sensitive species or other botanical resources including native plant communities from the application of retardant because none would be applied. However, without the use of retardant, the probability of a wildland fire becoming larger burning more acreage is higher and may increase the need for additional ground suppression resources including engine crews, handcrews, helitack and dozers (Henderson and Lund 2011). Without the use of aerial retardant, there may be increased potential for some fires to be more intense, resulting in greater potential for severe environmental impacts such as localized soil sterilization, loss of native plants, and loss of viable soil seed banks in specific areas where these intense types of fires may occur. Increased use of ground suppression resources may also result in accidental trampling, vehicle damage or dozer line in areas where these species and habitats occur. As a result, there is the potential for species and habitats to be negatively impacted. Again, the effects of other fire suppression activities are not the focus of this analysis but are mentioned here to provide context.

Conversely, in some cases, allowing fires to burn through fire adapted ecosystems may result in beneficial effects on species and their habitats, particularly where fire has been suppressed historically. Local land management resource plans identify areas where fire could be beneficial and the use or non-use of aerial fire retardant is implemented locally to address local needs. Because of the scope of this analysis and the various types of ecosystems considered, variable effects could occur given local factors. In general, many plant species require, tolerate, or are not affected by fire, except where fires are intense, see above. For instance, in a classification of the effect of fire on 186 Federally listed, proposed and candidate plant species known or suspected to occur on NFS land, only 2 percent of the species were identified to have adverse effects due to fire (USDA Forest Service n.d.). Similar effects would be anticipated on Forest Service sensitive plant species. Significant literature is available related to fire effects to plant species and plant communities; the reader is referred to Wildland Fire in Ecosystems, Effects of Fire on Flora (Brown and Smith 2000).

Alternative 2—Proposed Action

Under this alternative, the Forest Service would continue aerial application of retardant under the 2000 Guidelines for Aerial Delivery of Retardant, with the adoption of the 2008 Reasonable and Prudent Alternatives (RPAs) as identified by the U.S. Fish and Wildlife Service and NOAA Fisheries (see Appendices A and B). Although there are more exceptions allowing for retardant use associated with this alternative and fewer designated avoidance areas compared to Alternative 3, similar amounts of retardant could be applied using different fire fighting tactics.

Direct and Indirect Effects

Effects on Native Plant Communities

Increases in vegetative growth as a result of added nutrients from retardant application (N and P) may result in a beneficial impact in some plant communities. However, some studies indicate that fire retardant or added nutrients may result in changes to plant community composition. For instance, a change to a more grass dominated community or potential for NNIS establishment or spread may be possible depending on specific site characteristics. The magnitude and direction of change is highly site specific and influenced by numerous factors other than retardant application alone. The broad-scale perspective of impacts associated with this analysis would indicate that because the amount of retardant applied per forest, per region or nationally is small, combined with the typical swath pattern of retardant application (50-75 feet wide by 800' length), and the relative abundance of species the potential impact is expected to be minor, however for those species of limited supply, for instance federally listed and Forest Service listed sensitive species and with very specialized habitats a finer scale analysis was completed. Because of their specialized nature and limited extent some could be adversely affected.

Effects on Federally Listed Species

The adoption of RPA sub element 1, of the 2008 RPAs required avoidance mapping for 20 federally listed plant species and 14 designated critical habitats (USDI Fish and Wildlife Service 2008) as necessary to reduce jeopardizing these species and will prevent direct or indirect effects as previously described in the general effects to plants section, except for accidental drops or invoking of an exception. All remaining federally listed and Forest Service sensitive species would not receive retardant protection if needed and could be impacted if retardant is dropped on these individuals or populations. Nationally the Forest Service applies a small amount of retardant annually to its landbase (0.0025 percent). Although many forests vary in the estimated amount of retardant applied (Appendix C) to their landbases and the amount of landbase impacted remains relatively small, it is difficult to predict fires or retardant use areas in the future, therefore, a conservative approach to effects analysis outlined in the National Screening process (Appendix E) is applied.

Of the 169 federally (Threatened, Endangered or Proposed) listed species impacts are expected to be the following:

- 64 federally listed species would not be impacted because they either occur on forests that do not use retardant or occur in habitats where retardants would not be applied (Appendix G).
- All remaining 105 federally listed species may be affected if retardant is applied in the future. The species determination would result in a likely to adversely affect determination based on a conservative approach that if a species is not protected with retardant avoidance areas the potential remains for an effect (phytotoxic or change in vegetation diversity as described above) because it is unknown when or where retardant may be used in the future. Under alternative 2, twenty species have been mapped for avoidance however, the potential remains to likely adversely affect (LAA) these species because they occur on a forest that uses more retardant (0.01% or more of land base applied annually with retardant) and therefore, a greater potential for an accidental drop or invoking of an exception exists.
- Of the 24 designated critical habitats, 14 have mapped avoidance areas and retardant application would not impact primary constituent elements (PCE's), except in the event of a misapplication; in those cases a not likely to be adversely affected determination (NLAA). Of the remaining 10 designated critical habitats, application of retardant could potentially adversely affect PCE's of 9, with the remaining 1 resulting in no impact due to no impact to PCE's. To summarize designated critical habitat effects are: 14 NLAA, 9 Likely to Adversely Affect (LAA) and 1 No Effect (NE). Critical habitat primary constituent elements can be found in the Biological Assessment.

Effects to Forest Service Sensitive Species and Candidate Species

Forest Service sensitive species that occur in the 300-foot water body avoidance areas would be protected from direct and indirect effects unless a misapplication or invoking of an exception would occur. Upland sensitive species occurring on forest land outside the 300-foot water body avoidance area occurring where fire retardant could be applied (forests that use retardant or in habitats where fire and/or retardant is used) may result in some phytotoxic impacts or vegetation diversity changes similar to those described previously in this section. Effects would likely be species-specific and may depend on other environmental factors such as timing and rate of application, climatic factors, and other site-specific factors.

Of the 2,537 Forest Service sensitive species evaluated using the national screening process and the resulting determination statements corresponding with impacts (Appendix E), the following effects could occur if retardant is applied to species in the future: 440 species with "no effect", 1,879 species with a "may adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing" if aerial retardant would be applied in the future, and 223 species with a likely to result in a loss of viability in the Planning Area, or in a trend toward federal listing" if aerial retardant would be applied to them in the future. A Planning Area is defined as the area of NFS lands managed by a Forest Land Resource Management Plan.

If retardant is applied in the future to the 10 listed candidate species, 3 species could result in a a loss of viability in the Planning Area, or in a trend toward federal listing" because they are not protected by avoidance mapping with the remaining 7 species potentially adversely impacting individuals, but would not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing" because they are wide spread or occur in areas where retardant use is low due to local conditions.

All species and results of the screening process can be found in the Biological Evaluation and Botany Report.

Cumulative Effects

Application of actions and assumptions for cumulative effects described in the past, present and foreseeable activities relevant to cumulative effects section above in this section, and in the introduction section of Chapter 3, effects such as phytotoxicity and changes in vegetation diversity are likely to be minor under Alternative 2 because of the small amount of area affected by retardant each year, spread widely across the United States. Although there is the potential for aerial fire retardant to be applied to more federally listed plant species and Forest Service listed sensitive species under this alternative, the re-application to these same locations in the future is highly improbable due to the fact that fire and the subsequent use of retardant would not occur due because lower fuel loads have lower potential to burn. In other words, once a fire burns an area, it is highly improbable to burn at the same intensity, again, to cause the Forest Service to drop more retardant in that area. Wildland fire may temporarily increase local soil nutrient levels and could have an additive effect to nutrient increases from retardant application, but little information is available on this subject and one input may mask the other i.e., increases in nutrients to soil from fire likely would mask nutrient inputs from retardant (Napper 2011).

Fertilization is uncommon on National Forest System land and unlikely to add to nutrients in areas where fire retardant has been used. However, the private forest industry can and often does use fertilizers within the areas on some forests. In addition, fire and fire retardant can be used on other ownerships in the same area and at the same time as retardant is used on National Forest System land for instance inholdings or other ownerships. Cumulative effects resulting in increases in NNIS or changes in vegetation diversity in areas where federally listed or Forest Service listed sensitive species as a result of aerially applied retardant is theoretically possible where retardant is applied under these scenarios. As discussed earlier, the Forest Service will continue to implement NNIS and weed control measures as directed by national regional and local level programs on NFS lands.

Alternative 3

Under this alternative, the Forest Service would continue to apply aerial retardant implementing new direction. Although there are fewer exceptions allowing for retardant use associated with this alternative and more designated avoidance areas compared to Alternative 2, similar amounts of retardant could be applied using different fire fighting tactics.

Direct and Indirect Effects

Effects to Native Plant Communities

Effects would be similar to those described in Alternative 2. Additionally, under this alternative the increase in the amount of NFS landbase protected from retardant with avoidance areas could potentially lower the probability of fire fighting success for areas accustomed to fixed wing retardant assistance under high fire danger conditions and cause a decrease in the initial attack success rate and minimizing acres burned in those areas based on effectiveness comments from wildland fire professionals (Appendix O). The potential for larger, longer duration fires translates to the potential for more ground firefighting and aerial resources such as water in these areas. The potential for longer duration fires would be greater than Alternative 2 but much less than Alternative 1. Because of the potential for a longer duration fire, assoicated with this alternative, effects to native plant communities may experience effects described in alternative 1 but at a much smaller scale of impact.

Effects to Federally Listed Species

For federally listed species, identified designated critical habitat or Forest Service sensitive species identified as needing extra protection, avoidance areas are mapped (Appendix P) to prevent the direct or indirect effects previously described in the general effects to plants section. However, the potential for direct and indirect effects from aerially applied retardant dropped onto these plant species does exist from invoking an exception, the misapplication of retardant, or a retardant drop on an undocumented individual or population. Because it is impossible to predict when or where a retardant misapplication or exception for use or undocumented locations of threatened endangered proposed candidate, or Forest Service sensitive (TEPCS) species, even if forests have mapped potential habitat worst case scenarios (conservative analysis) for effects analysis are considered.

Of the 169 federally listed plant species analyzed for impacts and based on fire retardant use by individual forest the following impacts and reasons for impacts include:

- 64 federally listed species would not have any direct or indirect effects because they either occur on forests that do not use retardant or occur in habitats where retardants would not be applied (Appendix G).
- 56 species would not likely to be adversely affected (NLAA), and 49 species would likely be adversely affected (LAA). The amount of retardant use per forest and species specific habitat conditions were considered to determine the differences in effects from accidental drops or invoking of exceptions. Please refer to Appendix E for the screening methods and assumptions for determination calls and Appendix G for individual species determinations and habitats.
- Of the 24 designated critical habitats identified, 23 would receive avoidance mapping where retardant application could impact primary constituent elements. Only one misapplication in a designated critical plant habitat has been documented in the past three years (Division Fire, Appendix D). Given that one misapplication has occurred in a designated critical habitat for plant species in the past three years and 3,286 retardant drops are estimated to be applied annually, the chances of a misapplication in a designated critical habitat is small; it is predicted that these areas are adequately protected from effects and would not likely be adversely affected. The one remaining critical habitat would not be impacted because retardant would not impact primary constituent elements (Appendix G).

Effects to Forest Service Sensitive Species and Candidate Species

Of the 2,537 Forest Service sensitive species evaluated using the national screening process and the determination statements corresponding with impacts (Appendix E), the following effects determination statements) could occur if aerial retardant is applied to species in the future: 440 species with "no effect", 2, 097 species with a "may adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing" if aerial retardant would be applied in the future. Species likely to result in a loss of viability in the Planning Area, or in a trend toward federal listing" identified for impacts in Alternative 2 are protected with avoidance areas.

Of the 10 candidate species, using the same screening process mentioned above, all could be adversely impacted, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing if aerial retardant would be applied in the future.

All species and results of the screening process can be found in the Biological Evaluation and Botany Report.

Cumulative Effects

Cumulative effects would be the similar to those described in Alternative 2 except that more federally listed and Forest Service listed sensitive species would be protected due to retardant avoidance mapping. Because more avoidance areas are identified as no retardant application areas to protect plant resources, there would be a reduced potential for a cumulative effect to occur within those defined areas, however, the amount of retardant could increase or decrease or stay the same depending on fire fighting tactics used in the surrounding area. All other conditions remain the same.

3.5.3 Affected Environment: Noxious and Non-Native Invasive Plant Species

The affected environment analysis areas and general impacts on plants and vegetation apply to this analysis and discussion; please refer to these sections in the Environmental Consequences: Federally Listed Threatened, Endangered, Proposed, Candidate species and Forest Service Sensitive Plant Species section of this document.

The Forest Service has recognized the threat that invasive species pose to forest health, the economy, and the mission of the Forest Service. An estimated 3.5 million acres of National Forest System lands are infested with invasive weeds, according to the 2000 Resources Planning Act (RPA) assessment, which summarized local estimates from individual national forests (USDA Forest Service 2001). Current estimates of infested acres at the forest level vary (Enstrom 2010, Hagland 2010); present estimates indicate approximately 753 NNIS infest 2.0 million acres on 106 national forests (NRIS 2010). Species of particular concern to Forest Service managers include leafy spurge, knapweeds, starthistles, saltcedar, non-indigenous thistles, purple loosestrife, and cheatgrass in the West, and garlic mustard, kudzu, Japanese knotweed, tree-of-heaven, purple loosestrife, and hydrilla in the East (Mitchell 2000). For a complete discussion of noxious weeds and NNIS as well as Forest Service policies related to management, see the botany resource report available in the project record.

NNIS are currently damaging biological diversity and ecosystem integrity of lands within and outside national forests nationwide. Invasive plants create a host of adverse environmental effects including: displacement of native plants; reduction in habitat and forage for wildlife and livestock; loss of threatened endangered and sensitive species; increased soil erosion and reduced water quality; reduced soil productivity; and changes in the intensity and frequency of fires (USDA Forest Service 2005). These species spread beyond National Forest System lands to neighboring areas, affecting all land ownerships.

Fire is a process integral to the function of most temperate wildland ecosystems and lightning-caused and anthropogenic fires have influenced the vegetation of North America profoundly for millennia (Brown and Smith 2000, Pyne 1982). In some cases, fire has been used to manipulate the species composition and structure of ecosystems to meet management objectives, including control of NNIS (DiTomaso et al. 2006, Keeley 2001). Yet, under some conditions, fire can increase abundance of non-native invasive plants (Goodwin et al. 2002), which may subsequently alter fire behavior and fire regimes, sometimes creating new, self sustaining invasive plant/fire cycles (Brooks et al. 2004). These altered fire regimes in and of themselves can reduce native species diversity and alter ecosystem functions. Therefore, in some instances, differentiating the impacts from retardant application and fire itself can be difficult.

3.5.4 Environmental Consequences: Noxious and Non-Native Invasive Plant Species

As a general overview, disturbance from wildfire modifies ecosystem processes and favors early successional plant species (Vitousek et al. 1996). Because of their aggressive nature, many NNIS exploit the initial decreases in competition (Harrod and Reichard 2001) and the flush of nutrients after fire (Certini 2005), essentially out-competing many native early-seral plants. Given these conditions and other activities associated with fire suppression, including ground-disturbing actions, this effects analysis focuses on those areas where fire retardant would be applied and only briefly summarizes effects of these other actions related to potential increases in NNIS.

Methodology

Because of the national scope of this document, the variability of specific species impacts on the landscape on-going treatments at local forest levels that may change areas of impact annually, quantitative data is not presented here and qualitative effects are discussed. The following information is used to provide a baseline to analyze effects 1) phytotoxic effects to individual plants and impacts to vegetation diversity as discussed in the previous section, 2) historical fire and retardant application over the past 10 years, and, 3) estimated area of future retardant application on NFS lands (Appendix C).

The spatial extent of this analysis includes all National Forest System lands (193 million acres) and the temporal extent for cumulative effects analysis is the next 5 to 20 years, which allots time for non-native invasive species controls to be implemented and effective. It is expected that fire retardant application and product constituents will remain similar to those analyzed in this document during this time frame.

Alternative 1—No Action

No retardant would be applied with this alternative therefore, potential effects associated with fertilizing effects of retardant application and increases in NNIS would not occur. However, without the use of aerially applied retardant, more acres may be burned increasing the demand for additional ground suppression resources including engine crews, handcrews, helitack, dozers and smoke-jumpers (Henderson and Lund 2011). Some non-native species are favored over native plant species after wildland fire in some plant communities under some conditions (Zouhar et al. 2008). In certain areas, post fire invasions can be intense and lead to severe impacts on native plant communities. Increases of additional disturbance by ground tactics and given certain site specific conditions, there is the potential for non-native invasive species to increase with this alternative.

Alternative 2—Proposed Action

Direct and Indirect Effects

Alternative 2 would direct retardant use away from waterway buffers and terrestrial areas identified for protection in the 2008 RPA's. Approximately 30% of NFS lands would be avoided. In those locations where it is applied retardant has the potential to increase plant growth because of the added nutrients. Indirect effects from increased nitrogen and phosphorus from fire retardants could increase density of non-native invasive species (NNIS) and reduce native plant diversity where applied. Many NNIS species are good competitors and opportunistic. Increases in densities of NNIS may also attract more herbivores to these areas as a result of increased forage thus providing additional potential for spread of NNIS from redistribution of propagules into other non-infested areas. Strips of retardant application may additionally provide a pathway for NNIS to establish into non-infested areas given favorable climatic and site-specific conditions.

Most studies conducted on retardant effects to plant communities were short term (1–3 years) and indicate minor short-term effects noting that longer-term studies may be necessary to fully understand or evaluate effects as summarized in the general effect of fire retardant on plants and plant communities section of this document. One longer term study, evaluating effects of phosphorus fertilizer treatment on nutrient deficient sandy soils in Australia, reported potential for changes in plant community diversity after 22 years. These results may indicate that changes to plant diversity within the application zone of retardant may occur under certain circumstances under specific environmental or climatic conditions. Sufficient data do not exist to definitively predict a short- or long-term effect at this broad level of analysis. It is important to note however, that national regional and forest level NNIS programs, as well as those associated with fire, to control and eradicate NNIS would continue to be implemented at the local level. Changes in nitrogen and phosphorus inputs into bogs, grasslands, and freshwater wetlands have been shown to promote the invasion of non-native plants (Tomassen et al. 2004, Green and Galatowitsch 2002). The 300-foot buffer no retardant application) for all waterways would reduce potential for retardant (nitrogen and phosphorus) entering water bodies (see the hydrology section of this EIS, and Thornton 2011). In most cases, except for the use of retardant in an misapplication, this would eliminate impacts on aquatic plant diversity from aerially applied retardant in these areas from invasions of NNIS species.

The spatial extent of potential impact from increases in NNIS from the fertilizing effect from aerially applied retardant swaths depends on presence or proximity of NNIS to retardant application sites, the area (size) of application, and the post-application non-native invasive treatment. Aerially applied retardant is typically applied in swaths across the landscape (50–100 feet wide by up to 800 feet long per drop). At the scale of this analysis (193 million acres) and the unknown future application sites of aerially applied retardant, it is reasonable to conclude that there may be the potential for an increase of NNIS under certain site-specific conditions. It could, however, be hypothesized that because NNIS are more prevalent in areas where there is increased disturbance such as near roads, high recreational use areas, urban interfaces or other disturbed areas, the potential effect may be increased in areas compared to more remote areas of NFS lands.

As a result of NNIS treatments that are ongoing at the local level not associated with fire retardant application and that retardant has the potential to impact 0.002 percent of the total National Forest System landbase annually (2,358 to 4,715 acres annually), the potential for NNIS to increase and cause detrimental damage to NFS lands is minor especially in comparison to other activities that occur across NFS lands (such as recreation, fuel treatments, logging, grazing, and fire).

Cumulative Effects

Multiple activities occur on NFS lands (recreation, timber projects, grazing, roads, fires, etc) that have the potential to impact the establishment and spread of NNIS species. The relevant actions to cumulative effects are focused on aerially applied retardant only and actions similar to retardant effects See Section 3.1 for the list assumptions and actions that may contribute to cumulative effects of aerially applied fire retardant at the national scale.

Cumulative effects are likely to be minor under Alternative 2 because of the small amount of area affected by retardant each year, spread widely across the United States. Cumulative effects are unlikely but possible under certain scenarios. The potential for fire adding to local nutrient levels in soils thereby potentially providing a similar fertilizing input as retardant is possible.

Fertilization is uncommon on National Forest System land and unlikely to add to nutrients in areas where fire retardant has been used. However, the private forest industry can and often does use fertilizers within the areas on some forests. In addition, fire and fire retardant can be used on other ownerships in the same area and at the same time as retardant is used on National Forest System land. Cumulative effects resulting in increases in NNIS or changes in vegetation diversity as a result of aerially applied retardant are unlikely but theoretically possible where retardant is applied under these scenarios. As discussed earlier, the Forest Service will continue to implement NNIS and weed control measures as directed by national regional and local level programs.

Alternative 3

Direct and Indirect Effects

Direct and indirect effects would be similar to those described in Alternative 2. Alternative 3 would direct retardant use away from areas designated as avoidance areas for federally listed and certain forest-identified sensitive species. An additional 0.8% (approximate) of NFS lands would be protected over Alternative 2. Under this alternative the pre-indentified avoidance areas could potentially lower the probability of fire fighting success for areas accustomed to fixed wing retardant assistance under high fire danger conditions and cause a decrease in the initial attack success rate and minimizing acres burned in those areas based on effectiveness comments from wildland fire professionals (Appendix O). The potential for larger, longer duration fires translates to the potential for more ground firefighting and aerial resources such as water in these areas. This increase is potentially greater than Alternative 2 but much less than Alternative 1. With this alternative similar effects as those described in alternative 1 but at a much smaller scale of impact.

Cumulative Effects

The impacts to NNIS and associated changes in vegetation diversity resulting from the incremental impact of the action added to past, present, and reasonably foreseeable future actions are expected to be the same as those described in Alternative 2.

3.5.5 Summary of Effects on Federally Listed TEPCS Plant Species and Noxious and Non-Native Invasive Plant Species

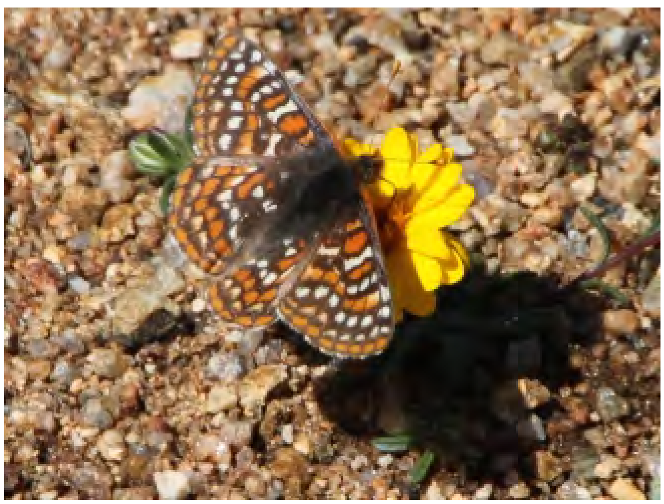
The delivery of aerial retardant to NFS lands is estimated to impact only a small proportion of lands annually (0.002%) and exact locations of when and where this will be applied in the future is unknown. Because of this unknown event, effects to plant species and botanical resources are based on the 'potential' for an effect. Alternative 1 would result in no effects from retardant to TESPC species or plant communities because none is applied. Variable effects (beneficial or negative) to native plant communities from the potential of increased fire size, fire intensity, ground suppression activities, could occur, the extent of these variable effects would be dependent on site specific conditions of the fire and the location. Alternative 2 may result in the potential for more TESPC species likely to be adversely affected because fewer species are protected from retardant effects Implementation of Alternative 3 may result in the potential for fewer TESPC species likely to be adversely affected as a result of more avoidance area mapping. Effects to native plant communities are expected to be variable based on site specific conditions. Increases in vegetative growth as a result of added nutrients (N and P) may illicit a beneficial impact in some native plant communities, whereas retardant may negatively impact or affect plant community composition if some species respond more favorably to additional nutrient inputs. The magnitude and direction of potential change is highly site specific and influenced by numerous factors other than retardant application alone. NNIS may increase in some areas where retardant is applied (Alternatives 2 and 3); increases may also occur with Alternative 1 with increased demand for ground suppression resources. Existing NNIS treatment strategies would be implemented based on local site specific conditions and national regional, or forest approved plans.

3.6 Wildlife Species and Habitats

The Forest Service is responsible for managing a diversity of landscapes, from grasslands and high deserts to coniferous and deciduous forests and alpine mountaintops. These landscapes provide scenery wildlife habitats, grazing, timber products, recreation, and other benefits. Under the National Environmental Policy Act (NEPA), Forest Service-proposed projects require analysis of impacts on federally listed threatened and endangered (T&E) species or proposed (P) or candidate (C) species under the Endangered Species Act (ESA); Forest Service regional foresters' sensitive species (S) lists for wildlife; and general wildlife species and associated habitats. Environmental effects have been analyzed on a nationwide, programmatic scale for all National Forest System (NFS) lands, comprising 193 million acres, covering 155 national forests and 20 national grasslands across nine regions.

Information on averages and estimates of acreage and amounts of fire retardant use contained in this analysis is derived from the most accurate, readily available data on aerial application of fire retardant use (Appendix C). Quantifications are limited because this analysis is national in scope; relative qualitative measurements (less, more, etc.) will be used for comparison of alternatives rather than precise calculations because it is impossible to determine when, where, or in which habitat type a wildland fire event will occur, or how large it will be.

The endangered Quino checkerspot butterfly, which occurs only in Riverside and San Deigo counties, CA. Photo by J. Zylstra.



3.6.1 Affected Environment

This section focuses on the effects of aerial application of fire retardant on terrestrial wildlife species and their habitats. More than 600 wildlife species are listed as either threatened endangered proposed candidate, or sensitive (TEPCS) (see Appendix I), in habitats ranging from arid and semi-arid to riparian, upland, forest, rocky areas, and many others. TEPCS species are being used as surrogates for all wildlife species because TEPCS species tend to be more susceptible to effects and tend to be in specialized habitats.

For most of this analysis, the affected environment is described as ecologists would do: by eco-regions (Bailey 1995) and wildlife/habitat groups, which are used to determine effects on habitat types. However, because most of the data recorded for aerial fire retardant use are by national forest/grassland or Forest Service region, there is not a direct correlation to habitat type by eco-region. See Appendix C for complete descriptions and fire retardant application rates for each eco-region.

Firefighters and fire planners describe the affected environment by fuel-model type. Firefighters integrate fuel models and fuel descriptions to determine the appropriate fire retardant coverage level. Fuel models are classified into four fuel -complex groups that include grasses, brush, timber litter, and slash (Anderson 1982). The fire behavior relates to the fuel loading expressed in tons/acre and the fuel bed depth, which relates to the fuels distribution among the fuel-size classes. Scott and Burgan (2005) further refined fuel models by including non-burnable fuel types (urban, ice, water rock) and sub-grouping the fuel complexes by adding moisture-climatic-condition classes along with the fuel loading and distributions. Knowledge of which fuel model a certain habitat type occurs in determines the amount of fire retardant that may be applied to that habitat type (refer to Appendix C and table on coverage level by fuel type in the Fire Retardant Use in Wildland Fire Management section of this chapter).

Thus, determination of the impacts on wildlife habitats may best be displayed by describing the habitat's ecological function, rather than eco-region type or fuel-model type. The analysis includes the following wildlife habitat types (Cooperrider et al. 1996):

- Wetlands, tidal marshes, bogs, springs (with aquatic associated plant species);
- Riverine wash and riparian upland (those areas immediate adjacent to streams and waterways discussed under the aquatics section);
- Arid, semi-arid, or desert; Great Basin, Mojave, Sonoran, and Chihuahuan;
- Grasslands and meadows and pine-oak savannah;
- Brush or chaparral (including southern rough and pinyon-juniper-sage);
- Fossorial or subterranean;
- Forested (including hardwood, coniferous and mixed forest as well as various seral stages of development and age groups);
- Rocky areas (including outcrops, talus, cliffs, and caves); and
- Arboreal (snags, poles, and other perch sites for birds).

3.6.2 Environmental Consequences

Methodology

This analysis focuses on the effects of the proposed use of aerial application of fire retardant on terrestrial wildlife species and their habitats. The amount of fire retardant used depends on the vegetation type, fuel models, and also the eco-region area in which the fire is occurring. Risks from using aerial application of fire retardant to wildlife include: direct application to individuals and habitat disturbance to individuals, indirect ingestion through food and prey sources, and changes in habitat characteristics due to changes in species composition from the fertilizing effects of fire retardant chemicals.

The analysis of impacts on wildlife habitat and species focused on the use of the following indicators:

- Effects on threatened endangered or proposed species and/or their designated critical habitats under the Endangered Species Act (ESA) and required consultation under Section 7 with the U.S. Fish and Wildlife Service.
  - The Biological Assessment (BA) serves as the analysis for these species.
  - The BA is a separate supporting document and is included in the project record; a summary of effects on ESA-listed species is included in Appendix I.

- Effects on Regional Foresters' sensitive species (including candidate species) for all Forest Service regions.
  - The Biological Evaluation (BE) serves as the analysis for these species.
  - The BE also includes the BA analysis.
  - The BE is a separate supporting document and is included in the project record.
  - A summary of effects on all species analyzes is in Appendix I.

Screening Process

Two different screening processes were used to evaluate the effects of aerial application of fire retardant on wildlife species and habitats. The first process, a Terrestrial Wildlife Effects Screening Process (Appendix I) was developed to help guide the effects analysis for wildlife species (using TEPCS as surrogates for all wildlife). The determinations are based on species mobility, disturbance to species, effects on habitat potential for use, distribution and population size, and duration of the event (i.e., amount of application of fire retardant).

The second process, a National Effects Screening Process (Appendix E) was developed as a coarse filter for all threatened endangered and proposed species to determine the effects based on the potential use of aerial application of fire retardant on wildlife, plant and aquatic species and habitats. Threatened endangered and proposed species with a may affect determination were then included in the wildlife portion of the BA and consulted on under the ESA Section 7 consultation with the U.S. Fish and Wildlife Service.

In addition to all wildlife species and habitats, the BA and BE include analysis of effects on approximately 106 species listed as either threatened endangered or proposed and/or their designated critical habitats listed under the ESA; and the approximately 550 sensitive species, including candidates species for listing (under the ESA), listed as part of the regional foresters' sensitive species list for each of the Forest Service regions (Forest Service Manual 2670).

Given the national programmatic broad scale of this analysis and the existence of several hundred wildlife species listed as TEPCS, the analysis uses the following grouping process:

- Each group is a major animal type: mammals, birds, reptiles, invertebrates and amphibians (see Appendix I);
- Each subgroup is similar species within the larger Group: small mammals, bats, ungulates, etc. (see Appendix I);
- Analysis was conducted on the group or subgroup rather than each individual species (except those analyzed in the BA and BE) (Appendix I).

Analysis of Effects Common to All Species

The analysis conducted was on a broad scale and can be applied to all species within the group or subgroup listed above regardless of listing status under the ESA, national forest and grassland land management plans, or Forest Service policy. The potential effects on TEPCS are reasonable examples of potential effects on most other wildlife species, because most TEPCS species have either specialized habitats or habitats common to most non-TEPCS species.

Given the broad scale of this analysis, this assessment uses qualitative rather quantitative values because it is impossible to accurately predict where and when the aerial application of fire retardant will be used as a firefighting tool, or how much it will be used; therefore, it is impossible to predict the specific effects that would affect individual species and their associated habitats.

Regardless of whether fire retardant is used, the following assumptions may be made concerning large wildland fires (Geier-Hayes 2011), they:

- Often burn for long durations in a variety of weather and fuel conditions that can produce high fire severity effects across a large area.
- Have more potential to affect a greater proportion of the population of a species or their habitats at one time, particularly for endemics or species whose populations or habitats are limited in distribution or have been affected by fragmentations or changes in land use surrounding them.
- Have the potential to increase the spread of non-native plant species, which favor ground disturbances and thus may reduce the quality of habitat for native plant species.

In general, fire suppression chemicals do not cause harm to most terrestrial wildlife, vegetation, and soils because the ammonium compounds used have minimal or minor toxicological or ecological effects (see discussion below) to terrestrial ecosystems (Labat Environmental 2007). However, most research has been limited to effects on aquatic species. The analysis contained in the *Ecological Risk Assessment: Wildland Fire-fighting Chemicals* (Labat Environmental 2007) was prepared for the Forest Service for a number of chemicals used in long-term fire retardants, foams, and water enhancers. The toxicity analysis for fire retardant salts associated with risks to terrestrial species. This analysis tested the lethal dosage for many products formulated by current chemical retardant manufacturers (Labat Environmental 2007).

Representative terrestrial species analyzed in the Labat Environmental Report (2007) are as follows:

- Mammals: deer (large herbivore), coyote (carnivore), and deer mouse (omnivore, prey species);
- Birds: American kestrel (raptor), red-winged black bird (songbird), and bobwhite quail (ground nester);
- Aquatic species, including tadpoles of frogs or toads.

These groups of animals correlate to the subgroups used for mammals and birds in the wildlife analysis for this EIS and information found in Appendix I.

Environmental Consequences Common to All Species

Direct Effects Common to All Species

The potential risks to or impacts on terrestrial species from the use of fire retardants under Alternatives 2 and 3 are expected overall to be minimal or minor, because these risks are small in scale: they are not likely to affect more than a few individuals or a portion of a population or habitat at any one time, and the fire retardant is not likely to have a lasting effect on most of the species. These effects are considered to be temporary or short-term in nature. Additionally, the use of fire suppression chemicals is not likely to have a long-term effect on terrestrial ecosystems (Labat Environmental 2011) because fire retardant is water soluble; thus, it is expected that most will dissipate and be removed during the first wet-weather event.

Small, endemic (or localized) populations with limited mobility or a specialized habitat may be affected by the aerial application of long-term fire retardant if directly hit. However, given the mobility of most species and their natural instinct to avoid a fire, direct application of fire retardants on wildlife species is expected to rarely occur. Instances where direct impacts from the application of fire retardant may occur more often is where nest trees or breeding sites are occupied at the time of the wildland fire incident or where the mobility of the individual species is such that it cannot avoid the area of application, such as with young individuals.

Another potential direct effect resulting from the aerial application of fire retardant is disturbance associated with low-flying aircraft that could stress animals (disrupt calving, rearing, or nesting) or displace animals to areas of less suitable habitat Although short in duration, this activity may cause a change in behavior for any wildlife that may be present or within the vicinity of the fire retardant drop. Disturbance by low-flying aircraft may affect an area up to ½-mile from an occupied site, which is a commonly accepted distance from raptor and other bird nests for most species (such as northern spotted owl, marbled murrelet, and bald eagle in the Pacific Northwest). Even those species with a moderate to high rate of mobility, which have the ability to escape the wildlife fire area and are able to avoid direct drops of fire retardant, may be affected by the aircraft flying overhead or in the vicinity if individuals are roosting or nesting within approximately 1 mile.

A third possible direct effect on habitat is the breaking off of tree tops/vegetation by a low, fast drop of a large load (2,500 gallons) of aerially applied fire retardant. It is possible that fire retardant drops could adversely affect components of critical habitat or required breeding and rearing habitat either with a direct hit, thus covering vegetation, or by breaking vegetation necessary for nesting, foraging, or perching. However, the probability of this occurring to a nest tree in mature and old-growth habitat is highly unlikely, since the use of fire retardant in closed-canopy forests is not very effective, thus is unlikely to be used.

Indirect Effects Common to All Species

Indirect impacts of fire retardant use on the food and water resources are likely to be short-term and localized, whereas those from uncontrolled wildfire potentially could have long-term adverse effects on the food and water resources of the entire population. Indirect effects of the use of aerial application of fire retardant may include the coating or covering of vegetation and food sources consumed by species. According to the assessment done by Labat Environmental (2007)(later updated February 2011), the effects on a species from ingestion of vegetation or insects coated or covered with fire retardant depends on the amount of fire retardant used (the amount of coverage by vegetation/eco-region type), timing of ingestion after application, ability of the animal to avoid feeding on chemicals, and availability of alternate food supplies in the immediate area.

Depending on the feeding habitats of some species, a small amount of prey burden or bio-accumulation (toxins that are ingested by a prey species and then are ingested by a predator that eats the prey), may be expected to occur in areas with high use or application rate of fire retardants. However, bio-accumulation or prey burden generally occurs across a long time span and may not affect certain types of species in the long term. In the short term, an individual would have to consume excessive amounts of fire retardant to exceed the lethal dose for that species, which is highly unlikely.

A potential risk exists if a sufficient portion of an individual's diet or water source is contaminated; however, the entire population is not likely to be affected. If contamination of a food base occurs, it may cause avoidance of certain areas by an individual or group. This may have a short-term negative effect on some individuals of a species, but it is unlikely to adversely affect the entire population in the long-term (Labat Environmental 2007, 2011).

Additionally, since fire retardants are composed mostly of fertilizers, long-term use of these chemicals may benefit some wildlife because of increased tree, plant and grass (seed) growth. Conversely, if non-native plant species are present in the same area, these species may out-compete native vegetation and may cause a short- and long-term negative impact if not controlled.

Finally, there is a very low probability that the use of aerial application of fire retardants would actually cause impacts on TEPCS or other wildlife species or habitat due to the relatively small amount of fire retardant actually used in wildland fire suppression activities: on less than 1 percent of the land base and on less than 5 percent of the total number of fires.

Cumulative Effects Common to All Species

Numerous human and natural actions, past, present, and reasonably foreseeable are likely to or potentially may cause negative or positive impacts on federally listed threatened and endangered or sensitive species viability or habitats. Activities such as habitat restoration and rehabilitation projects, habitat destruction from land development, recreational activities, natural disasters (such as hurricanes), climate change, grazing, timber harvesting, road construction and maintenance, mining, etc, all may have the potential to impact wildlife species and habitats resources. NFS lands have land management plan guidance that provides for protection and restoration of threatened endangered or sensitive species and habitats, as well as standards and guidelines for other wildlife species and habitats.

As shown in most of the analysis for wildlife, the use of aerial application of fire retardant is expected to have short-term effects. Additionally, the use of aerial application of fire retardant is expected to assist in preventing wildfires from becoming potentially larger and consuming most or the entire habitat for a species.

Application of actions and assumptions for cumulative effects are likely to be minor under Alternative 2 because of the small amount of area affected by fire retardant each year, spread widely across the United States (less than 1 percent of all NFS land). Although there is the potential for aerial fire retardant to be applied to more federally listed species and Forest Service-listed sensitive species under this alternative, the re-application to these same locations in the future is highly improbably because fire and use of fire retardant would not occur owing to low fuel loads. In other words, once a fire burns an area, it is highly improbable to burn at the same intensity again to cause the Forest Service to drop more fire retardant in that area. As shown in most of the analysis for wildlife, the use of aerial application of fire retardant is expected to have short-term effects Additionally, the use of aerial application of fire retardant is expected to assist in preventing wildfires from becoming potentially larger and consuming most or the entire habitat for a species.

Cumulative effects in Alternative 3 would be the similar to those described in Alternative 2 except that more federally listed threatened and endangered species and Forest Service listed sensitive species would be protected because of fire retardant avoidance area mapping. Because more avoidance areas are identified as no-fire-retardant-application areas to protect wildlife resources, there would be a reduced potential for a cumulative effect to occur within those defined areas. However, the amount of fire retardant could increase or decrease or stay the same depending on firefighting tactics used in the surrounding area. In addition, establishment of trigger points for restricting the use of fire retardants within watersheds where fire retardant has caused adverse affects to a species or population, and the required annual coordination should help reduce impacts on species and habitats. Lastly, under Alternative 3, the mitigation measures of avoidance area mapping for habitats and populations, establishment of trigger points for restricting the use of fire retardants within watersheds where fire retardant has caused adverse effects on a species or population, and the required annual coordination should help reduce impacts on species and habitats.

Potential direct, indirect, and cumulative impacts under Alternatives 2 and 3 are not expected to impede the long-term recovery of a species or the conservation value of its critical habitat. Implementation of the use of aerial application of fire retardants would allow essential features of critical habitat to remain functional because fire retardants are not likely to have lasting effects on terrestrial ecosystems. For species that are wide-ranging and have larger populations, aerial application of fire retardant on a specific fire would occur only on a very small portion or fraction of a population; therefore, cumulative effects would be very minor.

In summary, mitigation measures including avoidance area mapping for habitat and populations, the establishment of trigger points for restricting the use of fire retardants within watersheds where fire retardant previously has caused adverse effects to a species or population, and yearly operations planning should all help to reduce impacts on terrestrial species and habitats.

Overall, the potential risks to most terrestrial species are minimal, with the exception of small, isolated, endemic populations. For the most part, at a coarse or broad scale, the potential effects from the use of aerial application of fire retardants are expected to be minimal or minor; in they are expected to have small impacts in scale, are not likely to affect more than a few individuals or a portion of a population or habitat type at any given time, and are not likely to have a long-term effect on a species or habitat There are some species for which at a finer or local scale, such as with a small, isolated, locally endemic species that has a small population in relative abundance, limited distribution, or specific habitat requirements, the potential effects from the use of aerial application of fire retardants could adversely affect them, where adverse effects are possible.

Comparison of Alternatives

Alternative 1

Under Alternative 1, the use of aerial application of fire retardants would be discontinued. With this alternative, the conditions for all wildlife species and habitats would remain the same as if no aerial application of fire retardant activities were used during fire suppression activities.

The effect of not using fire retardant is the potential for some fires to burn uncontrolled. An uncontrolled wildfire may have a long-term negative effect, with the potential of eliminating habitat and food sources for a species for the lifespan of that species, depending upon the severity, duration, and size of the fire.

There would be no effects or impacts from toxicity to animal species or changes in habitat conditions from using only water during aerial suppression activities; therefore, no avoidance area protection are needed.

Disturbance to animal species from low-flying aircraft potential would still occur. This alternative may potentially have more disturbance that Alternatives 2 and 3 because water is expected to be less effective than fire retardant at suppressing fires; thus, more aerial water drops would be required for the same area, which potentially would create more disturbance from low-flying aircraft.

Alternative 2

Under Alternative 2, aerial application of fire retardants would continue under the current the 2000 *Guidelines* plus the 2008 Reasonable and Prudent Alternatives (Appendix A), with the three exceptions: anchoring to waterways, to protect other resources, and to protect human life. This alternative would continue to provide protection for waterways and a very small amount of terrestrial habitat in the form of avoidance area mapping for only a few (3) listed threatened and endangered species.

Alternative 2 may prevent wildfires from becoming potentially much larger and consuming most, if not all, of the habitat for a species, because it allows for the use of fire retardant to protect some wildlife species populations and habitats. Two of the exceptions allowed under this alternative permit the use of fire retardant within threatened and endangered species habitat to anchor to waterways and to use if other resources are deemed more important. Because of these two exceptions, the potential to keep more fires smaller is higher with this alternative than with Alternatives 1 and 3. Beneficial effects may include the protection of habitat from burning by the prevention of large-scale, stand-replacing events.

Alternative 2 has the same impact on species from disturbance from low-flying aircraft as Alternative 3, but less than Alternative 1, because fire retardant is more effective than water thus requiring fewer drops on the same area.

For Alternative 2, it is possible that terrestrial species with limited mobility could be directly affected from the aerial application of fire retardant, the same as with Alternative 3. The indirect effects of the use of the aerial application of fire retardant may include the coating or covering of vegetation and food sources consumed by species. Ingestion of fire retardant on vegetation or insects by a species depends on the amount of fire retardant used (coverage by vegetation/eco-region type), timing of ingestion after application, and the ability of an animal to avoid feeding on chemicals.

The potential impacts from Alternative 2 are expected to be more than Alternative 3 because of fewer species protected by avoidance areas. This is because the reasonable and prudent alternative from 2008 require avoidance mapping for only three federally listed wildlife species and their critical habitats (USDI Fish and Wildlife Service 2008) as necessary to reduce jeopardizing the species and mitigating the effects on these species. The three exceptions could still be used, which would impact T&E species and habitat more than Alternative 3. All other ESA-listed species and all Forest Service-listed sensitive species would not receive any protection measures.

Direct and indirect impacts from the implementation of Alternative 2 are not expected to impede the long-term recovery of a species or the conservation value of its critical habitat. Implementation of Alternative 2 would allow essential features of critical habitat to remain functional because long-term fire retardants are not likely to have lasting effects on terrestrial ecosystems. Additionally, Alternative 2 will prevent wildfires from becoming potentially much larger and consuming most or all of the critical habitat of a species.

Cumulative effects are likely to be minor under Alternative 2 because of the small amount of area affected by fire retardant each year, spread widely across the United States (less than 1 percent of all NFS land). Although there is the potential for aerial fire retardant to be applied to more federally listed wildlife species and Forest Service-listed sensitive wildlife species under this alternative, the re-application to these same locations in the future is highly improbably because fire and the use of fire retardant would not occur owing to low fuel loads. In other words, once a fire burns an area, it is highly improbable to burn at the same intensity again to cause the Forest Service to drop more fire retardant in that area. As shown in most of the analysis for wildlife, the use of aerial application of fire retardant is expected to have short-term effects. Additionally, the use of aerial application of fire retardant is expected to assist in preventing wildfires from becoming potentially larger and consuming most or the entire habitat for a species.

Implementation of Alternative 2 may result in the potential for more threatened, endangered or proposed (TEP) species likely to be adversely affected because fewer species (only three species) are protected from fire retardant effects with fire retardant avoidance areas. Additionally, Alternative 2 allows for fire retardant use in the avoidance areas, which potentially causes more impacts to TEP species. Effects associated with potential fire retardant application for the 105 TEP species analyzed include:

- 43 species with no effect, because they either occur on forests that do not use retardant or occur in a habitat where retardant would not be used.
- 62 species and 28 designated critical habitats determined to may affect - likely to adversely affect.

Effects or impacts associated with potential fire retardant application for Forest Service sensitive and candidate (SC) species include:

- 437 species where fire retardant application may impact individuals or habitat but not likely to result in a loss of viability in the planning area nor cause a trend toward Federal listing.
- 27 sensitive and 9 candidate species where application of fire retardant would adversely impact individuals or habitat resulting in a loss of viability in the planning area or trend toward Federal listing without protection from avoidance area designation for a total of 36 species.
- 74 sensitive species with no impact because they either occur on national forests or grasslands that do not use fire retardant or occur in a habitat where fire retardant would not be used.

Alternative 3

Under Alternative 3, the use of aerial application of only fire retardants would continue. This alternative still incorporates the 2000 *Guidelines* for waterways with the 2008 Reasonable and Prudent Alternatives (Appendix A). However, this alternative proposes additional protections in the form of avoidance area mapping for some of the remaining 102 threatened endangered or proposed (TEP) species under the ESA, as well as for some of the approximately 550 Forest Service sensitive (S) or candidate (for listing under the ESA) (C) terrestrial species.

Also, only one exception to the guidelines (the use of fire retardant for protection of human life and safety) is allowed under this alternative. Because of having only one exception, Alternative 3 would be expected to have less of an impact on habitat and species than Alternative 2, which allows for three exceptions to the guidelines; the other two exceptions under Alternative 2 could potentially affect populations and habitats.

In addition, Alternative 3 proposes monitoring of areas were fire retardant drops have been used within a watershed to determine if adverse impacts on any terrestrial species are occurring. If aerial application of fire retardant has occurred within a watershed and has a significant impact on a species or a portion of that species' population (or habitat then the area may have certain thresholds of impacts associated with it to restrict the future use of fire retardant for a specific period of time depending on the species affected, reproductive needs, life-cycle requirements, how the fire retardant impacts the critical life phases, and other factors.

Alternative 3 may prevent wildfires from becoming potentially much larger and consuming most, if not all, of the critical habitat for a species, because it allows for the use of fire retardant to protect habitats, same as Alternative 2. Beneficial effects may include the protection of habitat from burning by the prevention of large-scale, stand-replacing events.

Alternative 3 would have the same impact on species from disturbance from low-flying aircraft as Alternative 2 and less than Alternative 1 because of fire retardant's being more effective than water thus having fewer drops on the same area. Impacts from the direct application of fire retardant on species have a very low potential to occur, because of the mobility of most species.

With Alternative 3, it is possible that terrestrial species with limited mobility could be directly affected from the aerial application of fire retardant, the same as Alternative 2. The indirect effects of the use of the aerial application of fire retardant may include the coating or covering of vegetation and food sources consumed by species. Ingestion of fire retardant on vegetation or insects by a species depends on the amount of fire retardant used (coverage by vegetation/eco-region type), timing of ingestion after application, and the ability of an animal to avoid feeding on chemicals; the same as Alternative 2.

The use of additional avoidance area mapping for more species than Alternative 2 is expected to minimize the potential for direct and indirect impacts caused from the aerial delivery of fire retardant in the vicinity of the threatened endangered or sensitive species populations that may be affected during a critical period of their life cycle, such as nesting, if the predominate fire season coincides with this life-cycle period. Thus Alternative 3 provides more protection for more species and habitats from the direct and indirect impacts that Alternative 2.

However, under Alternative 3, these additional avoidance areas and the use of only the single exception to protect life could potentially lower the probability of success of suppression for some areas by fixed-winged aircraft under higher fire danger conditions, thus increasing the potential for more acres of habitat to burn. The potential for larger and longer duration fires may result in more ground-based suppression resource, more use of water and potentially longer term effects from disturbance on species from these and aerial activities associated with water drops, for a given area. This increase in potential is greater than Alternative 2 but less than Alternative 1.

Direct and indirect impacts from the implementation of Alternative 3 are not expected to impede the long-term recovery of a species or the conservation value of its critical habitat. Implementation of Alternative 3 would allow essential features of critical habitat to remain functional because long-term retardants are not likely to have lasting effects on terrestrial ecosystems. Additionally, Alternative 3 would prevent wildfires from becoming potentially much larger and consuming most or all of the critical habitat of a species.

Cumulative effects in Alternative 3 would be the similar to those described in Alternative 2 except that more federally listed threatened and endangered species and Forest Service-listed sensitive species would be protected because of fire retardant avoidance mapping. Because more avoidance areas are identified as no-fire-retardant-application areas to protect wildlife resources, there would be a reduced potential for a cumulative effect to occur within those defined areas. However, the amount of fire retardant could increase or decrease or stay the same depending on firefighting tactics used in the surrounding area. In addition, the establishment of trigger points for restricting the use of fire retardants within watersheds where fire retardant has caused adverse effects on a species or population, and the required annual coordination, should help reduce impacts to species and habitats.

Finally, Alternative 3 proposes monitoring of areas were fire retardant drops have been used within a watershed to determine whether impacts on terrestrial wildlife are exceeding some threshold established for a given species. If exceeded, then the use of aerial application of fire retardant may be restricted for a given timeframe until the species/habitat has recovered. Therefore, Alternative 3 provides more protections and fewer impacts than Alternative 2.

Of the 106 terrestrial wildlife species (including amphibians) federally listed under the ESA, analysis for impacts based on aerial application of fire retardant used by individual national forests resulted in the following:

- 43 species would have a no effect determination due to occurrence on national forests or grasslands that do not use aerial application of fire retardant, or occur in habitats where fire retardant would not be applied.
- 12 species would have a may affect - likely to adversely affect determination because of impacts expected from either from change in habitat disturbance, or toxicity expected from the use of aerial application of fire retardants.
- 50 species would have a may affect - not likely to adversely affect determination because of fewer impacts from change in habitat disturbance, or toxicity expected from the use of aerial application of fire retardants.
- 22 critical habitats with no effect; 6 critical habitats with a may affect - not likely to adversely affect.
- 32 species and 18 critical habitats would receive protection by avoidance area mapping.

For the 547 Forest Service-listed sensitive wildlife species, including candidate species, the expected impacts are:

- 74 species with no impacts because of no fire retardant use or not in habitat where fire retardant would be used.
- 473 species have a may impact individuals or habitat determinations.
- 36 sensitive species, including 9 candidate species, that have a potential risk to be trending toward listing with use of aerial application of fire retardant.

For the ESA-listed threatened or endangered species avoidance area mapping is required for 24 species and recommended for 8 species, for a total of 32 species. Avoidance area mapping is required for 16 designated critical habitats and recommended for 2 designated critical habitats, for a total of 18. Twelve species are located within riparian habitats and 20 species are located within terrestrial habitats.

For Forest Service-listed sensitive species, avoidance area mapping is recommended for 27 sensitive species and 9 candidate species; 17 species are located within riparian habitats, 8 species are located within meadow habitats, and 11 species are located within terrestrial habitats.

Comparison of Effects of the Alternatives on Wildlife Species and Habitats

Table 15 'Comparison of Effects of the Alternatives on Wildlife Species and Habitats' is a comparison of the potential effects of the three alternatives on wildlife species and habitats.

Table 15 Comparison of Effects of the Alternatives on Wildlife Species and Habitats

Effect	Indicator	Alternative 1	Alternative 2	Alternative 3
Aerial application of fire retardant	Use	No	Yes	Yes
Impacts on wildlife species/habitat	Relative amount	Lowest of all alternatives	More than Alternative 3 expected because fewer protections in place	Less than Alternative 2 expected because more protections in place
	Disturbance from low-flying aircraft	Expect more than Alternatives 2 and 3 because more drops needed with water in comparison to using retardant	Expect less than Alternative 1 and the same as Alternative 3	Expect less than Alternative 1 and the same as Alternative 2
	Toxicity	None because no retardant used	Very low probability of toxicity - higher than Alternative 3 because fewer avoidance area protections	Very low probability of toxicity - lower than Alternative 2 because more avoidance area protections
	Potential for larger fires that could affect habitat	Higher than Alternatives 2 and 3 because water is less effective - larger scale fires expected - could affect more habitat	Lowest of all alternatives; lower than Alternative 3 because of exception to anchor within protected areas; most effective at suppression	Lower than Alternative 1 but higher than Alternative 2 because of single exception for protecting life and safety - may be less effective at suppression than Alternative 2
Impacts on federally listed species	Relative amount	0[1] - due to only water being used	More than Alternative 3 because of three exceptions leading to retardant use in waterways and habitat	Less than Alternative 2 because of single exception for life and safety and additional avoidance area designations for certain candidate species

Effect	Indicator	Alternative 1	Alternative 2	Alternative 3
	Protections provided	No avoidance area mapping required	Only for three species and their designated critical habitats from the FWS 2008 BO for jeopardy determination	Avoidance area mapping of 32 listed species and 18 critical habitats No jeopardy expected because of conservation measures
	# of species and critical habitats affected	0	43 - No Effect 62 - May Affect - Likely to Adversely Affect For designated critical habitats - 28 - May Affect - Likely to Adversely Affect	43 - No Effect 12 - May Affect - Likely to Adversely Affect 50 - May affect - Not Likely to Adversely Affect For designated critical habitats - 22 - No Effect, 6 - May Affect - Not Likely to Adversely Affect,
Impacts on Forest Service sensitive species	Relative Amount	0 [2]- because only water being used	More than Alternative 3 because of three exceptions leading to retardant use in waterways and habitat	Less than Alternative 2 because of single exception for life and safety and additional avoidance area designations for certain candidate and sensitive species
	Protections provided	No avoidance area mapping required	No protections in place for sensitive species	Avoidance area mapping for 36 sensitive species that may be trending toward listing with fire retardant use, including 9 candidate species for listing under ESA
	# species affected	0	74 - No Impacts 36 - Likely to Trend Toward Listing or loss of viability on the planning unit	74 - No Impacts 471 - May Impact Individuals or Habitat but not likely to result in a trend toward listing or loss of viability

Effect	**Indicator**	**Alternative 1**	**Alternative 2**	**Alternative 3**
			437 - May Impact Individuals or Habitat but not likely to result in a trend toward listing or loss of viability	
Direct impacts	Relative amount	None, except disturbance	More than Alternative 3 because fewer proposed protections	Less than Alternative 2 because of proposed additional protections
Indirect impacts	Relative amount	None	More than Alternative 3 because of fewer protections	Less than Alternative 2 because of more protections
Cumulative impacts	Relative amount	None	More than Alt 3 because of fewer protections	Less than Alternative 2 because of more protections
Aerial application guidance	Guidance	None needed	2000 *Guidelines,* including 2008 Reasonable and Prudent Alternatives (Appendix A)	Aerial Application of Fire Retardant Direction, Including 2008 Reasonable and Prudent Alternatives (Appendix R) and additional terrestrial mapping, reporting, and monitoring
Misapplications	Potential	0	0-15 per year; less expected than under Alternative 3 due to fewer avoidance areas	15 per year; more expected than under Alternative 2 because of more avoidance areas
Exceptions	Number of	0	Three; life or property threatened, anchor point to waterway, other natural resources loss outweighs loss of aquatic life	One; threat to life or public safety only
Avoidance area mapping	Type and amount	None required None	Aquatic and terrestrial for threatened and endangered species only Avoidance mapping of the three jeopardy wildlife species and their critical habitats	Aquatic and terrestrial TEP species and some CS species Avoidance mapping of 32 threatened and endangered species and 18 critical

Effect	Indicator	Alternative 1	Alternative 2	Alternative 3
				habitats plus 36 sensitive species for a total of 68 wildlife species
Mapping standards	Type	None	Only for aquatics	National standards for both aquatics and terrestrial
Annual coordination	Occurs	None required	Yes	Yes
Reporting of misapplications and assessment of effects	Amount	None	Report of misapplication done on annual basis. If 'no effect' determination, then no further assessment If 'may affect' determination, then local FWS office contacted for emergency consultation	Reporting of misapplication at time of incident regardless of impact determination and annual reporting Effects determination done at time of incident to determine if incidental 'take' limits are exceeded; If take exceeded, then re-initiation of formal consultation is triggered
Monitoring of use of aerial application of fire retardant for misapplications	Amount	None	None currently required under the 2000 *Guidelines* and 2008 RPAs (Appendix A)	Monitoring of 5% of all initial attack fires less than 300 acres where retardant has been used and avoidance areas are present, for potential impacts on resources; reported to FWS/NOAA
Consultation	Type/amount	None	Initiate emergency consultation for 'may affect' or 'likely to adversely affect' determination for some species at time of misapplication	Incidental take statement included as record of decision for EIS for 'may affect' and 'likely to adversely affect' determinations for some species, and for 'not likely to adversely affect' determination for most

Effect	Indicator	Alternative 1	Alternative 2	Alternative 3
				species. If take exceeded, then formal consultation is re-initiated.
Trigger point for closure of area to aerial fire retardant use	Amount	None	None	Report of mishap and impacts on TES species requires consultation with Forest Service, FWS, NOAA Fisheries to determine appropriate restriction period on use of future application in an area (species-dependent)

1. Disturbance covered in above under all wildlife
2. Disturbance covered in above under all wildlife

3.7 Social and Economic Considerations

The material contained in this section is a summary of information presented in the specialist report on social and economic effects, available in the project record. Multiple statutes, regulations, executive orders, and agency directives identify the general requirements for the application of economic and social evaluation in support of Forest Service decisionmaking. These include, but are not limited to, the National Environmental Policy Act (NEPA) of 1969, Forest Service directives (FSM 1970; FSH 1909.17), and Executive Order 12898 (US President 1984) (i.e., Environmental Justice).

3.7.1 Affected Environment

General background information about the history, application, and use of aerially applied fire retardant is summarized in the Wildland Fire Management section in this chapter. Additional information about recent rates of use and costs of retardant for small and large fires on NFS lands is presented below.

The average number of fires on Forest Service land is estimated to be 9,320 per year (Table 16 'Current Average Suppression and Retardant Costs for Forest Service Fires (2000–2010) (2010$). '); average annual Forest Service suppression costs are estimated to be $917 million per year (2010$).

The average annual NFS cost of retardant use (i.e., cost for airtanker flight time and retardant purchase) is estimated to range from $24 million to $36 million per year for 2000 to 2010, or approximately 2.6 percent to 4.0 percent of the average total NFS suppression costs per year [3]. Tanker flight time accounts for 48 percent of the lower bound

3 Source of total suppression costs: Forest Service accounting system, Foundation Financial Information System (FFIS) as adjusted according to Prestemon et al. 2008 (as summarized in USDA Forest Service 2011a).

fire retardant application cost estimate and 32 percent of the upper bound fire retardant application costs. See Table 16 'Current Average Suppression and Retardant Costs for Forest Service Fires (2000–2010) (2010$). '[4] Fire retardant application costs do not include general aviation program operation, support, and acquisition costs.

Table 16 Current Average Suppression and Retardant Costs for Forest Service Fires (2000–2010) (2010$).

Annual Average Number of Wildfires 1	Average Total Suppression Cost Per Year ($000s) 2	Annual Cost of Retardant Application (000's) 3		Annual Cost of Retardant Application as Percent of Suppression Costs	
		Lower-bound	Under-bound	Lower-bound	Upper-bound
9320	$916,623	$24,027	$36,350	2.6%	4.0%

1. Estimated from FIRESTAT data for 2000–2010 (USDA Forest Service 2011b).
2. Total cost derived from: FS accounting system and Foundation Financial Information System (FFIS) as adjusted according to Prestemon et al. 2008.
3. Cost of applying retardant (i.e., airtanker flight time and fire retardant material cost) is derived from a range of retardant prices ($1.50 to $3.00 per gallon (2010$), and estimates of airtanker flight time costs obtained from National Interagency Fire Center databases and airtanker and contract data (USDA Forest Service 2011b). Retardant costs do not include acquisition or operation and support costs for the aviation and tanker bases. The aviation program is expected to continue under all alternatives, though some change in fleet composition and base operation may occur under Alternative 1 compared to existing conditions. Little difference in fleets and base operations is expected under Alternatives 2 and 3.

3.7.2 Environmental Consequences

Methodology

Existing agency policy and direction characterizes the goals and objectives (i.e., outcome constraints) that are used to help design wildland fire suppression plans and strategies. Those goals and objectives include consideration of a number of values-at-risk (e.g., property, infrastructure, and natural resources), including priorities regarding firefighter safety, while accounting for the effectiveness of different suppression strategies and tools to protect those values over a range of environmental and physical/topographic conditions. For example, the Guidance for Implementation of Federal Wildland Fire Management Policy (Feb 13, 2009) (as cited in the Interagency Standards for Fire and Fire Aviation Operations (2011) states that fire management programs should protect, maintain, and enhance federal lands in a cost effective manner. Specific objectives include: (1) protect human health property, and natural resources, (2) minimize damages and maximize overall benefits of wildland fire within the framework of land use objectives and land management plans, and (3) provide for firefighter and public safety and minimize cost and resource damage consistent with values to be protected and management objectives. The Interagency Aerial Supervision Guide (IAS guide) (NWCG 2010) states that strategies (ground and air operations) are based on values-at-risk and resource management objectives, while tactics are based on fuel type, fire intensity, rate of spread, resource availability, and estimated (fire) line production rates (chapter 8 of IAS guide). The IAS guide also states (in chapter 8) that tactical plans are based on a number of principles and considerations, including target priorities, such as in the following order: (i) human safety, (ii) structure protection, and (iii) natural resources.

4 Source: Data and calculations are summarized in USDA Forest Service 2011a.

Given that the proposed action affects the degree to which aerially applied fire retardant can be used to contain fires[5] and thereby achieve pre-existing suppression goals and objectives (outputs), the economic effects in this analysis will be discussed in the context of increases or decreases in cost efficiency. This indicator is consistent with the goal of the IAS guide (NWCG 2010): “to promote safe, effective, and cost-efficient aerial supervision services in support of incident goals and objectives.”

Differences in cost efficiency across alternatives are characterized by comparing potential changes in agency costs to potential changes in capacity to meet fire suppression objectives (see Table 17 'Components of Cost Efficiency'). This analysis makes the following general assumptions:

- This analysis focuses on fire management where decisions are made to suppress or control a wildfire. None of the alternatives will directly affect fire management objectives; alternatives to fire retardant (e.g., water) are expected to be implemented to help meet suppression objectives as specified in pre-existing regulations, policies, and land management plans.
- While potential suppression objectives, including protection of health safety, and values-at-risk, are assumed to remain unchanged under all alternatives, the capacity to meet suppression objectives may change under the alternatives. The capacity to meet suppression objectives is a function of tools and strategies available and used to meet the fire control or tactical objectives listed in the "Purpose and Need" statement for this action (e.g., reduce fire intensity and rate of spread; enable quicker response) (as stated in chapter 1 of this Final Environmental Impact Statement [FEIS]).

Table 17 Components of Cost Efficiency

Costs	Suppression Objectives
1. **Retardant Costs**: Volume and flight time as a function of proposed restrictions (e.g., avoidance areas) and exceptions; 2. **Compliance Costs:** Mapping of avoidance areas,assessments/consultations for misapplication, monitoring of resource impacts from application to fires <300 acres; and 3. **Other Wildfire Suppression Costs:** Use of other suppression tools (water, additional ground resources) and suppression strategies in the absence of retardant in an effort to maintain capacity to meet existing fire management goals/objectives.	***Protection of public and firefighter health and safety:*** 1. From direct effects of exposure to retardant, and 2. From indirect effects of changes in wildfire characteristics. ***Protection of (or reduced probability of losses/damages to)Values at Risk*:** 1. Protection of property, structures, facilities from changes in fire characteristics and conditions, 2. Protection of goods and services derived from natural and cultural resources, consistent with existing resource management objectives, as specified in regulations and: a. from direct effects of exposure to retardant b. from effects of changes in fire characteristics and conditions.

5 See the ‘Wildland Fire Management Specialist report’ (Henderson and Lund 2011) for details about the link between fire retardant use and suppression effectiveness as it relates to this proposed action.

Assumptions

Costs

Costs consist of (1) compliance costs (i.e., mapping, monitoring, and assessment/consultation activities); (2) costs of aerial fire retardant application (i.e., material costs and flight time); and (3) other wildfire suppression costs (i.e., all other suppression costs, excluding cost of fire retardant use and compliance with fire retardant application guidelines). See for costing assumptions (details are provided in the "Specialist Report - Social and Economic Effects," prepared for the FEIS).

Under Alternatives 1 and 3, other suppression costs may be affected by: (1) use of alternative types of suppression tools and tactics used for initial attack and large fires, and (2) changes in suppression effort needed to address potential changes in the size and characteristics of fires. Quantifying or projecting future suppression costs is difficult due to uncertainty about future fire conditions and characteristics that affect tool selection and strategy design and the relative effectiveness of those tools and tactics under reasonably foreseeable constraints on interagency fire management resources (e.g., crews, equipment, tankers, etc.). As a consequence, no attempt is made to quantify the incremental or indirect suppression costs associated with Alternatives 1 and 3. (For more details about suppression effectiveness and capacity, see the ‘Wildland Fire Management’ section in this chapter.) However, changes in suppression costs are discussed qualitatively, and estimates of average suppression costs associated with large fires are discussed to help demonstrate the potential value of effective suppression in the context of avoided large fire costs.

The aviation program is expected to continue under all alternatives, though some change in fleet composition and base operation may occur under Alternative 1 compared to existing conditions. For the purposes of this analysis, agency costs associated with potential changes in the aviation program are not addressed further and are assumed to remain relatively constant across the alternatives. For details about costing assumptions, see cost results footnotes in Table 18 'Annualized Costs, by Alternative (2010$).'

Capacity to Meet Suppression Objectives

Capacity or ability to meet suppression objectives associated with protecting values-at-risk, public health and safety, and firefighter safety is a function of direct effects from exposure to aerially applied fire retardant or due to the ecological consequences of fire retardant use (e.g., nutrient effects in waterbodies) and indirect effects from changes in fire conditions resulting from the use of fire retardant. Direct effects from exposure to and ecological consequences of aerially applied fire retardant are discussed in relevant sections of chapter 3 and summary of effects in chapter 2 of this document and therefore not reproduced in this section. Potential changes in fire characteristics and conditions depend on a number of unknown site-specific conditions and circumstances associated with future fires and are therefore described in qualitative terms only, as explained in the Wildland Fire Management section within chapter 3 of this document. As a consequence of the uncertainty surrounding indirect effects from future changes in fire conditions, no attempt is made to characterize potential changes in capacity to meet suppression objectives. Instead, the potential to meet the tactical wildland firefighting objectives listed in the "Purpose and Need" (see chapter 1 of this document) is adopted as a qualitative indicator of capacity to meet suppression objectives, such as protection of safety and values-at-risk (as explained in the Methodology section above). Other indicators for resource effects are described in resource-specific sections within chapter 3 of this document. To compare the suppression cost efficiency results presented in this section to the direct effects to sensitive resources resulting from exposure to and/or ecological consequences of aerially applied fire retardant, the reader is referred to the summary of effects in chapter 2.

Alternative 1—No Action

Direct and Indirect Effects

Compliance, aerially applied fire retardant use, and other suppression costs are presented by alternative in Table 18 'Annualized Costs, by Alternative (2010$).'. Details about other suppression costs and effects associated with "capacity to meet suppression objectives" are discussed separately for each alternative.

Table 18 Annualized Costs, by Alternative (2010$).

	Compliance Costs				Annual cost of Aerial Retardant Application [1]	Other Suppression Costs [2]
	Annualized Mapping Cost [3]	Annual Small Fire Monitoring Cost [4]	Annual Misapplication Assessment and Consultation [5]	Total Annualized Compliance Cost		
Alt 1	$0	$0	$0	$0	$0	>Alt 2
Alt 2	$830,000	$0	$130,000	$960,000	$24 to $36 million	~ $880 to $892 million
Alt 3	$1,020,000	$70,000	$130,000	$1,220,000	~Alt 2 costs	≥ Alt 2

1. Costs for retardant volumes and flight time. Decreases in retardant use due to new restrictions may be offset by increases in retardant use in other (non-avoidance) areas under Alternative 3; insufficient evidence exists to conclude that Alternative 3 costs will differ from Alternative 2 costs.
2. Remaining suppression costs, excluding retardant and compliance costs. Alternative 2 costs are derived from total baseline suppression costs in Table 1 ($917 million). Costs for Alternatives 1 and 3 affected by (i) adoption of alternatives to retardant (e.g., water) for small and large fires and (ii) potential increases in numbers of escaped or large fires are not included. Costs do not include annualized acquisition or operation and support costs for the aviation and tanker bases in general. The aviation program is expected to continue under all alternatives, though some change in fleet composition and base operation may occur under Alternative 1 compared to existing conditions. Little difference in fleets and base operations is expected under Alternatives 2 and 3.
3. Mapping costs are higher during the first or initial year and then constant for subsequent years. A 4-percent discount rate and 15-year period is assumed. Costs include mapping tasks and pre-season coordinated meetings.
4. For Alternative 3, monitoring (4 days per fire) is assumed to occur on an average of one small fire (<300 acres) per year on 75 forest units; only one forest units was estimated to apply retardant on more more than 30 small fires, on average, per year. No monitoring of small fires occurs under Alternative 2.
5. Similar effort (i.e., 10 to 24 days staff time per incident) is assumed for Alternatives 2 and 3 for monitoring, assessment, and consultation to address 15 misapplication incidents per year combined with 15 additional incidents identified as a result of small fire monitoring, across all forest units. Potential differences in misapplication rates and effort under Alternative 3 are difficult to project. Costs do not reflect cultural resource assessments and consultation; these costs are not expected to have a substantial effect on overall compliance cost estimates.

Compliance and Retardant Costs

Under Alternative 1, there are no direct costs associated with aerial application of fire retardant. Correspondingly, there will be no compliance costs associated with mapping, monitoring, or misapplication requirements.

Other Suppression Costs

There is potential for increases in other suppression costs (see the Wildland Fire Management section in this chapter for details about suppression tools and strategies) under Alternative 1 given expectations that alternative suppression tools and tactics will be used in the absence of aerially applied fire retardant.

As discussed in the Wildland Fire Management section, water is estimated to be only 50 percent as effective as fire retardant, implying that twice as many flights may be necessary. However, there are a number of site-specific factors and conditions as well as fire program constraints that could affect the ability to substitute water for fire retardant and achieve the same level of suppression. If overall capacity for suppression is reduced in some situations, then the probability for larger fires could increase, contributing to potential increases in costs associated with managing large or escaped fires. For details about fire program constraints and potential changes in fire characteristics, see the Wildland Fire Management Specialist report (USDA Forest Service 2011c) and corresponding section in this chapter. Given the uncertainty regarding future fire locations and conditions and corresponding factors affecting the use and effectiveness of substitute tools and tactics, changes in other suppression costs are not quantified for this analysis. However, examples of large fire suppression costs are discussed below to help demonstrate potential changes in suppression cost associated with escaped fires and the value of aerially applied fire retardant in the context of avoided costs.

The incremental cost of an escaped fire (i.e., value of prevention of a large fire) on NFS lands has been estimated to be approximately $2.8 million, based on large fire (>300 acres) expenditures for 2000 to 2009[6] (as summarized in USDA Forest Service 2011a). As noted in Table 13, current costs associated with retardant application range from $24 to $36 million per year. The number of avoided escaped fires that might justify fire retardant delivery costs can be obtained by dividing fire retardant delivery costs by an average of $2.8 million per escaped fire, yielding 9 to 13 fires per year. These results suggest that the benefits of retardant use would just outweigh the cost of aerially applied fire retardant if the number of escaped fires increased by 9 to 13 fires per year in the absence of aerially applied fire retardant. There are other indirect costs associated with escaped fires that are not accounted for in the estimate of $2.8 million, such as loss of property, resources, increased risk of adverse health and safety effects and rehabilitation, recognizing that indirect costs may be offset by future suppression cost savings. As emphasized above, these figures are simply an example to demonstrate how incremental suppression costs might justify retaining aerially applied fire retardant as a suppression option under Alternatives 2 and 3 compared to Alternative 1; actual correlations between probability of escaped fires and fire retardant use have not been estimated due to the uncertainty stated above.

6 The average cost per large fire (>300 acres; categories E–G) is estimated to be approximately $3 million based on a range of $2.9 million (2000 to 2009) to $3.1 million (2005 to 2009) per fire derived from expenditure data, by fire p-code, from the Forest Service's FFIS. The average cost is reduced by 5 percent to account for initial attack expenses and retardant costs on some fires.

In general, the costs associated with using alternative suppression tools and strategies under Alternative 1 cannot be quantified; however, there is potential for increases in suppression costs associated with use of alternative tools and tactics on both small and large fires as well as general suppression effort (including time) needed to address potential changes in the size and characteristics of fires combined with management constraints imposed by limitations on the availability of crews and equipment as substitutes for retardant.

Capacity to Meet Suppression Objectives

For fires where decisions are made to implement suppression, overall risk to public and firefighter health and safety, as well as probability of loss or damage to values-at-risk, are expected to increase under Alternative 1 as a consequence of decreased capacity to meet tactical objectives stated in the "Purpose and Need" and corresponding changes in potential size and characteristics of wildland fires. For details about capacity to meet tactical objectives, see specialist sections related to fire operations and health and safety elsewhere in this chapter. For details about effects of fire retardant on other resources (e.g., sensitive species and habitat cultural resources), the reader is referred to summary of effects in chapter 2 and resource-specific sections in chapter 3.

Cumulative Effects

Cumulative effects under Alternative 1 may occur as a result of interagency fire management operations, in which fires may involve multiple agencies and jurisdictions. Aerially applied fire retardant use strategies, policies, and trends for other land management agencies (such as Federal or State) may be such that the elimination of aerially applied fire retardant by the Forest Service will create inconsistencies with air operation standards and guides adopted by other agencies, resulting in higher probability for confusion (and attendant safety hazards) among ground and air crews and increased time needed to plan and coordinate strategies (i.e., increased costs) when suppression involves multiple agencies or crosses agency boundaries.

Alternative 2—Proposed Action

Direct and Indirect Effects

Compliance and Retardant Costs

Compliance costs (mapping, monitoring, assessment, and consultation) under Alternative 2 are estimated to be approximately $1 million per year, accounting for only 3 to 4 percent of all direct costs associated with the sum of compliance and retardant costs (see Table 18 'Annualized Costs, by Alternative (2010$).'). Most compliance costs are due to avoidance mapping ($830,000), with misapplication assessments and consultation accounting for the remaining $130,000 per year. Costs for retardant use are estimated to range from $24 million to $36 million per year, which is simply the average annual material and flight time costs from 2000 to 2010, as discussed earlier in the Affected Environment section (i.e., retardant costs are assumed *not* to change from costs incurred over the past decade).

Other Suppression Costs

Aggregate wildfire suppression and other costs are assumed to remain unchanged as availability and use of aerially applied fire retardant as a component of overall suppression strategies is assumed to continue at a level consistent with operations over the past 10 years. Total suppression costs are assumed to be $917 million per year based on historical data from 2000 to 2010, implying that costs associated with suppression efforts, excluding fire retardant use and compliance costs, are approximately $880 to $892 million per year.

Capacity to Meet Suppression Objectives

For fire operations in which decisions are made to implement suppression, capacity to meet tactical objectives and corresponding suppression objectives (e.g., protection of firefighter safety, public health and values-at-risk) are expected to remain unchanged under Alternative 2 relative to recent periods of time over which retardant has been used under the 2000 guidelines. For details regarding capacity to meet tactical as well as indirect effects from retardant on sensitive resources (e.g., species and habitat cultural resources), see Chapter 2 and the specialist sections in this chapter.

Cumulative Effects

There are no cumulative effects projected under Alternative 2.

Alternative 3

Direct and Indirect Effects

Compliance and Retardant Costs

Compliance costs (mapping, monitoring, assessment, and consultation) under Alternative 3 are estimated to be approximately $1.2 million per year, with most compliance costs attributable to avoidance mapping, similar to Alternative 2. The increase in compliance costs relative to Alternative 2 (about $300,000 per year) is due to additional mapping costs associated with sensitive species and terrestrial standards and additional monitoring costs related to small fire monitoring. Assessment and consultation costs for misapplications are assumed to be similar for Alternatives 2 and 3. There may be some potential for fewer misapplications under Alternative 3 compared to Alternative 2 due to fewer exceptions and adoption of pre-existing criteria for determining whether effects constitute the need for emergency consultation (i.e., analysis of effects and potential for emergency consultation for Federally listed species is assumed to occur for all incidents under Alternative 2 but only for those incidents in which effects may exceed pre-established consultation determinations under Alternative 3). The addition of terrestrial avoidance areas may increase potential for misapplications for some units under Alternative 3. The aggregate effect of the changes under Alternative 3 (compared to Alternative 2) on misapplications and corresponding costs is therefore difficult to project.

Additional assessment and consultation, as well as monitoring effort, may be needed to determine the effects on cultural resources, including historic properties, traditional cultural resources, and sacred sites in the event of misapplication of aerially applied fire retardant. It is difficult to estimate misapplication rates for cultural resources, and calculated compliance costs therefore do not reflect cultural resource assessments and monitoring requirements for Alternative 3. However, there is little evidence to indicate that misapplication rates and compliance costs related to cultural resources will have a substantial effect on the relative magnitude of assessment, consultation, and monitoring costs (calculated to be $130,000 per year for resources other than cultural resources) compared to the magnitude of other costs (i.e., $1.02 million per year for mapping; $24 to $36 million per year for fire retardant use) under Alternative 3.

As noted in the methodology section above, it is not possible to conclude that annual retardant use and costs will be higher or lower under Alternative 3 compared to Alternative 2. Retardant use under Alternative 3 may be lower due to: (1) fewer exceptions for using retardant in avoidance areas, (2) increased acreage of avoidance areas (additional sensitive species mapping), and (3) possible decisions by some forest units that rarely use aerially applied fire retardant to eliminate its use (due to the perception that the benefits of fire retardant use do not outweigh additional costs and effort required to comply with the additional requirements under Alternative 3).However, decreases in fire retardant use in avoidance areas and near waterways might be offset by increases in fire retardant use in other areas to compensate for the inability to use aerially applied fire retardant in avoidance areas. Compensation by applying retardant in other areas may result in more retardant being used or deviations from efficient suppression strategies. As a consequence, there is insufficient evidence to conclude that fire retardant use under Alternative 3 will be different from the range of costs identified for Alternative 2.

Other Suppression Costs

The additional restrictions and constraints imposed on fire retardant use under Alternative 3 may result in greater use of suppression methods and tools that are less cost-effective and/or result in potential changes in the size and characteristics of fires, which could lead to greater demand for resources and time in suppression efforts for those fires that overlap with areas where additional restrictions apply. The aggregate costs of wildfire suppression could therefore increase under Alternative 3 relative to Alternative 2 for some fires. However, it is difficult to predict the difference in the degree to which substitute tools and tactics or additional suppression effort will result in higher suppression costs. The direction and magnitude of changes in other suppression costs are therefore uncertain compared to Alternative 2 but are still expected to be lower than Alternative 1. For more details about changes in fire operations and fire suppression capacity, see the Wildland Fire Management section within this chapter.

Capacity to Meet Suppression Objectives

For fires on which decisions are made to implement suppression, the additional restrictions and constraints on aerial application of fire retardant under Alternative 3 may result in reduced capacity to meet the tactical objectives listed in the Purpose and Need (see Wildland Fire Management section in chapter 3 of this FEIS for details about fire management effects of Alternative 3) in certain situations, thereby creating slight potential for increased risks to firefighter safety and public health as well as values-at-risk relative to Alternative 2, but still substantially less than Alternative 1. For details about capacity to meet tactical objectives and indirect effects from aerial application of fire retardant on sensitive resources (e.g., species and habitat cultural resources), see specialist sections in Chapters 2 and 3 of this final EIS (USDA Forest Service, 2011b).

New avoidance area requirements under Alternative 3 are expected to result in 0.83 percent of NFS lands being added to avoidance areas where aerial application of fire retardant is not permitted (with the exceptions specified under Alternative 3). However, it is not possible to show how new avoidance areas could potentially affect tactical flexibility and capacity to protect values-at-risk, such as property within the wildland–urban interface (WUI), because the location of future fire incidents and characteristics of those fire remain unknown in relation to the WUI.

Cumulative Effects

The same cumulative effect described for Alternative 1 may occur under Alternative 3; however, the magnitude of the effect is expected to be less because there would be fewer differences in guidance for using aerially applied fire retardant across agencies. Differences in guidance under Alternative 3 would therefore be less likely to create confusion or inconsistency across agencies.

Summary of Direct and Indirect Effects

Table 19 'Summary of Direct and Indirect Effects' summarizes cost efficiency results for this section. As noted in the methodology section above, cost efficiency is represented by capacity to meet the tactical objectives stated in the "Purpose and Need" for this action (see chapter 1). Capacity to meet tactical objectives does not capture all potential resource effects resulting from this action, and as such, the reader is referred to chapter 2 for a more complete comparison of all effects, including effects to sensitive resources from exposure to retardant and/or the ecological consequences of retardant.

Table 19 Summary of Direct and Indirect Effects

Effect	Indicator	Alternative 1	Alternative 2	Alternative 3
Agency Costs	Annualized compliance costs [1]	$0	$1 million/yr	$1.2 million/yr
	Average annual retardant costs [2]	$0	$24 to $36 million	Similar to Alternative 2
	Other suppression costs [3]	Greater than Alternative 2 due to (1) use of substitute tools and tactics for some small and large fires and (2) suppression effort (e.g., resources, time) to address changes in size and characteristics of fires.	$880 to $892 million/yr (i.e., baseline suppression costs)	Similar to or slightly higher than Alternative 2; Lower than Alternative 1
Capacity to satisfy suppression objectives	Capacity to meet suppression objectives listed in "Purpose and Need" (see chapter 1) for fires where decisions are made to suppress	Decreased capacity; increased probability of changes in size and characteristics of fires.	No change	Capacity similar to or slightly lower than Alternative 2; potential for slight changes in fire size or characteristics for some forest units depending on avoidance area mapping results.
Suppression cost efficiency		Lower	Unchanged	Similar to or slightly lower than Alternative 2

1. To comply with avoidance mapping, assessments, consultation for misapplications, and monitoring requirements.
2. Retardant volume and flight time.
3. Total Forest Service suppression costs for all fire sizes, net of compliance and retardant costs.

Environmental Justice

Executive Order 12898 (US President 1994) directs Federal agencies to focus attention on the human health and environmental conditions in minority communities and low-income communities. The purpose of the executive order is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. The Council on Environmental Quality (CEQ) (1997) provides the following definitions in order to provide guidance with the compliance of environmental justice requirements:

- "Minority population: Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis...."
- "Low-income population: Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another or a set of individuals (such as migrant workers or Native Americans) where either type of group experiences common conditions of environmental exposure or effect."

The proposed guidelines for aerial application of fire retardant applies to future unknown wildland fire locations on NFS lands in all regions of the country; as such, it is not possible to identify specific populations, demographics, or specific minority populations that might be exposed to aerially applied fire retardant. It is also estimated that fire retardant has been applied to fewer than 5,000 acres per year, on average, over the past 10 years (as noted in the Wildland Fire Management section in chapter 3 of this document), suggesting that potential for direct exposure to fire retardant is low. There is potential for larger and longer duration fires under Alternative 1 (though only a slight potential under Alternative 3), translating to increased exposure to risks for firefighters, the public, and values-at-risk; however, there is no evidence indicating that risks will be disproportionately higher for minority or low-income population areas. Based on this evidence, the proposed action is not expected to have a disproportionately high and adverse human health or environmental effect on minority populations or low-income populations.

3.8 Public Health and Safety

3.8.1 Affected Environment

Firefighter and public safety are the most important factors that the Forest Service considers when determining the firefighting strategies to use on National Forest System (NFS) lands. Incident commanders are responsible for considering the risks associated with all management decisions, including the safety of the public and firefighters.

The Forest Service has taken many steps to ensure that long-term retardants (also referred to as retardant or fire retardant) used by the field are as safe and effective as possible. Most of these steps occur as part of product evaluation. Successful completion of this evaluation is required before a product can be placed on the qualified products list (QPL). All long-term fire retardants purchased and used by the Forest Service during firefighting operations must be on the QPL. Long-term fire retardants are a mixture of fertilizer salts, thickening and coloring agents, and other ingredients such as corrosion inhibitors and stabilizers. The concentrate, which may be either a liquid or powder, is added to water to produce the aerially applied fire retardant used in firefighting operations.

The Forest Service adheres to quality control and safety requirements in the mixing or blending of aerially applied fire retardant chemicals (see Appendix J). In addition, the Forest Service uses fire retardant formulations that do not contain cyanide. See also the revised U.S. Forest Service Specification 5100-304c for Long-Term Retardant, Wildland Firefighting, June 1, 2007 (Appendix L).

Evaluation Process

Before the Forest Service accepts a long-term fire retardant product for evaluation, the supplier is required to provide the Forest Service with the following specific information necessary for the initial step of the evaluation process.

- A confidential disclosure of all raw materials used to make the retardant;
- The chemical abstract services (CAS) numbers for each of the raw materials. The CAS number is a unique identifier of the raw material in much the same way a Social Security number is a unique identifier;
- The manufacturer and grade of each raw material;
- The amount of each raw material in the product concentrate that will be delivered to the Forest Service;
- The amount of each raw material in the product that is prepared for application during firefighting operations;
- The material safety data sheet (MSDS) for each of the raw materials; and
- The MSDS for the retardant concentrate that will be delivered to the Forest Service.

The submitted information is reviewed to determine that the product does not contain the following chemicals of concern.

- Chemicals listed in the specification (Forest Service 5100-304c, section 2.2);
- Extremely hazardous substances as listed at *40 Code of Federal Regulations 355 Appendix A–Comprehensive Environmental Response, Compensation and Liability Act, List of Extremely Hazardous Substances and Their Threshold Planning Quantities;* and
- Known or suspect carcinogens as determined by the *National Toxicology Program's Annual Report on Carcinogens or the International Agency for Research on Cancer*monographs for potential carcinogens.

If any of the raw materials appear on any of these regulatory lists, a chemical profile and potentially a product risk assessment (described in more detail below) may be required before any further steps in the evaluation of the submitted formulation occur. An assessment of this type is performed by the Forest Service or an approved third party using accepted methodology described by the National Research Council and affirmed, as necessary, by the Environmental Protection Agency (EPA). If the hazard potential and amount of the raw material in the product do not change the hazard potential of the fire retardant product in question, the evaluation may continue; otherwise, the evaluation stops and the supplier is notified that the Forest Service will not enter into an agreement to evaluate the formula as submitted.

Once the product is accepted for evaluation, specific mammalian toxicity tests, as required by the specification, are performed on the concentrate and on the mixed fire retardant. Product samples for all tests are supplied by the Forest Service from the evaluation sample and all reports are submitted directly to the Forest Service to maintain a chain-of-custody for evaluation products and test results.

The tests are performed at a toxicity laboratory approved by the Forest Service using health effects guidelines and test protocols approved by the EPA, Office of Chemical Safety and Pollution Prevention (OCSPP) (formerly, the Office of Prevention, Pesticides, and Toxic Substances [OPPTS]). The specific tests required by the Forest Service retardant specification are identified below. [7]

- Acute oral toxicity (OPPTS 870.1100);
- Acute dermal toxicity (OPPTS 870.1200);
- Acute eye irritation (OPPTS 870.2400); and
- Acute dermal irritation (OPPTS 870.2500).

The acceptable performance levels are based on Office of Safety and Health Administration (OSHA) performance standards in place in 1982, when the requirement was added to the fire retardant specification. These are all pass/fail tests.

Fire Retardant Use Policy and Firefighting Operations

Personnel involved in firefighting operations are required to complete specialized training in the safe and appropriate use of long-term fire retardant. Requirements and information on appropriate use, required personal protective equipment, aerial application guidelines, and restrictions on the application of fire retardant are found in the *Interagency Standards for Fire and Fire Aviation Operations*, which is updated annually.

Programmatic Risk Assessments

Historically, the aerial application of fire retardant was most often done in remote areas. However, the increase in human population inhabiting and recreating the wildland–urban interface (WUI) has increased the potential for civilian exposure to aerially applied fire retardants.

A programmatic risk assessment of human health hazards is prepared every 5 to 10 years as the products on the Qualified Products List are modified or new products are added. The most recent document is the *Human Health Risk Assessment: Wildland Fire-Fighting Chemicals* (Labat Environmental 2003). This broad-scope risk assessment

7 The OPPTS designation is shown because it was in effect at the time the tests were performed, but it is anticipated that those numbers will change as OCSPP completes the reorganization of this office:

is an examination of potential human health hazards and is performed by recognized professionals in the field under contract to the Forest Service. Several products (Phos-Chek D75-R, Phos-Chek D75-F, Phos-Chek G75-F, and Phos-Chek G75-W) that were used in 2011 and, therefore, are included in the EIS even though they will no longer be used as of January 1, 2012. Other products (Fire-Tro FTR, Fier-Trol GTS-R, Fire-Trol LCA-R, and Fire-Trol LCG-R) that were included in the risk assessment are no longer commercially available, have been removed from the QPL, and are not included.

The risk assessment process consists of three steps:

- The **Hazard Analysis** uses the results of product toxicity tests performed during product evaluations to estimate a reference dose or "acceptable daily intake" that is expected to be safe according to available information. The results of toxicity tests on individual ingredients are also included if they are included in one of these categories: suspected carcinogens, highly toxic, or reportable under the provisions of OSHA or Superfund Amendments and Reauthorization Act 313.
- The **Exposure Analysis** develops estimated doses and estimates the extent and duration of exposure during firefighting operations. These estimates are developed in consultation with firefighters that have extensive on-the-ground firefighting experience. The exposures include typical and maximum exposures for workers such as airtanker base personnel (mixers and loaders), line firefighters (helitack crews, smokejumpers, hotshot crews, type 2 firefighters, engine crews, and overhead workers), male and female workers (representing different body weights), and adult and child members of the public.
- The **Risk Characterization** is estimated by calculating the hazard quotient, which is the estimated dose divided by the reference dose. When the hazard quotient is less than or equal to 1.0, the risk of health effects is predicted to be negligible.

The types of clothing worn by target groups greatly influences the potential for exposure and skin absorption.

- Firefighters wear boots, long pants, long-sleeved shirts, gloves, hard hats, and sometimes goggles and neck shrouds, all of which offer some level of protection from skin absorption.
- The public is more often exposed during cleanup of a structure after the fire has passed by and frequently wear lightweight clothes (such as shorts and tank tops), increasing the likelihood of absorption through the skin.

No risks to line firefighters, airtanker base personnel, or the public are predicted for routine exposures. Most groups are not predicted to have increased risks from a severe exposure or accidental drench. However, mixers exposed to Phos-Chek G75-W powder concentrate for 8 hours or more are predicted to have some increased absorption risk. This risk can be mitigated by removing the powder residue from clothing and exposed skin by washing with soap and water

- For *typical exposure* scenarios, all products and individual ingredients resulted in hazard quotients less than 1, indicating negligible risk to firefighting personnel from the retardants under typical conditions of exposure Estimated cancer risk to workers is less than 1 in 1 million, also indicating a negligible risk.
- For *maximum exposure* scenarios, product formulations had hazard quotients greater than 1, indicating a possible health risk for mixmasters exposed to dry powder concentrates, for loaders exposed to mixed Phos-Chek G75-W, and to female loaders exposed to mixed Phos-Chek 259-F.
- For *maximum exposure scenarios with individual ingredients*, possible health risks are indicated for mixmasters exposed to a retardant salt in Phos-Chek D75-R, Phos-Chek D75-F, Phos-Chek G75-W, and Phos-Chek G75-F and for females from a corrosion inhibitor in Phos-Chek 259-F. The hazard index for Phos-Chek G75-F

exceeded 1 when the risks from individual ingredients were summed, although the individual hazard quotients were all less than 1.

- No risks are predicted for either adult or child members of the public from cleaning a structure that had been treated with a fire retardant.
- In an *accidental drench* scenario for workers in the path of an aerially applied fire retardant, no significant risks are predicted. For the same scenario, risks were predicted for adult and child members of the public exposed to Phos-Chek G75-W.
- Risks to people reentering the area following a fire, such as rehabilitation teams, mushroom and berry harvesters, hunters, and salvage loggers, are unlikely.
- Eating produce from home gardens where fire retardant was applied is not advised.
- No significant risks are expected from human contact with domestic animals having retardant on their skin or coats.

Phos-Chek G75-W is not used at airtanker bases and is qualified for application from ground engines and helicopter buckets only, which are the most accurate delivery methods.

Phos-Chek G75-W is usually used for portable operations where residual color may be an issue or it is applied as a fire prevention aid where the likelihood of accidental ignitions is relatively high, such as campgrounds or where firework displays are planned.

One thousand pounds of Phos-Chek G75-W fire retardant concentrate, enough to make 955 gallons of mixed retardant, was sold to the Forest Service in the past 10 years and was used in one area to provide protection to natural gas wells during prescribed fire operations. This very limited and minimal use suggests that the exposure to mixers is unlikely to continue long enough to increase the risk.

Fire retardant products have been used for many years. During that time, reports of adverse health effects have been limited to skin and eye irritation and possible allergic reactions. This history does not appear to warrant additional extensive testing, especially given the transient emergency use of fire retardant products.

3.8.2 Environmental Consequences

Alternative 1—No Action

Based on the available information related to human health effects of fire retardant, there will be no change in the frequency and severity of these effects under this alternative because aerially applied fire retardant is not used. In remote areas, the use or non-use of fire retardants will likely have no effect on human health When fires occur on NFS lands near developed communities, smoke from fires may have a greater impact on human health than fire retardants applied during firefighting operations. Respiratory problems aggravated by smoke inhalation have the potential to affect many more people directly (resulting in respiratory distress, bronchial infections, and hospitalizations) and indirectly (as access to forest lands, outdoor recreation, and employment is restricted) than does the aerial application of fire retardant.

Alternative 2—Proposed Action

The human health effects under this alternative are likely to be minimal (primarily skin irritations) based on records of past incidents. The use of aerially delivered fire retardant has the potential to reduce smoke concentrations in some areas; however, the greater influence on smoke concentrations is likely to be the presence of wind sufficient to remove the smoke. There is some potential for application of fire retardant on private property, including gardens and pets. As discussed above, cleaning property and pets is unlikely to have health effects, although consumption of garden produce that was coated with retardant is not advised, even after removing the retardant.

Alternative 3

Based on the overall lack of significant human health hazards from the aerially application of fire retardant, it is unlikely that this alternative will have significant differences from the other alternatives with regard to human health and safety.

3.9 Cultural Resources

3.9.1 Affected Environment

The term, cultural resources, as used in this EIS, includes all resources referred to as cultural, historical, archaeological, ethnographic, and tribal sacred sites or traditional cultural properties. Cultural resources, which represent past human activities or contemporary uses, are considered irreplaceable and nonrenewable. Cultural resources represent important cultural values and are of special concern to tribal groups, the public, and specific ethnic groups.

As manager of almost 200 million acres of public land, the Forest Service is entrusted with the stewardship of a large share of the nation’s historical and cultural heritage. National forests contain many of the nation's best preserved heritage sites in some of the least disturbed natural settings, with more than 380,000 sites currently inventoried on National Forest System (NFS) lands. Conservative estimates of the number of archaeological and historic sites that may exist on Forest Service holdings range from 1.5 million to 2.0 million sites. The Forest Service currently has more than 3,300 formal listings on the National Register of Historic Places, at least 19 national historic landmarks, and 1 property identified as having potential for listing as a world heritage site. A comprehensive array of laws, executive orders, Federal regulations, and Forest Service policy and direction provides the basis for the protection of cultural resources.

Cultural resources on National Forest System lands are protected by an array of laws, regulations, and executive orders. The following list highlights selected key provisions; see the Cultural Resources Specialist Report in the project record for a full list of relevant protections and regulations.

- **National Historic Preservation Act of 1966 (NHPA) (16 U.S.C. 470)**. Directs all Federal agencies to take into account effects of their undertakings (actions, financial support, and authorizations) on properties included in or eligible for the National Register.
- **Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), (25 U.S.C. 3001)**. Provides a process for Federal agencies to return certain Native American cultural items to lineal descendants and culturally affiliated Indian tribes and Native Hawaiian organizations, with penalties for non-compliance and illegal trafficking.
- **Food, Conservation, and Energy Act of 2008** provides for the reburial of Native American human remains on National Forest System lands, and the closure of National Forest System lands for the privacy of tribal groups engaged in traditional and cultural practices, and provides for the non-disclosure of information about reburial locations as well as traditional and cultural practices
- **Executive Order 13007–Indian Sacred Sites, issued May 24, 1996**. Directs Federal land management agencies to avoid affecting the physical integrity of Indian sacred sites wherever possible.
- **Executive Order 13175–Consultation and Coordination with Indian Tribal Governments, issued November 6, 2000**. Directs Federal agencies to establish regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications.

3.9.2 Environmental Consequences

As a general rule, any activity that causes ground disturbance (disturbance to the soil matrix containing the cultural resource) has the potential to adversely affect cultural resources, both directly and indirectly. Ground disturbance may cause changes to the physical attributes of the resource that, in turn, compromise the integrity of the cultural resource and its context. Its context (the spatial relationship between the various artifacts, features, and components of the cultural resource) is what is scientifically studied and interpreted and is the basis for determining the site significance. This effect of ground disturbance is irreparable and considered adverse under the National Historic Preservation Act (U.S. Congress 1966). Even a scientific archaeological excavation has an adverse effect because the integrity and context of the cultural resource are destroyed by removing the artifacts, features, and components.

In the case of sacred sites, effects that are not so easily defined must also be considered. Tribal religious practitioners may hold beliefs that are difficult to reconcile with our usual consideration of effects The aerial application of fire retardant may have no long-term consequences for the salient features of a sacred site, but may have a serious impact on the perceived integrity of the place. Tribal practitioners must be consulted on a case-by-case basis to determine the nature of site and the impacts on both tangible and intangible properties of the site.

Alternative 1—No Action

Under Alternative 1, there would be no aerial application of fire retardant, and therefore, no effects on cultural resources from aerial application of fire retardant.

There is potential for some wildfires to become larger if aerial fire retardant is no longer available (see Wildland Fire Management section in this EIS). Without the ability to reduce wildfire intensities and rates of spread in support of fire suppression forces, the possibility of some cultural resource being burned over would likely increase. High-intensity fires can destroy historic wooden structures and can damage artifacts such as pottery, bone, glass, and stone structures through exposure to intense heat. However, to say how many or what cultural resource sites might be lost without the availability of fire retardant would be highly speculative.

Alternative 2—Proposed Action

The aerial application of fire retardants may affect cultural resources. The effects would vary according to the nature and age of the properties. Retardants, including the various chemicals contained in retardants, react in different ways to different materials or types of cultural resources. Cultural resources consist of many materials including, but are not limited to, wood, stone, bone, shell, ceramics, glass, and plants. A comprehensive discussion of how retardant chemicals can react with each of the mentioned materials is contained in the Cultural Resource Specialist Report, available in the project record. What follows is a summary of potential effects to various cultural resources from retardant:

Deterioration

Long-term retardants contain fertilizer salts (ammonium phosphate or ammonium sulfate) that can leave a residue when dry. These salts can attract water and can cause the surface that they are in contact with, to swell and contract. Soluble salts crystallize as water evaporates, causing a great increase in volume. When crystallization occurs within a porous material such as wood, bone, shell, or some ceramics, it can cause physical damage, such as the spalling of the object's surface, resulting in the loss of any detail present (Society for Historic Archaeology n.d.). Additionally, rapid temperature changes caused by application of retardant to hot rocks may cause spalling of stone and degradation of mortar.

Staining

Retardants containing iron oxide have a high potential for staining raw wood, stone, bone, ceramics, shell, and vegetation. Any applied decoration, pigment ,or other applications (scoring, etching) will be similarly affected. Retardant applications may have very different effects on painted surfaces. In some cases it easily washes off and in others it does not. Materials are a critical consideration—sandstone will absorb the retardant and the ferric oxide will bond to the stone, making removal very difficult. Less porous materials, such as slate, may be more easily cleaned. In the case of rock art, especially pictographs, applied pigment designs may be irreversibly altered. The use of fugitive (non-iron oxide) colorants will minimize these effects.

Protein Residues

Aerial fire retardant applications may present particular problems for the analysis of protein residues on bone and shell tools, ceramics, and ground stone surfaces. Recent analyses indicate that protein residues may survive exposure to high temperatures, but ammonia compounds will cause deterioration of the residues.

Discussion

As previously discussed, the physical attributes and spatial relationship among various artifacts constitute a site's physical context. In the case of sacred sites and some traditional cultural properties, the socio-cultural setting must also be considered. The study of this context contributes to the determination of a sacred site's significance to a group of tribal practitioners. Aerially applied fire retardant does not disturb the ground, and therefore does not affect the spatial relationships between and among artifacts in the physical context of a cultural resource.

The artifacts themselves, including residues from past uses, may be adversely affected by the application of fire retardants. Scientific studies and site interpretations can account for a known site contaminant, such as fire retardant, and provide a legal and regulatory basis for determining site significance regardless of cultural affinity. The significance of a sacred site is primarily established in a belief system that may or may not recognize the aerial application of fire retardant as an impact to the integrity of the site. Only consultation with practitioners can determine the severity of impacts on sacred sites.

Heritage specialists with local area knowledge are assigned to each large fire incident to ensure compliance with historic preservation laws and local land and resource management plans and fire management plans and to provide incident commanders with information, analysis, and advice on various areas including archeological, historic, and traditional cultural resources, as well as sacred sites and other areas or resources that may be of local concern National Interagency Fire Center 2007a; National Wildlife Coordinating Group 2004). These resource advisors assist incident commanders in weighing potentially adverse effects of aerial application of fire retardant against potential damage from managing a wildfire without retardant.

Cumulative Effects

Given the protection afforded by Federal law, regulation, and executive order, there are no other past, present, or reasonably foreseeable future actions that would contribute cumulatively to the effects of aerial application of fire retardant on cultural resources.

Alternative 3

The effects described in Alternative 2 are equally applicable under Alternative 3. However, Alternative 3 requires assistance from tribes and cultural resource specialists prior to aerial application of fire retardant. The assistance and consideration of effects would likely create a management context and actions that will not adversely affect the integrity or data potential of any cultural resources.

Alternative 3 addresses the potential for misapplication and directs incident commanders to consult on the effects of a misapplication on cultural resources. It is expected that consultation would likely result in recommendations for actions to resolve or mitigate any adverse effects However, the impacts on sacred sites may be unresolvable. Lacking resolution or any agreeable mitigation, the misapplication may result in perceived loss of integrity and, consequently, an irretrievable loss of the resource.

In the event that a misapplication occurs, or that other resource considerations require an application that affects cultural resources, then the effects must be the subject of consultation with tribes and state historic preservation offices (SHPOs) depending on the nature of the affected site. Alternative 3 provides direction for the development of a plan for long-term monitoring in the event that it is determined to be necessary during consultation. Monitoring will allow for data collection and better understanding of effects on a variety of resources.

3.10 Scenery Management

3.10.1 Affected Environment

The scenic resources of NFS lands are valued by local communities and visitors. NFS lands, approximately 193 million acres, occur in 44 of the 50 states. These landscapes often serve as the backdrop and backyard for local residents and are integral to the quality of life and sense of place for surrounding communities.

Scenic landscapes often draw visitors to NFS lands and are a central theme in tourism and marketing efforts across the country. National Scenic Byways, National Scenic Backways, Wild and Scenic Rivers, National Scenic Areas, and National Scenic Trails are a few of the Agency's programs that highlight, celebrate, and protect the scenic resources sought by those visiting and those who live adjacent to NFS lands.

Maintaining the scenic integrity of these landscapes includes consideration of both biophysical and cultural attributes. Due to the diversity of ecosystems and cultural contexts across which NFS lands span, landscape character descriptions serve as the foundation for inventorying, assessing, and establishing objectives for scenic resources at the landscape scale.

"Landscape character" is defined as the overall sense of place created by valued physical and cultural attributes contained within a landscape Ecological units, such as Bailey's ecoregions (Bailey 1995), are often the starting point for delineating the geographic boundaries of distinct landscapes. The combination of each area's physical, biological, and cultural attributes is then refined to form the context in which deviations in scenic integrity are analyzed.

Regulatory Framework

Visual resources on NFS lands are protected by an many laws, regulations, and executive orders. Highlights of selected key provisions include the National Environmental Policy Act of 1969 (42 U.S.C. 4321), which guides the Federal government to "(2) assure for all Americans . . . healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, [or] risk to health . . .; [and] (4) preserve important historic, cultural, and natural aspects" of our environment. It further directs agencies to "insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment." This act directs agencies to develop methods and procedures "which will insure that scenery and other] unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations."

Forest Plan Direction

The management of all NFS lands must be consistent with its land management plan (LMP). Depending on the year that a unit completed its LMP, either the Visual Management System (VMS) or the Scenery Management System (SMS) is used to structure plan direction pertaining to scenic resources. These two systems are outlined in the Forest Service directives referenced below.

Forest Service Manual and Handbook Direction

Forest Service Manual (FSM) 2380 outlines policy and direction for the management of scenic resources. Updated in 2003, the manual contains direction on the transition from VMS to SMS.

Forest Service Handbooks (FSH), as listed below, provide guidance on how-to implement agency policy, requirements, and direction. In addition, publications in the Department of Agriculture's National Forest Landscape Management Series provide technical guidance in managing landscape aesthetics and scenery. The series is organized by volumes and chapters: Volume 1 is issued in Agriculture Handbook (AH) 434 and Volume 2 contains eight chapters issued in eight separate Department handbooks.

Forest Service handbooks pertaining to the management of scenic resources include:

- USDA Forest Service. 1995. National Forest Landscape Management: Landscape Aesthetics—A Handbook for Scenery Management. Agriculture Handbook 701. Washington DC. 257 pages.
- USDA Forest Service. 1974. National Forest Landscape Management: Volume 2, Chapter 1. Agriculture Handbook 462. Washington DC. 47 pages.

3.10.2 Environmental Consequences

Alternative 1—No Action

There would be no direct, indirect or cumulative effects to scenic resources from the aerial application of fire retardant under this alternative because no fire retardant would be applied. However, because it is expected that some fires may get larger there may be effects to scenic resources as a result.

Alternatives 2 and 3

The application of various aerial applied fire retardants may have a temporary impact on scenic resources on NFS lands. Colored fire retardants can temporarily stain surfaces a reddish color. The duration of this impact varies and depends both on the site conditions (soils, vegetation, and other physical characteristics) and on weather events (rain and snow) following the application. The visibility of the residual retardant will last longest in rocky areas and where little precipitation occurs. Areas composed of more porous surfaces and receiving more frequent precipitation will have shorter duration impacts. Most commonly, the effect on the scenic resource is short-lived and of minimal consequence. As the shift is made to the use of fire retardant with fugitive colorant, which fades and is less durable than iron oxide-colored fire retardant, the effects on the scenic resources would diminish.

3.11 Wilderness Character

This section focuses on the potential effects of aerially applied fire retardant on wilderness areas and their characteristics.

3.11.1 Affected Environment

The Wilderness Act allows for actions necessary for fire control, which includes application of fire retardant. Use of fire retardant in wilderness or wilderness study areas must be consistent with maintaining the desired qualities of those areas. These include the ecological qualities, aesthetic values, and recreational opportunities of the areas. Special features within wilderness areas are considered resources of value for their unique nature alone and merit protection. The nature of each attribute and the potential short-term and long-term impacts of fire retardant use are as follows.

Untrammeled

This quality monitors modern human activities that directly control or manipulate the components or processes of ecological systems inside wilderness. Wilderness in untrammeled areas is essentially unhindered and free from modern human control or manipulation.

Natural

This quality monitors both intended and unintended effects of modern people on ecological systems inside wilderness since the time the area was designated Wilderness ecological systems in natural areas are substantially free from the effects of modern civilization.

Undeveloped

This quality monitors the presence of structures, construction, habitations, and other evidence of modern human presence or occupation. Wilderness in undeveloped areas is essentially without permanent improvements or modern human occupation.

Primitive Recreation and Solitude

This quality monitors conditions that affect the opportunity for people to experience solitude or primitive, unconfined recreation in a wilderness setting, rather than monitoring visitor experiences per se. Wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge.

Special Features

A special feature is an attribute that recognizes that wilderness may contain other values of ecological, geologic, scientific, educational, scenic historic, or cultural significance. Unique fish and wildlife species, unique plants or plant communities, potential or existing research natural areas, outstanding landscape features, and significant cultural resource sites should all be considered as types of values that might exist.

3.11.2 Environmental Consequences

Direct and Indirect Effects

Alternative 1—No Action

Under Alternative 1, there would be no effects on wilderness characteristics from the use of aerially applied fire retardant because none would be used.

Alternatives 2 and 3

The effects on wilderness characteristics would be the same under both alternatives since there are no differences between these alternatives due to the presence of wilderness.

Untrammeled

Fire retardant introduces chemicals into the environment that at the very local level will affect nutrient loads, nutrient cycling, growth rates, and potentially some toxicity issues. The retardant may affect plant growth, may impact micro-habitats for microorganisms, and may affect use of vegetation that is treated. The presence of fire retardant chemicals could affect ecological processes at the micro scale. The degree of impact depends on the amount and type of retardant.

Natural

The presence of fire retardant dye creates an unnatural appearance, which is another indicator of the presence of man and civilization. To the extent that fire retardant chemicals disrupt natural processes or detract from the natural surroundings via coloration of vegetation, it is a negative effect on the natural quality of wilderness. As the use of fugitive colorant in fire retardant increases, these effects are expected to decrease. Retardant loads that are dropped low or fail to disperse may also damage vegetation, leading to an unnatural appearance with localized impact.

Undeveloped

While fire retardant is not a structure or installation, the presence of the dye trace can result in visible presence of the fire retardant in wilderness. When the dye is dropped in highly visible locations, it can detract from the scenic qualities of wilderness. As the use of fugitive colorant in fire retardant increases, these effects are expected to decrease.

Primitive Recreation and Solitude

Fire suppression activities, including the application of retardant, are unlikely to adversely affect human use and visitation, because most active fire suppression areas are closed to human use. If visitors are in the area, they may be affected by the sights and sounds of aircraft and fire retardant drops, but since these are transient and of short duration they are not likely to have any long-lasting effect on the visitor experience. Some people may find these activities unusual and an enhancement to their experience, as they are not readily seen in other locations. Others may find the intrusion of aircraft and fire retardant a negative effect upon their experience within wilderness areas.

Special Features

Fire retardant drops may adversely affect cultural resources, historic structures, and other features in wilderness. Effects include coloration, application damage, and small changes in nutrient loading. The long-term impacts are slight and are usually mitigated through the use of fire resource advisors, who choose areas to avoid during active fire events.

Cumulative Effects

The number and degree of current and projected fire retardant drops are not sufficient to have long-lasting effects on wilderness character nor would they result in any cumulative effects

3.12 Air Quality

3.12.1 Affected Environment

National Forest System (NFS) lands managed by the Forest Service comprise a range of existing air quality conditions from pristine to highly impacted by air pollution. The Forest Service is tasked through the Federal Clean Air Act of 1970 to provide particular protection to Air Quality Related Values, including visibility, in Class 1 areas. Federal class I areas are defined in the Clean Air Act as national parks larger than 6,000 acres and Wilderness Areas and memorial parks larger than 5,000 acres, established as of 1977. All other Federal land manager (FLM) areas are designated class II.

The Clean Air Act states that FLMs have an "affirmative responsibility" to protect AQRVs. Typically this involves considering whether emissions from a new or modified source may have an adverse impact on AQRVs in a Class I area and providing comments to permitting authorities (States or EPA). FLMs have no permitting authority under the Clean Air Act, and they have no authority under the Clean Air Act to establish air quality-related rules or standards. The States develop specific programs to meet the goals of the Clean Air Act. States may develop programs that are more restrictive than the Clean Air Act requires but never less. The Forest Service can develop internal practices and guidelines in order to address air quality concerns and issues that could occur with agency operations.

Under the Federal Clean Air Act, any area that violates National Ambient Air Quality Standards (NAAQS) for any of the six criteria pollutants is designated as a "non-attainment area." Criteria pollutants include sulfur dioxide, fine particulate matter, carbon monoxide, ozone, nitrogen oxides, and lead. Maintenance areas are any non-attainment areas that have been re-designated to attainment status and may be more sensitive to maintaining the designation. Actions taken by the Federal Government must not prevent or delay a state from accomplishing air quality goals to attain or maintain ambient air quality standards or contribute to an exceedance of a NAAQS. An emergency event, such as a response to a wildfire, is given a six month exemption from General Conformity requirements of the Clean Air Act (40 CFR Parts 51 and 93, Federal Register Vol. 75, No 64 Monday, April 5, 2010). If States measure a NAAQS exceedances that they believe were caused by wildfire, they can document the event and apply to the Environmental Protection Agency to have affected data points excluded from their official record of air quality standard attainment as guided by the ''Treatment of Data Influenced by Exceptional Events'' rule (72 FR 13559, March 22, 2007). This documentation process can be time consuming and expensive for a state and there is no guarantee that EPA will approve the request.

In a recent report (USDI National Park Service 2010) that covers the years 1999–2008, 241 National Park Service units had enough data on-site or nearby to report on one or more air quality indicators. Of these, 97 percent showed stable or improving trends in visibility, 100 percent showed stable or improving trends in ozone concentrations, and 93 percent showed stable or improving trends in atmospheric deposition of sulfate, nitrate, and ammonium ions. Since many NFS lands are in close proximity to NPS lands, these values may be illustrative of air quality indicators on NFS lands.

Air quality on and surrounding Forest Service managed-lands is periodically impacted by smoke from unplanned wildfire. Smoke from fires consists primarily of fine particulate matter which is one of the regulated criteria pollutants. Fine particulate matter is unhealthy to humans and can cause visibility impairment. Fires can also cause elevated ozone in some cases, especially some distance downwind of the fire where it is more likely to impact urban areas. Wildfire is highly variable in time and space and smoke impacts range from mild and very short-lived, to severe and long duration. Residents of the wildland urban interface are likely affected most often from wildland fire smoke although urban areas many miles downwind may also be affected.

3.12.2 Environmental Consequences

Alternative 1—No Action

With no aerial delivery of fire retardant there would be no direct impact on air quality associated with this alternative. Although it is likely under this alternative that more acres would burn in wildfires therefore indirect and cumulative effects on air quality are likely to increase. Any increase in the potential for larger, longer duration fires due to a ban on the use of fire retardant would likely result in increased public exposure to the serious health hazards caused by high levels of air pollutants in wildfire smoke. These wildfire smoke impacts can rise to levels considered hazardous by EPA as measured by air regulatory agencies (EPA, states, tribes and local authorities) as well as by FLM agencies).

It is reasonable to expect that more NAAQS exceedances will occur from the extra smoke and more state resources will be tied up with the time and expense needed to deal with the implications. States could find themselves dealing with new non-attainment areas and/or efforts to document and exclude data through the time-consuming and expensive Exceptional Events process. In addition, fire fighters are likely to experience increased exposure to smoke.

Alternatives 2 and 3

There would be no measurable direct, indirect, or cumulative effects from the aerial delivery of fire retardant on air quality under either Alternatives 2 or 3. The retardant remains in the air less than a minute, and is typically in the path of the fire which is well removed from areas accessible to the public.

Chapter 4. Preparers and Contributors

Chapter 4. Preparers and Contributors

4.1 Preparers and Contributors

ID Team Members

- David A. Austin — Wildlife Biologist
- C. Kenton Call — Public Affairs/Collaboration
- Mary Carr — Writer/Editor, Publishing Arts
- Kat Carsey -- Botanist
- Madelyn Dillon — Program Manager, Publishing Arts
- Kevin Donham — Fire Management Specialist
- Kathy Geier-Hayes — Fire Ecologist
- Tory (Victoria) Henderson — Fire Chemicals and Equipment Program Manager
- Pete Lahm — Air Quality
- Julie Laufmann — Botanist
- Timothy Love — Sr. Geospatial Applications Coordinator
- Elizabeth Lund — Deputy Director Fire & Aviation, Intermountain Region
- Chris J. Miller — Economist
- Jennifer Mickelson – Fisheries Biologist
- Craig Morris — Analyst
- Carolyn Napper — Soil Scientist
- Joey Pearson — Project Records Manager
- Will Reed — Heritage Specialist
- Glen Stein — Interdisciplinary Team Leader
- Marry Taylor Stewart — Public Affairs Specialist
- Carol Thornton — Hydrologist
- Kate Walker — Fisheries Biologist

Others

The interdisciplinary team consulted with the following individuals who contributed to the development of this draft programmatic environmental impact statement. Individuals are Forest Service unless otherwise noted.

- Louis Brueggeman — Fire Management Liaison, BLM
- Joseph Burns — National Threatened and Endangered Species Coordinator
- Jon Curd — Fire Management Specialist, BLM
- Thomas Dzomba — Air Quality
- Brad Harwood — Computer Specialist
- Cecelia Johnson — Fire Chemicals Technical Specialist
- Michael Kania – Landscape Architect
- Ted S. Milesnick — Chief, Fire Planning and Research, BLM
- Lis Novak — Landscape Architect

- Terry Svalberg — Air Quality
- Shirley Zylstra — Wildland Fire Chemical Project Leader
- Mikaila Rimbenieks — Hydrologist CIP/Resources for wildlife/plants

4.2 Distribution of the Final Environmental Impact Statement

This draft programmatic environmental impact statement has been distributed to the following Federal, State, and local governments and Tribal agencies; organizations and businesses, and individuals who, through their comments, have contributed to the preparation of this programmatic draft environmental impact statement.

Agencies

- Susan E. Bromm — Environmental Protection Agency
- Kevin Buhl — U.S. Geological Survey
- Sherry Buss — USDA Forest Service
- Robin Calfee — U.S. Geological Survey
- Fred Clark — USDA Forest Service
- Joe Carriero — USDI National Park Service
- Thomas Crews — USDI Fish and Wildlife Service
- Patricia Cole — U.S. Fish and Wildlife Service
- John Curd — USDI Bureau of Land Management
- Robyn Darbyshire — USDA Forest Service
- Doug Dodge — USDA Forest Service
- Michael Drayton — USDA Forest Service
- Kim Ernstrom — USDI National Park Service
- Tate Fischer — USDI Bureau of Land Management
- Nick Giannettino — USDA Forest Service
- Randall Hayman — USDA Forest Service
- Larry Hood — USDA Forest Service
- Roy Irwin — USDI National Park Service
- Jason Kahn — NOAA Fisheries
- Joel Kerley—Bureau of Indian Affairs, National Interagency Fire Center
- Kevin Knouth — USDI Bureau of Land Management
- Wade McMaster — USDA Forest Service
- Ted Milesnick — USDI Bureau of Land Management
- Charisa Morris — U.S. Fish and Wildlife Service
- Steve Potts — Environmental Protection Agency
- Daniel Purcell — British Columbia Forest Service
- Dalan Romero— Bureau of Indian Affairs, National Interagency Fire Center
- Brian Sines — USDA Forest Service
- Scott Steil — Navy Region Northwest Fire & Emergency Services
- Steve Tome — USDA Forest Service
- Jeff Ulrich — USDA Forest Service
- David Welby — USDA Forest Service

Tribes

Absentee-Shawnee Tribe of Indians of OK	Agua Caliente Band of Cahuilla Indians
Ak-Chin Indian Community Council	Alabama-Coushatta Tribes of Texas
Alabama-Quassarte Tribal Town	Alturas Rancheria
Apache Tribe of Oklahoma	Arapaho Tribe of Wind River
Aroostook Band of Micmacs	Assiniboine and Sioux Tribes of Fort Peck
Atmautluak Traditional Council	Augustine Band of Mission Indians
Bad River Band of Lake Superior Chippewa	Barona Band of Mission Indians
Bay Mills Indian Community	Bear River Band of Rohnerville Rancheria
Berry Creek Rancheria	BIA Fort Yuma Agency
Big Lagoon Rancheria	Big Pine Paiute Tribe of the Owens Valley
Big Sandy Rancheria Band of Western Mono Indians	Big Valley Rancheria
Blackfeet Tribal Business Council	Blue Lake Rancheria
Bodaway/Gap Navajo Chapter	Bridgeport Indian Colony
Buena Vista Rancheria	Burns Paiute Tribe, General Council
Cabazon Tribal Business Committee	Cachil DeHe Band of Wintun Indians
Caddo Nation of Oklahoma	Cahto Tribal Executive Committee
Cahuilla Band of Mission Indians National Forest System Land Management Planning	California Valley Miwok Tribe
Cameron Navajo Chapter	Campo Band of Diegueno
Capitan Grande Band of Diegueno Mission Indians	Carson Community Council
Catawba Indian Nation	Cayuga Nation
Cedarville Rancheria	Chemehuevi Tribe
Cher-Ae Heights Indian Community	Cherokee Nation
Cheyenne River Sioux Tribe	Cheyenne-Arapaho Tribes of Oklahoma
Chickasaw Nation	Chicken Ranch Rancheria

Chippewa Cree Business Committee	Chitimacha Tribe of Louisiana
Choctaw Nation of Oklahoma	Chukchansi Tribe
Citizen Potawatomi Nation	Cloverdale Rancheria
Cocopah Tribal Council	Coeur d'Alene Tribal Council
Cold Springs Rancheria	Colorado River Tribal Council
Comanche Nation	Confederated Salish & Kootenai Tribes
Confederated Tribes and Bands of the Yakama Nation	Confederated Tribes of Colville
Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians	Confederated Tribes of Siletz Indians of Oregon
Confederated Tribes of the Chehalis Reservation	Confederated Tribes of the Grand Ronde
Confederated Tribes of the Umatilla Indian Reservation	Confederated Tribes of the Warm Springs Reservation, Tribal Council
Coquille Indian Tribe	Cortina Rancheria
Coushatta Indian Tribe	Cow Creek Band of Umpqua Tribe of Indians
Cowlitz Indian Tribe	Coyote Valley Reservation
Crow Creek Sioux Tribal Council	Crow Tribal Council
Death Valley Timbisha Shoshone Tribe	Delaware Nation
Delaware Tribe of Indians of Oklahoma	Dry Creek Rancheria
Duckwater Tribal Council	Eastern Band of Cherokee Indians
Eastern Shawnee Tribe of Oklahoma	Elem Indian Colony
Elk Valley Rancheria	Ely Shoshone Tribe
Enterprise Rancheria	Ewiiaapaayp Band of Kumeyaay Indians
Federated Indians of Graton Rancheria	Flandreau Santee Sioux Tribe
Forest County Potawatomi Tribe	Fort Belknap Community Council
Fort Bidwell Reservation	Fort Independence Reservation
Fort McDermitt Tribal Council	Fort McDowell Yavapai Tribal
Fort Mojave Tribal Council	Fort Sill Apache Tribe of Oklahoma

Gila River Indian Community Council	Goshute Indian Tribe
Grand Traverse Band of Ottawa and Chippewa Indians	Greenville Rancheria
Grindstone Rancheria	Guidiville Rancheria
Habematolel Pomo of Upper Lake	Hannahville Indian Community
Havasupai Tribal Council	Ho-Chunk Nation
Hoh Indian Tribe	Hoopa Valley Tribal Council
Hopi Tribal Council	Hopland Reservation
Houlton Band of Maliseet Indians	Hualapai Tribal Council
Inaja-Cosmit Reservation	Inter Tribal Council of Arizona
Ione Band of Miwok Indians	Iowa Tribe of Kansas & Nebraska
Iowa Tribe of Oklahoma	Jackson Rancheria Band of Miwuk Indians
Jamestown S'Klallam Tribe of Indians	Jamul Indian Village
Jena Band of Choctaw Indians	Jicarilla Apache Nation
Kaibab Band of Paiute Indians	Kalispel Indian Community of the Kalispel Reservation
Karuk Tribe of California	Kashia Band of Pomo Indians
Kaw Nation National Forest System Land Management Planning	Kialegee Tribal Town
Kickapoo Traditional Tribe of Texas	Kickapoo Tribe in Kansas
Kickapoo Tribe of Oklahoma	Kiowa Indian Tribe of Oklahoma
Kootenai Tribal Council	La Jolla Band of Luiseno Indians
La Posta Band of Mission Indians	Lac Courte Oreilles Band of Chippewa Indians
Lac du Flambeau Band of Lake Superior Chippewa	Lac Vieux Desert Band of Lake Superior Chippewa Indians
Las Vegas Tribe of Paiute Indians Tribal Council	Leupp Navajo Chapter
Little River Band of Ottawa Indians	Little Traverse Bay Bands of Odawa Indians
Los Coyotes Reservation	Lovelock Tribal Council
Lower Brule Sioux Tribal Council	Lower Elwha Tribal Council

Lower Lake Rancheria KOI Nation	Lower Sioux Indian Community of Minnesota
Lummi Indian Business Council	Lytton Rancheria
Makah Indian Tribal Council	Manchester - Point Arena Band of Pomo Indians
Manzanita Band of Mission Indians	Mashantucket Pequot Tribe
Mashpee Wampanoag Tribal Council	Match-e-be-nash-she-wish Band of Pottawatomi Indians of Michigan
Mechoopda Indian Tribe of the Chico Rancheria	Menominee Indian Tribe of Wisconsin
Mesa Grande Band of Mission Indians	Mescalero Apache Tribe
Miami Tribe of Oklahoma	Miccosukee Indian Tribe
Middletown Rancheria	Minnesota Chippewa Tribe
Mississippi Band of Choctaw Indians	Moapa Business Council
Modoc Tribe of Oklahoma	Mohegan Indian Tribe
Mooretown Rancheria	Morongo Band of Mission Indians
Muckleshoot Tribal Council	Muscogee (Creek) Nation
Narragansett Indian Tribe	Navajo Nation
Nez Perce Indian Tribe	Nisqually Indian Community Council
Nooksack Indian Tribal Council	Northern Cheyenne Tribe
Northfork Rancheria of Mono Indians of California	Northwestern Band of Shoshone Nation
Nottawaseppi Huron Potawatomi, Inc.	Oglala Sioux Tribal Council
Ohkay Owingeh Pueblo	Omaha Tribe of Nebraska
Oneida Indian Nation	Oneida Tribe of Indians of Wisconsin
Onondaga Indian Nation	Osage Nation
Otoe-Missouria Tribe of Indians	Ottawa Tribe of Oklahoma
Paiute Indian Tribe of Utah Tribal Council	Paiute-Shoshone Indians of the Bishop Community
Paiute-Shoshone of the Lone Pine Reservation	Paiute-Shoshone Tribe of the Fallon Reservation
Pala Band of Mission Indians	Paskenta Band of Nomlaki Indians

Pasqua Yaqui Tribal Council	Passamaquoddy Tribe - Indian Township
Pauma/Yuima Band of Mission Indians	Pawnee Nation of Oklahoma
Pechanga Band of Mission Indians	Penobscot Indian Nation
Peoria Tribe of Indians of Oklahoma	Picayune Rancheria of Chukchansi Indians
Pinoleville Reservation	Pit River Tribal Council
Poarch Creek Indians	Pokagon Band of Potawatomi Indians
Ponca Tribe of Indians of Oklahoma	Ponca Tribe of Nebraska
Port Gamble S'Klallam Tribe	Potter Valley Rancheria
Prairie Band of Potawatomi Nation	Prairie Island Indian Community
Pueblo of Acoma	Pueblo of Cochiti
Pueblo of Isleta	Pueblo of Jemez
Pueblo of Laguna	Pueblo of Nambe
Pueblo of Picuris	Pueblo of Pojoaque National Forest System Land Management Planning
Pueblo of San Felipe	Pueblo of San Ildefonso
Pueblo of Sandia	Pueblo of Santa Ana
Pueblo of Santa Clara	Pueblo of Santo Domingo
Pueblo of Taos	Pueblo of Tesuque
Pueblo of Zia	Pueblo of Zuni
Puyallup Tribe of the Puyallup Reservation of the State of Washington	Pyramid Lake Paiute Tribal Council
Quapaw Tribal Business Committee	Quartz Valley Indian Community Reservation
Quechan Tribal Council	Quileute Tribe
Quinault Indian Nation	Quinault Tribe, Intertribal Timber Council
Ramona Band of Cahuilla	Red Cliff Band of Lake Superior Chippewa Indians of Wisconsin
Red Lake Band of Chippewa Indians	Redding Rancheria

Redwood Valley Reservation	Reno-Sparks Tribal Council
Resighini Rancheria	Rincon Band of Mission Indians
Robinson Rancheria	Rosebud Sioux Tribal Council
Round Valley Reservation	Sac & Fox Tribe of the Mississippi in Iowa
Sac and Fox Nation of Missouri	Sac and Fox Nation of Oklahoma
Saginaw Chippewa Indian Tribe of Michigan	Saint Croix Chippewa Indians of Wisconsin
Saint Regis Band of Mohawk Indians	Salt River Pima-Maricopa Indian Council
Samish Indian Nation	San Carlos Apache Tribal Council
San Juan Southern Paiute Council	San Manuel Band of Mission Indians
San Pasqual Band of Diegueno Indians	Santa Rosa Band of Mission Indians
Santa Rosa Rancheria	Santa Ynez Band of Mission Indians
Santa Ysabel Band of Mission Indians (Iipay Nation)	Santee Sioux Nation
Sauk-Suiattle Indian Tribe	Sault Ste. Marie Tribe of Chippewa Indians of Michigan
Scotts Valley Rancheria	Seminole Indian Tribe
Seminole Nation of Oklahoma	Seneca Nation of Indians
Seneca-Cayuga Tribe of Oklahoma	Shakopee Mdewakanton Sioux Community of Minnesota
Shawnee Tribe	Sherwood Valley Rancheria
Shingle Springs Rancheria	Shoalwater Bay Indian Tribe of the Shoalwater Bay Indian Reservation
Shoshone Business Council	Shoshone Fort Hall Business Council
Shoshone-Paiute Business Council	Sisseton-Wahpeton Oyate
Skokomish Tribal Council	Skull Valley Band of Goshute Indians
Smith River Rancheria	Snoqualmie Tribe
Soboba Band of Luiseno Indians	Sokaogon Chippewa Community
Southern Ute Tribe	Spirit Lake Tribal Council
Squaxin Island Tribe	Standing Rock Sioux Tribal Council

Standing Rock Sioux Tribal Council	Stillaguamish Tribe of Indians
Stockbridge Munsee Community of Wisconsin	Summit Lake Paiute Tribe
Suquamish Tribal Council	Susanville Indian Rancheria
Swinomish Indian Tribal Community	Sycuan Band of Mission Indians
Table Mountain Rancheria	Te-Moak Tribe of Western Shoshone
The Klamath Tribes	The Spokane Indian Tribe
The Tulalip Tribes	Thlopthlocco Tribal Town
Three Affiliated Tribes Business Council	Tohono O'odham Nation
Tonawanda Band of Seneca	Tonkawa Tribe of Indians of Oklahoma
Tonto Apache Tribal Council	Torres-Martinez Desert Cahuilla Indians
Tubatulabal Tribe	Tule River Reservation
Tule River Reservation Fire Department	Tunica-Biloxi Tribe
Tuolumne Rancheria	Turtle Mountain Band of Chippewa
Tuscarora Nation	Twenty-Nine Palms Band of Mission Indians National Forest System Land Management Planning United Auburn Indian Community
United Keetoowah Band of Cherokee Indians	Upper Sioux Community of Minnesota
Upper Skagit Tribal Council	Ute Indian Tribe
Ute Mountain Ute Tribe	Utu Utu Gwaitu Paiute Tribe
Viejas Band of Kumeyaay Indians	Walker River Paiute Tribal Council
Wampanoag Tribe of Gay Head/Aquinnah	Washoe Tribal Council
White Mesa Administration	White Mountain Apache Tribe
Wichita and Affiliated Tribes	Wilton Miwok Rancheria
Winnebago Tribal Council	Winnemucca Tribal Council
Wiyot Tribe - Table Bluff Reservation	Wyandotte Nation
Yankton Sioux Tribe	Yavapai-Apache Nation
Yavapai-Prescott Board of Directors	Yerington Paiute Tribe

Yocha Dehe Wintun Nation	Yomba Tribal Council
Ysleta del Sur Pueblo	Yurok Tribe
Zuni Pueblo	

Organizations

- Ted Adams — California Fire Safe Council
- John Ahlman — California Fire Safe Council
- Kimberly Baker — Environmental Protection Information Center
- James Barnes — Associated Aerial Firefighters
- Ken Bonner — Newton County Wildlife Association
- John Buckley — Central Sierra Environmental Resource Center
- Mike Dubrasich — Western Institute for Study of the Environment
- Mike Dykzeul — Oregon Forest Industries Council
- Lenny Eliason — National Association of Counties
- Fran Galt — Milpas Community Association
- Roger Haines — Wildland Resident Association
- Eddie Harris — Santa Barbara Urban Creeks Council
- Doug Heiken — Oregon Wild
- Timothy Ingalsbee — Firefighters United for Safety, Ethics and Ecology
- Jeff Juel — The Lands Council
- Jim Karels — National Association of State Foresters
- Jay Linnger — Center for Biological Diversity
- Wally McCall — California Fire Safe Council
- Charlie Morgan — Southern Group of State Foresters
- Bob Mullba — Santa Barbara Botanical Gardens
- Ed O'Brien — Montana Public Radio
- Jonathan Oppenheimer — Idaho Conservation League
- Duane Short — Biodiversity Conservation Alliance
- Andy Stahl — Forest Service Employees for Environmental Ethics
- Julia Stephens — Central Sierra Environmental Resource Center
- Brian Trautwen — Environmental Defense Center
- Ann Walker — Western Governors' Association
- Allan J. West — National Association of Forest Service Retiree

Businesses

- Jeff Akridge — Columbia Pacific Aviation
- Stan Bain — President, Cold Fire Enterprise
- David Baskett — BE-200, LP
- Rob Chaney — The Missoulian
- David C. Fredley —Northwest Barricade, LLC

- Chris Kunkle — Central Coast Jet Center
- Jim Kunkle — Central Coast Jet Center
- Phil Nelson — Phos-Chek
- Ron Raley — Phos-Chek
- Erica Wenig — Santa Barbara News Press

State Government Agencies

- Laurie Brown — State of Montana
- Scott Cooper — University of California, Santa Barbara
- Rick Dolan — Florida Department of Forestry
- Chuck Schneider — Florida Department of Forestry
- Sybil Smith — Arizona Department of Environmental Quality
- Jill Taylor — Department of Natural Resources, Alaska Coastal Management Program
- Del Walters — California Department of Forestry & Fire Protection
- Todd Welker — Washington Department of Natural Resources
- John Winder — CalFire

Local and Regional Government Agencies

- Ray Boudreaux — City of Fayetteville, Arkansas
- Andrew Dimizing — City of Santa Barbara Fire Department
- Alan D. Gardner —Washington County Commission
- Chris Hahn — Santa Barbara County
- Lauren Hanson — Goleta Water District
- Phil Mosher — Chalem County Fire Department
- Jill Murray — City of Santa Barbara, Creeks Division
- Brendan Ripley — Ventura County Fire
- Angie Sturm — Lahontan Regional Water Quality Control Board
- Kevin Wallave — Montecito Fire Protection District
- Jeanne Whalen — Crook County Land Use Planning & Zoning Commission

Individuals

- Stuart Alan
- Scott Amos
- Chris Bryant
- Jane Childers
- Bert Conner
- Walt Darran
- Robin DeMario
- Paul Friesema
- Jerry Geissler
- Lauri Hanauska-Brown

- Mary Jones
- Brad Joos
- Dave Kelly
- Neil Paulson
- Jean Public
- Dan Rieger
- Jamie Tackman
- Roberta Ulrich
- Katherine Worn

Glossary and Acronyms

Glossary and Acronyms

Alien species – With respect to a particular ecosystem, any species—including its seeds, eggs, spores, or other biological material capable of propagating that species—that is not native to that ecosystem (Executive Order 13122, 2/3/99). See exotic, introduced species, and non-indigenous species.

Anchor point – An advantageous location, usually a barrier to fire spread, from which to start constructing a fireline. The anchor point is used to minimize the chance of being flanked by the fire while the line is being constructed.

Aquatic invertebrate – An animal, such as a mollusk or crustacean, that lacks a backbone or spinal column and lives wholly or chiefly in or on water.

Aquatic vertebrate – Animals having a bony or cartilaginous skeleton with segmented spinal column and a large brain enclosed in a skull or cranium that lives wholly or chiefly in or on water.

Aquifer – An underground layer of permeable rock, sediment (usually sand or gravel), or soil that yields water. The pore spaces in aquifers are filled with water and are interconnected so that water flows through them. Sandstones, unconsolidated gravels, and porous limestone make the best aquifers. They can range from a few square kilometers to thousands of square kilometers in size.

Avoidance area – A protection area surrounding a listed species' habitat developed to mitigate or avoid possible impacts caused by an action; no-drop zone for aerial fire retardant.

Basin (river) – (1) Area of land that drains water, sediment, and dissolved materials to a common point along a stream channel; river basins are composed of large river systems; (2) Equivalent of a 3rd-field hydrologic unit code, an area of about 9 million acres, such as the Snake River Basin.

Beneficial water uses – Any of the various water uses including, but not limited to, domestic water supplies, fisheries and other aquatic life, industrial water supplies, agricultural water supplies, navigation, recreation in and on the water, wildlife habitat, and aesthetics.

Biological Assessment (BA) – A document prepared for the U.S. Fish and Wildlife Service and/or National Oceanic and Atmospheric Administration (NOAA) Fisheries Section 7 consultation process to determine whether a proposed major construction activity under the authority of a Federal action agency is likely to adversely affect listed species, proposed species, or designated critical habitat.

Biological Evaluation (BE) – A document prepared by the Forest Service to review planned, funded, executed, or permitted programs and activities for possible effects on endangered threatened proposed or sensitive species (FSM 2672.4).

Biological Opinion (BO) – A document prepared by the U.S. Fish and Wildlife Service that is the product of formal consultation, stating the opinion of the U.S. Fish and Wildlife Service and/or National Oceanic and Atmospheric Administration (NOAA) Fisheries on whether or not a Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

Biodiversity or biological diversity – The diversity of living things (species) and of life patterns and processes (ecosystem structures and functions), including genetic diversity, ecosystem diversity, landscape and regional diversity, and biosphere diversity (USDA Forest Service. *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins*, Vol. II, 1997).

Candidate species – Plants and animals that have been studied and that the U.S. Fish and Wildlife Service and/or National Oceanic and Atmospheric Administration (NOAA) Fisheries have concluded should be proposed for addition to the Federal endangered and threatened species list. These species have formerly been referred to as category 1 candidate species.

Contaminant(s) – A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful effects to humans or the environment.

Consultation – A requirement of the Endangered Species Act that requires the action agency to enter into discussions with a regulatory agency regarding the potential effects of a project on federally listed threatened or endangered species occurs when a project may affect any species. The action agency and regulatory agencies work together to mitigate or avoid impacts to the species.

Critical habitat – As defined and used in the Endangered Species Act, is a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection.

Cumulative effects – Impacts on environments that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions occurring during a period of time.

Determination – A decision made from analysis of impacts of an action on a species; either no effect or may affect, which are further analyzed into adverse or not adverse effects

Diammonium phosphate – A chemical compound that is commonly used as a fertilizer and a fire retardant, with a high concentration of phosphorus and high water solubility.

Diammonium sulfate – A chemical compound commonly used as a fertilizer and as a fire retardant.

Direct effects – Effects that are caused by the action and occur at the same time and place.

Disturbance – An effect of a human activity or natural or exotic agent or event that changes a landscape element, landscape pattern, or regional composition and may cause species behavioral change in response to the event. An effect of a planned human management activity, or unplanned native or exotic agent or event, which changes the state of a landscape element, landscape pattern, or regional composition" (USDA Forest Service. *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins*, Vol. II, 1997).

Diversity – The species richness of a community or area, although it provides a more useful measure of community characteristics when it is combined with an assessment of the relative abundance of species present.

DO – Dissolved oxygen

Ecosystem – The complex of a community of organisms and its environments (Executive Order 13122, 2/3/99).

Ecoregion – A large unit of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions.

Ecotype – A locally adapted population of a widespread species. Such populations show minor changes of morphology and/or physiology, which are related to habitat and are genetically induced. Heavy metal-tolerant ecotypes of common grasses, such as *Agrostis tenuis*, are examples.

Endangered – Any species listed in the *Federal Register* as being in danger of extinction throughout all or a significant portion of its range.

Endangered Species Act (ESA) – A law passed in 1973 to conserve species of wildlife and plants determined by the Director of the U.S. Fish and Wildlife Service or the National Marine Fisheries Service to be endangered or threatened with extinction in all or a significant portion of its range. Among other measures, ESA requires all Federal agencies to conserve these species and consult with the U.S. Fish and Wildlife Service or National Marine Fisheries Service on Federal actions that may affect these species or their designated critical habitat.

EPA – U.S. Environmental Protection Agency.

Ephemeral stream – A stream channel that carries water infrequently, generally only during and immediately after periods of rainfall or snowmelt and, except during periods of streamflow, does not intersect the local groundwater table.

Erosion – The wearing away of the land surface by running water, wind, ice, gravity, or other geological activities; can be accelerated or intensified by human activities that reduce the stability of slopes or soils.

Eutrophication –Waters rich in mineral and organic (frequently nutrients from run-off of animal waste, fertilizers, sewage) compounds that promote a proliferation of plant life, especially algae, which reduces the dissolved oxygen content of the water negatively impacting aquatic life.

Evapotranspiration – The loss of water from the soil both by evaporation and by transpiration from the plants growing in the soil.

Exotic – Not native; introduced from elsewhere but not completely naturalized. See alien, introduced, and non indigenous species.

Federally listed species – Formally listed as a threatened or endangered species under the Endangered Species Act. Designations are made by the U.S. Fish and Wildlife Service or National Marine Fisheries Service National Oceanic and Atmospheric Administration [NOAA] Fisheries).

Fertilizer – Any organic or inorganic material of natural or synthetic origin (other than liming materials) that is added to a soil to supply one or more plant nutrients essential to the growth of plants. Fertilizers typically provide, in varying proportions, six macronutrients: nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S).

Fire management plan – A strategic plan that defines a program to manage wildland and prescribed fires and documents the fire management program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans.

FLAG – Federal land managers' air quality-related values work group.

FPA – Fire Program Analysis model.

FPU – Fire planning unit.

Fugitive colorant – A mixed product that contains one or more ingredients that impart a high degree of visibility from the air when first applied to wildland fuels but that lose visibility gradually during the following several months not noticeably visible 3 months after application).

FWS – U.S. Fish and Wildlife Service.

Gamete – A mature sexual reproduction cell, as a sperm or egg, which unites with another cell to form a new organism.

Groundwater – Water beneath the earth's surface, often between saturated soil and rock, which supplies wells and springs.

Habitat – The place where a population (e.g., human, animal, plant, microorganism) lives and its surroundings, both living and non-living.

Heathland – A dwarf-shrub habitat found on mainly low-quality acidic soils, characterized by open, low-growing wood vegetation, often dominated by plants of the *Ericaceae* (heath) family.

Hyperplasia – Increased cell production in a normal tissue or organ; abnormal proliferation of cells.

IA – Initial attack.

Indirect effects – Those caused by an action that are later in time or farther removed in distance but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems including ecosystems.

Integrated weed management – An interdisciplinary weed management approach for selecting methods to prevent, contain, and control noxious weeds in coordination with other resource management activities to achieve optimum management goals and objectives (FSM 2080.5).

Intermittent stream – A stream that carries water a considerable portion of the time, but that ceases to flow occasionally or seasonally because bed seepage and evapotranspiration exceed the available water supply.

Introduced species – An alien or exotic species that has been intentionally or non-intentionally released into an area as a result of human activity. “Introduced (agricultural crops may fit the definition as well as ‘native’ or ‘introduced’ wildland species) or exotic species whose genetic material originally evolved and developed under different environmental conditions than those of the area in which it was introduced, often in geographically and ecologically distant locations.". See alien, exotic, and introduced species.

Introduction – The intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity (Executive Order 13122, 2/3/99).

Invasive plant species – An alien plant species whose introduction does or is likely to cause economic or environmental harm or harm to human health (Executive Order 13122, 2/3/99).

LAA – Likely to adversely affect a species listed under the Endangered Species Act.

LC50 – A statistically or graphically estimated concentration that is expected to be lethal to 50 percent of a group of organisms under specified conditions.

Leaching – the process by which soluble materials in the soil such as salts, nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water

Long-term fire retardant – Chemicals that inhibit combustion primarily through chemical reactions between products of combustion and the applied chemicals, even after the water component has evaporated. Other chemical effects also may be achieved, such as film-forming and intumescence (swelling).

Macroinvertebrate – Animals that have no backbone and are visible without magnification (i.e., aquatic worms, larvae of aquatic insects).

Misapplication – The accidental aerial application of fire retardant into a waterway, within the 300-foot buffer, or within an avoidance area or when resources are directed to apply fire retardant into a waterway, within the 300-foot buffer, or within an avoidance area based on allowable exceptions or a transportation accident.

Mobility – The ability of a species to move and avoid a situation.

Monitoring – For type 4-5 initial attack fires (those with a small number of people or a single resource assigned in either class size A = 0–¼ acre, B = ¼–10 acres, C = 10–99 acres, or D = 100–300 acres) where fire retardant has been applied and resource advisors are not present. Five percent of these are monitored for potential occurrences or impacts to resource values and reported to the U.S. Fish and Wildlife Service and National Marine Fisheries Service (National Oceanic and Atmospheric Administration [NOAA] Fisheries).

Native species – With respect to a particular ecosystem, a species that, other than as a result of an introduction, has historically occurred or currently occurs in that ecosystem (Executive Order 13122, 2/3/99).

Narrow endemic –Native species with restricted geographic distributions, soil affinities, and/or habitats; loss of these populations or their habitat within an area might jeopardize the continued existence or recovery of that species.

Naturalized – Applied to a species that originally was imported from another country but that now behaves like a native in that it maintains itself without further human intervention and has invaded native populations.

NIFC – National Interagency Fire Center.

NH_3 – ammonia.

NH_4 – ammonium ion.

Nitrate – A natural nitrogen compound NO_3) that is highly water soluble. In high concentrations, nitrates can be harmful to young infants or young livestock.

Nitrite – The univalent radical NO_2 or a compound containing it, such as salt or an ester of nitrous acid. The NO_2 ion can form methaemoglobin in the blood, reducing its ability to carry oxygen.

Non-indigenous – Plants and animals that originate elsewhere and migrate or are brought into an area. They may dominate the local species or have other negative impacts on the environment. See alien, exotic, and introduced species.

NOAA – National Oceanic and Atmospheric Administration.

NLAA – Not likely to adversely affect a species listed under the Endangered Species Act .

Nutrient – Any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorus but can include other essential elements.

NWCG – National Wildfire Coordinating Group.

Oligotrophic – Relatively low in plant nutrients and containing abundant oxygen in the deeper parts.

Osmoregulation – The control of the levels of water and mineral salts in the blood.

Perennial Stream – A stream that contains water at all times except during extreme drought.

pH – The measure of the acidity or basicity of a solution. Pure water is said to be neutral, with a pH close to 7.0 at 25 °C (77 °F). Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline.

Phos-Chek – A brand of long-term fire retardants, class A foams, and gels (water enhancers) that are manufactured as dry powder concentrates or as liquid concentrates and are diluted with water before use.

Phosphorus – A chemical element. The vast majority of phosphorus compounds are used as fertilizers.

Phytoplankton – Minute, free-floating aquatic plants.

Precipitation – Rain, sleet, hail, snow, and other forms of water falling from the sky.

Primary constituent element – Physical and biological features of a landscape that a species needs to survive and reproduce; the critical habitat for a species.

Propagule – A plant part, such as a bud, tuber, root, shoot, or spore, used to propagate individual plants vegetatively.

Pyrolysis – A chemical change that occurs as a result of the application of heat.

Riparian – The area adjacent to a stream, waterway, or wetland. Pertaining to areas of land directly influenced by water Riparian areas usually have visible vegetative or physical characteristics reflecting this water influence. Streamsides, lake borders, or marshes are typical riparian areas.

Runoff (surface) – Fresh water from precipitation and melting ice that flows on the earth's surface into nearby streams, lakes, wetlands, or reservoirs.

RPA – Reasonable and prudent alternatives.

Salmonid – Of, belonging to, or characteristic of the family Salmonidae, which includes salmon, trout, and whitefish.

Screening process – A logic flow used to help determine the effects of an action on species. The national screening process considers the amount of use of aerial fire retardant for a given area to determine a probability of risk to a species. The wildlife screening process considers a series of flowcharts to help determine effects on critical habitat and species under certain conditions, such as mobility and potential use. There are assumptions that are applied to the processes.

SEAT – Single-engine air tanker.

Sensitive species – Those plant and animal species identified by a Forest Service regional forester for which population viability is a concern, as evidenced by:

a. Significant current or predicted downward trends in population numbers or density.

b. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (FSM 2670.5).

Threatened – The classification provided to an animal or plant likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

TEPCS – Threatened Endangered Proposed Candidate, or Sensitive species.

Trigger – A report of misapplication, where there is an effect on threatened and endangered species, requires consultation with the Forest Service/U.S. Fish and Wildlife Service/NOAA Fisheries to determine the appropriate restriction on use of future application in the area (species dependent).

Type 1 incident – An incident that is typically larger and more complex than a type 2 incident. The factors that affect the decision to go to a type 1 operation are extremely variable and depend to a large extent upon the needs and policies of the agency or agencies involved. A type 1 incident almost always requires the establishment of divisions that require division/group supervisor qualified personnel, may require the establishment of branches, and involves a fairly complex aviation component. Some of the factors that raise the complexity to type 1 include: extreme fire behavior with no relief in sight in the foreseeable future, complex support needs including large aviation organization, urban interface/infrastructure and/or unique resources threatened, fatalities/serious accidents and/or unusually hazardous control objectives, multiple jurisdictions threatened and/or involved, potential claims, sensitive or controversial external influences. Generally when the size of the operational organization exceeds 500 personnel and up to or more than 1,000 total personnel on the incident, this also leads to type 1 complexity.

Type 2 incident – The first level at which most or all of the command and general staff positions are activated. The incident commander and the command/general staff must function as a team handling all aspects of supervising a large organization, multiple operational periods, the gathering of information to develop an action plan, the development of an action plan, and the provision of logistical support including the establishment and operation of a base and possibly camps. Agency administrators and their staff determine if a wildland fire should be managed by a type 2 incident management team. The complexity decision considers factors of fire behavior, size of organization/need for logistical support for multiple operational periods, values to be protected, and firefighter and public safety.

USGS – U.S. Geological Survey.

Vernal pool – Temporary **pools** of water, also called **vernal** ponds or ephemeral **pools**. A large number of rare, endangered, and endemic species occur in vernal pool areas.

WFDSS – Wildfire Decision Support System.

Water quality – The chemical physical, and biological characteristics of water usually in respect to its suitability for a particular purpose.

Watershed – (1) The region draining into a river, river system, or body of water; or (2) subdivisions within a sub-basin, which generally range in size from 40,000 to 250,000 acres; the fifth level (10-digits) in the hydrologic hierarchy.

Waterway – A body of water including lakes, rivers, streams, and ponds whether or not they contain aquatic life.

Wetland – For regulatory purposes under the Clean Water Act, refers to "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

Wildland-urban interface (WUI) – The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

Literature Cited

Literature Cited

Adams, Robyn and Dianne Simmons. 1999. Ecological Effects of Fire Fighting Foams and Retardants, Conference Proceedings, Australian Bushfire Conference, Albury, July 1999. 8 p.

Alabaster, J.S., D.G. Shurben, and M.J. Mallett. 1983. The acute lethal toxicity of mixtures of cyanide and ammonia to smolts of salmon, *Salmo salar*, at low concentrations of dissolved oxygen. Journal of Fish Biology 22: 215-222.

Anderson, Hal E. 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. General Technical Report INT-122, USDA Forest Service, Intermountain Forest and Range Experimental Station, Ogden, Utah 84401. 22 p.

Angeler, David G. and Jose M. Moreno. 2006. Impact-Recovery patterns of water quality in temporary wetlands after fire retardant pollution, Can. J. Fish. Aquat. Sci. 63: 1617-1626.

Augspurger, Tom, Anne E. Keller, Marsha C. Black, Gregory Cope, and F. James Dwyer. 2003. Water Quality Guidance for Protection of Freshwater Mussels (Uniondae) from Ammonia Exposure Environmental Toxicology and Chemistry, 22(11):2569-2575.

Backer, Dana M., Sara E. Jensen, and Guy R. McPherson. 2004. Impacts of Fire-Suppression Activities on Natural Communities, Conservation Biology 18(4): 937-946.

Bailey, R.G. 1995. Description of the ecoregions of the United States. 2d ed., Misc. Publ. No. 1391 (rev.). Washington, DC: U.S. Department of Agriculture, Forest Service. 108 p.

Bell, T.L. 2003. Effects of fire retardants on vegetation in eastern Australian heathlands – a preliminary investigation. Department of Sustainability and Environment, Research Report No. 68.

Bell, Tina, Kevin Tolhurst, and Michael Wouters. 2005. Effects of the fire retardant Phos-Chek on vegetation in eastern Australian heathlands, International Journal of Wildland Fire, 14: 199-211.

Binkley, Dan, Heather Burnham, and H. Lee Allen. 1999. Water quality impacts of forest fertilization with nitrogen and phosphorus. Forest Ecology and Management 121:191-213.

Bradstock, R., J. Sanders, and A. Tegart. 1987. Short-term effects on the foliage of a eucalypt forest after an aerial application of a chemical fire retardant, Australian Forestry 50(2): 71-80.

Brady, Nyle C. 1984. The Nature and Properties of Soils. Cornell University and United States Agency for International Development. MacMillan Publishing Co., New York (complete publication with Carolyn Napper, WO Soils Scientist).

Brooks, Matthew L., Carla M. D'Antonio, David M. Richardson, James B. Grace, Jon E. Keeley, Joseph M. DiTomaso, Richard J. Hobbs, Mike Pellant, and David Pyke. 2004, Effects of Invasive Alien Plants on Fire Regimes, BioScience 54(7): 677-688.

Brown, James K. and Jane Kapler Smith. 2000. Wildland fire in ecosystems: Effect of fire on flora. Gen. Tech. Rep. RMRS-GRT-42, Vol.2, Ogden, UT. USDA, Forest Service, Rocky Mountain Research Station. 257 p.

Brown, Thomas C. and Dan Binkley. 1994. Effect of Management on Water Quality in North American Forests, Gen. Tech. Rep. RM-248, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. USDA, Forest Service. 31 p.

Brown, Thomas C., Michael T. Hobbins, and Jorge A. Ramirez. 2008. Spatial Distribution of Water Supply in the Coterminous United States. Journal of the American Water Resources Association. 44(6): 1474-1487.

Buhl, K.J. and S.J. Hamilton

1998. Acute Toxicity of Fire-Control Chemicals to Early Life Stages of Chinook Salmon. Environmental Toxicology and Chemistry, 17(8): 1589-1599.

2000. Acute Toxicity of Fire-Control Chemicals, Nitrogenous Chemicals and Surfactants to Rainbow Trout. American Fisheries Society 29: 408-418.

Calloway, R. 2010. Research scientist, University of Montana, Missoula, MT. Telephone conversation, December, 9, 2010.

Carlson, Joan. 2009. Water Quality Management on National Forest System Lands, USDA Forest Service, Rocky Mountain Region.

Carmichael, N.B. 1992. Results of Stone Creek spill samples collected July 1992.

Certini, Giacomo. 2005. Effect of fire on properties of forest soils. Oecologia 143: 1-10.

Chandler, C., P. Cheney, P. Thomas, L. Trabaud, and D. Williams. 1983. Fire in Forestry, Vol. II. Forest Fire Management and Organization. J. Wiley & Sons, Canada, 441 p.

Cooperrider, Allen Y., Raymond J. Boyd, and Hanson R. Stuart Eds. 1986. Inventory and Monitoring of Wildlife Habitat. US Department of the Interior, Bureau of Land Management. Service Center. Denver, CO. 858 p.

Crouch, R.L., H.J. Timmenga, T.R. Barber, and P.C. Fuchsman. 2006. Post-fire surface water quality: comparison of fire retardant versus wildfire-related effects Chemosphere 62: 874-889.

Dassonville, Nicolas, Sonia Vanderhoeven, Valerie Vanparys, Mathieu Hayez, Wolf Gruber, and Pierre Meerts. 2008. Impacts of alien invasive plants on soil nutrients are correlated with initial site conditions in NW Europe, Oecologia 157:131-140.

DeBano, Leonard F., Daniel G. Neary, and Peter F. Ffolliott. 1998. Fire's Effects on Ecosystems, John Wiley & Sons, Inc., New York (complete publication on file at National FS Library, St. Paul, MN).

Dissmeyer, George E. 2000. Drinking Water from Forests and Grasslands, A Synthesis of the Scientific Literature, USDA Forest Service, Southern Research Station, GTR-SRS-39. 250 p.

DiTomaso, J., M. Brooks, E. Allen, R. Minnich, P. Rice, G. Kyser. 2006. Control of invasive weeds with prescribed burning. Weed Technology 20: 535-548.

Dubrovsky, Neil M. 2010. Nutrients in the Nation's Streams and Groundwater, 1992-2004. Briefing sheet prepared for a congressional briefing in Washington, D.C., Sept. 24, 2010. USDI Geological Survey.

Dubrovsky, Neil M. and Pixie A. Hamilton. 2010. Nutrients in the Nation's Streams and Groundwater: National Findings and Implications. Fact Sheet 2010-3078, USDI Geological Survey.

Dubrovsky, Neil M., Karen R. Burow, Gregory M. Clark, JoAnn M. Gronberg, Pixie A. Hamilton, Kerie J. Hitt, David K. Mueller, Mark D. Munn, Bernard T. Nolan, Larry J. Puckett, Michael G. Rupert, Terry M. Short, Norman E. Spahr, Lori A. Sprague, and William G. Wilber. 2010. The Quality of Our Nation's Water - Nutrients in the Nation's Streams and Groundwater, 1992-2004, US Geological Survey Circular 1350. 194 p.

Dunham, J.B., M.K. Young, R.E. Gresswell, B.E. Rieman. 2003. Effects of fire on fish populations: landscape perspectives on persistence of native fishes and nonnative fish invasions. Forest Ecology and Management 178: 183–196.

Eliason, Scott

2010a. Personal communication re Division Fire endangered plant effects

2010b. Biological Assessment, Division Incident, for consultation under Section 7 of the Endangered Species Act on the Effects of the Emergency Response and Associated Actions, San Bernardino National Forest.

Enstrom, Gregory. 2010. Enstrom, B. Project Manager, Natural Resource Management System, USDA_FS, Corvallis, OR. Email communication with Julie Laufman, Botanist, 12/03/2010.

ERM-New England Inc. 1987. Potential environmental and public health impacts of sodium ferrocyanide in deicing salt. Unpublished report on file at: Degussa Corporation, Teterboro, NJ. 24 p. plus appendices.

Field, C.B., L.D. Mortsch, M. Brklacich, D.L. Forbes, P. Kovacs, J.A. Patz, S.W. Running and M.J. Scott. 2007. North America. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 617-652 Website at: www.ipcc.ch/publications_and_data/ar4/wg2/en/ch14.Html.

Finger, S.E. (ed.). 1997. Toxicity of fire retardant and foam suppressant chemicals to plant and animal communities, Final Report. Columbia, MO: USGS/Biological Resources Division. 186 p. plus executive summary.

Fontenot, Q.C., J.J. Isely, and J.R. Tommaso. 1998. Acute toxicity of ammonia and nitrite to shortnose sturgeon fingerlings. Progressive Fish-Culturist 60(4): 315-318.

Food and Drug Administration. 2000. Office of Federal Register. Section 100.155 – Salt and iodized salt. 2 p. In: Code of Federal Regulations, Title 21, Washington, D.C. US Government Printing Office.

Furniss, Michael J., Brian P. Staab, Sherry Hazelhurst, Caty F. Clifton, Ken B. Roby, Bonnie L. Ilhardt, Elizabeth B. Larry, Albert H. Todd, Leslie M. Reid, Sarah J. Hines, Karen A. Bennett, Charlie H. Luce, and Pamela J. Edwards. 2010. Water, Climate Change, and Forests, Watershed Stewardship for a Changing Climate, USDA Forest Service, Pacific Northwest Research Station, GTR-PNW-812. 80 p.

Gaikowski, M.P., S.J. Hamilton, K.J. Buhl, S.F. McDonald, and C.H. Summers. 1996. Acute toxicity of three fire-retardant and two fire-suppressant foam formulations to the early life stages of rainbow trout (*Oncorhynchus mykiss*). Environmental Toxicology and Chemistry 15(8): 1365-1374.

Geier-Hayes, Kathleen. 2011. Fire Ecology Specialist Report for Aerial Application of Fire Retardant Final EIS.

George, Charles W. 1985. An Operational Retardant Effectiveness (ORE) Study, Fire Management Notes, Volume 46, Number 2, pp 18-23.

Gimenez, Anna, Elsa Pastor, Luis Zarate, Eulalia Planas, and Josep Arnaldos. 2004. Long-term forest fire retardants: a review of quality, effectiveness, application and environmental considerations. International Journal of Wildland Fire 13: 1-15.

Goodwin, K., R. Sheley, and J. Clark. 2002. Integrated noxious weed management after wildfires. ED-160. Bozeman, MT: Montana State University, Extension Service. 46 p.

Green, Emily K. and Susan M. Galatowitsch. 2002. Effects of Phalaris arundinacea and nitrate – N addition on the establishment of wetland plant communities. Journal of Applied Ecology 39: 134-144.

Gresswell, R.E. 1999. Fire and aquatic ecosystems in forested biomes of North America. Transactions of the American Fisheries Society 128(2): 193-221.

Gutzmer, Michael P. and J.R. Tomasso. 1985. Nitrite Toxicity to the Crayfish Procambarus clarkii. Bull. Environ. Contam. Toxicol. 34: 369-376.

Haglund, John. 2010. Hagland, J., Ecologist, National Resource Management System, Sandy, OR. Email communication with Gregory Enstrom 12/07/2010.

Hamilton, Steve, Diane Larson, Susan Finger, Barry Poulton, Nimish Vyas, and Elwood Hill. 1998. Ecological effects of fire retardant chemicals and fire suppressant foams. Jamestown, ND: Northern Prairie Wildlife Research Center Online

Harrod, Richy J. and Sarah Reichard. 2001. Fire and invasive species within the temperate and boreal coniferous forests of western North America. In Galley, Krista E.M: Wildon, Tyrone P. eds Proceedings of the invasive species workshop: The role of fire in the control and spread of invasive species; Fire conference 2000; the first national congress on fire ecology, prevention and management 2000, November 27-Dec1; San Diego , CA Misc Publication No. 11. Tallahassee, Fl. Tall Timbers Research Station: 95-101

Heddle, E.M. and R.L. Specht. 1975. Dark Island Heath (Ninety-Mile Plain, South Australia). VIII. The effect of fertilizers on composition and growth, 1950-1972. Australian Journal of Botany 23: 151-164.

Henderson, Tory and Elizabeth Lund. 2011. Wildland Fire Management Specialist Report for Aerial Delivery of Fire Retardant Final EIS.

Hopmans, Peter and Ross Bickford. 2003. Effects of fire retardant on soils of heathland in Victoria, Research Report No. 70, Forest Science Centre, Heidelberg, Fire Management Department of Sustainability and Environment, Victoria. 29 p.

Ingalsbee, Timothy. 2004. Western Fire Ecology Center - Biscuit Fire Suppression Impacts. Western Fire Ecology Center, American Lands Alliance. 43 p.

Interagency (FRCC). 2008. Fire Regime Condition Class (FRCC) Guidebook, Version 3.0.

International Code Council. 2008. The Blue Ribbon Panel Report on Wildland Urban Interface Fire.

Johansen, R.W. and J.H. Dieterich. 1971. Fire Retardant Chemical Use on Forest Wildfires. Southern Forest Fire Laboratory, Southeast Forest Experiment Station. Macon GA. 23 p.

Johnson, Cecilia

2010. Retardant Composition Application, unpublished report by C. Johnson, Fire Chemicals Technical Specialist, USDA Forest Service MTDC, Missoula, MT.

2011. C. Johnson, Fire Chemicals Technical Specialists, MTCD-Wildland Fire Chemical Systems, Missoula, MT. Email communication with Julie Laufman 1/05/2011.

Johnson, W.W. and H.O. Sanders. 1977. Chemical Forest Fire Retardants: Acute Toxicity in Five Freshwater Fishes and a Scud. Technical Papers of the U.S. Fish and Wildlife Service, #91. Washington D.C. 9 p.

Kalkhan, Mohammed A., Evan J. Stafford, Peter J. Woodly, Thomas J Stohlgren. 2007. Assessing exotic plant species invasions and associated soil characteristics: A case study in eastern Rocky Mountain National Park, Colorado, USA, using the pixel nested plot design. Soil Ecology 35: 622-634.

Keeley, Jon E. 2001. Fire and invasive species in Mediterranean-climate ecosystems of California. Pages 81-94 in K.E.M. Galley and T.P. Wilson (eds.). Proceedings of the Invasive Species Workshop: the Role of Fire in the Control and Spread of Invasive Species. Fire Conference 2000: the First National Congress on Fire Ecology, Prevention, and Management. Misc Publication No. 11, Tall Timbers Research Station, Tallahassee, FL.

Kimbell, Abigail R. and Hutch Brown. 2009. Using Forestry to Secure America's Water Supply, Journal of Forestry, April/May 2009.

Krehbiel, R. 1992. The use of Firetrol 931 in British Columbia, 1992 Stoner Fire retardant spill, Memorandum dated November 24, 1992. British Columbia Environmental Protection. 8 p.

Labat Environmental

2003. Human Health Risk Assessment: Wildland Fire-fighting Chemicals. Prepared for Missoula Technology and Development Center, USDA Forest Service, Missoula, MT.

2007. Ecological Risk Assessment: Wildland Fire-fighting Chemicals, prepared for Missoula Technology and Development Center, USDA Forest Service, Missoula, MT. 69 p.

2011. Risk Comparison of Uncontrolled Wildfires and the Use of Fire Suppression Chemicals, prepared for National Interagency Fire Center, USDA Forest Service, Boise ID. 32 p.

Labat-Anderson, Inc.

1994. Ecological risk assessment chemicals used in wildland fire suppression. Arlington, VA: Labat-Anderson. 108 p. plus appendices.

1996. (Update) Chemicals Used in Wildland Fire Suppression - A Risk Assessment. Prepared for Fire and Aviation Management USDA Forest Service.

Landsberg, Johanna D. and Arthur R. Tiedemann. 2000. Chapter 12 - Fire Management, In: Dissmeyer, George E., Ed. Drinking Water from Forests and Grasslands, USDA Forest Service, Southern Research Station, Gen. Tech. Rep. SRS-39.

Large-Cost Fire Independent Review Panel. 2009. Fiscal Year 2008 Large-Cost Fire Independent Review. United States Secretary of Agriculture, Washington D.C.

Larson, Diane L. and Wesley E. Newton. 1996. Effects of fire retardant chemicals and fire suppressant foam on North Dakota prairie vegetation. Proceedings of the North Dakota Academy of Science 50: 137-144.

Larson, Diane L., Wesley E. Newton, Patrick J. Anderson, Steven J. Stein. 1999. Effects of fire retardant chemical and fire suppressant foam on shrub steppe vegetation in northern Nevada. International Journal of Wildland Fire 9(2): 115-127.

Larson, Jeanne R. and Don A. Duncan. 1982. Annual grassland response to fire retardant and wildlife. Journal of Range Management 35(6): 700-703.

Leishman, Michelle R. and Vivien P. Thomson. 2005. Experimental evidence for the effects of additional water nutrients and physical disturbance on invasive plants in low fertility Hawkesbury sandstone soils Sydney, Australia. Journal of Ecology. 93: 38-49.

Little, E.E. and R.D. Calfee

2000. The Effects of UVB radiation on the toxicity of firefighting chemicals. Final Report. March 23; Columbia, MO: U.S. Geological Survey, Columbia Environment Research Center. 66 p.

2002. Effects of Fire-Retardant Chemicals, Fire-Trol GTS-R, and Phos-Chek D75-R to Fathead Minnows in Pond Enclosures. U.S. Geological Survey, Biological Resources Division, Columbia Environmental Research Center. Columbia, MO. 28 p.

Lonsdale, W.M. 1999. Global Patterns of Plant Invasions and the Concept of Invasibility. Ecology 80(5): 1522-1536.

McDonald, Susan F., Steven J. Hamilton, Kevin J. Buhl, and James F. Heisinger

1995. Acute Toxicity of Fire-Retardant and Foam-Suppressant Chemicals to Hyalella azteca (Saussure). Environmental Toxicology and Chemistry. 16(7):1370-1376.

1996. Acute Toxicity of Fire Control Chemicals to Daphnia Magna (Straus) and Selenastrum capricornutum (Printz). Ecotoxicology and Environmental Safety 33: 62-72.

1997. Acute Toxicity of Fire-Retardant and Foam-Suppressant Chemicals to Hyalella Azteca. Environmental Toxicology and Chemistry. 16(7): 1370-1376.

Mitchell, J.E. 2000. Rangeland resource trends in the United States: A technical document supporting the 2000 USDA Forest Service RPA assessment. RMRS-GTR-68. USDA Forest Service Rocky Mountain Research Station. 84 p.

Napper, Carolyn. 2011. Soils Specialist Report for Aerial Delivery of Fire Retardant Final EIS.

NBII National Biological Information Infrastructure. 2011. Ants as Pollinator, from website http://www.nbii.gov/portal/server.pt/community/ants/855.

Neary, Daniel G., Kevin C. Ryan, and Leonard F. DeBano, Eds. 2005. Wildland fire in ecosystems: effects of fire on soils and water. Gen. Tech. Rep. RMRS-GTR-42, Vol. 4, Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 250 p.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16(4): 693-727.

Newton, Jeresa J. and Michelle R. Bartsch. 2007. Lethal and sublethal effects of ammonia to juvenile Lampsilis mussels (unionidae) in sediment and water-only exposures. Environmental Toxicology and Chemistry, Vol. 26(10):2057-2065.

NIFC National Interagency Fire Center

2007a. Wildland Fire Statistics. Available on the internet at: http://www.nifc.gov/fire_info/fire_stats.htm. Accessed on September 28, 2007.

2007b. Federal wildland fire management. Policy and program review. Final Report. Boise, ID. 45 p.

Norris, L.A., C.L. Hawkes, W.L. Webb, D.G. Moore, W.B. Bollen, and E. Holcombe. 1978. A Report of Research on the Behavior and Impact of Chemical fire Retardants in Forest Streams. U.S. Forest Service, Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station. Corvallis OR. 287 p.

Norris, L.A., H.W. Lorz, and S.V. Gregory

1983. Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America, USDA Forest Service, GNT-PNW-149. pp. 50-70.

1991. Forest chemicals. In: Meehan, W.R. ed. Influence of forest and rangeland management on salmonid fishes and their habitats. Bethesda, MD: American Fisheries Society. Special Publication No. 19: chapter 7.

Norris, Logan A. and Warren L. Webb. 1989. Effects of Fire Retardant on Water Quality.

NRE Natural Resources and Environment. 2000. Fire Management - Assessment of the effectiveness and environmental risk of the use of retardants to assist in wildfire control in Victoria. Research Report No 50. Department of Natural Resources and Environment, State of Victoria.

NWCG National Wildfire Coordinating Group

2003. Interagency Airtanker Base Operations Guide, PMS 444-3, NFES 2271, USDA Forest Service and USDI BLM.

2004. PMS 410-1 Fireline Handbook.

2011. Interagency Aerial Supervision Guide, PMS 505, NFES 2544, 155 p.

Omernik, J.M. 1976. The influence of land use on stream nutrient levels. US Environmental Protection Agency, EPA Pub. 600/3-76-014, Seattle, WA.

Pappa, A., N. Tzamtzis, and S. Koufopoulou. 2006. Effect of fire retardant application on phosphorus leaching from Mediterranean forest soil short-term laboratory-scale study. International Journal of Wildland Fire 15: 287-292.

Pattle Delamore Partners. 1996. Detection of Hydrogen Cyanide Evolved from Fire-Trol. Auckland, New Zealand. 38 p.

Pimentel, D., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics 52: 273-288

Plucinski, M., J. Gould, G. McCarthy, and J. Hollis. 2007. The Effectiveness and Efficiency of Aerial Firefighting in Australia, Part 1. Bushfire CRC Technical Report Number A0701. Ensis Bushfire Research; School of Forests and Ecosystems Science, University of Melbourne; Department of Environment and Conservation. 11 p.

Potts, Stephen. 2011. Email(s) with US EPA regarding regulations to require states to strengthen water quality standards.

Potyondy, John P. and Theodore W. Geier. 2010. Forest Service Watershed Condition Classification Technical Guide. USDA Forest Service. 72 p.

Poulton, B., S. Hamilton, E. Hill, N. Vyas, and D. Larson. 1993. Toxicity of fire retardant and foam suppressant chemicals to plant and animal communities. Report. (USFS paper 28).

Poulton, Barry, Steven Hamilton, Kevin Buhl, Nimish Vyas, Elwood Hill, and Diane Larson. 1997. Toxicity of Fire Retardant and Foam Suppressant Chemicals to Plant and Animal Communities, Final Report prepared for Interagency Fire Coordination Committee, Boise, ID.

Prestemon, J., K. Abt, and K. Gebert. 2008. Suppression cost forecasts in advance of wildfire seasons. Forest Science 54(4): 381-396.

Pyne, Stephen J. 1982. Fire in America. Princeton University Press, Princeton, NJ.

Quigley, Thomas M. and Sylvia J. Arbelbide, Tech, Eds. 1997. An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins, Vol. II, General Technical Report PNW-GTR-405, Portland, Oregon, USDA Forest Service, Pacific Northwest Research Station, (contains pages 337 through 1,055)

Raybould, Steve, Cecilia W. Johnson, Dale L. Alter, et al. 1995. Lot acceptance, quality assurance, and field quality control for fire retardant chemicals. 5th ed. PMS 444-1, [NFES 1245]. Boise, ID: U.S. Department of Agriculture, Forest Service, National Interagency Fire Center, [National Wildfire Coordinating Group]; April: 55 p.

Ringler, Neil H. and James D. Hall. 1975. Effects of logging on water temperature and dissolved oxygen in spawning beds. Trans. Amer. Fish. Soc., No 1, pp 111-121.

Rothermal, R.C. and C.W. Philpot. 1974. Reducing Fire Spread in Wildland Fuels. Reprinted from: Experimental Methods in Fire Research. 1975. Proceedings of the Meeting to Honor Clay Preston Butler, Stanford Research Institute, May 9-10, 1974. pp 369-403.

Scott, Joe H. and Robert E. Bergan. 2005. Standard Fire behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model. General Technical Report RMRS-GTR-153, USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 72 p.

Sedell, James, Maitland Sharpe, Daina Dravnieks Apple, Max Copenhagen, and Mike Furniss. 2000. Water and the Forest Service, FS-660. USDA Forest Service, Washington, DC

Seymour, B. and N.G. Collett. 2009. Effects of fire retardant application on heathland surface-dwelling ant species (Order Hymenoptera; Family Formicidae) in Victoria, Australia. Forest Ecology and Management 257: 1261-1270.

Society for Historic Archaeology, n.d. Conservation Treatments.

Thornton, Carol. 2011. Hydrology Specialist Report for Aerial Delivery of Fire Retardant Final EIS.

Thurston, R.V., G.R. Phillips, R.C. Russo, and S.M. Hinkins. 1981. Increased toxicity of ammonia to rainbow trout (Salmo giardneri) resulting from reduced concentrations of dissolved oxygen. Canadian Journal of Fisheries and Aquatic Sciences 38(8):983-988.

Tiedemann, A.R., J.D. Helvey, and T.D. Anderson. 1978. Stream Chemistry and Watershed Nutrient Economy Following Wildfire and Fertilization in Eastern Washington. Journal of Environmental Quality, 7(4): 580-58.

Tilman, David. 1987. Secondary succession and the pattern of plant dominance along experimental nitrogen gradients. Ecological Monographs 57: 189–214.

Tisdale, Samuel L., Werner L. Nelson, and James D. Beaton. 1985. Soil Fertility and Fertilizers, Fourth Edition. Macmillan Publishing Company, New York, NY.

Tomassen, H., A. Smolders, J. Limpens, L. Lamers, and J. Roelofs. 2004. Expansion of invasive species on ombrotrophic bogs: desiccation or high N deposition? Journal of Applied Ecology 41: 139-150.

Tome, M. and C. Borrego. 2002. Fighting wildfires with retardants applied with airplanes. Forest Fire Research & Wildland Fire Safety, Viegas (ed.) ISBN 90-77017-72-0.

Trussel R.P. 1972. The Percent Un-ionized Ammonia in Aqueous Ammonia Solutions at Different pH levels and Temperatures Journal of the Fisheries Research Board of Canada, 29(10): 1505-1507.

US Congress

1966. National Historic Preservation Act.

1972. Federal Water Pollution Control Act.

1973. Endangered Species Act.

1990. Native American Graves Protection and Repatriation Act.

1996. Safe Drinking Water Act.

2008. Food, Conservation and Energy Act.

US District Court, District of Montana, Missoula, MT. 2010. Court Order CV-08-43-M-DWM FSEEE vs. USDA Forest Service, USDI Fish & Wildlife Service, and NOAA Fisheries. 80 p.

US Fire Administration. 2010. Report Data – Firefighter Fatalities in the U.S. 2000-2010.

US President

1994. Executive Order 12898. Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, issued January 11, 1994.

1999. Executive Order 13112. Invasive Species, issued February 3, 1999.

1996. Executive Order 13007. Indian Sacred Sites, issued May 24, 1996.

2000. Executive Order 13175. Consultation and Coordination with Indian Tribal Governments, issued November 6, 2000.

USDA Forest Service

nd. Standard Burn Test - Combustion Retarding Effectiveness Test, Test Method 2.

nd. The Effects of Fire on Rare Plants.

1974. National Forest Landscape Management, Vol. 2, Ch 1, The Visual Management System, Agriculture Handbook No 462. 52 p.

1995. Landscape aesthetics: a handbook for scenery management. Agriculture Handbook No. 701.

2000. Letter dated June 1, 2000, from Jose Cruz, Director of Fire and Aviation Management, US Forest Service, Washington Office, to FIRE-TROL Holdings, LLC, regarding the use of sodium ferrocyanide.

2001. 2000 RPA assessment of forest and range lands. USDA Forest Service, FS-687, February 2001.

2002. Letter dated October 4, 2002, from Jerry T. Williams, Director of Fire and Aviation management, US Forest Service, Washington Office, to FIRE-TROL Holdings, LLC, regarding the use of sodium ferrocyanide.

2005. Pacific Northwest Region Invasive Plant Program, Preventing and Managing Invasive Plants, Record of Decision. USDA Forest Service, Pacific Northwest Region. 64 p.

2005. Rheology Drop Test Study - Marana 2005.

2007. Specification 5100-304c, Long-Term Retardant, Wildland Firefighting (amendments inserted into the text May 17, 2010).

2011a. Forest Service Retardant Use Costs for Wildfire Suppression. Spreadsheet compiled by C. Miller (Economist, USDA Forest Service, WO/EMC/NEPA) summarizing information and data gathered by T. Henderson (Region 4), K. Gebert (Region 1), and T. Love (GSTC), US Department of Agriculture, Forest Service.

2011b. Fire Occurrence and Retardant Use (2000-2010) on Forest Service Lands. Spreadsheet summarizing NIFC and ABS data compiled by Forest Service Staff: J. Laufman (Forest Service Planner, Enterprise Technical Services), T. Love (Senior Applications Coordinator, GSTC), and T. Henderson (Fire and Aviation, Assistant to Director). US Department of Agriculture, Forest Service, Washington DC.

2011c. Airtanker Flights by Fire Size Category (2007-2011). Spreadsheet summarizing Aviation Business System (ABS) data compiled by J. Herynk and M. Thompson. USDA Forest Service, Rocky Mountain Research Station, Missoula, MT.

2011d. Developed Urban Interface versus Terrestrial Avoidance Areas for the San Bernardino National Forest. Spreadsheet summarizing GIS overlay information prepared by T. G. Love (Senior Applications Coordinator, GSTC) using urban interface data prepared by Headwaters Economics.

USDA Forest Service, USDI Bureau of Land Management, National Park Service, USDI Fish and Wildlife Service. 2000. Guidelines for Aerial Delivery of Retardant or Foam near Waterways. 2 p.

USDA Forest Service, USDI Bureau of Land Management, Fish and Wildlife Service, National Park Service, and Bureau of Indian Affairs. 2009. Guidance for Implementation of Federal Wildland Fire Management Policy, dated February 13, 2009.

USDA Forest Service, National Park Service, and USDI Fish and Wildlife Service. 2010. Federal land managers' air quality related values work group (FLAG): phase I report—revised (2010). Natural Resource Report NPS/NRPC/NRR—2010/232. National Park Service, Denver, CO

USDI Environmental Protection Agency

1986. Quality Criteria for Water 1986. EPA 440/5-86-001. Office of Water Regulations and Standards, Washington, D.C.

2009. National Recommended Water Quality Criteria, Office of Water Office of Science and Technology.

USDI Fish and Wildlife Service. 2008. Final Biological and Conference Opinion on the USDA Forest Service's Application of Fire Retardant on National Forest System Lands.

USDI Geological Survey. 2008. USGS 09480500 Santa Cruz River near Nogales, AZ. Water quality: field/lab sample.

USDI National Park Service. 2010. Air quality in national parks: 2009 annual performance and progress report. Natural Resource Report NPS/NRPC/ARD/NRR—2010/266. National Park Service, Denver, CO.

Van Meter, W.P. and Charles E. Hardy. 1975. Predicting effects on fish of fire retardants in streams. Res. Pap. INT-166. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 16 p.

Vitousek, P, M D'Antonio, C. Loope, L Lloyd and R. Westbrooks. 1996. Biological invasions as global environmental change. American Scientist 84: 468-478.

Wang, Ning, Christopher G. Ingersoll, Douglas K. Hardesty, Christopher D. Ivey, James L. Kunz, Thomas W. May, F. James Dwyer, Andy D. Roberts, Tom Augspurger, Cynthia M. Kane, Richard J. Neves, and M. Chris Barnhart. 2007a. Acute toxicity of copper, ammonia, and chlorine to glochidia and juveniles of freshwater mussels (unionidae), Environmental Toxicology and Chemistry, Vol. 26(10):2036-2047.

Wang, Ning, Christopher G. Ingersoll, I. Eugene Greer, Douglas K. Hardesty, Christopher D. Ivey, James L. Kunz, William G. Brumbaugh, F. James Dwyer, Andy D. Roberts, Tom Augspurger, Cynthia M. Kane, Richard J. Neves, and M. Chris Barnhart. 2007b. Chronic toxicity of copper and ammonia to juvenile freshwater mussels (unionidae). Environmental Toxicology and Chemistry, Vol. 26(10):2048-2056.

Wells, Jason B., Edward E. Little, and Robin D. Calfee. 2004 Behavioral Response of Young Rainbow Trout (Oncorhunchus mykiss) to Forest Fire-Retardant Chemicals in the Laboratory.

Wilcove, David S. and Linus Y. Chen. 1998. Management costs for endangered species. Conservation Biology 12(6): 1405-1407.

Williamson, Mark. 1996. Biological Invasions. Population and Community Biology Series 15. Chapman & Hall, 2-6 Boundary Row, London, SEI 8HN (complete publication on file at National FS Library, St. Paul, MN).

Williamson, Mark H. and Alastair Fitter. 1996. The characters of successful invaders. Biological Conservation 78: 163-170.

Wilson, Scott D. and Jennifer M. Shay. 1990. Competition, fire, and nutrients in a mixed-grass prairie. Ecology 71: 1959–1967.

Zouhar, Kristin, Jane Kapler Smith and Steve Sutherland. 2008. Effects of Fire on Nonnative Invasive Plants and Invisibility of Wildland Ecosystems. USDA Forest Service, Gen. Tech. Report RMRS-GTR-42-Vol. 6, 26 p.

Appendix A – 2000 Guidelines for Aerial Delivery of Retardant or Foam Including the 2008 Reasonable and Prudent Alternatives

Appendix A – 2000 Guidelines for Aerial Delivery of Retardant or Foam Including the 2008 Reasonable and Prudent Alternatives

Definition:

Waterway – Any body of water including lakes, rivers, streams and ponds whether or not they contain aquatic life.

Guidelines:

Avoid aerial application of retardant or foam within 300 feet of waterways.

These guidelines do not require the helicopter or airtanker pilot-in-command to fly in such a way as to endanger his or her aircraft, other aircraft, or structures or compromise ground personnel safety.

Guidance for pilots:

To meet the 300-foot buffer zone guideline, implement the following:

- **Medium/Heavy Airtankers:** When approaching a waterway visible to the pilot, the pilot shall terminate the application of retardant approximately 300 feet before reaching the waterway. When flying over a waterway, pilots shall wait one second after crossing the far bank or shore of a waterway before applying retardant. Pilots shall make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant within the 300-foot buffer zone.
- **Single Engine Airtankers:** When approaching a waterway visible to the pilot, the pilot shall terminate application of retardant or foam approximately 300 feet before reaching the waterway. When flying over a waterway, the pilot shall not begin application of foam or retardant until 300 feet after crossing the far bank or shore. The pilot shall make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant within the 300-foot buffer zone.
- **Helicopters:** When approaching a waterway visible to the pilot, the pilot shall terminate the application of retardant or foams 300 feet before reaching the waterway. When flying over a waterway, pilots shall wait five seconds after crossing the far bank or shore before applying the retardant or foam. Pilots shall make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant or foam within the 300-foot buffer zone.

Exceptions:

- When alternative line construction tactics are not available due to terrain constraints, congested area, life and property concerns or lack of ground personnel, it is acceptable to anchor the foam or retardant application to the waterway. When anchoring a retardant or foam line to a waterway, use the most accurate method of delivery in order to minimize placement of retardant or foam in the waterway (e.g., a helicopter rather than a heavy airtanker).

- Deviations from these guidelines are acceptable when life or property is threatened and the use of retardant or foam can be reasonably expected to alleviate the threat.
- When potential damage to natural resources outweighs possible loss of aquatic life, the unit administrator may approve a deviation from these guidelines.

Threatened and Endangered (T&E) Species:

The following provisions are guidance for complying with the emergency section 7 consultation procedures of the ESA with respect to aquatic species. These provisions do not alter or diminish an action agency's responsibilities under the ESA.

Where aquatic T&E species or their habitats are potentially affected by aerial application of retardant or foam, the following additional procedures apply:

1. As soon as practicable after the aerial application of retardant or foam near waterways, determine whether the aerial application has caused any adverse effects to a T&E species or their habitat. This can be accomplished by the following:

a. Aerial application of retardant or foam outside 300 ft of a waterway is presumed to avoid adverse effects to aquatic species and no further consultation for aquatic species is necessary.

b. Aerial application of retardant or foam within 300 ft of a waterway requires that the unit administrator determine whether there have been any adverse effects to T&E species within the waterway.

These procedures shall be documented in the initial or subsequent fire reports.

2. If there were no adverse effects to aquatic T&E species or their habitats, there is no additional requirement to consult on aquatic species with Fish and Wildlife Service (FWS) or National Marine Fisheries Service (NMFS).

3. If the action agency determines that there were adverse effects on T&E species or their habitats then the action agency must consult with FWS and NMFS, as required by 50 CFR 402.05 (Emergencies). Procedures for emergency consultation are described in the Interagency Consultation Handbook, Chapter 8 (March, 1998). In the case of a long duration incident, emergency consultation should be initiated as soon as practical during the event. Otherwise, post-event consultation is appropriate. The initiation of the consultation is the responsibility of the unit administrator.

Each agency will be responsible for insuring that the appropriate guides and training manuals reflect these guidelines.

National Marine Fisheries Service Reasonable and Prudent Alternatives

1. Provide evaluations on the two fire retardant formulations, LC 95-A and 259R, for which acute toxicity tests have not been conducted, using standard testing protocols. Although direct fish toxicity tests have not been conducted on three additional formulations, G75-W, G75-F, LV-R, studies are not warranted in light of the fact the USFS intends to phase out their use of these formulations by 2010. All formulations expected to be in use beyond 2010 shall be evaluated using, at a minimum, the established protocols to assess acute mortality to fish. Evaluations must be completed and presented to NMFS no later than two years from the date of this Opinion. Depending on the outcome of these evaluations and after conferring with NMFS, the USFS must make appropriate modifications to the program that would minimize the effects on NMFS' listed resources (e.g., whether a retardant(s) should be withdrawn from use and replaced with an alternative retardant(s)).

2. Engage in toxicological studies on long-term fire retardants approved for current use in fighting fires, to evaluate acute and sublethal effects of the formulations on NMFS' listed resources. The toxicological studies will be developed and approved by both the USFS and NMFS. The studies should be designed to explore the effects of fire retardant use on: unique life stages of anadromous fish such as smolts and buried embryo/alevin life stages ranging in development from spawning to yolk sac absorption and the onset of exogenous feeding (approximately 30 days post-hatch); and anadromous fish exposed to fire retardants under multiple stressor conditions expected during wildfires, such as elevated temperature and low DO. Within 12 months of accepting the terms of this Opinion, USFS provide NMFS with a draft research plan to conduct additional toxicological studies on the acute and sublethal effects of the fire retardant formulations. Depending on the outcome of these studies described per the research plan and after conferring with NMFS, the USFS must make appropriate modifications to the program that would minimize the effects on NMFS' listed resources (e.g., whether a retardant(s) should be withdrawn from use and replaced with an alternative retardant(s)).

3. Develop guidance that directs the US Forest Service to conduct an assessment of site conditions following wildfire where fire retardants have entered waterways, to evaluate the changes to on site water quality and changes in the structure of the biological community. The field guidance shall require monitoring of such parameters as macro-invertebrate communities, soil and water chemistry, or other possible surrogates for examining the direct and indirect effects of fire retardants on the biological community within and downstream of the retardant drop area as supplemental to observations for signs of dead or dying fish. The guidance may establish variable protocols based upon the volume of retardants expected to have entered the waterway, but must require site evaluations commensurate with the volume of fire retardants that entered the waterway.

4. Provide policy and guidance to ensure that USFS local unit resource specialist staff provide the local NMFS Regional Office responsible for section 7 consultations with a summary report of the site assessment that identifies: (a) the retardant that entered the waterway, (b) an estimate of the area affected by the retardant, (c) a description of whether the retardant was accidentally dropped into the waterway or whether an exception to the 2000 Guidelines was invoked and the reasons for the accident or exception, (d) an assessment of the direct and indirect impacts of the fire retardant drop, (e) the nature and results of the field evaluation that was conducted following control and abatement of the fire, and any on site actions that may have been taken to minimize the effects of the retardant on aquatic communities.

5. Provide NMFS Headquarter's Office of Protected Resources with a biannual summary (every two years) that evaluates the cumulative impacts (as the Council on Environmental Quality has defined that term pursuant to the National Environmental Policy Act of 1969) of their continued use of long-term fire retardants including: (a) the number of observed retardant drops entering a waterway, in any subwatershed and watershed, (b) whether the observed drops occurred in a watershed inhabited by NMFS' listed resources, (c) an assessment as to whether listed resources were affected by the misapplication of fire retardants within the waterway, and (d) the USFS' assessment of cumulative impacts of the fire retardant drops within the subwatershed and watershed and the consequences of those effects on NMFS' listed 139 resources. The evidence the USFS shall use for this evaluation would include, but is not limited to: (i) the results of consultation with NMFS' Regional Offices and the outcome of the site assessment described in detail in the previous element of this RPA (Element 4) and (ii) the results of new fish toxicity studies identified within Element 2; and (d) any actions the USFS took or intends to take to supplement the 2000 Guidelines to minimize the exposure of listed fish species to fire retardants, and reduce the severity of their exposure.

U.S. Fish and Wildlife Service Reasonable and Prudent Alternatives

1. Coordinate with local Fish and Wildlife Service offices each year to the onset of the fire season to ensure that 1) the most up-to-date detailed maps or descriptions of areas on National Forest System lands that are designated critical habitat or occupied by species found in Table 1, 2) this information is incorporated in local planning and distributed to appropriate resources by the local Fire Management Officer, 3) maps and information are made available to incident commanders and fire teams for the purpose of avoiding application of retardants to areas designated critical habitat or occupied by species found Table 1, whenever possible, including the use of best available technologies to avoid areas designated critical habitat or occupied by species found in Table 1, 4) any other appropriate conservation measures are included to avoid the likelihood of jeopardizing species or adversely modifying or destroying critical habitat, such measures may include enhancement of populations or other appropriate contingency measures.

2. Wherever practical, the Forest Service will prioritize fuels reduction projects for lands in the National Forest System that are in close vicinity to areas designated critical habitat or occupied by species listed in Table 1, so as to reduce the need to use aerially applied fire retardants.

3. Whenever practical, the Forest Service will use water or other less toxic fire retardants than those described in the proposed action within areas designated critical habitat or occupied by species in Table 1.

4. If areas designated critical habitat or occupied by species found in Table 1 are exposed to fire retardant, then the Forest Service will initiate Emergency Consultation pursuant to regulations at 50 CFR 402.05 implementing section 7 of the Endangered Species Act of 1973, as amended. As part of the Emergency Consultation, the following measures may apply:

a. Conduct monitoring in coordination with the local Fish and Wildlife Service office of the direct, indirect, and cumulative impacts of the fire retardant application on listed species. Fish and Wildlife Service-approved monitoring protocols and reporting frequency will be developed. Monitoring for aquatic species may include water quality.

b. If appropriate, and in consultation with the Fish and Wildlife Service, include measures to prevent or compensate for population declines due to application of fire retardant.

c. During monitoring, all non-native plant species will be removed from areas of concern as appropriate for the area and listed species affected, as determined in consultation with the appropriate Fish and Wildlife Service office. Appropriate weed control methods will be developed in coordination with the local Fish and Wildlife Service office.

Appendix B – Implementation of the Reasonable and Prudent Alternatives

Appendix B – Implementation of the Reasonable and Prudent Alternatives

The US Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) biological opinions were accepted with reasonable and prudent alternatives (RPAs). The Forest Service immediately began the implementation of the RPAs upon issuing the Decision Notice (February 2008).

The following provides the current status of each RPA accepted by the Forest Service:

Fish and Wildlife Service

RPA Sub-Element

Coordinate with local FWS offices each year to the onset of the fire season to ensure that 1) the most up-to-date detailed maps or descriptions of areas on National Forest System lands that are designated critical habitat or occupied by species found in Table 1, 2) this information is incorporated in local planning and distributed to appropriate resources by the local Fire Management Officer, 3) maps and information are made available to incident commanders and fire teams for the purpose of avoiding application of retardants to areas designated critical habitat or occupied by species found Table 1, whenever possible, including the use of best available technologies to avoid areas designated critical habitat or occupied by species found in Table 1, 4) any other appropriate conservation measures are included to avoid the likelihood of jeopardizing species or adversely modifying or destroying critical habitat, such measures may include enhancement of populations or other appropriate contingency measures.

Status

Each impacted region updated maps, established pre-fire procedures that engage and incorporate USFWS personnel, and identified areas where retardant would not be allowed. This information is provided to Incident Management Teams when teams are assigned. Forest Supervisors/District Rangers continue to assign Resource Advisors to fires to ensure resource protection requirements are known and followed, which includes using water only at times. Where necessary, resource protection requirements would be incorporated into the Delegation of Authority given to the Incident Commander.

Initial information of the RPAs was given to the Regional Foresters, Fire Directors, Threatened and Endangered Species Directors and Forest Supervisors. This direction included the requirement for Forest Supervisors to contact their local FWS and NMFS (if applicable) offices prior to the beginning of fire season. The memo containing this direction was delivered on March 27, 2008. Each following year a memo has been sent to the field reminding them of the requirements with a national standard reporting form. This information has been posted to both the Fire and Aviation’s web page and the Wildland Fire Chemical Systems web page.

In addition the information has been included in the Interagency Fire and Aviation Standards for Operations and the Incident Pocket Response Guide.

RPA Sub-Element

Wherever practical, the Forest Service will prioritize fuels reduction projects for lands in the National Forest System that are in close vicinity to areas designated critical habitat or occupied by species listed in Table 1, so as to reduce the need to use aerially applied fire retardants.

Status

The Decision Notice and RPAs were shared with the Regional Foresters through the March 27, 2008 letter. The Forest Supervisor has the responsibility to review the planned fuel treatments for prioritization based on the RPA as well as future treatments.

To monitor this nationally the Washington Office collects the information from the forests on what acres were treated in the identified areas through FACTS reporting (Forest Service Activity Tracking System), although adding the TES information in the report is not considered a mandatory field . The Washington Office pulled information from the reporting system from 2009 that provided information of 16,515 acres treated specifically within TES habitat listed, however numerous projects were completed near the TES species habitat. For FY2010 176,181 acres were reported as treated in the TES habitat for those species identified in the biological opinion (BO). It is important to remember that the identified for the TES is not a required reporting element, so the reported acres could actually be underestimated. Also it is important to note that other acres were treated that could be in TES designated habitats they just were not ones identified in the BO.

RPA Sub-Element

Whenever practical, the Forest Service will use water or other less toxic fire retardants than those described in the proposed action within areas designated critical habitat or occupied by species in Table 1.

Status

Included in the direction provided to an Incident Commander are any restrictions of tactics. Some areas did only allow water for aerially delivery, unless the situation of threat to life and property was so high. The direction will come in the form of the Delegation of Authority and the resource advisors direction.

RPA Sub-Element

If areas designated critical habitat or occupied by species found in Table 1 are exposed to fire retardant, then the Forest Service will initiate Emergency Consultation pursuant to regulations at 50 CFR 402.05 implementing section 7 of the Endangered Species Act of 1973, as amended. As part of the Emergency Consultation, the following measures may apply:

a. Conduct monitoring in coordination with the local Fish and Wildlife Service office of the direct, indirect, and cumulative impacts of the fire retardant application on listed species. Fish and Wildlife Service-approved monitoring protocols and reporting frequency will be developed. Monitoring for aquatic species may include water quality.

b. If appropriate, and in consultation with the Fish and Wildlife Service, include measures to prevent or compensate for population declines due to application of fire retardant.

c. During monitoring, all non-native plant species will be removed from areas of concern as appropriate for the area and listed species affected, as determined in consultation with the appropriate Fish and Wildlife Service office. Appropriate weed control methods will be developed in coordination with the local Fish and Wildlife Service office.

Status

Direction to the field with a national standard form for reporting retardant in waterways, 300 foot buffer, or T&E species habitat has been sent annually beginning in 2008. Any reports generated due to accidents, spills, and exceptions to the Aerial Delivery of Retardant were submitted to our Wildland Fire Chemicals System program for consolidation and summarization. Initial reports submitted included if Section 7 consultation was initiated or not required, as well as monitoring. Forest Supervisors/District Rangers would initiate the monitoring requirements where applicable.

Forests use long-established local procedures for monitoring effects of activities to listed species and critical habitat, and for meeting and communication with their local USFWS personnel when needed to fully evaluate the significance of effects On June 16-17, 2009 the FS and USGS met to develop the national template for protocols for monitoring in the event it is necessary. These protocols were reviewed by USFWS and direction was sent to the field May 27, 2010 with the national monitoring elements as well as a guide for assessing the impact of an application to a waterway or the TES habitat In addition, a Dispersal/Toxicity Calculator (developed by the USGS) for field use was included in that direction. The Dispersal/Toxicity Calculator can help the resource advisor or other personnel determine the potential impact of an application in a waterway. This will serve as a basis for initial surveying which may or may not lead to consultation.

National Marine Fisheries Service

RPA Sub-Element

Provide evaluations on the two fire retardant formulations, LC 95-A and 259R, for which acute toxicity tests have not been conducted, using standard testing protocols. Although direct fish toxicity tests have not been conducted on three additional formulations, G75-W, G75-F, LV-R, studies are not warranted in light of the fact the USFS intends to phase out their use of these formulations by 2010. All formulations expected to be in use beyond 2010 shall be evaluated using, at a minimum, the established protocols to assess acute mortality to fish. Evaluations must be completed and presented to NMFS no later than two years from the date of this Opinion. Depending on the outcome of these evaluations and after conferring with NMFS, the USFS must make appropriate modifications to the program that would minimize the effects on NMFS' listed resources (e.g., whether a retardant(s) should be withdrawn from use and replaced with an alternative retardant(s)).

Status

USGS completed the acute toxicity testing on LC 95-A and 259R. Results were shared with NMFS and USFWS at the May 29, 2008 joint meeting. No issues or concerns were raised.

The revised USDA Forest Service Specification 5100-304c for Long-Term Retardant, Wildland Firefighting, June 1, 2007 includes the Acute Fish Toxicity testing requirements and established protocols. The process we use was explained to NMFS and accepted. The timing of a company submitting a product for evaluation against this specification varies therefore the information provided to NMFS will be dependent upon that timeline which may be later than the two years from accepting the Biological Opinion. NMFS recognizes this, as well as the Forest Service does not utilize any product prior to its meeting the requirements of the specification.

Testing was completed for LC 95-A and 259R. There are no additional tasks under this sub-element unless formulations are changed that would require discussions with NMFS prior to adding a product to the QPL.

Testing for P100-F was completed by the end of March 2010. This product is being formulated according to the specification that will be implemented April 2011. The additional acute fish toxicity tests have been completed and the formulation and test results were provided to NMFS. No issues were identified and the product has been added to the QPL.

RPA Sub-Element

Engage in toxicological studies on long-term fire retardants approved for current use in fighting fires, to evaluate acute and sublethal effects of the formulations on NMFS' listed resources. The toxicological studies will be developed and approved by both the USFS and NMFS. The studies should be designed to explore the effects of fire retardant use on: unique life stages of anadromous fish such as smolts and buried embryo/alevin life stages ranging in development from spawning to yolk sac absorption and the onset of exogenous feeding (approximately 30 days post-hatch); and anadromous fish exposed to fire retardants under multiple stressor conditions expected during wildfires, such as elevated temperature and low DO. Within 12 months of accepting the terms of this Opinion, USFS provide NMFS with a draft research plan to conduct additional toxicological studies on the acute and sublethal effects of the fire retardant formulations. Depending on the outcome of these studies described per the research plan and after conferring with NMFS, the USFS must make appropriate modifications to the program that would minimize the effects on NMFS' listed resources (e.g., whether a retardant(s) should be withdrawn from use and replaced with an alternative retardant(s)).

Status

Forest Service personnel met with NMFS, USFWS, and USGS on May 29, 2008 and identified key elements for developing a toxicological study. The Forest Service received proposed investigations of the toxicity of long-term retardants on the survival and health of smolting salmonid from NMFS and USGS. The proposal was accepted, an interagency agreement was executed and NMFS performed the work. The report was completed and provided to the Forest Service, USGS, and NMFS Headquarters. The report recommended additional research which was agreed to by the Forest Service. The NMFS recommended examining the temporal lethal and sub‐lethal effects of currently approved fire retardants on ocean‐type Chinook, as well as characterizing the temporal sublethal effects on stream‐type Chinook testing. This work is expected to be completed in 2011.

RPA Sub-Element

Develop guidance that directs the US Forest Service to conduct an assessment of site conditions following wildfire where fire retardants have entered waterways, to evaluate the changes to on site water quality and changes in the structure of the biological community. The field guidance shall require monitoring of such parameters as macro-invertebrate communities, soil and water chemistry, or other possible surrogates for examining the direct and indirect effects of fire retardants on the biological community within and downstream of the retardant drop area as supplemental to observations for signs of dead or dying fish. The guidance may establish variable protocols based upon the volume of retardants expected to have entered the waterway, but must require site evaluations commensurate with the volume of fire retardants that entered the waterway.

Status

Received proposal from USGS for assessment of site conditions and worked through the proposal with NMFS and USFWS. The monitoring protocols and data to be collected in order to establish a national sampling and monitoring template was completed and direction sent to the field May 2010. This direction included a dispersal/toxicity calculator that was to be beta tested during the 2010 fire season in order to determine if it meets the needs for determining area potentially affected and the degree of monitoring required.

RPA Sub-Element

Provide policy and guidance to ensure that USFS local unit resource specialist staff provide the local NMFS Regional Office responsible for section 7 consultations with a summary report of the site assessment that identifies: (a) the retardant that entered the waterway, (b) an estimate of the area affected by the retardant, (c) a description of whether the retardant was accidentally dropped into the waterway or whether an exception to the 2000 Guidelines was invoked and the reasons for the accident or exception*, (*d) an assessment of the direct and indirect impacts of the fire retardant drop, (e) the nature and results of the field evaluation that was conducted following control and abatement of the fire, and any on site actions that may have been taken to minimize the effects of the retardant on aquatic communities.

Status

A memo to Regional Foresters was sent on June 2, 2008 providing direction for reporting requirements for retardant and foam in waterways and T&E species habitats. A form was included with the direction for reporting requirements. All information was posted to the Forest Service web site relative to the Environmental Assessment, Decision notice, and the Biological Opinions. The form included all the elements cited in the RPA sub-element. Subsequent to 2008 memos have been issued annually to the field with the requirements for reporting and entering into consultation. Policy documents have been edited to incorporate these requirements.

The forms are collected by the Wildland Fire Chemical Systems program staff and consolidated in order to provide the NMFS with a summary of accidental or purposeful drops and if consultation was required, as well as if a biological assessment was required and completed.

RPA Sub-Element

Provide NMFS Headquarter's Office of Protected Resources with a biannual summary (every two years) that evaluates the cumulative impacts (as the Council on Environmental Quality has defined that term pursuant to the National Environmental Policy Act of 1969) of their continued use of long-term fire retardants including: (a) the number of observed retardant drops entering a waterway, in any subwatershed and watershed, (b) whether the observed drops occurred in a watershed inhabited by NMFS' listed resources, (c) an assessment as to whether listed resources were affected by the misapplication of fire retardants within the waterway, and (d) the USFS' assessment of cumulative impacts of the fire retardant drops within the subwatershed and watershed and the consequences of those effects on NMFS' listed 139 resources. The evidence the USFS shall use for this evaluation would include, but is not limited to: (i) the results of consultation with NMFS' Regional Offices and the outcome of the site assessment described in detail in the previous element of this RPA (Element 4) and (ii) the results of new fish toxicity studies identified within Element 2; and (d) any actions the USFS took or intends to take to supplement the 2000 Guidelines to minimize the exposure of listed fish species to fire retardants, and reduce the severity of their exposure.

Status

The two year summary report was completed and submitted to NMFS in early 2010. Any need for consultation and biological assessment was identified in the report with the copies of the biological assessments being provided. A three-year report was submitted in early 2011 for their information and use.

Appendix C – Fire and Retardant Use Information

Appendix C – Fire and Retardant Use Information

Table C-1. Estimated Area of Fire Retardant Application on USFS Lands.

FS Region	Acres/region[1]	# fires 2000-2010	# Retardant Drops 2000-2010[2]	Total Gallons 2000-2010 (11 yrs)	Avg gallons/ yr [3]	Acres of impact at 4 gpc [4]	Acres of impact at 8 gpc [4]	% USFS Land w/fire retardant at 4 gpc [4]	% USFS Land w/fire retardant at 8 gpc [4]
R1	25,599,732	10,703	4,082	10,203,789	927,617	532	266	0.00208	0.00104
R2	22,109,098	6,591	1,101	2,753,524	250,320	144	72	0.00065	0.00032
R3	20,808,318	18,597	7,550	18,875,476	1,715,952	985	492	0.00473	0.00237
R4	31,962,282	10,234	4,197	10,493,664	953,969	548	274	0.00171	0.00086
R5	20,218,821	15,884	11,266	28,165,743	2,560,522	1,470	735	0.00727	0.00363
R6	24,774,462	14,834	6,165	15,411,352	1,401,032	804	402	0.00325	0.00162
R8	13,356,285	10,165	1,487	3,716,469	337,861	194	97	0.00145	0.00073
R9	12,124,173	5,835	300	749,790	68,163	39	20	0.00032	0.00016
R10	21,956,250	359	0	0	-	-	-	0.00000	0.00000
Total	192,909,421	93,202	36,148	90,369,807	8,215,437	4,715	2,358	0.00244	0.00122

[1] USFS 2010 Table 2 Lands area report: http://www.fs.fed.usdaland/staff/lar/LAR2010/lar2010index.html

[2] Data derived from: NIFC – ABS database 12/08/2010

[3]Data averaged over 2000–2011

[4]Calculations: gpc = 100 ft 2 ; 4gal/100sq ft = 1, 740 gal/acre; 8gal/100sqft=3,480 gal/acre - (43,500sqft/acre)

Table C-2. Estimated area of Fire Retardant Application on USFS Lands by Forest.

USFS Region	Forest Name	Acres[1]	Total Number of Drops 2000-2011[2]	Avg drop/yr[3]	Avg gallon/yr (based on 2000-2011)[4]	Acres of impact at 4 gpc [4]	Acres of impact at 8 gpc [4]	% USFS Land w/fire retardant at 4gpc [4]	% USFS Land w/fire retardant at gpc [4]
05	San Bernardino National Forest	677,628	1,607	146	365,271	210	105	0.0309369	0.01547
05	Los Padres National Forest	911,733	2,811	256	638,947	367	183	0.0402207	0.02011
05	Angeles National Forest	668,727	1,257	114	285,573	164	82	0.0245087	0.01225
05	Sequoia National Forest	1,144,296	978	89	222,385	128	64	0.0111537	0.00558
03	Coronado National Forest	1,786,620	1,429	130	324,770	186	93	0.0104327	0.00522
05	Cleveland National Forest	439,035	314	29	71,358	41	20	0.0093282	0.00466
03	Lincoln National Forest	1,103,897	765	70	173,920	100	50	0.0090422	0.00452
08	Cherokee National Forest	654,169	441	40	100,215	58	29	0.0087922	0.00440
03	Prescott National Forest	1,239,791	777	71	176,693	101	51	0.0081794	0.00409
05	Shasta Trinity National Forest	2,210,368	1,330	121	302,235	173	87	0.0078475	0.00392
01	Helena National Forest	983,057	537	49	121,971	70	35	0.0071208	0.00356
06	Fremont-Winema National Forests	2,252,587	1,218	111	276,773	159	79	0.0070517	0.00353

USFS Region	Forest Name	Acres[1]	Total Number of Drops 2000-2011[2]	Avg drop/yr[3]	Avg gallon/yr (based on 2000-2011)[4]	Acres of impact at 4 gpc[4]	Acres of impact at 8 gpc[4]	% USFS Land w/fire retardant at 4gpc[4]	% USFS Land w/fire retardant at gpc[4]
05	Mendocino National Forest	911,733	453	41	102,997	59	30	0.0064835	0.00324
06	Deschutes National Forest	1,596,899	772	70	175,394	101	50	0.0063036	0.00315
03	Gila National Forest	2,710,338	1,276	116	290,078	166	83	0.0061425	0.00307
05	Plumas National Forest	1,176,005	530	48	120,546	69	35	0.0058829	0.00294
06	Okanogan-Wenatchee National Forests	3,237,440	1,458	133	331,364	190	95	0.0058743	0.00294
05	Stanislaus National Forest	898,121	393	36	89,274	51	26	0.0057048	0.00285
04	Payette National Forest	2,327,541	1,007	92	228,755	131	66	0.0056406	0.00282
03	Cibola National Forest	1,633,783	699	64	158,826	91	46	0.0055793	0.00279
03	Santa Fe National Forest	1,566,141	666	61	151,312	87	43	0.0055449	0.00277
08	National Forests In Florida	1,110,416	470	43	106,886	61	31	0.0055244	0.00276
03	Tonto National Forest	2,872,876	988	90	224,557	129	64	0.0044860	0.00224
06	Columbia River Gorge National Scenic Area	72,810	24	2	5,375	3	2	0.0042371	0.00212
06	Wallowa-Whitman National Forest	2,266,075	730	66	165,967	95	48	0.0042034	0.00210

USFS Region	Forest Name	Acres[1]	Total Number of Drops 2000-2011[2]	Avg drop/yr[3]	Avg gallon/yr (based on 2000-2011)[4]	Acres of impact at 4 gpc [4]	Acres of impact at 8 gpc [4]	% USFS Land w/fire retardant at 4gpc [4]	% USFS Land w/fire retardant at gpc [4]
01	Flathead National Forest	2,404,892	722	66	164,110	94	47	0.0039164	0.00196
04	Boise National Forest	2,654,004	750	68	170,559	98	49	0.0036883	0.00184
06	Umatilla National Forest	1,407,087	392	36	89,048	51	26	0.0036321	0.00182
01	Gallatin National Forest	1,819,515	499	45	113,513	65	33	0.0035805	0.00179
05	Tahoe National Forest	878,030	235	21	53,380	31	15	0.0034892	0.00174
01	Custer National Forest	1,188,130	311	28	70,728	41	20	0.0034165	0.00171
02	Nebraska National Forest	141,864	37	3	8,351	5	2	0.0033784	0.00169
09	Superior National Forest	1,050,177	268	24	60,849	35	17	0.0033254	0.00166
05	Six Rivers National Forest	998,540	234	21	53,292	31	15	0.0030630	0.00153
06	Siuslaw National Forest	634,210	135	12	30,662	18	9	0.0027748	0.00139
05	Lake Tahoe Basin Mgt Unit	150,000	31	3	7,088	4	2	0.0027119	0.00136
05	Lassen National Forest	1,070,992	222	20	50,404	29	14	0.0027010	0.00135
06	Willamette National Forest	1,678,037	332	30	75,394	43	22	0.0025786	0.00129

USFS Region	Forest Name	Acres[1]	Total Number of Drops 2000-2011[2]	Avg drop/yr[3]	Avg gallon/yr (based on 2000-2011)[4]	Acres of impact at 4 gpc [4]	Acres of impact at 8 gpc [4]	% USFS Land w/fire retardant at 4gpc [4]	% USFS Land w/fire retardant at gpc [4]
04	Wasatch-Cache National Forest	1,614,193	309	28	70,220	40	20	0.0024966	0.00125
04	Sawtooth National Forest	1,804,090	338	31	76,718	44	22	0.0024406	0.00122
05	Sierra National Forest	1,311,833	237	22	53,845	31	15	0.0023557	0.00118
03	Coconino National Forest	1,855,955	311	28	70,662	41	20	0.0021851	0.00109
06	Rogue River-Siskiyou National Forests	1,723,179	284	26	64,569	37	19	0.0021505	0.00108
01	Idaho Panhandle National Forests	3,221,685	530	48	120,451	69	35	0.0021458	0.00107
08	National Forests In North Carolina	1,254,523	206	19	46,773	27	13	0.0021398	0.00107
06	Malheur National Forest	1,465,286	231	21	52,456	30	15	0.0020546	0.00103
05	Klamath National Forest	1,737,774	271	25	61,496	35	18	0.0020310	0.00102
06	Mt. Hood National Forest	1,071,442	167	15	37,899	22	11	0.0020301	0.00102
06	Colville National Forest	954,410	147	13	33,328	19	10	0.0020041	0.00100
02	Pike-San Isabel National Forest	2,230,898	336	31	76,328	44	22	0.0019636	0.00098

USFS Region	Forest Name	Acres[1]	Total Number of Drops 2000-2011[2]	Avg drop/yr[3]	Avg gallon/yr (based on 2000-2011)[4]	Acres of impact at 4 gpc[4]	Acres of impact at 8 gpc[4]	% USFS Land w/fire retardant at 4gpc[4]	% USFS Land w/fire retardant at gpc[4]
03	Apache-Sitgreaves National Forests	2,632,350	390	35	88,609	51	25	0.0019319	0.00097
01	Bitterroot National Forest	1,587,070	233	21	52,974	30	15	0.0019157	0.00096
04	Dixie National Forest	1,888,507	261	24	59,234	34	17	0.0018001	0.00090
01	Lolo National Forest	2,196,314	297	27	67,589	39	19	0.0017662	0.00088
05	Modoc National Forest	1,663,401	224	20	51,004	29	15	0.0017598	0.00088
06	Umpqua National Forest	983,129	128	12	29,044	17	8	0.0016955	0.00085
04	Fishlake National Forest	1,461,226	189	17	43,029	25	12	0.0016900	0.00085
04	Manti-Lasal National Forest	1,270,886	163	15	36,959	21	11	0.0016690	0.00083
01	Beaverhead-Deerlodge National Forest	3,357,832	402	37	91,366	52	26	0.0015616	0.00078
03	Kaibab National Forest	1,560,165	180	16	40,853	23	12	0.0015028	0.00075
01	Lewis and Clark National Forest	1,863,468	206	19	46,854	27	13	0.0014430	0.00072
02	San Juan National Forest	1,878,852	186	17	42,297	24	12	0.0012920	0.00065
06	Ochoco National Forest	851,033	76	7	17,239	10	5	0.0011626	0.00058

USFS Region	Forest Name	Acres[1]	Total Number of Drops 2000-2011[2]	Avg drop/yr[3]	Avg gallon/yr (based on 2000-2011)[4]	Acres of impact at 4 gpc [4]	Acres of impact at 8 gpc [4]	% USFS Land w/fire retardant at 4gpc [4]	% USFS Land w/fire retardant at gpc [4]
04	Salmon-Challis National Forest	4,235,940	375	34	85,128	49	24	0.0011534	0.00058
01	Nez Perce National Forest	2,224,176	194	18	44,059	25	13	0.0011369	0.00057
04	Uinta National Forest	880,719	74	7	16,897	10	5	0.0011011	0.00055
08	Daniel Boone National Forest	560,787	46	4	10,497	6	3	0.0010742	0.00054
08	Ozark-St Francis National Forest	1,160,183	92	8	20,889	12	6	0.0010334	0.00052
02	Grand Mesa, Uncompahgre and Gunnison National Forests	346,555	27	2	6,127	4	2	0.0010146	0.00051
08	Ouachita National Forest	1,788,429	135	12	30,719	18	9	0.0009858	0.00049
04	Humboldt-Toiyabe National Forest	5,639,195	385	35	87,476	50	25	0.0008903	0.00045
02	Black Hills National Forest	1,534,471	102	9	23,176	13	7	0.0008668	0.00043
04	Caribou-Targhee National Forest	2,630,716	174	16	39,547	23	11	0.0008628	0.00043

USFS Region	Forest Name	Acres[1]	Total Number of Drops 2000-2011[2]	Avg drop/yr[3]	Avg gallon/yr (based on 2000-2011)[4]	Acres of impact at 4 gpc [4]	Acres of impact at 8 gpc [4]	% USFS Land w/fire retardant at 4gpc [4]	% USFS Land w/fire retardant at gpc [4]
02	Arapaho and Roosevelt National Forests	1,538,474	99	9	22,555	13	6	0.0008414	0.00042
05	Inyo National Forest	1,948,726	108	10	24,541	14	7	0.0007228	0.00036
02	Medicine Bow-Routt National Forest	2,222,323	119	11	26,948	15	8	0.0006959	0.00035
03	Carson National Forest	1,391,674	69	6	15,671	9	4	0.0006463	0.00032
06	Gifford Pinchot National Forest	1,321,506	65	6	14,794	8	4	0.0006425	0.00032
04	Ashley National Forest	1,382,346	67	6	15,160	9	4	0.0006294	0.00031
02	White River National Forest	2,286,192	110	10	24,978	14	7	0.0006271	0.00031
09	Chippewa National Forest	666,623	30	3	6,841	4	2	0.0005890	0.00029
01	Kootenai National Forest	1,812,425	80	7	18,204	10	5	0.0005765	0.00029
05	Eldorado National Forest	686,667	30	3	6,887	4	2	0.0005757	0.00029
01	Clearwater National Forest	1,679,952	70	6	15,798	9	5	0.0005397	0.00027
04	Bridger-Teton National Forest	3,402,684	107	10	24,287	14	7	0.0004096	0.00020

USFS Region	Forest Name	Acres[1]	Total Number of Drops 2000-2011[2]	Avg drop/yr[3]	Avg gallon/yr (based on 2000-2011)[4]	Acres of impact at 4 gpc [4]	Acres of impact at 8 gpc [4]	% USFS Land w/fire retardant at 4gpc [4]	% USFS Land w/fire retardant at gpc [4]
08	Kisatchie National Forest	603,393	19	2	4,210	2	1	0.0004004	0.00020
08	George Washington & Jefferson National Forest	1,795,084	51	5	11,698	7	3	0.0003740	0.00019
08	National Forests In Texas	512,882	10	1	2,383	1	1	0.0002666	0.00013
08	Francis Marion and Sumter National Forests	629,765	12	1	2,649	2	1	0.0002414	0.00012
02	Bighorn National Forest	1,107,571	19	2	4,360	3	1	0.0002259	0.00011
02	Rio Grande National Forest	1,823,403	18	2	4,038	2	1	0.0001271	0.00006
06	Olympic National Forest	633,577	4	0	1,021	1	0	0.0000925	0.00005
08	National Forests In Mississippi	1,172,531	4	0	941	1	0	0.0000461	0.00002
02	Shoshone National Forest	24,367,731	49	4	11,163	6	3	0.0000263	0.00001
06	Mt Baker-Snoqualmie National Forest	2,560,903	3	0	703	0	0	0.0000158	0.00001

USFS Region	Forest Name	Acres[1]	Total Number of Drops 2000-2011[2]	Avg drop/yr[3]	Avg gallon/yr (based on 2000-2011)[4]	Acres of impact at 4 gpc [4]	Acres of impact at 8 gpc [4]	% USFS Land w/fire retardant at 4gpc [4]	% USFS Land w/fire retardant at gpc [4]
09	Huron Manistee National Forest	978,906	1	0	236	0	0	0.0000138	0.00001
09	Mark Twain National Forest	1,491	1	0	236	0	0	0.0000091	0.00000
	All remaining NF's and Grasslands		0	0	0	0	0	0	
	Totals:		36,148	3,267	8,215,437	4,715	2,358		

[1] USFS 2010 Table 2 Lands area report: http://www.fs.fed.usdaland/staff/lar/LAR2010/lar2010index.html

[2] Data derived from NIFC – ABS database 12/08/2010

[3]Data averaged over 2000-2011

[4]Calculations: gpc = 100 ft^2; 4gal/100sq ft = 1, 740 gal/acre; 8gal/100sqft=3,480 gal/acre - (43,500sqft/acre)

Table C-3. Total Retardant Drops and Fires, 2000–2010.

FS Region	National Forest	State(s)	Total Number of Retardant Drops 2000-2010	Total Number of Fires 2000-2010
01	Beaverhead-Deerlodge National Forest	MT	402	575
01	Bitterroot National Forest	ID/MT	233	1,016
01	Clearwater National Forest	ID	70	814
01	Custer National Forest	MT	311	607
01	Dakota Prairie Grasslands	SD, ND	0	272
01	Flathead National Forest	MT	722	806
01	Gallatin National Forest	MT	499	407
01	Helena National Forest	MT	537	403
01	Idaho Panhandle National Forests	ID	530	1,344
01	Kootenai National Forest	MT	80	1,424
01	Lewis and Clark National Forest	MT	206	303
01	Lolo National Forest	MT	297	1,427
01	Nez Perce National Forest	ID/MT	194	1,305
02	Arapaho and Roosevelt National Forests	CO	99	573
02	Bighorn National Forest	WY	19	156
02	Black Hills National Forest	WY/SD	102	1,156
02	Grand Mesa, Uncompahgre and Gunnison National Forests	CO	27	506
02	Medicine Bow-Routt National Forest	WY/CO	119	770
02	Nebraska National Forest	NE	37	259
02	Pike-San Isabel National Forest	CO	336	1,210
02	Rio Grande National Forest	CO	18	186
02	San Juan National Forest	CO	186	1,037

FS Region	National Forest	State(s)	Total Number of Retardant Drops 2000-2010	Total Number of Fires 2000-2010
02	Shoshone National Forest	WY	49	289
02	White River National Forest	CO	110	449
03	Apache-Sitgreaves National Forests	AZ	390	2,475
03	Carson National Forest	NM	69	751
03	Cibola National Forest	NM	699	1,090
03	Coconino National Forest	AZ	311	4,074
03	Coronado National Forest	AZ	1429	1,035
03	Gila National Forest	NM	1276	2,077
03	Kaibab National Forest	AZ	180	1,909
03	Lincoln National Forest	NM	765	505
03	Prescott National Forest	AZ	777	835
03	Santa Fe National Forest	NM	666	1,395
03	Tonto National Forest	AZ	988	2,451
04	Ashley National Forest	UT	67	252
04	Boise National Forest	ID	750	1,495
04	Bridger-Teton National Forest	WY	107	738
04	Caribou-Targhee National Forest	ID	174	654
04	Dixie National Forest	UT	261	1,062
04	Fishlake National Forest	UT	189	575
04	Humboldt-Toiyabe National Forest	NV	385	1,609
04	Manti-Lasal National Forest	UT/CO	163	699
04	Payette National Forest	ID	1007	889
04	Salmon-Challis National Forest	ID	375	842

FS Region	National Forest	State(s)	Total Number of Retardant Drops 2000-2010	Total Number of Fires 2000-2010
04	Sawtooth National Forest	ID	338	398
04	Uinta National Forest	UT	74	503
04	Wasatch-Cache National Forest	UT	309	518
05	Angeles National Forest	CA	1257	1,240
05	Cleveland National Forest	CA	314	762
05	Eldorado National Forest	CA	30	961
05	Inyo National Forest	CA	108	568
05	Klamath National Forest	CA	271	1,159
05	Lake Tahoe Basin Mgt Unit	CA/NV	31	435
05	Lassen National Forest	CA	222	706
05	Los Padres National Forest	CA	2,811	433
05	Mendocino National Forest	CA	453	307
05	Modoc National Forest	CA	224	1,055
05	Plumas National Forest	CA	530	1,093
05	San Bernardino National Forest	CA	1,607	1,463
05	Sequoia National Forest	CA	978	668
05	Shasta Trinity National Forest	CA	1,330	1,597
05	Sierra National Forest	CA	237	1,006
05	Six Rivers National Forest	CA	234	786
05	Stanislaus National Forest	CA	393	767
05	Tahoe National Forest	CA	235	878
06	Columbia River Gorge National Scenic Area	OR	24	12

FS Region	National Forest	State(s)	Total Number of Retardant Drops 2000-2010	Total Number of Fires 2000-2010
06	Colville National Forest	WA	147	531
06	Deschutes National Forest	OR	772	2,192
06	Fremont-Winema National Forests	OR	1,218	1,385
06	Gifford Pinchot National Forest	WA	65	357
06	Malheur National Forest	OR	231	1,592
06	Mt Baker-Snoqualmie National Forest	WA	3	439
06	Mt. Hood National Forest	OR	167	694
06	Ochoco National Forest	OR	76	921
06	Okanogan-Wenatchee National Forests	WA	1,458	1,702
06	Olympic National Forest	WA	4	91
06	Rogue River-Siskiyou National Forests	OR	284	755
06	Siuslaw National Forest	OR	135	95
06	Umatilla National Forest	OR	392	992
06	Umpqua National Forest	OR	128	766
06	Wallowa-Whitman National Forest	OR	730	1,134
06	Willamette National Forest	OR	332	1,176
08	Chattahoochee-Oconee National Forests	GA	0	627
08	Cherokee National Forest	TN	441	653
08	Daniel Boone National Forest	KY	46	894
08	Francis Marion and Sumter National Forests	SC	12	796
08	George Washington & Jefferson National Forest	VA/WV	51	403
08	Kisatchie National Forest	LA	19	663

FS Region	National Forest	State(s)	Total Number of Retardant Drops 2000-2010	Total Number of Fires 2000-2010
08	Land Between the Lakes National Recreation Area	KY, TN	0	16
08	National Forests in Alabama		0	571
08	National Forests In Florida	FL	470	1,383
08	National Forests In Mississippi	MS	4	1,197
08	National Forests In North Carolina	NC	206	1,168
08	National Forests In Texas	TX	10	517
08	Ouachita National Forest	AR	135	818
08	Ozark-St Francis National Forest	AR	92	459
09	Allegheny National Forest	PA		111
09	Chequamegon / Nicolet National Forest	WI	0	443
09	Chippewa National Forest	MN	30	607
09	Green Mountain And Finger Lakes National Forests	VT	0	16
09	Hiawatha National Forest	MI	0	129
09	Hoosier National Forest	IN	0	286
09	Huron Manistee National Forest	MI	1	942
09	Mark Twain National Forest	MO	1	1,730
09	Midewin National Tallgrass Prairie	IL	0	13
09	Monongahela National Forest	WV	0	106
09	Ottawa National Forest	WI	0	60
09	Shawnee National Forest	IL	0	234
09	Superior National Forest	MN	268	626
09	Wayne National Forest	OH	0	482

FS Region	National Forest	State(s)	Total Number of Retardant Drops 2000-2010	Total Number of Fires 2000-2010
09	White Mountain National Forest	NH	0	50
10	Chugach National Forest	AK	0	94
10	Tongass National Forest	AK	0	265
	TOTAL		36,148	93,202

Table C-4. Representative Ecoregions for Retardant Application.

FS Region	Description	Eco-Regions- Divisions	Geo Location	# fires 2000 – 2010	Retardant Application Gallons /100 sq ft	Peak Fire Season
R1	Shrubland, needleleaf forest annual and perennial grasslands, sagebrush with grass	Prairie; Temperate Desert; Temperate Steppe ; Temperate Steppe Mountains	ID, MT, ND, SD, WY	10703	1 to 3	Apr-Oct
R2	Shrubland, needleleaf forest, annual and perennial grasslands, sagebrush with grass	Temperate Desert; Temperate Desert Mountains; Temperate Steppe; Temperate Steppe Mountains; Tropical/Subtropical Mountains; Tropical/Subtropical Steppe	SD, NE, CO, WY	6591	1 to 3	Jun-Oct
R3	Shrubland, needleleaf forest, annual and perennial grasslands, woodlands	Temperate Steppe; Temperate Steppe Mountains; Tropical/Subtropical Desert; Tropical/Subtropical Mountains; Tropical/Subtropical Steppe	AZ, NM	18597	1 to 4	May-Jul eastern NM similar to TX)
R4	Shrubland, needleleaf forest; dry steppe, annual and perennial grasslands, woodlands	Mediterranean Mountains; Temperate Desert; Temperate Desert Mountains; Temperate Steppe ; Temperate Steppe Mountains; Tropical /Subtropical Desert; Tropical/Subtroical Steppe	NV, UT, WY, ID	10234	1 to 4	Jun-Oct
R5	Mosaic of fire adapted woodland/shrubland, needle leaf evergreen and broadleaf woodlands; sagebrush with grass	Mediterranean; Mediterranean Mountains; Temperate Desert; Tropical/Subtropical Desert	CA	15884	3 to >6	Aug-Oct
R6	Short needle closed confier; needle leaf evergreen and broadleaf woodlands; sagebrush with grass; short needle conifer	Marine, Marine Mountains: Mediterranean Mountains; Temperate Desert; Temperate Steppe Mountains	OR, WA	14834	3 to 4	Jun-Oct

FS Region	Description	Eco-Regions- Divisions	Geo Location	# fires 2000 – 2010	Retardant Application Gallons /100 sq ft	Peak Fire Season
R8	Cold-deciduous broadleaf forests; cold-deciduous broadleaf forests; fall hardwood; southern rough; summer hardwood; herbaceous with broadleaf; shrublands	Hot Continental; Hot Continental Mountains; Prairie; Savanna Mountains; Subtropical	South Eastern U.S.	10165	2	Sep-Jul
R9	Short and long needle conifer cold-deciduous broadleaf forests; summer hardwood; herbaceous woodlands; shrublands	Hot Continental; Hot Continental Mountains; Prairie; Warm Continental	North Eastern	5835	2	Apr-Oct
R10	Pacific coastal mountains and meadows	Marine Mountains; Subartic	AK	359	3 to 6	Jun-Sep

Appendix D – Misapplication of Fire Retardant Data Analysis on Forest Service Lands.

Appendix D – Misapplication of Fire Retardant Data Analysis on Forest Service Lands.

Table D-1. Misapplication of Fire Retardant Data, 2008–2010.

Year	Region	Forest	Fire	Intrusion Reports	Loads	Drops	Accidental	Exception	Direct to water	Buffer Only	Terrestrial TES	Gallons Estimated Water	Gallons Estimated Buffer	Gallons Estimated Terrestrial	Notes
2008	R4	Dixie	Corn Creek	2	2	3	3		3			1103			
2008	R5	Mendicino	Lantz	1	1	1	1			1					
2008	R5	Mendicino	Mill/soda	1	1	1	1		1			1			
2008	R5	San B	Slide	1	1	1		1		1			2700		
2008	R6	Deschutes	Royce Butte	1	1	1	1		1			2500			wetland*
2008	R6	Malheur	Deardorff	1	1	1	1		1				1100		some in water*
2008	R6	Mt. Hood	Barlow	1	1	1	1			1			1800		
2008	R6	Mt. Hood	Polallie ck	1	1	1	1		1			40	400		
2008	R6	Mt. Hood	Eliot	1	1	1	1		1			20	500		
2008	R6	Willamette	Red King	1	1	1	1		1			284			
2008	Total			11	11	12	11	1	9	3	0	3948	6500	0	
2009	R3	Coconino	Reservoir	1	13	13	13				13			27817	
2009	R4	Boise	Needles	1	1	2	2		2			150			
2009	R5	Angeles	Station	1	1	1		1	1			3000			
2009	R5	Los Padres	Ponderoso	1	1	1	1		1			2	50		
2009	R5	Mendicino	Summit	1	1	1	1		1			3000			
2009	R5	Plumas	Silver	1	1	1	1		1			20			

Year	Region	Forest	Fire	Intrusion Reports	Loads	Drops	Accidental	Exception	Direct to water	Buffer Only	Terrestrial TES	Gallons Estimated Water	Gallons Estimated Buffer	Gallons Estimated Terrestrial	Notes
2009	R5	Shasta-T	Backbone	1	1	1		1		1			500		
2009	R6	Malheur	251	1	3	3	3		3			10			
2009	R6	Willamette	Canal Ck	1	1	1	1			1			2082		
2009	Total			9	23	24	22	2	9	2	13	6182	2632	27817	
2010	R3	Ap-Sit	Boggy	1	2	2	2		2			150			
2010	R4	Boise	Hurd	5	5	5	5		5			664			
2010	R4	Boise	Grimes	1	1	1	1		1			10			
2010	R4	Sawtooth	Deer Park	1	1	1	1		1			7			
2010	R4	Salmone Challis	Banner	1	1	1	1		1			215			
2010	R5	Cleveland	Tenaja 2	1	1	1	1			1					
2010	R5	Lassen	Windy	1	1	1	1		1			2.5			
2010	R5	San B	Division	1	1	1		1			1				
2010	R5	Shasta-T	Hidden	1	1	2		2		2					
2010	R5	Sequoia	Bull	1	1	1	1		1			30			
2010	R6	Deschutes	Incident	1	1	2	1			2					drift*
2010	R6	Willamette	Scott Mtn	2	2	2	2		2			2317			
2010	R6	Willamette	Scott Mtn	1	48	48		48			48				* talked to shirley drops into marginal spotted owl habitat
2010	Total			18	66	68	16	51	14	5	49	3395.5	0	0	

The 13 drops on the Coconino NF in 2009 were all in terrestrial habitat for the Mexican spotted owl on one fire.

The 48 drops on the Willamette NF in 2010 were all in terrestrial habitat – marginal dispersal habitat for the northern spotted owl, again all on one fire.

These two incidents would have no effect on spotted owl habitat since owl habitat consists of mature and old-growth forest conditions; both which would not be changed with the application of fire retardant. Marginal dispersal consists of mixed coniferous forest habitat which is around 11 inches diameter breast height with at least 40 percent canopy closure. Again, fire retardant would not change conditions for habitat

Appendix E – National Screens for Federally Listed Species and Forest Service Listed Sensitive Species

Appendix E – National Screens for Federally Listed Species and Forest Service Listed Sensitive Species

Table E-1. National Screening Process for Federally Listed Species

Impact [1]	National Screening Factor Aerially Applied Retardant	Retardant Application Potential
NE	If species/habitat occur in areas with no fires. No fires = no potential for retardant use.	None
NE	If no fire or retardant recorded in past 10 years on forests where species are suspected or occur or critical habitat is designated (assumption future fires would be put out without aerial resources).	None
NE	Designated critical habitat areas protected with avoidance mapping or the use of fire retardant does not impact or change the Primary Constituent Elements.	Low
Aquatics		
LAA	If a Forest/Grassland has more than 1 retardant drop a year then the chance of misapplication is greater than 0.1%.	
Terrestrial		
NLAA	If species is not an isolated population[2] and aerial application of fire retardant is applied on less than 0.01% annually on a specific forest where species occurs or is suspected of occurring (by forest based on past 10 yr data).	Low
NLAA	If a species occurs or is suspected of occurring on a forest with more than 0.01% annually, yet occurs in habitats with very low likelihood of retardant application.	Low
LAA	Aerial application of fire retardant is applied on more than 0.01% annually on NFS lands (based on past 10 yr data).	Mod-high
LAA	If species is a small isolated population [2] and occurs on any forest where retardant application is likely to occur (based on past 10 yr data) - recognizing impact to these species from a misapplication or invoking an exception.	Low-high

1. NE = no effect, NLAA = may affect, not likely to adversely affect, LAA = likely to adversely affect
2. Isolated population: an area where individuals or populations(s) occur within a small isolated area where the application of retardant could reduce viability, or jeopardize the further existence of the species.

Assumptions used for the effects screening process:

- The 2000-2010 fire season statistics provide a reasonable representation of the risk of retardant applications in the next 10-15 years relative to the USFS landbase even though past or future decades could have more fires (Geier-Hayes, 2011).
- Known species occurrences and designated critical habitat areas would be protected from adverse effects on a species by species case by avoidance area designations that direct use of retardant away from these areas.
- Designated critical habitat where the use of aerial application of fire retardant does not affect or change primary constituent elements does not require protection or avoidance mapping.

Specific screens and assumptions for species and critical habitat are described in further detail in the Plants, Wildlife and Aquatic sections of this final EIS.

Table E-2. National Screen for Forest Service Sensitive Species.

Impact [1]	National Screening Factor	Retardant Application Potential
NI	If no aerially applied retardant and no fires recorded in past 10 years on forests where species occur or are suspected of occurring. If species occurs in habitat with no fire potential.	None
NI	If no aerially retardant use in last 10 years on forests where species occur or are suspected of occurring (forests may still have small fires that get put out without aerial resources).	None
MII	Sensitive species occurring on forests with past history of retardant application WHERE APPLICATION OF AERIAL FIRE RETARDANT WOULD RESULT IN AN ADVERSE EFFECT THAT WOULD RESULT IN A TREND TOWARDS FEDERAL LISTING OR LOSS OF VIABILITY ON THE PLANNING UNIT AND occurrences are *protected with avoidance mapping* (for instance species with limited distribution, isolated population or species trending towards listing N1-N3 Nature Serve Listings). These known occurrences would be protected with avoidance mapping as applicable to further protect from negative adverse effects.	Low to high
MII	Sensitive species occurring on forests with past history of retardant application not protected with avoidance mapping (for instance stable secure populations or species occurring across a wide range of distribution N4-N5 Nature Serve Listings). Species occurrences could be impacted, yet would not trend toward federal listing or loss of viability in the planning unit due to wide ranging distributions and non-limiting habitat availability.	Low to high
LII	Sensitive species occurring on forests where the application of fire retardant is likely to result in a trend towards federal listing or a loss of viability on the planning unit.	Low to high

1. NI = no impact, MII = may impact individuals or habitat but not likely to trend towards Federal listing, LII = likely to result in a trend toward listing or a trend toward loss of viability on the planning unit

Literature Cited

Geier-Hayes, Kathleen. 2011. Fire Ecology Specialist Report for Aerial Application of Fire Retardant Draft EIS.

Appendix F – Fish and Aquatic Invertebrate Species List and Effects

Appendix F – Fish and Aquatic Invertebrate Species List and Effects

Table F-1. Federally Listed Aquatic Fish, Mollusk, and Crustacean Species Under the Jurisdiction of U.S. Fish and Wildlife Service, by Forest Service Region, Considered for this Consultation.

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name	Sub-group
				5					Conservancy Fairy Shrimp	E	*Branchinecta conservatio*	Crustaceans
				5					Longhorn Fairy Shrimp	E	*Branchinecta longiantenna*	Crustaceans
				5					Vernal Pool Fairy Shrimp	T	*Branchinecta lynchi*	Crustaceans
						8			A Cave Crayfish	E	*Cambarus aculabrum*	Crustaceans
						8			Hell Creek Cave Crayfish	E	*Cambarus zophonastes*	Crustaceans
				5					Vernal Pool Tadpole Shrimp	E	*Lepidurus packardi*	Crustaceans
				5					Shasta Crayfish	E	*Pacifastacus fortis*	Crustaceans
						8			Cumberland Elktoe	E	*Alasmidonta atropurpurea*	mollusks
						8			Dwarf Wedgemussel	E	*Alasmidonta heterodon*	mollusks
						8			Appalachian Elktoe	E	*Alasmidonta raveneliana*	mollusks
						8			Fat Three-Ridge Mussel	E	*Amblema neislerii*	mollusks
						8			Ouachita Rock Pocketbook	E	*Arkansia wheeleri*	mollusks
						8			Spectacle case	PE	*Cumberlandia monodonta*	mollusks

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name	Sub-group
						8	9		Fanshell	E	*Cyprogenia stegaria*	mollusks
						8			Dromedary Pearlymussel	E	*Dromus dromas*	mollusks
						8			Purple Bankclimber Mussel	T	*Elliptoideus sloatianus*	mollusks
						8			Cumberlandian Combshell	E	*Epioblasma brevidens*	mollusks
						8			Oyster Mussel	E	*Epioblasma capsaeformis*	mollusks
							9		Curtis Pearlymussel	E	*Epioblasma florentina curtisi*	mollusks
						8			Yellow Blossom (Pearlymussel)	E	*Epioblasma florentina florentina*	mollusks
						8			Tan Riffleshell	E	*Epioblasma florentina walkeri*	mollusks
						8			Upland Combshell	E	*Epioblasma metastriata*	mollusks
						8			Purple Cat's Paw Pearlymussel	E	*Epioblasma obliquata obliquata*	mollusks
						8			Southern Acornshell	E	*Epioblasma othcaloogensis*	mollusks
						8			Green Blossom (Pearlymussel)	E	*Epioblasma torulosa gubernaculum*	mollusks
						8	9		Northern Riffleshell[1]	E	*Epioblasma torulosa rangiana*	mollusks

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name	Sub-group
						8			Tubercled-blossom Pearlymussel	E	*Epioblasma torulosa torulosa*	mollusks
						8	9		Snuffbox	PE	*Epioblasma triquetra*	mollusks
						8			Turgid Blossom	E	*Epioblasma turgidula*	mollusks
						8			Shiny Pigtoe	E	*Fusconaia cor*	mollusks
						8			Finerayed Pigtoe	E	*Fusconaia cuneolus*	mollusks
						8			Cracking Pearlymussel	E	*Hemistena lata*	mollusks
						8	9		Pink Mucket	E	*Lampsilis abrupta*	mollusks
						8			Finelined Pocketbook	T	*Lampsilis altilis*	mollusks
						8			Orangenacre Mucket	T	*Lampsilis perovalis*	mollusks
						8			Arkansas Fatmucket	T	*Lampsilis powellii*	mollusks
						8			Shinyrayed pocketbook	E	*Lampsilis subangulata*	mollusks
						8			Carolina Heelsplitter	E	*Lasmigona decorata*	mollusks
						8			Birdwing Pearlymussel	E	*Lemiox rimosus*	mollusks
						8	9		Scaleshell Mussel	E	*Leptodea leptodon*	mollusks
						8			Louisiana Pearlshell	T	*Margaritifera hembeli*	mollusks

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name	Sub-group
						8			Alabama Moccasinshell	T	*Medionidus acutissimus*	mollusks
						8			Coosa Moccasinshell	E	*Medionidus parvulus*	mollusks
						8			Ochlockonee Moccasinshell	E	*Medionidus simpsonianus*	mollusks
						8			Ring Pink (Mussel)	E	*Obovaria retusa*	mollusks
						8			Littlewing Pearlymussel	E	*Pegias fabula*	mollusks
							9		Orangefoot pimpleback	E	*Plethobasus cooperianus*	mollusks
						8			Sheepnose	PE	*Plethobasus cyphyus*	mollusks
						8			Clubshell	E	*Pleurobema clava*	mollusks
						8			James Spinymussel	E	*Pleurobema collina*	mollusks
						8			Southern Clubshell	E	*Pleurobema decisum*	mollusks
						8			Dark Clubshell	E	*Pleurobema furvum*	mollusks
						8			Southern Pigtoe	E	*Pleurobema georgianum*	mollusks
						8			Georgia Pigtoe	E	*Pleurobema hanleyianum*	mollusks
						8			Ovate clubshell	E	*Pleurobema perovatum*	mollusks
						8	9		Rough Pigtoe	E	*Pleurobema plenum*	mollusks

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name	Sub-group
						8			Oval Pigtoe	E	*Pleurobema pyriforme*	mollusks
						8			Heavy Pigtoe	E	*Pleurobema taitanum*	mollusks
						8			Fat Pocketbook	E	*Potamilus capax*	mollusks
						8			Triangular Kidneyshell	E	*Ptychobranchus greenii*	mollusks
						8			Rough Rabbitsfoot	E	*Quadrula cylindrica strigillata*	mollusks
						8			Winged Maplefoot	E	*Quadrula fragrosa*	mollusks
						8			Cumberland Monkeyface (pearlymussel)	E	*Quadrula intermedia*	mollusks
						8			Appalachian Monkeyface	E	*Quadrula sparsa*	mollusks
						8			Purple Bean Mussel	E	*Villosa perpurpurea*	mollusks
						8	9		Rayed bean	PE	*Villosa fabalis*	mollusks
						8			Cumberland Bean Pearlymussel	E	*Villosa trabalis*	mollusks
						8			Cumberland Combshell	E	*Epioblasma brevidens*	mollusks
						8			Yellowblossom Pearlymussel	E	*Epioblasma florentina florentina*	mollusks
						8			Gulf Sturgeon	T	*Acipenser oxyrinchus desotoi*	Fish

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name	Sub-group
						8			Alabama Sturgeon	E	*Scaphirhynchus suttkusi*	Fish
						8			Cherokee Darter	T	Etheostoma scotti	Fish
1									White Sturgeon (Kootenai R. Pop.)	E	*Acipenser transmontanus*	Fish
						8			Ozark cavefish	T	*Amblyopsis rosae*	Fish
				5	6				Modoc sucker	E	*Catostomus microps*	Fish
				5					Santa Ana Sucker	T	*Catostomus santaanae*	Fish
					6				Warner Sucker	T	*Catostomus warnerensis*	Fish
				5	6				Shortnose Sucker	E	*Chasmistes brevirostris*	Fish
			4						June Sucker	E	*Chasmistes liorus*	Fish
						8			Pygmy Sculpin	T	*Cottus patulus*	Fish
			4						Railroad Valley Springfish	T	*Crenichthys nevadae*	Fish
						8			Blue Shiner	T	*Cyprinella caerulea*	Fish
		3							Desert Pupfish	E	*Cyprinodon macularius*	Fish
				5	6				Lost River Sucker	E	*Deltistes luxatus*	Fish
						8			Spotfin Chub	T	*Erimonax monacha*	Fish
						8			Slender Chub	T	*Erimystax cahni*	Fish

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name	Sub-group
						8			Etowah Darter	E	*Etheostoma etowahae*	Fish
						8			Duskytail Darter	E	*Etheostoma percnurum*	Fish
						8			Cumberland Darter	PE	*Etheostoma susanae*	Fish
				5					Tidewater Goby	E	*Eucyclogobius newberryi*	Fish
				5					Unarmored Threespine Stickleback	E	*Gasterosteus aculeatus williamsoni*	Fish
				5					Owens Tui Chub	E	*Gila bicolor snyderi*	Fish
	2		4						Humpback chub	E	*Gila cypha*	Fish
		3							Sonora Chub	T	*Gila ditaenia*	Fish
	2		4						Bonytail Chub	E	*Gila elegans*	Fish
		3							Gila Chub	E	*Gila intermedia*	Fish
		3							Chihuahua Chub	T	*Gila nigrescens*	Fish
		3							Yaqui Chub	E	*Gila purpurea*	Fish
		3							Rio Grande Silveryminnow	E	*Hybognathus amarus*	Fish
				5					Delta Smelt	T	*Hypomesus transpacificus*	Fish
		3							Yaqui Catfish	T	*Ictalurus pricei*	Fish
		3							Little Colorado Spinedace	T	*Lepidomeda vittata*	Fish
		3							Spikedace	T	*Meda fulgida*	Fish

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name	Sub-group
						8			Palezone Shiner	E	*Notropis albizonatus*	Fish
						8			Cahaba Shiner	E	*Notropis cahabae*	Fish
		3							Arkansas River Shiner	T	*Notropis girardi*	Fish
						8			Cape Fear Shiner	E	*Notropis mekistocholas*	Fish
						8			Smoky Madtom	E	*Noturus baileyi*	Fish
						8			Yellowfin Madtom	T	*Noturus flavipinnis*	Fish
				5					Little Kern Golden Trout	T	*Oncorhynchus aguabonita whitei*	Fish
		3							Apache (Arizona) Trout	T	*Oncorhynchus apache*	Fish
			4	5					Lahontan Cutthroat Trout	T	*Oncorhynchus clarki henshawi*	Fish
			4	5					Paiute Cutthroat Trout	T	*Oncorhynchus clarki seleniris*	Fish
	2								Greenback Cutthroat Trout	T	*Oncorhynchus clarki stomias*	
		3							Gila trout	T	*Oncorhynchus gilae gilae*	Fish
					6				Oregon Chub	E	*Oregonichthys crameri*	Fish
						8			Amber Darter	E	*Percina antesella*	Fish
						8			Goldline Darter	T	*Percina aurolineata*	Fish

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name	Sub-group
						8			Conasauga Logperch	E	*Percina jenkinsi*	Fish
						8			Leopard Darter	T	*Percina pantherina*	Fish
						8			Roanoke Logperch	E	*Percina rex*	Fish
						8			Snail Darter	T	*Percina tanasi*	Fish
						8			Blackside Dace	T	*Phoxinus cumberlandensis*	Fish
		3							Gila Topminnow	E	*Poeciliopsis occidentalis*	Fish
	2	3	4						Colorado (=squawfish) Pikeminnow	E	*Ptychocheilus lucius*	Fish
			4						Kendall Warm Springs Dace	E	*Rhinichthys osculus thermalis*	Fish
1			4		6				Bull Trout	T	*Salvelinus confluentus*	Fish
	2		4			8	9		Pallid Sturgeon	E	*Scaphirhynchus albus*	Fish
						8			Alabama Sturgeon	E	*Scaphirhynchus suttkusi*	Fish
		3							Loach Minnow	T	*Tiaroga cobitis*	Fish
	2	3	4						Razorback Sucker	E	*Xyrauchen texanus*	Fish

Table F-2. Determinations for Fish Species Under the Jurisdiction of U.S. Fish and Wildlife Service.

Species Common Name	Federal Status	Species Effects Determination	Critical Habitat Determination
Alabama Sturgeon	E	NE	NE
Amber Darter	E	LAA	LAA

Species Common Name	Federal Status	Species Effects Determination	Critical Habitat Determination
Apache (Arizona) Trout	T	LAA	None
Arkansas River Shiner	T	NLAA	NLAA
Blackside Dace	T	LAA	None
Blue Shiner	T	LAA	LAA
Bonytail Chub	E	LAA	LAA
Bull Trout	T	LAA	LAA
Cahaba Shiner	E	NE	NE
Cape Fear Shiner	E	NLAA	NLAA
Chihuahua Chub	T	LAA	None
Colorado (=squawfish) Pikeminnow	E	LAA	LAA
Conasauga Logperch	E	LAA	LAA
Cumberland Darter	PE	NLAA	None
Delta Smelt	T	NE	NE
Desert Pupfish	E	LAA	LAA
Duskytail Darter	E	LAA	None
Etowah Darter	E	NLAA	NLAA
Gila Chub	E	LAA	LAA
Gila Topminnow	E	LAA	None
Gila trout	T	LAA	None
Goldline Darter	T	NLAA	NLAA
Greenback Cutthroat Trout	T	LAA (600 ft buffer)	None
Gulf Sturgeon	T	NLAA	NLAA
Humpback chub	E	LAA	LAA
June Sucker	E	LAA	LAA

Species Common Name	Federal Status	Species Effects Determination	Critical Habitat Determination
Kendall Warm Springs Dace	E	LAA (1/2 mile buffer)	None
Lahontan Cutthroat Trout	T	LAA	None
Leopard Darter	T	LAA	LAA
Little Colorado Spinedace	T	LAA	LAA
Little Kern Golden Trout	T	LAA (600 ft buffer)	LAA
Loach Minnow	T	LAA	LAA
Lost River Sucker	E	LAA	Not requesting conferencing at this time
Modoc sucker	E	LAA	LAA
Oregon Chub	E	LAA	LAA
Owens Tui Chub	E	LAA	None
Ozark cavefish	T	LAA	None
Paiute Cutthroat Trout	T	LAA (600 ft buffer)	None
Palezone Shiner	E	LAA	None
Pallid Sturgeon	E	LAA	None
Pygmy Sculpin	T	NE	NE Proposed
Railroad Valley Springfish	T	LAA	LAA
Razorback Sucker	E	LAA	LAA
Rio Grande Silveryminnow	E	NLAA	NLAA
Roanoke Logperch	E	LAA	None
Santa Ana Sucker	T	LAA (600 ft buffer)	LAA
Shortnose Sucker	E	LAA	Not requesting conferencing at this time
Slender Chub	T	LAA	LAA
Smoky Madtom	E	LAA	LAA

Species Common Name	Federal Status	Species Effects Determination	Critical Habitat Determination
Snail Darter	T	LAA	LAA
Sonora Chub	T	LAA	LAA
Spikedace	T	LAA	LAA
Spotfin Chub	T	LAA	LAA
Tidewater Goby	E	LAA	LAA
Unarmored Threespine Stickleback	E	LAA	None
Warner Sucker	T	LAA	LAA
White Sturgeon (Kootenai R. Pop.)	E	LAA	LAA
Yaqui Catfish	T	LAA	LAA
Yaqui Chub	E	LAA	LAA
Yellowfin Madtom	T	LAA	LAA

Table F-3. Likelihood of Adverse Effects to Species and Critical Habitat Under the Jurisdiction of U.S. Fish and Wildlife Service by National Forest / Grassland.

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
Alabama Sturgeon	Low	Low	National Forests of Alabama
Amber Darter	High	High	Cherokee National Forest
	Medium	Medium	Chattahoochee-Oconee National Forests
Apache (Arizona Trout)	High	None	Coronado National Forest
	High	None	Kaibab National Forest
	High	None	Apache-Sitgreaves National Forests
Arkansas River Shiner	Medium	Medium	Cibola National Forest
Blackside Dace	Medium	None	Daniel Boone National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
	High	None	George Washington and Jefferson National Forest
Blue Shiner	High	High	Cherokee National Forest
	Medium	Medium	Chattahoochee-Oconee National Forests
	Low	Low	National Forests in Alabama
Bonytail Chub	High	High	San Juan National Forest
	Medium	Medium	Manti-Lasal National Forest
	Medium	Medium	Uinta-Wasatch-Cache National Forest
	Medium	Medium	Ashely National Forest
	Medium	Medium	Bridger-Teton National Forest
	Low	Low	Arapaho and Roosevelt National Forests
	Low	Low	White River National Forest
	Low	Low	Fishlake National Forest
Bull Trout	High	High	Nez Perce National Forest
	High	High	Bitterroot National Forest
	High	High	Lolo National Forest
	High	High	Beaverhead-Deerlodge National Forest
	High	High	Idaho Panhandle National Forests
	High	High	Helena National Forest
	High	High	Flathead National Forest
	High	High	Clearwater National Forest
	High	High	Kootenai National Forest
	High	High	Sawtooth National Forest
	High	High	Salmon-Challis National Forest
	High	High	Humboldt-Toiyabe National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
	High	High	Boise National Forest
	High	High	Payette National Forest
	High	High	Columbia River Gorge National Scenic Area
	High	High	Colville National Forest
	High	High	Mt. Hood National Forest
	High	High	Malheur National Forest
	High	High	Gifford Pinchot National Forest
	Medium	Medium	Mount Baker-Snoqualmie National Forest
	High	High	Ochoco National Forest
	Medium	Medium	Olympic National Forest
	High	High	Okanogan-Wenatchee National Forest
	High	High	Wallowa-Whitman National Forest
	High	High	Willamette National Forest
	High	High	Umatilla National Forest
	High	High	Deschutes National Forest
	High	High	Fremont-Winema National Forests
Cahaba Shiner	Low	Low	National Forests in Alabama
Cape Fearshiner	Medium	Medium	National Forests In North Carolina
Cherokee Darter	Medium	Medium	Chattahoochee-Oconee National Forests
Chihuahua chub	High	None	Gila National Forest
Colorado (=squawfish) Pike minnow	Medium	Medium	Ashely National Forest
	Medium	Medium	Bridger-Teton National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
	Low	Low	Arapaho and Roosevelt National Forests
	Low	Low	White River National Forest
	High	High	San Juan National Forest
	High	High	Coconino National Forest
	High	None	Prescott National Forest
	High	None	Tonto National Forest
	Medium	Medium	Manti-Lasal National Forest
	High	High	Uinta-Wasatch-Cache National Forest
	Low	Low	Fishlake National Forest
Conasauga Logperch	High	High	Cherokee National Forest
	Medium	Medium	Chattahoochee-Oconee National Forests
Cumberland Darter	Medium	None	Daniel Boone National Forest
	Low	None	George Washington and Jefferson National Forest
Delta Smelt	Low	Low	Eldorado National Forest
	Low	Low	Lassen National Forest
	Low	Low	Sierra National Forest
	Low	Low	Mendocino National Forest
	Low	Low	Plumas National Forest
	Low	Low	Sequoia National Forest
	Low	Low	Lake Tahoe Basin Management Area
	Low	Low	Shasta Trinity National Forest
	Low	Low	Stanislaus National Forest
	Low	Low	Tahoe National Forest
Desert Pupfish	Medium	Medium	Prescott National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
	High	High	Tonto National Forest
	Low	Low	Coronado National Forest
Duskytail Darter	High	None	Cherokee National Forest
	High	None	Daniel Boone National Forest
	High	None	George Washington and Jefferson National Forest
Etowah Darter	Medium	Medium	Chattahoochee-Oconee National Forests
Gila Chub	High	High	Coconino National Forest
	High	High	Apache-Sitgreaves National Forests
	High	High	Prescott National Forest
	High	High	Tonto National Forest
	High	High	Gila National Forest
	High	High	Coronado National Forest
Gila Topminnow	Medium	None	Prescott National Forest
	High	None	Tonto National Forest
	High	None	Coronado National Forest
Gila Trout	High	None	Coconino National Forest
	High	None	Apache-Sitgreaves National Forests
	High	None	Gila National Forest
	High	None	Coronado National Forest
	Low	None	Tonto National Forest
Goldline Darter	Medium	Medium	Chattahoochee-Oconee National Forests
Greeenback Cuttthroat Trout	High	None	White River National Forest
	High	None	San Juan National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
	High	None	Manti-Lasal National Forest
	High	None	Arapaho and Roosevelt National Forests
	High	None	Medicine Bow – Route National Forest
	High	None	Grand Mesa, Uncompahgre and Gunnison National Forests
	High	None	Pike-San Isabel National Forest
Gulf sturgeon	Medium	Medium	National Forests in Mississippi
	Low	Low	National Forests in Alabama
Humpback chub	High	High	San Juan National Forest
	Medium	Medium	Manti-Lasal National Forest
	Medium	Medium	Uinta-Wasatch-Cache National Forest
	Medium	Medium	Ashely National Forest
	Medium	Medium	Bridger-Teton National Forest
	Low	Low	Arapaho and Roosevelt National Forests
	Low	Low	White River National Forest
	Low	Low	Fishlake National Forest
	Low	Low	Dixie National Forest
June Sucker	High	Medium	Uinta-Wasatch-Cache National Forest
Kendall Warm Springs Dace	High	None	Bridger-Teton National Forest
Lahontan Cutthroat Trout	High	None	Humboldt-Toiyabe National Forest
	High	None	Tahoe National Forest
	High	None	Sierra National Forest
	High	None	Stanislaus National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
	Medium	None	Inyo National Forest
	High	None	Lake Tahoe Basin Management Area
Leopard darter	High	High	Ouachita National Forest
Little Colorado Spinedace	High	High	Coconino National Forest
	High	High	Apache-Sitgraves National Forests
	High	High	Gila National Forest
Little Kern Golden Trout	High	High	Sequoia National Forest
Loach Minnow	Medium	Medium	Kaibab National Forest
	High	High	Coconino National Forest
	High	High	Apache-Sitgreaves National Forests
	High	High	Prescott National Forest
	High	High	Tonto National Forest
	High	High	Gila National Forest
Lost River Sucker	High	High (Proposed)	Modoc National Forest
	High	High	Fremont-Winema National Forests
	Low	Low	Klamath National Forest
	Low	Low	Shasta Trinity National Forest
Modoc sucker	High	High (Proposed)	Modoc National Forest
	High	High	Fremont-Winema National Forests
Oregon Chub	High	None	Umpqua National Forest
	High	High	Willamette National Forest
Owen’s Tui Chub	High	None	Inyo National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
Ozark cavefish	High	None	Ozark-St. Francis National Forest
Paiute Cutthroat Trout	High	None	Humboldt-Toiyabe National Forest
	High	None	Sierra National Forest
	Medium	None	Inyo National Forest
Palezone Shiner	High	None	Daniel Boone National Forest
Pallid Sturgeon	High	None	Ozark-St. Francis National Forest
	Medium	None	National Forests in Mississippi
	Low	None	Arapaho and Roosevelt National Forests
	Low	None	Bridger-Teton National Forest
	Low	None	Shawnee National Forest
Pygmy Sculpin	Low	Low	National Forests of Alabama
Railroad Valley Springfish	High	High	Humboldt-Toiyabe National Forest
Razorback Sucker	High	High	Coronado National Forest
	High	High	Coconino National Forest
	High	High	Apache-Sitgreaves National Forests
	High	High	Prescott National Forest
	High	High	Tonto National Forest
	Medium	Medium	Manti-Lasal National Forest
	Medium	Medium	Ashely National Forest
	Medium	Medium	Bridger-Teton National Forest
	Low	Low	Arapaho and Roosevelt National Forests
	Low	Low	White River National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
	Low	Low	Fishlake National Forest
	Low	Low	Dixie National Forest
Rio Grande Silvery Minnow	Medium	Medium	Cibola National Forest
Roanoke logperch	High	None	George Washington and Jefferson National Forest
Santa Ana Sucker	High	High	Angeles National Forest
	High	High	San Bernardino National Forest
Shortnose Sucker	High	High (Proposed)	Modoc National Forest
	High	High	Fremont-Winema National Forests
	Low	Low	Klamath National Forest
	Low	Low	Shasta Trinity National Forest
Slender Chub	High	High	George Washington and Jefferson National Forest
Smoky Madtom	High	High	Cherokee National Forest
Snail Darter	High	High	Cherokee National Forest
Sonora Chub	High	High	Coronado National Forest
Spikedace	High	High	Tonto National Forest
	Medium	Medium	Kaibab National Forest
	High	High	Coconino National Forest
	High	High	Apache-Sitgreaves National Forests
	High	High	Prescott National Forest
	High	High	Gila National Forest
	High	High	Coronado National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
Spotfin Chub	Medium	Medium	National Forests In North Carolina
	High	High	George Washington and Jefferson National Forest
Tidewater Goby	High	None	Los Padres National Forest
	Low	None	Six Rivers National Forest
	Low	None	Klamath National Forest
Unarmored Threespined stickleback	High	None	Angeles National Forest
	High	None	San Bernardino National Forest
Warner Sucker	High	High	Fremont-Winema National Forests
White Sturgeon (Kootenai R. Pop)	High	High	Kootenai National Forest
Yaqui Catfish	High	High	Coronado National Forest
Yaqui Chub	High	High	Coronado National Forest
Yellowfin Madtom	High	High	Cherokee National Forest
	High	High	George Washington and Jefferson National Forest

Table F-4. Determinations for Aquatic Crustaceans and Mollusks under the Jurisdiction of U.S. Fish and Wildlife Service.

Species Common Name	Federal status	Species Effects Determination	Critical Habitat Determination
A Cave Crayfish	E	LAA	None
Alabama Moccasinshell	T	NLAA	NLAA
Appalachian Elktoe	E	LAA	LAA
Appalachian Monkeyface	E	LAA	None
Arkansas Fatmucket	T	LAA	None

Species Common Name	Federal status	Species Effects Determination	Critical Habitat Determination
Birdwing Pearlymussel	E	LAA	None
Carolina Heelsplitter	E	LAA	LAA
Clubshell	E	NE	NE
Conservancy Fairy Shrimp	E	LAA	LAA
Coosa Moccasinshell	E	LAA	None
Cracking Pearlymussel	E	LAA	None
Cumberland Bean Pearlymussel	E	LAA	None
Cumberland Combshell	E	LAA	LAA
Cumberland Elktoe	E	LAA	LAA
Curtis Pearlymussel	E	NLAA	NLAA
Dark Clubshell	E	NE	NE
Dromedary Pearlymussel	E	LAA	None
Dwarf Wedgemussel	E	NE	NE
Fanshell	E	LAA	None
Fat Pocketbook	E	LAA	None
Fat Three-Ridge Mussel	E	LAA	LAA
Finelined Pocketbook	T	LAA	LAA
Finerayed Pigtoe	E	LAA	None
Georgia Pigtoe	E	NLAA	NLAA
Green Blossom (Pearlymussel)	E	LAA	None
Heavy Pigtoe	E	NE	NE
Hell Creek Cave Crayfish	E	LAA	None
James Spinymussel	E	LAA	None
Littlewing Pearlymussel	E	LAA	None

Species Common Name	Federal status	Species Effects Determination	Critical Habitat Determination
Longhorn Fairy Shrimp	E	NE	None
Louisiana Pearlshell	T	LAA	None
Northern Riffleshell	E	LAA	None
Ochlockonee Moccasinshell	E	LAA	LAA
Orangefoot pimpleback	E	NE	NE
Orangenacre Mucket	T	NLAA	NLAA
Ouachita Rock Pocketbook	E	LAA	None
Oval Pigtoe	E	LAA	LAA
Ovate clubshell	E	NLAA	NLAA
Oyster Mussel	E	LAA	LAA
Painted Rocksnail	E	NE	NE
Pink Mucket	E	LAA	None
Purple Bankclimber Mussel	T	LAA	LAA
Purple Bean Mussel	E	LAA	LAA
Purple Cat's Paw Pearlymussel	E	NE	None
Rayed bean	PE	LAA	LAA
Ring Pink (Mussel)	E	NE	None
Rough Pigtoe	E	LAA	None
Rough Rabbitsfoot	E	NLAA	NLAA
Scaleshell Mussel	E	LAA	None
Shasta Crayfish	E	LAA	None
Sheepnose	PE	LAA	None
Shiny Pigtoe	E	LAA	None
Shinyrayed Pocketook	E	LAA	LAA

Species Common Name	Federal status	Species Effects Determination	Critical Habitat Determination
Snuffbox	PE	NLAA	None
Southern Acornshell	E	NE	None
Southern Clubshell	E	NLAA	NLAA
Southern Pigtoe	E	LAA	LAA
Spectacle case	PE	NLAA	None
Tan Riffleshell	E	LAA	None
Triangular Kidneyshell	E	NLAA	NLAA
Tubercled-blossom Pearlymussel	E	NE	None
Turgid Blossom	E	NE	NE
Upland Combshell	E	NLAA	NLAA
Vernal Pool Fairy Shrimp	T	LAA	LAA
Vernal Pool Tadpole Shrimp	E	NE	None
Winged Maplefoot	E	LAA	None
Yellowblossom Pearlymussel	E	NE	None

Table F-5. Likelihood of Adverse Effects to Mollusks and Crustaceans Under the Jurisdiction of U.S. Fish and Wildlife Service by National Forest / Grassland.

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
A Cave Crayfish	High	None	Ozark-St Francis National Forest
Alabama Moccasinshell	Low	Low	National Forests in Alabama
	Medium	Medium	Chattahoochee-Oconee National Forests
Appalachian Elktoe	High	High	National Forests in North Carolina
	High	High	Cherokee National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
Appalachian Monkeyface	High	None	George Washington & Jefferson National Forest
Arkansas Fatmucket mussel	High	None	Ouachita National Forest
Birdwing Pearlymussel	High	None	George Washington & Jefferson National Forest
Carolina Heelsplitter	High	High	Francis Marion and Sumter National Forests
	Medium	Medium	National Forests in North Carolina
Clubshell	Low	Low	Daniel Boone National Forest
	Low	Low	Allegheny National Forest
Conservancy Fairy Shrimp	High	High	Los Padres
	Low	None	Plumas National Forest
Coosa Moccasinshel	Medium	None	Chattahoochee-Oconee National Forests
	High	None	Cherokee National Forest
Cracking Pearlymussel	High	None	George Washington & Jefferson National Forest
	Low	None	Daniel Boone National Forest
Cumberlain Combshell	High	High	Cherokee National Forest
	Low	Low	National Forests in Alabama
Cumberland Bean Pearlymussel	High	None	Cherokee National Forest
	High	None	Daniel Boone National Forest
	High	None	George Washington & Jefferson National Forest
	Low	None	National Forests in North Carolina
Cumberland Elktoe	High	High	Daniel Boone National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
Cumberland Monkeyface	High	None	George Washington & Jefferson National Forest
Cumberlandian Combshell	High	High	Daniel Boone National Forest
	High	High	George Washington & Jefferson National Forest
Curtis Pearlymussel	Low	Low	Mark Twain National Forest
Dark Clubshell	Low	Low	National Forests in Alabama
Dromedary Pearlymussel	High	None	George Washington & Jefferson National Forest
	Low	None	Daniel Boone National Forest
Dwarf Wedgemussel	Low	Low	National Forests in North Carolina
Fanshell	High	None	Daniel Boone National Forest
	High	None	George Washington & Jefferson National Forest
	Low	None	Hoosier National Forest
	Low	None	Wayne National Forest
	Low	None	Shawnee National Forest
Fat pocketbook	High	None	Ozark-St Francis National Forest
	Low	None	Shawnee National Forest
Fat Three-Ridge Mussel	High	High	National Forests of Florida
Finelined Pocketbook	High	Low	Cherokee National Forest
	Medium	None	Chattahoochee-Oconee National Forests
	Low	Low	National Forests in Alabama
Finerayed Pigtoe	High	None	George Washington & Jefferson National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
Georgia Pigtoe	Medium	Medium	Chattahoochee-Oconee National Forests
Green Blossom	High	None	George Washington & Jefferson National Forest
Heavy Pigtoe	Low	Low	National Forests in Alabama
Hell Creek Cave Crayfish	High	None	Ozark-St Francis National Forest
James Spinymussel	High	None	George Washington & Jefferson National Forest
Littlewing Pearly mussel	Medium	None	National Forests in North Carolina
	High	None	Daniel Boone National Forest
	High	None	George Washington & Jefferson National Forest
Longhorn Fairy Shrimp	Low	None	Los Padres
Louisiana Pearlshell	High	None	Kisatchie National Forest
Northern Riffleshell	High	None	Daniel Boone National Forest
	Low	None	Allegheny National Forest
	Low	None	Mark Twain National Forest
Ochlockonee Moccasinshell	High	High	National Forests of Florida
Orangefoot Pimpleback	Low	Low	Shawnee National Forest
Orangenacre Mucket	Medium	Medium	Chattahoochee-Oconee National Forests
	Low	Low	National Forests in Alabama
Ouachita Rock Pocketbook	High	High	National Forests in Texas

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
Ouachita Rock Pocketbook mussel	High	None	Ouachita National Forest
Oval Pigtoe	High	High	National Forests of Florida
Ovate Clubshell	Medium	Medium	Chattahoochee-Oconee National Forests
	Low	Low	National Forests in Alabama
Oyster Mussel	High	None	Cherokee National Forest
	High	High	George Washington & Jefferson National Forest
	Low	Low	Daniel Boone National Forest
Painted Rocksnail	Low	Low	National Forests in Alabama
Pink Mucket	High	Medium	Ozark-St Francis National Forest
	High	None	Daniel Boone National Forest
	High	None	George Washington & Jefferson National Forest
	Medium	None	Wayne National Forest
	Medium	None	Shawnee National Forest
	Low	None	Mark Twain National Forest
Purple Bankclimber mussel	High	High	National Forests of Florida
Purple Bean Mussell	High	High	George Washington & Jefferson National Forest
Purple Cat’s Paw Pearlymussel	Low	None	Daniel Boone National Forest
Rayed Bean	High	None	George Washington & Jefferson National Forest
	Low	None	Allegheny National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
Ring Pink	Low	Low	Daniel Boone National Forest
Rough Pigtoe	High	None	George Washington & Jefferson National Forest
	Low	None	Daniel Boone National Forest
	Low	None	Hoosier National Forest
Rough Rabbitsfoot	Medium	Medium	George Washington & Jefferson National Forest
Scaleshell mussel	High	None	Ozark-St Francis National Forest
	High	None	Ouachita National Forest
	Medium	None	Chattahoochee-Oconee National Forests
Shasta Crayfish	High	None	Modoc National Forest
	High	None	Shasta Trinity National Forest
	Low	None	Lassen National Forest
Sheepnose	High	None	George Washington & Jefferson National Forest
Shineyrayed Pocketbook	High	High	National Forests of Florida
Shiny Pigtoe	High	None	George Washington & Jefferson National Forest
Snuffbox	Medium	None	Daniel Boone National Forest
	Medium	None	George Washington & Jefferson National Forest
Southern Acornshell	Low	None	National Forests in Alabama
Southern Clubshell	Medium	Medium	Chattahoochee-Oconee National Forests
	Medium	Medium	National Forests in Mississippi
	Low	Low	National Forests in Alabama

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
Southern Pigtoe	High	High	Cherokee National Forest
	Medium	Medium	Chattahoochee-Oconee National Forests
	Low	Low	National Forests in Alabama
	Low	Low	National Forests in Alabama
Spectacle case	Medium	None	George Washington & Jefferson National Forest
Tan Riffleshell	High	None	Cherokee National Forest
	High	None	Daniel Boone National Forest
	High	None	George Washington & Jefferson National Forest
Triangular Kidneyshell	Medium	Medium	Chattahoochee-Oconee National Forests
	Low	Low	National Forests in Alabama
Tubercled-blossom pearlymussel	Low	None	Daniel Boone National Forest
Turgid Blossom	Low	Low	National Forests in Alabama
Upland Combshell	Medium	Medium	Chattahoochee-Oconee National Forests
	Low	Low	Daniel Boone National Forest
Vernal Pool Fairy Shrimp	High	High	Los Padres
	Low	None	Klamath National Forest
	Low	Low	Mendocino National Forest
Vernal Pool Tadpole Shrimp	Low	None	Mendocino National Forest
	Low	Low	Lassen National Forest
Winged Maplefoot	High	None	Ouachita National Forest
Yellow Blossom (Pearlymussel)	Low	None	Cherokee National Forest

Species	Likelihood of Adverse Effects to Species	Likelihood of Adverse Effects to Critical Habitat	National Forest / Grassland
	Low	None	Daniel Boone National Forest

Table F-6. Species and Critical Habitat Designations Under the Jurisdiction of NOAA Fisheries Considered in This Consultation.

Common Name	Scientific Name	Listed As	Critical Habitat
Chinook salmon (California coastal) (CC)	*O. tshawytscha*	Threatened	Yes
Chinook salmon (Central Valley spring-run) (CV)		Threatened	Yes
Chinook salmon (Lower Columbia River) (LCR)		Threatened	Yes
Chinook salmon (Sacramento River winter-run)		Endangered	Yes
Chinook salmon (Snake River fall-run)		Threatened	Yes
Chinook salmon (Snake River spring/summer-run)		Threatened	Yes
Chinook salmon (Upper Columbia River spring-run) (UCR)		Endangered	Yes
Chinook salmon (Upper Willamette River)		Threatened	Yes
Chinook salmon (Puget Sound)		Threatened	
Chum salmon (Columbia River)		Threatened	Yes
Chum salmon (Hood Canal summer-run)			

Common Name	Scientific Name	Listed As	Critical Habitat
Coho salmon (Lower Columbia River) (LCR)	*O. kisutch*	Threatened	No
Coho salmon (Southern Oregon Northern Coast California) (SONCC)		Threatened	Yes
Coho salmon (Oregon Coast)		Threatened	Yes
Sockeye salmon (Snake River)	*O. nerka*	Endangered	Yes
Steelhead (California Central Valley) (CCV)	*O. mykiss*	Threatened	Yes
Steelhead (Lower Columbia River) (LCR)		Threatened	Yes
Steelhead (Middle Columbia River) (MCR)		Threatened	Yes
Steelhead (Northern California)		Threatened	Yes
Steelhead (Snake River Basin)		Threatened	Yes
Steelhead (South Central California Coast) (SCCC)		Threatened	Yes
Steelhead (Southern California)		Endangered	Yes
Steelhead (Upper Columbia River) (UCR)		Threatened	Yes
Steelhead (Upper Willamette River)		Threatened	Yes
Steelhead (Puget Sound)			
Shortnose sturgeon	*A. brevirostrum*	Endangered	No
Southern DPS Atlantic sturgeon	*A.o. oxyrinchus*	Endangered	No

Common Name	Scientific Name	Listed As	Critical Habitat
Carolina DPS Atlantic sturgeon		Endangered	No
Chesapeake DPS Atlantic sturgeon		Endangered	No
New York Bight DPS Atlantic sturgeon		Endangered	No
Gulf of Maine DPS Atlantic sturgeon		Threatened	No
Green sturgeon	*A. medirostris*	Threatened	Yes
Pacific eulachon smelt	*T. pacificus*	Threatened	Yes

Table F-7. Species, Critical Habitat, and Essential Fish Habitat Determinations by Species Under the Jurisdiction of NOAA Fisheries.

Common Name	Scientific Name	Species Determination	Critical Habitat Determination	Essential Fish Habitat Determination
Puget Sound Chinook salmon	*Oncorhynchus tshawytscha* pop. 15	LAA	LAA	NAA
Lower Columbia River Chinook salmon	*Oncorhynchus tshawytscha* pop. 1	LAA	LAA	MAA
Upper Columbia River Chinook salmon	*Oncorhynchus tshawytscha* pop. 12	LAA	LAA	MAA
Upper Willamette River Chinook salmon	*Oncorhynchus tshawytscha* pop. 16	LAA	LAA	MAA
Snake River spring/summer-run Chinook salmon	*Oncorhynchus tshawytscha* pop. 8	LAA	LAA	MAA
Snake River fall-run Chinook salmon	*Oncorhynchus tshawytscha* pop. 2	LAA	LAA	MAA
Sacramento River winter-run Chinook salmon	*Oncorhynchus tshawytscha* pop. 7	LAA	LAA	MAA

Common Name	Scientific Name	Species Determination	Critical Habitat Determination	Essential Fish Habitat Determination
Central Valley spring-run Chinook salmon	*Oncorhynchus tshawytscha* pop. 11	LAA	LAA	MAA
California Coastal Chinook salmon	*Oncorhynchus tshawytscha* pop. 17	LAA	LAA	MAA
Columbia River Chum salmon	*Oncorhynchus keta* pop. 3	LAA	LAA	MAA
Hood River summer-run Chum salmon	*Oncorhynchus keta* pop. 2	LAA	LAA	NAA
Lower Columbia River Coho salmon	*Oncorhynchus kisutch* pop. 1	LAA	NONE	MAA
Southern Oregon/Northern California Coast Coho salmon	*Oncorhynchus kisutch* pop. 2	LAA	LAA	MAA
Snake River Sockeye salmon	*Oncorhynchus nerka* pop. 1	LAA	LAA	MAA
Puget Sound Steelhead	*Oncorhynchus mykiss* pop. 37	NE	NONE	NAA
Upper Columbia River Steelhead	*Oncorhynchus mykiss* pop. 12	LAA	LAA	MAA
Lower Columbia River Steelhead	*Oncorhynchus mykiss* pop. 14	LAA	LAA	MAA
Upper Willamette River Steelhead	*Oncorhynchus mykiss* pop. 20	LAA	LAA	MAA
Snake River Steelhead	*Oncorhynchus mykiss* pop. 13	LAA	LAA	MAA
Northern California Steelhead	*Oncorhynchus mykiss* pop. 16	LAA	LAA	MAA
South-Central California Coast Steelhead	*Oncorhynchus mykiss* pop. 9	LAA	LAA	MAA
Southern California Steelhead	*Oncorhynchus mykiss* pop. 10	LAA	LAA	MAA

Common Name	Scientific Name	Species Determination	Critical Habitat Determination	Essential Fish Habitat Determination
California Central Valley Steelhead	*Oncorhynchus mykiss* pop. 11	LAA	LAA	MAA
Shortnose sturgeon	*Acipenser brevirostrum*	LAA	NONE	MAA
Green sturgeon	*Acipenser medirostris*	LAA	LAA	MAA
Pacific Eulachon	*Thaleichthys pacificus*	LAA	LAA	MAA
Atlantic sturgeon	*Acipenser oxyrinchus*	LAA	LAA	MAA

Table F-8. Northwest National Forests and Determinations of Effects.

Mount Baker-Snoqualmie	0	0	Hood Canal summer-run chum salmon	LAA	LAA	MAA
			Puget Sound Chinook salmon	LAA	LAA	MAA
			Puget Sound steelhead	NONE	LAA	MAA
Olympic	0	0	Hood Canal summer-run chum salmon	LAA	LAA	MAA
			Puget Sound Chinook salmon	LAA	LAA	MAA
			Puget Sound steelhead	NONE	LAA	MAA
			Pacific Eulachon	LAA	LAA	MAA
Columbia River Gorge	2	5375	Columbia River chum salmon	LAA	LAA	MAA
			LCR coho salmon	NONE	LAA	MAA
			Snake River spring/summer Chinook salmon	LAA	LAA	MAA
			Snake River fall-run Chinook salmon	LAA	LAA	MAA
			LCR Chinook salmon	LAA	LAA	MAA
			Snake River Basin steelhead	LAA	LAA	MAA
			LCR steelhead	LAA	LAA	MAA
			MCR steelhead	LAA	LAA	MAA
			UCR steelhead	LAA	LAA	MAA
			Pacific eulachon	LAA (P)	LAA	MAA

Deschutes	70	175394	MCR steelhead (reintroduced population above Pelton-Round Butted Dam complex)	NONE	LAA	MAA
Gifford Pinchot	6	14794	LCR coho salmon	NONE	LAA	MAA
			LCR Chinook salmon	LAA	LAA	MAA
			LCR steelhead	LAA	LAA	MAA
			Pacific Eulachon	NONE	LAA	MAA
Ochoco	7	17239	Middle Columbia River Steelhead	LAA	LAA	MAA
Clearwater	6	15798	Snake River Basin steelhead	LAA	LAA	MAA
			Snake River Spring/summer Chinook salmon	LAA	LAA	MAA
			Snake River fall Chinook salmon	LAA	LAA	MAA
Siuslaw	12	30662	Oregon Coast coho salmon	LAA	LAA	MAA
			Pacific eulachon	LAA (P)	LAA	MAA
Umpqua	12	29044	Oregon coast coho salmon	LAA	LAA	MAA
			North American Green Sturgeon	NONE	LAA	MAA
Mt. Hood	15	37899	LCR Coho salmon	NONE	LAA	MAA
			Upper Willamette River Chinook salmon	LAA	LAA	MAA
			LCR Chinook salmon	LAA	LAA	MAA
			LCR steelhead	LAA	LAA	MAA
			Pacific Eulachon	LAA	LAA	MAA
Nez Perce	18	44059	Snake River steelhead	LAA	LAA	MAA
			Snake River spring /summer Chinook salmon	LAA	LAA	MAA
			Snake River fall Chinook salmon	LAA	LAA	MAA
			Snake River sockeye salmon	LAA	LAA	MAA
Malheur	21	52456	MCR steelhead	LAA	LAA	MAA
Bitterroot	21	52974	Snake River steelhead	LAA	LAA	MAA
Siskiyou	26	64569	Southern Oregon/Northern California Coast coho salmon	LAA	LAA	MAA

			Oregon Coast coho salmon	LAA	LAA	MAA
			Pacific Eulachon	LAA	LAA	MAA
			North American Green Sturgeon	LAA	LAA	MAA
Rogue River	26	64569	Southern Oregon/Northern California Coast coho salmon	LAA	LAA	MAA
			North American Green Sturgeon	LAA	LAA	MAA
Willamette	30	75394	Upper Willamette River Chinook salmon	LAA	LAA	MAA
			Upper Willamette River Steelhead	LAA	LAA	MAA
Sawtooth	31	76718	Snake River sockeye salmon	LAA	LAA	MAA
Salmon/Challis	34	85128	Snake River sockeye salmon	LAA	LAA	MAA
			Snake River spring/summer Chinook salmon	LAA	LAA	MAA
			Snake River steelhead	LAA	LAA	MAA
Umatilla	36	89048	Snake River spring/summer Chinook salmon	LAA	LAA	MAA
			Snake River fall-run Chinook salmon	LAA	LAA	MAA
			Snake River Basin Steelhead	LAA	LAA	MAA
			Middle Columbia River Steelhead	LAA	LAA	MAA
Payette	92	228755	Snake River steelhead	LAA	LAA	MAA
			Snake River spring/summer Chinook salmon	LAA	LAA	MAA
Boise	68	170559	Snake River steelhead	LAA	LAA	MAA
			Snake River spring/summer Chinook salmon	LAA	LAA	MAA
Okanogan/Wenatchee	133	331364	UCR spring-run Chinook salmon	LAA	LAA	MAA
			MCR steelhead	LAA	LAA	MAA
			UCR steelhead	LAA	LAA	MAA
Wallowa-Whitman	66	165967	Snake River sockeye salmon	LAA	LAA	MAA
			Snake River spring/summer Chinook salmon	LAA	LAA	MAA
			Snake River fall-run Chinook salmon	LAA	LAA	MAA

			Snake River steelhead	LAA	LAA	MAA

Table F-9. Southwest National Forests and Determinations of Effects for Species Under the Jurisdiction of NOAA Fisheries.

Eldorado	3	6887	Central Valley steelhead	LAA	LAA	MAA
Lassen	20	50404	Central Valley spring Chinook salmon	LAA	LAA	MAA
			Sacramento winter run Chinook salmon	LAA	LAA	MAA
			Central Valley steelhead	LAA	LAA	MAA
Six Rivers	21	53292	Southern Oregon/Northern California Coast coho salmon	LAA	LAA	MAA
			Northern California steelhead	LAA	LAA	MAA
			California Coastal Chinook salmon	LAA	LAA	MAA
			Pacific eulachon	LAA (P)	LAA	MAA
			North American Green Sturgeon	LAA	LAA	LAA
Tahoe	21	53380	Sacramento winter run Chinook salmon	LAA	LAA	MAA
			Central Valley steelhead	LAA	LAA	MAA
Sierra	22	53845	Green sturgeon	LAA	LAA	MAA
Klamath	25	61496	Southern Oregon/Northern California Coast coho salmon	LAA	LAA	MAA
			Pacific Eulachon	LAA (P)	LAA	MAA
Mendocino	41	102997	Northern California steelhead	LAA	LAA	MAA
			Central Valley spring Chinook salmon	LAA	LAA	MAA
			California Coastal Chinook salmon	LAA	LAA	MAA
			Sacramento winter run Chinook salmon	LAA	LAA	MAA
			Southern Oregon/Northern California Coast coho salmon	LAA	LAA	MAA
			Central Valley steelhead	LAA	LAA	MAA
			North American Green Sturgeon	LAA	LAA	MAA

Plumas	48	120546	Sacramento winter run Chinook salmon	LAA	LAA	MAA
			Central Valley steelhead	LAA	LAA	MAA
Angeles	114	285573	Southern California steelhead	LAA	LAA	MAA
Shasta-Trinity	121	302235	Southern Oregon/Northern California Coast coho salmon	LAA	LAA	MAA
			Sacramento winter run Chinook salmon	LAA	LAA	MAA
			Central Valley steelhead	LAA	LAA	MAA
			Central Valley spring run Chinook salmon	LAA	LAA	MAA
			California Coastal Chinook salmon	LAA	LAA	MAA
			Northern California steelhead	LAA	LAA	MAA
			Green sturgeon	LAA	LAA	MAA
Los Padres	256	638947	South-Central California Coast steelhead	LAA	LAA	MAA
			Southern California steelhead	LAA	LAA	MAA

Table F-10. Southeast National Forests and Determinations of Effects for Species Under the Jurisdiction of NOAA Fisheries.

National Forest	Avg drops/yr	Avg gals/yr	Listed Species	Critical Habitat	Status
Francis Marion	1	2,649	Shortnose sturgeon Atlantic sturgeon	NONE LAA (P)	LAA LAA (P)
National Forests in Florida	43	106,886	Shortnose sturgeon Atlantic sturgeon	NONE LAA (P)	LAA LAA (P)
National Forests in North Carolina	19	46,773	Atlantic sturgeon	LAA (P)	LAA (P)
National Forests of Mississippi	0	0	Gulf Sturgeon	NLAA	NLAA
National Forests in Alabama	0	0	Gulf Sturgeon	NE	NE

Appendix G – Plant Species Lists and Effects Determinations

Appendix G – Plant Species Lists and Effects Determinations

Analysis Framework

Analysis Framework – Statutes, Regulations, and other direction

This section summarizes management direction for Federally listed and Forest Service Sensitive plants, noxious and non-native invasive plants and other botanical resources as it relates to the use of aerially applied fire retardant.

Endangered Species Act

Pursuant to Section 7 of the Federal Endangered Species Act (ESA), any federal agency undertaking a federal action that may affect a species listed or proposed as threatened or endangered under the ESA must consult with USFWS. In addition, any federal agency undertaking a federal action that may result in adverse modification of Critical Habitat for a federally-listed species must consult with USFWS.

The Endangered Species Act contains protection for all species federally-listed as endangered or threatened

- Federal agencies shall seek to conserve endangered species and threatened species and shall, in consultation with U.S. Fish and Wildlife Service, utilize their authorities in furthering the purposes of the Endangered Species Act by carrying out programs for the conservation of endangered and threatened species.
- Regulations for species that are proposed for listing as endangered or threatened are included in the Endangered Species Act
- Federal agencies shall confer with U.S. Fish and Wildlife Service on any agency action that is likely to jeopardize the continued existence of any species proposed to be listed.

Forest Service Manual and Handbooks (FSM/H 2670)

Forest Service Manual and Handbooks (FSM/H 2670) Forest Service Sensitive (FSS) species are plant species identified by the Regional Forester for which population viability is a concern. The Forest Service develops and implements management practices to ensure that rare plants and animals do not become threatened or endangered and ensure their continued viability on national forests. It is Forest Service policy to analyze impacts to sensitive species to ensure management activities do not create a significant trend toward federal listing or loss of viability. The Biological Evaluation (BE) is summarized or referenced in the EIS and includes:

- United States Department of Agriculture Regulation 9500-4 directs the Forest Service to avoid actions which may cause a sensitive species to become threatened or endangered (FSM 2670.12). Further, it is a Forest Service objective to "maintain viable populations of all native ... plant species in habitats distributed throughout their geographic range on National Forest System lands" (FSM 2670.22).
- Sensitive Plant Protection (FSM 2670.32; USDA FS, 1995) requires the Agency to reduce, minimize or alleviate possible adverse effects to Sensitive Plants.
- Individual forest plans directing management of Federally Listed and Regional Foresters Sensitive Plants**.** Each individual forest may have forest specific directions that "provide for and manage plant habitats and activities for threatened and endangered species to achieve recover objectives so that special protection measures provided under the Endangered Species Act (ESA) are no longer necessary". General direction for

management of Sensitive Plants under specific Forest Plans may provide additional guidance for plants and habitats specific for the region or forest.

Executive Order 13112 (1999)

Created the National Invasive Species Council (NISC) co-chaired by the Departments of Agriculture, Commerce and Interior. The executive order recognized the ecological and economic threat posed by invasive species and directed a broad intergovernmental effort to address invasive species problems. An Invasive Species Advisory Committee of non-federal representatives was appointed by NISC to provide advice and information to federal agencies. NISC's Management Plan, published in 2001, set nine goals including prevention, early detection and rapid response, control and management, restoration, international cooperation, research and education (NISC, 2001).

The Federal Noxious Weed Act of 1974, as amended (7 U.S.C. 2801 et. seq.), 36 C.F.R. 222.8, Departmental Regulation 9500-10

The Act provides for the control and management of nonindigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health. The Act requires that each federal agency: develop a management program to control undesirable plants on federal lands under the agency's jurisdiction; establish and adequately fund the program; implement cooperative agreements with state agencies to coordinate management of undesirable plants on federal lands; establish integrated management systems to control undesirable plants targeted under cooperative agreements (for additional information see: http://www.fedcenter.gov).

Forest Service Manual (FSM) 2080

Directives outline agency responsibilities for noxious weed management. FSM 2080 provides guidance to the National Forest System to address the more narrowly defined "noxious weed management". FSM 2080 Objectives outline an integrated weed management approach to control and contain the spread of noxious weeds on National Forest System lands and from National Forest System lands to adjacent lands. Achievement of objectives through management include: prevention of introduction and establishment, containment and suppression of existing infestations, formal and informal cooperation with State agencies, local landowners, weed control districts and board and other Federal agencies, and education and awareness of threats to native plant communities and ecosystems. FSM 2080 Policy states : "In consultation with Federal, State, and local government entities and the public, develop and implement a program for noxious weed management on National Forest System lands. Activities implementing the noxious weed management program must be consistent with the goals and objectives identified in Forest Land and Resource Management Plans (FSM 1910, 1920, and 1930). Responsibility of these directives falls on all levels of forest management, from Washington office staff, Regional Foresters, Forest Supervisors and District Rangers. Regional or forest level management direction provide guidance and tools to prevent and manage invasive plants and noxious weeds.

Each National Forest maintains a list of noxious weeds and non-native, invasive pest plants of concern. Inventory and treatment for NNIS are implemented at each forest level. Treatment strategies at local levels in general, include early detection, rapid response and treatment of new invasive plant sites, increased emphasis on protecting and restoring healthy native plant communities, long-term site goals providing mechanisms to link treatment to prevention, revegetation/restoration and monitoring in an integrated and adaptive process.

Burned Area Emergency Rehabilitation Program and Forest Service Handbook 2509.13

Provides specialized guidance and instruction for carrying out direction within the FSM. Objective of the program is to determine the need for and to prescribe and implement emergency treatments on Federal lands to minimize threats to life or property resulting from effects of a fire or to stabilize and prevent unacceptable degradation to natural and cultural resources.

USDA Forest Service Guide to Noxious Weed Prevention Practices, section Fire Management

Contains guides to prevent invasive weed establishment and spread including pre-fire and pre-incident training, planning, and rehabilitation.

National Strategy and Implementation Plan for Invasive Species Management (USDA 2004)

This document is intended to identify a strategic direction for Forest Service programs spanning Research and Development, International Programs, State and private Forestry, and the National Forest system. This strategy encompasses four program elements: prevention, early detection and rapid response, control and management, rehabilitation and restoration. In this plan each program element includes a description of success, accountability measures, summary of current program and list of strategic priorities divided into short- and long-term actions.

USDA Forest Service Strategic Planning

Over the past years continues to include in their goals and objectives to address impacts of invasive species (USDA-FS 2007, USDA-FS 2004a and b).

Monitoring and Consultation Requirements for Retardant and Foam in Waterways and Threatened and Endangered Species (TES) Habitats USDA (existing language for alternative 2)

Requires that is misapplications of fire retardant chemicals in habitats supporting T&E species requires an evaluation of the site to determine the extent of injury to the species and community and to document the degradation of the fire chemicals. Plant species within the affected area should be identified, photo document to confirm species, presence of T&E species, numbers and condition and ammonia concentration in retardant covered soil should be evaluated to determine degradation. Site characterization should be initiated to document spatial extent of the chemical application, terrain, slope and surface soil, site history, weather. For plants it is important to verify the survival through the next growing season and to document that invasive species have not increased as a result of fire retardant chemical misapplication.

Plant Species List and Effects Determinations

For a complete review of species distribution and baseline habitat information for federally listed species please refer to the Biological Assessment. For a complete listing of Forest Service listed sensitive species and candidate species and results of the national screeneing process and species specific impact determinations please refer to the Biological Evaluation and Botany Report. Tables 1 and 2 contain all federally listed plant species that occur on NFS considered in this analysis (169 species total).

Table G-1. Federally Listed Plant Species With the Potential to be Impacted by Aerial Fire Retardant.

	Scientific Name	Federal Status	Common Name
1	*Acanthomintha ilicifolia*	T, CH	San Diego thorn-mint
2	*Acanthoscyphus parishii var. goodmaniana (Oxytheca parishii)*	E, CH	Cushenbury puncturebract
3	*Allium munzii*	E, CH	Munz's onion
4	*Arabis macdonaldiana*	E	McDonald's rock Cress
5	*Arabis serotina*	E	Shale Barren Rock-cress
6	*Arenaria cumberlandensis*	E	Cumberland Sandwort
7	*Arenaria ursine*	T, CH	Bear Valley sandwort
8	*Argemone pleiacantha* spp. *pinnatisecta*	E	Sacramento prickly poppy
9	*Asclepias meadii*	T	Mead's Milkweed
10	*Astragalus albens*	E, CH	Cushenbury milk-vetch
11	*Astragalus brauntonii*	E	Brauton's milk-vetch*
12	*Astragalus limnocharis* var. *montii*	T, CH	Heliotrope Milk-vetch
13	*Astragalus osterhoutii*	E	(Osterhout milkvetch)
14	*Astragalus tricarinatus*	T	Triple-ribbed milk-vetch*
15	*Baccharis vanessae*	T	Encinitas baccharis
16	*Berberis nevinii (Mahonia nevinii)*	E, CH	Nevin's barberry
17	*Betula uber*	T	Virginia Round-leaf Birch
18	*Bonamia grandiflora*	T	Florida bonamia

	Scientific Name	Federal Status	Common Name
19	*Brodiaea filifolia*	T	Thread-leaved brodiaea
20	*Calyptridium pulchellum*	T	Mariposa pussy-paws
21	*Calystegia stebbinsii*	E	Stebbin's morning glory
22	*Castilleja cinerea*	T, CH	Ashy-grey paintbrush
23	*Caulanthus californicus*	E	California jewelflower
24	*Ceanothus ophiochilus*	T, CH	Vail Lake ceanothus
25	*Chlorogalum purpureum* var. *reductum*	T, CH	Camatta Canyon amole
26	*Cirsium vinaceum*	T	Sacramento mts. Thistle
27	*Clarkia springvillensis*	T	Springville clarkia
28	*Conradina verticillata*	T	Cumberland rosemary
29	*Coryphantha scheeri* var. *robustispina*	E	Pima pineapple cactus
30	*Dodecahema leptoceras*	E	Slender-horned spineflower
31	*Echinacea laevigata*		Smooth Purple Coneflower
32	*Echinocereus fendleri* var. *kuenzleri*	E	Kuenzler hedgehog cactus
33	*Echinocereus triglochidiatus* var. *arizonicus*	E	Arizona hedgehog cactus
34	*Eriastrum densifolium ssp. sanctorum*	E	Santa Ana River woolystar*
35	*Erigeron parishii*	T, CH	Parish's daisy
36	*Erigeron rhizomatus*	T	Zuni fleabane
37	*Eriogonum kennedyi* var. *austromontanum*	T, CH	Southern mountain buckwheat
38	*Eriogonum longifolium var. gnaphalifolium*	T	Scrub buckwheat
39	*Eriogonum ovalifolium var. vineum*	E	Cushenbury buckwheat
40	*Eutrema penlandii*	T	Penland alpine fen mustard
41	*Fritillaria gentneri*	E	Gentner Mission-bells
42	*Geum radiatum*	E	Spreading avens

	Scientific Name	Federal Status	Common Name
43	*Gymnoderma lineare*	E	Rock gnome lichen
44	*Hackelia venusta*	E	Showy stickseed
45	*Harperocallis flava*	E	Harper's beauty
46	*Hedeoma todsenii*	E	Todsen's pennyroyal
47	*Helenium virginicum*	T	Virginia sneezeweed
48	*Helianthus schweinitzii*	E	Schweinitz's sunflower
49	*Helonias bullata*	T	Swamp pink
50	*Houstonia purpurea var. montana (Hedyotis)*	E, CH	Roan mountain bluet
51	*Howellia aquatilis*	T	Water howellia
52	*Hudsonia montana*	T	Mountain golden heather
53	*Hymenoxys texana*	E	Prairiedawn
54	*Ipomopsis polyantha*	P	Pagosa skyrocket
55	*Ipomopsis sancti-spiritus*	E	Holy ghost ipomopsis
56	*Isoetes louisianensis*	E	Louisiana quillwort
57	*Isotria medeoloides*	T	Small whorled pogonia
58	*Lesquerella filiformis (Physaria)*	E	Missouri Bladder-pod
59	*Lesquerella pallida*	E	White bladderpod
60	*Liatris helleri*	T	Heller's blazing star
61	*Lilaeopsis schaffneriana* spp. *recurva*	E, CH	Huachuca water umbel
62	*Lindera melissifolia*	E	Pondberry
63	*Lupinus oreganus* var. *kincaidii*	T	Kincaid's lupine
64	*Lysimachia asperulifolia*	E	Rough-leaf Loosestrife
65	*Macbridea alba*	T	White Bird-in-a-nest
66	*Mirabilis macfarlanei*	T	Macfarlane's four-o'clock

	Scientific Name	Federal Status	Common Name
67	*Nolina brittonia*	E	Britton's beargrass
68	*Opuntia basilaris* var. *trelease*	E	Bakersfield cactus
69	*Orcuttia tenuis*	T, CH	Slender orcutt grass
70	*Oxypolis canbyi*	E	Canby's dropwort
71	*Penstemon haydenii*	E	Blowout penstemon
72	*Phacelia argillacea*	E	Clay phacelia
73	*Phacelia scopulina var. submutica*	P	Debeque phacelia
74	*Phlox hirsuta*	E	Yreka phlox
75	*Physaria kingii* ssp. *bernardina (Lesquerella kingii ssp. bernardina)*	E, CH	San Bernardino Mountains bladderpod
76	*Pinguicula ionantha*	T	Godfrey's butterwort
77	*Pityopsis ruthii*	E	Ruth's Golden-aster
78	*Platanthera praeclara*	T	Western prairie fringed orchid
79	*Poa atropurpurea*	E, CH	San Bernardino bluegrass
80	*Polygala lewtonii*	E	Lewton's polygala
81	*Primula maguirei*	T	Maguire’s primrose
82	*Ptilimnium nodosum*	E	Harperella
83	*Purshia subintegra*	E	Arizona cliffrose
84	*Rhododendron minus* var. *champmanii*	E	Chapman's rhododendron
85	*Ribes echinellum*	T	Miccosukee gooseberry
86	*Schwalbea americana*	E	American chaffseed
87	*Scirpus ancistrochaetus*	E	Northeastern bulrush
88	*Sclerocactus glaucus*	T	Colorado hookless cactus
89	*Scutellaria floridana*	T	Florida skullcap
90	*Sencio franciscanus*	T, CH	San Fransisco peaks groundsel

	Scientific Name	Federal Status	Common Name
91	*Senecio layneae*	T	Layne's butterweed
92	*Sidalcea oregana* var. *calva*	E, CH	Wenatchee mountains checker mallow
93	*Sidalcea pedata*	E	Bird-foot checkerbloom
94	*Silene spaldingii*	T	Spalding's catchfly
95	*Solidago albopilosa*	T	White-haired goldenrod
96	*Solidago spithamaea*	T	Blue ridge goldenrod
97	*Spiraea virginiana*	T	Virginia spiraea
98	*Spiranthes delitescens*	E	Canelo Hills Ladies-tresses
99	*Spiranthes diluvialis*	T	Ute ladies'-tresses orchid
100	*Spiranthes parksii*	E	Navasota Ladies'-tresses
101	*Taraxacum californicum*	E, CH	California taraxacum
102	*Thelypodium stenopetalum*	E	Slender-petaled thelypodium
103	*Townsendia aprica*	T	Last chance townsendia
104	*Trifolium stoloniferum*	E	Running buffalo clover
105	*Tuctoria greenei*	E, CH	Greene's tuctoria

Table G-2. Federally Listed Plant Species With no Potential to be Impacted by Aerial Fire Retardant (No Effect Determination for Alternatives 2 and 3).

Scientific Name	Federal Status	Common Name	FS Region	Forest Names or State With NF	Retardant Use Past 10 Years	Effect	Reason (NR)= No Retardant Use
Aconitum noveboracense	T	Northern Wild Monkshood	9	Wayne	N	NE	NR
Aeschynomene virginica	T	Sensitive Joint-vetch	8	Suspected on Forests of NC	Y	NE	Suspected habitat surveyed
Apios priceana	T	Price's Potato-bean	8	Mississippi, Suspected on Tom Bigbee	Y	NE	Suspected habitat surveyed
Arenaria paludicola	E	Marsh Sandwort	5	susp on San B	Y	NE	Suspected only ongoing surveyts
Asplenium scolopendrium var. americanum	T	Hart's Tongue Fern	9	Hiawatha	N	NE	NR
Astragalus applegatei	E	Applegate's Milk-vetch	5	Suspected on Klamath	N	NE	Habitat not likely occupied
Astragalus desereticus	T	Deseret Milk-vetch	4	Susp on Manti-LaSal, Uinta	Y	NE	Suveys conducted no potential habitat on Uinta NF
Astragalus lentiginosus var. coachella	E	Coachella Milk-vetch	5	Suspected on San Bernardino	Y	NE	Suspected only ongoing surveys
Callicarpa ampla	E	Capa Rosa	8	Puerto Rico	N	NE	NR

Scientific Name	Federal Status	Common Name	FS Region	Forest Names or State With NF	Retardant Use Past 10 Years	Effect	Reason (NR)= No Retardant Use
Castilleja campestris ssp. succulenta	T	Succulent owl's-clover	5	Suspected on Sierra	N	NE	Suspected only ongoing surveys
Cirsium loncholepis	T	*La Graciosa thistle*	5	*Suspected on Los Padres*			*Suspected only ongoing surveys*
Cirsium pitcheri[1]	T	Pitcher's Thistle	9	Hiawatha, Huron Manistee	Y 1drop	NE	Habitat not prone to retardant use
Clematis socialis	E	Alabama Leather Flower	8	Alabama	N	NE	NR
Clitoria fragrans	T	Pigeon wings		Florida	Y	NE	Suspected habitat surveyed
Conradina glabra	F	Apalachicola Rosemary	8	Florida	Y	NE	Suspected habitat surveyed
Dudleya cymosa ssp. ovatifolia	T	Santa Monica Mountains dudleya	5	Suspected on Cleveland	Y	Y	Suspected only New taxonomic information on going surveys
Dalea foliosa	E	Leafy Prairie Clover	8,9	Alabama, Midewin	N	NE	NR
Eremalche kernensis (Eremalche parryi ssp. Kernensis)	E	Kern mallow	5	arid grasslands and scrublands of the San Joaquin Valley and adjacent foothills and valleys – not on FS lands	N	NE	NR

Scientific Name	Federal Status	Common Name	FS Region	Forest Names or State With NF	Retardant Use Past 10 Years	Effect	Reason (NR)= No Retardant Use
Eugenia haematocarpa	E	Uvillo	8	Puerto Rico	N	NE	NR
Fremontodendron mexicanum	E	Mexican Flannelbush	5	Suspected on Cleveland	Y	NE	Suspected only ongoing surveys
Geocarpon minimum	T	Geocarpon	8	Susp on Ozark	Y	NE	Suspected only ongoing surveys
Hexastylis naniflora	T	Dwarf-flowered Heartleaf	8	Suspected on NC Forests	Na	NE	Suspected habitat surveyed
Hymenoxys herbacea	T	Lakeside Daisy	9	Hiawatha	N	NE	NR
Ilex sintenisii	E	Cuero de Sapo	8	Puerto Rico	N	NE	NR
Iliamna corei	E	Peter's Mountain-mallow		Suspected on George Washington-Jefferson	Y	NE	Suspected only, ongoing surveys
Iris lacustris	T	Dwarf Lake Iris	9	Hiawatha	N	NE	NR
Lepidium papilliferum	T	Slick spot peppergrass	4	Suspected on Boise	Y	NE	Suspected habitat surveyed
Lepanthes eltoroensis	E	Babyfoot Orchid	8	Puerto Rico	N	NE	NR
Lesquerella lyrata	T	Lyrate Bladderpod	8	Alabama	N	NE	NR
Lilium occidentale	E	Western Lily	6	Suspected on Suislauw	Y	NE	Habitat does not burn
Limnanthes floccosa ssp. californica	E	Butte County (Shippee) meadowfoam	5	susp in Lassen	Y	N	Suspected only

Scientific Name	Federal Status	Common Name	FS Region	Forest Names or State With NF	Retardant Use Past 10 Years	Effect	Reason (NR)= No Retardant Use
Lomatium cookii	E	Cook's Lomation	6	Suspected on Rogue River-Siskiyou, OR	Y	NE	Habitat[1]
Marshallia mohrii	T	Mohr's Barbara's Buttons	8	Alabama	N	NE	NR
Mimulus glabratus var. michiganensis	T	Michigan Monkeyflower	9	Hiawatha	N	NE	NR
Monolopia congdonii (Lembertia congdonii)	E	San Joaquin woolythreads	5	Suspected on Sequoia	Y	NE	NR
Nasturtium gambelii	E	Gambel's watercress	5	Potential to occur on San B	Y	NE	Potential only
Oxytropis campestris var. chartacea	T	Fassett's Locoweed	9	Chequamegon /Nicolet	N	NE	NR
Pediocactus despainii	E	San Rafael Cactus	4	Suspected on Fish Lake	Y	NE	Habitat Suspected only – ongoing surveys
Pediocactus winkleri	T	Winkler Cactus	4	Suspected on Manti-LaSal	Y	NE	Habitat Suspected only – ongoing surveys
Platanthera leucophaea	T	Eastern Prairie White-fringed Orchid	9	Midewin	N	NE	NR
Plagiobothrys hirtus	E	Rough Popcorn Flower	6	Suspected on Umpqua in Oregon	Y	NE	Suspected habitat surveyed

Scientific Name	Federal Status	Common Name	FS Region	Forest Names or State With NF	Retardant Use Past 10 Years	Effect	Reason (NR)= No Retardant Use
Pleodendron macranthum	E	Chupacallos	8	Puerto Rico	N	NE	NR
Polystichum aleuticum	E	Aleutian Shield Fern	10	Alaska	N	NE	NR
Pseudobahia peirsonii		San Joaquin adobe sunburst	5	Suspected on Sequoia	Y	NE	Suspected only, ongoing surveys
Sagittaria fasciculata	E	Bunched Arrowhead	8	Suspected on Forests of NC	Y	NE	Suspected habitat surveyed
Sagittaria secundifolia	T	Kral's Water Plantain	8	Alabama	N	NE	NR
Sarracenia rubra ssp. alabamensis	E	Alabama Canebrake Pitcher Plant	8	Alabama	N	NE	NR
Sarracenia rubra ssp. jonesii	E	Mountain Sweet Pitcher Plant	8	3 Forests in R8	Y/N	NE	NR and Suspected habitat surveyed
Sarracenia oreophila	E	Green Pitcher Plant	8	State of AL, Chattahoochee-Oconee, NC Forests	Y	NE	NR on AL/Chat, suspected only onNC
Scutellaria montana	T	Large Flowered Skullcap	8	Chattahoochee Oconee	N	NE	NR
Senecio franciscanus	Chab	San Francisco peaks groundsel	3	Coconino	Y	NE	PCE's not impacted
Sidalcea keckii	E	Keck's Checkermallow	5	suspectedSequoia and Sierra	Y	NE	No species on or adjacent to forests

Scientific Name	Federal Status	Common Name	FS Region	Forest Names or State With NF	Retardant Use Past 10 Years	Effect	Reason (NR)= No Retardant Use
Sidalcea nelsoniana	T	Nelson's Checker Mallow	6	Suspected on the Suislaw	Y	NE	Suspected habitat surveyed; Habitat not prone to retardant use
Sisyrinchium dichotomum	E	White Irisette	8	Suspected on NC Forests	Y	NE	Suspected habitat surveyed
Solidago houghtonii	T	Houghton's Goldenrod	9	Hiawatha	N	NE	NR
Styrax portoricensis	E	Palo de Jazmin	8	Puerto Rico	N	NE	NR
Ternstroemia luquillensis	E	Palo Colorado	8	Puerto Rico	N	NE	NR
Ternstroemia subsessilis	E		8,	Puerto Rico	N	NE	NR
Thelypodium howellii ssp. spectabilis	T	Slender-petaled Mustard	6	suspected	Y	NE	Suspected habitat surveyed
Thelypteris pilosa var. alabamensis	T	Alabama Streak-Sorus Fern	8	Alabama	N	NE	NR
Thlaspi californicum	E	Kneeland Prairie penny-cress	5	Humbolt-Six Rivers California	Y	NE	Suspected habitat surveyed

Scientific Name	Federal Status	Common Name	FS Region	Forest Names or State With NF	Retardant Use Past 10 Years	Effect	Reason (NR)= No Retardant Use
Trillium persistens	E	Persistent Trillium	8	Francis-Marion-Sumter, Chattahoochee-Oconee	Y/N	NE	Suspected only ongoing surveys C-O does not use retardant
Trillium reliquum	E	Relict Trillium	8	Suspected on Francis Marion Sumter	Y	NE	only ongoing surveys
Xyris tennesseensis	E	Tennessee Yellow-eyed Grass	8	Alabama	N	NE	NR
Total Species	64 species; 1 designated critical habitat						

1 If species are found in the future, all known occurrences would be identified and avoidance mapped as necessary and consultation or reinitiation of consultation would occur.

Table G-3. Federally Listed Plant Species Protected by Avoidance Mapping Associated With RPA Adoption and Alternative 2 (20 Species and 14 Designated Critical Habitats, FWS 2008).

Common Name	Federal Status	Scientific Name	Destruction or Adverse Modification
Munz's Onion	E	*Allium munzii*	N
Bear Valley Sandwort	T	*Arenaria ursine*	N
Cushenbury Milk-vetch	E	*Astragalus albens*	N
Tripleribbed Milk-vetch	E	*Astragalus tricarinatus*	None
Mariposa pussypaws	T	*Calyptridium pulchellum*	None
Ashgray Paintbrush (aka Ash-Grey Indian Paintbrush	T	*Castilleja cinerea*	N
Vail Lake Ceanothus	T	*Ceanothus ophiochilus*	Y
Purple Amole (aka Camatta Canyon amole)	T	*Chlorogalum purpureum*	N
Slender-horned Spineflower	E	*Dodecahema leptoceras*	None
Parish's daisy	E	*Erigeron parishii*	N
Southern Mountain Buckwheat	T	*Eriogonum kennedyi var. austromontanum*	N
Cushenbury Buckwheat	E	*Eriogonum ovalifolium var. vineum*	N
Holy Ghost Ipomopsis	E	*Ipomopsis sancti-spiritus*	None
San Bernardino Mountains Bladderpod	E	*Lesquerella kingii ssp. Bernardina*	N
Nevin's Barberry (=Truckee)	E	*Mahonia (=Barberia) nevinii*	Y
Cushenbury Oxytheca	E	*Oxytheca parishii var. goodmaniana*	N
San Bernardino Bluegrass	E	*Poa atropurpurea*	N
Bird-footed Checkerbloom (aka Pedate Checkermallow)	E	*Sidalcea pedata*	None

Common Name	Federal Status	Scientific Name	Destruction or Adverse Modification
California Dandelion	E	*Taraxacum californicum*	N
Slender-petaled mustard	E	*Thelypodium stenopetalum*	None

Table G-4. Impacts to Designated Critical Habitat for Plant Species Impacted From Aerially Applied Fire Retardant for Alternatives 2 and 3.

NatureServe Global Sci. Name	Common Name	FS Region	Forest Names	Acres	Retardant use 0.01%[1]	Alt 2 Effect[2]	Alt 3 Effect[3]
Acanthomintha ilicifolia	San Diego thorn-mint	5	Cleveland	549	y	LAA	NLAA
Allium munzii	Munz's onion	5	Cleveland	176	y	NLAA	NLAA
Arenaria ursina	Bear Valley sandwort	5	San B	1,309	y	NLAA	NLAA
Astragalus albens	Cushenbury milk-vetch	5	San B	3,020	y	NLAA	NLAA
Astragalus limnocharis var. *montii*	Heliotrope milk-vetch	4	Manti-LaSal	65	n	LAA	NLAA
Berberis nevinii	Nevin's barberry	5	Cleveland	1	y	NLAA	NLAA
Brodiaea filifolia	Thread-leaved brodiaea	5	Angeles, Cleveland	20 & 249	y	LAA	NLAA
Castilleja cinerea	Ashy-grey paintbrush	5	San B	1603	y	NLAA	NLAA
Ceanothus ophiochilus	Vail lake ceanothus	5	Cleveland	203	y	NLAA	NLAA
Chlorogalum purpureum var. *reductum*	Camatta canyon amole	5	Los Padres	4770	y	NLAA	NLAA
Erigeron parishii	Parish's daisy	5	San B	2320	y	NLAA	NLAA

NatureServe Global Sci. Name	Common Name	FS Region	Forest Names	Acres	Retardant use 0.01%[1]	Alt 2 Effect[2]	Alt 3 Effect[3]
Eriogonum kennedyi austromontanum	La Graciosa thistle	5	San B	872	y	NLAA	NLAA
Eriogonum ovalifolium var. vineum	Cushenbury buckwheat	5	San B	5595	y	NLAA	NLAA
Hudsonia montana	Butte county meadowfoam	8	Pisgah	22	n	LAA	NLAA
Lesquerella kingii ssp. *bernardina*	Cook's komatium	5	San B	1005	y	NLAA	NLAA
Lilaeopsis schaffneriana spp. *recurva*	Kincaid's kupine	3	Coronado		y	LAA	NLAA
Lomatium cookii	Slender orcutt Grass	6	Rogue River Siskiyou	40	n	LAA	NLAA
Orcuttia tenuis	Keck's checker-mallow	5	Lassen	21885	n	LAA	NLAA
Oxytheca parishii var. goodmaniana	Cushionberry oxythea	5	San B	2590	y	NLAA	NLAA
Poa atropurpurea	San Bernardino bluegrass	5	Cleveland, San B	1115 & 804	y	NLAA	NLAA
Sencio franciscanus	Greene's tuctoria (=Orcutt grass)	3	Coconino	720	n	NE	NE
Sidalcea oregana var. *calva*	Wenatchee mountains checkermallow	6	Wenatchee	2280	n	LAA	NLAA
Taraxacum californicum	California dandelion		San B	1344	y	NLAA	NLAA
Tuctoria greenei	Greene's tructoria	5	Lassen	1551	n	LAA	NLAA

[1]Forests with potential of 0.01% of landbase applied annually with fire retardant

[2]Reason: Of the 24 designated critical habitats identified, 14 of them would receive avoidance mapping where retardant application would impact primary constituent elements, because only one documented occurrence of a misapplication on a designated critical habitat has been documented in the past three years out of 68 total drops nation wide (Division Fire, Appendix D) it is predicted these would not likely adversely affected. Remaining designated critical habitats would either likely be adversely affected or not effected because they do not receive any retardant avoidance areas mapped or where primary consitituent elements are clearly defined and retardant use would not affect these elements in combination with very low use of retardant in the designated critical habitat areas (i.e. cinder talus slopes on alpine tundra slopes) no effects (NE) are anticipated.

[3]Reason: Many of the primary constituent elements for designated critical habitats associated with this analysis all have some component within their elements that include: space for individual and population growth, reproduction and dispersal, plant communities dominated by native grasses and forbs, or native plant communities associated with the species of protection, or no or negligible presence of competitive or nonnative invasive plant species (refer to next section for description of Designated Critical Habitat Primary Constituent Elements). Because all areas where primary constituent elements within designated critical habitats will be protected with avoidance mapping no retardant application) no impacts are anticipated except for a misapplication or invoking of a exception, therefore a NLAA determination. For additional information related to critical habitats and primary constituent elements please refer to FWS (http://www.fws.gov/verobeach/images/pdflibrary/Critical%20Habitat%20Fact%20Sheet.pdf, accessed 04/2011). Where primary consitituent elements are clearly defined and retardant use would not affect these elements in combination with very low use of retardant in the designated critical habitat areas (i.e. cinder talus slopes on alpine tundra slopes) no effects (NE) are anticipated.

Table G-5. Federally Listed Plant Species Likely Adversely Affected From Aerially Applied Fire Retardant for Alternative 3.

Scientific Name	Fed. Status and Critical Habitat	Common Name	FS Region	Occurrence on Forest or State w/NF	Populations or Individuals in Single Isolated Area[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reason[2]
Acanthomintha ilicifolia	T, CH	San Diego thorn-mint	5	Cleveland	N	Y	Y/Y	Retardant use
Acanthoscyphus parishii var. goodmaniana (Oxytheca parishii)	E, CH	Cushenbury puncturebract	5	San Bernardino	N	Y	Y/Y	Retardant use
Allium munzii	E, CH	Munz's onion	5	Cleveland	Y	Y	Y/Y	Retardant use
Arenaria ursina	T, CH	Bear Valley sandwort	5	San B	N	Y	Y/Y	Retardant use
Argemone pleiacantha spp. Pinnatisecta	E	Sacramento prickly poppy	3	Lincoln	N	Y	Y	Retardant use
Astragalus albens	E, CH	Cushenbury milk-vetch	5	San B	N	Y	Y/Y	Retardant use
Astragalus brauntonii	E	Braunton's milk-vetch*	5	Angeles, susp on San B	N	Y	Y	Retardant use
Astragalus limnocharis var. montii	T, CH	Heliotrope Milk-vetch	4	Manti-LaSal	Y	N	Y/Y	Isolated pop
Astragalus tricarinatus	T	Triple-ribbed milk-vetch*	5	San B	Y	Y	Y	Retardant use

Scientific Name	Fed. Status and Critical Habitat	Common Name	FS Region	Occurrence on Forest or State w/NF	Populations or Individuals in Single Isolated Area[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reason[2]
Baccharis vanessae	T	Encinitas baccharis	5	Cleveland	N	Y	Y	Retardant use
Berberis nevinii (Mahonia nevinii)	E, CH	Nevin's barberry	5	Angeles, susp on San B	N	Y	Y/Y	Retardant use
Bonamia grandiflora	T	Florida Bonamia	8	FL forests	N	Y	Y	Retardant use
Brodiaea filifolia	T CH	Thread-leaved brodiaea	5	Angeles, Cleveland, susp San B	N	Y	Y/Y	Retardant use
Calyptridium pulchellum	T	Mariposa pussy-paws	5	Sierra	Y	N	Y	Isolated pop
Castilleja cinerea	T, CH	Ashy-grey paintbrush	5	San B	N	Y	Y/Y	Retardant use
Caulanthus californicus	E	California jewelflower	5	Los Padres, susp on Sequoia	N	Y	Y	Retardant use
Ceanothus ophiochilus	T, CH	Vail Lake ceanothus	5	Cleveland	Y	Y	Y/Y	Isolated pop
Chlorogalum purpureum var. reductum	T, CH	Camatta Canyon amole	5	Los Padres	N	Y	Y/Y	Retardant use
Cirsium vinaceum	T	Sacramento Mts. Thistle	3	Lincoln	N	Y	Y	Retardant use

Scientific Name	Fed. Status and Critical Habitat	Common Name	FS Region	Occurrence on Forest or State w/NF	Populations or Individuals in Single Isolated Area[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reason[2]
Clarkia springvillensis	T	Springville clarkia	5	Sequoia	N	Y	Y	Retardant use
Dodecahema leptoceras	E	Slender-horned spineflower	5	Angeles, Cleveland, San B	N	Y	Y	Retardant use
Eriastrum densifolium ssp. sanctorum	E	Santa Ana River woolystar*	5	susp on San B (occurs on mutual aid boundary)	N	Y	Y	Retardant use
Erigeron parishii	T, CH	Parish's daisy	5	San B	N	Y	Y/Y	Retardant use
Eriogonum kennedyi var. austromontanum	T, CH	Southern mountain buckwheat	5	San B	N	Y	Y/Y	Retardant use
Eriogonum longifolium var. gnaphalifolium	T	Scrub Buckwheat	8	FL forests	N	Y	Y	Retardant use
Eriogonum ovalifolium var. vineum	E CH	Cushenbury buckwheat	5	San B	N	Y/Y CH	Y/Y	Retardant use
Hackelia venusta	E	Showy Stickseed	6	Okanogan-Wenatchee	Y	Y	Y	Retardant use
Harperocallis flava	E	Harper's Beauty	8	FL forests	N	Y	Y	Retardant use

Scientific Name	Fed. Status and Critical Habitat	Common Name	FS Region	Occurrence on Forest or State w/NF	Populations or Individuals in Single Isolated Area[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reason[2]
Hedeoma todsenii	E	Todsen's pennyroyal	3	Lincoln	N	Y	N	Retardant use
Ipomopsis sancti-spiritus	E	Holy ghost ipomopsis	3	SantaFe	Y	Y	N	Retardant use
Lilaeopsis schaffneriana spp. recurva	E, CH	Huachuca water umbel	3	Coronado	N	Y	Y/Y	Retardant use
Lupinus oreganus var. kincaidii	T CH	Kincaid's Lupine	6	Umpqua, susp Siuslaw	N	N	Y/Y CH	Local retardant use, habitat in retardant prone area
Macbridea alba	T	White Bird-in-a-nest	8	FL forests	N	Y	Y	Retardant use
Mirabilis macfarlanei	T	Mac Farlane's Four-O'Clock	1,6	Nez Perce, Wallowa Whitman	N	N in OR N in MT	Y	Local etardant use, habitat in retardant prone area
Nolina brittonia	E	Britton's Beargrass	8	FL forests	N	Y	Y	Retardant use

Scientific Name	Fed. Status and Critical Habitat	Common Name	FS Region	Occurrence on Forest or State w/NF	Populations or Individuals in Single Isolated Area[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reason[2]
Orcuttia tenuis	T, CH	Slender Orcutt Grass	5	Lassen, Modoc, Plumas, susp on ShastaTrinity	N	Y	Y/Y	Retardant use
Phlox hirsuta	E	Yreka Phlox	5	Klamath	N	N	Y	Local retardant use in retardant prone area
Physaria kingii ssp. bernardina (Lesquerella kingii ssp. bernardina)	E, CH	San Bernardino Mountains bladderpod	5	San B	N	Y	Y/Y	Retardant use
Pinguicula ionantha	T	Godfrey's Butterwort	8	FL forests	N	Y	Y	Retardant use
Poa atropurpurea	E, CH	San Bernardino bluegrass	5	Cleveland, San B	Y	Y	Y/Y	Retardant use
Polygala lewtonii	E	Lewton's Polygala	8	FL forests	N	Y	Y	Retardant use
Scutellaria floridana	T	Florida Skullcap	8	FL forests	N	Y	Y	Retardant use
Senecio layneae	T	Layne's butterweed (=ragwort)	5	Eldorado, Plumas, Tahoe	N	Y	Y	Retardant use

Scientific Name	Fed. Status and Critical Habitat	Common Name	FS Region	Occurrence on Forest or State w/NF	Populations or Individuals in Single Isolated Area[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reason[2]
Sidalcea pedata	E	Bird-foot checkerbloom	5	San B	N	Y	Y	Retardant use
Sidalcea oregana var. calva	E, CH	Wenatchee Mountains Checker Mallow	6	Okanogan-Wenatchee	Y	Y	Y/Y	Retardant use and isolated population
Silene spaldingii	T	Spalding's Catchfly	1,6	Nez Perce, Umatilla, Wallowa Whitman, susp on Lolo, Koot, Idaho Panhandle	N	N	Y	Local retardant use and habitat in retardant prone areas
Spiranthes delitescens	E	Canelo Hills Ladies-tresses	3	Coronado	N	Y	Y	Retardant use
Taraxacum californicum	E, CH	California taraxacum	5	San B	N	Y	Y/Y	Retardant use
Thelypodium stenopetalum	E	Slender-petaled thelypodium	5	San B	N	Y	Y	Retardant use
Total No of Species 49								

[1]Isolated populations for plants includes areas where a narrow endemic or isolated population, occurs on a forest (that is species that occupy a small geographic area and no where else), may receive an accidental drop or retardant application from an exception and would be most vulnerable to an impact. Individual species distribution data derived from NatureServe Explorer (06/2011) and is available in pdf format in the project record.

[2]Forests with potential of 0.01% or more of landbase applied with fire retardant use more retardant and have a higher probability of misapplication or implementation of an exception

Table G-6. Federally Listed Plant Species Not Likely Adversely Affected From Aerially Applied Fire Retardant for Alternative 3.

NatureServe Global Sci. Name	Fed. Status and Critical Habitat	Common Name	FS Region	Forest Name or State With NF	Isolated Population[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reasons[3,4]
Arabis mcdonaldiana				Rogue-River Siskiyou, Six Rivers, Klamath and susp on Shasta Trinity	N	N	Y	LRUF
Arabis serotina	E	Shale Barren Rock-cress	8, 9	George Wash/Jeff, Monongahela	N	N	N	LRUF
Arenaria cumberlandensis (Minuaritia cumberlandensis)	E	Cumberland Sandwort	8	Daniel Boone	N	Y	Y	Habitat
Asclepias meadii	T	Mead's Milkweed	9	MarkTwain, Midewin, Shawnee	N	N	Y	LRUF
Astragalus osterhoutii	E	Osterhout milkvetch	2	susp on Arapahoe, MedBowRoutt	Na	N	N	Habitat and LRUF
Betula uber	T	Virginia Round-leaf Birch	8	George Washington-Jefferson	N	N	Y	LRUF
Calystegia stebbinsii	E	Stebbin's morning glory	5	Tahoe	N	N	Y	LRUF
Conradina verticillata	T	Cumberland Rosemary	8	Daniel Boone	N	N	Y	LRUF

NatureServe Global Sci. Name	Fed. Status and Critical Habitat	Common Name	FS Region	Forest Name or State With NF	Isolated Population[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reasons[3,4]
Coryphantha scheeri var. robustispina	E	Pima pineapple cactus	3	Coronado	N	Y	N	Habitat
Echinacea laevigata		Smooth Purple Coneflower	8	George Washington-Jefferson, Chattachochee-Oconee, Francis-Marion-Sumter National Forests and *suspected* on the National Forests of North Carolina	N	N	Y(FMS NF only)	LRUF and Habitat
Echinocereus fendleri var. kuenzleri	E	Kuenzler hedgehog cactus	3	Lincoln	N	Y	Y	Habitat
Echinocereus triglochidiatus var. arizonicus	E	Arizona hedgehog cactus	3	Tonto	N	N	N	Habitat
Erigeron rhizomatus	T	Zuni Fleabane	3	Cibola	N	N	N	LRUF and habitat
Eutrema penlandii	T	Penland alpine fen mustard	2	Pike San Isabel, WhiteRiver	N	N	Y	LRUF and habitat
Fritillaria gentneri	E	Gentner Mission-bells	5, 6	Rogue River Siskiyou, susp Klamath	N	n in r6, n in r5	N	Habitat- and LRUF

NatureServe Global Sci. Name	Fed. Status and Critical Habitat	Common Name	FS Region	Forest Name or State With NF	Isolated Population[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reasons[3,4]
Geum radiatum	E	Spreading Avens	8	Cherokee, NC forests	N	Y	Y	Habitat not in area where retardant use is high
Gymnoderma lineare	E	Rock Gnome Lichen	8	Chattahoochee-Oconee, Cherokee, NC Forests	N	Y	Y	Habitat
Helenium virginicum	T	Virginia Sneezeweed	8, 9	GeorgeWash Jeff, MarkTwain	N	N	N GWJ Y MTwain	LRUF, and habitat
Helianthus schweinitzii	E	Schweinitz's Sunflower	8	NC Forests	N	N	Y	LRUF
Helonias bullata	T	Swamp Pink	8	Chattahoochee-Oconee, George Wash/Jeff, NC Forests	N	N	Y	LRUF
Houstonia purpurea var. montana also see Hedyotis purpurea var montana	E	Roan Mountain Bluet	8	NC Forests, Cherokee	N	Y	Y	Habitat
Howellia aquatilis	T	Water howellia	1, 5, 6	Mendocino, Flathead, suspected on: Six Rivers, Lolo, Kootenei, Idaho Panhandle, Colombia River gorge (OR&WA), Gifford	N	Y in R6; Y in R5	Y	Habitat

NatureServe Global Sci. Name	Fed. Status and Critical Habitat	Common Name	FS Region	Forest Name or State With NF	Isolated Population[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reasons[3,4]
				Pinchot, Okanogan-Wenatchee, Mount Hood				
Hudsonia Montana	T CH	Mountain Golden Heather	8	NC Forests	N	N	Y/Y	Y
Hymenoxys texana	E	Prairiedawn	8	TX forests	N	N	N	LRUF
Ipomopsis polyantha	P	Pagosa skyrocket	2	Susp on SanJuan	Na	N	N	Habitat and LRUF
Isoetes louisianensis	E	Louisiana Quillwort	8	MS Forests	N	N	Y	LRUF
Isotria medeoloides	T	Small Whorled Pogonia	8,9	White Mtn, Monogahela, susp or known on Wayne, Allegheny, Chattahoochee-Oconee, Cherokee, George Wash/Jeff, NC Forests, Francis-Marion Sumter	N	Y on NC	Y	Species have been surveyed for past 15 yrs on NC and none have been found; habitat and LRUF
Lesquerella filiformis (Physaria)	E	Missouri Bladder-pod	8	Ouchita, susp on Ozark	N	N	Y	LRUF

NatureServe Global Sci. Name	Fed. Status and Critical Habitat	Common Name	FS Region	Forest Name or State With NF	Isolated Population[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reasons[3,4]
Lesquerella pallia	E	White Bladderpod	8	TX forests	N	N	N	LRUF
Liatris helleri	T	Heller's Blazing Star	8	NC Forests	N	N	Y	LRUF
Lindera melissifolia	E	Pondberry	8	MS forests, Francis-Marion Sumter	N	N	Y	LRUF and habitat
Lysimachia asperulifolia	E	Rough-leaf Loosestrife	8	NC Forests	N	N	Y	LRUF
Opuntia basilaris var. trelease	E	Bakersfield cactus	5	Sequoia	N	y	N	LRUF and habitat
Oxypolis canbyi	E	Canby's Dropwort	8	Francis Marion Sumter	N	N	Y	LRUF and habitat
Penstemon haydenii	E	Blowout Penstemon	2	NEBR known, MBR suspect	N	N	Y	LRUF
Phacelia argillacea	E	Clay Phacelia	4	Uinta, susp on Manti-LaSal	Introduced	N	N	LRUF
Phacelia scopulina var. submutica	P	Debeque phacelia	2	GrandMesa-Umcp, WhiteRiver	N	N	Y	LRUF and habitat
Pityopsis ruthii	E	Ruth's Golden-aster	8	Cherokee	2 wshds	Y	Y	Habitat

NatureServe Global Sci. Name	Fed. Status and Critical Habitat	Common Name	FS Region	Forest Name or State With NF	Isolated Population[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reasons[3,4]
Platanthera praeclara	T	Western prairie fringed orchid	1,2	Sheyenne National Grassland, in southeastern North Dakota, suspected in Nebraska NF, Samuel R McKelvie NF & Oglala, Buffalo Gap, or Fort Pierre NGs Nebraska	N	n in r2; n in r1	N	LRUF and habitat
Primula maguirei	T	Maguire primrose	4	Unita-Wasatch-Cache	Y	N	Y	LRUF – populations in area where retardant would not be applied
Ptilimnium nodosum	E	Harperella	8	AL forests, Ouachita	N	N	Y	LRUF and habitat
Purshia subintegra	E	Arizona cliffrose	3	Coconino, Tonto	N	N	N	LRUF
Rhododendron minus var. champmanii	E	Chapman's Rhododendron	8	Suspected FL forests	N	Y	N	Habitat

NatureServe Global Sci. Name	Fed. Status and Critical Habitat	Common Name	FS Region	Forest Name or State With NF	Isolated Population[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reasons[3,4]
Ribes echinellum	T	Miccosukee Gooseberry	8	Francis Marion Sumter	N	N	Y	LRUF
Schwalbea americana[5]	E	American Chaffseed	8	Daniel Boone, Francis Marion Sumter,	N	N	Y	LRUF
Scirpus ancistrochaetus	E	Northeastern Bulrush	8	George Wash/Jeff, suspected on Allegheny	N	Y	Y	LRUF and habitat
Sclerocactus glaucus	T	Colorado hookless cactus	2	GrandMesa-Ump, susp on WhiteRiver	N	N	Y	LRUF
Sencio franciscanus	T, CH	San Fransisco peaks groundsel	3	Coconino	N	N	N/N	LRUF and habitat
Solidago albopilosa	T	White-Haired Goldenrod	8	Daniel Boone	N	N	Y	LRUF
Solidago spithamaea	T	Blue Ridge Goldenrod	8	Cherokee, NC forests	N	Y	Y	Habitat not in area where retardant use is expected

NatureServe Global Sci. Name	Fed. Status and Critical Habitat	Common Name	FS Region	Forest Name or State With NF	Isolated Population[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reasons[3,4]
Spiranthes diluvialis	T	Ute ladies'-tresses orchid	2,4, 6	Uinta, Targhee, near border of Ashley Suspected: MedicineBow-Routt, PikeSan Isabel, White River, Okanogan, Boise, CaribouTarghee, Salmon, Sawtooth, Wasatch Cache, Challis, Fish Lake	N	y in r4, n in r2; n in r6;	Y where occurs	LRUF and habitat
Spiraea virginiana	T	Virginia Spiraea	8, 9	Daniel Boone, Cherokee, George Wash/Jeff, NC forests, Monoghela and susptect on the Wayne	N	Y	Y	Habitat
Spiranthes parksii	E	Navasota Ladies'-tresses	8	TX forests	N	N	N	LRUF
Townsendia aprica	T	Last Chance Townsendia	4	Dixie, Fishlake	N	N	Y	LRUF
Trifolium stoloniferum	E	Running Buffalo Clover	8,9	Daniel Boone, Wayne, Mark Twin, Monogahela	N	N	Y on MTwain, N Wayne and Monogahela	LRUF

NatureServe Global Sci. Name	Fed. Status and Critical Habitat	Common Name	FS Region	Forest Name or State With NF	Isolated Population[1]	Retardant Use 0.01% or More Land Base Annually[2]	Mapped Avoidance	Reasons[3,4]
Tuctoria greenei	E, CH	Greene's tuctoria (=Orcutt grass)	5	Modoc susp on Lassen	N	N	Y/Y	LRUF and habitat
Total species = 56								

[1]Isolated populations for plants includes areas where a narrow endemic or isolated population, occurs on a forest (that is species that occupy a small geographic area and no where else), may receive an accidental drop or retardant application from an exception and would be most vulnerable to an impact. Individual species distribution data derived from NatureServe Explorer (06/2011) and is available in pdf format in the project record.

[2]Forests with 0.01% or more of landbase applied with fire retardant have a higher probability of misapplication or implementation of an exception

Na= not applicable, species are only presently suspected to occur on these NFS lands

[3]Low retardant use forest (LRUF) limited use of retardant annually (less than 0.01% landbase annually);

[4]Habitat: can include various specific conditions such as species occurs in habitats not likely to receive fire retardant or protected with 300' waterbody avoidance areas already or suspected to occur on FS lands high probability of occurring yet no surveys completed (see individual species descriptions and effects determinations).

[5]American chaffseed (*Schwalbea americana*) is listed as Endangered Species for TX, although species is on USFS list, this species has not been found in TX (USDA-R8 National Forest of Texas 2011)

Descriptions of Critical Habitat Primary Constitutive Elements for Federally Listed Plant Species (24 species)

Please refer to the Biological Asessment for complete description of Critical Habitats and Primary Constituent Elements.

Candidate and Forest Service Sensitive Plant Species

Please refer to Botany Report and Biological Evaluation for a complete list by Forest Service sensitive species and candidate species proposed for listing.

Literature Cited

National Invasive Species Council. 2001. Meeting the Invasive Species Challenge: National Invasive Species Management Plan. 80 pp.

USDA Forest Service. 1995. Title 2600 – Wildlife, Fish, and Sensitive Plant Habitat Management, Amendment No. 2600-95-5, effective May 4, 1995. Forest Service Manual 2650

USDA Forest Service. 2004a. National Strategy and Implementation Plan for Invasive Species Management. USDA Forest Service, FS-805. 24 p.

USDA Forest Service. 2004b. USDA Forest Service Strategic Plan for Fiscal Years 2004-08. USDA Forest Service, FS 810. 40 p.

USDA Forest Service. 2007. USDA Forest Service Strategic Plan FY 2007-2012. USDA Forest Service, FS-880. 38 p.

USDI Fish and Wildlife Service. 2008. Final Biological and Conference Opinion on the USDA Forest Service's Proposed Guidelines for Aerial Application of Fire Retardant and Foams in Aquatic Environments

Appendix H – Fire Retardant Soil Risk Rating Indicators

Appendix H – Fire Retardant Soil Risk Rating Indicators

Table H-1. Soil Risk Rating Indicators and Levels

	Soil Risk Rating		
Soil Property	**Low**	**Moderate**	**High**
Soil Texture	Clay, Sandy Clay, Silty Clay, Silty Clay Loam, Clay Loam	Sandy clay loam, loam, silt loam, silt	Sandy loam, loamy sand, sand
Organic Matter Content (Labat Environmental 2007)	3.7% or >	3.6-1.5%	1.4 % or <
Soil pH	6.0-7.0	5.0-6.0 or 7.0-8.0	>5 or <8
K- Factor (erodibility) (Labat Environmental 2007)	.05-0.24	0.25-0.4	0.4+
Fire Regime (Bailey 2010)	Fire-independent	Fire-sensitive	Fire-dependent
Time of Retardant Application	Spring	Summer	Late-fall
Soil Condition Rating (Potyondy and Geier 2010)	Functioning Properly	Functioning at Risk	Impaired

Note: The above table can have several combinations of low, moderate, or high risk. It is important to determine which indicators are most appropriate at the forest or project scale.

Assumptions

Soil texture affects the ability of the soil to adsorb phosphorus and nitrogen anions and cations. Soils with high clay content attract phosphorus.

Organic matter content: soils with high organic matter also attract and retain phosphorus and nitrogen, reducing leaching and movement of these fertilizers.

Soil pH: Phosphorus in the soil is not available to most plants at low or very high soil pH.

Soil pH: Acidifying effects of fertilizers can reduce soil pH.

K-factor: nitrogen and phosphorus can move on soil particles through erosion. Soils with a high k-factor also have a corresponding greater erodibility.

Fire regime: The Nature Conservancy identified three broad fire regime types. In their analysis they identified fire-loving invasive alien plants moving into areas of fire sensitive and fire dependent ecosystems (Bailey 2010).

Time of retardant application: fire retardant containing phosphorus and nitrogen may have short term affects depending on temperatures and microbial activity (Vance 2001).

Soil condition rating is determined on a watershed scale for three attributes, soil productivity, soil erosion, and soil contamination. If any of these attributes were impaired at the watershed scale the fate of fire retardant applied could adversely affect soil vegetation, and water resources.

Consequences of Fire Retardant Application Based on Risk

Low Risk Soils: These soils generally are well–developed soils with both a high clay and organic matter content. The risk of nutrient movement from these soils and leaching to streams is low, the soils are not inherently erodible, and retardant placed in these locations would most likely fall on denser vegetation canopy or a litter layer. The consequence of applying retardant in these areas would have limited fertilizing effects due to the normally high productive soils, increased vegetative response would also be low, and adverse affects to water quality would be unlikely.

Moderate Risk Soils: The soils in the moderate risk category would also be productive. Soil texture classes show lower clay content but may have higher allophone content typical of volcanic soils with andic soil properties and would be effective in adsorbing phosphorus and nitrogen. Inherent soil erodibility is moderate and soil organic matter would also help to adsorb nutrients. Soil cover in the form of both plant and litter would be expected to be uniform. The consequence of applying retardant could show slight increase in fertilizing effects, increased vegetative response, and minor impacts to water quality.

High Risk Soils: The soils in this category are coarser textured with a lower organic matter content. Soils with these physical properties are prone to leaching and erosion. Soil cover in the form of both plant and litter would be expected to be patchy and soils may be more xeric in moisture regime. Fire retardant applied on these soils may show a greater fertilizing effect response to what otherwise is a low nutrient soil Vegetative response is likely to increase and the change in vegetative community composition is likely since other plants may better utilize the increased nitrogen and phosphorus. Movement of fire retardant into the water could occur from leaching of nitrates. The amount of nitrogen and phosphorus entering waterbodies would depend on the organic matter content, soil cover, and proximity to the stream.

Nutrient movement into waterbodies from fire retardant application can occur from leaching of nitrates in coarse textured soils, or from erosion of fine soil particles. Misapplication of fire retardant into waterbodies and buffers poses the highest likelihood of nutrient movement. Annual reporting of misapplications in waterways helps to track and document specific locations and environmental effects of the fire chemicals. Current guidelines include a 300-foot buffer around waterbodies, which helps to reduce potential movement of nitrogen or phosphorus into the waterbody.

Literature Cited

Bailey, Robert G. 2010. Fire regimes and ecoregions. Chapter 2, Cumulative watershed effects of fuel management in the western United States. General Technical Report, RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 18 p.

Labat Environmental. 2007. Ecological Risk Assessment: Wildland Fire-fighting Chemicals, prepared for Missoula Technology and Development Center, USDA Forest Service, Missoula, MT. 69 p.

Potyondy, John P. and Theodore W. Geier. 2010. Forest Service Watershed Condition Classification Technical Guide. USDA Forest Service. 72 p.

Vance, Carroll P. 2001. Symbiotic Nitrogen Fixation and Phosphorus Acquisition. Plant Nutrition in a World of Declining Renewable Resources. Plant Physiology, 127:390-397

Appendix I – Wildlife Species Lists and Effects Determinations

Appendix I – Wildlife Species Lists and Effects Determinations

Terrestrial Wildlife Effects Screening Process

To facilitate the analysis of the potential impacts to amphibian and terrestrial wildlife species, a Terrestrial Wildlife Screening Process was developed to eliminate species that would not be impacted by retardant, and to determine the potential effects/impacts to species and critical habitat. Based on the historical (10 year) retardant use data (appendix C), the proposed future potential use for the next ten years (none, very low, low, moderate, and high) was used to help with the screening process for determination of effects on species by Forest Service Regions.

A main assumption to this is that those forest that currently use aerial fire retardant would continue to do so at a rate similar to the last few years. For example, if a species occurs on a National Forest which has no use or very low potential for aerial retardant use, has no or less than 10 drops per year, then a No Effect determination was made and that species was eliminated from further analysis.

The effects from the use of aerial application of retardant on individuals species or populations can be influenced by that species ability to avoid areas where fires are burning (mobility), and by the length (term) or timing of the event. Mobility may be limited for a species. For instance, birds are very mobile with their ability to fly; however, given nesting and rearing season, may or may not be able to flee an impacted area. Also, if a species is highly specialized and limited by a special habitat type, the individual may not be able to flee far from the area, thus may be affected by the fire and related aerial application of retardant activities if used.

The determination is based upon mobility, disturbance, effects to habitat potential for use, distribution and size, and duration of event. The BA and BE includes analysis of effects to approximately 105 species listed as either threatened endangered or proposed and/or their designated critical habitats listed under the ESA and the approximately 550 sensitive species, including candidates (for listing under the ESA), listed as part of the regional foresters' sensitive species list for each of the Forest Service regions (Forest Service Manual 2670).

Given the national scale of this project analysis and the existence of several hundred wildlife species listed above, the analysis uses the following grouping process:

- Each Group is a major animal type: Mammals, Birds, Reptiles, Invertebrates and Amphibians;
- Each Subgroup is similar species within the larger Group: small mammals, bats, ungulates, etc.

Analysis was conducted on the group or subgroup rather than each individual species (except those analyzed in the BA and BE). Table I-1 defines the terms used in the screening process.

Table I-1. Definition of terms used in wildlife effects screening process.

Length of Effect		
Short - term	Immediate	Expected to last less than a few days; no impacts to life cycle
Long - term	Substantial	Will last longer than a few days; expected to interrupt portion of life cycle
Type of effect, either direct or indirect, are covered under species discussions – direct application on species and habitat disturbance, ingestion, etc.		
Likelihood of Fire Event -Timing of Effect		
During critical time period		Fire event likely to occur during reproduction and rearing of offspring
Outside critical time period		Fire event not expected to affect species reproductive viability
Distribution		
Very limited	only known for a limited area/populations	
Limited	known for few small areas/few populations	
Moderate	covers several areas/populations	
Wide	covers several states/populations	

The following six flowcharts demonstrate the logic use to make effects determinations for the potential use of aerial application of fire retardant when in the vicinity of amphibian or terrestrial wildlife federally listed T&E Species and Critical Habitat or Forest Service Sensitive Species.

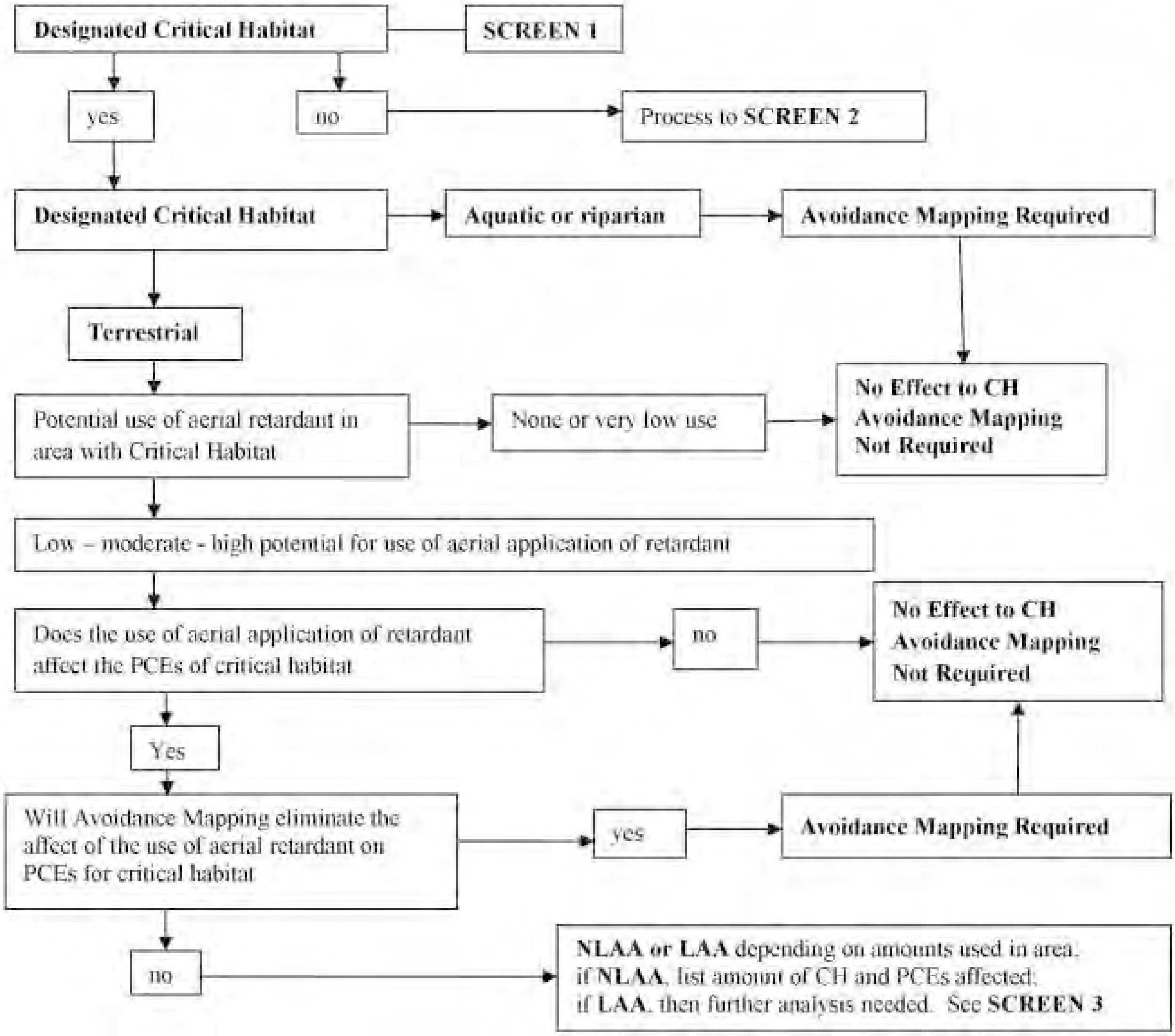
Coarse filters used were range and distribution, likelihood of exposure (rate of use and possibility of ingestion), avoidance mapping, mobility, and disturbance to species.

Effects of the use of aerial application of retardant on individuals species or populations can be influenced by the species ability to avoid areas where fires are burning (mobility), and by the length (term) or timing of the event.

Mobility may be limited by the given taxon for a species. For instance, birds are very mobile with their ability to fly; however, given nesting and rearing season, may or not flee an area. Also, if a species is highly specialized with limited habitat the individual may not flee far from the area. See exception under Screen 2 – Mobility.

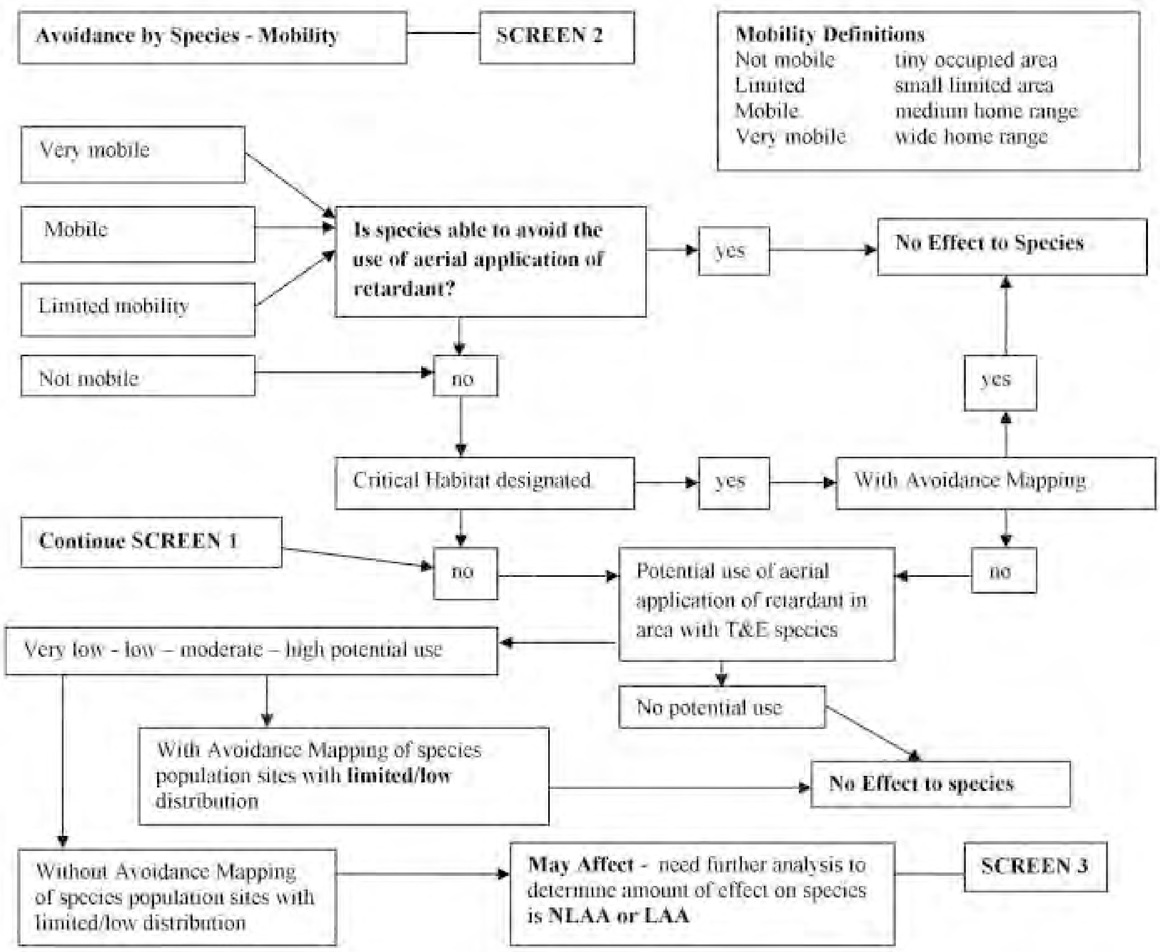
Similarly with mammals, larger more wide ranging species, such as lynx and grizzly bear, would be less likely to be affect at all by the use of aerial application of retardant. Whereas with a small rodent, such as a kangaroo rat, this species is limited in it's ability to avoid fire since it is tied to specific habitat type. Amphibians are the least mobile of all taxon groups due to their direct dependence on specific habitats, and very limited distributions, such as with the mountain yellow-legged frog.

Effects Screen for T & E Species - SCREEN 1: Critical Habitat

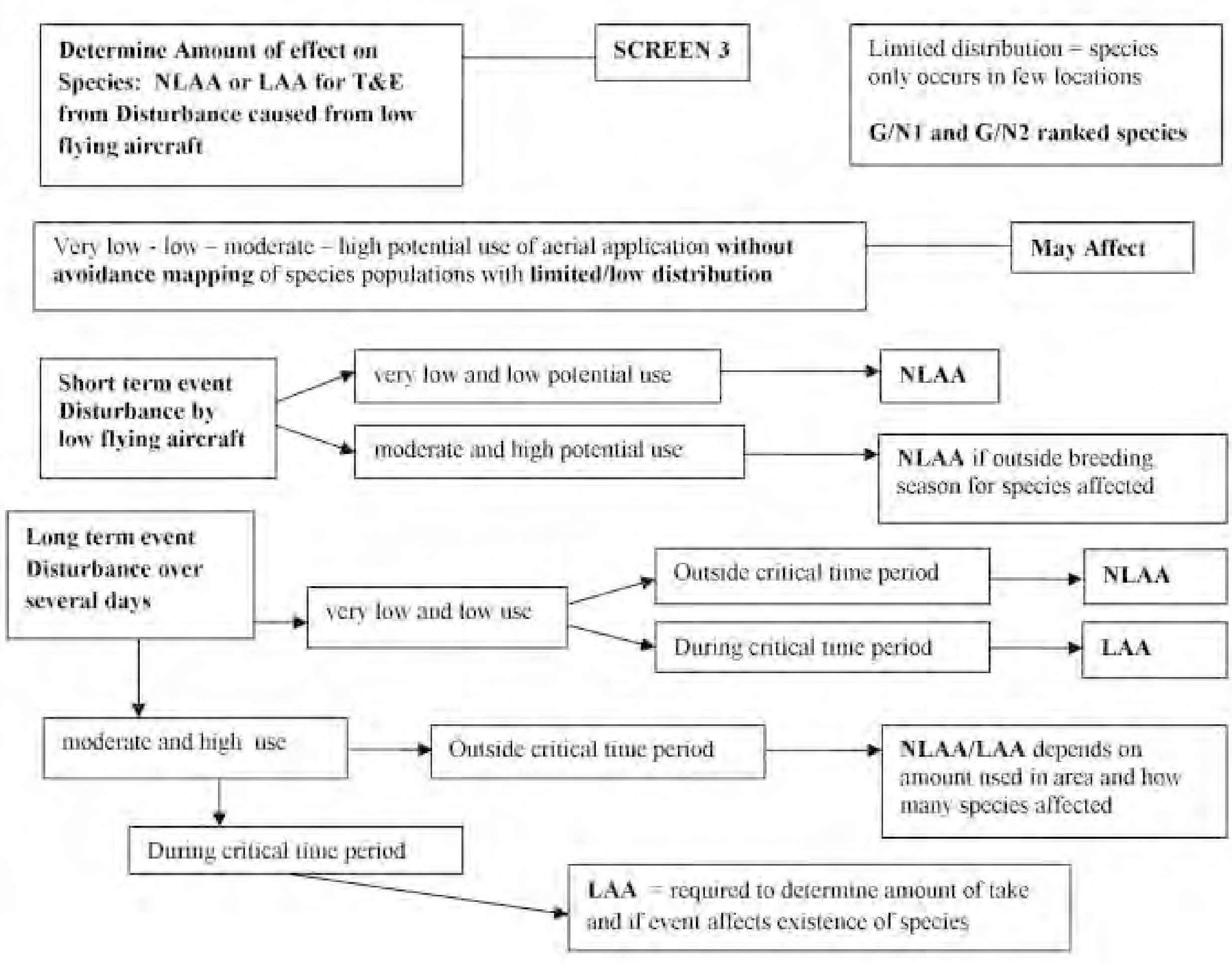


Effects Screens for Wildlife T & E Species - SCREEN 2: Mobility

Exception to mobility Screen: use of aerial application during the nesting period (non-volant bats) may need to be mitigated by imposing of seasonal restriction to allow for young to develop enough to be able to escape. This is to be determined at the local FS/FWS office level; determined by species and fire season.

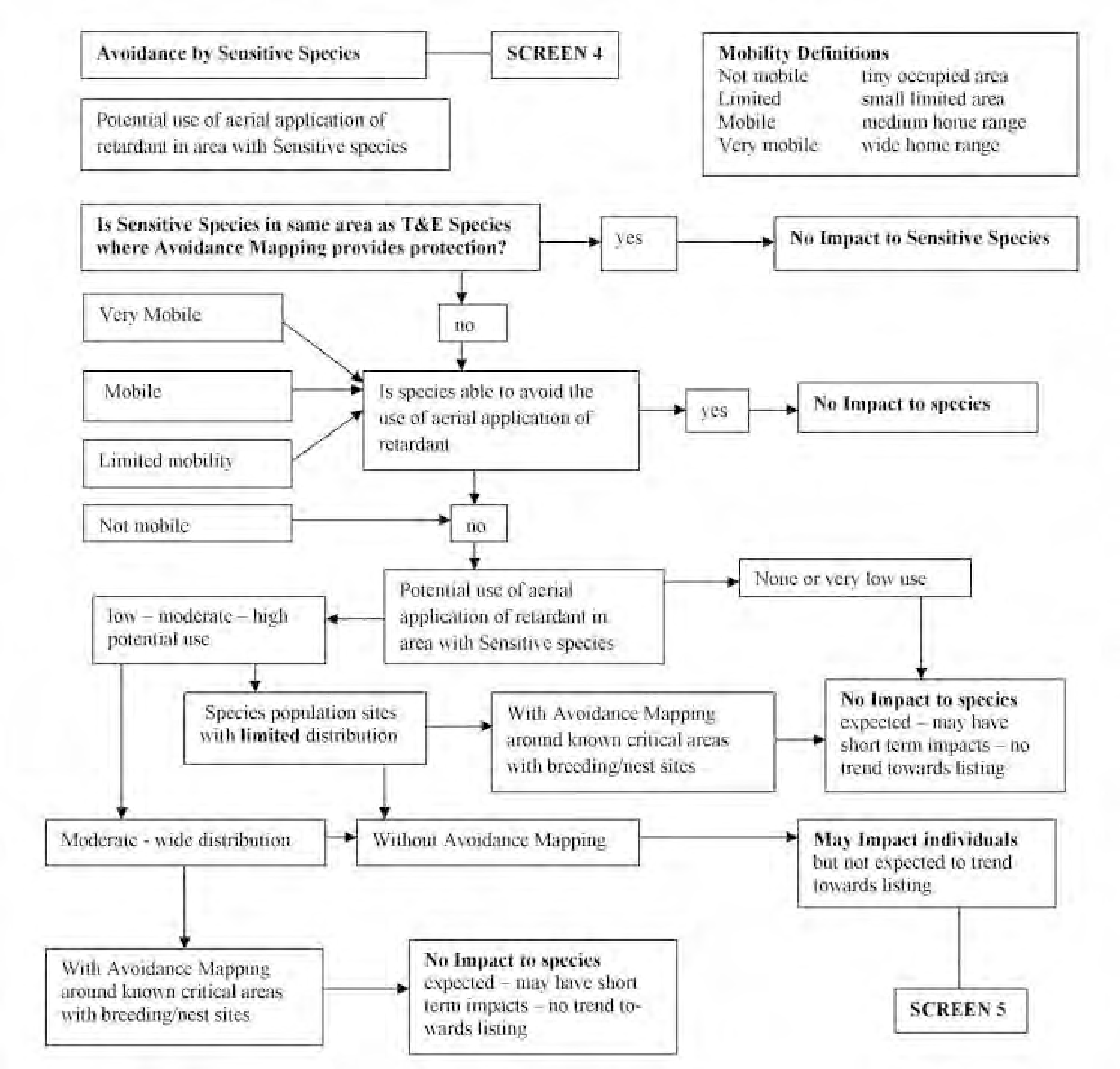


Effects Screens for Wildlife T & E Species - SCREEN 3: Disturbance



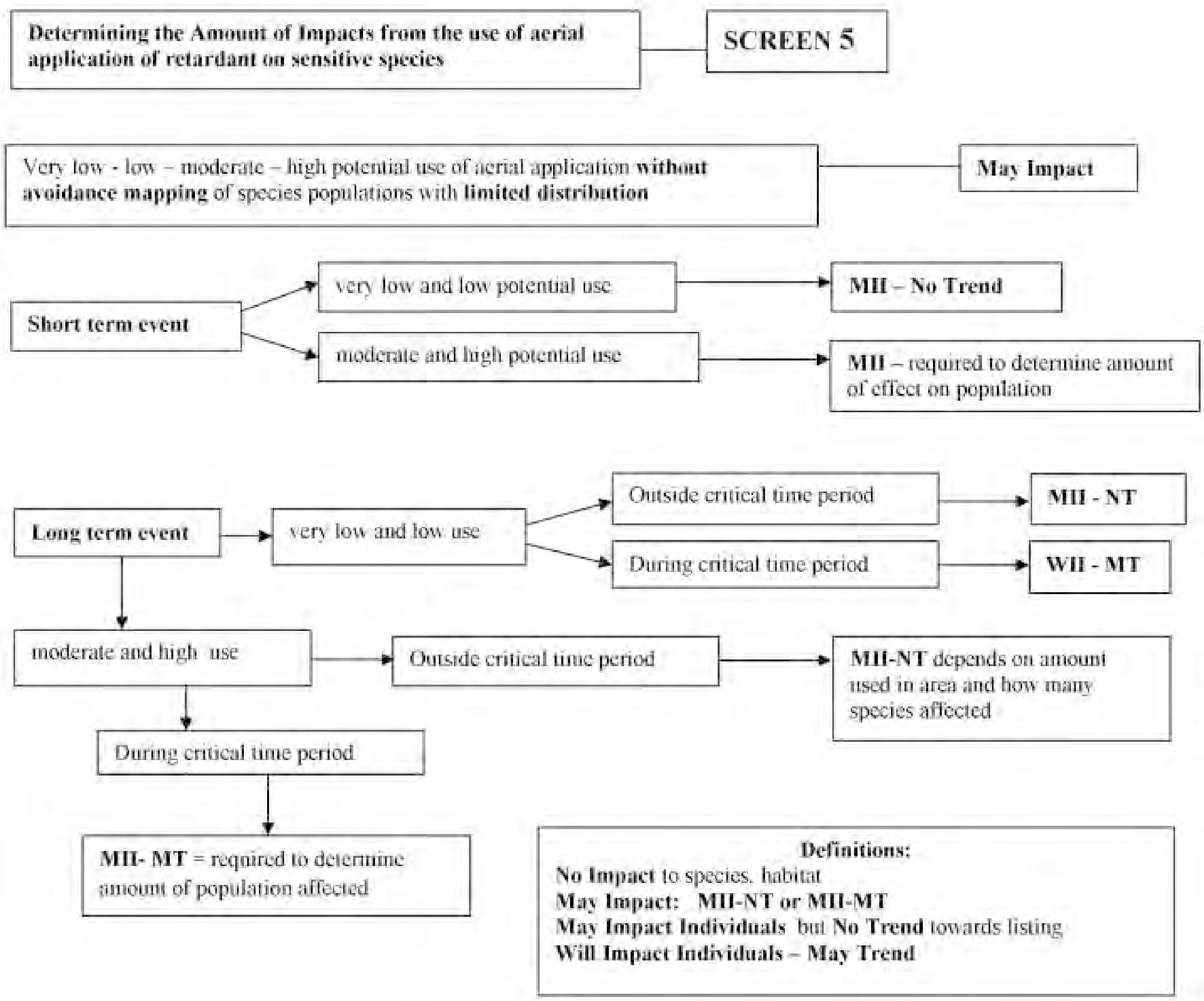
Effects Screens for Forest Service Sensitive Species - SCREEN 4

Screen process for Sensitive Species will follow T&E Step 2 without the critical habitat portion.



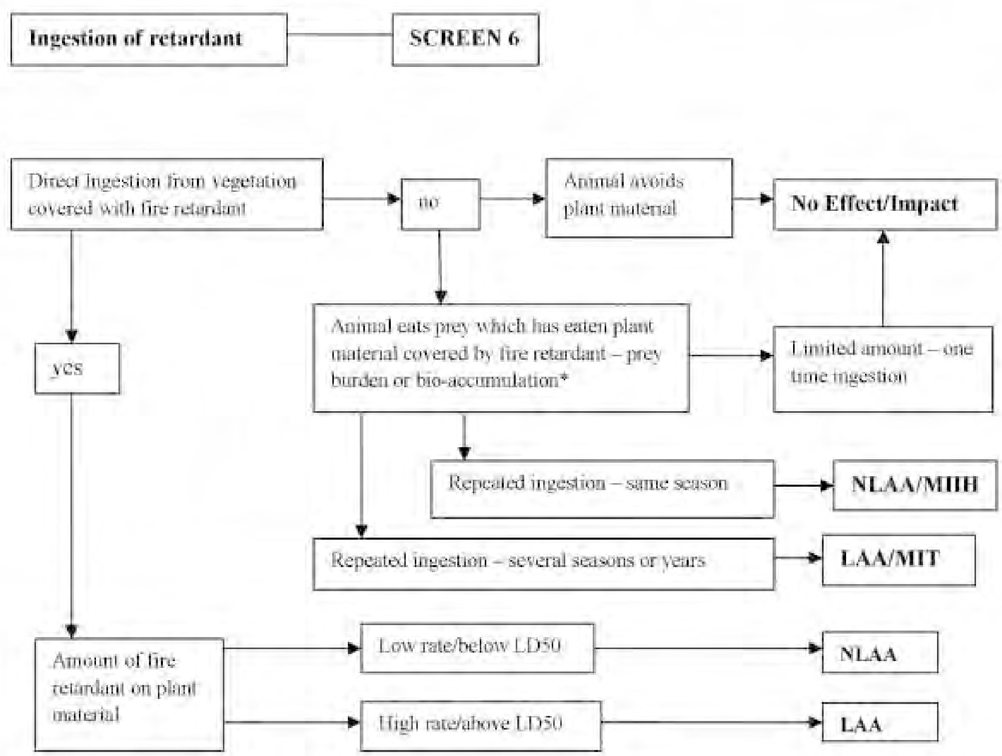
Effects Screens for Forest Service Sensitive Species - SCREEN 5

Screen process for Sensitive species will follow T & E Step 3.



Effects Screens for All Wildlife Species - SCREEN 6: Ingestion

In the Biological Assessment this is - SCREEN 4 – since the BA does not contain information pertaining to FS sensitive species.



Rate = varies by eco-region – most applications at 4 gallons per second for light fuels or 8 gallons per second for heavy fuels.

LD50 = refers to the lethal dose or amount of chemical intake to cause death, from Labat Environmental Report 2007

*Prey burden or bio-accumulation is a long process and would need repeated doses in order to be lethal.

Assumptions used for the Wildlife Screening Process: Screens 1-6

Critical Habitat and Isolated Populations: That the avoidance mapping would provide protection to Critical Habitat (CH).

- Guidelines for mapping avoidance of areas would be implemented at the field level; also determined at field level are which designated critical habitats need avoidance mapping – not all CH or the Primary Constituent Elements (PCEs) are affected by the use of retardant.
- Monitoring would occur nationally every year on 5 percent of fires per forest where aerial application of fire retardant occurred. This equates to 0.01 percent of the total amount of retardant applied annually on a national basis, but may be higher percentage on a individual forest basis.
- The mitigation measures of avoidance area mapping for habitat and populations will include established trigger points (at local level) for restricting the use of retardants within watersheds where retardant has cause adverse affects to a species or population,
- Annual coordination meetings will occur and will help in reducing impacts to species and habitats by discussing changes in CH, new population information, and monitoring needs for species prior to season use.
- Small isolated populations outside of critical habitat would also be determined to receive avoidance area mapping; determined at field level.

Species Avoidance - Mobility: That the wildland fire would be the primary cause of the disturbance to species; causing a species to flee an area or be engulfed by the fire prior to the use of aerial application of fire retardant.

- Most species are expected to flee (or avoid by retreating to burrows or are not active at the surface) the fire area prior to aerial application event occurring; exceptions to this assumption is the nesting period when offspring are not able to flee (non-volant juveniles for bats) – this depends on the eco-region in which the species resides and the timing of the fire regime/season.
- That certain species are more mobile than others in their ability to avoid the area where wildland fire may occur, thus avoid direct application from aerial delivery.
- Most burrowing species would take refuge during the wild fire, thus they are expected to avoid any direct exposure by aerial retardant drop.

Duration of Event – Disturbance: That the use of aerial application of fire retardant would primary late in the fire season and occur outside of critical event period for *most* species.

- That aerial application of retardant activities would be very short term – in that the use of aerial retardant aircraft would occur over an area for less than a minute or two to set up dry run and actual delivery;
- Most use of aerial application of fire retardant occurs later in the summer season and after certain protocol criteria are met; urban interface, few initial attack resources, high or extreme fire weather conditions, etc; most species have completed mating, nesting lambing/hatching and rearing activities by this time. This may vary by eco-region (refer to Appendix C, Table C-4).
- Most use of aerial application occurs only for a short term period of a less than a few days (2-3 days).

Indirect Ingestion: That retardant chemicals could be ingested through vegetation, water, or prey species that has been affected by retardant.

- Vegetation covered with retardant could be eaten by insects/herbivores thus in turn eaten by predators – prey body burden concentrations or bio-accumulation (LD50 concentrations tested by Labat Environmental 2007 on various species);
- Residue levels could occur in small streams, water sources following post – rain events and runoff in areas in close proximity to application areas;
- Application rates vary depending on eco-region/habitat type. (Appendix C - Table C-4)

Determination of Effects

The coarse filtering and wildlife screening process made determinations of **No Effect** for 46 federally listed proposed threatened or endangered species No Effect determination was made: due to these species occurring in habitats where fires do not occur; species does not occur on NFS land; or are located on National Forests which do not use aerial application of fire retardant (Table I-3).

The coarse filtering and wildlife screening process made determinations of either a **May Affect- Not Likely to Adversely Affect** (47 species) or **May Affect – Likely to Adversely Affect** (13 species). These species will be consulted on under ESA Section 7 consultation with the US Fish and Wildlife Service (Table I-2 listed below). The species with a **May Affect** determination will be discussed in the following sections. The filtering/screening process for each determination is addressed under each species discussion. There were 45 species with a **No Effect** determination (Table I-3).

For Forest Service listed Sensitive Species, 36 species were determined to have a possible **Trend Towards Listing** with the use of aerial application of fire retardants (Table I-4).

The proposed federal action provides for avoidance area mapping to be applied to those designated critical habitat areas where the use of fire retardant may affect or change the primary constituent elements for certain habitat types.

Also, those small isolated terrestrial areas outside of designated critical habitat, or that contain known occupancy for a T&E species, would be protected by proposed avoidance area mapping guidelines.

The use of Avoidance Area Mapping is expected to minimize the direct impacts to listed species or habitat with a May Affect determination by providing for protection from the use of aerial delivery of fire retardants.

Avoidance Area mapping is *required* for species with determination of Likely to Adversely Affect (LAA)(exceptions – Mexican spotted owl; species where FS/FWS have determined at the local level this is not required.

Avoidance Area mapping is *recommended* for some species with determination of Not Likely to Adversely Affect (NLAA). Need determined by Region/Forest with species occurrence.

Table I-2 lists those ESA species or critical habitat with a ***May Affect*** determination from the wildlife screening process.

Table I-3 lists those ESA species or critical habitat with a ***No Effect*** determination from the wildlife screening process.

No Effect determinations were made for those species using the following coarse filter factors:

1. Occur on national forests/grassland that does not use aerial application of fire retardant, or
2. Occur in a wetland, swamp, estuary or marine habitat, or
3. Occur in a habitat where the use of fire retardant is not likely to happen (alpine, open areas, desert, shoreline, large water body), or
4. There is no known occurrence on NFS lands, or
5. Thought to be extinct.

Table I-4 lists those Forest Service Sensitive Species with a ***Trend Towards Listing*** (TTL) determination from the screening process. ***In order to mitigation or reduce the effects to these species, avoidance area mapping is required for all Trend Towards Listing Sensitive Species.***

Table I-5 lists the National Forests with either recommended or required avoidance mapping for NLAA/LAA ESA listed species.

Table I-6 lists the National Forest with avoidance area mapping required for TTL - FS Sensitive Species.

Table I-2. List of USFWS ESA listed Threatened & Endangered Species that occur on or adjacent to NFS lands included in this Analysis with a May Affect Determination. [1]

R1	R2	R3	R4	R5	R6	R8	R9	Screens used	Determination	Common Name	Federal Status	NatureServe Global Sci. Name
										MAMMALS		
	2							1-4	NLAA	Preble's Meadow Jumping Mouse	T	*Zapus hudsonius preblei*
				5				1,2,4	NLAA	San Bernardino Kangaroo Rat	E	*Dipodomys merriami parvus*
				5				2,4	NLAA	Stephen's Kangaroo Rat	E	*Dipodomys stephensi*
						8		2,3,4	NLAA	Carolina Northern Flying Squirrel	E	*Glaucomys sabrinus coloratus*
						8		2,3,4	NLAA	Virginia northern flying squirrel	E	*Glaucomys sabrinus fuscus*

R1	R2	R3	R4	R5	R6	R8	R9	Screens used	Determination	Common Name	Federal Status	NatureServe Global Sci. Name
			4					2,3,4	NLAA	Utah Prairie Dog	T	*Cynomys parvidens*
			4					2,3,4	NLAA	Northern Idaho Ground Squirrel	T	*Spermophilus brunneus brunneus*
		3						1-4	NLAA	Mount Graham Red Squirrel	E	*Tamiasciurus hudsonicus grahamensis*
		3						2,4	NLAA	Lesser Long-nosed Bat	E	*Leptonycteris curasoae yerbabuenae*
		3						2,4	NLAA	Mexican Long-nosed Bat	E	*Leptonycteris nivalis*
						8		2,4	NLAA	Ozark Big-eared Bat	E	*Corynorhinus townsendii ingens*
						8	9	2,4	NLAA	Virginia Big-eared Bat	E	*Corynorhinus townsendii virginianus*
						8	9	2,4	NLAA	Gray Bat	E	*Myotis grisescens*
						8	9	2,4	NLAA	Indiana Bat	E	*Myotis sodalis*
1	2		4		6		9	2,3,4	NLAA/NLJ	Gray Wolf	T	*Canis lupus*
		3						2,3,4	NLJ	Gray Wolf, Southwestern pop. Mex.	XN	*Canis lupus baileyi*
1	2		4		6		9	1-4	NLAA	Canada Lynx	T	*Lynx canadensis*
	2		4					2,3,4	NLAA	Black-footed Ferret	E	*Mustela nigripes*
				5				1-4	NLAA	Bighorn Sheep (Peninsular)	E	*Ovis canadensis pop 2*

R1	R2	R3	R4	R5	R6	R8	R9	Screens used	Determination	Common Name	Federal Status	NatureServe Global Sci. Name
			4	5				1-4	NLAA	Bighorn Sheep (Sierra Nevada)	E	*Ovis canadensis sierrae*
		3						2,3,4	NLAA	Jaguar	E	*Panthera onca*
1					6			2,3,4	NLAA	Woodland Caribou	E	*Rangifer tarandus caribou*
						8		2,3,4	NLAA	Louisiana Black Bear	T	*Ursus americanus luteolus*
1	2		4		6			1-4	NLAA	Grizzly Bear (Lower 48)	T	*Ursus arctos horribilis*
				5				2,3,4	NLAA	San Joaquin Kit Fox	E	*Vulpes macrotis mutica*
		3						2, 3,4	NLAA	Ocelot	E	*Leoparadus paradalis*
										BIRDS		
						8		2,3,4	NLAA	Florida Scrub Jay	T	*Aphelocoma coerulescens*
				5	6			1-4	NLAA	Marbled murrelet	T	*Brachyramphus marmoratus*
	2	3	4	5				1-4	NLAA	Southwestern Willow Flycatcher	E	*Empidonax traillii extimus*
		3						2,3,4	NLAA	Northern Aplomado Falcon	E	*Falco femoralis septentrionalis*
		3		5				2,3,4	NLAA	California Condor	E	*Gymnogyps californianus*
						8		2,3,4	NLAA	Red-cockaded Woodpecker	E	*Picoides borealis*

R1	R2	R3	R4	R5	R6	R8	R9	Screens used	Determination	Common Name	Federal Status	NatureServe Global Sci. Name
				5				2,3,4	LAA	Coastal California Gnatcatcher	T	*Polioptila californica californica*
				5	6			1-4	NLAA	Northern Spotted Owl	T	*Strix occidentalis caurina*
	2	3	4					1-4	LAA	Mexican Spotted Owl	T	*Strix occidentalis lucida*
							9	2,3,4	NLAA	Kirtland's warbler	E	*Dendroica kirtlandii*
				5				1-4	NLAA	Least Bell's Vireo	E	*Vireo bellii pusillus*
										REPTILES		
		3						1,2,4	NLAA	New Mexico Ridgenose Rattlesnake	T	*Crotalus willardi obscurus*
				5				2,4	NLAA	Blunt-nosed Leopard Lizard	E	*Gambelia sila*
						8		2,4	NLAA	Gopher Tortoise	T	*Gopherus polyphemus*
										AMPHIBIANS		
						8		1,2	NLAA	Mississippi Gopher Frog	E	*Rana capito servosa*
						8		1,2	NLAA	Frosted Flatwoods Salamander	T	*Ambystoma cingulatum*
						8	9	2,4	NLAA	Ozark hellbender	P/T	*Cryptobranchus alleganiensis bishopi*

R1	R2	R3	R4	R5	R6	R8	R9	Screens used	Determination	Common Name	Federal Status	NatureServe Global Sci. Name
		3						2	NLAA	Sonoran Tiger Salamander	E	*Ambystoma tigrinum stebbinsi*
		3						2	NLAA	Chiricahua leopard frog	T	*Rana chiricahuensis*
				5				2	LAA	California tiger salamander, central population	T	*Ambystoma californiense*
				5				1,2	LAA	Arroyo Southwestern Toad	E	*Bufo californicus*
				5				1,2	LAA	California Red-legged Frog	T	*Rana aurora draytonii*
				5				1,2	LAA	Mt. Yellow-legged frog (So. CA DPS)	E	*Rana muscosa pop. 1*
										INVERTEBRATES		
						8		1,2	NLAA	Spruce-fir Moss Spider	E	*Microhexura montivaga*
				5				2,4	NLAA	Valley Elderberry Longhorn Beetle	T	*Desmocerus californicus dimorphus*
							9	1,2,4	NLAA	Hine's Emerald Dragonfly	T	*Somatochlora hineana*
	2							1,2,4	LAA	Pawnee Montane Skipper	T	*Hesperia leonardus montana*

R1	R2	R3	R4	R5	R6	R8	R9	Screens used	Determination	Common Name	Federal Status	NatureServe Global Sci. Name
	2					8	9	2,4	NLAA	American Burying Beetle	E	*Nicrophorus americanus*
				5				1,2,4	LAA	Quino Checkerspot Butterfly	E	*Euphydryas editha quino*
				5				1,2,4	LAA	Laguna Mountains Skipper	E	*Pyrgus ruralis lagunae*
				5				1,2,4	LAA	Smith's Blue Butterfly	E	*Euphilotes enoptes smithi*
				5				1,2,4	LAA	Kern Primrose Sphinx Moth	T	*Euproserpinus euterpe*
						8		1,2	NLAA	Magazine Mountain Shagreen	T	*Inflectarius magazinensis*
						8		1,2	NLAA	Noonday Globe	T	*Patera clarki nantahala*
		3						1,2	LAA	Alamosa Springsnail	E	*Tryonia alamosae*
		3						1,2	LAA	Three forks springtail	P/E	*Pyrgulopis trivalis*
						9		2,3,4	NLAA	Karner Blue Butterfly	E	Lycaeides melissa samuelis

1. Note: Region 10 not shown due to listed listed ESA species in this region are all No Effect in Table I-3.

Table I-3: List of USFWS ESA listed Threatened and Endangered Species that occur on or adjacent to NFS lands included in this Analysis with No Effect Determinations.

R2	R3	R4	R5	R6	R8	R9	R10	Factors used	Determination	Common Name	Federal Status	NatureServe Global Sci. Name
										MAMMALS		
					8			1,3	NE	Red Wolf	E	*Canis rufus*

R2	R3	R4	R5	R6	R8	R9	R10	Factors used	Determination	Common Name	Federal Status	NatureServe Global Sci. Name
							10	2	NE	Cook Inlet beluga whale	E	*Delphinapterus leucas*
			5					4	NE	Fresno Kangaroo Rat	E	*Dipodomys nitratoides exilis*
			5					4	NE	Giant kangaroo rat	E	*Dipodomys ingens*
			5					2	NE	Southern Sea Otter	T	*Enhydra lutris nereis*
			5				10	2	NE	Steller's Sea Lion (eastern)	T	*Eumetopias jubatus*
							10	2	NE	Steller's Sea Lion (western)	E	*Eumetopias jubatus*
							10	2	NE	Humpback whale	E	*Megaptera novaeangliae*
					8			2	NE	Florida Manatee	E	*Trichechus manatus*
					8			4	NE	Florida panther	E	*Puma concolor coryi*
					8			5	NE	Eastern cougar	E	*Puma concolor cougar*
										BIRDS		
					8			1	NE	Puerto Rican Sharp-Shinned Hawk	E	*Accipiter striatus*
					8			1	NE	Puerto Rican Parrot	E	*Amazona vittata*
					8			1	NE	Puerto Rican Broad-winged Hawk	E	*Buteo platypterus brunnescens*
			5	6				3	NE	Western Snowy Plover	T	*Charadrius alexandrinus nivosus*

R2	R3	R4	R5	R6	R8	R9	R10	Factors used	Determination	Common Name	Federal Status	NatureServe Global Sci. Name
2					8	9		3	NE	Piping Plover	T/E	*Charadrius melodus*
2	3							3	NE	Mountain Plover	P/T	*Charadrius montanus*
					8			1	NE	White-necked Crow	E	*Corvus leucognaphalus*
2		4						2,3	NE	Whooping Crane	E	*Grus americana*
					8			3	NE	Mississippi Sandhill Crane	E	*Grus canadensis pulla*
					8			2,3	NE	Wood Stork	E	*Mycteria americana*
	3							2,3	NE	Yuma Clapper Rail	E	*Rallus longirostris yumanensis*
2	3				8	9		1,2,3	NE	Least Tern	E	*Sterna antillarum*
					8			5	NE	Bachman's warbler	E	*Vermivora bachmanii*
			5					2,3	NE	California Least Tern	E	*Sterna antillarum browni*
					8			2,3	NE	Black-capped Vireo	E	*Vireo atricapilla*
										AMPHIBIANS		
2								2,3,4	NE	Wyoming Toad	E	*Bufo baxteri*
					8			2,3,4	NE	Houston Toad	E	*Bufo houstonensis*
					8			2,3,4	NE	Red hills salamander	T	*Phaeognathus hubrichti*
						9		2,3	NE	Cheat Mountain Salamander	T	*Plethodon nettingi*

R2	R3	R4	R5	R6	R8	R9	R10	Factors used	Determination	Common Name	Federal Status	NatureServe Global Sci. Name
					8			2,3,4	NE	Shenandoah Salamander	E	*Plethodon shenandoah*
										REPTILES		
					8			2,3	NE	Eastern Indigo Snake	T	*Drymarchon corais couperi*
					8			1	NE	Puerto Rican Boa	E	*Epicrates inornatus*
		4	5					3	NE	Desert Tortoise (Sonoran pop.)	T	*Gopherus agassizii pop 2*
					8			3	NE	Sand Skink	T	*Neoseps reynoldsi*
					8			2,3	NE	Flattened Musk Turtle	T	*Sternotherus depressus*
					8			2,3	NE	Bog turtle	TSA	*Clemmys muhlenbergii*
								2,3	NE	American alligator	TSA	*Alligator mississippiensis*
			5					2,3	NE	Giant Garter Snake	T	*Thamnophis gigas*
										INVERTEBRATES		
2								3	NE	Uncompahgre Fritillary Butterfly	E	*Boloria improba acrocnema*
					8			3	NE	Mitchell's Satyr	E	*Neonympha mitchelli mitchelli*
				6				3,4	NE	Oregon Silverspot Butterfly	T	*Speyeria zerene hippolyta*
			5					4	NE	Carson Wandering Skipper	E	*Pseudocopaeodes eunus obscurus*

Table I-4 – Wildlife Forest Service Sensitive Species – Trending Toward Listing with use of aerial application of fire retardant.

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name
									MAMMALS		
	2								River Otter	S	*Lontra canadensis*
		3							Long-tail vole	S	*Microtus longicaudus*
		3							White-bellied long-tailed vole	S	*Microtus longicaudus leucophaeus*
		3							Arizona montane vole	S	*Microtus montanus arizonensis*
		3							Erime	S	*Mustela erminea muricus*
		3							Mink	S	*Mustela vison energumenos*
		3							Arizona grey squirrel	S	*Sciurus arizonensis arizonensis*
		3							New Mexico shrew	S	*Sorex neomexicanus*
		3							Water shrew	S	*Sorex palustris navigator*
		3							Preble's shrew	S	*Sorex preblei*
		3							New Mexico meadow jumping mouse	C	*Zapus hudsonius luteus*
									BIRDS		

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name
			4						Greater sage grouse leks	S	*Centrocercus urophasianus*
			4						Yellow-billed cuckoo	C	*Coccyzus americanus*
	2								Black swift	S	*Cypseloides niger*
	2						9		Bald eagle – nest sites	S	*Haliaeetus leucocephalus*
									AMPHIBIANS		
1			4						Boreal (western) toad	S	*Bufo boreas*
			4						Yosemite toad	S	*Bufo canorus*
1	2								Great Plains toad	S	*Bufo cognatus*
	2								Northern leopard frog	S	*Rana pipiens*
			4						Columbia spotted frog	S	*Lithobates luteiventris*
1									Couer D'Alene salamander	S	*Plethodon idahoensis*
									INVERTEBRATES		
					6				Franklin's bumble bee	S	*Bombus franklini*
			4						Spring Mountain acastus checkerspot butterfly	S	*Chlosyne acastus robusta*
							9		Red-disked alpine	S	*Erebia discoidalis discoidalis*
							9		Taiga alpine	S	*Erebia mancinus*
			4						Mt Charleston blue butterfly	S	*Icaricia shasta charlestonensis*

R1	R2	R3	R4	R5	R6	R8	R9	R10	Common Name	Federal Status	NatureServe Global Sci. Name
							9		Nabokov's (northern) blue butterfly	S	*Lycaeides idas nabokovi*
							9		Jutta alpine	S	*Oeneis jutta ascerta*
					6				Insular blue butterfly	S	*Plebejus saepiolus littoralis*
					6				Mardon skipper	S	*Polites mardonii*
							9		Freija's grizzled skipper	S	*Pyrgus centaureae freija*
	2								Nokomis fritillary	S	*Speyeria nokomis nokomis*

Analysis of Effects – All Species

All Puerto Rico species

All species which occur in the territory of Puerto Rico on the El Yunque National Forest will not be affected by the use of aerial application of fire retardant since the use of fire retardant does not occur on the island of Puerto Rico; therefore a **No Effect/No Impact** determination has been made for these species and no further discussion or analysis will occur for these species since their habitat or populations will not be affected, either directly, indirectly, or cumulatively by the use of aerial application of fire retardant.

GROUP: MAMMALS

Characterized by the presence of hair, mammary glands, warm blooded and give live birth, mammals may be found in almost all of the terrestrial habitat types and in almost every eco-region.

Marine Mammals

The use of aerial application of fire retardant will not occur near or over marine environments, thus there is **No Effect/No Impact** determination for all of these species. Therefore, no further discussion or analysis will occur for these species since their habitat or populations will not be affected, either directly, indirectly, or cumulatively by the use of aerial application of fire retardant.

Rodents

These species consists of mice, vole, rats, prairie dogs, and squirrels, may be found in almost all of the terrestrial habitat types and in almost every eco-region. Most of the small rodent species in this subgroup are fossorial in nature, spending the majority of their lives in burrows or underground dens.

Although found through a variety of habitats and across the continent, most of the T&E small mammal species have very limited range, distribution, and ability to avoid aerial application of fire retardant. These species have a higher probability of ingesting fire retardant chemicals since they primarily are herbivores.

Impacts may be reduced through avoidance area mapping for some species; refer to the Tables I-5 and I-6 for those species with recommended or required avoidance area mapping.

Bats

The biggest threat to cave roosting bats is disturbance during periods when bats are hibernating or roosting. Most fire activity occurs in the warmer months outside the hibernating period (winter) for bats, thus most fire fighting activities would not occur inside of caves where bats may roost. An aircraft flying over a roost side is not likely to cause disturbance. Human disturbance from people entering caves is what affects roosting and hibernating bats.

All species of bats listed as T&E use caves or mines for roosting and hibernacula. These species are located in Forest Service Regions 8 and 9 which have little or low potential use for aerial application of fire retardant; and any possible use of aerial application of fire retardant is not expected to have effects on caves serving as bat roosts and hibernacula: avoidance mapping of occupied roost and hibernacula sites is possible if determined necessary by those National Forests with these known sites.

Effects to bat species from the use of aerial application of fire retardant are not expected since these species are highly mobile and able to avoid or flee areas with wildland fires (SCREEN 2) except for non-volant juveniles. They also occur in areas/regions with low to moderate potential for the use of aerial retardant, except for the species found in Region 3 and sensitive species listed in most regions.

However, a low, fast drop of 3,000 gallons of fire retardant does have the ability to break the tops off trees or knock weak snags over, thus having a small potential to cause some direct impacts to bats. If this was to occur on a population of bats in an area, additional items to consider for the ESA listed bat species are the potential indirect effects of increased production and survival of insects if there is a reduction in bat species populations. The aerial application of fire retardant would have to affect a significant number of bats in a given population in order for this to occur, a given the low potential for this type of impact to occur, it is not expected that any given population would have this happen.

During the summer and fall months when fires may occur, most bat species, including non-volant juveniles, can be found in the forest areas, roosting inside cavities in trees or snags, crevices in rock outcrops, or under loose bark on trees. Direct application is not expected to occur since bats would be protected by these features. Fall fires is when aerial fire retardant is expected to be used; at this time period, juveniles will have the ability to fly and escape areas where fire activity would be occurring.

No direct or indirect impacts to prey insects species are expected with the low potential use of aerial application of fire retardant in the areas (Regions 8 and 9) where the ESA listed bat species occur. Given that some bats species may forage several miles from their roost sites and prey may also travel in from outside the retardant use area; impacts are not expected.

Carnivores and omnivores: mustelids/canids/felines/bears

All listed carnivore species are highly mobile species that are able to escape from areas with fire activities. The likelihood of a direct application from aerial application is extremely low due to the high rate of mobility and ability to escape the wildlife fire area; thus expecting to avoid direct drops of retardant. However, low flying aircraft may cause disturbance for a very short term; thus having a small negative effect.

Indirect effects are not expected since these carnivores would likely travel outside of the burned areas to forage on prey species in adjacent unburned areas. An individual would need to consume several contaminated prey items in a relatively short period of time in order to be affected, thus the ingestion of retardant chemicals through the prey burden (Labat Environmental 2011 coyote – carnivore representative) is not expected to occur.

Ungulates: sheep, deer and caribou

All are highly mobile species that are able to escape from areas with fire activities. The direct impact from aerial drops of retardant on individuals is not expected; however impacts caused from a short term disturbance of the individuals due to low-flying aircraft is expected to occur. The likelihood that the bighorn sheep would be in an area where a fire retardant drop would occur is low or none due to they typically inhabit steep, open terrain, where fire retardant would be of little or no use.

Indirect effects are not expected to occur, since these species are likely to avoid feeding on plants with fire retardant present; and the effect of retardant chemicals on ruminants is related to length and quantity of exposure.

GROUP: REPTILES

Characterized by skin with scales, cold blooded, and either lay eggs or give live birth, most reptiles are found in temperature, tropical, and desert habitats. They occur either in aquatic or terrestrial habitats and can be found throughout most States.

Mobility or ability to avoid a wildland fire for reptilian species is limited due to their small size and small home range. These species tend to avoid wildland fires by retreating into their burrows or under rocks, etc. Some are associated with waterways and moist areas, such as garter snakes, eastern indigo snake and most turtles. These semi-aquatic species are not expected to be directly affects due to the protection guidelines in place for waterways.

Direct effects of the fire retardants to individuals that may be hit by a retardant drop and ingestion of chemical residues on prey items. For example, the New Mexico ridgenose rattlesnake (a listed ESA species) is active only certain periods of the year. The period of May through July is the peak fire season in southern Arizona and New

Mexico. Rattlesnakes are active on the surface as early as April and as late as October, with a seasonal peak between July and September. Individuals are known to be active during daylight and crepuscular periods. During those hours, they may be resting under vegetation (bunch grasses, leaf litter, and downed logs) or rocky cover, thermo-regulating in the open, or hunting. Between June and August, young of the year rattlesnakes are also present on the surface as the live-born young disperse from their birth sites (http://www.fws.gov/endangered/species/us-species /recovery plan/newmexicoridgenoserattlesnake). Individuals may also be in sub-surface dens during these hours, and the percentage of the population vulnerable to retardant drops at any given time is unknown.

Most of the listed reptile species occurs in areas with moderate to high potential for aerial retardant use (Regions 3, 4, and 5). There may be negative indirect effects of toxicity caused by eating mice that have consumed vegetation covered with retardant; (Labat Environmental 2011 - deer mouse toxicity); however, this build up of toxins through prey burden is a long term process; reptiles were not studied for toxicity by the Labat Environmental Report.

Most of the listed TES species have low distribution and population size, thus **terrestrial avoidance area mapping should be applied for these sites** in order to minimize impacts to this species due to this species occurring on a Forest with moderate to high potential for aerial retardant use. This is a slight likelihood of direct effects since this species mobility is limited due to their small size and small home range, thus may not be able to avoid the area of a retardant drop. Also, since species may be direct application due to the high use of retardant in the area, and negative indirect effects of toxicity caused by consuming insects or vegetation that has been covered with fire retardants; however, this is a very long process.

GROUP: AMPHIBIANS

Amphibians consist of frogs and salamanders. Some are totally aquatic some are semi-aquatic and some are terrestrial but live in semi-moist environments. They are cold blooded, lay eggs, and require a moist or aquatic habitat for reproduction.

For the aquatic dependent species: **Required Avoidance Area Mapping** of aquatic waterways (regardless of which FS Region the species occurs in) should avoid direct and indirect impacts to designated critical habitat consisting of breeding, rearing and shelter sites for all of these species.

For the terrestrial species: Recommended Avoidance Area Mapping (regardless of which FS Region the species occurs in) will minimize direct and indirect impacts to designated critical habitat consisting of breeding, rearing and shelter sites for all of these species.

Most of the listed PETS species have low distribution and population size, thus **terrestrial avoidance area mapping should be applied for these sites** in order to minimize impacts to this species due to this species occurring on a Forest with moderate to high potential for aerial retardant use. This is a slight likelihood of direct effects since species mobility is limited due to their small size and small home range, thus may not be able to avoid the area of a mis-application of a retardant drop.

Refer to Tables I-5 and I-6 for lists of species requiring avoidance area mapping

GROUP: BIRDS

Birds may be found in all of the aquatic and terrestrial habitat types and in every eco-region. They are characterized by skin with feathers, hollow bones, and lay eggs.

For all birds species: All are highly mobile species that are able to escape from areas with wildland fire activities. The likelihood of a direct application from aerial application is extremely low due to these species high rate of mobility; unless the species is still nesting or with young on the nest. Most impacts are caused with the use of low flying aircraft which is expected to cause disturbance only for a very short time; usually a few minutes for a single day; thus having a small negative effect.

Some species have been recommended for avoidance area mapping to reduce impacts/effects to these species from the use of aerial application of fire retardant. Refer to tables in this appendix for the species listed.

Indirect effects are not expected since most species would need to eat several contaminated prey items in a relatively short period of time in order to be affected, thus the ingestion of retardant chemicals through the prey burden is not expected to occur (Labat Environmental 2011).

Waterfowl, pelagic and shorebirds, included marsh and wetland species: ducks, rails, etc.

This subgroup consists of birds that are dependent on large bodies of water or shorelines for the majority of their life cycle. With a few exceptions, such as the marbled murrelet which nests in old-growth forests, most of these birds species occur in habitats where fire in not present, such as ocean, beaches, lakes, and marshes or wetlands, where the use of aerial application of fire retardant would not be effective, due to the 2000 Guidelines on no application of aerial fire retardants within 300 feet of waterways.

Water /riparian dependent species: flycatchers, herons, etc.

This subgroup consists of birds that use riparian areas for breeding, rearing, or foraging habitat **Required Avoidance Area Mapping** by the 2000 Guidelines within 300 feet of waterways (regardless of which FS Region the species occurs in) should avoid direct and indirect impacts to designated critical habitat consisting of breeding, rearing and shelter sites as well as foraging habitat for all of these species.

Raptor species: hawks, falcons, birds of prey

Species in this subgroup are known as birds of prey in that they actively hunt animals for food sources, with some feeding on carrion or dead animals. They occur in a variety of habitats including open prairie, mature and old growth forest, and mixed conifer-hardwood forests.

For all raptor species: all are highly mobile species that are able to escape from areas with fire activities. The likelihood of a direct application from aerial application is extremely low due to high rate of mobility and ability to escape the wildlife fire area and avoid direct drops of retardant; unless the species is still nesting or still have young on the nest. Most impacts are caused with the use of low flying aircraft which is expected to cause disturbance only for a very short time; usually a few minutes for a single day; thus having a small negative effect.

Indirect effects are not expected since these raptors would travel outside of the burned areas to forage on prey species (mostly small mammals) in adjacent unburned areas; or would need to eat several contaminated prey items in a relatively short period of time in order to be affected, thus the ingestion of retardant chemicals through the prey burden is not expected to occur.

Critical habitat for the northern spotted owl and Mexican spotted owl consists of mature and old-growth stands; the use of aerial application of fire retardant will not change the primary constituent elements for this critical habitat (mature and old-growth forest). The California condor nesting habitat consists of mountains with open cliffs for nesting and tall, open grown trees for roosting; again the use of aerial application and fire retardant would not change the Primary Constituent Elements for condor critical habitat.

Forest associated: woodpeckers/songbird species

Species in this subgroup occur in all forested habitat types and eco-regions. Forested habitats vary from open pine – oak savanna, hardwood, coniferous, or mixed species forests ranging in all seral stage types (seral stage is a function of age and stand structure).

All species are highly mobile species that are able to escape from areas with wildland fire activities. The likelihood of a direct application from aerial application is extremely low due to the high rate of mobility and ability to escape the wildlife fire area and avoid direct drops of retardant; unless the species is still nesting or still have young on the nest. Most impacts are caused with the use of low flying aircraft which is expected to cause disturbance only for a very short time; usually a few minutes for a single day; thus having a small negative effect. Another direct effect is the breaking of tops of trees which may remove nesting structures with a large load of several hundred gallons of retardant dropped at a low attitude and relatively moderate rate of speed.

Indirect effects are not expected since these species would need to eat several contaminated prey items in a relatively short period of time in order to be affected, thus the ingestion of retardant chemicals through the prey burden is not expected to occur.

Upland/grassland associated: gallinaceous, cranes, herons, etc.

Species in this subgroup occur in a variety of habitat types ranging from open grassland/prairies, scrub oak communities, to chaparral and into some forested habitat types and most eco-regions.

All species are highly mobile species that are able to escape from areas with wildland fire activities. The likelihood of a direct application from aerial application is extremely low due to the high rate of mobility and ability to escape the wildlife fire area and avoid direct drops of retardant on them; unless the species is still nesting or still have young on the nest. Most impacts are caused with the use of low flying aircraft which is expected to cause disturbance only for a very short time; usually a few minutes for a single day; thus having a small negative effect.

This subgroup occurs in the habitat type which has the highest probability for the use of aerial application of fire retardants. Scrub brush, chaparral, and grassland are the highest priority areas for retardant use; since these fuel types are best controlled with the aid of fire retardant due to the lack of over-story canopy closure which allows for the direct application of retardant onto the vegetation, thus increasing the effectiveness of the retardant (see Appendix C for application rates per eco-region and fuel type).

Indirect effects are not expected since these species would need to eat several contaminated prey items in a relatively short period of time in order to be affected, thus the ingestion of retardant chemicals through the prey burden is not expected to occur.

Desert/arid associated: cactus wren, etc.

Most of the birds species in this subgroup occur in habitats where fire in not present, such as the Mojave and Sonoran deserts which consist mainly of sandy soils with arid plants that are widely spaced, where the use of aerial application of fire retardant would not be as effective.

GROUP: INVERTEBRATES

This group contains spiders, butterflies, beetles and allies. To reduce impacts to some species, avoidance area mapping has been recommended; refer to the tables l-5 and I-6 for species listed.

Arachnids – spiders

The habitats occupied by the species are dependent on high moisture regimes. The effects of a fire in these areas would be devastating to the species. It is possible that the use of fire retardant would be recommended to protect known and suitable habitats for spider species to avoid catastrophic loss of either species and/or their habitat Therefore, while there could be adverse effects to the species from the use of fire retardant (though Phos-Chek's effects on arachnids has not been studied by the Labat Environmental 2011), the use of retardant (that would only affect a portion of the occupied habitat for a short duration of time) would be justified to protect the remainder of the habitat from the known detrimental effects of fire.

Most National Forests with listed spider species have conservation measures in place for the protection of these species. For example, the spruce fir moss spider occurs on the Nantahala and Pisgah National Forests, which have Forest Plan conservation measures to prevent any adverse impacts to the spruce-fir moss spider, no direct impacts are expected (USDI FWS 2008). On the Cherokee National Forest the primary direct effects on the spruce-fir moss spider could include physical injury to or death of spiders resulting from the force of the retardant hitting them, as well as impacts from physical changes in its sensitive habitat (force of retardant hitting the moss and rock) and chemical changes in the environment (pH, phosphorous, nitrogen, etc.) The likelihood of spiders being killed by the force of retardant hitting them or their habitat is probably minimal, as the likelihood of fire retardant use in their habitat is limited. The habitat in which the spider occurs on the Cherokee National Forest has low fire potential, as evidenced by the fact that there were only three fires on Roan Mountain in the past 35 years. The use of aerially applied fire retardant is considered a rare event on the Cherokee National Forest.

Insects: butterflies and beetles, etc.

Most of the species in this subgroup are limited in distribution and occur in habitats where a host plant must be present for the larvae stages of their life cycle. They occur in several Eco-regions and have complex lifecycles that may take up to 2-3 years for larvae to mature to adults, which may live only for a few months.

For butterflies: represented by Quino checkerspot butterfly (*Euphydryas editha quino)* and the Laguna Mountain skipper (*Pyrgus ruralis lagunae*), both ESA listed Endangered, the following impactsare expected for most butterfly species with similar habitat requirements and limited distributions.

Designated critical habitat for both species occurs throughout the southern California area in the form of coastal sage scrub communities with required host plants. The use of aerial application of fire retardant has a high probability of being used due to this habitat type being the largest in the area and the most volatile fuel type. A direct effect to habitat is the application of retardant and the fertilizing ability, thus a flush of new growth can be expected to occur in the short term after application. Another possible change in habitat condition may occur if non-native invasive plant species are present and may out compete native species which make up the PCEs for that habitat type.

The effects of the aerial application of fire retardants on butterflies can be manifested as a toxicity issue and as physical hazard issue. Few studies have been conducted to determine the effects of fire retardant chemicals on terrestrial invertebrates.

Direct physical hazards expected from the aerial application of fire retardant may result in some level of misting or coating of individuals, which may potentially kill adults, larvae, and pupae due to the effective sticky covering of the retardant itself rendering the animal immobilized, or possibly suffocating the individual and thus affecting its survival. The effects of fire retardant are likely influenced by the season of use and associated life-stage of the insect, canopy cover at the retardant drop site, retardant application rates and coverages, and the population density of the species.

Data on the potential toxicity of fire retardants to larvae of sensitive invertebrates are lacking (Labat Environmetal 2008). Indirect effects from the fertilizing affect of retardants on vegetation may have a beneficial effect for host plants, but conversely, may cause the promotion of non-native species into required host plant habitats given the high amount of disturbance within and adjacent to these two species habitats.

On both the Cleveland and San Bernardino NFs, **all Quino checkerspot butterfly and Laguna Mountain skipper designated critical habitat has been mapped as avoidance areas since 2008** as part of the reasonable and prudent alternative measures from the 2008 Environmental Assessment (USDA FS 2008). In addition, several hazardous fuels reduction projects are occurring adjacent to designated critical in an effort to reduce the potential damage caused by a catastrophe fire event happening in this area adjacent to or within designated critical habitat and known occupied sites again in compliance with the 2008 Reasonable and Prudent Alternatives to prioritize fuels projects in proximity to T&E species habitats.

Mollusks: snails and slugs

The subgroup called mollusks is comprised of snails and slugs. Some are totally aquatic, some are semi-aquatic and some are terrestrial but live in semi-moist environments, usually under thick brush or tree canopies and in deep litter layers or under rocks with moss. Most of the listed TES species have low distribution and population size, thus **terrestrial avoidance area mapping should be applied for these sites** in order to minimize impacts to this species due to this species occurring on a Forest with moderate to high potential for aerial retardant use. This is a slight likelihood of direct effects since this species mobility is limited due to their small size and small home range, thus may not be able to avoid the area of a retardant drop.

The habitats occupied by these species are dependent on high moisture regimes and are not typically vulnerable to wildfires. Most occur in riparian or north facing aspects where moisture regimes are higher than the surrounding areas. However, the effects of a fire in these areas would be devastating to the species. It is possible that the use of fire retardant would be recommended to protect known and suitable habitats to avoid catastrophic loss of either species and/or their habitats. Therefore, while there could be adverse effects to the species from the use of fire retardant (though Phos-Chek's effects on snails has not been studied by the Labat Environmental 2011), the use of retardant (that would only affect a portion of the occupied habitat for a short duration of time) would be justified to protect the remainder of the habitat from the known detrimental effects of fire. **Avoidance Area mapping** should be applied due to the limited distribution species for those forests that determine this mitigation is appropriate.

For example, the Ozark-St.Francis National Forest has developed a management plan specifically for the Magazine Mountain Special Interest Area that *prohibits the use of fire retardants within the area* – **Required Avoidance Area** due to small isolated population with no mobility. The Magazine Mountain shagreen snail *(Inflectarius (Mesodon) maganinesis)* is known only for one population that lives in wooded talus slopes near the summit of the north and west faces of Magazine Mountain, Logan Co, Arkansas and occurs entirely on the Ozark-St. Francis National Forest. All the species known habitat is designated as part of the Magazine Mountain Special Interest Area on the Ozark-St. Francis National Forest (USDI FWS BO 2008).

The Ozark- St Francis National Forests have used retardant approximately 92 times between 2000 and 2010, for an average of eight drops per year (moderate to high use)(USDA FS data; Appendix I-1). Due to this use rate, there is a low potential for a mis-application from aerial retardant if used in the immediate vicinity of the species known occupancy area. Data on the potential toxicity of fire retardants to invertebrates are lacking. However, direct effects from a possible mis-application of an aerial retardant drop in the vicinity of Magazine Mountain could potentially kill adults due to the effective sticky covering of the retardant itself rendering the animal immobilized, or possibly suffocating the individual and thus affecting its survival. Changes in soil pH are also expected, thus the chemicals in the retardant could cause burns or even direct kill due to the small size of the species.

Another example is the Noonday globe snail (*Petera (Mesodon) clarki natahala).* The noonday globe is endemic only to the southeast side of the Nantahala River Gorge in the Nantahala National Forest, Swain County, North Carolina; the species entire known range is within this forest unit. The steep southeastern side of the gorge is forested with a mix of various species of hardwood trees and hemlock and rich herbaceous undergrowth. The noonday globe appears to be most abundant on and around moist rocky outcrops, often covered with a variety of bryophytes and fungi, along the streams and scattered seeps draining the southeastern slope, but can also be found in thick leaf litter and humus layers around the base of ferns (USDI FWS BO 2008).

The USFS has designated the southeast slope of Nantahala Gorge (the portion of the gorge occupied by the Noonday globe) as a National Forest Special-Interest Management Area (Nantahala Gorge/Bowing Spring Management Area) with restriction on the use of aerial fire retardant; again, this can be categorized as a **Required Avoidance Area**.

Table I-5. Wildlife Avoidance Area Mapping: Threatened and Endangered Species.

			Avoidance Area		
Region	**Forest**	**Species**	**Critical Habitat**	**Population**	**Habitat Type**
1, 6, 10	no avoidance mapping required				
2,3,4,5	all populations	southwestern willow flycatcher	required	required	riparian
2	Arapaho-Roosevelt	Preble's meadowjumping mouse	required	required	riparian

			Avoidance Area		
Region	**Forest**	**Species**	**Critical Habitat**	**Population**	**Habitat Type**
2	Medicine Bow-Routt	Preble's meadowjumping mouse	required	required	riparian
2	Pike-San Isabel	Preble's meadowjumping mouse	required	required	riparian
		Pawnee montane skipper		recommended	terrestrial
3	Apache-Sitgraves	Chiricahua leopard frog		required	riparian
3	Cibola	Chiricahua leopard frog		required	riparian
		Alamosa springsnail		required	riparian
3	Coronado	Sonora tiger salamander		required	riparian
		Chiricahua leopard frog		required	riparian
3	Gila	Chiricahua leopard frog		required	riparian
		Alamosa springsnail		required	riparian
3	Tonto	Chiricahua leopard frog		required	riparian
4	Boise	Northern Idaho ground squirrel		recommended	terrestrial
4	Payette	Northern Idaho ground squirrel		recommended	terrestrial
4	Dixie	Utah prairie dog		recommended	terrestrial
4	Fishlake	Utah prairie dog		recommended	terrestrial

			Avoidance Area		
Region	**Forest**	**Species**	**Critical Habitat**	**Population**	**Habitat Type**
5	Angeles	Southwestern arroyo toad	required	required	riparian
		California red-legged frog	required	required	riparian
		mountain yellow-legged frog	required	required	riparian
		Coastal California Gnatcatcher		required	terrestrial
		least Bell's vireo	required	required	riparian
5	Cleveland	Stephen's kangaroo rat		recommended	terrestrial
		Southwestern arroyo toad	required	required	riparian
		Coastal California Gnatcatcher		required	terrestrial
		least Bell's vireo	required	required	riparian
		Laguna Mountain skipper	required	required	terrestrial
		Quino checkerspot butterfly	required	required	terrestrial
5	Eldorado	California red-legged frog	required	required	riparian
5	Los Padres	blunt-nosed leopard lizard		required	terrestrial
		California tiger salamander	required	required	riparian
		Southwestern arroyo toad	required	required	riparian
		California red-legged frog	required	required	riparian

			Avoidance Area		
Region	**Forest**	**Species**	**Critical Habitat**	**Population**	**Habitat Type**
		least Bell's vireo	required	required	riparian
		California condor - hacksites		required	terrestrial
		Smith's blue butterfly	required	required	terrestrial
5	Plumas	California red-legged frog	required	required	riparian
5	San Bernardino	San Bernardino kangaroo rat	required	required	riparian
		Stephen's kangaroo rat		recommended	terrestrial
		Southwestern arroyo toad	required	required	riparian
		mountain yellow-legged frog	required	required	riparian
		least Bell's vireo	required	required	riparian
		Quino checkerspot butterfly	required	required	terrestrial
5	Sierra	giant kangaroo rat		recommended	terrestrial
		California tiger salamander	required	required	riparian
5	Sequoia	giant kangaroo rat		recommended	terrestrial
		California tiger salamander	required	required	riparian
5	Shasta-Trinity	California red-legged frog	required	required	riparian
5	Stanislaus	California tiger salamander	required	required	riparian
5	Tahoe	California red-legged frog	required	required	riparian

			Avoidance Area		
Region	**Forest**	**Species**	**Critical Habitat**	**Population**	**Habitat Type**
5	Inyo	Kern primrose sphinx moth	required	required	terrestrial
8	Appalachicola	frosted flatwoods salamander	recommended	recommended	terrestrial
8	Cherokee	spruce-fir moss spider	required	required	terrestrial
8	Francis Marion	frosted flatwoods salamander	recommended	recommended	terrestrial
8	Osceola	frosted flatwoods salamander	recommended	recommended	terrestrial
8	Ozark- St Francis	Magazine Mountain shagreen	required	required	terrestrial
8	NF in Mississippi	Mississippi gopher frog		required	riparian
		red-cockaded woodpecker		recommended	terrestrial
8	Nantahala	spruce-fir moss spider	required	required	terrestrial
		noonday globe	required	required	terrestrial
8	Pisgah	spruce-fir moss spider	required	required	terrestrial
9	Mark Twain	Hine's emerald dragonfly	recommended	recommended	riparian
9	Huron-Manistee	Karner's blue butterfly		required	terrestrial

Table I-6. Wildlife

Region	**Forest**	**Species**	**Candidate Species?**	**Habitat Type**
1	all known populations	Boreal or western toad		riparian
1	all known populations	Great Plains toad		riparian
1	Couer D'Alene	Couer D'Alene salamander		terrestrial

Region	Forest	Species	Candidate Species?	Habitat Type
2	Arapahoe-Roosevelt	Boreal or western toad		riparian
2	Medicine Bow-Routt	Boreal or western toad		riparian
2	Pike-San Isabel	Boreal or western toad		riparian
2	Rio Grande	Boreal or western toad		riparian
2	White River	Boreal or western toad		riparian
		Nokomis fritillary		meadow
		Northern leopard frog		riparian
		black swift		riparian
		bald eagle		riparian
		river otter		riparian
3	all known populations	long-tailed vole		riparian
3	all known populations	white-backed vole		riparian/meadow
3	all known populations	Navajo mogollan vole		riparian/meadow
3	all known populations	New Mexico jumping mouse	candidate	meadow
3	all known populations	Arizona montane vole		meadow
3	Apache-Sitgraves	water shrew		riparian
3	Carson	ermine		terrestrial
		water shrew		riparian
		mink		riparian
3	Cibola	New Mexico shrew		riparian
3	Gila	Arizona grey squirrel		riparian
3	Santa Fe	water shrew		riparian
		mink		riparian
		ermine		terrestrial

Region	Forest	Species	Candidate Species?	Habitat Type
		Preble's shrew		terrestrial
3	Lincoln	New Mexico shrew		riparian
4	Humboldt-Toiyabe	Mount Charleston blue butterfly	candidate	meadow
		Spring Mountain acastus checkerspot butterfly		meadow
		Columbia spotted frog	candidate	riparian
		Yosemite toad	candidate	riparian
4	Salmon-Challis	Columbia spotted frog	candidate	riparian
		Greater sage-grouse leks	candidate	terrestrial
4	Unita-Wasach Cache	Boreal or western toad		riparian
		Greater sage-grouse leks	candidate	terrestrial
		yellow-billed cuckoo	candidate	riparian
5	Sierra	foothill yellow-legged frog		riparian
5	Sequoia	foothill yellow-legged frog		riparian
		mountain yellow-legged frog	candidate	riparian
5	Los Padres	foothill yellow-legged frog		riparian
5	Lake Tahoe	mountain yellow-legged frog	candidate	riparian
6	Fremont-Winema	Leonas little blue butterfly		meadow
		mardon skipper	candidate	meadow
6	Rogue River-Siskiyou	mardon skipper	candidate	meadow
		Franklin's bumble bee	candidate	meadow
6	Gifford Pinchot	mardon skipper	candidate	meadow
6	Okanogan-Wenatchee	mardon skipper	candidate	meadow
9	Superior	Freija grizzled skipper		terrestrial
		jutta arctic butterfly		terrestrial

Region	Forest	Species	Candidate Species?	Habitat Type
		Nabokov's or northern blue butterfly		terrestrial
		Taiga alpine butterfly		terrestrial
		red-disk alpine butterfly		terrestrial
9	Mark Twain	bald eagle sites		riparian

Appendix J – Suppression Chemicals and Delivery Systems

Appendix J – Suppression Chemicals and Delivery Systems

Redbook Chapter 12: Suppression Chemicals & Delivery Systems, Released Jan. 2010

Policy for Use of Fire Chemicals

Use only products qualified and approved for intended use. Follow safe handling procedures, use personal protective equipment recommended on the product label and Material Safety Data Sheet (MSDS).

A current list of qualified products and approved uses can be found on the Wildland Fire Chemical Systems (WFCS) website:

- http://www.fs.fed.us/rm/fire/wfcs/index.htm
- Link to appropriate Qualified Products List (QPL)

Refer to local jurisdictional policy and guidance related to use of wildland fire chemicals for protection of historic structures.

Products must be blended or mixed at the proper ratio prior to being loaded into the aircraft. Quality control and safety requirements dictate that mixing or blending of wildland fire chemicals be accomplished by approved methods.

Types of Fire Chemicals

Long-Term Retardant

Long-term retardants contain fertilizer salts that change the way fuels burn. They are effective even after the water has evaporated. Retardants may be applied aerially by large air tanker, single engine airtanker (SEAT) and helicopter bucket. Some products are formulated specifically for delivery from ground sources. See the QPL for specific uses for each product.

Recommended coverage levels and guidelines for use can be found in the *Principles of Retardant Application*, NFES 2048, PMS 440-2 pocket card. Retardant mixing, blending, testing, and sampling requirements can be found at the WFCS website Lot Acceptance and Quality Assurance page: http://www.fs.fed.us/rm/fire/wfcs/laqa.htm.

Fire Suppressant Foam

Fire suppressant foams are combinations of wetting and foaming agents added to water to improve the effectiveness of the water They are no longer effective once the water has evaporated. Foam may be applied by engines, portable pumps, helicopters and SEATs. Some agencies also allow application of foam from fixed-wing water scoopers. See the QPL for specific uses for each product.

Technical guidelines for equipment operations and general principles of foam application are discussed in *Foam vs. Fire; Class A Foam for Wildland Fires, NWCG, PMS 446-1, NFES 2246, 2nd ed., October 1993, and Foam vs. Fire, Aerial Applications, NWCG, PMS 446-3, NFES 1845, October 1995.*

Wet Water

Using foam concentrates at a mix ratio of 0.1 percent will produce a wet water solution.

Water Enhancer (Gel)

Water enhancers, such as fire fighting gels, are products added to water to improve one or more of the physical properties of water They are not effective once the water has evaporated. These products may be used in structure protection within the wildland interface or on wildland fuels. They are fully approved for use in helicopter bucket and engine application. Many are also approved, at specific mix ratios, for use in SEATs, and fixed tank helicopters. See the QPL for specific uses for each product.

Safety Information

Personnel Safety

All qualified wildland fire chemicals meet minimum (June 2007) requirements in regard to aquatic and mammalian toxicity, acute oral toxicity, acute dermal toxicity, primary skin irritation, and primary eye irritation. Specifications for long-term retardants, fire suppression foams, and water enhancers, can be found on the WFCS website.

Personnel involved in handling, mixing, and applying fire chemicals or solutions shall be trained in proper procedures to protect their health and safety and the environment. Approved fire chemicals can be irritating to the eyes. Personnel must follow the manufacturer's recommendations; including use of PPE, as found on the product label and product MSDS. The MSDSs for all approved fire chemicals can be found on the web site at http://www.fs.fed.us/rm/fire/wfcs/msds.htm.

Human health risk from accidental drench with fire chemicals can be mitigated by washing with water to remove any residue from exposed skin.

Containers of any fire chemical, including backpack pumps and engine tanks, should be labeled to alert personnel that they do not contain only water and the contents are not potable.

Slippery footing is a hazard at storage areas, unloading and mixing sites, and wherever applied. Because all fire chemical concentrates and solutions contribute to slippery conditions, all spills must be cleaned up immediately, preferably with a dry absorbent pad or granules. Firefighters should be aware **that** fire chemicals can conceal ground hazards. Wildland fire chemicals can penetrate and deteriorate leather boots, resulting in wet feet and potentially ruined leather.

Aerial Application Safety

Persons and equipment in the flight path of intended aerial drops should move to a location that will decrease the possibility of being hit with a drop.

Persons near aerial drops should be alert for objects (tree limbs, rocks, etc.) that the drop could dislodge.

During training or briefings, inform all fire personnel of environmental guidelines and requirements for fire chemicals application and avoid contact with waterways.

Avoid dipping from rivers or lakes with a helicopter bucket containing residual fire chemicals without first cleaning/washing down the bucket.

Consider setting up an adjacent reload site and manage the fire chemicals in portable tanks or terminate the use of chemicals for that application.

Policy for Delivery of Wildland Fire Chemicals near Waterways

Avoid aerial application of wildland fire chemicals within 300 feet of waterways and any ground application of wildland fire chemicals into waterways. The policy has been adopted from the *2000 Guidelines for Aerial delivery of Retardant or Foam near Waterways* which were established and approved by the FS, BLM, NPS, and FWS. It has been expanded to include all wildland fire chemicals, including water enhancers. This policy was updated in 4/09 and can be found at:

http://www.fs.fed.us/rm/fire/wfcs/Application_Policy-MultiAgency_042209- UPDATE.pdf

Exceptions

When alternative line construction tactics are not available due to terrain constraints, congested area, life and property concerns or lack of ground personnel. It is acceptable to anchor the wildland fire chemical application to the waterway. When anchoring a wildland fire chemical to a waterway, use the most accurate method of delivery in order to minimize placement of wildland fire chemicals in the waterway (e.g., a helicopter rather than a heavy airtanker).

When potential damage to natural resources outweighs possible loss of aquatic life, the unit administrator may approve a deviation from these guidelines.

Definition of Waterway 1

Any body of water including lakes, rivers, streams and ponds whether or not they contain aquatic life.

Guidance for Pilots

To meet the 300-foot buffer zone guideline, implement the following:

- **Medium/Heavy Airtankers:** When approaching a waterway visible to the pilot, the pilot shall terminate the application of wildland fire chemical approximately 300 feet before reaching the waterway. When flying over a waterway, pilots shall wait one second after crossing the far bank or shore of a waterway before applying wildland fire chemical Pilots shall make adjustments for airspeed and ambient conditions such as wind to avoid the application of wildland fire chemical within the 300-foot buffer zone.
- **Single Engine Airtankers:** When approaching a waterway visible to the pilot, the pilot shall terminate application of wildland fire chemical approximately 300 feet before reaching the waterway. When flying over a 16 waterway, the pilot shall not begin application of wildland fire chemical until 300 feet after crossing the far bank or shore. The pilot shall make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant within the 300-foot buffer zone.
- **Helicopters:** When approaching a waterway visible to the pilot, the pilot shall terminate the application of retardant or foams 300 feet before reaching the waterway. When flying over a waterway, pilots shall wait five seconds after crossing the far bank or shore before applying the wildland fire chemical Pilots shall make adjustments for airspeed and ambient conditions such as wind to avoid the application of wildland fire chemicals within the 300-foot buffer zone.

This policy does not require the helicopter or airtanker pilot-in-command to fly in such a way as to endanger his or her aircraft, other aircraft, structures or compromise ground personnel safety.

Reporting Requirements of Wildland Fire Chemicals into Waterways:

Any fire chemicals aerially applied into a waterway or within 300 feet of a waterway require prompt upward reporting to incident management and agency administrator. Notifications will also be made for any spills or ground applications of fire chemicals into waterways or with potential to enter the waterway.

If it is believed that fire chemicals have been introduced into a waterway, personnel should immediately inform their supervisor. The incident or host 41 authorities must immediately contact appropriate regulatory agencies and 42 specialists within the local jurisdiction.

Initial notifications of wildland fire chemical mishaps will be reported as soon as possible to the WFCS Fire Chemical Project Leader in Missoula, Montana at phone 406-329-4859 (if no answer please leave message) or to individuals listed on website referenced below. Include the date, location, and extent of the introduction.

All information, including reporting form and instructions, are posted on the web site at: http://www.fs.fed.us/rm/fire/wfcs/report.htm.

FS - *Additional Reporting Requirements for Threatened and Endangered Species. Reporting is also required for all introductions of wildland fire chemicals into habitat for those Threatened and Endangered species identified by the U.S Fish and Wildlife Service (FWS). The list and other information can be found at . This requirement resulted from the Forest Service's acceptance of Biological Opinions received from the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS). When wildland fire chemicals adversely affect any threatened endangered or proposed species, or designated or proposed critical habitat regardless of the 300' waterway buffer zone, the Forest Service Line Officer must initiate emergency consultation with the FWS and/or NMFS. The FS unit should coordinate with the local FWS or NMFS office to monitor, determine significance of effects and design appropriate responsive measures. The procedures, reporting form and instructions can be found at the same website as listed above.http://www.fs.fed.us/fire/retardant/index.html. This requirement resulted from the Forest Service's acceptance of Biological Opinions received from the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS). When wildland fire chemicals adversely affect any threatened endangered or proposed species, or designated or proposed critical habitat regardless of the 300' waterway buffer zone, the Forest Service Line Officer must initiate emergency consultation with the FWS and/or NMFS. The FS unit should coordinate with the local FWS or NMFS office to monitor, determine significance of effects and design appropriate responsive measures. The procedures, reporting form and instructions can be found at the same website as listed above.*

Endangered Species Act (ESA) Emergency Consultation

The following provisions are guidance for complying with the emergency section consultation procedures of the ESA with respect to aquatic species. These provisions do not alter or diminish an action agency's responsibilities under the ESA.

Where aquatic threatened &endangered (T&E) species or their habitats are potentially affected by aerial application of wildland fire chemical, the following additional procedures apply:

- As soon as practicable after the aerial application of wildland fire chemical near waterways, determine whether the aerial application has caused any adverse effects to a T&E species or their habitat. This can be accomplished by the following:
    - Aerial application of wildland fire chemical outside 300 ft of a waterway is presumed to avoid adverse effects to aquatic species and no further consultation for aquatic species is necessary.
    - Aerial application of wildland fire chemical within 300 ft of a waterway requires that the unit administrator determine whether there 41 has been any adverse effects to T&E species within the waterway.

- These procedures shall be documented in the initial or subsequent fire reports:
    - If there were no adverse effects to aquatic T&E species or their habitats, there is no additional requirement to consult on aquatic species with Fish and Wildlife Service (FWS) or National Marine Fisheries Service (NMFS).
    - If the action agency determines that there were adverse effects on T&E species or their habitats then the action agency must consult with FWS and/or NMFS, as required by 50 CFR 402.05 (Emergencies). Procedures for emergency consultation are described in the Interagency Consultation Handbook, Chapter 8 (March, 1998). In the case of a long duration incident, emergency consultation should be initiated as soon as practical during the event. Otherwise, post-event consultation is appropriate. The initiation of the consultation is the responsibility of the unit administrator.

Ground application of a wildland fire chemical into a waterway also requires determining whether the application has caused any adverse effects to a T&E species or their habitat. The procedures identified above also apply.

Each agency is responsible for ensuring that their appropriate agency specific guides and training manuals reflect these standards.

Appendix K – Retardant Avoidance Map Examples for Alternative 5

Appendix K – Retardant Avoidance Map Examples for Alternative 5

Figure K-1. Retardant Avoidance Areas, San Bernadino National Forest, California

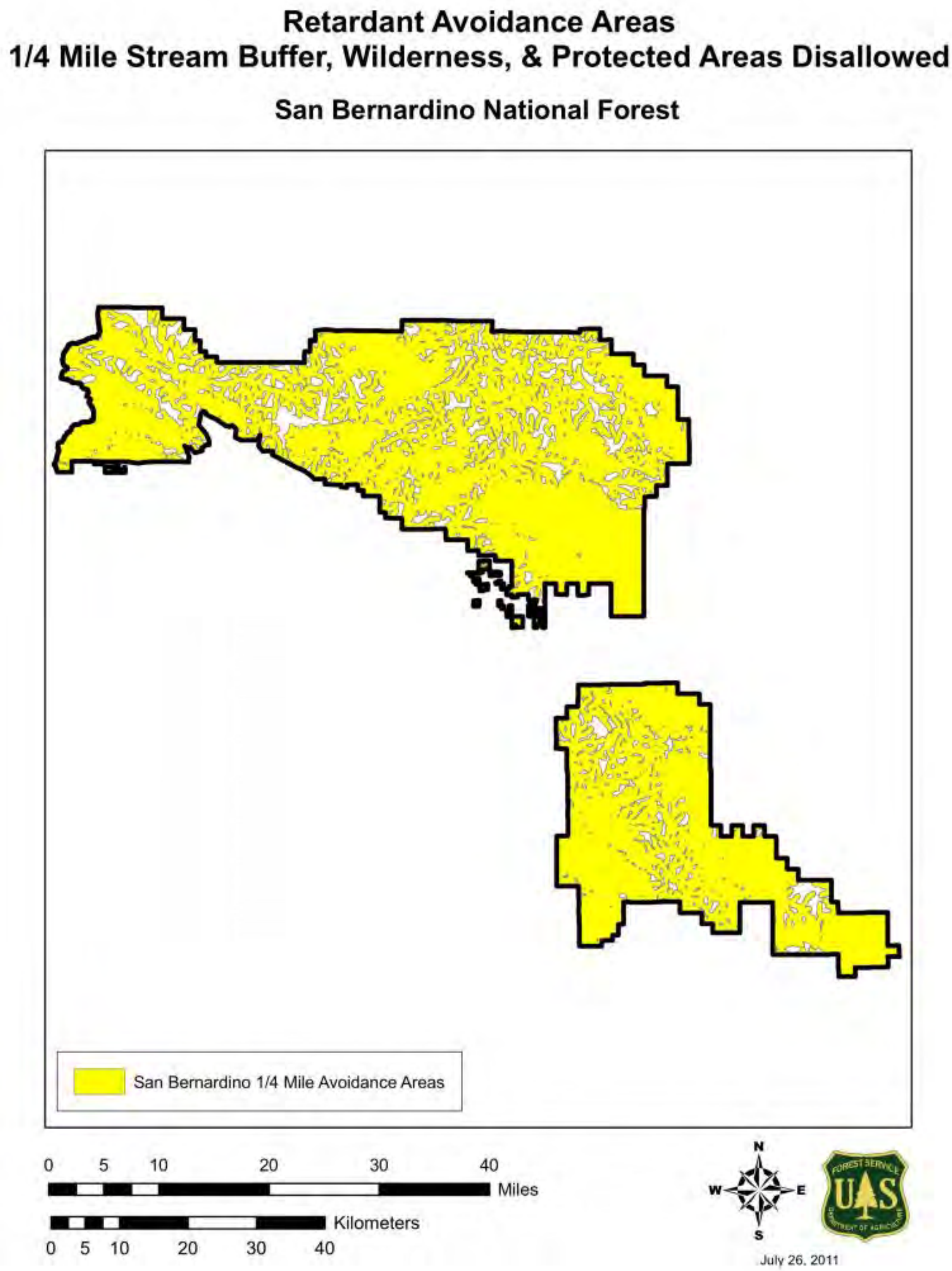
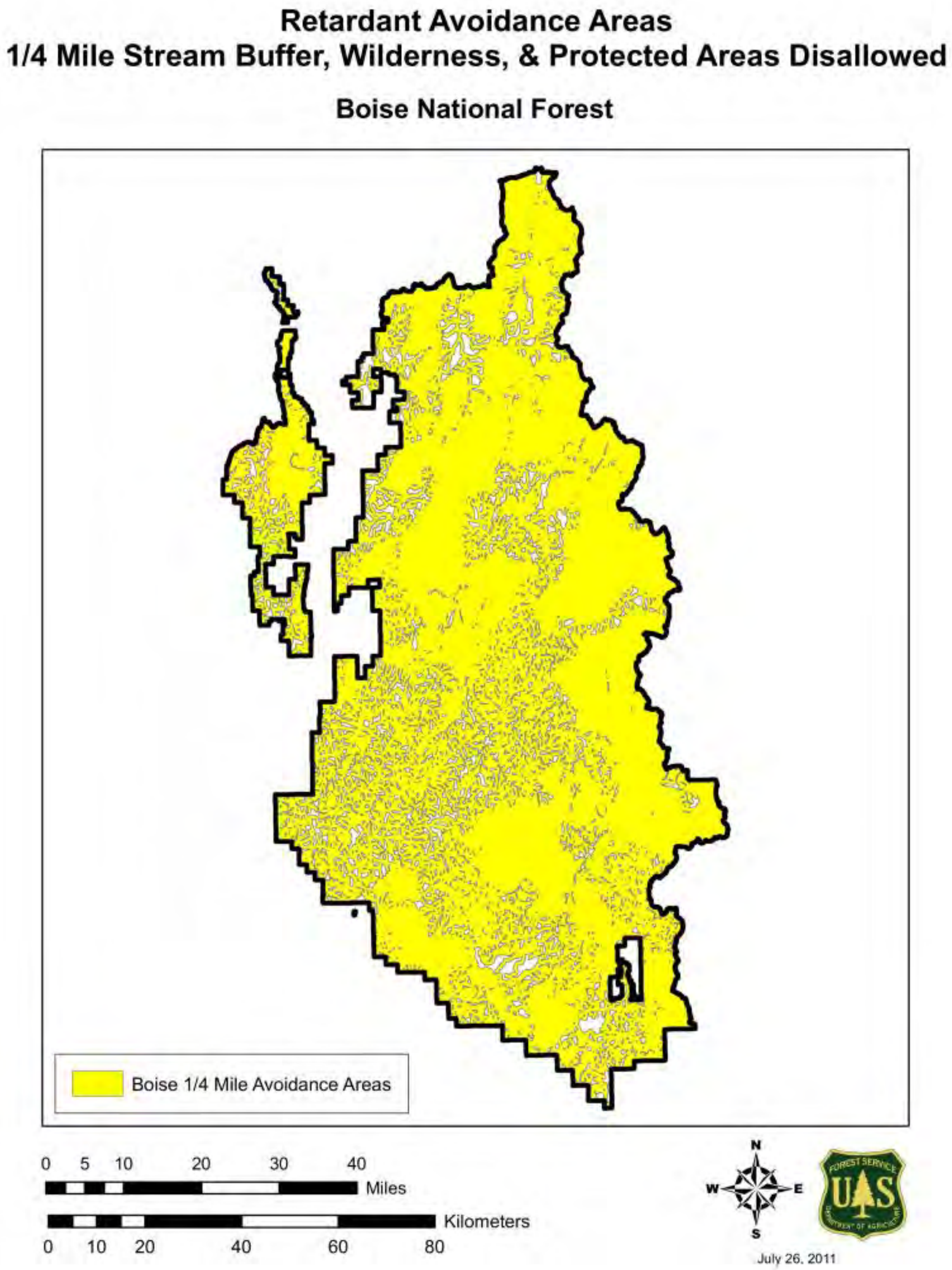


Figure K-2. Retardant Avoidance Areas, Boise National Forest, Idaho.



Appendix L – Forest Service Wildland Fire Chemical Program and Process

Appendix L – Forest Service Wildland Fire Chemical Program and Process

Process

Forest Service Manual 5100 includes the policy for the use of wildland fire chemicals on National Forest System lands and National Grasslands. The policy includes the requirement that all wildland fire chemicals undergo an evaluation based on the requirements within an established Forest Service specification prior to the product being place on a qualified products list (QPL) which is then used by field units to purchase only evaluated products.

Department of Interior agencies use the Forest Service QPLs through the Interagency Standards for Fire and Fire Aviation Operations. Other fire organizations at all levels from local to international use the QPL by reference as part of their fire chemical procurement processes.

The Forest Service implemented the wildland fire chemical systems program over 40 years ago to ensure that the agency had products available that were environmentally friendly and that would be effective in meeting our firefighting needs. The agency included requirements to ensure the health and safety of the firefighters, the public, and the equipment. The Wildland Fire Chemicals Program (WFCS) at the Missoula Technology and Development Center (MTDC) and its predecessors have coordinated and overseen the evaluation program from the beginning.

There are currently three categories of fire chemicals with formal specifications developed to address the needs of firefighters. The fire chemical categories are long-term retardants, class A foams, and water enhancers (gels). Each category has a purpose and specific strengths and weaknesses which are incorporated into the specific specifications. There are separate QPLs for each product type.

Although the specifications and requirements are specific to a product category, each specification has the same general categories of required characteristics. Some tests have required performance defined and others provide information used to define a range of performance that may be advantageous for certain firefighting tasks. Additionally all categories have the same requirements when uses or exposures are the same. These broad categories of requirements include:

- Effectiveness
- Fire retarding or suppressing characteristics
- Consistency and delivery performance
- Safety and Environmental Protection
- Review of the product composition for use of unacceptable ingredients or chemicals of concern which can trigger additional requirements such as risk assessments
- Mammalian toxicity
- Aquatic toxicity
- Materials Protection
- Uniform and intergranular corrosion
- Nonmetallic effects
- Pumpability and erosion
- Stability
- Concentrates and mixed retardants must maintain performance capabilities for prescribed times

- Physical Properties
- Set limits on weight to regulate aircraft loads
- Define stability
- Set quality and acceptance standards

The Forest Service identified standard test methods or developed unique test methods for use in the evaluation process. The methods are summarized in the specification and detailed in a separate document found on the public internet site, www.fs.fed.us/rm/fire/

The evaluation takes up to 24 months to complete. The cost of the evaluation is paid by the product supplier. A product is place on the QPL only if it meets or exceeds the established requirements defined in the specification and measured in the Forest Service laboratory or approved outside laboratory (for some specialized tests). All tests are performed on a sample of the product which is provided by the supplier, kept under Forest Service control, and disburses by the Forest Service when outside laboratories are used. All reports and findings are sent directly to the Forest Service to maintain a chain of custody throughout the evaluation.

The Forest Service is required to publish the requirements for information to be submitted by the proposed manufacturer/submitter, testing procedures, specifications, and the QPL per Department regulations, the Federal Acquisition Regulations, and the Office of Management and Budget.

The review process for the specifications includes a notification to the existing manufacturers, cooperating agencies, and the general public for submission of suggested changes to the specifications. In addition to this process, which occurs every four to five years, the WFCS program personnel review the Environmental Protection Agency (EPA) listing of known and suspect carcinogens and extremely hazardous substances to ensure no currently formulated wildland fire chemicals contain any of the ingredients. The WFCS personnel also review the websites for the EPA and other regulatory and standards making organizations to assure that chemical concerns and significant changes in product testing are up to date.

Examples of some of the changes to the use of fire chemicals and the evaluation process include:

- 1974 – Based on work by Robert Borovicka, BLM, published in Fire Management, firefighters and airtanker pilots were advised to make reasonable efforts to prevent retardant entering waterways.
- 1982 – Specific requirements for mammalian toxicity testing were included in the long-term retardant specification and all fire chemical specifications since then.
- 1995 – Forest Service started reporting to EPA in compliance with the Superfund Amendments and Reauthorization Act (SARA) Title III, Section 313 the Emergency Planning and Community Right to Know (EPCRA) - Form R of retardant distribution and use began based on ammonia content. WFCS prepares reports as necessary for all airtanker bases buying retardants under the National Retardant Contract.
- 1996 – Complies with letter policy from the Director, Fire and Aviation Management regarding use of chemical listed on certain advisory lists from EPA for hazardous chemicals and the National Toxicology Program (NTP) and International Agency for Research on Cancer (IARC) for known and suspect carcinogens.
- 1992 – Commissioned the first of several Human Health and Ecological Risk Assessments on the use of Wildland Fire Chemicals. The first assessments were published in 1994 and were most recently updated in 2003 for human health and 2007 for ecological effects
- 1992 – Began working with the staff of the Columbia Environmental Research Center (CERC) of the United States Geological Services (USGS), formerly part of the Fish and Wildlife Service (FWS) research branch to develop testing methods and requirements to assess aquatic toxicity of wildland fire chemicals.

- 2000 – The Forest Service provided formal guidelines for the use of retardant and avoidance of applications in waterways or sensitive habitat. Reinforced ESA section 7 consultation as required.
- 2000 – Aquatic toxicity performance requirements were added to Specification 5100-307 for Class A Foams. The same requirements have been included in all fire chemical specifications for all categories of products since then.
- 2008 – The Forest Service conducted an Environmental Assessment on the use of Aerially Delivered Fire Retardant.
- 2008 – Reporting requirements were enhanced as part of the Decision Notice accepting the Reasonable and Prudent Alternatives (RPAs) in the Biological Opinions (BOs) of the National Marine Fisheries Service (NMFS) and FWS. Summaries of the intrusion reports are provided to each of the regulatory agencies and are available to the public through the Forest Service Fire and Aviation Management website.
- 2009 – The Forest Service worked with NMFS to determine potential effects of fire retardants on anadromous fish during the smoltification state. Exposure to retardant, salt water, and disease challenges occurred in a standard succession. Based on preliminary results, additional tests on both spring and summer Chinook salmon are being conducted with all commonly used retardants.
- 2009 – Forest Service and cooperating agencies began work to develop a monitoring plan to be used as part of the response to misapplication of fire chemicals. A first order calculator to determine amounts of chemical in waterways and a modification of a more sophisticated existing program (ICWater) were developed and initial testing on a small number of incidents was completed.
- 2010 – The Forest Service began work on a nationwide Environmental Impact Study.

The QPLs are posted on a publicly-accessible Forest Service web site at www.fs.fed.us/rm/fire/. Revisions and/or additions to the QPLs are made on the 5th of each month.

Most long-term retardants are purchased through the National Retardant Bulk or Full-Service Contracts. Additional products are purchased for resupply of mobile bases assigned to fires through blanket purchase agreements. Other fire chemicals are purchases through blanket purchase agreements and local procurements.

Most long-term retardant is applied from aircraft loaded at agency operated airtanker bases. During severe fire seasons, mobile bases can be activated at other available airports capable of supporting the anticipated fire operations and aircraft in use. Remote bases can be activated for helicopter and ground equipment near the fire where water and resupply services are available.

Fire and Dispatch units with help from their TES staffs have/are preparing hazard/avoid maps and briefing packages for pilots in their areas to help minimize applications in sensitive areas.

Shipping of products and support equipment to mobile and remote bases increases the potential for transportation accidents and resulting introduction of products into waterways and sensitive habitat. These incidents are also reportable under the existing agreements.

In 2009 and 2010 awareness training was included in a number of courses and training materials for all firefighters on the ground and the air. Additional materials are being developed and added to NWCG and other local through national courses as supplemental materials now and as part of the basic coursework during revisions.

New risk assessments on the use of fire chemicals are performed every five to ten years to ensure that newly qualified products are included and that the most recent guidelines and information on environmental concerns are included.

Currently approved long-term retardants are provided in the table below. **(Full details of these retardants are available from the WFCS Web site:**

http://www.fs.fed.us/rm/fire/wfcs/index.htm;

Current Qualified Products List

http://www.fs.fed.us/rm/fire/documents/qpl_r_r.pdf)

Table 20

CONCENTRATE TYPE	RETARDANT	MIX RATIO (Pounds concentrate per gallon of water)
DRY CONCENTRATE	D-75-R[1]	1.20 lb/gal
	D-75-F[1]	1.20 lb/gal
	G-75-F[1]	1.12 lb/gal
	G-75-W[1]	1.12 lb/gal
	P-100-F	1.0 lb/gal
LIQUID CONCENTRATE	LC-95-A-R	5.5:1
	LC-95-A-F	5.5:1
	LC-95-A-W	5.5:1

1. These retardants are being phased out and are no longer being manufactured; current stocks will be applied during fire season 2011, and no application of these products is expected in the future starting with fire season 2012

Specification

5100-304c

Amendments Inserted May 17, 2010

June 1, 2007

Superceding

Specification 5100-304b

January 2000

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

SPECIFICATION FOR

LONG TERM RETARDANT, WILDLAND FIREFIGHTING

1. **GENERAL.**

1.1. **Scope.** The long-term fire retardants described in this specification are for use in wildland fire management. They may be applied from aerial or ground application equipment.

After mixing with water in the prescribed ratio, the mixed retardant is applied to slow the spread and reduce the intensity of the fire.

Long-term retardants continue to be effective after the contained water has evaporated.

1.1.1. Long-term retardant concentrates may be wet or dry.

1.1.2. Products must be one component, i.e., mixed retardants shall be prepared by blending a single concentrate with water.

1.1.3. The mix ratio shall be specified by the manufacturer and confirmed by combustion-retarding effectiveness testing. Refer to 3.6 for additional information.

2. SUBMISSION AND EVALUATION.

2.1. Wildland Fire Chemical Product Qualification Testing. Qualification testing for wildland fire chemical products shall be performed prior to use (Forest Service Manual (FSM) 5100, Chapter 5160, Section 5162).

Testing shall include a laboratory evaluation and may include a field evaluation during firefighting operations.

-

2.2. Unacceptable ingredients. In addition to the ingredients identified in 2.4.1 as not meeting Forest Service direction the following ingredients shall not be accepted.

-

- Sodium ferrocyanide (Yellow Prussiate of Soda or YPS)
- Dichromates
- Thiourea
- Borate or other boron-containing compounds
- Polychlorinated biphenols (PCB) [Amendment 2 adds additional ingredients to list.]
- Polybrominated diphenyl ethers (PBDE) [Amendment 2 adds additional ingredients to list.]

2.3. Manufacturer Submission Process. The submitter (manufacturer, distributor, or supplier) shall make a request for evaluation to the USDA Forest Service, Branch Chief for Fire Equipment and Chemicals.

2.3.1. The following documents describing the submission procedures, evaluation process, and the required performance for acceptable products are available on the internet at www.fs.fed.us/rm/fire/wfcs/lt-ret.htm:

- The Manufacturers Submission Procedures for Qualification Testing of Long-Term Retardant Products,
- This Specification and current amendments,
- Standard Test Procedures for the Evaluation of Wildland Fire Chemical Products.

2.3.1.1. Paper copies of these documents can be obtained from the Program Leader or Project Leader, Wildland Fire Chemical Systems (WFCS), 5785 Highway 10 West, Missoula, MT, 59808, if web access is unavailable.

2.3.1.2. **Terms and Definitions.** A list of terms used in this specification and their definitions can be found in Section 6.

2.3.1.3. **Sources of Reference Materials.** A list of sources for obtaining all referenced standards and test methods in this specification can be found in Section 7.

2.3.2. **Classification.** The submitter shall specify the classifications of the wildland fire chemical product, according to Sections 2.3.2.1 through 2.3.2.5, for which qualification is sought.

The evaluation shall be conducted following the test methods and requirements contained in this specification, based on the classifications requested by the submitter.

2.3.2.1. **Application Methods.** Each mixed product shall be classified based on the listed application methods.

HF	Helicopters having a fixed tank, either internal or external in direct contact with the helicopter.
FW/Multi-Engine	Fixed-wing (all delivery systems) land-based, multi-engine aircraft having a tank and delivery system for aerial application of wildland fire chemicals.

FW/Single-Engine	Fixed-wing (all delivery systems) land-based, single-engine (SEAT) aircraft having a tank and delivery system for aerial application of wildland fire chemicals.
HB/G	Helicopters having a bucket suspended below the helicopter such that no chemical is likely to contact the helicopter during normal fire operations and all ground-based application equipment, such as wildland engines, portable pumps, and other such devices.

2.3.2.2. **Form of concentrate.** Each concentrate shall be classified as wet or dry.

Dry Concentrate	A single, dry component which is mixed with water to prepare the mixed product.
Wet Concentrate	A single, liquid component which is mixed with water to prepare the mixed product.

2.3.2.3. **Storability**. All concentrates shall be evaluated as storable products.

Each mixed product shall be classified to indicate the type and length of storage the product is designed for and whether or not recirculation is required or recommended.

Storable	Concentrate is stable for at least 52 weeks. The mixed product is stable for at least 52 weeks. [Amendment 3 adds clarification.] Products may be recirculated in storage and recirculation may be required to obtain a homogeneous and usable product.
Not Storable	Concentrate is stable for at least 52 weeks. Mixed product is stable for at least 14 days. [Amendment 3 adds clarification.]

Products are mixed or blended during transfer to aircraft or other application devices. Minimal additional mixing or recirculation is necessary.

These products are not routinely stored in the mixed form except in application equipment where recirculation is not available.

2.3.2.4. **Color**. Each mixed product shall be classified as uncolored, iron oxide colored, or fugitive colored, as described below. All products qualified and approved for aerial application of any type shall be either iron oxide colored or fugitive colored. [Amendment 1 clarifies the intent of section 2.3.2.4.]

Uncolored	A mixed product that contains no ingredients that impart color. The product in the container may have some earth-tone color; however it is not visible when applied to natural fuels.
Fugitive Colored	A mixed product that contains one or more ingredients that impart a high degree of visibility from the air when first applied to wildland fuels but will lose visibility gradually over several months.
Iron Oxide Colored	A mixed product that contains at least 12 grams of iron oxide per gallon to impart red color to provide a high degree of visibility from the air at the time of application to wildland fuels.

2.3.2.5. **Viscosity Range**. Each mixed product shall be classified based on the viscosity of the product.

Mixed products must achieve the desired viscosity by hydration of an appropriate amount of guar gum, guar gum derivatives, xanthan, or other thickeners that imparts elasticity as well as viscosity.

High Viscosity	Mixed product with a viscosity between 801 and 1500 centipoise (cP).

Medium Viscosity	Mixed product with a viscosity between 401 and 800 cP.
Low Viscosity	Mixed product with a viscosity between 101 and 400 cP.

2.3.2.6. **Base Type.** The evaluation shall be conducted following the test methods and requirements contained in this specification, based on the classifications shown above.

Approvals for use from specific base types shall be determined by product performance and mixing and storage needs.

Permanent	Storable mixed products or not storable mixed products made from wet concentrates are suitable. Recirculation is possible, large/long-term storage capability, and auxiliary equipment are readily available.
Temporary/Mobile	Not storable mixed products are suitable; storable products may be suitable. Small volumes of mixed product storage capability and limited auxiliary equipment, including recirculation, are available.

2.3.3. **Collection Agreement and Test Fee.** A Collection Agreement between the Forest Service, Missoula Technology and Development Center (MDTC)-WFCS and the submitter will be prepared. This document describes the roles and responsibilities of the Forest Service, WFCS laboratory personnel, and the submitter.

Specific information in the agreement includes a list of authorized contacts for the Forest Service and for the submitter, as well as an estimate of the cost and time required for the evaluation.

2.3.4. **<u>Product Information</u>.** All product information described below shall be provided to the Forest Service and reviewed by the designated agency representative, as summarized in 2.4 and described in "Manufacturer Submission Procedures for Qualification Testing of Long-Term Retardant Products," prior to acceptance of samples for testing.

2.3.4.1. **<u>Proprietary Information</u>.** The formulation disclosure and other product information provided to the Forest Service as a part of the submission process will be maintained within the WFCS Program for use during the evaluation process.

All proprietary or sensitive information is kept in a locked file accessible only to the Program Leader and Project Leader of WFCS.

Occasionally information will be provided in response to inquiries from the Director of Fire and Aviation, the Branch Chief for Equipment and Chemicals or their staffs.

2.3.4.2. **<u>Access to Information Under the Freedom of Information Act</u>.** Information provided to the Forest Service as part of the product submission is subject to the Freedom of Information Act (FOIA), 5 U.S.C., Section 552.

Confidential and trade secret information shall not be disclosed if determined to be exempt under FOIA.

The results of the testing performed by the Forest Service may be disclosed under some circumstances.

2.3.4.3. **<u>Formulation Disclosure Sheet</u>.** The submitter shall submit a Formulation Disclosure Sheet (Table 1 of Manufacturer Submission Procedures) that includes the required information on all ingredients contained in the formulation.

Full disclosure of the types and amounts of each chemical in the product, the Chemical Abstract Services (CAS) number, quality or grade, and manufacturer shall be included for each ingredient.

The manufacturing process, manufacturing site, and other information that the supplier considers significant about each ingredient should also be provided. [Amendment 3 adds manufacturing site to the list of information to be provided.]

2.3.4.4. **<u>Mix Ratio</u>.** The submitter shall specify the mix ratio for which the product is designed and qualification is being sought.

2.3.4.5. **<u>Health and Safety Information</u>.** The submitter shall provide the following safety information to the Forest Service for review, prior to shipping the product:

a. Mandatory: Material Safety Data Sheet (MSDS) for the proposed product.

b. Mandatory: MSDS for each ingredient of the proposed product.

c. Optional: Summary of any toxicity or related safety test results conducted by or for the manufacturer prior to submission to the Forest Service.

2.3.4.6. **<u>Technical Data Sheet</u>.** The submitter shall provide a completed Technical Data Sheet (Tables 2 and 3 of Manufacturer Submission Procedures) giving all required information on the physical properties and characteristics of the product.

A description of field mixing and handling requirements shall be included.

2.3.4.7. **<u>Other Technical Information</u>.** The submitter shall provide information regarding laboratory mixing, field mixing and handling, and any special cleanup procedures that may be of use to the laboratory personnel at WFCS.

2.3.4.8. **<u>Patents</u>.** Copies of patents covering any aspect of the formulation or its application in wildland fire operations should be included in the submission documentation.

2.4. **<u>Review Prior to Product Submittal</u> (STP-1.1).** The Project Leader, WFCS shall review the documentation package for completeness and consistency. Any questions that may arise shall be resolved at that time.

2.4.1. **Chemicals of Concern.** A review of environmental regulations as they apply to the formulation and the ingredients of the formulation shall be completed at the same time. Specifically, the status of each chemical with regard to the regulatory lists shown below shall be determined.

a. 40 Code of Federal Regulations (CFR) 355 Appendix A. – Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), List of Extremely Hazardous Substances and Their threshold Planning Quantities.

b. National Toxicology Program's Annual Report on Carcinogens.

c. International Agency for Research on Cancer (IARC) Monographs for Potential Carcinogens.

d. 40 CFR 302.4. – CERCLA, List of Hazardous Substances and Reportable Quantities.

e. 40 CFR 261.33. – Resources Conservation and Recovery Act (RCRA), Acutely Hazardous and Toxic Wastes.

f. 40 CFR 372. – Superfund Amendment and Reauthorization Act (SARA) Title III, sec 313, Emergency Planning and Community Right to Know (EPCRA), Toxic Release Inventory (TRI).

2.4.2. **Chemical Profile and/or Risk Assessment.** If any of the ingredients trigger concern, a basic chemical profile and/or a risk assessment may be required before further action is taken on the formulation evaluation.

The Forest Service shall make a written notification to the submitter of these concerns and include the acceptable remedies and the associated costs. The submitter has the choice to continue or not at this point, and shall be asked to notify the Forest Service in writing of that decision.

If required, this risk assessment shall be performed by the Forest Service or an approved third-party selected by the Forest Service, using accepted methodology. All costs associated with the additional work shall be the responsibility of the submitter.

2.5. **<u>Submission of Samples for Laboratory Evaluation</u>.** When requested, and at no cost to the Forest Service, the submitter shall provide the required amount of concentrate for use in the laboratory evaluation tests.

2.5.1. **<u>Packaging</u>.** The packaging of all wildland fire chemicals submitted for evaluation shall conform to regulations governing the ground and air transport of materials.

The concentrates, in the quantities shown, shall be packaged as specified in Table 1.

Table L-1. Test sample quantity and packaging. [Amendment 3 increases the volume of product required.]

Product Type	Packaging	Quantity
Dry concentrate	5-gallon (18.9 liter) Plastic Pails with Removable Lids	20 Pails – Each containing the amount of concentrate to be added to 25 gallons (95 liters) of water
Wet concentrate	5-gallon (18.9 liter) Plastic Pails with Removable Lids	225 gallons (852 liters) in pails weighing £50 lbs (22.7 kg) each

Note: Based on specific product information, the Project Leader may specify a different amount of product than shown here.

2.5.2. **<u>Marking</u>.** Individual containers of products submitted for evaluation shall be legibly marked in accordance with Federal Standard 123.

Labeling shall comply with Department of Transportation, Occupational Safety and Health Administration, and applicable State and Local requirements and in addition shall include the following:

a. Manufacturer's name or trademark.

b. Product identification, including formulation codes and production information codes.

c. Volume of concentrate (weight in the case of a dry concentrate) per container.

d. Month and year of submission.

2.5.3. **Shipping.** The laboratory test sample shall be shipped at the submitter's expense to WFCS at MTDC in Missoula, Montana.

The complete address shall be provided as part of the shipping instructions when the product is requested.

An MSDS for the product shall accompany the shipment.

If the product is imported, the supplier shall be responsible for the entire process necessary to deliver the product to the test laboratory. [Amendment 3 adds clarification of responsibilities.]

3. **REQUIREMENTS.**

3.1. **Evaluation Samples and Mix Ratio.** The evaluation shall be conducted on the concentrate and on the mixed product prepared using the manufacturers' recommended mix ratio or other mix ratio as described below.

If the manufacturers' recommended mix ratio meets the listed criteria in Section 3.5.2, then no burn testing is required; for all other cases, the mix ratio shall be confirmed by combustion-retarding effectiveness testing and if adjusted, agreed to by the submitter.

The mixed product prepared using the mix ratio agreed to by the submitter and WFCS shall be used throughout this evaluation.

3.2. **Performance Information.** The properties and characteristics of the concentrates and mixed products may vary over a wide range of values. For some tests, a specific result is not required for qualification.

All listed tests, including those for which no required performance level is given, shall be performed and reported for information.

The performance information developed will be provided to user agencies as input to their procurement and decision-making processes.

3.2.1. **Modifications and Changes to Requirements.** At a later date some or all of these requirements may be amended to include limits to the performance values.

3.3. **Determination of Laboratory Mixing Procedures.** In accordance with 4.2, a suitable set of conditions and methods for preparing laboratory samples of the mixed product shall be determined.

This procedure shall be used to prepare all samples for the laboratory evaluation.

3.4. **Health and Safety.**

3.4.1. **Mammalian Toxicity and Irritation Tests.** As required by 3.4.1.1 and 3.4.1.2, the mammalian toxicity and irritation performance of the concentrate and mixed product shall be determined in accordance with 4.3.

The results will be made available to users as performance information.

3.4.1.1. **Concentrate.** The toxicity of the wet or dry concentrate shall meet the requirements in Table 2 when tested in accordance with 4.3.

Table L-2. Toxicity and irritation requirements for wet or dry concentrate.	
Test	Requirement
Acute oral toxicity	LD_{50} > 500 mg/kg.
Acute dermal toxicity	LD_{50} > 2000 mg/kg.
Primary eye irritation for washed and unwashed eyes	Mildly irritating or less. If more irritating, recommend protective gear and safe handling procedures.
Primary dermal irritation	Primary irritation index < 5.0. If more irritating, recommend protective gear and safe handling procedures.

3.4.1.1.1. **Review of Mammalian Toxicity and Irritation Test Results.** When the test results for a concentrate indicate that protective gear and safe handling procedures are needed, the manufacturer shall make recommendations to be added to the product label and the Material Safety Data Sheet (MSDS).

In accordance with 4.3.2, the results and related recommendations shall be reviewed by the Program Leader and Project Leader, WFCS, and approved as appropriate.

For unusual situations, the Safety and Health Branch of the Forest Service, Washington Office will be contacted for technical assistance.

3.4.1.2. **Mixed Product.** The toxicity of the mixed product shall meet the requirements in Table 3 when tested in accordance with 4.3.

Table L-3. Toxicity and irritation requirements for mixed product.

Test	Requirement
Acute oral toxicity	LD_{50} > 5000 mg/kg.
Acute dermal toxicity	LD_{50} > 2000 mg/kg.
Primary eye irritation for washed and unwashed eyes	Mildly irritating or less.
Primary dermal irritation	Primary irritation index < 5.0.

3.4.2. **Fish Toxicity**. The LC_{50} for rainbow trout exposed to the concentrate shall be greater than 100 mg/L when tested in accordance with 4.4.

The results will be made available to users as performance information.

3.5. **Combustion-Retarding Effectiveness.** All mixed retardants shall meet the criteria in 3.5.1.

All mixed retardants shall meet the requirements of 3.5.2 or 3.5.3.

3.5.1. **Retarding Salts.** All products shall use one or a combination of diammonium phosphate, monoammonium phosphate, or ammonium polyphosphate (10-34-0 or 11-37-0) to impart combustion retarding effectiveness.

3.5.2. **Required Retarding Salt Concentration.** A product containing one of the following retarding salts or mixtures of salts at or greater than the listed concentrations shall not require a burn test.

The salt concentration shall be verified by chemical analysis during the evaluation.

a. Diammonium phosphate (DAP), industrial grade or better (21-53-0), in the mixed retardant at a concentration of 10.6 percent or greater.

Fertilizer grade and other lower grades shall be burn tested to establish an acceptable mix ratio.

b. Monoamonium phosphate (MAP), industrial grade or better (12-62-0), in the mixed retardant at a concentration of 9.2 percent or greater.

Fertilizer grade and other lower grades shall be burn tested to establish an acceptable mix ratio.

c. P_2O_5 in fertilizer grade ammonium polyphosphates (APP; 10-34-0 or 11-37-0) in the mixed retardant at a concentration of 8.0 percent or greater ortho phosphate.

d. Combinations of DAP and MAP, industrial grades or better, having a total of 10.6 percent DAP (21-53-0) equivalents or greater using the conversions described below.

Use the DAP concentration without conversion.

Use the MAP concentration multiplied by 1.15.

e. Fertilizer grade DAP or MAP, alone or in combination shall require a burn test.

3.5.3. **<u>Combustion-Retarding Effectiveness Test</u>.** When a mixed retardant does not meet one of the criteria in 3.5.2, the product shall undergo a fire effectiveness test in accordance with 4.5.

A reduction index greater or equal to the reduction index of the standard chemical, 10.6-percent DAP, shall be acceptable.

3.6. **Physical Properties.** In accordance with 4.6, the physical properties of the dry and wet concentrate and all mixed retardants shall be determined as specified in 3.6.1, 3.6.2, and 3.6.3.

These test results shall define the standard characteristics for the submitted product and be used to address quality issues.

The results will be made available to users as performance information.

3.6.1. **Physical Properties of the Dry Concentrate.** In accordance with 4.6, the retarding salt content of the dry concentrate shall be determined.

The values determined shall be used as baseline values for stability tests as required in 3.9.

The results will be made available to users as performance information.

3.6.2. **Physical Properties of the Wet Concentrate.** In accordance with 4.6, the retarding salt content, viscosity, density, and pH of the wet concentrate shall be determined.

The values determined shall be used as baseline values for stability tests as required in 3.9

The results will be made available to users as performance information.

3.6.3. **Physical Properties of the Mixed Retardant.** In accordance with 4.6, the retarding salt content, the refractometer reading, steady-state viscosity, density, and pH of the mixed retardant shall be determined.

The values determined shall be used as baseline values for stability tests as required in 3.9.

The results will be made available to users as performance information.

3.6.3.1. **Retarding Salt Content.** When tested in accordance with 4.6.1 the retarding salt content shall meet the requirements of 3.5.2 or 3.5.3.

The results will be made available to users as performance information.

3.6.3.2. **Steady State Viscosity.** When tested in accordance with 4.6.3.1, the steady state viscosity shall meet the requirements of the classification for which the product was submitted.

The results will be made available to users as performance information.

3.7. **Materials Effects.** As required by 3.7.1 through 3.7.4, the effects of the wet concentrate and mixed retardant on metallic and non-metallic materials shall be determined in accordance with 4.7.

The results will be made available as performance information.

3.7.1. **Uniform Corrosion.** When tested in accordance with 4.7.1, wet concentrate and freshly prepared mixed retardant shall not have corrosion rates exceeding those shown in Table 4 for the alloys listed.

3.7.2. **Intergranular Corrosion.** When tested in accordance with 4.7.2, the alloys specified in 3.7.2.1 through 3.7.2.4 shall show no evidence of intergranular corrosion.

3.7.2.1. **Helicopter Fixed Tank.** When tested in accordance with 4.7.2, coupons made of alloy 2024-T3 aluminum and Az-31B magnesium shall not exhibit intergranular corrosion following exposure to mixed retardant during the uniform corrosion tests.

3.7.2.2. **Multi-Engine, Fixed-Wing Air Tanker.** When tested in accordance with 4.7.2, coupons made of alloy 2024-T3 aluminum shall not exhibit intergranular corrosion following exposure to mixed retardant during the uniform corrosion tests.

3.7.2.3. **Single-Engine, Fixed-Wing Air Tanker.** When tested in accordance with 4.7.2, coupons made of alloy 2024-T3 aluminum shall not exhibit intergranular corrosion following exposure to mixed retardant during the uniform corrosion tests.

3.7.2.4. **Helicopter Bucket and Ground Based Application Equipment.** There are no intergranular corrosion requirements for helicopter bucket.

Table L-4. Maximum Allowable Corrosion Rates (mils-per-year) for Wildland Fire Chemical Products.[1]

	2024-T3 Aluminum				4130 Steel				Yellow Brass	Az31B Magnesium			
	Total		Partial		Total		Partial		Partial	Total		Partial	
Temperature: °F	70	120	70	120	70	120	70	120	120	70	120	70	120
	-mils-per-year-												
Concentrates													
Wet concentrates	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Wet concentrates [2]	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0				
Mixed Products													
Fixed-tank helicopters [3]	2.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0
Fixed-wing air tankers [4]	2.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	5.0				
Helicopter bucket and [2]	2.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	5.0				

[1] All uniform corrosion rates shall be determined by 90-day weight loss tests. All uniform corrosion rates are the maximum allowable average of all replicates.

[2] Magnesium uniform corrosion tests shall be performed for performance information. Intergranular corrosion tests are not required on aluminum or magnesium.

[3] Intergranular corrosion tests shall be performed on aluminum and magnesium coupons; no intergranular corrosion is allowed.

[4] Intergranular corrosion tests shall be performed on aluminum coupons; no intergranular corrosion is allowed. Magnesium uniform corrosion tests shall be performed for performance information. Intergranular corrosion tests are not required on magnesium.

3.7.3. **Effects of Concentrate and Mixed Product on Non-Metallic Materials.** In accordance with 4.7.3, the wet concentrates and all mixed retardants shall be tested to determine their effect on the non-metallic materials listed in Table 5 and their ability to meet the requirements of 3.7.3.1.

Table L-5. Materials to be tested to determine the effect of exposure to wet concentrate and/or mixed retardant.

Material	Material Specification
- - Shall Be Tested And Performance Provided To User Agencies. - -	
Chloroprene rubber	AMS 3208M
PVC Plastic, Flexible	MIL A-A-55859A
Sealant	AMS S-8802
Fiberglass/Epoxy Resin	AMS C-9084
High-Density Polyethylene	ASTM D 4976
Low-Density Polyethylene	ASTM D 4976
Sealant	MIL PRF-81733D
Flexible Cross-Linked Polyolefin	AMS DTL-23053/5

3.7.3.1. **Effect of Exposure to Wet Concentrate and Mixed Product on Non-Metallic Materials.** When tested as required in 3.7.3, the changes in hardness and volume of each of the materials listed in Table 5 shall be determined.

All results shall be reported to user agencies as performance information.

Characteristics	Reportable Change
Hardness	≤ 10-percent decrease
Hardness	≤ 20-percent increase
Volume	£ 0.5 mL from initial

3.7.4. **Abrasion.** When tested in accordance with 4.7.4, all wet concentrates and mixed retardants prepared from dry concentrates, shall be tested for the abrasiveness of the retardant to aluminum 2024-T3.

Total abrasion of the disc and the wear plate shall not exceed 0.010 inch (0.25 mm), when rotated at 1800 rpm for 50 hours.

3.8. **Pumpability.** When tested in accordance with 4.8 the pumpability of all wet concentrates and mixed retardants prepared from dry concentrates shall be determined.

A minimum flow rate of 18 gallons (68.1 liters) per minute is required.

3.9. **Product Stability.** When tested in accordance with 3.9, concentrates and mixed retardants shall meet all applicable requirements of 3.9.1 through 3.9.3.

3.9.1. **Outdoor Storability.** When tested in accordance with 4.9.1, the concentrate and mixed products shall meet all applicable requirements of 3.9.1.1 and 3.9.1.2.

3.9.1.1. **Concentrates.** All concentrates shall meet the requirements of either 3.9.1.1.1 or 3.9.1.1.2.

3.9.1.1.1. **Dry Concentrates.** In accordance with 4.9.1.1.1, dry concentrates shall be stored outdoors for 52 weeks.

The stored concentrate shall have no visual separation such as discoloration or caking. Lumps shall fit through a 0.25-inch (0.625 cm) sieve-size.

The stored concentrate shall be used to prepare mixed retardant as required in 3.9.1.1.3.

3.9.1.1.2. **Wet Concentrates.** In accordance with 4.9.1.1.2, wet concentrates shall be stored outdoors for 52 weeks.

There shall be no separation resulting in particles larger than 0.25-inch (0.625 cm) sieve-size.

The stored concentrate shall be tested to determine the following properties:

a. Viscosity, in accordance with 4.6.3,
b. Density, in accordance with 4.6.4,and
c. pH, in accordance with 4.6.5.

The stored concentrate shall be used to prepare mixed retardant as required in 3.9.1.1.3.

The results will be made available to users as performance information.

3.9.1.1.3. **Mixed Retardant from Stored Concentrate.** As required by 3.9.1.1.1 and 3.9.1.1.2, the mixed retardant shall be prepared from the stored concentrate and tested as required in 3.9.1.1.4 through 3.9.1.1.6.

3.9.1.1.4. **Physical Properties of Mixed Retardant from Stored Concentrate.** The mixed retardant, prepared as required in 3.9.1.1.3, shall be tested to determine the following properties:

a. Viscosity, in accordance with 4.6.3,
b. Density, in accordance with 4.6.4, and
c. pH, in accordance with 4.6.5.

These values shall be within the allowable variation, as shown in Table 6, from the original values, determined in 3.6.2, for the initial values for the mixed retardant prepared from fresh concentrate. [Amendment 3 adds clarification.]

The results will be made available to users as performance information.

Table L-6. Allowable Variation of Physical Properties of Mixed Retardant Prepared from Concentrate Stored for 52 weeks.

Property	Allowable Variation from Initial Value
Steady-State Viscosity	± 15 percent
Density	± 1 percent
pH	± 0.75 units

3.9.1.1.5. **Stability of Mixed Retardant from Stored Concentrate.** The mixed retardant, prepared as required by 3.9.1.1.3, shall be stored outdoors for 14 days, in accordance with 4.11.1.2, for freshly prepared mixed retardant.

The stored mixed retardant shall be tested as required in 3.9.1.1.4 and 3.9.1.1.5.

3.9.1.1.6. **Corrosivity of Mixed Retardant from Stored Concentrate.** The mixed retardant, prepared as required by 3.9.1.1.3, shall be tested to determine for uniform and intergranular corrosion and shall meet the uniform and intergranular corrosion requirements of 3.7.1 and 3.7.2.

3.9.1.2. **Outdoor Stability of the Mixed Retardant.** In accordance with 4.9.1.2, the mixed retardant shall be stored outdoors for 14 days.

At the end of the storage period, the stored mixture shall be examined visually and shall have no separation resulting in particles larger than 0.25-inch (0.635 cm) sieve size.

The stored mixed retardant shall be tested as required in 3.9.1.2.1 or 3.9.1.2.2. and 3.9.1.2.3.

Table L-7. Allowable Variation of Physical Properties of Stored Mixed Retardant.

Property	Required Performance
Steady-State Viscosity	Shall be ³ 60 percent of the initial value
Density	Shall be ± 1 percent of the initial value

pH	Shall be ± 0.75 units of the initial value

3.9.1.2.1. **<u>Storable</u>.** In accordance with 4.9.1.2.1, the mixed retardant shall be stored outdoors for 52 weeks.

Following recirculation, there shall be no separation resulting in crystals or other particles larger than 0.25-in (0.635 cm) sieve size.

The mixed retardant shall be tested to determine the following physical properties:

a. Steady-State Viscosity, in accordance with 4.6.3.1,
b. Density, in accordance with 4.6.4, and
c. pH, in accordance with 4.6.5.

These values shall be within the allowable variation from the initial values, determined in 4.5.3, physical properties, on the fresh retardant, as shown in Table 7.

The mixed retardant shall meet the corrosion requirements shown in Table 4 for uniform and intergranular corrosion when tested in accordance with 4.7.1 and 4.7.2.

3.9.1.2.2. **<u>Not Storable</u>.** In accordance with 4.11.1.2.2, the mixed retardant shall be stored outdoors for 14 days.

Following recirculation, there shall be no separation resulting in crystals or other particles larger than 0.25-in (0.635 cm) sieve size.

The mixed retardant shall be tested to determine the following physical properties:

a. Steady-State Viscosity, in accordance with 4.6.3.1,
b. Density, in accordance with 4.6.4, and
c. pH, in accordance with 4.6.5.

These values shall be within the allowable variation from the initial values, determined in 4.5.3, physical properties, on the fresh retardant, as shown in Table 7.

3.9.2. **<u>Effect of Temperature Cycling on Wet Concentrate and Mixed Retardant</u>.** In accordance with 4.9.2, the wet concentrate and mixed retardant prepared from dry concentrate shall be subjected to temperature cycling.

The stored concentrate shall be tested to determine the following properties:

a. Viscosity, in accordance with 4.6.3,
b. Density, in accordance with 4.6.4,and
c. pH in accordance with 4.6.5.

The results shall be made available to users as performance information.

The concentrate shall be used to prepare mixed retardant which shall be tested as required in 3.9.2.1.

3.9.2.1. **Mix Retardant Prepared from Temperature-Cycled Concentrate.** As required by 3.9.2, mixed retardant prepared from temperature-cycled concentrate and fresh water shall be tested in accordance with 4.9.3 to determine the following properties:

a. Steady-State Viscosity, in accordance with 4.6.3.1,
b. Density, in accordance with 4.6.4, and
c. pH, in accordance with 4.6.5.

Changes in these properties shall be calculated.

Results will be made available to users as performance information.

3.9.3. **Resistance of Wet Concentrates and Mixed Retardant to Microbial Growth.** After 14 days in storage in accordance with 4.9.4, wet concentrates and mixed retardant shall show no visible sign of microbial contamination, including growths on the surface or within the fluid, significant discoloration, or other change in appearance.

3.10. **Color Properties and Visibility.** All mixed retardants shall be evaluated in accordance with 4.12.1 and 4.12.2 and meet the requirements of 4.10.1 and 4.10.2 as applicable for the color system used.

3.10.1. **Color of Iron-Oxide Colored Retardant.** The iron-oxide colored mixed retardant shall contain a minimum of at least 12 grams of iron oxide per gallon to impart red color to the mixed retardant.

3.10.2. **Laboratory Evaluation of Fugitive-Colored Mixed Retardant.** As required by 3.10.2.1 and 3.10.2.2, all fugitive-colored mixed retardant shall be tested to determine the opacity and fading of films applied in accordance with 4.10.1.1 through 4.10.1.4

3.10.2.1. **Opacity of Fugitive-Colored Mixed Retardant.** When tested in accordance with 4.10.1.2, all fugitive-colored mixed retardant shall be tested to determine their opacity on a 20-step black-white opacity chart.

The results shall be made available to users as performance information.

3.10.2.2. **Fading of Fugitive-Colored Mixed Retardant.** In accordance with 4.10.1.4, at the end of the exposure period in accordance with 4.10.1.3, the mixed retardant with fugitive colorant shall be no more colored than a sample of the uncolored product in water applied and treated in the same manner as the mixed retardant.

3.10.3. **Field Visibility.** In accordance with 4.10.2, the visibility of each mixed retardant shall be determined by an experienced observer team designated by the government and shall meet the requirements in 3.10.3.1, 3.10.3.2, or 3.10.3.3.

All costs associated with the field visibility test shall be the responsibility of the submitter.

3.10.3.1. **Field Visibility of Uncolored Mixed Retardant.** The mixed retardant shall be determined to be not noticeably visible 24 hours after application.

3.10.3.2. **Field Visibility of Iron Oxide-Colored Mixed Retardant.** The mixed retardant shall be determined to be acceptably visible immediately after application.

3.10.3.3. **Field Visibility of Fugitive-Colored Mixed Products.** When tested in accordance with 4.10.2, all fugitive-colored mixed products for aerial application shall be determined to be acceptably visible immediately after application; and shall be determined to be not noticeably visible 3 months after application.

3.11. **Air Drop Characteristics.** When deemed necessary by the Forest Service and when tested in accordance with 4.11, the air drop characteristics of the mixed product shall be determined.

All costs associated with the air drop characteristics test shall be the responsibility of the submitter.

3.12. **Operational Field Evaluation.** In accordance with 4.12, after meeting requirements of 4.4 through 4.10, an analysis shall be undertaken to determine the need for an operational field evaluation. A copy of the analysis shall be provided to the submitter.

The analysis will document the rationale for no field test or provide a summary of the issues and performance to be addressed during the field evaluation.

Product for the operational field evaluation shall be purchased by the Forest Service or other cooperating agency according to the classification established during qualification testing. All other costs associated with the operational field evaluation shall be the responsibility of the submitter.

The product shall perform satisfactorily under operational conditions during a fire season. An acceptable test should include fire fighting operations on a variety of fuel types, slopes, aspects, and exposures.

Operations should include both routine and accelerated burning conditions and multiple ignitions over several months.

4. **TEST PROCEDURES.** Detailed test methods are described in Standard Test Procedures for the Evaluation of Wildland Fire Chemical Products (STP). The web and postal addresses are given in 7.2.2.

4.1. **Simplification of Terms.** Specifying temperatures, sample containers, and coupons dimensions is cumbersome and leads to confusion regarding the required test.

The full description of these terms is provided as definitions in Section 6 and a simplified version is used throughout the remainder of this specification.

Evaluation and Exposure Temperatures. Frequently used exposure temperatures – including allowable ranges and conversions to Celsius are described in detail in Section 6.

Other temperature and range requirements are shown in detail within the applicable section of the specification.

Sample Containers. Two types of sample containers are used throughout the evaluation process. They are defined in Section 6 and referred to throughout the specification as a large sample container and a small sample container.

Coupons. Three types of coupons are used throughout the evaluation. They may be made of different alloys, but the dimensions in English and metric units are provided in Section 6 and referred to throughout the specification as a large stability coupon, a small stability coupon, and a corrosion coupon.

4.2. **Determination of Laboratory Mixing Procedures (STP-3).** As required by 3.3, procedures for the optimum mixing of the retardant shall be determined, in order to obtain maximum stability and performance characteristics.

4.3. **Mammalian Toxicity and Irritation Tests (STP-1.2).** As required by 3.4.1, mammalian toxicity and irritation testing on all wet and dry concentrates and mixed retardant, shall be conducted by an independent biological testing laboratory approved by the Forest Service.

All testing shall be conducted in compliance with 40 CFR 160 and 792 Good Laboratory Practice Standards, in accordance with EPA/OPPTS Health Effects Test Guidelines, Series 870 and shall include:

a. OPPTS 870.1100, Acute Oral Toxicity;

b. OPPTS 870.1200, Acute Dermal Toxicity;

c. OPPTS 870.2400, Primary Eye Irritation; in addition to the standard test, a test shall be performed with washed eyes.

In the test with washed eyes, three test animals shall be exposed to the test product for 30 seconds. The exposed eyes shall then be washed with room-temperature, deionized water for 1 minute. Examinations, schedules, and ratings shall be the same as for the standard test.

d. OPPTS 870.2500, Primary Dermal Irritation.

4.3.1. **Report of Test Results.** The results of mammalian toxicity and irritation testing shall be certified by the testing laboratory and submitted directly to the Project Leader, MTDC-WFCS Missoula, Montana for review and recommendations.

4.3.2. **Review of Mammalian Toxicity and Irritation Test Results.** When required in accordance with 3.4.1.1.1, the Project Leader, WFCS shall review the results of the testing and the submitter's recommended protective gear and safe handling procedures to ensure adequate protection for workers and the general public who may come into contact with the product. Recommendations shall be reviewed by the Program Leader prior to final approval.

For unusual situations, the Washington Office Safety and Health Branch will be contacted for technical assistance.

4.4. **Fish Toxicity (STP-1.4).** As required by 3.4.2, the toxicity of the concentrate to rainbow trout (Oncorhynchus mykiss) shall be determined in accordance with OPPTS 850.1075, Ecological Effects Test Guidelines, Fish Acute Toxicity Test, Freshwater and Marine.

Static test conditions in ASTM soft water (described in ASTM E 729) at 54 ± 2ºF (12 ± 1ºC) shall be maintained throughout the 96-hour test period.

All fish shall be 60 ± 7 days post hatch.

4.5. **Combustion Retarding Effectiveness Test (STP-2).** As required by 3.5.3, when the retardant does not meet the requirements in 3.5.2, the combustion retarding effectiveness of the mixed retardant shall be determined.

Fuel beds of aspen excelsior or Ponderosa pine needles shall be prepared and treated with mixed retardant or 10.6-percent diammonium phosphate (control) and then dried at standard temperature and humidity to remove the water contained in the retardant or control.

The mixed retardant-treated fuel beds shall be tested and the effect of the mixed retardant on the rate of flame spread and rate of fuel weight loss determined.

The reduction index shall be calculated by comparing the rate of flame spread and rate of weight loss of the retardant-treated and control-treated beds to the untreated beds made from the same fuels as the treated beds.

4.6. **Physical Properties.** As required by 3.6, the concentrate and the mixed retardant shall be tested to determine the retarding salt content, refractometer reading, viscosity, steady state viscosity, density, and pH.

4.6.1. **Retarding Salt Content Test (STP-4.1).** As required by 3.6.3.1, the mixed retardant shall be tested using recognized analytical methods to determine the retarding salt content.

Ortho and total phosphate shall be determined in accordance with AOAC accepted test methods.

4.6.2. **Refractometer Reading (STP-4.2).** As required by 3.6.3, the refractometer reading of a properly mixed retardant shall be determined using a hand-held refractometer that incorporates the scale found in Reichert industrial fluid testers or the Brix scale.

4.6.3. **Viscosity Test (STP-4.5).** As required by 3.6.2 and 3.6.3, the viscosity of all wet concentrates and mixed retardants at 70 °F shall be measured using a Brookfield Viscometer, model LVF, or equal, set at 60 rpm with the appropriate spindle.

The same spindle shall be used for the initial and final viscosity measurements to determine stability performance.

4.6.3.1. **Steady State Viscosity.** As required by 3.6.3.2, the viscosity of the mixed retardant at 10 minutes, 1 hour, 4 hours, 8 hours, 1 day, and daily for 8 days after mixing shall be determined as described in 4.6.3.

Viscosity values shall be graphed against time. The viscosity value corresponding to the plateau of the viscosity curve, typically 24 hours, shall be determined. This shall be referred to as the steady state viscosity.

4.6.4. **Density Test (STP-4.3).** As required by 3.6.2 and 3.6.3, the density of the wet concentrate and mixed retardant shall be determined to the nearest 0.001 g/mL by fluid displacement or electronic density meter.

4.6.5. **pH Value Test (STP-4.4).** As required by 3.6.2 and 3.6.3, the pH of wet concentrates and mixed retardant shall be determined using a full range pH meter, capable of being read to 0.1 pH.

4.7. **Materials Effects Tests**. As required by 3.7, wet concentrates and mixed retardant shall be tested to determine uniform and intergranular corrosion of selected alloys and the effects to non-metallic materials.

4.7.1. **Uniform Corrosion (STP-5.1).** As required by 37.1, the uniform corrosion caused by the wet concentrate and mixed retardant shall be determined as summarized below.

Test coupons of 2024-T3 aluminum, 4130 steel, UNS C27000 yellow brass, and Az31B magnesium shall be engraved with a unique identification number, measured, cleaned, dried, and weighed.

Each coupon shall be immersed in the test solution and allowed to remain undisturbed at the required conditions for 90 days.

At the end of the test duration, each coupon shall be cleaned, dried, and weighed, and the corrosion rate calculated.

All corrosion rates for the same product, alloy, immersion condition and temperature shall be averaged.

4.7.2. **Intergranular Corrosion Test (STP-5.2).** As required by 3.7.2, mixed retardant shall be tested for intergranular corrosion.

At least one coupon from each exposure and temperature from the uniform corrosion tests on the specified alloys shall be sliced as shown in Figure 3.

The coupon shall be mounted, polished to 0.3 micron alumna finish, and etched using Keller's reagent for aluminum coupons and Nital reagent for magnesium coupons.

The etched coupons shall be examined microscopically with a magnification of 500X.

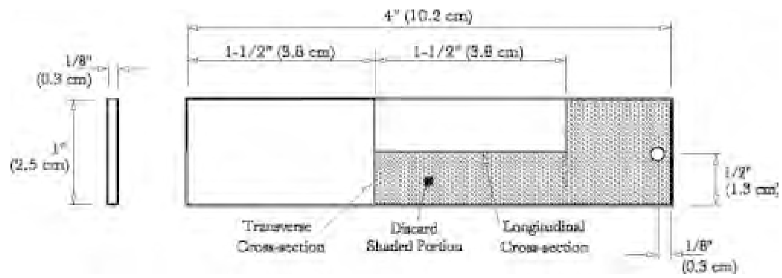


Figure L-1. Diagram for cutting and examining coupons for intergranular corrosion.

4.7.3. **Effect of Wet Concentrate and Mixed Retardant on Non-Metallic Materials (STP-5.3).** As required by 3.7.3, the wet concentrate and all mixed retardants shall be tested to determine their effect on non-metallic materials, as summarized below.

Prior to exposure of the non-metallic materials, the hardness and volume of each non-metallic sample shall be determined. A hand-held durometer, of the prescribed type, shall be used to measure the hardness and either fluid displacement or dimensional analysis shall be used to determine the volume.

The test pieces of each non-metallic material shall be exposed for 20 cycles. Each cycle shall consist of the material being immersed in the fluid at night and on weekends and in the air during the work day.

At the end of the test period, each test piece shall be rinsed, allowed to air dry, and the hardness and volume of each piece determined on the same day as the exposure ends.

The change in hardness and volume from the initial value of each shall be calculated.

If the result of either exceeds the allowable maximum, the measurements shall be repeated the next day and the calculation of change calculated. No additional measurements shall be allowed.

The results of the last set of measurements taken shall be used to determine performance.

4.7.4. **Abrasion Test (STP-7).** As required by 3.7.4, the abrasiveness of the wet concentrate or mixed retardant from dry concentrate to aluminum 2024-T3 shall be determined as summarized below.

Abrasion tests shall be performed following acceptable results on the outdoor storage test.

A disc and a wear plate made of aluminum 2024-T3 shall be installed on the apparatus, parallel to each other with a 0.020-inch (0.5-mm) gap between them, and submerged in retardant.

The top plate shall be rotated at 1800 rpm for 50 hours.

The plate and disc shall be measured to the nearest0.001 inch (0.025 mm) before and after the test.

The maximum wear on the disc and the wear plate shall be added to determine the total abrasion.

4.8. **Pumpability Test (STP-6).** As required by 3.8, the pumpability of the wet concentrate or mixed retardant from dry concentrate shall be determined as summarized below.

Pumpability tests shall be performed following acceptable results on the outdoor storage test.

The test apparatus shall consist of a storage tank, a pump and a scale-mounted weighing tank.

The time required for the retardant to be transferred from the storage tank to the weighing tank shall be determined.

The change in weight over time shall be used to calculate the flow rate of the product.

4.9. **Product Stability Test (STP-4).** As required by 3.9, all concentrates and mixed retardant shall be tested for product stability as summarized in 4.9.1 through 4.9.3.

4.9.1. **Outdoor Storage Test.** As required by 3.9.1, concentrates and mixed retardant shall be tested to determine the effects of storage in outdoor weather conditions.

4.9.1.1. **Concentrates.** Each retardant concentrate shall be evaluated to determine outdoor stability in accordance with 4.9.1.1.1 or 4.9.1.1.2.

4.9.1.1.1. **Dry Concentrates.** As required by 3.9.1.1.1, each dry concentrate shall be evaluated for outdoor stability.

To document the initial condition of the product, the fresh concentrate shall be examined visually to determine the general condition of the concentrate, including the fluidity, presence or absence of lumps, the ease of crumbling the lumps, or visually separate layers.

The fresh concentrate shall then be stored, in large sample containers outdoors at MTDC-WFCS and San Dimas Technology and Development Center (SDTDC) for 52 weeks.

At the end of the 52 week storage period, the samples shall be examined visually to determine that there are not changes in the general condition, such as fluidity and/or presence of hard lumps, from the original sample.

As required by 3.9.1.1.3, the stored concentrate shall be used to prepare mixed retardant in accordance with 4.11.1.1.3.

4.9.1.1.2. **Wet Concentrates.** As required by 3.9.1.1.2, each wet concentrate shall be evaluated for outdoor stability.

The initial condition of the fresh concentrate shall be documented including the presence or absence of crystals or other solids greater than 0.25 inch (0.635 cm).

The fresh concentrate shall then be stored, in a large sample container containing a steel stability coupon, outdoors at MTDC-WFCS and SDTDC for 52 weeks.

At the end of the 52 week storage period, the sample shall be inspected to determine that changes from in the general condition of the concentrate have not occurred and tested as required in 3.9.1.1.2.

As required by 3.9.1.1.3, the stored concentrate shall be circulated and used to prepare mixed retardant in accordance with 4.11.1.1.3.

4.9.1.1.3. **Mixed Retardants from Stored Concentrate**. As required by 3.9.1.1.3, the mixed product shall be prepared using the method determined in 4.2.

As required by 3.9.1.1.4 and 3.9.1.1.5, mixed product shall be prepared from stored concentrate and fresh water and tested to determine the density, pH, and steady-state viscosity.

As required by 3.9.1.1.6 and 3.9.1.1.7, mixed product shall be prepared from stored concentrate and fresh water and tested to determine the outdoor stability and corrosivity of the mixed retardant from stored concentrate.

4.9.1.2. **Mixed Retardant.** Each mixed retardant shall be evaluated to determine outdoor stability in accordance with 4.9.1.2.1 or 4.9.1.2.2.

4.9.1.2.1. **Storable.** As required by 3.9.1.2.1, the mixed retardant shall be stored in large sample containers, each containing alarge,mild steel stability coupon, outdoors at MTDC-WFCS and SDTDC for 52 weeks.

During the 52-week storage period, the sample shall be visually inspected monthly and any visual changes noted.

At the end of the 52-week storage period, the sample shall be mixed for 1 minute with low shear (1800 rpm with 2-bladed propeller-type stirrer).

The recirculated sample shall then be tested in accordance with 4.6 to determine steady-state viscosity, density, pH value, and 4.7.1 and 4.7.2 to determine uniform corrosion and intergranular corrosion.

4.9.1.2.2. **Not Storable.** As required by3.9.1.2.2, the mixed retardant shall be stored in large sample containers, each containing a large, 2024-T3 aluminum stability coupon, outdoors at MTDC-WFCS and SDTDC for 14 days.

During the 14-day storage period, the sample shall be visually inspected at 7 and 14 days and any visual changes noted.

At the end of the 14-day storage period, the carboy shall be opened. The stored product shall be mixed for one minute with low shear (1800 rpm with 2-bladed propeller-type stirrer).

The recirculated sample shall be tested in accordance with 4.6 to determine, steady-state viscosity, density, and pH value.

4.9.2. **Temperature Cycling Test.** As required by 3.9.2, small sample containers containing 800-mL samples of the wet concentrate and mixed retardant prepared from dry concentrate shall be examined visually as described below.

At the beginning of the test, the physical appearance of each sample shall be described. The presence of growths on the surface or within the fluid, significant discoloration or other changes in odor or appearance which might be related to microbial degradation shall be noted.

The samples shall then be exposed to temperature cycling as described in 4.9.2.1 through 4.9.2.4.

Each cycle shall consist of 1 day (8 to 10 hours) and the following night (or weekend).

Following each prescribed exposure, the samples shall sit for 24 hours at 70 °F to come to room temperature.

Each sample shall again be examined visually and any changes from the initial appearance noted.

The density, viscosity, and pH of the samples shall be determined in accordance with 4.6.

As required by 3.9.2.1, the concentrate shall be used to prepare mixed retardant and tested in accordance with 4.9.3.

4.9.2.1. **Exposure 1**: The sample shall be stored for 30 cycles. Each cycle shall consist of 1 day at 70 °F and 1 night (or weekend) at 120 °F.

4.9.2.2. **Exposure 2**: The sample shall be stored for 30 cycles. Each cycle shall consist of 1 day at 70 °F and 1 night (or weekend) at 15 °F.

4.9.2.3. **Exposure 3**: The sample shall be stored for a total of 60 cycles. The first 30 cycles shall consist of 1 day at 70 °F and 1 night (or weekend) at 120 °F. The last 30 cycles of 1 day at 70 °F and 1 night (or weekend) at 15 °F.

4.9.2.4. **Exposure 4**: The sample shall be stored for a total of 60 cycles. The first 30 cycles shall consist of 1 day at 70 °F and 1 night (or weekend) at15 °F. The last 30 cycles of 1 day at 70 °F and 1 night (or weekend) at 120 °F.

4.9.3. **Performance of Mixed Retardant Prepared from Temperature-Cycled Concentrate.** As required by 3.9.2.1, the temperature-cycled, wet concentrate shall be used to prepare mixed retardant in fresh water and tested to determine the density, pH, and steady-state viscosity.

4.94. **Resistance to Microbial Growth Test (STP-6.4).** As required by 3.9.3, the mixed retardant shall be tested, observed, and assessed for microbial contamination.

A small sample container containing 800 mL of the mixed retardant and a 2024-T3 aluminum small, stability coupon, shall be capped tightly to prevent evaporation, and allowed to sit undisturbed at 70 °F for 14 days.

The physical appearance, including growths on the surface or within the fluid, significant discoloration, or other changes shall be described and recorded at the initiation of the test and on days 1, 2, 7, and 14.

4.10. **Visibility Tests.** As required by 3.10 and at the fire chemical manufacturer's expense, the iron oxide-colored, uncolored, and fugitive-colored mixed retardant shall be tested to determine the visibility of the mixed products.

4.10.1. **Laboratory Visibility Test of Fugitive-Colored Retardant.** As required by 3.10.1, the mixed retardant shall be tested to determine the opacity and fading characteristics of the fugitive-colored retardant.

4.10.1.1. **Preparation of the Test Panels.** The fugitive-colored product and the product without color, as a control, shall be used to prepare the test panels.

Five test panels of plate glass shall be treated by applying a 0.064 inch (4 GPC) thick layer of the test product with a Gardner knife or equivalent.

Five control panels shall be treated in the same manner with the uncolored product.

4.10.1.2. **Opacity of the Mixed Retardant (STP-10.2).** As required by 3.10.2.1, the opacity of the mixed retardant film on the glass panel shall be determined immediately after application and again after 24 hours.

4.10.1.3. **Light Exposure of the Mixed Retardant.** The test and control panels shall be exposed outdoors to natural light at a test facility acceptable to the Forest Service.

All exposures shall be performed in accordance with ASTM G-24 (Standard Recommended Practice for conducting Natural Light Exposures) until 50,000 Langleys are accumulated.

Visual observations and photographic records shall be made after each 10,000 Langleys of exposure.

At the end of the exposure period, the test panels shall be returned to the laboratory for final assessment in accordance with 4.10.1.4.

4.10.1.4. **Assessment of Fading.** As required by 3.10.2.2, the acceptability of fading of the test panels shall be assessed.

The outer edges of the film shall not be considered during the assessment. This area, the outer edge of the film, approximately 1 in (2.5 cm), shall be removed or masked.

Each panel shall be examined and the appearance of the film shall be compared with the appearance of the control panels.

The appearance of the panels with the test material shall be neutral in color and not significantly different from the appearance of the control material.

4.10.2. **Field Evaluation of Product Visibility (STP-10.3).** As required by 3.10.3, the uncolored and fugitive colored enhanced water mixtures shall be tested for visibility on a variety of fuel types and conditions (slope, aspect, daylight conditions, and weather).

An experienced observer team, in the air at 2500 feet (762 meters), directly overhead, and on the ground, shall evaluate the visibility of each product applied by air dropping or ground tanker application depending on manufacturer's designated use.

4.11. **Air Drop Characteristics Test (STP-9).** As required by 3.11, and as deemed necessary by the Forest Service, the mixed retardant shall be tested to determine the air drop characteristics.

4.12. **Operational Field Evaluation (STP-12).** As required by 3.12, the Forest Service shall undertake an analysis to address any concerns arising from the nature of the formulations and/or results of the laboratory evaluation.

The laboratory testing shall be completed prior to conducting an operational field evaluation. When an operational field evaluation is needed, a test plan will be developed.

The evaluation will be conducted in accordance with the developed test plan. Detailed test methods are described in Standard Test Procedures for the Evaluation of Wildland Fire Chemical Products.

5. **QUALIFICATION.**

5.1. **Qualification Tests.** The samples submitted shall be subjected to the tests listed in Section 4 to determine if they meet the applicable requirements of Section 3 and classifications as indicated in 2.3.2.

These tests shall be conducted at the Forest Service WFCS laboratory or in third-party laboratories approved by WFCS on samples provided by WFCS. All reports of third-party testing will be submitted directly to WFCS.

5.1.1. **Additional Testing at the Discretion of the Forest Service**. Additional tests not specified in this document may be required at the discretion of the Forest Service when information provided in the product information or otherwise known to the Forest Service suggests a need.

The submitter shall be informed, before any additional testing is performed, of the specific tests to be performed, the reason for the tests, and the cost of the tests.

All costs of the additional testing shall be borne by the submitter.

5.1.2. **Waiver of Testing at the Discretion of the Forest Service.** At the discretion of the Forest Service, the requirement for the performance of specific tests may be waived.

When a test is waived, a written notice of the decision will be prepared by Forest Service WFCS and provided to the submitter.

5.2. **Notice of Qualification.** When the information submitted in accordance with 2.3.4 has been approved and the product is tested and found to meet all requirements of section 3, the products will be added to the Qualified Products List (QPL) and an informal notification made to the supplier.

A formal Notice of Product Qualification shall be issued in writing by the National Director, Fire and Aviation Management, USDA Forest Service.

5.2.1. **Use of the Forest Service Shield or Implied Endorsement by the Forest Service.** No use of the Forest Service shield is permitted. The logo is a protected image under Title 36, Code of Federal Regulations, Part 264. Use includes but is not limited to portrayal on product brochures, advertising, presentations, web sites, or other promotional items.

No statements implying endorsement by the Forest Service are permitted.

Following the laboratory evaluation of a product and listing on the QPL, the following statement may be used on product brochures or other similar informational material

"This product has been evaluated by the USDA Forest Service and meets the requirements of Forest Service Specification 5100-304c for applications as determined during the product evaluation and shown on the QPL."

[Amendment 3 adds restrictions on the use of the Forest Service shield and certain language relating to product qualification.]

5.2.2. **Ownership of Evaluation Results.** The entity submitting the product and paying the costs of the evaluation is the only entity that may benefit directly from the results of the evaluation.

Information developed during the course of the evaluation will not be transferred to other parties except at the direct request of the submitter. The Forest Service will not acknowledge that a submitted formulation is similar to or the same as a product submitted by another. Testing of each product will proceed independently of products submitted by any other company.

The submitting entity may transfer the rights to the evaluation and listing on the qualified products list at its discretion; however, the Forest Service must be notified of such transfer to assure legitimate access to information on file.

5.2.3. **Access to Product Information and Test Results.** When a product is added to the Forest Service Qualified Products List (QPL), the product name, mix ratio, and classification shall be available to the public as part of the QPL. The results of all tests performed by the Forest Service will be summarized and made available to agency personnel and others upon request.

The performance information developed will be provided to user agencies as input to their procurement and decision-making processes.

5.3. **Notice of Failure to Qualify.** The submitter shall be notified in writing within 45 days following completion of testing if qualification cannot be granted.

Written notification shall include all test results and identify unacceptable performance.

5.4. **Qualification of Changed or Modified Product.** The Forest Service Branch Chief, Fire Equipment and Chemicals shall be notified of planned formulation changes. Any change to the formulation, including but not limited to changes in the type, quantity, quality, processing, supplier, manufacturer, or manufacturing site of individual ingredients shall be considered a formulation change.

Qualification testing may be required for any formulation change deemed significant by the Forest Service.

5.5. **Acceptance Inspection and Quality Assurance Tests**. During qualification testing, the Forest Service test facility shall establish requirements and procedures for lot acceptance and quality assurance of field shipments of product.

5.6. **Other Tests.** The Forest Service reserves the right to perform any other tests it deems necessary at agency expense.

6. DEFINITIONS.

Component. Each combination of ingredients, packaged together by the manufacturer for use in preparation of the mixed product by the user.

Mixed product shall be prepared by mixing a single component with water; except that in the case of enhanced water mixtures colored products may be prepared either by mixing a single component with water or by mixing an uncolored single component and a single color component with water.

Coupon, Large Stability. A metal sample, approximately 2 in x 12 in x 1/8 in (5 cm x 30 cm x 0.3 cm), made of mild steel or 2024-T3 aluminum for use in outdoor stability testing.

Coupon, Small Stability. A metal sample, approximately, 1 in x 1 in x 1/8 in (2.5 cm x 2.5 cm x 0.3 cm), made of mild steel or 2024-T3 aluminum for use in indoor stability testing.

Coupon, Corrosion. A metal test specimen, approximately 1 in x 4 in x 1/8 in (2.5cm x 10.2 cm x 0.3 cm), made of 2024-T3 aluminum, mild steel, yellow brass, or Az31B magnesium for use in uniform corrosion testing.

Density. The weight in grams of 1 milliliter (mL) of product.

Dry Concentrate. A dry, single component which is mixed with water to prepare the mixed retardant.

Exposure Cycle. Each exposure cycle shall consist of 1 day (8 to 10 hours) and the following night or weekend.

Forest Service. The term Forest Service as used throughout this document refers to the U.S. Department of Agriculture, Forest Service.

Fugitive Color. A coloring agent which imparts a high degree of visibility to the mixed product when first applied to wildland fuels but will gradually disappear over several months.

Hydration. The action of a combination of concentrate with water required to produce a thickened product.

Ingredient. Each single chemical used by the manufacturer in the formulation of the product.

Intergranular Corrosion. A corrosive attack on metal at the grain boundary.

LC_{50}. The concentration of product in water, usually expressed as milligrams of product in a liter of solution that results in the death of 50 percent of the aquatic test specimens within a specified time frame.

LD_{50}. The dosage of a product, usually expressed as milligrams of the product per kilogram of body weight of the test animal, at which 50 percent of the test animals die within a specified time frame.

Long-Term Retardant. A product containing one or more inorganic salts to reduce the intensity of a fire. It contains water which serves to aid in uniform distribution of the retardant salts over the target fuel.

The product continues to be an effective fire retardant after the water it originally contained has completely evaporated.

Mixed Product. The combination of a wet or dry concentrate and water at the qualified mix ratio for use in fire management activities.

Mix Ratio. The proportion of concentrate and water in the mixed product.

The mix ratio can be expressed in several ways:

- Pounds of dry concentrate added to a gallon of water
- Gallons of wet concentrate to be added to a gallon of water
- Volume percentage of concentrate and water – typical for foams and wet concentrate water enhancers

pH. A measure of the acidity or alkalinity of a solution, represented on a numeric scale with 7 representing neutral solutions. Higher numbers represent alkaline solutions and lower numbers represent acidic solutions.

Reduction Index. A measure of the reduction in fire intensity (flame spread and weight loss) during the combustion retarding effectiveness test.

Retarding Salt. A single salt or combination of salts that impart combustion retarding effectiveness.

Sample Container, large. A 5.5-gallon (20 liter), low-density polyethylene carboy without spigot. Carboy shall be closed with a size 13.5 rubber stopper secured by a polypropylene screw cap.

Sample Container, small. A straight-sided, wide-mouth glass jar having a capacity of approximately 1 quart (946 mL) with Bakelite ® screw cap, 89 mm diameter with vinyl-backed fiber liner.

Standard Chemical. Technical grade diammonium phosphate (DAP) mixed with water to produce a 10.6-percent (weight/weight) solution. This solution is used as a reference for the combustion-retarding effectiveness test.

Steady State Viscosity. The viscosity after hydration is complete and viscosity is stable,

Temperature. Each temperature included in the specification consists of a Fahrenheit temperature and allowable variation from that temperature and the Celsius equivalents for the temperature and range.

Commonly used temperatures and variations are shown in the first section below and included in the specification requirements and test descriptions by listing a simple Fahrenheit temperature.

Other temperatures are described in detail in the second section. Sufficient information is provided within the individual specification requirements and test descriptions to determine the proper choice of conditions.

Fahrenheit	Variation	Celsius	Variation
15 °F	± 5 °F	-9.4 °C	± 2.8 °C
40 °F	± 5 °F	4.4 °C	± 2.8 °C
70 °F	± 5 °F	21.1 °C	± 2.8 °C
100 °F	± 5 °F	37.8 °C	± 2.8 °C

120 °F	± 5 °F	48.9 °C	± 2.8 °C
5 °F	± 2 °F	-15 °C	± 1 °C
35 °F	± 2 °F	2 °C	± 1 °C
40 °F	± 2 °F	4 °C	± 1 °C

Uniform Corrosion. Removal of metal by chemical means over the entire surface.

Viscosity. A measure of the resistance of a liquid to flow, expressed in centipoise (cP).

Water, Artificial Sea. A solution of chemicals in deionized water in the prescribed percentages to approximate natural seawater. All percentages are expressed as weight of chemical to total weight of solution.

Water, Deionized. Water treated by distillation, ion exchange, reverse osmosis, or a combination of these methods to remove most salts in conformance to ASTM D-1193 Type IV reagent water.

Water, Fresh. Tap water with a hardness of 120 to 140 ppm of calcium carbonate. A mixture of 3 volumes of ASTM hard water and 1 volume of ASTM soft water as defined in ASTM E-729 may be substituted for the fresh water..

Wet Concentrate. A liquid, single component which is added to water to prepare the mixed product.

7. SOURCES FOR OBTAINING APPLICABLE DOCUMENTS.

7.1. Order of Precedence. In the event of conflict between the text of this document and the references cited herein, the text of this document takes precedence.

Nothing in this document, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

7.2. **United States Government Documents**. The specifications, standards, and handbooks referenced form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents in effect on the date of the invitation for bids or request for proposals shall apply.

7.2.1. **Code of Federal Regulations (CFR).** The text of the Codes of Federal Regulations are available at http://www.gpoaccess.gov/cfr/index.html

7.2.2. **U.S. Department of Agriculture, Forest Service.** The following Forest Service documents are available on the internet at www.fs.fed.us/rm/fire/wfcs/lt-ret.htm unless otherwise noted.

Paper copies of these documents can be obtained from the Program Leader or Project Leader, WFCS, 5785 Highway 10 West, Missoula, MT, 59808, if web access is unavailable.

Manufacturer Submission Procedures for Qualification Testing of Long-Term Retardant Products.

Standard Test Procedures for the Evaluation of Wildland Fire Chemical Products, version in effect on the date of submission for evaluation.

USDA Forest Service Manual (FSM) 5160, Section 5162 – Fire Management Chemicals. Available at http://www.fs.fed.us/im/directives

7.2.3. **U.S. Department of Agriculture and U.S. Department of Interior; Interagency Standards.**

Interagency Standards for Fire and Fire Aviation Operation. Department of Agriculture, Forest Service, and Department of the Interior Agencies: Bureau of Land Management, National Park Service and U.S. Fish and Wildlife Service. Available at http://www.fire.blm.gov/Standards/redbook.htm

7.2.4. **U.S Environmental Protection Agency (EPA), Office of Prevention, Pesticides, and Toxic Substances (OPPTS).** EPA documents can be obtained from the web site at http://www.epa.gov/opptsfrs/home/guidelin.htm or by mail from U.S. Environmental Protection Agency, National Service Center for Environmental Publication (NSCEP), P.O. Box 42419, Cincinnati, OH 45242.

7.2.5. **United States Department of Health and Human Services,** National Toxicology Program: Report on Carcinogens. Available at http://ntp-server.niehs.nih.gov/

7.2.6. **International Agency for Research on Cancer (IARC).** IARC Monographs of Carcinogens. Available at http://www-cie.iarc.fr/monoeval/grlist.html

7.2.7. **Federal Standards.** Federal Standards can be obtained from http://dsp.dla.mil/onlinedocs-dsp.htm

7.2.8. **Military Specification.** Military Specifications can be obtained from http://dsp.dla.mil/onlinedocs-dsp.htm

7.2.9. **Freedom of Information Act (FOIA).** The Forest Service FOIA information can be found at http://www.fs.fed.us/im/foia/

7.3. **Other Publications**. The following publications of the issue in effect on the date of invitation for bids form a part of this specification.

7.3.1. **American Society for Testing and Materials (ASTM).** Copies of ASTM publications can be obtained on the web at http://www.astm.org or by mail from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

7.3.2. **National Association of Corrosion Engineers International (NACE).** Copies of NACE publications can be obtained on the web at http://www.nace.org or by mail from NACE International, 1440 South Creek Drive, Houston, TX 77084.

7.3.3. **Society of Automotive Engineers, Inc. (SAE).** Copies of SAE publications can be obtained on the web at http://sae.org or by mail from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

7.3.4. **Association of Official Agricultural Chemists (AOAC).** Copies of AOAC publications can be obtained on the web at http://aoac.org or by mail from AOAC International, 481 Frederick Avenue, Suite 500, Gaithersburg, Maryland 20877-2417.

Appendix M – Guidance for Pilots

Alternative 2: Aerial Application of Long-Term Retardant Guidance for Pilots

The Chief of the Forest Service announced February 18, 2008 that the Guidelines for Aerial Delivery of Retardant or Foams near Waterways, also known as the 2000 Guidelines, will become permanent. At the same time, the Chief accepted reasonable and prudent alternatives from both the National Marine Fisheries Service (NMFS) and the Fish and Wildlife Service (FWS) in order to avoid potential jeopardy to threatened, endangered or proposed aquatic, plant, animal, and insects.

Using long-term retardant and foams through aerial delivery will continue. What's different this year is what has to happen on the ground prior to fire season, as well as what happens if long-term retardants or foams end up in a place where it will need to be reported.

Forest Service units should already be underway in working with their specialists and the Fish and Wildlife Service specialists in identifying the known areas of any Threatened Endangered or Proposed (TEP) species and their habitats in order to develop avoidance zones concerning the use of long-term retardant or foams. The 300 foot buffer that was established in 2000 still applies concerning aquatic waterways. Retardant that is dropped in these areas must be reported.

What does this mean if you are a pilot?

You will be directed by a fire official as to where to deliver your load of retardant or foam. The fire host unit will provide the appropriate individuals with the areas to avoid concerning the use of long-term retardant or foam and this should be taken into consideration as coordinates for delivery of a load are passed on to the pilot. You may also be directed to drop in these areas in an emergency. That is alright, but reporting must be accomplished.

What happens if long-term retardant or foam ends up where it isn't supposed to?

If you know a portion or all of your load ends up within the 300 foot buffer or entered the actual waterway or into the area that was to be avoided due to TEP, the individual directing you is the individual you will immediately report to. Regardless of the reason for the missed delivery, all pilots need to report the incident.

The individual you report this to has the responsibility to report it to the appropriate fire official on the ground or their immediate supervisor. Ultimately, the Agency Administrator for that unit is responsible to ensure the appropriate consultation and reporting requirements are initiated and completed.

What else should I be aware of or know if I am a pilot?

In order to be completely informed, you should take time to review some of the materials and guidelines that have been established to date to assist agency personnel with implementing the Chief's February 18 decision. The information compiled includes which National Forests and Grasslands have been identified with TEP. Becoming familiar with which units are listed will give you a heads-up that some additional information should be shared with you prior to taking action on any fire on that piece of land. This information may be shared with you by a variety of different agency officials including airtanker base personnel, lead plane pilots, air attack personnel, or ground personnel.

Alternative 3: Aerial Application of Long-Term Retardant and Foams Guidance for Pilots

Whenever practical, as determined by the fire incident, the Forest Service will use water other suppressants, or the least toxic approved fire retardant(s) in areas occupied by threatened endangered and proposed species or their designated critical habitat. Some species and habitats require that only water can be used to protect habitat and populations; these habitats and populations have been mapped as avoidance areas."

Incident Commanders and pilots are required to avoid aerial application of retardant on mapped avoidance areas for terrestrial threatened, endangered or proposed (TEP) species or within 300 feet of waterways. This distance is based on the air tanker pilot's reaction time and the speed of the airtanker, plus a safety factor. This allows time and distance that once the pilot saw the terrestrial avoidance area or waterway and reacted (by removing his thumb from the trigger), there would still be a safety buffer before the air tanker and its load reached the terrestrial avoidance area or waterway. After crossing the terrestrial avoidance area or waterway, the same guidelines applied before dropping the next part of the load.

What does this mean if you are a pilot?

You will be directed by a fire official as to where to deliver your load of retardant or foam. The fire host unit will provide the applicate maps and other briefing materials prior to incident response. The unit may provide appropriate individuals (resource advisor or other official) to review the materials specific to the areas to avoid concerning the use of long-term retardant. This should be taken into consideration as the coordinates for delivery of a retardant load are passed on to the pilot. You may also be directed to drop in these areas in an emergency with the allowable exception. That is alright, but reporting must be accomplished.

In addition prior to the actual application of the retardant you will make a "dry run" over the intended application area to identify avoidance areas and waterways in the vicinity of the wildland fire. When approaching mapped avoidance areas for TEP species or waterways or riparian vegetation *visible to the pilot,* the pilot will terminate the application of retardant approximately 300 feet before reaching the mapped avoidance area or waterway. When flying over a mapped avoidance area or waterway, pilots will wait 1 (one) second after crossing the far border of a mapped avoidance area or waterway before applying retardant.

Pilots will make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant within the 300-foot buffer zone, or mapped avoidance area in order to avoid drift into protected areas.

What happens if long-term retardant ends up where it is not supposed to be applied?

If you know a portion or all of your load ends up within the 300 foot buffer of a waterway or mapped avoidance area for terrestrial threatened, endangered and proposed (TEP) species or waterway, the individual directing you is the individual you will immediately report to. Regardless of the reason for the misapplication of the retardant, all pilots need to report the incident.

The individual you report this to has the responsibility to report it to the appropriate fire official on the ground or their immediate supervisor. Ultimately, the Agency Administrator for that unit is responsible to ensure the appropriate consultation and reporting requirements are initiated and completed.

What else should I be aware of or know if I am a pilot?

In order to be completely informed, you should take time to review the applicable avoidance area maps for the locations you may serve as a pilot with the potential to deliver retardant tot he ground. Requesting a briefing upon arrival for your incident support with a local official is part of your responsibility as well as the incident units. If your aircraft has electronic equipment that can be programmed with the GPS coordinates of the mapped avoidance areas take time to enter those.

Reviewing any wildland fire chemical use materials, attending training necessary to maintain your qualifications, as well as taking any other training available with the focus on the delivery of aerially applied wildland fire chemicals will assist in the most effective delivery of fire retardants. Reviewing Chapter 12 of the Interagency Standards for Fire and Aviation and Aviation Operations will provide additional information and reporting requirements.

Appendix N – Retardant Avoidance Map Examples for Alternative 3

Appendix N – Retardant Avoidance Map Examples for Alternative 3

Figure N-1. Retardant Avoidance Areas, San Bernadino National Forest, California

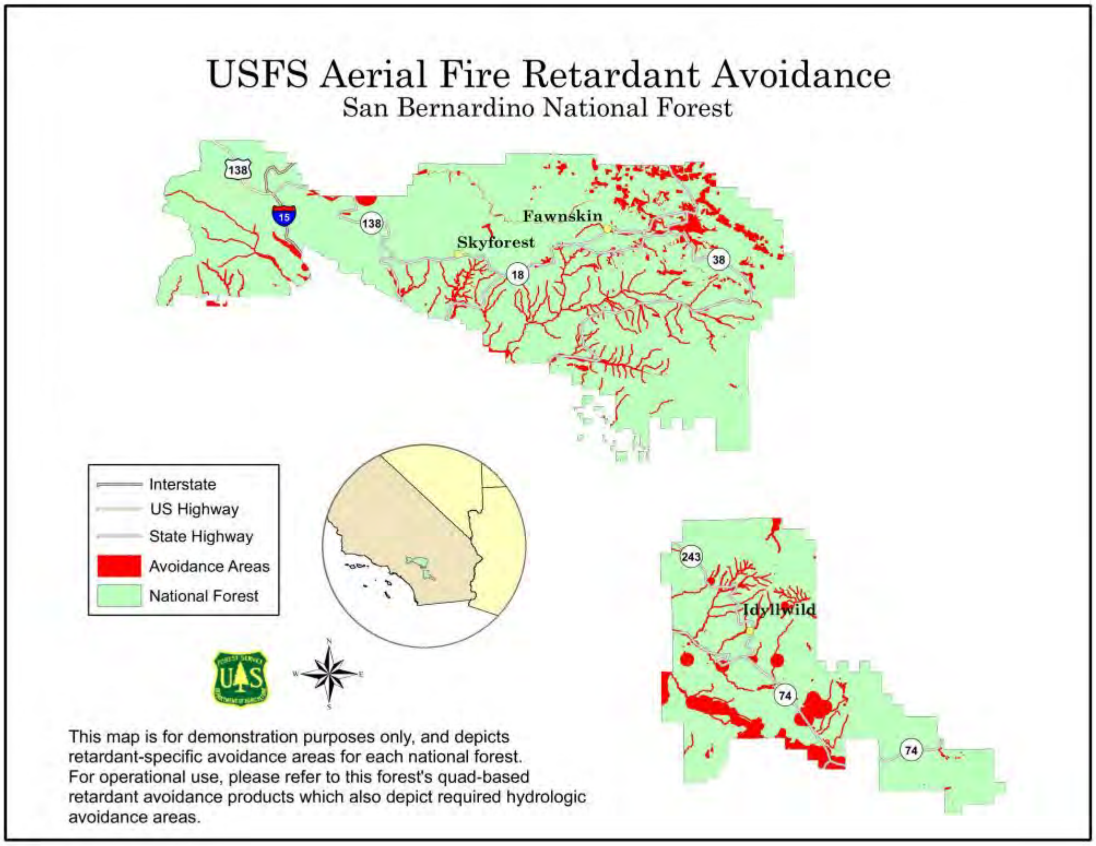


Figure N-2. Retardant Avoidance Areas, Onyx Peak Area, San Bernadino National Forest, California

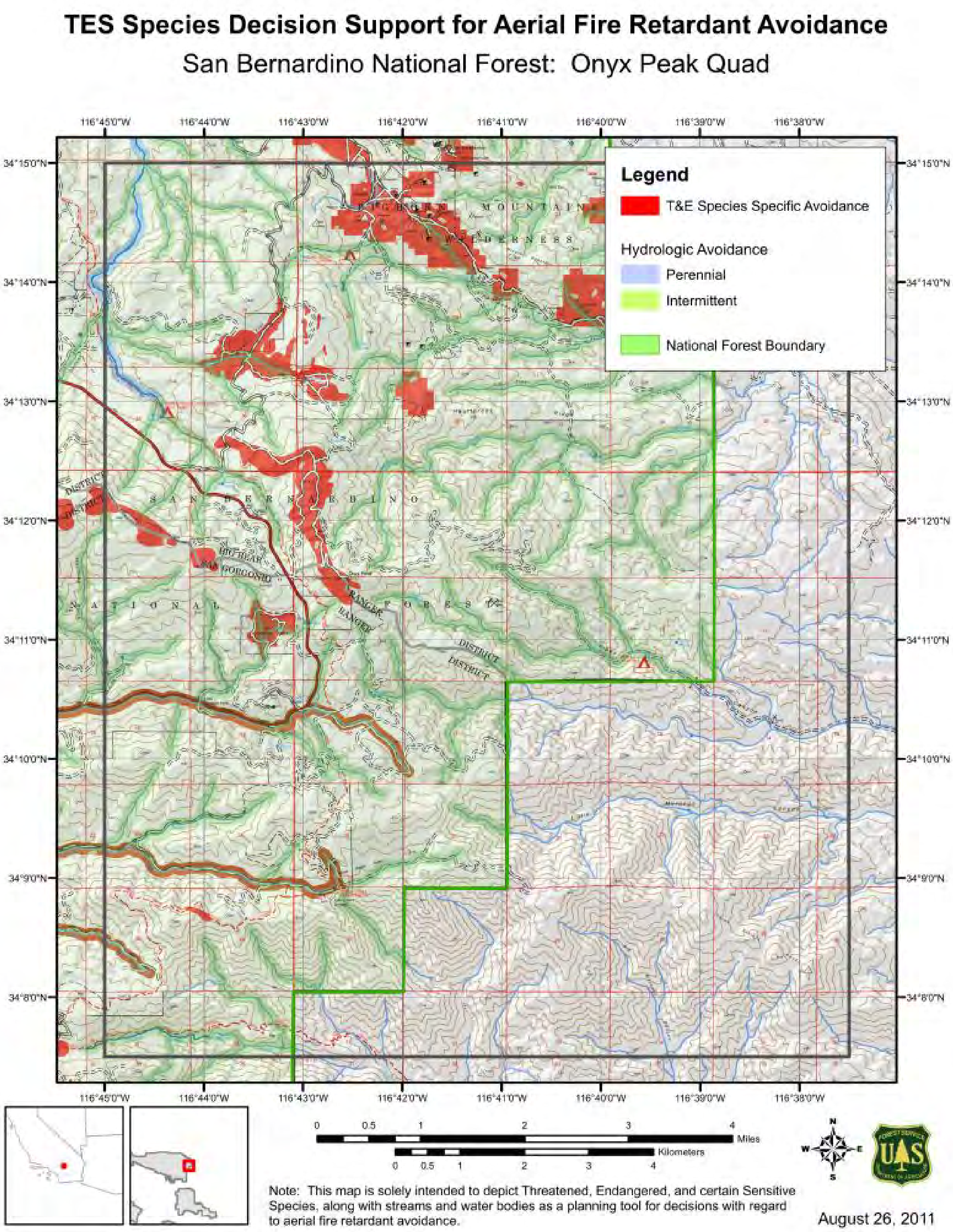
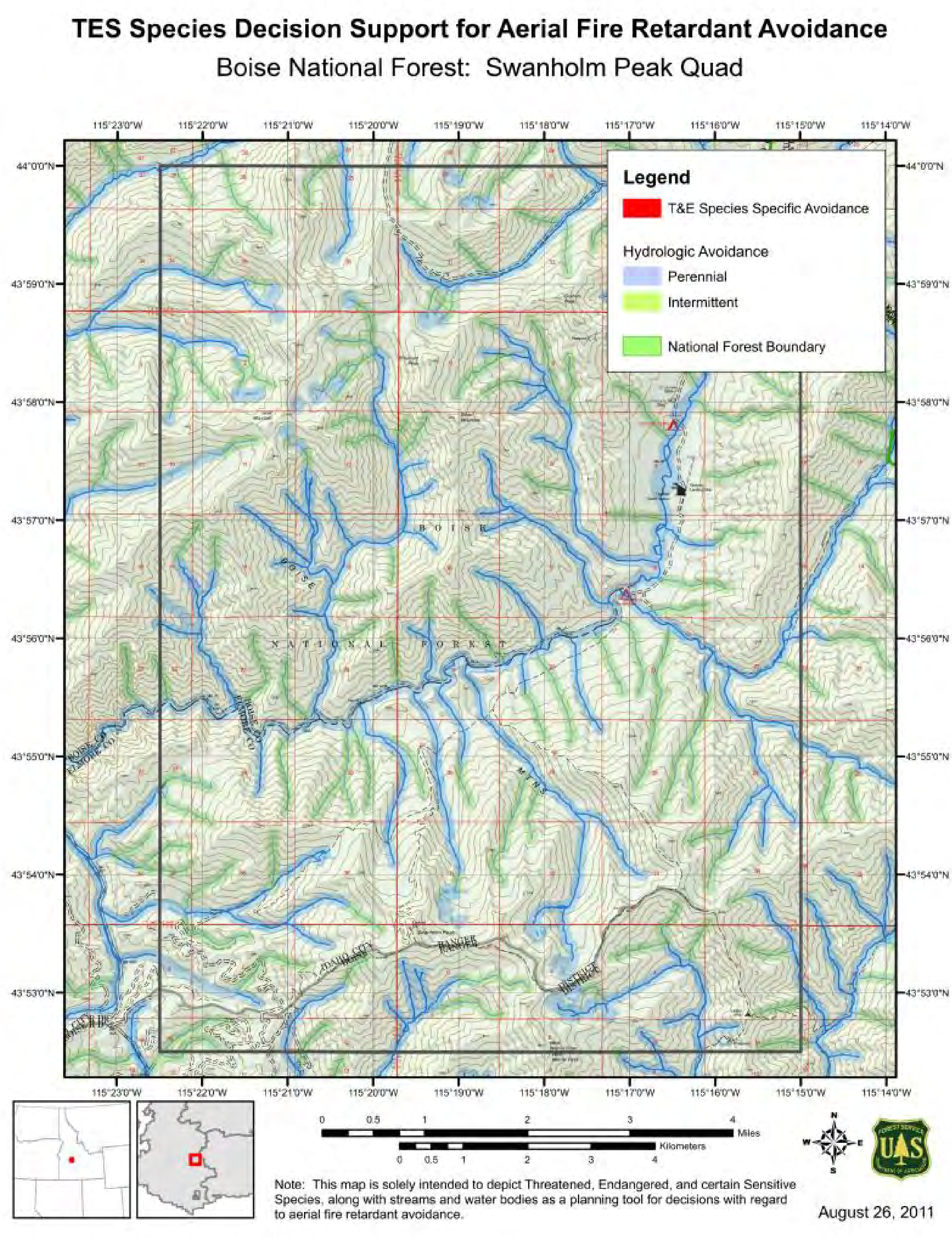


Figure N-3. Retardant Avoidance Areas, Swanholm Peak Area, Boise National Forest, Idaho



Appendix O – Fire Professionals Comments on Retardant Effectiveness Summary

Appendix O – Fire Professionals Comments on Retardant Effectiveness Summary

In an effort to obtain testimonials from Fire Professionals within the national fire community, four questions were sent out in an email to all fire managers across the nation. On July 27, 2011 Lund and Henderson (ID Team members—Wildland Fire Management) sent out a questionnaire asking for some professional opinions on the operational effectiveness of retardant in the field. We gave the respondents 8 days to respond. Despite the timing (middle of fire season) we received 58 responses from the field. Below is a copy of the emails we sent out to National Fire Directors, Hotshot community and the National Interagency Fire Center manager. From there this email was sent out far and wide in the fire community.

All responses had relatively similar answers to the four questions. Following is a summary, mostly comprised of a sampling of excerpts from the responders:

1. **What is your current position and highest incident qualification? How long have you participated in fire operations? Briefly describe your degree of experience in fire operations?**

- We received 56 responses within the response period from a wide variety of firefighters with a wide variety of qualifications.
- We received responses from Type 1 Incident Commanders to Type 4/5 Incident Commanders, Air Tactical Group Supervisors (Air Attack)/pilots to Hotshots, and Fire Management Officers to Engine Captains.
- Years of experience ranged from 5+ years to 30+ years. There were also responders from most of the agencies: USFS, BLM, NPS, and State.

2. Have you observed, commanded, and/or participated in fire tactics under similar conditions of fuel, weather, and topography and observed any differences in fire behavior where fire retardant is and is not used under similar conditions affecting fire behavior?

- "Absolutely retardant makes a difference. It can hold a fire while ground resources make their way in to finish containment. It works in grass brush and timber especially on at least 80 percent of the days during the summer. It's not as much help on midslopes or on windy hot days when nothing much seems to work but it is awesome at least 8 days out of 10."
- "It is well noted that retardant applied just ahead of the burning edge has a big effect on the combustibility of the fuels burning. Highly effective in light fuels, moderately effective in heavy brush and heavy canopy timber (depending on coverage levels and the ability to get mud to the ground). It is noted that fireline intensities are significantly less if retardant is applied at the proper coverage level. Also, most effective when applied directly in support of ground efforts."
- "Yes numerous times as DIVS, ATGS and OSC2 I have observed and ordered aircraft to complete missions using both retardant and water. Retardant is very effective at reducing fire spread, intensity and increase the time for ground resources to engage and complete operations. It increases the safety margin for the folks on the ground when working in many of the area that have poor access. Retardant is very effective in Grass and brush fuel models where rate of spread and fire intensity can change very quickly."
- "Yes, I have observed, commanded and participated in fire tactics under various conditions where retardant has and hasn't been used. When the fuel type is grass, retardant is extremely effective in slowing, or even stopping in some cases, the advance of fire especially when crews are also able to quickly respond. Retardant and crews must really work together in order to be most effective. Retardant by itself is not a standalone

resource. In timber, if timber is not exceptionally tall, retardant can be helpful but only if crews are on scene or enroute. I have ordered retardant on a small fire on the Gallatin NF to be dropped on a ridge top to keep the fire from dropping down into the adjacent drainage with great success. Crews were already on scene and it was an insurance that contained our fire in the area we were working, not letting it spread into a whole other area, reducing the need to order additional crews.”

- “Working fires with similar fuel conditions and not having retardant as an option required a big change in fire tactics, and instead of being proactive and putting direct line in with retardant we had to back off and increase the fire acreage and have additional firefighting resources to work the fire.”
- “On any fire that I have ordered retardant and on fires that I have participated on in a overhead position, retardant has proved to be an effective material for reducing the fire behavior (flame length and rate of spread) in all instances. The most recent was on the Hidden Fire on my District. Large quantities of retardant were used to stop this fire. Photos taken by the Air Attack clearly show the effectiveness of retardant at stopping fast moving fires in the fine fuels in the modified environment (modified by cheatgrass and red brome) of the Pakoon Basin. The final size of this fire was 17,188 acres. It would have been much larger if not for the use of retardant. Previous fires in the Pakoon Basin, and other locations in the Mohave Desert ecosystem, have grown to over 40,000 acres in one day. Additionally, As the Incident Commander on fires in Wyoming big sage as well as Pinyon and Juniper fuels I have seen the effectiveness of retardant at slowing rapid rates of spread to the point where wildland fire engines have caught and stopped the fire before it could move into the wildland urban interface.
  Not having retardant in our most recent fire would have resulted in the fire being larger impacting critical habitat for the Desert Tortoise. Not having retardant in the case of wildland urban interface fires, increases the risk firefighters have to take to keep fire from moving off federal jurisdictions or damaging structures and other values at risk on federal jurisdictions.”

3. What differences, if any, have you observed?

- “It reduces many/most free moving fires to a creeping stage for a period of time."
- “Proper retardant application results in significant moderated fire behavior through wetting and coating the fuels. Proper application includes using the appropriate coverage level for the fuel type, proper drop height ensuring the retardant rains vertically on to the fuels, and having ground firefighters to support the retardant.”
- “Humidity is raised in the immediate area resulting in lower fireline intensities. Rate of Spread is severely retarded for a short time in most cases. ROS begins to increase as retardant dries, but remains substantially lower than the untreated fuels, as observed acceleration occurs once fire breaks out of the retardant line. Flame Lengths (ground) are usually about half of what they were, though, that depends on the fuel type.”
- “I have worked numerous Initial attack fires that were held in place long enough for fire personal to arrive and suppress the fire. Without the use of retardant the fires would have escaped initial attack and become long term events which would have exposed more fire fighters and cost many time more to control.”
- “I have mostly seen retardant used in Pinyon Juniper stands and I have observed that it really slows down the spread of the fire. Moments before the retardant was applied the fire behavior was much greater then after application.”
- “Last month on the Vandenberg Fire outside of Cedar City, the weather and fuels conditions were such that direct attack by engines was not possible on the head or the leading flanks. The two helicopters available could not keep up with the spread even with fairly short (3-4 min.) turns. I used two P2Vs and two SEATs dropping a total of eleven loads of retardant. Of this retardant used: 1 load was completely ineffective; 1 load slowed the fire spread to a "creeping" rate of spread where it was later suppressed by firefighters; the 9 remaining loads were 100% effective as "fire lines". Had the retardant not been available, the fire almost

certainly would have overwhelmed all available ground forces and spread through the early evening consuming at least 10 times the size and probably a dozen or more residences."

- "Use of retardant effects fire behavior by diminishing fire intensity to allow firefighters to directly attack the fire or slows the fire movement to allow firefighters time to construct indirect fireline. I have observed the use of water instead of retardant in airtankers and have noted that the affect of water is minimal (at best) compared to that of retardant."
- "Yes. We recently had an Initial Attack in a sensitive species area where retardant could have a negative impact. I used retardant on the ridge lines and were able to successfully suppress the fire. The area had several million dollars of threats to T&E, watershed, homes, life and public. Without the use of retardant on the initial attack the forest would have had a very large, expensive, and damaging fire that would have resulted in a likely loss of the T&E species and a complete loss in habitat
- "I have noticed a significant change in fire behavior when it burned into retardant line. This is in many fuel types. I have seen in go from 4-6 foot flame lengths in grass to going out. I have seen it go from 12 to 20 foot flame lengths in brush and slow down to 6 inch flame lengths with heavy white smoke in the retardant line. I have seen the fire jump in places where retardant was not used and held where it was applied. This is when the retardant is properly placed on ridge tops and flanks. I have also used helicopters to rehydrate retardant lines and they have held well also.
  When used correctly—the right time and conditions—they have been effective. I have seen people use then in hot weather for pre-treatment and the retardant is too dry when the fire hits that area. Retardant is less effective in fuels with a thick canopy cover (mature timber) because it cannot make it to the ground.
  If ground resources do not make it to the area in a short time frame the fire becomes active again. Retardant does not put fires out in this fuel type or in many other fuel types. It retards the growth until people can get there to put the fire out.
  Retardant has little to no effect depending on the location it is placed on a fast moving (crowning) timber fire. The placement and timing of retardant is critical to the success of the retardant drop. Retardant has a greater effect on fire behavior on lighter fuels where I have seen less waste because it makes it to the ground, it's easier to see the fire, and less topography to deal with.
  Bottom line is retardant can be very effective when used in the right locations at the right time. I think we need some better training on the effective use of retardant on fires."

4. Have you observed differences in the effectiveness on fire tactics relative to fire-fighter safety, fire size, loss of property/improvements/infrastructure with and without the use of fire retardant under similar conditions of fuel, weather, and topography affecting fire behavior?

- "On tactics, it makes direct attack possible in situations where it is otherwise not possible. It also helps hold indirect lines so you don't have to fire out two or three times before you have success."
- "Yes. There is no question that proper retardant application provides for increased firefighter safety by providing a barrier between the fire and firefighter as well as moderating fire behavior so firefighters can get closer to the fire line for suppression action. Retardant also significantly impedes and at times extinguishes the fire it comes in contact with thereby reducing overall fire size and protecting structures."
- "Many of property saves have been made by treating near structures or angle-directing the retardant line so that fire flanks away along the retardant line from the point of protection. Lower intensities occur near the target areas, minimizing flame and heat exposure to the structure (or ground personnel trying to get around the head). Of course retardant lowers fireline intensity and flame lengths, and many times, makes it where crews can go direct on the fire. This is almost always safer than being indirect or parallel to the fire where it has room to run at you and you don't have immediate black to get into. Early retardant Application can also

keep a fire "in check" until ground resources arrive. This is a substantial advantage in minimizing acres burned and providing an anchor point and is a tactic I use regularly as a Duty Officer."

- “Yes, in my experience over the years I have witnessed multiple times where retardant has proved effective when used properly. This tool often makes the difference between a positive and a negative outcome when protecting life and property. Using water is not always effective due the short effective life of the treatment due to quick drying. Retardant has a longer effective life which allows crews more time to get critical work done. Use of retardant can also limit aviation exposure due to less drops being more effective. Over the last few years the agencies have also provided better direction and training in regards to proper use of the tool. This has assisted in improving the effectiveness of use as well as limited the negative impacts of retardant on the environment. Proper use during initial attack can greatly impact the final fire size and the overall cost."
- “I have clearly witnessed the effectiveness of fire retardant as it pertains to fire tactics relative to fire-fighter safety, fire size, loss of property/improvements/infrastructure with and without the use of fire retardant under similar conditions of fuel weather, and topography affecting fire behavior. In the situations where retardant is effective it directly effects the safety of the folks on the ground by mitigating fire intensity and behavior thus allowing them employ tactics and strategies that allow them to keep close to their safety zones. Retardant also minimizes the loss of or direct impact to property/improvements/infrastructure. Again this is due to the effectiveness of retardant in mitigating fire intensity and behavior thus allowing folks on the ground to often times effectively suppress fires before they can greatly impact these assets.”
- “Without the use of retardant on initial attack, fires become larger and direct attack is usually not possible. I have seen structures saved by use of retardant that would have otherwise burned (most recently, Monument fire June 2011-Coronado N.F., R-3)”
- “I have had to disengage when aerial support was unavailable due to flame lengths, intensities, and rates of spread that would not allow for our line to hold, or were simply unapproachable to begin with. In addition to direct line construction, retardant has played a big role in indirect tactical options. I have conducted burn out operations that certainly would not have held (and probably not attempted) without pretreatment of fuels on the "green" side. I have been involved in numerous initial attack and emerging extended attack incidents where the proper use of retardant allowed the resources on scene to contain the fire in several shifts - thereby keeping acreage, cost, and exposure to ground resources lower due to a shorter duration incident. I have been witness to well placed drops that have saved property (homes).”
- “Retardant is commonly used to reinforce hand and dozer line, strengthen lines for burning operations, protect structures and buy time for firefighters who are trying to complete handline. This spring and summer I have been in Texas, Arizona and Idaho flying Air Attack. I have personally observed retard and save structures, catch breakouts in firelines, hold a fire in check until dozer or handline is completed, establish anchor points etc. Bottom line is it works under the right conditions and works well. On the fire I referred to above we dropped 18 SEAT loads that held the fire in check (1100 acres) for 2 hours until line was constructed, saved thousands of dollars worth of hay, and stopped to breakouts that burned around a disk line.”
- “Yes - In the initial attack phase of fires the presence of retardant can heavily influence the strategy and tactics applied. By reducing fire intensity and rate of spread the type of resource, number of resources needed and line location the tactics applied have differed greatly from similar fires where retardant was not available. On large fires the availability of retardant is not as heavily weighted when developing strategy. However, success of selected tactics has been significantly improved with the support of retardant. The longer term effect of retardant assists in reducing number of flight hours and pilot exposure over what would be experienced using alternate resources such as helicopter w/ water.”
- “When aerial applied fire retardant is used, I have noticed substantial differences in the ability to utilize tactics that are safer for the fire fighter, reduction of fire size and property loss, and increases probability of meeting the desired objectives.”

Appendix P – Table of Avoidance Area Percentages by Forest

Appendix P – Table of Avoidance Area Percentages by Forest

Table P-1. Terrestrial Threatened, Endangered and Sensitive Species Aerial Fire Retardant Avoidance Areas within National Forest System Lands

National Forest	Percentage of Terrestrial TES Aerial Fire Retardant Avoidance Areas
Beaverhead-Deerlodge National Forest	0.23%
Bitterroot National Forest	0.22%
Clearwater National Forest	0.93%
Custer National Forest	0.17%
Flathead National Forest	1.32%
Gallatin National Forest	0.07%
Helena National Forest	0.13%
Idaho Panhandle National Forests	0.10%
Kootenai National Forest	0.72%
Lewis and Clark National Forest	0.20%
Lolo National Forest	0.12%
Nez Perce National Forest	2.35%
R1 Total	0.56%
Arapaho and Roosevelt National Forests	0.17%
Bighorn National Forest	< 0.00%
Black Hills National Forest	< 0.00%
Grand Mesa, Uncompahgre and Gunnison National Forests	0.53%
Medicine Bow-Routt National Forest	0.13%
Nebraska National Forest	0.05%
Pike-San Isabel National Forest	0.11%

National Forest	Percentage of Terrestrial TES Aerial Fire Retardant Avoidance Areas
Rio Grande National Forest	< 0.00%
San Juan National Forest	0.33%
Shoshone National Forest	< 0.00%
White River National Forest	4.73%
R2 Total	0.56%
Apache-Sitgreaves National Forests	0.16%
Carson National Forest	0.01%
Cibola National Forest	0.23%
Coconino National Forest	0.77%
Coronado National Forest	0.47%
Gila National Forest	0.17%
Kaibab National Forest	0.03%
Lincoln National Forest	0.15%
Prescott National Forest	0.04%
Santa Fe National Forest	< 0.00%
Tonto National Forest	0.23%
R3 Total	0.22%
Ashley National Forest	< 0.00%
Boise National Forest	< 0.00%
Bridger-Teton National Forest	0.15%
Caribou-Targhee National Forest	0.06%
Dixie National Forest	6.39%
Fishlake National Forest	2.58%
Humboldt-Toiyabe National Forest	0.02%

National Forest	Percentage of Terrestrial TES Aerial Fire Retardant Avoidance Areas
Manti-Lasal National Forest	6.10%
Payette National Forest	0.13%
Salmon-Challis National Forest	2.46%
Sawtooth National Forest	0.06%
Uinta National Forest	0.08%
Wasatch-Cache National Forest	0.10%
R4 Total	1.10%
Angeles National Forest	1.00%
Cleveland National Forest	1.55%
Eldorado National Forest	0.04%
Inyo National Forest	0.69%
Klamath National Forest	0.02%
Lake Tahoe Basin Mgt Unit	< 0.00%
Lassen National Forest	0.02%
Los Padres National Forest	2.61%
Mendocino National Forest	< 0.00%
Modoc National Forest	0.16%
Plumas National Forest	0.05%
San Bernardino National Forest	4.18%
Sequoia National Forest	3.22%
Shasta Trinity National Forest	< 0.00%
Sierra National Forest	0.01%
Six Rivers National Forest	0.13%
Stanislaus National Forest	0.19%

National Forest	Percentage of Terrestrial TES Aerial Fire Retardant Avoidance Areas
Tahoe National Forest	0.13%
R5 Total	0.79%
Columbia River Gorge National Scenic Area	0.60%
Colville National Forest	0.02%
Deschutes National Forest	0.02%
Fremont-Winema National Forests	0.01%
Gifford Pinchot National Forest	0.04%
Malheur National Forest	0.02%
Mt Baker-Snoqualmie National Forest	< 0.00%
Mt. Hood National Forest	0.01%
Ochoco National Forest	0.10%
Okanogan-Wenatchee National Forests	0.21%
Olympic National Forest	< 0.00%
Rogue River-Siskiyou National Forests	0.03%
Siuslaw National Forest	0.00%
Umatilla National Forest	0.12%
Umpqua National Forest	0.05%
Wallowa-Whitman National Forest	0.03%
Willamette National Forest	0.01%
R6 Total	0.06%
Cherokee National Forest	0.15%
Daniel Boone National Forest	0.06%
Francis Marion and Sumter National Forests	0.34%

National Forest	Percentage of Terrestrial TES Aerial Fire Retardant Avoidance Areas
George Washington & Jefferson National Forest	< 0.00%
Kisatchie National Forest	2.40%
National Forests In Florida	2.90%
National Forests In Mississippi	0.40%
National Forests In North Carolina	2.98%
National Forests In Texas	< 0.00%
Ouachita National Forest	0.00%
Ozark-St Francis National Forest	0.33%
R8 Total	0.81%
Chippewa National Forest	< 0.00%
Huron Manistee National Forest	23.67%
Mark Twain National Forest	0.35%
Superior National Forest	0.02%
R9 Total	4.87%
TOTAL	0.82%

Table P-2. National Forest System Lands Covered by Water Features Buffered by 300 Feet

National Forest	Percentage of Forest Service Lands Covered by Hydrographic Features Buffered by 300 Feet
Beaverhead-Deerlodge National Forest	22%
Bitterroot National Forest	23%
Clearwater National Forest	25%
Custer National Forest	25%
Flathead National Forest	24%
Gallatin National Forest	20%

National Forest	Percentage of Forest Service Lands Covered by Hydrographic Features Buffered by 300 Feet
Helena National Forest	22%
Idaho Panhandle National Forests	27%
Kootenai National Forest	23%
Lewis and Clark National Forest	24%
Lolo National Forest	23%
Nez Perce National Forest	27%
Arapaho and Roosevelt National Forests	33%
Bighorn National Forest	29%
Black Hills National Forest	23%
Grand Mesa, Uncompahgre and Gunnison National Forests	36%
Medicine Bow-Routt National Forest	33%
Nebraska National Forest	31%
Pike-San Isabel National Forest	31%
Rio Grande National Forest	38%
San Juan National Forest	43%
Shoshone National Forest	45%
White River National Forest	38%
Apache-Sitgreaves National Forests	26%
Carson National Forest	25%
Cibola National Forest	23%
Coconino National Forest	21%
Coronado National Forest	36%
Gila National Forest	30%
Kaibab National Forest	23%

National Forest	Percentage of Forest Service Lands Covered by Hydrographic Features Buffered by 300 Feet
Lincoln National Forest	28%
Prescott National Forest	29%
Santa Fe National Forest	26%
Tonto National Forest	32%
Ashley National Forest	25%
Boise National Forest	26%
Bridger-Teton National Forest	27%
Caribou-Targhee National Forest	23%
Dixie National Forest	26%
Fishlake National Forest	24%
Humboldt-Toiyabe National Forest	25%
Manti-Lasal National Forest	24%
Payette National Forest	23%
Salmon-Challis National Forest	24%
Sawtooth National Forest	25%
Uinta National Forest	26%
Wasatch-Cache National Forest	24%
Angeles National Forest	26%
Cleveland National Forest	22%
Eldorado National Forest	58%
Inyo National Forest	36%
Klamath National Forest	31%
Lake Tahoe Basin Mgt Unit	60%
Lassen National Forest	18%

National Forest	Percentage of Forest Service Lands Covered by Hydrographic Features Buffered by 300 Feet
Los Padres National Forest	33%
Mendocino National Forest	61%
Modoc National Forest	22%
Plumas National Forest	67%
San Bernardino National Forest	25%
Sequoia National Forest	13%
Shasta Trinity National Forest	45%
Sierra National Forest	74%
Six Rivers National Forest	49%
Stanislaus National Forest	77%
Tahoe National Forest	59%
Columbia River Gorge National Scenic Area	18%
Colville National Forest	23%
Deschutes National Forest	10%
Fremont-Winema National Forests	14%
Gifford Pinchot National Forest	43%
Malheur National Forest	14%
Mt Baker-Snoqualmie National Forest	45%
Mt. Hood National Forest	28%
Ochoco National Forest	22%
Okanogan-Wenatchee National Forests	17%
Olympic National Forest	38%
Rogue River-Siskiyou National Forests	13%
Siuslaw National Forest	52%

National Forest	**Percentage of Forest Service Lands Covered by Hydrographic Features Buffered by 300 Feet**
Umatilla National Forest	28%
Umpqua National Forest	23%
Wallowa-Whitman National Forest	38%
Willamette National Forest	39%
Cherokee National Forest	40%
Daniel Boone National Forest	27%
Francis Marion and Sumter National Forests	36%
George Washington & Jefferson National Forest	29%
Kisatchie National Forest	34%
National Forests In Florida	59%
National Forests In Mississippi	35%
National Forests In North Carolina	31%
National Forests In Texas	40%
Ouachita National Forest	28%
Ozark-St Francis National Forest	26%
Chippewa National Forest	30%
Huron Manistee National Forest	27%
Mark Twain National Forest	32%
Superior National Forest	26%
TOTAL	30%

Appendix Q – Response to Comments

Appendix Q – Response to Comments

Introduction

A Notice of Availability was posted in the *Federal Register* on May 13, 2011, by the U.S. Environmental Protection Agency (EPA) for the Draft Environmental Impact Statement (EIS) titled *Nationwide Aerial Application of Fire Retardant Project, Proposing to Continue the Aerial Application of Fire Retardant on National Forest System Lands*. This began the 45-day comment period, which ended on June 27, 2011. The Forest Service received 53 comment letters from individuals, organizations, agencies, and business owners; these comments were received by email and via the U.S. Post Office.

The Forest Service responded in the following five basic ways to the substantive comments, as prescribed in 40 CFR 1503.4:

- Modifying alternatives;
- Developing or analyzing alternatives not given detailed consideration in the draft EIS;
- Supplementing, improving, or modifying the analysis that the draft EIS documented;
- Making factual corrections; and/or
- Explaining why the comments do not need further Agency response..

A Notice of Availability was posted in the *Federal Register* on May 13, 2011, for the draft EIS titled *Nationwide Aerial Application of Fire Retardant Project, Proposing to Continue the Aerial Application of Fire Retardant on National Forest System Lands*. This began the 45-day comment period, which ended on June 27, 2011. The Forest Service received 53 comment letters from individuals, representatives of businesses, special interest groups, tribal governments, and Federal and State agencies; these comments were received by email and via the U.S. Post Office.

All 53 comment letters were read by the interdisciplinary team members. In the 53 comment letters, there were 375 comments that were unique and substantially different. Public Concern (PC) statements were then developed for the 375 comments based on the similarity of the comments. There are a total of 99 PCs that capture the concerns of the 375 comments. This report includes the responses to the 99 PCs.

Content Analysis Process

Content analysis followed a systematic process of logging, numbering, reading, coding, and summarizing all public comments that were submitted. The process ensures that every comment was read, analyzed, and considered. The comments that were most helpful were those that were unique, substantially different, and were specifically related to the analysis disclosed in the EIS and the proposed action. In addition to capturing unique and substantially different comments, this report attempts to reflect the emotion and strength, as conveyed in the comment, to represent the concerns as fairly as possible. When an individual raised multiple comments within the same letter, each unique comment was numbered and tracked separately. Each comment was assigned a unique tracking number and coded by subject or topic (see Summary of Public Comments and Forest Service Response report in the project record.)

Once the unique comments were coded, those that were made by different commenters on the same subject were grouped and summarized into PC statements that captured the essence of like-comments. Each PC statement is accompanied by a single response developed by subject-matter experts. In some cases, more nuanced or complex concerns were answered through multiple responses to multiple PC statements or they may have a single response dedicated to the specific comment. Every comment has the same value, whether expressed by many or by one respondent.

Commenters and Public Concern Statements

Table 1 is of a list of the commenters, their letter number, and the associated PCs. In Table 2, the PCs are organized by subject. Commenters can look for the subject that most closely aligns with their particular comment, note the PC number(s) associated with their letter then locate the narrative response in this report. Table 3 consists of the number of substantive (coded) comments by subject. The PCs and their responses follow Table 3 and are organized by subject.

Following the tables are sections providing the public concern statements and the response to the public concerns, organized by subject.

Table Q-1. Draft EIS Commenters, Letter Numbers, and Associated PCs.

Organization	Name	Letter #	Public Concern (PC) #
	Public, Jean	1	92
	Public, Jean	2	1, 11, 19, 40, 65, 80, 92
Bombardier Aerospace	Gonsalves, John	3	97
Buffalo Airways	McBryan, Joe	4	3, 97
Natural Resources Conservation Service	Green, Allen	5	4
	Mehrman, Maryann	6	80, 92
	Joos, Brad	7	3, 16, 35, 41, 53, 54, 58, 61, 66, 82, 86, 88, 91
Quebec Government Air Tankers	Carrier, Benoit	8	97
	Hanson, Lauren	9	39
Oregon Forest Industries Council	Dykzeul, Mike	10	1, 4, 29, 33, 41, 45, 61, 82, 83, 86, 91
	Turn,er James	11	91
Evergreen International Aviation, Inc.	Wahlberg, Tim	12	7, 97
	Milligan, Danny	13	97
	Boernke, Chris	14	2, 92

Organization	Name	Letter #	Public Concern (PC) #
Forest Service Employees for Environmental Ethics	Stahl, Andy	15	84, 89, 90, 92
	McCloy, Margie	16	92
	Soffler, Judy	17	92
National Association of State Foresters	Smith, Dan	18	4, 83, 91
Environmental Protection Agency, Washington DC	Bromm, Susan	19	1, 16, 43, 45, 60, 82, 86, 91
Fire Chief's Association of Santa Barbara County	Mingee, Michael	20	4, 16, 53, 55, 82, 83, 85, 86, 91
The Lands Council	Juel, Jeff	21	98
	Delp, DJ	22	28
	Ulrich, Roberta	23	16, 60
	Woodcock, Jennifer	24	92
Environmental Protection Information Center	Baker, Kimberly	25	16, 17, 19, 36, 50, 67, 71, 72, 76, 80, 84, 89, 92
Southern Group of State Foresters	Frederick, David	26	7
	Geissler, Jerry	27	48, 93, 94
Firefighters United for Safety, Ethics, and Ecology (FUSEE)	Ingalsbee, Timothy	28	46, 49, 61, 95, 97, 98, 99
	Hull, Richard	29	9, 91
Santa Barbara County Fire Department	Dyer, Michael	30	8, 82, 91
	Trimble, Eric	31	45, 91
National Association of Forest Service Retirees	West, Allan	32	8, 9, 18, 21, 52, 53, 54, 91
Oregon Department of Forestry	Decker, Doug	33	3, 4, 6, 16, 33, 91
Montecito Fire Department	Wallace, Kevin	34	4, 55, 82, 83, 91
Sky Island Alliance	Emerson, Melanie	35	2

Organization	Name	Letter #	Public Concern (PC) #
Phos-Check	Raley, Ron	36	8, 45, 56, 68, 83, 86, 91
Department of Natural Resources, Washington State	Everette, Aaron	37	3, 4, 7
Idaho Conservation League	Oppenheimer, Jonathan	38	87, 98
	Eagle, Dan	39	97
Central Sierra Environmental Resource Center	Buckley, John	40	4, 6, 7, 8, 45, 77
	Balog, Cameron	41	3, 4, 9
CAL FIRE	McMurray, Andrew	42	1, 3, 4, 5, 9, 20, 33, 34, 36, 37, 53, 62, 73, 82, 83
Center for Biological Diversity	Leninger, Jay	43	19, 22, 28, 38, 40, 95
	Doten, Leonard	44	5, 14, 16, 97
Crook County Land Use Planning and Zoning	Smith, Nels	45	4, 6, 9, 20
Department of Interior	Taylor, Willie	46	6, 25, 26, 27, 45, 47, 54, 64, 69, 75, 81, 83, 86, 96
	Unknown	47	92
City of Santa Barbara	Dimizio, Andrew	48	5, 9, 36, 53, 55, 66, 85
League of Wilderness Defenders – Blue Mountains Biodiversity Project	Coulter, Karen	49	10, 11, 12, 13, 14, 15, 16, 17, 19, 23, 24, 28, 30, 31, 32, 35, 36, 40, 42, 44, 57, 58, 59, 60, 63, 70, 72, 75, 78, 79, 80, 92
	Murray, Jerry and Mary	50	74, 92
Mineral County Board of Commissioners	Simons, Duane	51	3, 4
	Osman, Cathy	52	92
County of Los Angeles	Antonovich, Michael	53	4

Table Q-2. Public Concern Statements Organized by Subject.

Subject	Public Concern Numbers Associated With This Subject
Air Quality	1
Alternatives	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
Aquatics	19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32,
Collaboration and Coordination with Other Agencies etc.	33, 34
Cultural Resources	35, 36, 37
Hydrology	38, 39, 40, 41, 42, 43, 44
Monitoring	45
NEPA	46, 47, 48, 49, 50, 51, 52, 53, 54, 55
Plant Species	56, 57, 58, 59
Public Health and Safety	60, 61, 62, 63
Scenery	64
Social and Economics	65, 66, 67, 68, 69, 70
Environmental Justice	71
Soils	72, 73
Wilderness	74, 75, 76, 77
Wildlife	78, 79, 80, 81
Wildland Fire Management	82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99

Table Q-3. Number of Coded (Substantive) Comments by Subject.

Subject	# of Coded Comments by Subject
Air Quality	5
Alternatives	76
Aquatics	37

Subject	# of Coded Comments by Subject
Collaboration and Coordination with Other Agencies etc.	5
Cultural Resources	13
Hydrology	18
Monitoring	6
NEPA	23
Plant Species	17
Public Health and Safety	10
Scenery	1
Social and Economics	12
Environmental Justice	2
Soils	5
Wilderness	5
Wildlife	22
Wildland Fire Management	118
TOTAL	**375**

Public Concerns and Responses to Comments

Air Quality – Alternative 1 - Environmental Consequences

Public Concern 1

The Forest Service should analyze the effects of catastrophic fires where fire retardant is not used and compare those effects to fire-retardant-controlled fire events, especially in regards to effects on air and water quality. This would include providing supporting data for the conclusions that fire retardant is not in the air longer than a minute, precluding drift and impacts to non-target areas and that volatization of nitrogen in the retardant, resulting in nitrous oxide emissions, would be offset by nitrogen in vegetation not burned.

Response to PC 1

The final EIS analyzes the effects suggested above in both air quality and water quality sections. When opportunities exist, monitoring of air quality and analysis of the emissions from wildfires has been performed. The air quality impact of wildland fires depends on a number of complex factors, including weather, fire behavior, and fuels. There have been a number of these studies over the years with extremely complex and variable results.

Long-term fire retardant is used on relatively few fires, depending on the availability of other resources, anticipated delay in arrival of ground resources, and the proximity to people and property. On large fires, long-term fire retardant is used near the perimeter of the actively burning area to assist firefighters by slowing fire spread and intensity to mitigate the danger to firefighters and the public. These factors increase the difficulty of making meaningful comparison between environmental effects from fires when fire retardant is used and when it is not.

Studies performed as part of aircraft and fire retardant evaluations have consistently shown that the time for fire retardant to reach the ground is very short, often taking as little as 10 seconds (Schonhuber et al. 2005). Estimating that fire retardant takes 60 seconds to reach the ground provides an additional margin of safety (Schonhuber et al. 2005).

Alternative 1 Pro with Rationale

Public Concern 2

The Forest Service should select Alternative 1, No Aerial Application of Fire Retardant, because according to research done by Forest Service Employees for Environmental Ethics it appears that: fire retardant use is uncorrelated or weakly negatively correlated with initial attack success rates; fire retardant use is uncorrelated or weakly negatively correlated with average fire size; no data support the proposition that retardant lessens structure losses to wildland fires and the available data suggest its use is irrelevant to structure losses; and the known environmental and human costs of aerial retardant use outweigh its firefighting benefits.

Response to PC 2

Interpreting a correlation between fire retardant use and initial attack success or fire size is very difficult, especially using national data collected from highly variable fire behavior conditions. Statistical analysis can identify mathematical relationships between data sets or, in other words, tell us if there is a mathematical correlation or lack of correlation among data. However, while these correlations can sometimes indicate cause and effect, or a lack of correlation may indicate lack of cause and effect, reaching any such conclusions requires proper interpretation of the data and evaluation of whether correlative relationships should be construed to indicate cause-and-effect relationships. Many factors influence fire behavior, including:

- Topography
- Weather
- Fuel type
- Fuel density
- Initial ground resource response
- Fire size at engagement.

In addition to the above, there are many variables affecting effectiveness of fire retardant application including:

- Pilot skills
- Aircraft
- Availability of ground forces to follow up application
- Fire size and behavior
- Visibility.

To truly understand the influence of fire retardant on initial attack success and ultimate fire size, one would have to compare outcomes under similar fire behavior and fire retardant application circumstances. Simply put, what is the comparative fire size when fire retardant is used or not used under the same or similar conditions? Only a comparison of fire retardant use and non-use under similar circumstances can allow any valid conclusions to be drawn as to effectiveness of fire retardant. However, as noted, it is extremely difficult to accomplish this kind of controlled experimentation given the high degree of variability among wildfire incidents and the limited circumstances where fire can be allowed to burn unchecked for purely experimental purposes.

In reaching any statistically significant conclusions, sample size is also an important factor. The fact that fire retardant is used in only 5 percent of initial attacks further detracts from the ability to conclude that there is any correlation, much less cause-and-effect relationship, shown by the data used. For example, it is expected that, because of cost, fire retardant is not used in low-hazard fuel types with low risk of extreme fire behavior and spread. Because of these characteristics, initial attack without the use of fire retardant is also generally very successful, and therefore data will show small fires and successful initial attack without the use of fire retardant in these fuel types and fire behavior conditions. Conversely, in high-hazard fuel types with high risk of extreme fire behavior and high fire spread rates, it is more likely that fire retardant will be used and yet, because of extreme fire behaviors, it is more likely that these fires escape initial attack and become large notwithstanding the use of fire retardant. Comparing these two data sets, one could erroneously reach the conclusion that using fire retardant decreases the chances of initial attack success, if that were the only variable considered. That conclusion would be in error, because fire size and initial attack success are primarily a function of the factors listed above, not whether or not fire retardant is used.

In the absence of controlled scientific experiments that could be used to support a valid statistical analysis, we must look to other means to evaluate the effectiveness of fire retardant. Laboratory experiments show that, under controlled conditions, fire retardant lowers fire intensity and slows the rate of spread in certain fuel types and fire behavior conditions. In addition, data show that long-term retardant applications show a reduction in fire spread and intensity of about 39 to 45 percent, when compared to water, when the fuels are still wet from application. When the water has evaporated off, the fuels treated with retardant still show a reduction in spread and intensity of 0.53 to 0.57, or a reduction of greater than 50 percent compared to untreated fuels. Data for water-treated fuels show no reduction in spread or intensity (0 reduction factor) after they are dried (Appendix O).From these experiments, it is reasonable to conclude that similar results are obtained under field conditions, where fire retardant can be effectively applied.

Wildland firefighters who have experienced hundreds of fires under similar fire behavior conditions and observed fire behavior with and without the use of fire retardant have attested to the conclusion that the use of fire retardant reduces fire intensity and rate of spread, allowing earlier control and containment, and reducing overall fire size (Appendix O). In the absence of an ability to conduct controlled, scientific experimentation, the observations of these experienced firefighters provides a reasonable basis to conclude that fire retardant is an effective firefighting tool, which can be used to reduce the size of wildland fires and resulting damage to natural resources and human improvements.

Alternative 1 Con with Rationale

Public Concern 3

The Forest Service should not select Alternative 1, No Aerial Application of Fire Retardant, because by not using fire retardant:

A) The impacts on air, water, social, economics, visuals, etc. are great as was demonstrated in the Jesusita Fire when fire retardant was limited/restricted and 80 homes were destroyed;

B) Within the wildland-urban interface (WUI), the social and economic effects will increase (loss of life, property, and critical infrastructure) because of large, destructive wildfires;

C) On National Forest System (NFS) lands, fires could potentially increase in size, complexity, cost, and cross ownership boundaries, thus transferring risk to other agencies and exposing risk to resource values such as private landowner timber values;

D) There will be significant ramifications on other resource values because of not being able to successfully fight fires—such as air quality and human health, the emissions of greenhouse gases, recreational opportunities, changes in aesthetics, alterations in the direction and rates of vegetation succession, and firefighter safety;

E) The cost of aerial application of fire retardant will increase significantly, creating additional costs for other agencies; and

F) The number of large fixed wing aircraft contracted by the Forest Service to apply aerial retardant is declining; therefore, transferring the cost and responsibility of responding to Federal jurisdiction wildfires to other Federal and state aerial resources.

Response to PC 3

A) The draft EIS on page 28, Table 1, presents the effects of Alternative 1. The draft EIS also considers the impacts on affected environment and environmental consequences in chapter 3 (pages 32–134). The draft EIS identifies that under Alternative 1 some fires are likely to get larger and there may be more risk to property and natural resources, including those mentioned by the commenter.

B) There are many "at risk communities," as defined in the *Wildland Urban Interface Communities Within the Vicinity of Federal Lands That Are at High Risk From Wildfire* [66 Fed. Reg. 753, January 4, 2001], created pursuant to Title IV of the Department of the Interior and Related Agencies Appropriations Act, 2001 (114 Stat. 1009). There are also communities within the wildland-urban interface (WUI) (as defined by the Health Forest Restoration Act of 2003 (Pub. L. 108-148) near National Forest System (NFS) lands. The Agency acknowledges the potential damages to values-at-risk, including property, infrastructure, and natural resources within "at risk communities" and communities within the WUI. The Agency also notes that those effects may differ across the alternatives because of potential increases in probability of escaped fires when fire retardant use is eliminated or excepted, as noted in the draft EIS (Tables 12 and 14, pages 88 and 94). However, given the uncertainty regarding future fire locations and conditions, as well as the uncertainty associated with the effectiveness of other tools and tactics when fire retardant is not allowed, changes in probability of escaped fires and corresponding damages to values-at-risk, including property associated with at-risk-communities, are not quantified. Analysis of effects of escaped fires would not yield reliable, replicable, and quantifiable results as the variables that exist nationwide that affect wildfire suppression on NFS lands are many, and the data either do not exist or are not reliable at the scale of this analysis.

C) The Forest Service fire community is currently guided by manuals, handbooks, and guidelines relative to wildland fire preplanning with cooperators and establishing and modifying cooperative agreements. These various documents will be modified with the necessary changes and direction based upon the alternative selected in the record of decision by the Chief of the Forest Service. Regardless of which alternative is selected, coordination and communication with the interagency fire community will occur annually, pre-fire season, to ensure that the appropriate updates and changes are made to all master cooperative agreements, annual operating plans, standard operating plans, pre-season training, and modification of automated dispatch plans (draft EIS, chapter 3, Wildland Fire Management, Environmental Consequences, Alternative 1, page 123).

D) On pages 32–134 in the draft EIS, the effect of wildfires on natural resources is considered, as well as the economic, social, health, safety, and visual impacts. Broadly, it can be stated that without the use of fire retardant to fight fires on NFS lands, some fires might get larger and could cause more property damage. The analysis evaluates the potential effects on the resources of no action.

E) The Forest Service acknowledges the longer term and complex costs associated with damages to resources, property, and other values-at-risk resulting from potential changes in the probability of escaped fires (or decreases in initial attack success rates), particularly for Alternative 1 compared to Alternatives 2 and 3 (draft EIS, page 88, Table 12); however, there is no attempt to characterize or estimate cost details because of the uncertainty and unknowns about the locations and characteristics of future fire incidents. Qualitative discussion of potential changes in initial attack success rates, adopted as an indicator of potential hazards to values-at-risk (Table 14, page 94 of the draft EIS), is provided in the Wildland Fire Management section within chapter 3 of the draft EIS (pages 106–121). Quantifying or projecting changes in future suppression costs associated with changes in firefighting strategies or tactics when fire retardant is not available is not attempted because of uncertainty about future fire conditions and characteristics that affect tool selection and strategy design, the relative effectiveness of those tools and tactics, and overall capacity of alternative tools and tactics to maintain initial attack success rates under reasonably foreseeable constraints on interagency fire management resources (e.g., crews, equipment, tankers, etc.).

F) Because of the aging large airtanker fleet, measures to prevent accidents have been taken—the Continued Airworthiness Program (CAP) and Operational Service Life (OSL)—to implement additional safety requirements to reduce the risk. OSL requirements were added to the large airtanker contracts to provide additional inspection and maintenance requirements to help mitigate potential accidents. As a result of the CAP and OSL, the large airtanker fleet has been reduced by approximately 63 percent and additional safety and maintenance requirements have also been added to the contracts for both single-engine airtankers and helicopters. These requirements are in place whether the aircraft is delivering water fire chemicals, cargo, or personnel. In addition, the Forest Service conducts risk assessments on these programs in order to make determination for use of a particular tactic or tool in the suppression of fires. Therefore, the Forest Service and other Federal agencies are depending more on other aerial resources and other agencies for aerial resources.

Alternative 2 Pro with Rationale

Public Concern 4

The Forest Service should select Alternative 2, Continued Aerial Application of Fire Retardant Under 2000 Guidelines, Including 2008 Reasonable and Prudent Alternatives, because:

A) The tradeoffs of resource damage from wildfires compared to the damage from fire retardant use, even though difficult to quantify, would dictate that the loss of resources (natural, cultural), habitats, or communities from fire are far worse;

B) It is most aligned with current policy, is reasonable and prudent, minimizes adverse impacts of fire retardant on aquatic life and habitat, and addresses the first and highest priority in fighting fires—firefighter and public safety;

C) It has the least impact to other Federal, state, and local agencies, including fire departments; maintains priorities and protocols among partners and cooperators; and is a more fiscally responsible approach than the preferred alternative;

D) Adjacent lands would not be put at greater risk of spreading wildfires from NFS lands;

E) It provides adequate species protection by restricting the use of aerially applied retardant within the habitat of threatened and endangered species; and

F) In Alternative 3 the argument for fewer exceptions, more restrictions, and the relatively minor potential for reduction of environmental degradation provided is not worth increasing the potential for large-scale natural resource and habitat loss by fast-moving wildfires; thus, Alternative 2 is the preferred alternative.

Response to PC 4

A) Pages 28–30, Table 1, of the draft EIS compare the effects of all three alternatives on public health and safety, Federally listed species, Forest Service sensitive species, invasive species, water soil wilderness, and air and visual quality. The analysis indicates that under the Alternative 3 without aerial fire retardant to slow the growth of more isolated fires, potential exists for some of these fires to grow larger before firefighters can safely fight the fires (Henderson and Lund 2011). As indicated, although Alternative 2 would continue the status quo, it may not provide adequate protection to some resources including threatened and endangered species and their habitats, while Alternative 3 would provide additional protection to many of these species and their habitats and still allow the continued availability of aerially delivered fire retardant as a firefighting tool in most situations.

B) Although Alternative 2 would continue the status quo, it may not provide adequate protection to some resources including threatened and endangered species and their habitats, while Alternative 3 would provide additional protection to many of these species and their habitats and still allow the continued availability of aerially delivered fire retardant as a firefighting tool in most situations. Alternative 3 does provide for the use of aerially delivered fire retardant, as necessary, for the protection of human life and public safety.

C) The Forest Service fire community is currently guided by manuals, handbooks, and guidelines relative to wildland fire preplanning with cooperators and establishing and modifying cooperative agreements. These various documents will be modified with the necessary changes and direction based upon the alternative selected in the record of decision by the Chief of the Forest Service. Regardless of which alternative is selected, coordination and communication with the interagency fire community will occur annually, pre-fire season, to ensure that the appropriate updates and changes are made to all master cooperative agreements, annual operating plans, standard operating plans, pre-season training, and modification of automated dispatch plans (draft EIS, chapter 3, Wildland Fire Management, Environmental Consequences, Alternative 1, page 123). Table 13 on page 89 of the draft EIS shows the compliance, fire retardant use, and other suppression costs for all three alternatives considered.

D) Wildland fire management objectives include protection of human life, property, and natural/cultural resources, both within and adjacent to Agency-administered lands (USDA Forest Service et al. 2009). These objectives would continue to guide firefighting actions on all NFS lands regardless of the alternative chosen in the record of decision by the Chief of the Forest Service.

The draft EIS identifies on pages 121–126 that under Alternatives 1 and 3 some fires might be larger; however, there is always a risk that wildfires may spread from NFS land even under Alternative 2. Additionally, given the uncertainty regarding future fire locations and conditions, as well as the uncertainty associated with the effectiveness of firefighting tools and tactics, changes in probability of escaped fires and corresponding damages, including those on adjacent lands, are not quantified. Analysis of effects of escaped fires would not yield reliable, replicable, and quantifiable results, because the variables that exist nationwide that affect wildfire suppression on NFS lands are many, and the data either do not exist or are not reliable at the scale of this analysis.

E) The analysis in the draft and final EIS shows that Alternative 2 does not provide for the protections of some TEPCS species as well as Alternative 3. Alternative 3 provides additional protections for these species, as well as protection for some Forest Service listed sensitive species. The Forest Service is completing consultation with these agencies to determine if Alternative 3 provides adequate protection for all listed species.

F) Alternative 3 provides significantly more protection to listed species while minimizing the potential for changes to how aerially delivered fire may be used. The final EIS in Appendix P identifies the percentages of lands included in fire retardant avoidance areas for forests that reported retardant usage from 2000 to 2010, and maps, which have been developed for all forests that use aerially delivered fire retardant and have listed species. The data in the draft EIS Appendix D pages 194–196, show that fire retardant is rarely used in aquatic avoidance areas. Nationally only 0.83 percent of NFS lands for which retardant usage 2000–2010 was reported are included in terrestrial avoidance areas; thus, we anticipate little change in the use of aerially delivered fire retardant nationally.

Public Concern 5

The Forest Service should select Alternative 2, Continued Aerial Application of Fire Retardant Under 2000 Guidelines, Including 2008 Reasonable and Prudent Alternatives, with the following modifications:

A) Not include the 2008 Reasonable and Prudent Alternatives or ensure that implementation of these Guidelines involves state and local agencies; and incident commanders on Federal fires should be given clear direction that places a priority on protection of public health, public safety, and firefighter safety;

B) A delineation and institution of a programmatic review to actively determine if less toxic and environmentally stressful alternatives are available; and

C) Allow aerial application of fire retardant for all initial attack in areas that have a history of burning values at risk; and this would allow Alternative 3 to be used in areas such as wilderness or where burning is environmentally deemed appropriate.

Response to PC 5

A) Incident commanders (ICs) are delegated the authority to manage fires. All decisions regarding the management of that fire are the responsibility of the IC. Incident commanders are responsible for considering the risks associated with all management decisions including the safety of the public and the firefighters, which is the first concern of the Forest Service. The 2008 Reasonable and Prudent Alternatives were adopted by the Forest Service because National Oceanic and Atmospheric Administration (NOAA) Fisheries and the FWS determined that continued use of fire retardant under the 2000 guidelines may be likely to jeopardize the continued existence of 65 species. No matter what alternative is selected, protection of human life and public safety will be a priority.

B) Regardless of the alternative selected, the Forest Service may continue to pursue less toxic formulations or make future decisions on changes to the fire retardant program. See pages 345–349, Appendix J, in the draft EIS, for the use of qualified and approved fire retardant products. The Forest Service is always looking for less toxic and more environmentally safe formulations for use as fire retardant. This is an ongoing program and is not part of this analysis. See Appendix J in the draft EIS for the Agency's protocol for applying qualified fire retardant products.

Additionally, on pages118–119 in the draft EIS and in Appendix L, the current wildland fire chemical program is discussed, which includes working with industry in the development of new formulations. The Forest Service uses a formal process to develop and adjust the current specifications, which establish the requirements for industry to submit formulations for evaluation and potential use. These requirements include evaluation criteria (draft EIS, Appendix L, USFS 5100-304c Specification) to ensure that toxicity does not reach certain thresholds.

C) Alternative 3 provides for the identification of fire retardant avoidance areas as may be needed to adequately address concerns for threatened and endangered species in consultation with the U.S. Fish and Wildlife Service (FWS) at the local level. Local Forest Service offices may identify, if necessary and with the agreement of the FWS, areas where fire retardant avoidance is not needed for the protection of listed species; some of these areas may be in the wildland-urban interface. The Forest Service and other Federal agencies, as well some state and local agencies, have adopted the 2000 guidelines for the protection of aquatic areas. Exceptions to these guidelines are rarely invoked (draft EIS Appendix D, pages 194–196). Additionally, all other fire suppression tools would be available for use in avoidance areas; therefore, we would not expect significantly greater risks to areas that have a history of burning values at risk under Alternative 3 than under Alternative 2.

Alternative 3 Con with Rationale

Public Concern 6

The Forest Service should not select or should modify Alternative 3, Continued Aerial Application of Fire Retardant, and Adopting 2008 Reasonable and Prudent Alternatives to address the issue of avoidance areas because such areas:

A) May lead to potential loss of critical habitat by not allowing aerial application of fire retardant near these areas;

B) Cannot be easily recognized by air crews (crews must rely on lines drawn on a map), and may require specialist equipment;

C) Are difficult for pilots to fly over at high speeds and make split-second decisions on where to apply retardant;

D) May eliminate strategic areas for aerial application;

E) Increase risk to private land/timber owners natural resources and homes due to wildfires escaping National Forest System (NFS) boundaries and crossing onto private lands; and

F) Will involve extensive consultation and coordination on an annual basis. If the Forest Service implements a more complex mapping system for ground and aerial resources on NFS lands as a result, effective coordination with partners and cooperators will become very difficult. Avoidance mapping for Forest Service sensitive species “that may be trending toward listing under the ESA” indicates that the additional protections being sought through the process will be extensive. This is of grave concern to rural communities in the wildland-urban interface, where effective initial attack measures are often necessary to protect lives, homes, and infrastructure.

Response to PC 6

A) The analysis evaluates the potential effects of Alternatives 2 and 3 and their associated avoidance areas on threatened endangered proposed candidate and sensitive species. The purpose of the avoidance areas is to reduce the potential of adverse effects on aquatic species and on those species with specialized habitats and limited mobility. The effects of precluding the use of retardant in these areas was weighed against the effects of wildland fire in these areas.

B) Air crews will need to rely on a number of techniques to know where fire retardant avoidance areas are, including but not limited to: preseason briefings with local officials, hard copy maps, electronic maps, and, potentially, GPS systems. Local dispatch offices, duty officers and other fire officers will have this information readily available for reference. Ultimately, all decisions regarding the management of a fire are the responsibility of the incident commander. Incident commanders are responsible for considering the risks associated with all management decisions as well as when and where to aerially apply fire retardant.

C) The decision to use fire retardant or not is made based on a series of policy, guidelines, specific unit direction, and priority setting for initial attack response. This decision may include a specific fire suppression resource or may include multiple fire suppression resources used in suppression tactics. Appendices A, C, J, L, M, and the avoidance mapping provide the guidance for the application of fire retardant or foam.

Pilots will know ahead of time the location of avoidance areas. It is the responsibility of air attack group supervisors, lead plane pilots, and ground forces to ensure that fire retardant pilots know where these areas are located. Ultimately, all decisions regarding the management of a fire are the responsibility of the IC. Incident commanders are responsible for considering the risks associated with all management decisions as well as when and where to aerially apply fire retardant.

D) The decision to use fire retardant or not is made based on a series of policy, guidelines, specific unit direction, and priority setting for initial attack response. This decision may include a specific fire suppression resource or may include multiple fire suppression resources used in suppression tactics. Appendices A, C, J, L, M, and the avoidance mapping provide the guidance for the application of fire retardant or foam.

While some areas may be restricted from using aerial application of fire retardant, other tactics would continue to be available for use by fire fighters. The percentage of NFS land included in avoidance areas will be included in the final EIS. The maps of the actual avoidance areas will be made available for review in the project record and will be distributed to the respective national forests.

E) It is possible that there may be some increase in risk to other land ownerships; however, it is unlikely because all other firefighting tactics would still be available to firefighters if fire retardant cannot be used. However, since aerial fire retardant resources, large airtankers in particular, are generally in short supply already, there are already situations where these resources may be unavailable. This is not expected to change regardless of the alternative chosen.

F) The Endangered Species Act requires Federal agencies, in consultation with the FWS and/or NOAA Fisheries, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. The consultation for this project is considered "formal" because harm is believed to be likely The Forest Service will complete this consultation process and identify mitigation measures needed to minimize the potential harm to listed species.

Mapping of avoidance areas was implemented in 2008 based on the decision notice and the acceptance of the Reasonable and Prudent Alternatives. Mapping of 300 feet adjacent to waterways and waterways, specific terrestrial plant and animal species has been completed for both alternatives 2 and 3.

When the Forest Service accepted the RPAs, monitoring was included as part of the implementation, and monitoring protocols were established. Adjustments to these protocols have been included in the current consultation, as well as establishing the 5 percent monitoring criteria. The Forest Service will work at the local level with all the appropriate cooperators, regulatory agencies, and others to ensure communication and application of the selected alternative is accomplished to minimize damage to the environment, including in the wildland-urban interface, whether from applying fire retardant or the control of the fire.

There are many "at risk communities," as defined in the *Wildland Urban Interface Communities Within the Vicinity of Federal Lands That Are at High Risk From Wildfire* [66 Fed. Reg. 753, January 4, 2001], created pursuant to Title IV of the Department of the Interior and Related Agencies Appropriations Act, 2001 (114 Stat. 1009). There are also communities within the wildland-urban interface (WUI) (as defined by the Health Forest Restoration Act of 2003 (Pub. L. 108-148) near NFS lands. The Agency acknowledges the potential damages to values-at-risk, including property, infrastructure, and natural resources within at-risk communities and communities within the WUI. The Agency also notes that those effects may differ across the alternatives because of potential increases in probability of escaped fires when fire retardant use is eliminated or excepted, as noted in the draft EIS (Tables 12 and 14, pages 88 and 94). However, given the uncertainty regarding future fire locations and conditions, as well as the uncertainty associated with the effectiveness of other tools and tactics when fire retardant is not allowed, changes in probability of escaped fires and corresponding damages to values-at-risk, including property associated with at-risk-communities, are not quantified.

Alternative 3 Pro with Rationale

Public Concern 7

The Forest Service should select Alternative 3, Continued Aerial Application of Fire Retardant, and Adopting 2008 Reasonable and Prudent Alternatives, because:

A) The use of fire retardants/foam is essential for firefighter and public safety;

B) It would have little or no additional impact on non-NFS lands and it protects special habitats and species while remaining effective in suppressing wildfires; and

C) It better responds to ESA, tribal concerns, and general resource issues.

Response to PC 7

The Chief of the Forest Service has identified Alternative 3 as the preferred alternative in the draft EIS, in part because of the reasons mentioned by the commenter. The effects of Alternative 3 have been described in detail in chapter 3 of the draft EIS (pages 32–134).

Public Concern 8

The Forest Service should select Alternative 3, Continued Aerial Application of Fire Retardant Under Aerial Application of Fire Retardant direction, and Adopting 2008 Reasonable and Prudent Alternatives, with the following modifications:

A) Minimize restrictions on the application of aerial retardant during Initial Attack (Alternative 2 as well);

B) Minimize restrictions on the application of aerial retardant on fires encroaching on the WUI in order to meet the incident priorities and to protect life and property (Alternative 2 as well);

C) Even though Alternative 3 includes the newly developed 2011 direction, there is no estimate of cost to implement these guidelines, and no recognition of the difficulty to practically implement these guidelines;

D) Provide for broad discretion for incident commanders (ICs) and Agency administrators to evoke exceptions or to have exceptions evoked, in a timely fashion, even if by a higher authority;

E) Base the 300-foot buffers for avoidance areas on pilot skill and judgment, not by evaluating very complex maps for each forest;

F) Expand the 300-foot buffer or establish an adaptive management approach by which the buffer is expanded if misapplications are determined to continue to occur to any measurable degree except for rare circumstances; and

G) Add additional constraints so as to avoid applications inside wilderness and inventoried roadless areas.

Response to PC 8

A) If Alternative 3 were modified to minimize restrictions on the use of aerial fire retardant during initial attack, it would not address the concerns for the protection of threatened and endangered (T&E) and sensitive species as specifically designed. Alternative 2 does allow for a minimum of restrictions during initial attack, and the difference in effects between these two alternatives was compared throughout the draft EIS.

B) Again, this modification would not meet the intent of Alternative 3 to protect T&E and sensitive species. Alternative 2 allows for three exceptions, which include protection of life and property. Alternative 3 allows for an exception for protection of life and public safety.

C) The draft EIS discusses the costs of implementing Alternative 3 in the Social and Economics section on pages 86–95. The Forest Service recognizes the difficulties associated with implementing Alternative 3, including effects on cooperators (draft EIS pages 86–95).

D) Alternative 3 provides for ICs to invoke exceptions, using the delegation of authority granted by Agency administrators. Incident commanders are delegated the authority to manage fires and all decisions regarding the management of that fire are the responsibility of the IC.

E) The 2000 Guidelines contain direction for pilots, and Alternative 3 would provide similar direction for pilots. However, maps provide information for dispatchers, air operations, and ground troops to help determine if aerially delivered fire retardant is appropriate in a give location.

F) Alternative 3 provides the flexibility to expand the 300-foot buffer in cooperation with FWS and NOAA Fisheries, if the need has been determined. This is the case for several species, for example, the greenback cut throat trout in Colorado. Also, Alternative 3 provides a trigger to identify whether larger areas may need to be closed because of a misapplication.

G) This was considered in Alternatives 5 and 10 but eliminated from detailed study. See pages 27 and 28 in the draft EIS for further discussion.

Public Concern 9

The Forest Service should not select Alternative 3, Continued Aerial Application of Fire Retardant, and Adopting 2008 Reasonable and Prudent Alternatives, because:

A) Thick canopy cover and steep terrain make it nearly impossible for pilots to make drops based on visual identification of waterways;

B) It is difficult to implement and not always practical when trying to achieve suppression objectives; need maximum flexibility;

C) Decisions on where and when fire retardant can be applied could compromise working relationships across landowners and/ agencies;

D) It would be the most expensive to implement due primarily to mapping and monitoring requirements;

E) Additional guidelines/restrictions would put firefighter and public lives at risk; and will likely significantly restrict state aerial resources from performing fire retardant drops over NFS lands; that restriction will in turn create a significantly greater risk of damage to state lands adjacent and downstream from NFS lands;

F) Required post-fire monitoring is unlikely to come with additional funding or other agency support, and hypothesis-driven research on post-retardant effects would be more beneficial than collecting data. Suggestion to fund researchers through the Joint Fire Sciences Program, National Science Foundation, or the one of the Forest Service fire labs, as these findings are much more likely to be peer-reviewed, interdisciplinary, and objective;

G) To assess the potential for risk to human life or safety prior to dropping fire retardant will likely result in a delay in fire retardant use, thus putting more structures, watersheds, and wildlife at a significantly higher risk of damage or destruction;

H) Additional money spent on the mapping process will reduce funding for actual firefighting efforts; and

I) It is inadequate because it doesn't address the WUI; need to narrow the focus to remote, non-urban interface locations.

Response to PC 9

The points within the concerns were discussed and evaluated relative to the effects analysis for the three alternatives considered in detail in the draft EIS, pages 32–134. The current guidelines for the aerial delivery of fire retardant are part of Alternative 3. Mapping of avoidance areas was implemented in 2008 based on the decision notice and the acceptance of the Reasonable and Prudent Alternatives. Establishing national mapping standards and the completion of all the applicable avoidance maps for Alternative 3 have been completed; therefore, there will not be additional cost associated with the selection of Alternative 3 as it has already been incurred. When the Forest Service accepted the RPAs, monitoring was included as part of the implementation and monitoring protocols were established. Adjustments to these protocols will be included in the current consultation, as well as establishing the 5 percent monitoring criteria. The Forest Service will work at the local level with all the appropriate cooperators, regulatory agencies, and others to ensure communication and application of the selected alternative is accomplished to minimize damage to the environment, including in the wildland-urban interface, whether from applying fire retardant or the control of the fire.

Alternative 5

Public Concern 10

The Forest Service should consider in detail Alternative 5, Prohibit Aerial Application of Retardant in areas within ¼-mile from Waterways, Wilderness, Wilderness Study Areas, and Other Withdrawn Land Allocation areas, because it is a reasonable alternative and there are other ways to protect property and respond quickly to fires.

Response to PC 10

This alternative was not considered for detailed analysis because it is already reflected in an alternative and would not contain a magnitude of change that provides a sharply different approach. . The Forest Service considered Alternative 5 (draft EIS, page 27 and Appendix K) by completing an analysis to include these areas as avoidance areas. Based on that analysis the Forest Service concluded that Alternative 5 eliminated more than 90 percent of NFS lands and would, in all practicality, be the same as Alternative 1.

Alternative 6

Public Concern 11

This alternative was not considered for detailed analysis because the alternatives analyzed in detail adequately address this concern. The Forest Service should consider in detail Alternative 6, Use only Water for Aerial Suppression of Fire, because:

A) Fire retardant drifts from air turbulence so is not more effective than water; and

B) Water is more commonly used in fighting most fires, often without fire retardant, and is effective.

Response to PC 11

Alternative 6 was not considered in detail because it is essentially the same as Alternative 1. In addition, the Forest Service recognizes that water is commonly used in fire suppression actions. However drop test evaluations and studies indicate gum-thickened retardant does reach the ground in sufficient coverage levels to provide the benefits of retardant versus water The gum-thickening allows the retardant solution to adhere to the water which serves as the carrier for the retardant and minimize drift as compared to water chapter 3, Fire Retardant Operational Use identifies why retardant would be used as well as its application in order to realize its benefits of use during suppression actions. Local national forests have the discretion to use one or more fire suppression tools, as long as the decision to apply fire retardant is guided by the initial size-up and assessment.

Alternative 7

Public Concern 12

The Forest Service should sufficiently analyze Alternative 7, Restrict the Use of Retardant to Those Exceptional Situations Where the Benefits Far Outweigh the Risks, to support the conclusion that this alternative doesn't meet the purpose and need of reducing wildfire intensities and rate of spread.

Response to PC 12

This alternative was not considered for detailed analysis because the alternatives analyzed in detail adequately address this concern. It is not possible to develop detailed site-specific guidance for evaluating and weighing various risks and effectiveness of fire retardant necessary to satisfy Alternative 7 because too many factors are involved that vary across incidents. The potential effectiveness of fire retardant in reducing and slowing the rate of spread and intensity has been shown in laboratory analyses (chapter 3, page 120 in the draft EIS), as well as fire observations and experience of fire management officials which contribute support for the continued use and success of fire retardant in slowing and managing wildland fires (also see Public Concern 89).

To validate and document the observation and experience of fire personnel, a questionnaire was distributed among the national wildfire community (July 2011). More than 50 responses were received to the questionnaire and a summary was put into the Wildland Fire Management Specialist Report, Appendix O. The respondents to this survey concurred with the statements made in the EIS that fire retardant slows the wildfire's rate of spread and intensity and allows firefighters time and the ability to take direct actions when, without its use, they would not have been successful in either initial attack or impeding the spread of the fire. The final EIS contains additional clarification regarding this point.

Alternative 3 facilitates efficient decisions about aerial application of fire retardant by (1) placing restrictions on fire retardant use to minimize risks to aquatic terrestrial and plan life, in addition to cultural resources and sites; and (2) still allowing for the use of fire retardant as one of a number of tools to help maximize the effectiveness of suppression efforts for those incidents where decisions have been made to suppress or contain fire. As such, Alternative 3 is designed to help identify those situations where the benefits of using fire retardant (that is, facilitating suppression to help achieve suppression objectives and goals) outweigh the potential risks.

Alternative 8

Public Concern 13

The Forest Service should consider in detail Alternative 8, Use Retardant Only Where Proven Safe and Effective, because this alternative is more restrictive than Alternative 3 but not impossible and supports those who desire fire retardant to be used only as a last resort.

Response to PC 13

This alternative was not considered for detailed analysis because the alternatives analyzed in detail adequately address this concern. Laboratory experiments (Gimenez et al. 2004; Plucinski et al. 2007; USDA Forest Service n.d.), the Operational Retardant Effectiveness (ORE) study (George 1990) and firefighter experience (Appendix O) have shown that aerial application of retardant is an effective tool for reducing fire intensity and rate of spread in certain fuel types and fire behavior conditions, enabling fire fighters to contain fires more quickly and safely to protect life and property. Alternative 3 was designed to identify areas where it is safe to use fire retardant, for example, where it will not adversely affect species listed under the Endangered Species Act (ESA). Incident commanders, as well as firefighters, must consider whether aerially delivered fire retardant will be effective in a given situation based on their professional judgment. An alternative could not be designed where fire retardant could only be used if it were proven to be effective because fire starts are unpredictable and fire characteristics are extremely variable. Fires of any size can have a wide range of characteristics based on weather, terrain, and the fuel types and amounts and their complex interactions.

Alternative 9

Public Concern 14

The Forest Service should consider in detail Alternative 9, Do Not Use Retardant Until a New, Less Toxic Retardant is Developed, because the concept of investigating and evaluating improved delivery system capabilities is not specifically implied in Alternative 2 or 3 and should be part of the final decision.

Response to PC 14

Regardless of the alternative selected, the Forest Service may continue to pursue less toxic formulations and improved delivery systems, make future decisions on changes to the fire retardant program, and evaluate improved delivery system capabilities. Appendix J (draft EIS, pages 345–349) describes the Agency's policy regarding suppression chemicals and delivery systems. The Forest Service considered in detail Alternative 1, which would eliminate the use of fire retardant.

Alternative 10

Public Concern 15

The Forest Service should consider in detail Alternative 10, Increase the Size of Protections for Waterways and Increase Protection for Some Specially Designated Areas, because there isn't sufficient rationale to not analyze in detail.

Response to PC 15

Alternative 10 is essentially the same as Alternative 5. The Forest Service considered both these alternatives and the draft EIS provides the rationale for eliminating it from detailed study (draft EIS page 28). In addition to the rationale discussed in the draft EIS, no specific issues were identified or provided during scoping that indicated a need for increased protections in any specially designated areas (scoping comments are part of the project record). Alternative 1, which was considered in detail, considers the effects of discontinuing use of aerial applied fire retardants on all National Forest System lands, which includes specially designated areas. Generally application outside the 300-foot buffer is unlikely to have a measurable impact on stream water quality (Crouch et al. 2006). Intrusions into the buffer but at least 3 meters from water are unlikely to have a high impact on water because of uptake by vegetation and adherence of phosphorus to soils (Norris et al. 1978). Areas with steep slopes, coarse-textured soils, and little vegetation cover will have greater potential for movement of fire retardant to water and associated negative impacts (Napper 2011). Larger buffers may be considered in Alternative 3 at the local level based on site-specific conditions if it is determined to be needed for the protection of a specific species.

New Alternatives or Range of Alternatives

Public Concern 16

The Forest Service should consider a new alternative that:

A) Allows aerial fire retardant to be used unrestricted in all initial attack situations, thus allowing the IC all the suppression tools to suppress the fire when it is the smallest, least damaging, least costly, and safest to attack;

B) Differentiates between remote forest and non-remote forests (that is, forest with WUI and major interfaces with populated areas) and the definition of wilderness can't be a deciding factor, because there is now urban wilderness areas and remote wilderness areas and they are different due to nearness to populated areas;

C) Includes the suggestions from EPA to protect water quality, air quality and other natural resources (see Public Concerns 1 air quality 19–33 (aquatics), and others);

D) Includes weather condition restrictions and that wind drift be taken into consideration in the guidelines;

E) Restricts the use of aerial fire retardant to those exceptional situations in which the benefits far outweigh the risks, to only use fire retardant where proven safe and effective, and to develop non-toxic alternatives (Alternatives 7, 8 and 9);

F) If the 2000 Guidelines are not part of the final alternative and new guidance is developed, consider the following: (1) maintain consistency in guidance for the delivery and use of fire retardants between and across jurisdictional boundaries so as to minimize confusion and delay in fire suppression efforts, misapplication of fire retardants and unnecessary environmental damage; (2) ensure that the new guidance relies on current, updated, readily available information, data sources, and maps so as to not hinder initial attack efforts or delay the deployment of firefighting resources that arrive from other states and agencies; and (3) recognize the variability that occurs among environments, resources, habitats, and settings, and produce guidance that is regionally specific as opposed to one-size-fits-all nationally; and

G) Is more dynamic and less static to seek to provide improved mitigation of the problems related to fire retardant use on a programmatic basis, while recognizing the need to continue a somewhat more restricted version of the present program for the near future.

Response to PC 16

A) and B) Alternative 2 would allow the use of aerially delivered fire retardant in as unrestricted a manner for initial attack and in WUI. However, NOAA Fisheries, the FWS, and the District Court in Montana (Forest Service Employees for Environmental Ethics v. United States Forest Service 08-43 (D. Mont)) (U.S. District Court, Montana 2010) have determined that Alternative 2 may not provide adequate protections for threatened and endangered species and there were determinations that the use of aerially delivered fire retardant in such a manner may jeopardize the continued existence of 65 species. The 2000 Guidelines have been in use for approximately 12 years. The Forest Service has no documented cases where use of the 2000 guidelines for the protection of waterways on initial attach or in WUI on NFS lands has caused any fires to be more damaging, more costly or less safe. Therefore, we believe Alternative 2 already addresses this concern. In addition, no data exist that would enable quantification of differences in fire size due to the 2000 Guidelines; therefore, an alternative as described would not show significance.

C) EPA's suggestions do not require the development of a new alternative to protect water quality, air quality or other natural resources; their concerns have been addressed in the draft EIS (pages 32–134). Additional analysis is included in the final EIS in the Hydrology section to address drift due to wind, and water quality concerns.

D) Existing guidance and options for strategies in managing fires on NFS lands are based on land management goals and objectives that consider fuels, weather (including wind drift), topography, social and political factors, and involvement of other jurisdictions that might have different missions and objectives.

E) See responses to Public Concerns 12, 13, and 14.

F) The 2000 Guidelines are part of Alternative 2, which the Agency is currently using for the aerial application of fire retardant. These guidelines, with additional protections for species and tribal and cultural resources, are also included in Alternative 3.

G) Alternative 3 addresses of these concerns and would provide for an adaptive approach that would allow changes in the direction, as needed.

Public Concern 17

The Forest Service should consider a reasonable range of alternatives because the draft EIS failed to provide rationale for not considering all of the alternatives that were not considered in detail and other alternatives, and there seems to be little difference between Alternatives 2 and 3, especially in regards to human health and safety.

Response to PC 17

The Forest Service provided detailed consideration and sufficient rationale for Alternatives 1 and 3 and the rationale for eliminating Alternatives 4–10 from detailed consideration on pages 24–30 in the draft EIS. Federal agencies are required by NEPA to rigorously explore and objectively evaluate reasonable alternatives and to briefly discuss the reasons for eliminating alternatives that were not developed in detail. As stated in 40 CFR 1502.14:

General criteria for eliminating requests for additional management direction from detailed study included:

1. Management direction would not meet the purpose and need;

2. Management direction is not within the authority of the Forest Service;

3. Management direction is conjectural in nature or not supported by scientific evidence;

4. Management direction is already reflected in an alternative or does not contain a magnitude of change that provides a sharply different approach; or

5. Management direction does not pertain to Aerial Retardant EIS.

People who commented during scoping and on the draft EIS suggested a number of different alternatives that reflect their values and preferred management options. These alternatives examined but not evaluated in detail fall into three primary categories additional:

- Restrictions based on locations
- Restrictions based on criteria
- Limitations on type of application

These alternatives were reviewed and weighed by the deciding official during the course of the process. Therefore, they contribute to the range of reasonable alternatives and a reasoned choice, even though they were eliminated from detailed study.

Alternatives 2 and 3 fully consider the potential effects on human health and safety on pages 80–83 in the draft EIS; however, there is little difference in effects on human health and safety because under any alternative human health and safety are the Forest Service's primary concern. However, in other respects there is actually quite a bit of difference between Alternatives 2 and 3. Alternative 3 provides much more protection for threatened and endangered species than Alternative 2 and also includes protections for some Forest Service listed sensitive species. Alternative 3 also provides additional protection for tribal and cultural resources, which are not included under Alternative 2.

Public Concern 18

The Forest Service should provide further analysis and descriptions for the table "Comparison of Alternatives" on pages 28–30 of the draft EIS because under:

A) "Fertilizing Effects," there's an error in calculation of percentage of NFS land affected annually. If you use 200 million acres as the base then only 0.00002 percent of NFS land will be affected annually;

B) “Leaching or Erosion,” under Alternative 1, it should be stated that there will be no applied chemical into streams, although ash and natural elements from soil etc. will go into waterways; and

C) "Air Quality," under Alternatives 2 and 3, it should also be noted that air quality could be improved by keeping fires smaller.

Response to PC 18

A) We used the figure of 194 million acres; on average approximately 4,000 acres of NFS land have fire retardant applied to them annually. Using these figures, the calculation is: 4,000/194,000,000 = .00002 x 100 = .002, which is what is displayed in the analysis.

B) The analysis considers the effects of aerially delivered fire retardant. Under Alternative 1, aerially applied fire retardant would not be used; therefore, there would be no effect from fire retardant. Under any circumstance there would be ash and natural elements deposited in waterways as a result of a fire. It would be impossible to quantify the difference between the amounts of ash and natural elements from soil deposited into waterways under either Alternatives 1, 2, or 3, because the number of influencing factors are many and varied, and the predictability of fire occurrence is speculative.

C) Under Alternative 1 on page 34 in the draft EIS, it is noted that the potential exists for more smoke in the air, but that the potential amount of increased smoke is not quantifiable. The inverse is true for Alternatives 2 and 3; that is, that there could be less smoke in the air if fires are smaller because of the use of fire retardant, but again, because of the multitude of variables and conditions and the inability to predict fire starts, this potential effect is not quantifiable.

Aquatics – Environmental Consequences, General Effects

Public Concern 19

The Forest Service should further analyze the negative effects of aerial application of fire retardant on aquatic species, invertebrates, and T&E species; and further explain the conclusion that the action alternatives may impact individuals but such impacts are not expected to trend towards listing because:

A) The effects, such as reduced hatching success, reduced growth rate, impaired morphological development, injury to gill tissue, liver and kidneys, development of hyperplasia, and poisoned prey are detrimental to aquatic species;

B) The justification and conclusion of likely to adversely affect for T&E species on page 8 of the draft EIS is confusing and needs further analysis;

C) The agency must provide for a minimum number of reproductive individuals and the habitat required for well-distributed individuals to interact with others;

D) There are potential misapplication effects on listed and sensitive species that occur in California forests;

E) The draft EIS contains no data or analysis to support this conclusion for one, any, or all sensitive species that may be impacted by the action alternatives; and

F) The use of fire retardant should be curtailed until such analysis is completed (draft EIS, page 39).

Response to PC 19

The negative effects on aquatic species are primarily demonstrated in toxicity studies and described as such in the final EIS, and in the Biological Evaluation and Biological Assessments for this project. Toxicity is the primary direct effect on aquatic species from all chemicals, and its consideration is standard practice and a requirement for any fire retardant formulations.

A) The final EIS acknowledges that there are effects as described above and is working with USGS on a study to determine the effects of those sub-lethal effects (final EIS, Aquatics, Sub-lethal Effects on Aquatic Species). The Forest Service will adjust its fire retardant use practices as needed based on the outcomes of the studies. This research is ongoing and all findings will be available to the public.

B) A likely to adversely affect call was given to many species, even with avoidance areas. This call is based on the potential for misapplication. There are a number of cases where fish mortality has been documented in recent years due to misapplication of fire retardant to streams; therefore it is reasonable to assume a potential for future misapplication.

In addition, Alternative 3 proposes monitoring of areas where fire retardant drops have been used within a watershed to determine if adverse impacts on any aquatic species are occurring. If aerial application of fire retardant has occurred within a watershed and has a significant impact on a species or a portion of that species' population (or habitat then the area may have certain thresholds of impacts associated with it to restrict the future use of fire retardant for a specific period of time depending on the species affected, reproductive needs, life-cycle requirements, how the fire retardant impacts the critical life phases, and other factors.

C) The National Forest Management Act does not contain a requirement to determine minimum number of reproductive individuals for each species. Instead it requires the analysis to consider how the action provides for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple use objectives, and within the multiple use objectives of a land management plan adopted (16 USC 1604 (g)(3)(B)). Our analysis has evaluated the capability of the land to provide for aquatic species. Based on this analysis we determined a need to provide avoidance areas around waterways to reduce the risk of adverse effects on aquatic species.

D) The draft EIS and final EIS evaluated the potential effects of misapplications, including the potential effects on sensitive species. Specifically, Alternative 3 incorporates avoidance areas for some sensitive species that are determined to be trending toward Federal listing, it includes a monitoring and reporting requirement for misapplications; and it requires an assessment of the impacts to the species or habitats. Alternative 3 also requires the Forest Service to annually monitor 5 percent of all fires that are less than 300-acres in size where aerial fire retardant has been used.

E) The Forest Service has completed that Biological Evaluation that analyzes the the potential effects on sensitive species.

F) The analysis has been completed for the responsible official to make a reasoned decision. The analysis evaluates the potential effects on listed and sensitive species. Avoidance areas have been mapped. The Forest Service will apply all identified buffers where fire retardant will not be applied to avoid affecting listed species. The data for 2008–2010 show that out of an average of 9,853 fire retardant drops over the 3-year period, there were 42 misapplications that landed either in the buffer area or in the waterway (draft EIS page 42–43, Table 4), which is a very low number of misapplications in relation to total fire retardant use.

Public Concern 20

The Forest Service should consider the direct, indirect, and cumulative negative effects on fish habitat from wildfires, which are more detrimental than aerial application of fire retardant, in the final EIS. These effects include: heating of water and ash in waterways causes fish mortality; long-term detrimental effects on aquatic habitats can result from erosion and sedimentation, removal of stream shading, and increased levels of ammonium nitrate, organic nitrogen, and phosphorous; and low concentrations of ash that falls or is blown into waterways can clog fish gills and interfere with respiration. In addition, exclusion of fire retardant could conflict with state and local policies and ordinances protecting biological resources. They could also conflict with habitat conservation plans if such plans call for the exclusion of uncontrolled wildfires from the habitat being protected. These impacts can be expected over the entire State Responsibility Area.

Response to PC 20

The final EIS analysis is focused on the effects of fire retardant use, not on the effects of fire on the environment. The effects of fire and water use on aquatic species and their habitats, in particular, will depend on the intensity of the fire, prior watershed conditions, and ability of local aquatic communities to repopulate, which depends on life history patterns and overlapping generations. The final EIS Aquatics Section acknowledges that the effects of wildland fire are minimal however local conditions can intensify those effects.

The Endangered Species Act requires Federal agencies, in consultation with the FWS and/or NOAA Fisheries, to ensure that actions they authorize, fund, or conduct are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. The consultation for this project is considered "formal" because harm is believed to be likely The Forest Service will complete this consultation process and identify mitigation measures needed to minimize the potential harm to species.

Part of the Endangered Species Act consultation process requires each forest or grassland to work with their respective FWS and NOAA Fisheries offices to address effects on threatened and endangered species at the local level. Site-specific issues are best identified and resolved among local Forest Service biologists in consultation local agencies (FWS, NOAA Fisheries) because issues relative to that forest or grassland can be focused upon. Therefore, local or state policies or ordinances or habitat conservation plan requirements will be addressed at the appropriate forest or grassland level.

Public Concern 21

The Forest Service should remove the long-term fire retardants D75-R and D75-F or add a footnote to Table 2 on page 36 of the draft EIS because they will no longer be used by the Forest Service after December 2011.

Response to PC 21

The Forest Service acknowledges this error, which was corrected in the final EIS.

Public Concern 22

The Forest Service should analyze and provide information as to population status or trend for any of the sensitive species that are listed on pages 35, 36, and 66 of the draft EIS.

Response to PC 22

The Forest Service has completed a Biological Evaluation to analyze effects on sensitive species. The BE includes an analysis of populations and trends at a broad scale. Individual forests and grasslands have also identified local site-specific issues for populations or trends for sensitive species, and they are incorporated in the BE. In addition, sensitive species effects are addressed in the chapter 3 of the draft EIS (pages 32–134).

Public Concern 23

The Forest Service clarified what the sentence means under "Fish Response to Retardant Toxicity" on page 35 of the draft EIS, 2nd paragraph, that ends with "in certain instances." In addition, in the 3rd paragraph clarify what is meant by "established protocols."

Response to PC 23

The Forest Service acknowledges that the sentence on page 35 of the draft EIS under Fish Response to Retardant Toxicity was an incomplete sentence and was missing a word. This section has been clarified in the final EIS. Any fire retardant that is proposed for use by the Forest Service goes through a rigorous testing protocol by the manufacturer and then additional testing by the Agency, as outlined on pages 119–120 in the draft EIS Fire Effects discussion.

Public Concern 24

The Forest Service should provide sufficient data for other formulations for toxicity especially in regards to mayflies, and on concentration for adverse effects from other formulations.

Response to PC 24

Available data for toxicity testing on aquatic species has been referenced on pages 35–39 in the draft EIS. All available information for concentrations and toxicity specific to mayfly species is provided on pages 37–38 in the draft EIS. The formulations analyzed for mayflies are the fire retardants that are currently used by the Forest Service. Any fire retardant that is proposed for use by the Forest Service goes through a rigorous testing protocol, which includes concentration and toxicity test, by the manufacturer and then additional testing by the Agency, as outlined on pages 119–120 in the draft EIS Fire Effects discussion.

Aquatics – Environmental Consequences, Methodology

Public Concern 25

The Forest Service should consider that the National Hydrography Dataset (NHD) that was used to map waterways on public lands, which led to delineation of zones of concern and a 300-foot buffer on waterways, is inadequate because there's a cumulative effect in the NHD of under-representing the waterways on public lands in 2011; therefore, NHD doesn't support the conclusion in the draft EIS that the 300-foot buffer to waterways will adequately address environmental concerns since the "very small proportion of the land base, avoidance area mapping (the 300-foot buffer on waterways) protects species except when a misapplication occurs" (page 8). In addition, the Forest Service should include more detailed standards (scale and resolution) for mapping and monitoring the avoidance areas considering that NHD is not a fine-scaled hydrography dataset.

Response to PC 25

The USGS National Hydrography Dataset (NHD) is available at medium and high resolutions and is used for hydrologic analyses, including development of aerial fire retardant avoidance areas for water features. The medium-resolution dataset provides a coarse representation of water features, while the high-resolution dataset includes all available information. The draft EIS interdisciplinary team consistently used the high-resolution version for both quad-based avoidance maps and hydrologic analyses. The NHD datasets used for this project were downloaded from the Forest Service Natural Resource Information System/Natural Resource Manager data repository. The Forest Service has no evidence that indicates that the NHD data underestimate aquatic buffers by as much as 25 percent. In fact, the data location links directly with the routinely updated NHD and incorporates any submitted changes or updates from all national forests that choose to provide this information. Therefore, a large number of local water features residing on local national forest archives are included in the NHD used for this EIS.

National forest hydrologic data that are available locally but not available in the NHD do not significantly affect the reliability of the NHD used in projects at the national spatial scale, as does this EIS. Additionally, once the final EIS and record of decision are completed, avoidance maps will be updated by individual national forests and grasslands will be maintained by the Forest Service's Geospatial Technology Center in Salt Lake City, UT.

Public Concern 26

The Forest Service should modify Part Two of Alternative 3 to state that only habitats for species with a determination of likely to be adversely affected from fire retardant would be included in avoidance areas, and discuss whether any adverse effects from fire retardant would be worse than impacts caused by wildfires burning the habitat. In addition, include language that, in special cases, increase in the avoidance area could be negotiated on a case-by-case basis between the regulatory agency and the Forest Service.

Response to PC 26

The determination to identify a mapped avoidance area for a species was made based on the individual requirements for that species and the potential for effects from the application of long-term fire retardant on that species or its habitat. The Forest Service made the initial determination and used that information to help with the determination in the Biological Assessment. This determination was the basis for consultation with the FWS. Some species received a "not likely to be adversely affected" determination because they were in a mapped avoidance area. Other species received a "likely to be adversely affected" determination even though they were in mapped avoidance areas, because of the possibility of misapplications. Most plants that are in fire-prone areas are adapted to fire and are less likely to be affected by fire than they would be affected by the application of aerial delivered fire retardant. Where this was the case, the plants were protected with a mapped avoidance area.

Alternative 3 includes a provision that buffer areas may be adjusted for local conditions and coordinated with the FWS and NOAA Fisheries local offices.

Public Concern 27

The Forest Service should modify Appendix L to include the two examples as quoted in the text found on page 41 of the draft EIS, and include standards for the 1974 and 2000 avoidance briefings.

Response to PC 27

The Forest Service acknowledges this error, which has been corrected in the final EIS.

Aquatics – Alternative 1 - Environmental Consequences

Public Concern 28

The Forest Service should select Alternative 1, No Aerial Application of Fire Retardant, for aquatic species because:

A) Aerial application of fire retardant will drive T&E and sensitive species to extinction and poison all species, and wildfire is natural and use of toxic chemicals is unnatural;

B) The assumption in the draft EIS "without the use of retardant, the probability of a fire burning more acreage is also higher." Id. at 43 is not compared with any assessment of sensitive species populations or adaptations to fire disturbance and there is no discussion of cumulative effects of ongoing forest management activities to particular sensitive species; and

C) Habitat avoidance mapping will not provide for viability of several sensitive species that may be impacted by the action alternatives.

Response to PC 28

The Chief of the Forest Service will consider the environmental impacts of each alternative before making his decision. The Forest Service has evaluated the impacts from aerially applied fire retardant, including water only (Alternative 1) for all T&E and sensitive species (draft EIS pages 35–45, 65–79, 127–135). The analysis of impacts on T&E and sensitive species focuses primarily on the impacts of aerially applied fire retardant, yet considers fire-adapted ecosystems and the potential for fires to become larger if fire retardant is not used. The Biological Evaluation evaluates the potential effects on sensitive species. The analysis shows that there is a 99.58% confidence that a single application of fire retardant will not reach the water within the 300-foot buffers. The analysis also acknowledges that there is still a potential risk. Alternative 3 includes annual coordination with FWS and NOAA, as well as monitoring and reporting requirements so that adjustments can be made if they are found necessary.

Aquatics – Alternative 2 - Direct and Indirect Effects

Public Concern 29

The Forest Service should select Alternative 2, Continued Aerial Application of Fire Retardant Under 2000 Guidelines, Including 2008 Reasonable and Prudent Alternatives, for aquatic species because existing guidelines are reasonable, responsible, and prudent with only minimal (accidental) use.

Response to PC 29

The Chief of the Forest Service will consider the environmental impacts of each alternative before making his decision. Alternative 2 provides protection to aquatic areas with a 300-foot buffer, and it provides three exceptions. This alternative provides some avoidance of terrestrial species, but only for those identified by the FWS as likely to jeopardize their continued existence from the 2008 Biological Opinion and the adoption of the Reasonable and Prudent Alternatives. Alternative 3 was identified as the preferred alternative because it provided better protection for terrestrial and plant species as well as aquatic species.

Public Concern 30

The Forest Service should not select or should modify Alternative 2, Continued Aerial Application of Fire Retardant Under 2000 Guidelines, Including 2008 Reasonable and Prudent Alternatives, for aquatic species because:

A) There's potential for misapplication or drift, thus effect on aquatic species;

B) There should be additional avoidance mapping for the many sensitive listed species; and

C) Cumulative effects, such as uplisting, loss of viability, and/or local or regional extirpation or extinction, could be enormous and significant to T&E and sensitive aquatic species, because 43.4 percent of the land base contains aquatic habitat.

Response to PC 30

The Chief of the Forest Service will consider the environmental impacts of each alternative before making his decision. The Forest Service developed Alternative 3 to minimize effects on aquatic, terrestrial and plant species. We worked closely with the FWS and NOAA Fisheries in developing Alternative 3 to address their concerns, some of which in 2008, resulted in 65 determinations that the use of aerially delivered fire retardant may jeopardize the continued existence of certain species.

A) Alternative 3 provides the opportunity to adjust aquatic buffer widths, if necessary, to protect species. The draft EIS identifies that on average there are 14 misapplications per year into aquatic avoidance areas; some never make it into the water and most have only small amounts of fire retardant that enter the water (draft EIS page 42–43, Table 4). In addition, the fire retardant we use currently is less toxic to fish than previous formulations (draft EIS page 35).Under Alternative 3, if a misapplication occurs units will be required to evaluate the effects of that misapplication. Under Alternative 2, units only had to report misapplications.

B) Alternative 3 includes avoidance mapping for those sensitive species that analysis shows that the use of aerial application of fire retardant may lead to a trend towards listing under the ESA, or may have a loss of viability within the planning unit.

C) The effects under Alternative 3 on listed species are discussed in the BA. The effects under Alternative 3 on sensitive species are discussed in the BE. These documents are both part of the project record. The Forest Service developed Alternative 3 cooperatively with the FWS and NOAA Fisheries and believes it addresses the commenter’s concerns.

Aquatics – Alternative 2 - Cumulative Effects

Public Concern 31

The Forest Service should conduct a cost-benefit analysis for threatened endangered (T& E), and sensitive and sensitive species that addresses the potential losses from fire retardant poisoning as opposed to the effects of wildfires.

Response to PC 31

Potential effects from direct exposure to fire retardant, as well as changes in fire characteristics and conditions, depend on a number of site-specific conditions and circumstances associated with future fire locations that are unknown. As a consequence, no attempt is made to conduct a quantitative cost-benefit analysis for resources, including T&E and sensitive species. Instead, the capacity to meet the tactical objectives listed in the purpose and need for this action is adopted as an indicator to represent potential effects on capacity to meet suppression objectives (such as protection of health safety, and values at risk, including protection of T&E and sensitive species) for qualitative discussions of suppression cost efficiency (see response to Public Concern 70). The adverse effects on aquatic terrestrial and plant species from exposure to fire retardant, as well from the indirect environmental consequences of fire retardant application, are addressed in resource-specific sections in chapter 3 of the draft EIS (pages 32–134).

By placing restrictions on fire retardant use to minimize risks (e.g., mapping and implementation of avoidance areas) to aquatic terrestrial and plant life while still allowing for the use of fire retardant to facilitate the effectiveness of suppression efforts for those incidents where decisions have been made to suppress or contain fire, the 2011 direction is designed to help identify those situations where the benefits of using fire retardant (that is, facilitating suppression to help achieve suppression objectives and goals) outweigh the potential risks to biological resources from exposure to future fire retardant. The degree to which adverse or beneficial effects of wildfire on T&E and sensitive species are considered during future decisions about whether or not to suppress fire and fire management strategies is assumed to be the same regardless of the availability of fire retardant. Therefore, any consideration of the effects of fire on T&E and sensitive species is assumed to occur prior to decisions about if and how to use fire retardant for suppressing a fire.

Aquatics – Alternative 3 - Direct and Indirect Effects

Public Concern 32

The Forest Service should not select Alternative 3, Continued Aerial Application of Fire Retardant, and Adopting 2008 Reasonable and Prudent Alternatives, for aquatic species:

A) Because the biodiversity of native species needs to be fully protected as required by the NFMA;

B) And consider the cumulative effects of increasing exotic invasive species and then using poisons on them (herbicides and pesticides), thereby increasing the poisoning of ecosystems as a whole; and

C) Because the cumulative effects discussion is very incomplete and biased toward the action alternatives.

Response to PC 32

The National Forest Management Act (NFMA) does not state that the biodiversity of native species be fully protected. The act requires the analysis to consider how the action provides for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple use objectives, and within the multiple use objectives of a land management plan adopted (16 USC 1604 (g)(3)(B)). Our analysis has evaluated the capability of the land to provide for aquatic species. Based on this analysis we determined a need to provide avoidance areas around waterways and limit the number of exceptions to reduce the risk of adverse effects on aquatic species.

Alternative 3 provides for avoidance area mapping of T&E and sensitive species habitats to mitigate adverse effects from the use of aerial delivered fire retardant. Alternative 3 provides one exception, for protection of human life and public safety. The potential effects of aerial applied fire retardant and the increase of invasive plant species was discussed in the effects section of in the draft EIS, pages 65–79. The analysis also discusses the very low likelihood of misapplications. The Forest Service has identified any known potential for cumulative effects from the use of aerial delivered fire retardant.

Collaboration – Coordination with Other Agencies and Local Governments

Public Concern 33

The Forest Service should seriously consider and analyze the effects on interagency cooperative protection agreements that allow direct protection actions regardless of borders, if critical resources that are agreed to in these agreements aren't available because of the final decision for aerial application of fire retardant.

Response to PC 33

The Forest Service acknowledges that eliminating or limiting the use of a critical wildfire management tool, such as fire retardant on NFS lands, will create inconsistencies and strain relationships with partners, potentially causing confusion and other problems (chapter 3, Wildland Fire Management, Environmental Consequences, Alternative 1, page 123). Federal fire policy clearly articulates that all aspects of fire management will be done on an interagency basis to “promote an interagency approach to managing fires on an ecosystem basis” (USDA Forest Service et al. 2009).

In addition, if this alternative were selected, it would be important that master cooperative agreements and annual operating plans be developed collaboratively with cooperators to ensure that policies guidelines and standard operating procedures with regard to aerial resources and the use of fire retardant are understood. Clarification and revision of the above instruments will be necessary and must be understood in situations where the Forest Service is responsible for protecting other Federal or non-Federal lands and where other cooperators are responsible for protecting NFS lands.

Public Concern 34

The Forest Service should include direction in the selected alternative that requires coordination with state and local agencies with respect to preplanning, fire suppression tactics, incident command team training, information sharing, and involvement of wildlife and water quality agencies. Adoption of these modifications will minimize potential for impacts on listed species through improved, informed, and coordinated fire suppression efforts.

Response to PC 34

The Forest Service fire community is currently guided by manuals, handbooks, and guidelines relative to wildland fire preplanning with cooperators and establishing and modifying cooperative agreements. These various documents will be modified with the necessary changes and direction based upon the alternative selected in the record of decision by the Chief of the Forest Service. Regardless of which alternative is selected, coordination and communication with the interagency fire community occurs annually, pre-fire season, to ensure that the appropriate updates and changes are made to all master cooperative agreements, annual operating plans, standard operating plans, pre-season training, and modification of automated dispatch plans (final EIS, chapter 3, Wildland Fire Management, Environmental Consequences, Alternative 1).

Cultural Resources – Affected Environment

Public Concern 35

The Forest Service should map cultural and sacred sites and include them in the avoidance areas, to avoid all impacts to cultural resources; and complete pre-attack fire work on cultural sites such as hazard reduction, trigger points to install shelters at sites, etc.

Response to PC 35

During the past 35 years, the Forest Service has completed cultural resource inventories on millions of acres of national forests and grasslands. These inventories have identified more than 380,000 cultural resources, many of which are sacred sites, but the inventory is not complete. Unlike the mapping conducted for threatened and endangered species, the cultural resources identified are site specific and the known locations cannot be accurately extrapolated to predict additional specific locations for protection.

Information regarding the location and nature of these sites is protected from general release under the National Historic Preservation Act, the Archaeological Resources Protection Act, the Native American Graves protection and Repatriation Act, and the Freedom of Information Act. When site protection is required during the course of fire management, heritage specialists provide the information to incident commanders and other personnel responsible for site protection.

Sacred sites identified by tribal representatives are protected under the provisions of the Food, Conservation, and Energy Act of 2008. This act provides for the privacy of tribal groups engaged in traditional and cultural practices, and provides for the non-disclosure of information about reburial locations as well as traditional and cultural practices. In respect for tribal concerns about dissemination of such sensitive information, there will be no national mapping of sacred sites or sacred places, ceremonial areas, or such traditional resources as medicinal plants.

However, information about the nature and location of cultural resources, including sacred sites, is available at the local administrative unit level, when needed for site protection. Heritage specialists and tribal representatives provide this information for the express purpose of protection during fire management.

Cultural Resources – Alternative 1- Environmental Consequences

Public Concern 36

The Forest Service should select Alternative 1, No Aerial Application of Fire Retardant, and sufficiently analyze the direct, indirect, and cumulative effects from the use of fire retardant in Alternatives 2 and 3 on cultural resources because:

A) They violate Executive Order 13007 and any ground disturbance of sacred sites and cultural artifacts can usually be avoided;

B) Cultural resource specialists, not fire incident commanders, should be weighing the adverse effects on cultural sites from fire retardant; and

C) On page 49 of the draft EIS, it states that Alternative 3 could still result in irretrievable losses to cultural sites.

Response to PC 36

Executive Order 13007 directs Federal agencies to develop policy regarding the protection and access to sacred sites. Currently, Forest Service policy is being finalized, but lacking final direction, Agency policy is to avoid affecting the integrity of sacred sites, when possible.

Alternatives 2 and 3 consider the potential effects that may result from the aerial application of fire retardant and provide for the avoidance of cultural resources and sacred sites that may be affected. Although avoidance of cultural resources and sacred sites is not always possible, it is certainly the desired objective of fire management.

Incident commanders (ICs) are delegated the authority to manage fires. All decisions regarding the management of that fire are the responsibility of the IC. Incident commanders are responsible for considering the risks associated with all management decisions and they depend on specialists, including cultural resources specialists, to provide necessary information, including information about cultural sites. Although heritage specialists do not have the necessary skills to make all fire management decisions, they certainly are consulted and make recommendations pertaining to the potential affects to cultural sites.

In chapter 3, page 49, in the draft EIS, it is acknowledged that even under the best of circumstances, with all due consideration for cultural resources, misapplications may occur. Alternative 3 contains several provisions to ensure that in the event of a misapplication, consultation with tribes and State Historic Preservation Officers will occur to determine the appropriate resolution or mitigation of any adverse effects (draft EIS pages 6 and 26).

Cultural Resources – Alternative 2 Discussion

Public Concern 37

The Forest Service should select Alternative 2, Continued Aerial Application of Fire Retardant, and Adopting 2008 Reasonable and Prudent Alternatives, for cultural resources because Alternatives 1 and 3, or any policy change, further restrict the use of aerial fire retardant and this would result in an increase in the use of bulldozers to clear areas and construct firelines. Mechanical firelines have caused enormous damage to these fragile resources by drastically displacing soil crushing artifacts, mixing midden and non-midden soils together, erasing surface features such as housepits, and causing other impacts that would not likely occur from the use of fire retardant. See the following reports for supporting information: * Fire and Archaeology: A Review of the 2004 Fire Season; * The Coyote Fire: A Success Story; * Canyon Fire; * Archaeology and the Pines Fire; and * Archaeology and the Highway 88 Fire.

Response to PC 37

When using either bulldozers to construct fire lines or fire retardant to assist crews in the construction of fire lines, the critical factor in protecting cultural resources is the availability of heritage specialists. The use of bulldozers does increase the risk of adverse effects on cultural resources, but this risk is mitigated by archaeologists and tribal representatives working with ICs and dozer operators. There is not necessarily any relationship between the increased use of dozers and increased damages to cultural resources, or between the use of fire retardant and the use of bulldozers. In either case, the potential for damages is mitigated by having heritage specialists to guide avoidance procedures.

A review of the referenced literature does not support the conclusion that less use of fire retardant would result in more site damages because of an increased use of bulldozers. The referenced literature does illustrate that damages to cultural resources can be successfully avoided when using bulldozers. The examples where bulldozers have had an impact on cultural resources do illustrate the damages that may be caused by dozers; however, these damages are not shown to be a direct consequence of restrictions on the use of fire retardant.

Hydrology – Environmental Consequences, General Effects

Public Concern 38

The Forest Service should address in the EIS how it plans to comply with the Clean Water Act in its aerial application of fire retardant because discharge of chemicals from Forest Service aircraft is a point source of pollution that requires a National Pollutant Discharge Elimination System permit (40 CFR § 122.27; also see League of Wilderness Defenders v. Forsgren, 309 F.3d 1181 (9th Cir. 2002).

Response to PC 38

The 2000 Guidelines for Aerial Delivery of Fire Retardant established a 300-foot buffer zone on either side of any surface of water to mitigate the potential delivery of fire retardant to waterways. Based on a determination by EPA, a National Pollutant Discharge Elimination System (NPDES) permit is not necessary and the final EIS Hydrology section has been revised to document this determination. While the League of Wilderness Defenders v. Forsgren, 309 F.3d 1181 (9th Cir. 2002) held that the direct application of pesticides to waters of the United States to control Douglas-fir tussock moths on NFS lands required an NPDES permit (40 CFR § 122.27), that case focused on pesticides; fire retardant was not an issue in that case and was not discussed.

Public Concern 39

The Forest Service should reanalyze and disclose the direct, indirect, and cumulative effects from aerial application of Phos-Chek on municipal watersheds in the wildland-urban interface, and work with municipal water districts to better understand the effects on these water districts from Phos-Check because:

A) Additional treatment needed to treat the reservoirs for human consumption is resulting in increased levels of by-products called tri-halomethanes (THMs) and haloacetic acids, both of which are regulated contaminants and carcinogens. After the Zaca fire, water districts using Cahchuma water saw increased levels of THMs and haloacetic acids in the years after the fire and does the use of Phos-Chek play into that situation; and

B) Even though in a very large reservoir such as Cachuma (Zaca fire), presumably dilution would provide adequate protection to the people who would be drinking that water for years, there may be amounts draining into small reservoirs and into compact groundwater basins that serve private drinking water wells, which could lead to significant exposure if treatment of the water does not remove the Phos-Chek components (see Labat-Anderson Inc., 2003 titled, Human Health Risk Assessment: Wildland Fire-fighting Chemicals" for the daily dosage of Phos-Check that was calculated based on human body weight and looks at three different types of Phos-Chek - all of which were used on the Zaca fire).

Response to PC 39

Fire retardant drops often happen near homes to protect them from burning and do not necessarily occur in isolated areas. The chemicals tri-halomethanes (THMs) and haloacetic acids, are byproducts of water treatment. One change in water treatment that has substantially lowered THM and haloacetic acid production has been the change from raw water chlorination in favor of filter-top chlorination. These bioproducts tend to be formed in environments with high chlorine levels, high temperatures (especially during summer months), high dissolved organic carbon levels, and high turbidity levels.

If there is high precipitation over the next few years after a wildfire, large amounts of organics would be expected to wash into the water leading to higher amounts of THMs and haloacetic acids after water treatment. Phosphorus and nitrogen, which are included in the organic contaminants, can be from the fire retardant or released from the vegetation burned in the fire.

Post-fire water quality monitoring for streams near four wildfires showed that application of fire retardant near streams but not into the stream had minimal effects on surface water quality (Crouch et al. 2005) (draft EIS page 58). Ammonia and phosphorus were found in streams in burned areas where fire retardant was not used, but most likely due to direct effects from the fire, as a result of burning wood and other organics, at concentrations similar to those found in areas where fire retardant was applied. This implies that the amount of organics released from a large wildfire, including nitrogen, phosphorus, and carbon, would overwhelm the amount of nitrogen and phosphorus released from the use of fire retardant.

Both the organics from the fire as well as fire retardant can lead to algae blooms. The smaller the waterway the more likely this is to occur. Large lakes have more volume of water for dilution and are less likely to be affected, although after a large fire large, amounts of sediment, ash, and associated organics could affect water quality for both small and large waterways.

Based upon USGS studies of impacts on surface and groundwater from fertilizers (Dubrovsky and Hamilton 2010, Dubrovsky et al. 2010), it is known that shallow groundwater with coarse overlying sediments and low amounts of vegetative matter is more likely than deeper aquifers to become contaminated from nutrients because of the shorter flow path. Much of the shallow groundwater would be associated with riparian areas along streams and would be protected by the 300-foot buffer (draft EIS page 59).

The exact formulation and ingredients in fire retardants are disclosed to the appropriate officials in order to determine if there are any ingredients that could pose a threat to either the environment or human populations. This initial screening identifies whether there are ingredients of potential concern and if there are, a risk assessment is conducted by a third-party laboratory prior to proceeding with the full evaluation. The manufacturers have proprietary ownership of certain ingredients, which is allowed under the procurement regulations and policies. The Forest Service would not knowingly expose employees, the environment, or the public to chemicals of harm. Details of the established requirements and toxicity thresholds are identified in the Forest Service Specification 5100-304c Long-Term Fire Retardant, Wildland Firefighting, which is available on the Wildland Fire Chemicals Web site (http://www.fs.fed.us/rm/fire/wfcs/index.htm). The Specification has been added as Appendix J to the final EIS for reference.

Hydrology – Alternative 2 - Direct and Indirect Effects

Public Concern 40

The Forest Service should select Alternative 1, No Aerial Application of Fire Retardant, and further analyze and disclose the direct, indirect, and cumulative effects of fire retardant in Alternatives 2 and 3, for watersheds because:

A) Fire retardant formulations are primarily inorganic fertilizers, the active compound being ammonia sulfate, or ammonia polyphosphates, most commonly the latter (USDA Forest Service 2007 and Crouch et al. 2006). The ammonia salt causes the solution to adhere to vegetation and other surfaces; this stickiness makes the solution effective in retarding the advance of fire (Johansen and Dieterich 1971). Scientific research has demonstrated that ammonia concentrations known from three widely used fire retardants are highly toxic to aquatic systems, and their effects may last several years as they move through groundwater to open bodies of water (Gaikowski et al. 1996, Hamilton et al. 1996, McDonald et al. 1996 and 1997, Poulton et al. 1997);

B) Fire retardant also triggers algae blooms in still bodies of water which, through reducing the oxygen content in water, can kill fish and other aquatic species over a prolonged time period;

C) On page 60 of the draft EIS, there are expected negative effects on water quality for at least 2 years;

D) Because on page 8 of the draft EIS, a major fish kill in Fall River on the Deschutes National Forest was caused by fire retardant spraying, and this also needs to be mentioned on this page of the draft EIS;

E) On page 9 of the draft EIS, 0.25 percent of fire retardant drops does not address the severity of impacts from "exceptional" or accidental drops into water which could cumulatively lead to the uplisting of T&E and sensitive species; and

F) On page 61 of the draft EIS, the comparison to other agricultural use and reference to application changes has little or nothing to do with potential for an aquifer to be contaminated from fire retardant.

Response to PC 40

The Chief of the Forest Service will consider the environmental impacts of the alternatives, as well as, how well the alternatives meet the purpose and need. The purpose and need for this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. The effects of use of fire retardant on aquatic species is discussed in the Aquatic section of the draft EIS, pages 35–45. The effects on aquatic systems from ammonia and algal blooms are disclosed in that section on pages 35–41.

The main strategy for protecting water when using fire retardant is avoidance of water except for a limited number of exceptions that vary by alternative. Where fire retardant affects watersheds due to misapplication or to use under an exception, elevated nutrients can cause water quality standards to be exceeded until dilution reduces the concentration of nutrients. Where this happens in a small body of water with little inflow, the additional nutrients could lead to eutrophication and then to reduced oxygen in the water (draft EIS page 56). Where fire retardant is dropped on vernal pools or other small waterways, there is likely to be negative effects on water quality for at least 2 years because of the lack of flow to dilute the fire retardant, as occurs in streams (Angeler and Moreno 2006). Discussion of fertilizers is applicable because the active ingredients in fire retardant are fertilizers. While contamination of groundwater by fertilizers is well-studied (Dubrovsky and Hamilton 2010, Dubrovsky et al. 2010), groundwater contamination by fire retardant has not been studied because of the comparatively small amount of aerially applied fire retardant used per year, and the scattered nature of application (draft EIS page 59). From the studies mentioned above, it is known that shallow groundwater with coarse overlying sediments and low amounts of vegetative matter is most likely to become contaminated with nutrients. Much of the shallow groundwater would be associated with riparian areas along streams and would be protected by the 300-foot buffer (draft EIS page 59). Because of the use of the 300-foot buffer, the likelihood of contamination of groundwater is as established in the 2000 Guidelines low.

While the effects on fish from misapplications can be found in the Aquatic section of the draft EIS (pages 41–43), the fish kill on the Fall River in Oregon is not discussed, because the draft EIS analysis focuses on NFS lands and this misapplication occurred on state land. However, the fire retardant used on the fire at Fall River contained sodium ferro cyanide, which is very toxic when exposed to light; current formulations of fire retardant no longer contain sodium ferro cyanide.

Public Concern 41

The Forest Service should select Alternative 2, Continued Aerial Application of Fire Retardant, and Adopting 2008 Reasonable and Prudent Alternatives, for water quality because there are fewer long-term effects of wildfires on the watersheds.

Response to PC 41

As noted in response to PC 40, the Chief of the Forest Service will consider the environmental impacts of the alternatives, as well as, how well the alternatives meet the purpose and need. Wildfires on NFS lands will continue to be fought under all alternatives. Under Alternatives 2 and 3, aerial application of fire retardant would be one tool of choice, while under Alternative 1 aerial application of fire retardant would not be available.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. Fires, including large fires, would continue to occur under all alternatives. The effects of fire on hydrology are discussed in the Hydrology section of the draft EIS (pages 56–63). Impacts of fire on fish are discussed in the Aquatic section of the draft EIS (pages 35–45).

Hydrology – Alternative 2 - Risk by Region

Public Concern 42

The Forest Service should clarify the discrepancy between the percentage of fire retardant drops and the number of fires by Forest Service Region as displayed in Figure 2 on page 61 of the draft EIS, because it appears they are dropping fire retardant before there are fires in some regions; and it does not take into account potential changes in fire occurrence due to climate change.

Response to PC 42

Figure 2 compares the percentage of fires that occur in each Forest Service region (out of all fires on National Forest System (NFS) lands) to the percentage of fire retardant used by each region (on all NFS lands). For example, 17 percent of the fires on all NFS lands occur in the Forest Service Pacific Southwest Region (Region 5); however, Region 5 uses 30 percent of the total fire retardant used on all NFS lands.

The following information has been added to the Hydrology section in the final EIS. While precipitation is expected to decrease in the southwestern United States, it is expected to increase over the rest of the United States and Canada. In Alaska, some forested areas have seen a combination of warmer temperatures and increased insect infestations, and this trend would likely continue. This draft EIS analysis is for the next 10 to 15 years. While the warming trend would likely continue, no large changes would be expected from what is presently occurring over the next 10 to 15 years. National Forest System land in Alaska would still be at low risk for misapplications for the next 10 to 15 years, as there is no history of using fire retardant on NFS lands in the past 10 years even with the warming trend that is presently occurring (Field et al. 2007).

Hydrology – Alternative 3 - Direct and Indirect Effects

Public Concern 43

The Forest Service should include in the final EIS discussion of relevant Clean Water Act Water Quality Standards (WQSs) and evaluate the potential for aerial application of fire retardant to contribute to exceedances of WQSs, including water quality criteria to protect designated beneficial uses of surface waters (e.g., aquatic life uses, drinking water irrigation, and primary contact recreation), even though NPDES permits are not required for operators that are not discharging into waters of the United States.

Response to PC 43

A discussion of water quality standards has been added to the Hydrology section of the final EIS. Surface Water Quality Standards are established by states and tribes, and then approved by EPA under Section 303 of the Clean Water Act. This is to assure that all states meet at least minimal national water quality protection requirements, although states can choose to establish more stringent standards than are required nationally but cannot go below national standards. Surface Water Quality Standards include water quality criteria to protect designated beneficial uses of surface waters (e.g., aquatic life uses, drinking water irrigation, primary contact recreation, etc.).

Currently most states have only a narrative standard to control the amount of nitrogen and phosphorus allowed in surface waters (for example, statements that prohibit "discharges that create conditions which produce undesirable aquatic life"). However, such narrative standards are often ambiguous regarding the concentration of nutrients allowed in surface waters, making it more difficult to implement or enforce a narrative standard. EPA has been encouraging states and tribes to establish numeric surface water quality standards for nutrients (http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/ memo_nitrogen_framework.pdf) accessed 7-26-2011. Efforts are underway by EPA and the states to tighten allowable nutrient levels in surface waters (e.g., total nitrogen levels as low as 0.13 mg/l and total phosphorus levels as low as 0.006 mg/l) (personal communication, Steven Potts, 6/2/2001). These standards are more stringent than drinking water standards.

To meet these standards, this project takes an avoidance approach, using a 300-foot buffer on all waterways including perennial and intermittent streams, lakes, ponds, and reservoirs. If nutrients (nitrogen and phosphorus) from the fire retardant do contact water there is potential for short-term exceedances of these standards to occur. If a misapplication occurs in a smaller body of water without sufficient inflow for dilution, there is potential for exceedances to continue for several years.

Hydrology – Alternative 3 - Cumulative Effects

Public Concern 44

The Forest Service should include toxic herbicide use and impacts from livestock grazing, logging, and mining under the cumulative effects analysis for Alternative 3 on page 62 of the draft EIS, because these actions all cumulatively affect water quality.

Response to PC 44

The Hydrology Cumulative Effects discussion has been enhanced in the final EIS to discuss other impacts on water quality and to clarify why nutrients are the focus. Past and present actions on all management areas, private or government, affect water resources. They include agriculture, past and present grazing, logging, mining, roads, buildings, fires, fighting fires, invasive species, and treatment of invasive species. These actions can increase sediment input to streams, raise water temperatures where shading is reduced, or add nutrients or pollutants.

Waste water treatment plants can add high amounts of nutrients to streams in urban areas. As populations increase, it would be expected that impacts from urbanization would increase. However, most NFS land is located high in the watershed in rural areas. Overall, nutrient content on NFS land is low compared to large agriculture and urban areas. The focus of the analysis is the impact of fire retardant on water quality. Nutrients are the focus of the cumulative effects analysis because they are the main ingredients of fire retardant.

Monitoring

Public Concern 45

The Forest Service should develop and implement an effective monitoring program for the final decision to ensure no unintended consequences to species, habitats, or adjacent private resources; and the program should include:

A) Key indicators to measure air quality impacts from fire events, with and without the use of fire retardant, to measure benefits and trends;

B) A definition for "missing fire retardant drops" and clarify whether these drops are "unaccounted" for or are misapplied drops, as described on page 7 of the draft EIS "To determine if the Forest Service is missing fire retardant drops, the Agency will annually monitor 5 percent of type 4-5 fires per Forest where fire retardant has been applied"; and

C) Aggressively monitoring larger fires as opposed to 5 percent of type 4-5 fires, as CSERC recommends that to accurately locate misapplications, personnel on each large fire of 5,000 acres or larger be assigned during and after fires to personally visit the greatest extent possible of drop sites and to communicate intensely with fire line personnel to identify where misapplications did occur.

Response to PC 45

The Forest Service implemented a monitoring process after the environmental assessment was completed and the decision notice issued in 2007. The process established provides for the primary data set needed at a national level for determining whether adjustments are necessary in the avoidance areas, and at the local unit level for identifying additional data elements needed on a site specific basis.

The monitoring component included in alternative 3 focuses on implementation monitoring and the protection of the species identified in the Biological Opinions. In addition, the monitoring component allows for adjustments at the local level. If air quality is a component that the local unit determines is critical, it would be monitored.

The 5 percent monitoring will be conducted in order to determine if the Forest Service is discovering drops that may have been accidentally applied in a waterway, the 300-foot buffer, or mapped avoidance areas. The monitoring plan and procedures for use by the Forest Service units will be established and provided to the units if Alternative 3 is selected in the ROD. If it is discovered that a number of fires on which fire retardant was applied, regardless of fire size, had misapplications that had not been reported, the local unit can implement a more rigorous monitoring program.

NEPA – Issues from Scoping Comments

Public Concern 46

The Forest Service should clarify and discuss how the scoping comments were used in the development of the draft EIS because it appears that requests for analysis of the cumulative effects of connected fire suppression actions and the indirect effects of continued fire exclusion were not considered; consequently, the draft EIS is flawed and does not meet its legal obligations under NEPA.

Response to PC 46

Scoping comments were used to determine the significant environmental issues deserving of study, alternatives to the proposed action, and identifying interested and affected persons, as well as other agency coordination needs. The purpose and need for this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.

- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire.

The EIS is not intended to address fire exclusion. Rather, the EIS addresses the potential effects of aerial application of fire retardant. The Biological Assessments and avoidance areas in the draft EIS address cumulative effects and provide for ongoing monitoring activities in local forests that will reduce cumulative effects on resources. The draft EIS adequately addresses any negative indirect effects on resources on which Endangered Species Act listed species depend (draft EIS pages 40–41).

NEPA – Process and Decisionmaking

Public Concern 47

The Forest Service should clarify and be consistent in terminology throughout the draft EIS what the title is for Alternative 1 and what it really means because the existing situation or no action is really Alternative 2; therefore recommend removing the term "proposed action."

Response to PC 47

In the case of this draft EIS, the no-action alternative is not the current state of fire retardant use in the Forest Service. The Agency and scoping comments determined that an alternative addressing use of water only to fight fire on NFS lands was appropriate as the “no-action” alternative. Therefore, Alternative 2 is presented as the current state of fire retardant use in the Forest Service. The final EIS will clarify the terminology used in the draft EIS.

NEPA – Purpose and Need for Action

Public Concern 48

The Forest Service should re-evaluate the Purpose and Need because the question should not be how or can long-term fire retardant be applied differently than we are today but what are the options for using other effective fire chemicals in lieu of long-term fire retardant products.

Response to PC 48

The purpose and need for this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.

- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. The EIS is not intended to determine what type of fire retardant product should be applied currently or in future fire suppression. Rather, the EIS provides an analysis of various options for the Chief of the Forest Service to consider when issuing a record of decision; that decision will provide local forests parameters to guide the application of fire retardant should the decision be made to use fire retardant as a suppression tool.

The Forest Service uses only those products qualified and approved for use in the Wildland Fire Chemical Systems (WFCS) (draft EIS, page 345, Appendix J). The Agency adheres to quality control and safety requirements in the mixing or blending of wildland fire chemicals (draft EIS, page 345, Appendix J). In addition, the Agency uses fire retardant formulations that do not contain cyanide (draft EIS page 35). See also the revised U.S. Forest Service Specification 5100-304c for Long-Term Fire Retardant, Wildland Firefighting, June 1, 2007.

Public Concern 49

The Forest Service should prepare a Supplemental draft EIS that incorporates full analysis (direct, indirect, and cumulative effects) and disclosure of wildland fire management and risks, costs, and impacts of reactive wildfire suppression methods, including fire retardant, because wildland fire management clearly falls within the Purpose and Need and scope of this project, and the social, economic, and ecological impacts need to be analyzed and disclosed.

Response to PC 49

The District Court of Montana ruled that the scope of the analysis should be limited to the use of aerially delivered fire retardant (Forest Service Employees for Environmental Ethics v. United States Forest Service 08-43 (D. Mont))(U.S. District Court, Montana 2010). The EIS is not intended to determine what type of fire retardant product should be applied currently or in future fire suppression. Decisions about wildland fire management are made in forest plans and fire management plans.

The purpose and need for this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.

- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

NEPA – Regulations, Laws, and Policies

Public Concern 50

The Forest Service should explain the statement in the draft EIS that states the use of aerial application of fire retardant may not be consistent with the National Historical Preservation Act (NHPA) because the Forest Service must adhere to the NHPA.

Response to PC 50

The National Historic Preservation Act (NHPA) requires that Federal agencies consider the effects of proposed actions on historic properties. When an agency determines that an action may result in adverse effects on cultural resources, as in this case, then the agency must either modify the action to have no adverse effect or find ways to resolve or mitigate the adverse effects The draft EIS statements reflect this consideration (draft EIS pages 46–49); it is recognized and clearly stated that adverse effects may result from the aerial application of fire retardant. Heritage specialists will work with incident commanders and tribes to ensure the avoidance of sensitive historic properties, traditional cultural properties, and sacred sites. In the event of a misapplication, or as the result of an application on a historic property for the purposes of site protection, the Forest Service will take action to mitigate the potentially adverse effects after consultation with state historic preservation officers and/or tribal historic preservation officers or tribal representatives. Alternative 3 includes direction that shows the Agency's recognition of the potential for adverse effects from the aerial application of fire retardant (draft EIS page 49), which shows that the Agency is not simply considering the effects of the proposed action on cultural resources, but is, in Alternative 3, proposing means to resolve the potentially adverse effects (draft EIS page 6).

Public Concern 51

The Forest Service should explain the contradiction between direction in the Interagency Aerial Supervision Guide (NIAC 2010), where it states that tactical plans for fire suppression prioritize: "1) human safety, 2) structure protection, and 3) natural resources" (draft EIS page 87); and the direction in the interagency Wildland Fire Management Policy that mandates that private property and natural resources should be valued equally in terms of importance and prioritization for suppression resources. The Wildland Fire Management Policy should supercede and direct the priorities of the IAS Guide.

Response to PC 51

Wildland fire management objectives include (USDA Forest Service et al. 2009):

- Protect human life, property and natural/cultural resources, both within and adjacent to agency administered lands;
- Minimize damages and maximize overall benefits of wildland fire within the framework of land use objectives and land management plans.

Federal Fire Policy is the guiding principle for managing wildfire on Federal lands. The 2001 Wildland Fire Management Policy has established firefighter and public safety as the first priority in every fire management activity.

Fire suppression operations achieve objectives that support unit-specific management goals and objectives as set forth in individual forest or grassland plans for fire. Strategies are based on values at risk and resource management objectives, while tactics are based on fuel type, fire intensity, rate of spread, resource availability, and estimated line production rate. The Interagency Aerial Supervision Guide serves as a guide for firefighting resources in terms of decisionmaking and tactics and is not in conflict with the Federal Wildland Fire Management Policy; decisions on wildland fires are made with these guidelines in mind, but each situation dictates the tactical priorities as defined in the land management plan or other policy documents—but always with human life being the first priority.

Public Concern 52

The Forest Service should include discussion in the final EIS regarding the impacts of Alternatives 1, 2, and 3 in relation to the Multiple-Use Sustained-Yield Act, Forest and Rangeland Renewable Resources Planning Act, and the National Forest Management Act; as the Clean Air Act, Clean Water Act, Endangered Species Act etc. are discussed throughout the draft EIS.

Response to PC 52

The Forest Service is required to ensure that implementation of a Federal action does not violate laws such as the Endangered Species Act (ESA) and the Clean Air and Clean Water acts. Other laws mentioned by the commenter are addressed during forest and grassland planning efforts, which identify those acts in conformance with mandates expressed in National Forest Management Act. Additionally, planning efforts incorporate other laws such as the Multiple-Use Sustained-Yield Act and the Resource Planning Act. Consistency with other laws will be addressed by the Chief of the Forest Service in the record of decision.

NEPA – Scope

Public Concern 53

The Forest Service should re-analyze the scope of this project because it is too broad covering the entire United States, and the alternatives do not properly address the impacts and display the consequences as they are significantly different for each forest and surrounding communities across the country; therefore, the need for differing suppression, prevention, and mitigation strategies must be recognized and developed to meet the goals and objectives of the 2010 Strategic Fire Plan.

Response to PC 53

This EIS addresses the direction for aerial application of fire retardant and alternatives to that direction. The District Court of Montana ruled that the scope of the analysis should be limited to the use of aerially delivered fire retardant (Forest Service Employees for Environmental Ethics v. United States Forest Service 08-43 (D. Mont))(U.S. District Court, Montana 2010). The EIS is not intended to determine what type of fire retardant product should be applied currently or in future fire suppression. In addition, decisions about wildland fire management are made in forest plans and fire management plans. The EIS is also not intended to enumerate the only planning strategy that is applicable to every forest and in every fire suppression action. Rather, the EIS is intended to provide an analysis of various options and strategies for the Chief of the Forest Service to consider when issuing a record of decision; that decision will provide a framework to guide local forests' decisionmaking with respect to the use of aerial application of fire retardant in suppression actions.

The Forest Service prepared the draft EIS in accordance with the scope decided upon in the scoping process (USDA Forest Service 2010, page 52713). The purpose and need for this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire.

NEPA – Other Effects Analysis

Public Concern 54

The Forest Service should include an effects analysis of wildfires that escape initial attack because fire retardant was either prohibited, not used, or not allowed potentially because of an avoidance area and analyze the:

A) Economic impacts;

B) Impacts on resources including, soils, hydrology, vegetation habitat wildlife, fisheries, etc.;

C) Impacts of downstream damage from flooding and mud flows following fires, which could cause to private property and potentially significant threat to human life and injury; and

D) Potential threat if the fire escapes by including a detailed risk assessment in the final EIS, which would also include discussion about the timeframe for an incident commander to make a yes or no decision on the use of fire retardant.

Response to PC 54

An analysis, as suggested, would not yield reliable, replicable, and quantifiable results because the variables that exist nationwide affecting wildfire suppression on NFS lands are many, and the data either do not exist or are not reliable at the scale of this EIS. On pages 32–134 of the draft EIS, the effect of wildfires on natural resources, as well as the economic, social, health, safety, and visual impacts, are considered. Broadly, it can be stated that without the use of fire retardant to fight fires on NFS lands, some fires might get larger and could cause more property damage. In addition, because avoidance areas under Alternative 3 do not currently exist, the data do not yet exist to analyze wildfires that escape initial attack because fire retardant was either prohibited, not used, or potentially not allowed because of an avoidance area. The analysis conducted shows that some fires may get larger if Alternative 3 is implemented due, in part, to avoidance areas.

NEPA – Comment Period Extension

Public Concern 55

The Forest Service should extend the comment period on the draft EIS because counties, cities, and fire districts have not had adequate time to analyze the impacts to their agencies.

Response to PC 55

The District Court of Montana ordered the completion of the final EIS, ROD, and consultation no later than December 31, 2011 (Forest Service Employees for Environmental Ethics v. United States Forest Service 08-43 (D. Mont))(U.S. District Court, Montana 2010). Because of the time necessary to analyze comments and prepare an final EIS and ROD, it would be impossible to extend the comment period and meet this deadline. In addition, the Forest Service has determined that both the length of the scoping and draft EIS commenting periods, as well as held public meetings, met the intent of NEPA in providing sufficient opportunity for public involvement. The Forest Service initiated a 45-day scoping period for comments on August 27, 2010, and the comments received during the scoping comment period are part of the project record. The Forest Service initiated a 45-day period for commenting on the draft EIS on May 13, 2011. In addition, the Agency conducted stakeholder assessments to facilitate public involvement (draft EIS page 21). Some of the results of these assessments are currently available on the Fire Retardant Projection website: http://www.fs.fed.us/fire/retardant/index.html. Comments and their associated responses to the draft EIS will be available upon publication of the final EIS.

Plant Species – Environmental Consequences (T&E and Sensitive)

Public Concern 56

The Forest Service should develop an Adaptive Management Plan that allows for changes in management over time due to new scientific knowledge because the draft EIS clearly acknowledges that lack of scientific evidence supports conclusions that fire retardant increases competition of noxious or non native invasive plant species (NNIS) and adversely affects threatened and endangered (T&E) species. While several studies document the observed negative effects, many lack temporal criteria and any replication necessary to make sound conclusions. This is significant in that in some cases in the exclusion zones it removes a valuable firefighting tactic from the Forest

Service program. Grazing allotments are managed in this way. Cattle and sheep are only allowed on the allotment based on plant phenology. When the forage has matured to a certain state, and carbohydrate root reserves are sufficient to maintain the plant, then the animals are allowed to graze.

Response to PC 56

Only a small portion of NFS lands— between 2,358 and 4,715 acres (approximately 0.002 percent) (draft EIS page 180)—are expected to have aerially fire retardant applied annually. The areas of aquatic avoidance areas are in the draft EIS, Table 5, page 51. Additionally, the amount FS landbase (%) identified as terrestrial avoidance areas will be provided in the final EIS in the comparison of alternatives table in chapter 2. The Forest Service acknowledges that certain conditions may exist that result in unpredictable effects on plants when fire retardant is applied. The development of avoidance areas around Federally listed plant species is based on factors including physiology, lifecycles, distribution, species-specific habitat effects on species viability from other local threats, and the potential for phytotoxic impacts or changes in vegetation diversity from additional nutrient inputs. As a result of this analysis, it was determined that some species (for instance western prairie fringed orchid and Bakersfield cactus) do not require inclusion in an avoidance area while for other species a conservative approach (that is, development of fire retardant avoidance areas) is implemented to protect them from potential effects An adaptive management process that will adjust avoidance areas in the future will be implemented, as needed, as new information becomes available as a result of annual reviews of avoidance areas described in the reporting and monitoring section in the Biological Assessment or as new studies become available.

Regarding the concern that avoidance areas will remove a valuable firefighting tactic, Alternatives 2 and 3 both include the ability to use aerially application of fire retardant (draft EIS pages 24–26). Managers use a decision-support process to guide and document wildfire management decisions. The process provides for situational assessment, hazard and risk analysis, definition of implementation actions, and documentation of decisions and rationale. Fire managers use principles of fire suppression for conducting fire suppression operations, which include consideration of objectives, speed and focus, positioning, simplicity, and safety.

Public Concern 57

The Forest Service should further analyze the direct, indirect, and cumulative effects from aerial application of fire retardant on native plant communities, T&E and sensitive plant species, and overall biodiversity as discussed on pages 69 and 70 of the draft EIS.

Response to PC 57

The direct and indirect effects of aerially applied fire retardant on plants and plant communities is described broadly in the General Effects of Fire retardant on Plants and Plant Communities section of the draft EIS (pages 67–70) as it addresses the potential effects on plants and plant communities across diverse ecosystems nationwide. Fire retardant could potentially be applied to any of the numerous types of native plant communities that occur in various ecoregions throughout the United States (draft EIS pages 106–108, and the Biological Assessment). This potential, combined with the minimal scientific evidence that clearly identifies effects on certain native plant communities, allows for only a qualitative description of the potential effects of aerial applied fire retardant. Statements describing these generalized effects on native plant communities, including cumulative effects is included the final EIS.

Plant Species – Environmental Consequences (T&E and Sensitive), Alternative 2 - Direct and Indirect Effects

Public Concern 58

The Forest Service should not select and further analyze Alternative 2, Continued Aerial Application of Fire Retardant Under 2000 Guidelines, Including 2008 Reasonable and Prudent Alternatives, for direct, indirect, and cumulative effects for Federally listed sensitive or native plant species because:

A) Additional analysis needs to be completed for specific seasons of plant and animal usage of the areas impacted;

B) 62 Federally listed plant species being likely adversely affected is unacceptable, as indicated on page 9 of the draft EIS;

C) Negatively impacting 2,719 candidate species for Federal listing is unacceptable, as indicated on page 9 of the draft EIS;

D) Only 20 plants and 14 critical habitats are being planned for protection and there is no justification for the assumption found in the 3rd bullet on page 73 of the draft EIS;

E) Cumulative effects should include past, ongoing, and planned herbicide use, not just a list of cumulative effects and not be biased, as shown on page 71 of the draft EIS; and

F) Cumulative effects could increase the chances of a species being uplisted or extirpated.

Response to PC 58

A), B), C) - The best available science was used to determine potential effects on the potential seasonal application of fire retardant and animal usage in areas that may receive fire retardant. The effects of fire retardant on plants and animals is described within the draft EIS on pages 67–70 and 127–132. Given the fact that it is impossible to predict where fire retardant may be used in the future and because limited scientific data is available to predict site-specific or species-specific impacts at the national level of analysis, general impacts are presented.

As stated in the draft EIS on page 65, adjustments to the numbers of Federally listed species and sensitive species are likely to occur as a result of local national forest review, which will be included in the final EIS. The number of affected species by alternative is presented in the final EIS in the Plant Resources section. In the draft EIS the number of sensitive species affected was based on the potential for aerially applied fire retardant to be applied to the sensitive species listed for each Forest Service region. Because no species-specific information was available at the time of completion of the draft EIS, it was assumed at all species may have the potential to have aerial fire retardant applied and thus a potential for an effect. As indicated within the draft EIS, page 73, additional field review at the local level will be completed between publication of the draft EIS and publication of the final EIS and, based on the results of that field review, determination of effects may change. The methodology of impact analysis will remain similar as to the national screens for Federally listed species (draft EIS, Appendix E, page 197). In that screen, if sensitive species occur on forests that do not apply fire retardant or if species occur in areas where fire retardant would not be applied, then there would be no effect. If the potential existed for aerial application of fire retardant to occur in the future, then there may be the potential for an effect. Although the literature is limited as the effects of fire retardant on individual plant species, there is some indication of the potential for negative effects and thus, a conservative approach to the potential for an impact was implemented (draft EIS, pages 72–76). Changes to the effects analysis for sensitive species will be presented in the final EIS.

D) - Plant species and designated critical habitats—20 and 14, respectively—under Alternative 2 are protected under the 2008 Reasonable and Prudent Alternatives, adopted from the Fish and Wildlife 2008 Reasonable and Prudent Alternatives. These species were identified within the Biological Opinion (USDI Fish and Wildlife Service 2008), as adopted by the Forest Service as Reasonable and Prudent Alternatives to receive additional protection to ensure they would not be jeopardized. Appendix B, page 174, of the draft EIS describes this implementation.

E), F) - Cumulative effects consider a variety of actions that threaten species viability or critical habitats, such as destruction of habitat from land development, recreation, encroachment of non-native invasive species, and climate change (draft EIS page 73). Use of herbicides for other activities, including this project, would comply with existing national regional, or local programs and are evaluated for effects therein. The cumulative effects that threaten species viability or critical habitats due to the application of aerially applied fire retardant combined with the effects of other activities that occur on National Forest System lands—such as destruction of habitat from land development, recreation, encroachment of non-native species or climate change—are considered to be minimal. See the cumulative effects section of Alternative 2, draft EIS page 73.

Plant Species – Environmental Consequences (NNNI), Alternative 2 - Direct and Indirect Effects

Public Concern 59

The Forest Service should not select and further analyze Alternative 2, Continued Aerial Application of Fire Retardant Under 2000 Guidelines, Including 2008 Reasonable and Prudent Alternatives, for direct, indirect, and cumulative effects for noxious or non-native invasive plant species because the analysis is inadequate and there is no quantification of minor impacts.

Response to PC 59

The best available science that pertains to the direct, indirect, and cumulative effects are presented within the general effects on plants and plant communities section on pages 67–70 of the draft EIS. Scientific studies quantifying impacts from non-native invasive species have described them as short-term (one to two growing seasons) and confined to a few limited types of plant communities on a few number of invasive species. These studies, cited within the draft EIS on pages 67–70, were used to predict potential direct, indirect, and cumulative effects for this national-level environmental analysis for ecoregions nationwide. Because of the lack of long-term studies and only a limited number of studies in specific ecological communities (draft EIS pages 68–70) to apply to this broad-scale analysis, quantification of minor direct, indirect, and cumulative effects at a local scale is speculative.

Public Health and Safety – Evaluation Process

Public Concern 60

The Forest Service should include the specifications used in the "Evaluation Process" (draft EIS page 80) and the 2007 revisions to USFS Specification 51 00-304c for long-term fire retardant, including acute toxicity testing in the final EIS. This process is an effective way to keep chemicals of concern such as polybrominated diphenyl ethers

(PBDEs) from being added to the fire retardant formulations. In addition, the Agency should adequately disclose the fire retardant ingredients and the nature, severity, and potential subsequent long-term chronic health effects on the public, as discussed on page 82 and 83 of the draft EIS.

Response to PC 60

The Forest Service would not knowingly expose employees, the environment, or the public to chemicals of harm. The exact formulation and ingredients of fire retardant is disclosed to the appropriate officials to determine if there are any ingredients that could pose a threat to either the environment or human populations. This screening identifies whether there are ingredients of potential concern and, if there are, a risk assessment is conducted by a third party laboratory before proceeding with a full evaluation. It is not possible to disclose fire retardant ingredients because fire retardant manufacturers have proprietary ownership of certain ingredients, which is allowed under the procurement regulations and policies. Details of the established requirements and toxicity thresholds are identified in the Forest Service Specification 5100-304c Long-Term fire retardant, Wildland Firefighting, which is available on the Wildland Fire Chemicals website (http://www.fs.fed.us/rm/fire/wfcs/index.htm). The specification has been added as part of Appendix L in the final EIS for reference.

Public Health and Safety – Fire Retardant Use Policy and Operations

Public Concern 61

The Forest Service should consider the requirements, complexity, and possible distractions, especially in regards to avoidance areas, of pilots and firefighters, in the alternative selected, as this is an aviation safety concern.

Response to PC 61

The decision as to whether to use fire retardant or not is made based on a series of policies, guidelines, specific unit direction, and priority-setting for initial attack response. This decision may include a specific fire suppression resource or may include multiple fire suppression resources used in suppression tactics. Appendices A, C, J, L, M, and avoidance mapping provide the guidance for the application of fire retardant or foam.

Pilots will know ahead of time the location of avoidance areas. It is the responsibility of air attack group supervisors, lead plane pilots, and ground forces to ensure that fire retardant pilots know where these areas are located. Ultimately, all decisions regarding the management of a fire are the responsibility of the incident commander. Incident commanders are responsible for considering the risks associated with all management decisions as well as when and where to aerially apply fire retardant.

The Forest Service has considered the safety concern regarding the aerial application of fire retardant, and this concern is addressed in the Fire Retardant Operation Use section in chapter 3 in the final EIS. While the Agency strives for 100 percent accuracy in aerial application of fire retardant, we know that we occasionally experience misapplications, which are documented and reported to NOAA Fisheries and FWS. Implementation direction will be developed after the record of decision to further ensure that pilots and firefighters are prepared with appropriate preseason and preflight briefings.

Public Health and Safety – Alternative 1 - Environmental Consequences

Public Concern 62

The Forest Service should consider that discontinuing the use of aerial application of fire retardant creates a safety concern for firefighters and the public.

Response to PC 62

Firefighter and public safety are the most important factors that the Agency considers when determining the firefighting strategies to use on National Forest System lands (FSM 5100). The effects analysis for the three alternatives considered in detail included the safety of firefighters and the public. chapter 3, Fire Retardant in Wildland Fire Management, Environmental Consequences of the final EIS includes information concerning firefighter and public safety as tied to the use of fire retardant.

The Forest Service recognizes the tragedy of any firefighter fatality. The incidence of 61 firefighters who died as a result of aviation accidents over the past 10 years is not specific to the aerial delivery of fire retardant, the focus of this EIS. These accidents were analyzed, and it was determined that 35 of the fatalities were associated with the delivery of fire retardant. The National Transportation Safety Board investigated the accidents and provided reports to the Forest Service and the air-services companies with the findings. The Forest Service has taken the findings, along with the Blue Ribbon Panel report International Code Council 2008) very seriously and implemented measures to improve the safety of the large airtanker fleet. In addition, due to the aging large-airtanker fleet, measures to prevent accidents have been taken—specifically, the Continued Airworthiness Program (CAP) and Operational Service Life (OSL)—to implement additional safety requirements to reduce airborne operations risk. OSL requirements were added to the large-airtanker contracts to provide additional inspection and maintenance requirements in order to help avoid potential accidents. As a result of the CAP and OSL, the large-airtanker fleet has been reduced by approximately 63 percent, and additional safety and maintenance requirements have been added to the contracts for both single-engine airtankers and helicopters. These requirements are in place whether the aircraft is delivering water fire chemicals, cargo, or personnel. In addition, the Forest Service conducts risk assessments of these programs to determine proper utilization of the tactic or tools in the suppression of fires.

Public Health and Safety – Alternative 2 - Environmental Consequences

Public Concern 63

The Forest Service should modify Alternative 2 Continued Aerial Application of Fire Retardant Under 2000 Guidelines, Including 2008 Reasonable and Prudent Alternatives, if selected, to include mitigation or warnings to the public.

Response to PC 63

The suggestion to not eat garden produce that has been coated with fire retardant is precautionary. The Forest Service requires extensive testing of the toxicity fire retardant, and the requirements and results of the testing are displayed in the draft EIS on pages 80–83. While fire retardant is generally not toxic to humans, the consumption of foreign materials on food is generally not recommended. As described in the draft EIS on pages 80–81, most adverse health effects have been limited to skin and eye irritation and possible allergic reactions.

Scenery – Alternatives 2 and 3 - Environmental Consequences

Public Concern 64

The Forest Service should change the descriptor "fugitive" for the residual pink color left from fire retardant, to a descriptor such as "fading" or "less durable" to clarify the pink staining for the public (draft EIS, pages 10, 30, 48, 67, 85, 104, and 152).

Response to PC 64

Fugitive colorant is contained in the Forest Service Specification 5100-304c Long-Term fire retardant, Wildland Firefighting. The final EIS contains a glossary of terms that includes the definition of "fugitive colorant" to provide the reader with a complete description of the term. Specification 5100-304c has been added to Appendix L of the final EIS to provide additional information.

The pages in the draft EIS where "fugitive" is used were reviewed to determine if additional descriptors are appropriate. To change the term out-of-hand is not appropriate as it is a term inherent to the entire specification and in the evaluation process. However, additional clarification of the term has been included in the Summary Chapter, Scenery Management in the final EIS.

Social and Economics – Affected Environment

Public Concern 65

The Forest Service should validate the figures for population increase as shown on page 17 of the draft EIS, as they appear inaccurate.

Response to PC 65

Page 17 of the draft EIS does not include a human population figure. Instead, the information contained on page 17 includes figures of fire activity and acreages (National Interagency Fire Center: Fire Information, Wildland Fire Statistics 1986-1999).

Social and Economics – Environmental Consequences, Assumptions

Public Concern 66

The Forest Service should further analyze the impacts to communities of not using fire retardant and adequately address the values at risk, including the assessed values in excess of 10 billion dollars.

Response to PC 66

There are many "at risk communities," as defined in the *Wildland Urban Interface Communities Within the Vicinity of Federal Lands That Are at High Risk From Wildfire* [66 Fed. Reg. 753, January 4, 2001], created pursuant to Title IV of the Department of the Interior and Related Agencies Appropriations Act, 2001 (114 Stat. 1009). There are also communities within the Wildland-Urban Interface (WUI), as defined by the Health Forest Restoration Act of 2003 (Pub.L. 108-148) near NFS lands. The Agency acknowledges the potential damages to values-at-risk, including property, infrastructure, and natural resources within 'at-risk communities' and communities within the WUI. The Agency also notes that those effects may differ across the alternatives due to potential changes in the size and characteristics of wildland fires when fire retardant use is eliminated or excepted, as noted in the draft EIS (Tables 12 and 14, pages 88 and 94) and final EIS (Wildfire Operations section in chapter 3). However, given the uncertainty regarding future fire locations and conditions, as well as the uncertainty associated with the effectiveness of other tools and tactics when fire retardant is not allowed, changes in the size and characteristics of fires and corresponding damages to values-at-risk, including property associated with at-risk-communities, are not quantified. Analysis of effects related to changes in size and characteristics of fires would not yield reliable, replicable, and quantifiable results as the variables that exist nationwide that effect wildfire suppression on NFS lands are many, and the data either do not exist or are not reliable at the scale of this analysis (see response to Public Concern 54).

Public Concern 67

The Forest Service should disclose in the final EIS who makes the aerial fire retardant, how much the government pays for it, and how much it costs.

Response to PC 67

Cost to the agency of fire retardant is assumed to range from $1.50 to $3.00 per gallon (draft EIS, Table 11, footnote #3, page 87), as summarized in USDA Forest Service spreadsheets referenced in the draft EIS. The price of fire retardant is estimated to be approximately $1.50 per gallon based on Forest Service National fire retardant Contract data. The cost per gallon of $3.00 is adopted to reflect the full cost of fire retardant, which includes cost of delivery to operating locations and to the aircraft. As noted in the draft EIS (Appendix L), the Forest Service has implemented a wildland fire chemical systems program to ensure that the agency has products that would be effective and safe in meeting firefighting needs (http://www.fs.fed.us/rm/fire).

All long-term fire retardant, foams, and gels used by the Forest Service must be evaluated for effectiveness and toxicity and placed on a qualified products list (QPL) under this program. The Forest Service awards a final contract for airtanker bases for either bulk fire retardant purchasing or full service fire retardant and services. In addition, field units are free to purchase from approved manufacturers while conforming to Agency competitive bidding requirements. The primary long-term fire retardant is Phos-Chek, which is supplied by ICL Performance Products according to the wildland fire chemical system. Information about cost to manufacturer for long-term fire retardant was not available and may be considered confidential by manufacturers.

Public Concern 68

The Forest Service should disclose long-term and complex costs, including impacts on watersheds, ecosystems, infrastructure, businesses, individuals, and the local and national economy; and discuss how these costs affect fire strategies and tactics at the time of the incident, especially when comparing Alternative 1 to Alternatives 2 and 3.

Response to PC 68

The Forest Service acknowledges the longer term and complex costs associated with damages to resources, property, and other values-at-risk resulting from potential changes in the size and characteristics of fires, particularly for Alternative 1 compared to Alternatives 2 and 3 (final EIS, chapter 3, Social and Economic Considerations), but does not attempt to characterize or estimate cost details because of uncertainty and unknowns about the location and characteristics of future fire incidents. Qualitative discussion of potential changes in capacity to meet the tactical objectives stated in the purpose and need for this action (final EIS, chapter 1), adopted as an indicator of potential hazards to values-at-risk (final EIS, chapter 3, Social and Economic Considerations), is provided in the Fire Retardant in Wildland Fire Management section within chapter 3 of the final EIS, as well as additional material in a similar section in the final EIS. Quantifying or projecting changes in future suppression costs associated with changes in firefighting strategies or tactics when fire retardant is not available is not attempted because of uncertainty about future fire conditions and characteristics that affect tool selection and strategy design, the relative effectiveness of those tools and tactics, and overall capacity of alternative tools and tactics to maintain capacity for meeting the tactical objectives under reasonably foreseeable constraints on interagency fire management resources (e.g., crews, equipment, tankers, etc.).

The costs associated with damages (and damage mitigation) to a variety of values-at-risk may vary across alternatives as a consequence of any future changes in the size and characteristics of fires; however, the degree to which potential damage avoidance is considered in decisions regarding strategies and tactics is assumed to be the same under all alternatives. The Aerial Application of Fire Retardant direction directly affect the use of aerial application of fire retardant as a tool to facilitate effective and efficient fire suppression and may have indirect effects on capacity to meet suppression objectives for some incidents. However, the Aerial Application of Fire Retardant direction have no direct effect on the types of suppression objectives and goals that must be considered during suppression or suppression strategy decisionmaking as described in existing policy and guidance regarding wildland fire management and suppression. For example, the Guidance for Implementation of Federal Wildland Fire Management Policy (Feb 13, 2009) (as cited in the Interagency Standards for Fire and Fire Aviation Operations 2011) states that fire management programs should protect, maintain, and enhance Federal lands in a cost-effective manner.

Specific objectives include: (1) protect human health, property, and natural resources; (2) minimize damages and maximize overall benefits of wildland fire within the framework of land-use objectives and land management plans; and (3) provide for firefighter and public safety and minimize cost and resource damage consistent with values to be protected and management objectives.

As such, it is assumed that the Aerial Application of Fire Retardant direction will have no effect on the consideration of various objectives and goals, including protection of values-at-risk, on suppression decisions. The only effect of the Aerial Application of Fire Retardant direction is on capacity to achieve pre-established suppression objectives, goals, and anticipated benefits of suppression. As a consequence, the economic effects section in the draft EIS focuses on relative cost-effectiveness and cost-efficiency of the Aerial Application of Fire Retardant direction as they relate to suppressing fire for those incidents where suppression objectives or goals have already been weighed and considered in suppression decisions. Cost-efficiency, as an economic indicator, is consistent with the goal of the Interagency Aerial Support Supervision Guide (NIAC 2010): “to promote safe, effective, and cost efficient aerial supervision services in support of incident goals and objectives.” In general, the Aerial Application of Fire Retardant direction affect how fire suppression and suppression objectives are achieved, but they do not affect how objectives, goals, or anticipated suppression benefits (e.g., avoided damages) are taken into consideration during suppression decisions.

Public Concern 69

The Forest Service should recalculate the following cost estimates for Alternatives 2 and 3 as they appear to be inaccurate:

A) Initial identification, mapping, and establishment of critical habitat and buffers’ estimates may be close;

B) Agency labor costs associated with reporting, monitoring, negotiating in formal section 7 consultation, and designing and implementing appropriate mitigation measures seem optimistic;

C) Costs of invasive plant species removal from fire retardant drop zones appear to be underestimated; and

D) Fire retardant is not sent on unstaffed fires, so the requirement to monitor 5 percent of type 4-5 fires is unreasonable.

Response to PC 69

The comment cites a cost estimate of $45,000 for Alternatives 2 and 3, but this cost does not appear to be consistent with cost estimates presented in the draft EIS (draft EIS, page 89, Table 13). The assumptions for labor costs for reporting, monitoring, and consultations are cited in the footnotes to the table summarizing the cost results in the Social and Economic Considerations section in chapter 3 of the final EIS and presented in more detail in the Specialist Report: Social and Economic Effects (prepared to support the final EIS, available in the Project Record). Costs associated with invasive plant removal from drop zones is not estimated; evidence is not available to suggest that differences in costs associated with removal of invasive plant species between the alternatives would be measureable.

The Forest Service does apply fire retardant to some small fires that are unstaffed (in contrast, the USDI Bureau of Land Management does not usually apply fire retardant to fires that are unstaffed). For Alternative 3 in the Aerial Application of Fire Retardant direction, monitoring costs are estimated under the assumption that 5 percent of all small fires are monitored (75 fires monitored per year). Monitoring costs are shown to be relatively small compared to total suppression costs (recognizing that Forest Service units using fire retardant must monitor at least one small fire) (draft EIS, Social and Economic Considerations section of chapter 3). Monitoring small fires is not required under draft EIS Alternatives 1 and 2. There is no requirement to monitor large fires where fire retardant is applied; however, reporting is required for any fire in which misapplication occurs under Alternative 2 as well as Alternative 3, and the costs for misapplication reporting is captured in the table summarizing costs in the Social and Economic Considerations section in chapter 3 of the final EIS. Details about cost assumptions are provided in the Social and Economic Effects section of the Specialist Report what was prepared for the final EIS.

Social and Economics – Alternative 1 - Environmental Consequences, Other Suppression Costs

Public Concern 70

The Forest Service should complete a cost-benefit analysis assessing the following costs associated with use of fire retardant (page 91 of the draft EIS):

A) Lost resources, including impacts on fish, aquatic ecosystems, water quality, native plant biodiversity, human health wildlife, native sites, etc.;

B) Ecological imbalances;

C) Social costs, such as feelings of safety, access to a natural commons, sacred site integrity etc., should not be confined to economic costs;

D) Further define the cumulative effects because it appears the priority for firefighting is not for protection.

Response to PC 70

Potential changes in adverse effects from exposure to fire retardant or from chronic environmental impacts resulting from fire retardant (e.g., eutrophication) on aquatic life, water resources, plants, human health wildlife, and cultural sites are considered and are discussed for each alternative in respective resource sections in chapter 3 of the draft EIS (pages 33–134); these discussions are not repeated, but are referenced in the section regarding social and economic effects (draft EIS pages 86–97). For a comparison of the suppression cost-efficiency results to a summary of the direct and indirect resource effects associated with direct exposure to fire retardant (including effects on sensitive resources resulting from exposure to and/or the ecological consequences of fire retardant application), see the Social and Economic Considerations section of chapter 3 and the summary of effects in chapter 2 in the final EIS respectively.

Public relations or "feelings of safety" are not considered to be suppression goals or objectives within existing policy and guidance for fire suppression and management, and are therefore not included in the discussion of benefits. Accurate communication of safety and security implications associated with suppression decisions and strategies in the event of a fire is a component of public relations and outreach programs.

As noted in the response for Public Concern 68, the Aerial Application of Fire Retardant direction do not directly alter the objectives and goals considered during suppression and suppression strategy decisions. The degree to which ecological conditions or imbalances (resulting from past fires and fire management decisions) are considered during future decisions regarding fire incidents and suppression strategies is assumed to be the same regardless of the availability of fire retardant; these considerations are therefore not discussed separately in cost and economic effects analysis, nor considered in the context of cost-benefit analysis. Also see response to Public Concern 12.

Support for jobs associated with firefighting-related industry sectors is not considered as an objective or goal directly affecting suppression decisions. As a consequence, economic impacts associated with those sectors are not analyzed as part of direct, indirect, or cumulative effects.

Social and Economics – Environmental Justice

Public Concern 71

The Forest Service should analyze the effects of the proposed action on Native Americans and/or Federally recognized tribes as a minority; and low income rural communities—specifically those communities and people living directly adjacent to or surrounded by national forests—in the Environmental Justice section of the draft EIS. In addition, the Agency must consider those tribes whose aboriginal territory is within National Forest System boundaries.

Response to PC 71

The purpose of Executive Order (EO) 12898 is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. The Forest Service recognizes that Native American and/or Federally recognized tribes, as well as low income rural communities, meet the definition of minority or low-income populations under EO 12898; however, there is no evidence suggesting that direct effects associated with exposure to fire retardant or indirect effects related to changes in risk associated with potential changes in size and characteristics of wildland fires will occur at a rate disproportionately higher for those populations or communities. As noted in the Environmental Justice section of chapter 3 in the draft EIS(pages 86–96), the location of future fires is unknown; as such, it is not possible to identify specific populations, demographics, or specific minority populations who might experience the effects of the Aerial Application of Fire Retardant direction.

Soils – Environmental Consequences, General Effects

Public Concern 72

The Forest Service should re-analyze the direct, indirect, and cumulative effects on soils from Alternative 2 and demonstrate how Alternative 2 meets soil standards in national forest land resource management plans. In addition, there are actually no scientific references in the proposed action section but all soils science is based on the no-action alternative, which again, the Forest Service references an unsubstantiated Henderson and Lund Report.

Response to PC 72

The potential effects on the soil resource from aerial application of fire retardant is disclosed in discussion of the soil physical, chemical and biological properties that can be affected by fire retardant (draft EIS pages 97–98). Long-term fire retardant can interact with the soil in two ways: (1) direct application on bare soil or areas of sparse and patchy vegetation cover, and (2) indirectly from rain washing the fire retardant off both live vegetation and litter that it intercepts during application. Appendix H (draft EIS page 329) provides soil-risk rating information that shows how soil texture, soil pH, organic matter, vegetation, and time of application affect the fate of the fire retardant.

Additionally, numerous studies on the soil response to fire retardant are included in the General Effects of Fire retardants on Soils (draft EIS pages 97–99). These studies show that the potential direct, indirect, and cumulative effects of fire retardant vary with fire retardant concentration and soil quality. Forest Service soil quality standards are used as a metric to ensure that long-term soil productivity is maintained. The response of soils to aerial application of fire retardant can show an increase in soil productivity on sites with low fertility. On sites with high productivity (clay and loam soil textures, high soil organic matter), the response is not as pronounced.

Soils – Alternative 2 - Environmental Consequences, Direct and Indirect Effects

Public Concern 73

The Forest Service should select Alternative 2 or 3 because discontinuing the use of fire retardant would increase the potential for damage or destruction of biological resources from number of acres burned by wildfires, soil erosion, loss of topsoil, landslides, and an increased risk of loss, injury, and death.

Response to PC 73

Firefighting strategies are improved with fire retardants because fire retardants help slow the rate of spread of fire and allow ground personnel to access the area and complete suppression actions (draft EIS, Wildland Fire Management section, Fire retardant Operational Use, pages 111–116). Other firefighting strategies include use of bulldozers and handlines, which significantly disturb vegetation and soil cover. Increased soil disturbance can lead to increased soil erosion and reduce soil quality and productivity (Ingalsbee 2004, Backer et al. 2004).

Wilderness – Affected Environment, Untrammeled

Public Concern 74

The Forest Service should re-analyze the fire retardant dye effects years after the fire on untrammeled, natural, and undeveloped lands, as described on page 104 of the draft EIS.

Response to PC 74

The effects of dye staining by fire retardant are dependent on the site-specific conditions where it is applied (see draft EIS, pages 9 and 85). The dye trace will remain longer on rocky and drier sites than on wet porous sites. It is most visible the year it is applied, but is generally less noticeable in following years because of weathering by rain and snow. It is unusual for dye stains to still be visible after 5 years where there is precipitation. Dye tracing may be visible longer in drier climates, but is typically not noticeable at a distance. One must be directly within the area affected in order to see the effects of the reddish coloration of the dye. The slight discoloration in these persistent sites is not sufficient to detract from the naturalness of the area. Dye tracing does not detract from the undeveloped character of the area since it is not a building or structure or a development feature on the landscape The dye is inert and has no lasting effect on natural processes. While some short-term spot effects on natural processes may occur because of application of fire retardant (draft EIS page 43), these are on such a small portion of the land base in any given area that they would have no lasting adverse effect on local populations or ecosystem processes.

Wilderness – Affected Environment, Primitive Recreation and Solitude

Public Concern 75

The Forest Service should consider removing the last sentence in the paragraph on page 11 of the draft EIS under "Primitive Recreation and Solitude" that states, “Many people find these activities unusual and an enhancement to their experience because these activities are not readily seen in other locations” because this statement runs contrary to the values placed on primitive areas.

Response to PC 75

Wilderness areas are established to protect and preserve their wilderness character as well as to provide outstanding opportunities for solitude or a primitive and unconfined type of recreation. People do not come to wilderness specifically to view fire retardant operations, although they may be exposed to such activities when a fire is under suppression action. Fire control activities are allowed by the Wilderness Act (P.L. 88-577, Sec 4 (d) (1)) and, therefore, are part of the experience users may expect in wilderness areas. Fire retardant drops are unusual to most people. Language has been added to the final EIS that addresses that some people may find the intrusion of aircraft and fire retardant a negative effect upon their experience within wilderness areas.

Wilderness – Alternative 1 - Direct and Indirect Effects

Public Concern 76

The Forest Service should not select Alternative 2 Continued Aerial Application of Fire Retardant Under 2000 Guidelines, Including 2008 Reasonable and Prudent Alternatives, because while the draft EIS lists the negative effects of fire retardant it does not discuss or analyze any of the effects it is not consistent with NEPA, and aerial fire retardant dropping violates the Wilderness Act.

Response to PC 76

The effects of fire retardant have been analyzed for wilderness and other portions of NFS lands in the draft EIS, pages 32–134,including pages 104–105 specifically for wilderness character. The analysis of effects includes descriptions of the resources affected, how fire retardant drops affect those resources, and describes the cumulative effects of fire retardant drops across all the resources of the national forest.

Fire retardant drops are one of many fire control activities that are allowed under the Wilderness Act provision in Section 4 (d)(1), which states that “such measures may be taken as may be necessary in the control of fire.” This provision allows for a full suite of fire suppression actions, including fire retardant drops, to be planned and implemented within wilderness areas.

Wilderness – Alternatives 2 and 3 - Environmental Consequences

Public Concern 77

The Forest Service should modify Alternative 3, Continued Aerial Application of Fire Retardant Under Aerial Application of Fire Retardant direction, and Adopting 2008 Reasonable and Prudent Alternatives because of the lack of different strategies for Wilderness and roadless (semi-primitive non-motorized) versus motorized non-wilderness areas, to include:

A) Whenever practical, the Forest Service will use water or other less toxic fire retardants than those described in Alternative 2 within areas designated as Wilderness or Inventoried Roadless Areas;

B) Wherever and whenever it is not practical to use water or low toxicity fire retardants inside designated wilderness or inventoried "roadless" areas, then fire retardant drops will only be approved by incident commanders for use in "high risk" situations, rather than as a standard fire suppression tool, unless the incident commander determines that the use of fire retardant in wilderness or inventoried roadless areas is truly essential to protect property or lives;

C) Fire retardant will not be allowed to be applied in wilderness areas or inventoried roadless areas simply because alternative line construction tactics are not available or potential damage to natural resources may outweigh possible loss of aquatic life; and

D) Whenever an incident commander approves the use of fire retardant within a designated wilderness or inventoried roadless area, a detailed post-fire report must be submitted stating the justification for deviating from "water only" drops and specifying the property or lives that were the rationale for deviating and allowing fire retardant use.

Response to PC 77

The Wilderness Act does not limit the use of fire retardant activities. Section 4 (d)(1) allows for a full suite of fire suppression actions, including fire retardant drops, to be planned and implemented within wilderness areas. Placing restrictions as proposed would create a higher standard of exclusivity in wilderness than directed by Congress. Wilderness managers currently report incidents of fire retardant drops as part of annual motorized equipment/mechanical transport authorization reporting in the INFRA-Wild database. There are no current restrictions or limitations on the use of fire retardant in inventoried roadless areas. The analysis does not indicate significant adverse effects on wilderness or roadless areas; therefore there was no need to add additional direction to reduce adverse effects The general effects listed throughout this document apply equally to roaded and non-roaded portions of NFS lands. Limiting the use of fire retardant, such as the commenter suggests, could result in additional acres burned each year.

Wildlife – Environmental Consequences, Screening Process

Public Concern 78

The Forest Service should decide whether MIS and special status species are impacted by aerial application of fire retardant and should analyze the impacts on these species because the analysis cannot be deferred, as discussed under the Screening Process on pages 129 and 130 of the draft EIS. Inadequate environmental effects analysis and lack of scientific accuracy and integrity are NEPA violations. In addition, the Forest Service should conduct population surveys or studies for any management indicator species or T&E and sensitive species, not only nest observations for northern goshawk, osprey, and bald-eagle, which is in violation of NFMA requirements to protect the viability of all native vertebrate species and monitor MIS.

Response to PC 78

The Forest Service has analyzed the effect of the application of aerial fire retardant on various groups of wildlife species, such as mammals, birds, amphibians, reptiles, and invertebrates. The analysis on pages 127–134 of the draft EIS are broad-scale and can be applied to all species. In addition, the Biological Assessment and the Biological Evaluation address threatened endangered and sensitive species. Threatened endangered proposed candidate and sensitive (TEPCS) species are being used as surrogates for all wildlife species since TEPCS species tend to be more susceptible to effects and tend to be in specialized habitats. Management indicator species (MIS) are addressed in local national forest and national grassland management plans, and the analysis is specific to each unit. Appendix I in the draft EIS (pages 336–344) shows the effects on various subgroups of wildlife species analyzed.

The Biological Assessment and Biological Evaluation analysis used species population information gathered from the individual national forests for the analysis of effects on wildlife species.

Public Concern 79

The Forest Service should clarify what "minimal" toxic and ecological effects means and they should define the mammal groupings, as discussed on page 130 of the draft EIS.

Response to PC 79

Pages 130 and 132 of the draft EIS, under the sections Environmental Consequences Common to All Species and Cumulative Effects Common to All Species, state that impacts “are expected to be minimal or minor”: specifically, the effects would be small in scale and should affect only a few individuals at a time” (page 130), and the use of fire retardants “is not likely to have a lasting effect on the species” (page 132). The toxic ecological effects of ammonium compounds used in fire retardant are considered to have minimal effects on terrestrial ecosystems (Labatt Environmental Report 2007, draft EIS page 130). These effects were summarized for each representative terrestrial species groups for wildlife species (draft EIS, Appendix I, pages 336–344). The representative terrestrial groups or species used to analyze the toxicology effects are: mammals: deer (large herbivore), coyote (carnivore), and deer mouse (omnivore, prey species). Bird species analyzed include: American kestrel (raptor), red-winged blackbird (songbird), and bobwhite quail (ground nester). Aquatic species include tadpoles of frogs and toads.

Draft EIS Appendix I, pages 336–342, further defines each of the various groups and subgroups for mammals, birds, amphibians, reptiles, and invertebrates. These species correlate to the various subgroups used for mammals and birds in the Biological Assessment and Biological Evaluation. For instance, under Group Mammals, there are the following subgroups: marine mammals, rodents, bats, carnivores and omnivores, and ungulates. The effects on each subgroup are described on pages 336–342 of Appendix I in the draft EIS.

Wildlife – Environmental Consequences, Direct Effects

Public Concern 80

The Forest Service should further analyze the expected direct, indirect, and cumulative effects of fire retardant on all wildlife species and their viability:

A) Because the conclusion found on page 12 of the draft EIS is not based on the best available science, the draft EIS fails to comply with NEPA, ESA, NFMA, and forest based LRMPs;

B) Because on page 130 of the draft EIS, it is not clear what are the "minor" impacts expected, to what species, and what "small in scale" means because small endemic populations are the most at risk;

C) And describe what species and how many species will be affected by aerial application of fire retardant (page 131 of draft EIS);

D) And describe what the effects are between application and the next wet weather (page 131 of draft EIS);

E) Because species have evolved with wildfire but not with fire retardant, yet this is not considered (page 131 of draft EIS);

F) And define "prey burden", how it affects species viability, and what species it affects (page 131 of draft EIS); and

G) And describe how "short term" is avoidance of a food source and how that affects the populations (page 131 of draft EIS).

Response to PC 80

A) The draft EIS analyzed the direct, indirect, and cumulative potential effects from the potential use of aerial application of fire retardant on all wildlife species. The conclusions on page 12 and pages 127–134 in the draft EIS and in Appendix I, pages 332–344, are a summary of the analysis conducted within the Biological Assessment and Specialist Report for Wildlife, which cites multiple scientific reports, such as the Labat Environmental Report (Labat Environmental 2007). The Biological Assessment has been reviewed by Forest Service and FWS biologists, and also incorporated recent information and reports for specific species.

B) The minor direct and indirect effects that are discussed on page 130 and 131 in the draft EIS include: direct application; disturbance from low flying aircraft; changes in habitat due to fertilizing effect or the breaking off of tops of trees from the release of a load of fire retardant; and possible ingestion through directly eating vegetation covered by fire or through drinking of water "after a wet weather event" where the possible run-off of fire retardant may occur. These effects are expected to occur to all groups and subgroups of wildlife species listed in Appendix I and in the Biological Assessment and Biological Evaluation.

C) The term small-scale refers to effects that should affect only a few individuals at a time and are not likely to have a lasting effect on the species; therefore, they are considered temporarily short-term in nature (draft EIS page 130). Effects on small endemic populations were analyzed in detail in the Biological Assessment. For those species determined to be adversely affected, avoidance areas were identified to mitigate the potential impacts from the use of aerial application of fire retardant. These avoidance areas have been incorporated into Alternative 3.

D) The Biological Assessment analyzed the impacts on threatened and endangered species (112 species) under the Endangered Species Act. These species are included in the draft EIS, Appendix I, pages 332–336. The final EIS summarizes the effects for all Forest Service sensitive species from the Biological Evaluation. This list includes approximately 650 species (draft EIS page 13), including analysis on species habitats and populations for all threatened endangered and sensitive species. Pages 336–342 in the draft EIS further define each of the various groups and subgroups for mammals, birds, amphibians, reptiles, and invertebrates. For instance, under the Group Mammals, there are the following subgroups: marine, rodents, bats, carnivores and omnivores, and ungulates. The effects on each group are shown on pages 336–342 in the draft EIS.

E) The purpose of the EIS is not to address how species have adapted to wildfire but to evaluate the effects of the direction for aerial application of fire retardant and alternatives to that direction.

F) Prey burden is defined on page 131 of the draft EIS as: "toxins ingested by prey species are then ingested by the predator that eats that species;" in this way, the prey passes the toxins on to the predator.

G) The short-term avoidance of a food source (draft EIS page 130) occurs when fire retardant is present on vegetation and animals avoid that vegetation for a relatively short time, usually until the fire retardant is removed by rainfall. This avoidance is expected to occur only for a few weeks or months, rather than a longer time period, which might affect the reproduction or life cycle of the species. This effect occurs only in the local area where fire retardant was dropped and only to a specific population or portion of that population in that local area, as described in the Labat Environmental Report (Labat Environmental 2007).

Public Concern 81

The Forest Service should clarify the following wording on page 12 of the draft EIS, "Alternative 3 proposes monitoring of areas where fire retardant drops have been used within a watershed to determine if impacts on any terrestrial species exceed an established threshold because it is unclear where and how these referenced impact thresholds are determined.

Response to PC 81

The final EIS Appendix R lists all monitoring and reporting requirements for the use of aerial application of fire retardant, including the guidelines for establishing and adjusting avoidance areas, operational guidelines, and monitoring and reporting.

If aerial application has occurred within a watershed and has had a significant impact on a species or a portion of that species' population (or habitat then the area may have certain thresholds of impact associated with it to restrict the further use of area fire retardant in that drainage from causing further impacts for a specified timeframe. This timeframe depends on the species affected, reproductive needs, life cycle requirements, etc., and how the fire retardant affected those critical life phases. This threshold would be determined at the local national forest/field office for those species and may result in re-initiation of consultation if it is determined that such consultation is needed.

Wildland Fire Management – Threats from Wildfire

Public Concern 82

The Forest Service should sufficiently address the direct, indirect, and cumulative effects restricting or eliminating the use of fire retardant in the wildland-urban interface (WUI) and consider the differences between the WUI and remote wilderness areas; one size doesn't fit all situations. The Forest Service should not use the definition of "wilderness" to be the deciding point for fire retardant because there are now urban wilderness areas and remote wilderness areas, and they are different due to nearness to populated areas. In addition, the draft EIS should address implementing more complete fuels treatment programs within the WUI because there are more people in the vicinity of ecosystems which depend on fire.

Response to PC 82

The purpose and need of the proposed action was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. Through forest plans, national forests have established criteria for the use of wildland fire chemicals within wilderness or other sensitive areas. In addition, land management plans may have established WUI areas as high priority for suppression response. The Forest Service at the local level is working with local city, county, and state governments to identify critical areas within the WUI to focus fuels reduction treatments and target funding. Overall, the Forest Service's fuels reduction program has increased over the past 10 years by an average of 50 percent, with emphasis in the WUI.

Public Concern 83

The Forest Service should analyze the change in fire suppression tactics because more fires are being managed for resource benefit, and by reducing Federal suppression capabilities and limiting the application of aerial delivered fire retardants, this can accelerate risk to private land owners, and state and local governments when sharing a common boundary with Federal partners. In addition, the Forest Service should consider that safe and aggressive suppression keeps fires small, and presents less safety and health risk to the public and firefighters while reducing the amount and intensity of resource loss, environmental damage, and long-term damage to critical species and habitat Any inadvertent short-term or isolated situation with fire retardant causes far less habitat and resource damage than left to an uncontrolled wildfire.

Response to PC 83

The purpose and need for this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. Therefore, the analysis did not include evaluation of the effects of other tools or tactics used to fight fire on NFS lands.

Currently, the Forest Service refers to two types of fire: prescribed fire and wildland fire; these are defined in Federal Wildland Fire Management Policy (February 13, 2009) and in the Glossary in the final EIS. All wildland fires will have suppression objectives, with the primary emphasis being consideration of risk to and protection of human life, property, and natural/cultural resources. A wildland fire may be concurrently managed for one or more objectives.

Public Concern 84

The Forest Service should further analyze and weigh the risk of aerial firefighting, including fire retardant use, and discuss it in more detail in the draft EIS because it is only briefing mentioned as "inherently risky" on page 110 of the draft EIS. The balance of environmental and loss of life costs and the benefits of aerial fire retardant should be significant, obvious, and substantiated.

Response to PC 84

The Forest Service recognizes the tragedy of any firefighter fatality. The 10-year data of 61 firefighters who died as a result of aviation accidents are not specific to the aerial delivery of fire retardant. These accidents are analyzed, and it was determined that 35 of the fatalities were associated with the delivery of fire retardant. The National Transportation Safety Board investigated the accidents and provided reports to the Forest Service and the companies with the findings. The Forest Service has taken the findings, along with the Blue Ribbon Panel report International Code Council 2008) very seriously and implemented measures to improve the safety of the large-airtanker fleet. In addition, due to the aging large-airtanker fleet, measures to prevent accidents have been taken through the Continued Airworthiness Program (CAP) and Operational Service Life (OSL) programs to implement additional safety requirements to reduce the risk. OSL requirements were added to the large-airtanker contracts to provide additional inspection and maintenance requirements to help prevent potential accidents. As a result of the CAP and OSL, the large-airtanker fleet has been reduced by approximately 63 percent, and additional safety and maintenance requirements have also been added to the contracts for both single-engine airtankers and helicopters. These requirements are in place whether the aircraft is delivering water fire chemicals, cargo, or personnel. In addition, the Forest Service conducts risk assessments on these programs in order to make determination of utilizing the tactic or tools in the suppression of fires.

Public Concern 85

The Forest Service should further analyze and adequately address the secondary impacts of fires which extend beyond the initial attack phase on the communities within the WUI, some of which include:

A) Loss of infrastructure including electric power grid, water treatment facilities, and gas transmission lines;

B) Destruction of watershed resulting in siltation of water reservoirs, increasing potential for downstream and urban flooding;

C) Loss of economic revenue, damage to business earnings, increased insurance premiums; and

D) Ongoing social issues, critical incident stress, damage to families, etc.

Response to PC 85

The purpose and need of the proposed action was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. The development of the direct and indirect effects for each alternative identifies the potential impact to resources; however, the Forest Service is reviewing the effects discussion for each alternative to determine if additional or clarifying language is warranted for the final EIS.

Wildland Fire Management – Fire Management - Decisionmaking

Public Concern 86

The Forest Service should consider the following when making fire management decisions regarding aerial application of fire retardant:

A) Pilots and firefighters should not be held personally liable for "misapplications";

B) Use all their suppression tools to stop fires before fires get to local jurisdictions;

C) Restriction of fire retardant use in stream areas, cultural areas, and T&E areas results in untreated fuels that act as "wicks" to allow fires to escape containment, cause more damage, and burn down communities;

D) Impacts of fires on the costs of BAER and post fire rehab treatments;

E) Fire behavior and risks can and do change in an instant and any additional requirements or considerations for fire retardant use can and will delay decisions and ultimately increase risk, cost, and loss;

F) Need clear and concise policy guidance in all fire suppression aspects, e.g., when specialists are needed on a fire to determine effects of fire retardant; and

G) Maintain consistency especially in proximity to jurisdictional boundaries and address policy variability and flexibility that allows for site and situational needs.

Response to PC 86

The purpose and need for this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. The analysis did not include evaluation of the effects of other tools, tactics, or specific operational considerations used to fight fire on NFS lands.

Alternatives 2 and 3 both include the ability to use the aerial application of fire retardant (final EIS, chapter 2). Managers use a decision-support process to guide and document wildfire management decisions (final EIS, chapter 3; Fire Retardant Operational Use). The process provides a mechanism whereby situational assessment, hazards and risks to be analyzed, implementation actions defined, values to be protected, and that the decisions and rationale are documented. Fire managers use the principles of fire-suppression actions for conducting fire-suppression operations, which include objectives, speed and focus, positioning, simplicity, and safety. All of these considerations inform the ultimate decisions that Agency administrators and incident commanders make on wildfires.

Public Concern 87

The Forest Service should provide some documentation in the final EIS as to whether and how aerial fire retardant is applied and whether it is applied effectively. Aerial application is most effective during periods of slow fire growth (i.e., generally in the morning hours) but numerous drops occur in the afternoon hours, even though some of these drops may be warranted. However if the intent is to minimize the potential effects associated with fire retardant, the Forest Service could analyze how fire retardant is currently being applied and how it could be applied to reduce the negative effects associated with its use, while still contributing towards desired conditions associated with protection of human safety, property, and resources while simultaneously contributing towards the reintroduction of fire as a landscape-level process.

Response to PC 87

Fire retardant operational use is addressed in the final EIS, chapter 3 Fire Retardant Operational Use, which states that the frequent use of fire retardant is to stabilize small remote fires before they mature into larger, long-duration incidents. Upon identifying an unplanned ignition, an initial size-up and assessment is completed as to how the fire will be suppressed (Incident Response Pocket Guide (IRPG)). If the decision is to use aerially applied fire retardant, the application of fire retardant will be positioned such that it will be the most effective and at the time of ignition discovery. Natural ignition fires typically occur in the afternoon and early evening hours, which are usually in the heat of the day and with the lowest humidity levels; therefore, using fire retardant is critical at that time in order to assist in slowing spread and intensity of the fire. In addition, fire managers will use fire retardant when it has been identified to be effective in the morning hours.

Incident commanders are delegated the authority to manage fires. All decisions regarding the management of that fire are the responsibility of the IC. Incident commanders are responsible for considering the risks associated with all management decisions.

Wildland Fire Management – Fire Retardant Operational Use

Public Concern 88

The Forest Service should consider the following for fire retardant operational use:

A) Developing new formulas for fire retardant; and

B) Updating air tankers with proper mapping equipment to track drops.

Response to PC 88

The decision as to whether and when to use fire retardant is made by the incident commander on the fire at time of fire and, appropriately, is not part of this programmatic, national-level EIS. However, chapter 3, Fire Retardant in Wildland Fire Management, Long-Term Retardant Background in the final EIS and in Appendix L, the current wildland fire chemical program is discussed, which includes working with industry in the development of new formulations. The Forest Service uses a formal process to develop and adjust the current specifications, which establish the requirements for industry to submit formulations for evaluation and potential use. These requirements include evaluation criteria (final EIS, Appendix L; USFS 5100-304c Specification) to ensure that toxicity does not reach certain thresholds. Aircraft used in the delivery of aerial fire retardant will be evaluated for the appropriate technology capability to be added in order to support the delivery of fire retardant and future data gathering needs.

Public Concern 89

The Forest Service should disclose the basis for the experts' opinions in the report cited on page 72 of the draft EIS (Henderson and Lund 2011) that fire retardant contributes to initial attack success, acres burned, or structures protected because there are no data or citations on which the authors based their opinions and the report cites data regarding fire retardant properties measured in the laboratory; therefore the draft EIS and the internal report on which it relies violates NEPA (40 CFR § 1502.24).

Response to PC 89

Page 72 of the draft EIS states that, “However, without the use of fire retardant, the probability of a fire burning more acreage is higher (Henderson and Lund 2011).” fire retardants have been proven to reduce and slow the rate of fire spread and intensity as based on the laboratory analysis as cited (draft EIS page 120). Many variables exist when studying a fire and applying fire retardant; therefore, any field study with the sole objective of studying the probability of a fire to burn more acreage without the use of fire retardant would not result in repeatable results and would, therefore, not provide sound scientific results. Fire observations and experience of fire management officials contribute to the continued use and success of fire retardant in slowing and managing wildland fires.

To validate and document the observation and experience of fire personnel, a questionnaire was distributed among the national wildfire community in July 2011. More than 50 responses were received to the questionnaire and a summary has been added as Appendix O in the final EIS. The respondents to this survey concurred with the statements made in the final EIS that fire retardant slows the wildfire’s rate of spread and intensity and allows firefighters time and the ability to take direct actions when, without its use, they would not have been successful in either initial attack or impeding the spread of the fire.

Public Concern 90

The Forest Service should add the 2009 Jesusita fire that burned 2,000 acres on the Los Padres National Forest to the list of misapplications of fire retardant during the 3-year period 2008–2010 found in Appendix D-4 of the draft EIS. A misapplication of fire retardant directly to Maria Ygnacio Creek during fire suppression efforts killed several dozen endangered southern California steelhead trout and the fire originated ¼-mile from the national forest boundary.

Response to PC 90

The misapplication report includes only misapplications into waterways that were within NFS lands, not lands adjacent to or near NFS lands. The Jesusita fire started on state-owned and private land and the misapplication did not occur on NFS lands. The Forest Service collects all reported misapplications through the established reporting process, which does include reports from other Federal agencies and states if they so choose to report. In this case, a report was submitted and the fish kill was recognized and reported. The misapplication was an accident and occurred immediately after extreme fire behavior was experienced and in an area where the fire could have moved and threatened nearby homes. This report is available on the Fire and Aviation website at http://www.fs.fed.us/fire/fire retardant/index.html.

Wildland Fire Management – Pro Fire Retardant

Public Concern 91

The Forest Service should select Alternative 2 or 3 and continue aerial application of fire retardant because:

A) Fires will get larger, damage more than just fisheries, and subsequently are more costly to taxpayers;

B) Significant potential for greater environmental, social, recreational, and safety concerns do not appear to warrant any change in current policy;

C) A fire suppression tool should be used that can prevent additional significant habitat and species loss;

D) And integrate fire retardant restrictions as seamlessly as possible into operations to ensure that fire personnel are not faced with yet more liability for implementing the restrictions;

E) Research and experience demonstrate that aerially applied fire retardant used in an appropriate manner reduces wildfire intensity and the rate of spread, which increases the effectiveness of fire suppression efforts on the ground;

F) Fire retardant is effective at catching fires in their early stage, any restrictions will increase the mercury levels, harming fish, birds, and human health therefore creating long-term negative effects compared to the short-term impact of nitrates;

G) It is an effective tool for fighting fire in the WUI;

H) It is quite effective at moderating surface fire behavior and, in the right circumstances, aerial fire retardant is effective at suppressing surface to crown fire transitions;

I) It allows firefighting personnel to slow fire progression to a point where ground personnel are able to contain and extinguish a fire. Fires often burn in areas that may be inaccessible to ground crews for hours, or may be so numerous that it takes days to begin control efforts;

J) It is an effective tool for initial attack; and

K) The unique utility of fire retardants are that they function as both a suppressant and a fire retardant. It retards and modifies combustion even after the water has left the solution making it an excellent tool for, indirect and parallel attack. In these cases the water is simply the carrier that helps to distribute the active fire retardant chemical uniformly on the fuel. After the water in the fire retardant solution has been “driven off” or evaporated, the remaining fire retardant salts, when combined with fire, alter the normal chemical processes associated with burning.

Response to PC 91

The purpose and need for this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can: The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. The points above were analyzed and are discussed in the draft EIS, chapter 3, Affected Environment (pages 32–134). The draft EIS contains three alternatives that were analyzed relative to the direct and indirect effects of the use of aerially delivered fire retardant. The range of alternatives provides the Chief of the Forest Service with options to select from that will best meet the need for managing wildland fires.

Wildland Fire Management – Con Fire Retardant

Public Concern 92

The Forest Service should select Alternative 1 and not continue aerial application of fire retardant:

A) Because it is toxic to fish, insects, wildlife, birds, frogs, toads, vegetation, water cultural resources, riparian areas, pets, and the entire ecosystem;

B) Because with 65 “jeopardy calls,” aerial fire retardant use is the Federal government’s single most widespread and damaging activity to ESA-protected species (page 4 of the draft EIS);

C) Because with 61 fatalities in a 10-year period (1999-2009), aerial firefighting is the single most hazardous Federal government activity, apart from military conflict;

D) And should be prohibited unless it proves more useful in protecting property and human life than building with nonflammable materials and removing vegetation from around the house;

E) Because of the short-term and long-term health effects on the public and firefighters;

F) And look for other non-toxic formulas other than using fire retardant; and

G) Because there is no evidence to support the conclusion that elimination of aerial application of fire retardant will significantly reduce effectiveness of aerial resources (primarily air tankers) and reduce success of firefighters on initial attack (also see spreadsheet attached to comment letter #15).

Response to PC 92

The draft EIS contains three alternatives that were analyzed relative to the direct and indirect effects of the use aerially delivered fire retardant. The range of alternatives provides the Chief of the Forest Service with options to select from that will best meet the need for firefighting wildland fires. Each alternative includes indirect, direct, and cumulative effects analysis for the species and habitats (draft EIS, chapter 3, pages 35–85 and 97–105; Biological Assessment).

A) Alternatives 2 and 3 identified avoidance areas for species to provide protection for species susceptible to the chemicals found in fire retardants. Analysis of impacts to resources from possible toxicity caused by fire retardants was conducted in chapter 3 - Environmental Consequences for aquatic vertebrates and invertebrates, cultural resources, water resources, plant species, public health soils, and wildlife species and habitats.

B) The 65 jeopardy calls are mitigated through the 2008 Reasonable and Prudent Alternatives in Alternative 2. Implementation of the RPAs ensures that the use of aerially applied fire retardant is not the single most-widespread and damaging activity to ESA protected species. Alternative 3 incorporates these RPAs plus provides for additional protections for threatened endangered proposed candidate and sensitive species with the identification of additional avoidance areas for those species that may adversely be affected by the use of fire retardants. With these measures in place, no jeopardy determinations are expected.

C) The Forest Service recognizes the tragedy of any firefighter fatality. The 10-year data of 61 firefighters who died as a result of aviation accidents are not specific to the aerial delivery of fire retardant, which is the focus of this EIS. These accidents are analyzed, and it was determined that 35 of the fatalities were due to the delivery of fire retardant. The National Transportation Safety Board investigated the accidents and provided reports and findings to the Forest Service and the companies. The Forest Service has taken the findings, along with the Blue Ribbon Panel report (2008), very seriously and implemented measures to improve the safety of the large-airtanker fleet. In addition, due to the aging large-airtanker fleet, measures to prevent accidents have been taken through the Continued Airworthiness Program (CAP) and Operational Service Life (OSL) programs to implement additional safety requirements to reduce risk. OSL requirements were added to the large-airtanker contracts to provide additional inspection and maintenance requirements to help mitigate potential accidents. As a result of the CAP and OSL, the large-airtanker fleet has been reduced by approximately 63 percent. Additional safety and maintenance requirements have also been added to the contracts for both single-engine airtankers and helicopters. These requirements are in place whether the aircraft is delivering water fire chemicals, cargo, or personnel. In addition, the Forest Service conducts risk assessments on these programs in order to make determination of utilizing the tactic or tools in the suppression of fires.

D) The protection of structures and the prevention of structure fires are not exclusive to one method. The use of any fire chemical to treat a structure or land surrounding can be beneficial in preventing a structure fire, along with the methods that are identified in the FIREWISE program.

E) Public health and safety are considered with the evaluation of any potential fire retardant that is submitted to the Forest Service. The final EIS contains the evaluation process used (chapter 3, Public Health and Safety section; Appendix L), which includes the need for a risk assessment to be completed if a formulation contains an ingredient(s) that may have potential for harm and is not present in other fire retardant formulations. If the risk assessment determines the ingredient is harmful, it would not be allowed.

F) The final EIS includes the current wildland fire chemical program (chapter 3, Fire Retardant in Wildland Fire Management, Long-Term Retardant Background section; Appendix L), which includes working with industry in the development of new formulations. The Forest Service uses a formal process to develop and adjust the current specifications, which establish the requirements for industry to submit formulations for evaluation and potential use. These requirements include evaluation criteria to ensure that toxicity does not reach certain thresholds. Long-term fire retardant has advantages that are necessary to afford the protection of resources and personnel, so if a non-toxic formulation is submitted for evaluation and meets the retarding characteristics needed as well as all other requirements, it would be added to the qualified products list and available for use.

G) Interpretation of any evidence of correlation between fire retardant use and initial attack success as well as final fire size is challenging due to confounding factors. Initial attack success is a measurement by total acres when a fire is contained. Multiple resources can influence this containment as can a variety of factors, such as wind, fuel type, relative humidity, slope, weather, etc. Based on professional firefighters experience (Appendix O), the delivery of fire retardant through airtankers or other aviation assets as observed by professionals after drops, and the extrapolation of the effectiveness of fire retardant identified in the laboratory testing (final EIS chapter 3, Fire Retardant in Wildland Fire Management, Long-Term Retardant Background it is reasonable to expect initial attack success without recourse to fire retardant use will not be as effective as it is currently.

Wildland Fire Management – Long-Term Fire Retardant

Public Concern 93

The Forest Service should reanalyze and discuss, in the final EIS, the issue of long-term fire retardant products, how they are delivered, and how the application might be marginally modified to reduce the damaging results because there are three assumptions throughout the draft EIS: (1) current fire suppression tactics of applying long-term fire retardants is desirable, productive, or even necessary; (2) current use practices of fire chemicals are strategically and tactically correct and completely appropriate; and (3) there is no suitable fire chemical substitute for long-term fire retardant.

Response to PC 93

The purpose and need for this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can: The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.

- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. Incident commanders are delegated the authority to manage fires. All decisions regarding the management of that fire are the responsibility of the IC. Incident commanders are responsible for considering the risks associated with all management decisions as well as when and where to aerially apply fire retardant.

The final EIS includes the current wildland fire chemical program (chapter 3, Fire Retardant in Wildland Fire Management, Long-Term Retardant Background section; Appendix L), which includes working with industry in the development of new formulations. The Forest Service uses a formal process to develop and adjust the current specifications, which establish the requirements for industry to submit formulations of evaluation and potential use. These requirements include evaluation criteria to ensure that toxicity remains below certain thresholds. Alternatives 2 and 3 were designed to reduce adverse effects on threatened endangered and sensitive species by applying avoidance areas on the ground. These alternatives identify different criteria for the avoidance areas, The final EIS evaluates the potential effects from applying these areas, including potential effects on resources as well as wildland fire.

Public Concern 94

The Forest Service should reanalyze and recognize that very good options exist to the current practices and use of the current inventory of long-term fire retardant products, and initial attack performance can be better than it is today and environmental damage less by using the most suitable fire chemicals for the fire attack situation.

Response to PC 94

The purpose and need for this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can: The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.

- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. However, the Forest Service evaluates and also uses suppressants other than fire retardant and water in the suppression of wildland fires. The purpose of fire retardant use is different than that of a suppressant and, depending on the tactic and strategy identified to fight a fire, fire retardant may be determined to be the more appropriate tool to use or it may be determined that the more appropriate tool to use is a suppressant (e.g., water, foams, and water enhancers).

Wildland Fire Management – Alternative 2 - Environmental Consequences, Cumulative Effects

Public Concern 95

The Forest Service should analyze the cumulative effects of aerial application of fire retardant and other fire suppression techniques because the whole array of suppression tools and techniques that are commonly used with aerial fire retardant constitute past, present, and reasonably foreseeable future actions, and thus require a cumulative effects analysis.

Response to PC 95

The purpose and need for this project of the proposed action was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can: The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. The purpose of the proposed action addresses the court order (Forest Service Employees for Environmental Ethics v. United States Forest Service 08-43 (D. Mont))(U.S. District Court, Montana 2010), which is specific to the continued aerial delivery of fire retardant on NFS lands.

At the local national forest level, the use of fire retardant is not necessarily dependent on any other suppression action, and the decision as to whether to use fire retardant or not is made based on a series of policies, guidelines, specific unit direction, and priority-setting for initial attack response. This decision may include a specific fire suppression resource or may include multiple fire suppression resources used in suppression tactics. Appendices A, C, J, L, M, and avoidance mapping provide the guidance for the application of fire retardant or foam.

The Forest Service is not required to analyze broader policy of fire suppression in this draft EIS and the final EIS includes the appropriate effects analysis for each alternative under consideration. The Biological Assessments also provide for direct, indirect, and cumulative effects for species listed under the Endangered Species Act.

Wildland Fire Management – Alternative 3 - Environmental Consequences, Direct and Indirect Effects

Public Concern 96

The Forest Service should clarify the statement on page 125 of the draft EIS that states, "Fire retardant cannot be used to anchor into waterways, steep terrain, or other areas of limited accessibility if located in a pre-identified avoidance areas. This could lower the probability of success in areas accustomed to fixed-wing fire retardant assistance in initial attack under high fire danger conditions. This could result in a "slight" decrease in initial attack success rate in those areas" because fire retardant is not anchored and there is a 300-foot buffer zone around waterways. In addition, the initial attack success rate will likely decrease more than slightly given the stated conditions of high fire conditions, inaccessibility, and steep terrain; therefore at a minimum, delete the word "slight."

Response to PC 96

Under Alternative 2, fire retardant application may be used to anchor fireline into waterways or certain identified or mapped avoidance areas when alternative line construction tactics are not available due to terrain constraints, congested area, life and property concerns, or lack of ground personnel; deviations are permitted only when human life or property is threatened and the use of fire retardant can be reasonable expected to alleviate the threat. Therefore, under this alternative, application of fire retardant would be permitted if alternative line construction tactics are unavailable and human life or property is threatened.

However, under Alternative 3, fire retardant application may occur in waterways or all mapped avoidance areas only when human life or safety is threatened and the use of fire retardant can be reasonable expected to alleviate the threat. In the final EIS, chapter 3, Fire Retardant in Wildland Fire Management, the direct and indirect effects of the aerial application of fire retardant include the appropriate effects analysis.

Wildland Fire Management – Other Options for Fire

Public Concern 97

The Forest Service should consider the following options to aerial application of fire retardant, either as new alternatives or modifications to the action alternatives in the draft EIS:

A) The 415 scooping aircraft supports the use of short-term fire retardant and water use for direct attack strategy in the early stage of initial attack made by Bombardier Aerospace;

B) The CL-415 and CL-215 water scooper bombers used in Ontario and Quebec that delivers Class A foam, which is designed to smother flames and act as a short-term fire retardant;

C) The VLAT aircraft, with their larger volumes and capacities offer a viable strategic and tactical alternative to fire retardant, used by Evergreen International Aviation. In addition, dispatching protocol is suggested in the comment letter;

D) Open all of the air attack bases to the interested companies who can deliver water enhancers' in multi engine aircraft that are on the Qualified Products List (QPL);

E) FireIce by GelTech is currently listed on the QPL, has satisfactory test results showing no toxicity towards mammals and fish, is friendly to the environment, and an absolute extinguisher of wildfire;

F) The increased use and phase in of alternative delivery systems, such as helicopters, may be the most effective tool to minimize misapplications and acute events, while concurrently contributing to, rather than limiting, the effectiveness of firefighting operations.

Response to PC 97

The purpose and need of this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. The purpose of the proposed action addresses the court order (Forest Service Employees for Environmental Ethics v. United States Forest Service 08-43 (D. Mont))(U.S. District Court, Montana 2010), which is specific to the continued aerial delivery of fire retardant on NFS lands.

The use of CL-215 and CL-415 on Forest Service fires is already occurring. The Forest Service policy does not allow for any wildland fire chemical to enter waterways or the 300-foot buffer except by invoking the current exceptions identified in the 2000 Guidelines; therefore, any water-scooping only aircraft will use water as the suppressant.

The Forest Service evaluates other aircraft for their potential use in fighting fires, including very large airtankers (VLATs) and maintains a qualified products lists for both water enhancers and foams as options available for use depending on tactics used in any given fire suppression action. Use of the appropriate wildland fire chemical and aircraft is the over arching program objective and is reviewed as necessary for any adjustments. The current aircraft under contract is used for mission-specific needs at the time of dispatch and is loaded with applicable wildland fire chemical to support that tactical mission. If the fire managers determine a change is needed in adjusting the wildland fire chemicals to be available for large airtankers, then that adjustment will be implemented through policy changes.

Wildland Fire Management – Effects of Fire Suppression

Public Concern 98

The Forest Service should analyze the direct, indirect, and cumulative effects that fire suppression continues to cause on the ecological integrity and fire-adapted ecosystems, especially in the Inland Northwest national forests. The draft EIS lumps wildland fire, which is critical to the health of these fire-adapted ecosystems, with all unplanned ignitions, and the Forest Service should be planning for wildland fire use to attain the beneficial effects for these fire-dependent ecosystems. In addition, the Forest Service should acknowledge that indirect effects of fire suppression, including the successful aerial application of fire retardant, include continued habitat degradation by the exclusion of fire from the ecosystem, contribution to a risk of adversely affecting the lynx by limiting the availability of foraging habitat within these areas, and the risk of habitat for fire-dependent species.

Response to PC 98

The purpose and need of this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.
- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. The purpose of the proposed action addresses the court order (Forest Service Employees for Environmental Ethics v. United States Forest Service 08-43 (D. Mont))(U.S. District Court, Montana 2010), which is specific to the continued aerial delivery of fire retardant on NFS lands.

Decisions on the management response to a wildland fire on National Forest System (NFS) lands are based on objectives established in the applicable forest plans for the unit. Options for strategies in managing unplanned ignitions are based on land management goals and objectives that consider fuels, weather, topography, social and political factors, and involvement of other jurisdictions that might have different missions and objectives. If a fire is managed to achieve an ecological benefit, then fire retardant may be applied, but that decision is based on the current conditions, tactics, and the overarching objectives to be achieved.

Lynx was covered in the Biological Assessment for the direct and indirect effects of aerial application (final EIS chapter 3, Wildlife Species and Habitats; Appendix I) in consultation with the FWS. The commenter’s statement refers to all suppression activities and strategies, not application of aerially delivered fire retardant alone.

The Forest Service is not required to analyze the broader policy of fire suppression in this final EIS. However, the final EIS does include direct and indirect effects analysis of using fire retardant relative to the resource identified in chapter 3, Wildlife Species and Habitats, Affected Environment and Environmental Consequences. The Biological Assessments also provide for direct, indirect, and cumulative effects for species listed under the Endangered Species Act.

Wildland Fire Management – Fire Suppression Tools

Public Concern 99

The Forest Service should completely analyze the indirect effects and full range of cumulative impacts of intended connected fire suppression actions that involve a wide array of suppression tools and techniques to be able to determine the full impact of fire retardant use on terrestrial vegetation and wildlife, aquatic habitats and species, water quality, soils, cultural resources, hydrology, scenery management wilderness character, public health and safety, and especially wildland fire management.

Response to PC 99

The purpose and need of this project was revised based on public comments and internal reviews. The purpose and need of this action is to ensure that the Forest Service has access to an effective tool for wild land firefighting that can:

- Constrain the size of fires in remote locations and rugged topography where access by ground forces is limited.
- Reduce fire intensity and rate of spread or control the direction of fire spread to help ground forces prevent fire from reaching improvements and natural resources where losses and environmental damage from fire are unacceptable.
- Enable faster fire management response to fires occurring in remote locations thus, controlling fires while they are smaller and less dangerous and damaging.
- Reduce the fire rate of spread and intensity to increase firefighter and public safety.

- Reduce exposure of firefighters and the public to risky and dangerous situations during fire activity; and
- When use of fire retardant is determined to be appropriate, provide a means of application that employs a sufficient volume of fire retardant to influence fire behavior and reduce the intensity and rate of spread on large sections of fire perimeter quickly, which is one of the primary tactics to minimize the fire size until ground crews can reinforce the line.

The Forest Service must also provide standards for use of fire retardant to balance the need to protect critical or sensitive resources with the need to use fire retardant as an effective firefighting tool to protect life and property from wildfire. The purpose of the proposed action addresses the court order (Forest Service Employees for Environmental Ethics v. United States Forest Service 08-43 (D. Mont))(U.S. District Court, Montana 2010), which is specific to the continued aerial delivery of fire retardant on NFS lands.

A full analysis of the direct, indirect, and cumulative effects of the continued aerial application of fire retardant to fight fires on NFS lands on terrestrial vegetation and wildlife, aquatic habitats and species, water quality, soils, cultural resources, hydrology, scenery management wilderness character, public health and safety, and wildland fire management was analyzed and can be found in the chapter 3 of the final EIS, the Biological Assessments, and the Biological Evaluation.

At the local forest level, the use of fire retardant is not necessarily dependent on any other suppression action and the decision as to whether to use fire retardant or not is made based on a series of policies, guidelines, specific unit direction, and priority-setting for initial attack response. This decision may include a specific fire suppression resource or may include multiple fire suppression resources used in suppression tactics. Appendices A, C, J, L, M, and the avoidance mapping provide the guidance for the application of fire retardant or foam.

LITERATURE CITED

Angeler, David G. and Jose M. Moreno. 2006. Impact-Recovery Patterns Of Water Quality In Temporary Wetlands After Fire Retardant Pollution. Can. J. Fish. Aquat. Sci. 63:1617-1626.

Backer, Dana M., Sara E. Jensen, and Guy R. McPherson. 2004. Impacts of Fire-Suppression Activities on Natural Communities, Conservation Biology 18(4):937-946.

Crouch, R.L., H.J. Timmenga, T.R. Barber, and P.C. Fuchsman. 2006. Post-fire Surface Water Quality: Comparison Of Fire Retardant Versus Wildfire-related Effects Chemosphere 62:874-889.

Dubrovsky, Neil M. and Pixie A. Hamilton. 2010. Nutrients in the Nation's Streams and Groundwater, 1992-2004. Briefing sheet prepared for a congressional briefing in Washington, D.C., Sept. 24, 2010. USDI Geological Survey.

Dubrovsky, Neil M., Karen R. Burow, Gregory M. Clark, Jo Ann M. Gronberg, Pixie A. Hamilton, Kerie J. Hitt, David K. Mueller, Mark D. Munn, Bernard T. Nolan, Larry J. Puckett, Michael G. Rupert, Terry M. Short, Norman E. Spahr, Lori A. Sprague, and William G. Wilber. 2010. The Quality of Our Nation's Water - Nutrients in the Nation's Streams and Groundwater, 1992-2004, US Geological Survey Circular 1350. 194 p.

Field, C.B., L.D. Mortsch, M. Brklacich, D.L. Forbes, P. Kovacs, J.A. Patz, S.W. Running and M.J. Scott. 2007. North America. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 617-652 Website at: www.ipcc.ch/publications_and_data/ar4/wg2/en/ch14.Html.

Gaikowski, Mark P., Steven J. Hamilton, Kevin J. Buhl, Susan F. McDonald, and Cliff H. Summers. 1996. Acute toxicity Of Firefighting Chemical Formulations To Four Life Stages Of Fathead Minnow. Ecotoxicology and Environmental Safety. 34(0070):252-263.

George, Charles W. 1985. An Operational Retardant Effectiveness (OR) Study, Fire Management Notes, Volume 46, Number 2, pp 18-23.

Gimenez, Anna, Elsa Pastor, Luis Zarate, Eulalia Planas, Josep Arnaldos. 2004. Long-term Forest Fire Retardants: A Review Of Quality, Effectiveness, Application and Environmental Considerations. International Journal of Wildland Fire 13:1-15.

Hamilton, Steven J., Susan F. McDonald, Mark P. Gaikowski, and Kevin J. Buhl. 1996. Toxicity of Fire Retardant Chemicals To Aquatic Organisms: Progress Report. International Wildland Fire Foam Symposium, Thunderbay, Ontario. 132-144 pp.

Henderson, Tory and Elizabeth Lund. 2011. Wildland Fire Management Specialist Report.

Ingalsbee, Timothy. 2004. Western Fire Ecology Center - Biscuit Fire Suppression Impacts. Western Fire Ecology Center, American Lands Alliance. 43 p.

International Code Council. 2008. The Blue Ribbon Panel Report on Wildland Urban Interface Fire.

Johansen, R.W. and J.H. Dieterich. 1971. Fire Retardant Chemical Use on Forest Wildfires. Southern Forest Fire Laboratory, Southeast Forest Experiment Station. Macon GA. 23 p.

Labat Environmental. 2003. Human Health Risk Assessment: Wildland Fire-fighting Chemicals. Prepared for Missoula Technology and Development Center, USDA Forest Service, Missoula, Montana.

Labat Environmental. 2007. Ecological Risk Assessment: Wildland Fire-fighting Chemicals, prepared for Missoula Technology and Development Center, USDA Forest Service, Missoula, MT. 69 p.

McDonald, Susan F., Steven J. Hamilton, Kevin J. Buhl, James F. Heisinger. 1995. Acute toxicity of fire-retardant and foam-suppressant chemicals to Hyalella azteca (Saussure). Environmental Toxicology and Chemistry. 16(7):1370-1376.

Napper, Carolyn. 2011. Soils Specialist Report for Aerial Delivery of Fire Retardant Final EIS.

NIAC National Interagency Aviation Council. 2010. Interagency Aerial Supervision Guide, NFES 2544. 157 p.

Norris, L.A., C.L. Hawkes, W.L. Webb, D.G. Moore, W.B. Bollen, and E. Holcombe. 1978. A Report of Research on the Behavior and Impact of Chemical fire Retardants in Forest Streams. U.S. Forest Service, Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station. Corvallis OR. 287 p.

Plucinski, M., J. Gould, G. McCarthy, and J. Hollis. 2007. The Effectiveness and Efficiency of Aerial Firefighting in Australia, Part 1. Bushfire CRC Technical Report Number A0701. Ensis Bushfire Research; School of Forests and Ecosystems Science, University of Melbourne; Department of Environment and Conservation. 11 p.

Potts, Stephen. 2011. Personal communications regarding surface water quality standards.

Poulton, Barry, Steven Hamilton, Kevin Buhl, Nimish Vyas, Elwood Hill, and Diane Larson. 1997. Toxicity of Fire Retardant and Foam Suppressant Chemicals to Plant and Animal Communities, Final Report prepared for Interagency Fire Coordination Committee, Boise, Idaho.

Schonhuber, M., G. Lammer, M. Prechtl, and W.L. Randeu. 2005. Analysis of Fire Retardant 2DVD Data, Institute of Applied Systems Technology (IAS), Joanneum Research, Graz (Austria), in response to Order of Sep. 22, 2004, by Phoenix Design Engineering, McCall, ID.

US Congress. 2003. Healthy Forest Restoration Act.

US Congress. 2008. Food, Conservation, and Energy Act of 2008.

US District Court, District of Montana, Missoula, MT. 2010. Court Order CV-08-43-M-DWM FSEEE vs. USDA Forest Service, USDI Fish & Wildlife Service, and NOAA Fisheries. 80 p.

US President. 1994. Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.

US President. 1996. Executive Order 13007 Indian Sacred Sites.

USDA Forest Service. n.d. Standard Burn Test - Combustion Retarding Effectiveness Test, Test Method 2.

USDA Forest Service. 2007. Specification 5100-304c, Long-Term Retardant, Wildland Firefighting (amendments inserted into the text May 17, 2010).

SDA Forest Service. 2010. Nationwide Aerial Application of Fire Retardant on National Forest System Lands, Notice of Intent to prepare an Environmental Impact Statement.

USDA Forest Service, USDI Bureau of Land Management, Fish and Wildlife Service, National Park Service, and Bureau of Indian Affairs. 2000. Guidelines for Aerial Delivery of Retardant or Foam near Waterways. 2 p.

USDA Forest Service, USDI Bureau of Land Management, Fish and Wildlife Service, National Park Service, and Bureau of Indian Affairs. 2001. Urban Wildland Interface Communities within the Vicinity of Federal Lands That are at High Risk from Wildfire, Notice. Federal Register Vol. 66, No 3, pp. 751-777.

USDA Forest Service, USDI Bureau of Land Management, Fish and Wildlife Service, National Park Service, and Bureau of Indian Affairs. 2009. Guidance for Implementation of Federal Wildland Fire Management Policy, dated February 13, 2009.

USDI Fish and Wildlife Service. 2008. Final Biological and Conference Opinion on the USDA Forest Service's Application of Fire Retardant on National Forest System Lands.

Appendix R – New Aerial Application of Fire Retardant Direction

Appendix R – New Aerial Application of Fire Retardant Direction

To protect federally listed threatened endangered proposed candidate, and sensitive species (TEPCS), national forests and national grasslands that apply fire retardant using aircraft propose the implementation of the following direction:

- Aircraft Operational Guidance,
- Avoidance Area Mapping Requirements,
- Annual Coordination, and
- Reporting and Monitoring Requirements.

Aircraft Operational Guidance

Whenever practical, as determined by the fire incident, the Forest Service will use water, other suppressants, or the least toxic approved fire retardant(s) in areas occupied by TEPCS species and/or their designated critical habitat(s). Some species and habitats require that only water can be used to protect habitat and populations; these habitats and populations have been mapped as “avoidance areas.”

Incident Commanders and pilots are required to avoid aerial application of retardant on mapped avoidance areas for terrestrial TEPCS species or within 300 feet of waterways. This distance is based on the air tanker pilot’s reaction time and the speed of the airtanker, plus a safety factor. This allows time and distance that once the pilot saw the terrestrial avoidance area or waterway and reacted (by removing his thumb from the trigger), there would still be a safety buffer before the air tanker and its load reached the terrestrial avoidance area or waterway. After crossing the terrestrial avoidance area or waterway, the same guidelines applied before dropping the next part of the load.

This direction does not require the helicopter or airtanker pilots-in-command to fly in such a manner as to endanger their aircraft, other aircraft, or structures, or compromise ground personnel safety or the public. ***The only exception to this direction is when human life or safety is threatened and the use of retardant can be reasonably expected to alleviate the threat.***

The operational guidance for pilots to ensure retardant drops are not made within the 300-foot buffer of waterways or mapped avoidance areas for TEPCS species or waterways includes the following:

Medium/Heavy Airtankers, Single Engine Airtankers, and Helicopters

- Prior to fire retardant application, all pilots shall be briefed on the locations of all TEPCS species avoidance areas on the unit.
- Prior to aerial application of fire retardant, the pilot will make a “dry run” over the intended application area to identify avoidance areas and waterways in the vicinity of the wildland fire.
- When approaching mapped avoidance areas for TEPCS species or waterways or riparian vegetation *visible to the pilot,* the pilot will terminate the application of retardant approximately 300 feet before reaching the mapped avoidance area or waterway.
- When flying over a mapped avoidance area or waterway, pilots will wait 1 (one) second after crossing the far border of a mapped avoidance area or waterway before applying retardant.

- Pilots will make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant within the 300-foot buffer zone, or mapped avoidance area in order to avoid drift into protected areas.
- Pilots are provided avoidance area maps at all briefings, and attend required training to maintain necessary certifications to fly for the Forest Service fire program, which includes applying the operational guidelines.

Avoidance Area Mapping Requirements

Identified avoidance areas are:

- **Aquatic Avoidance Area:**
    - All waterways with a 300-foot buffer; this includes perennial streams, intermittent streams, lakes, ponds, identified springs, reservoirs, and vernal pools. Buffer areas may be adjusted for local conditions and coordinated with the U.S. Fish and Wildlife Service (USFWS) and NOAA Fisheries offices.

- **Terrestrial Avoidance Area:**
    - May be used to avoid impacts on one or more federally listed threatened, endangered, or proposed plant or animal species or critical habitat where aerial application of fire retardant may affect habitat and/or populations.
    - May be used to avoid impacts on any Forest Service terrestrial sensitive or candidate species where aerial application of fire retardant may result in a trend toward federal listing under ESA or a loss of viability on the planning unit.

The following protocols are for a standardized national map template of avoidance areas for TEPCS species.

- Use USFWS and NOAA Fisheries designated critical habitat layers when available.
- Use National Hydrograph Dataset (NHD) for mapping waterbodies to create aquatic avoidance areas.
- Use USFWS, NOAA Fisheries, and Forest Service species population and designated critical habitat information for occupied sites.
- All forests/ grasslands that have listed species will complete avoidance area maps in cooperation with local offices of FWS and NOAA Fisheries.
- Update maps annually in cooperation with FWS and NOAA Fisheries; to reflect changes during the year on additional species or changes made for designated critical habitat.
- A national map template for all revisions and databases will be maintained by U.S. Forest Service Geospatial Service and Technology Center, Salt Lake City, Utah.

Annual Coordination

The Forest Service will coordinate with local U.S. Fish and Wildlife Service and NOAA Fisheries offices annually or as needed to ensure that:

- Any updates that are needed for retardant avoidance areas on National Forest System lands are mapped using the most up-to-date information.
- Reviewing the *Aerial Application of Fire Retardant Direction* will be conducted with Forest Service biologists/botanists, fire management personnel, and line officers. Fire management personnel should include Type 4 and higher incident commanders (ICs), assistant fire management officers (AFMO), fire management officers (FMO), aviation managers, captains, battalion and division chiefs; or personnel responsible for ordering the aerial delivery of fire retardant during a wildland fire incident.

This annual review will include:

- Review aircraft operational direction,
- Review avoidance area maps,
- Review of reporting process for misapplications, and
- Review of monitoring process.

Aviation managers or appropriate personnel will brief pilots on avoidance area mapping and aircraft operational direction as needed.

- Pilots will be briefed prior to fire operations occurring.
- Sets of avoidance area maps for each national forest will be available through the forest's aviation officer, at tanker bases, at helibases, at dispatch fire manager offices and with all appropriate cooperators.

The Forest Service will coordinate with all personnel involved in fire suppression activities.

- Monitoring and reporting requirements will be discussed at annual incident management teams meetings, meetings with cooperators, and fire refresher courses.

Reporting and Monitoring

The Forest Service will report **all** misapplications within all avoidance areas utilizing national standard reporting forms. In addition the Forest Service will conduct the following reporting and monitoring items:

1. **Reporting of ALL Misapplications of Aerial Application of Fire Retardant**:

    a. Report occurrences at time of event during suppression activities.
    b. Determine if the exception for human life safety was used.
    c. Conduct assessment of impacts to species or habitats; to be done by qualified biological resources personnel; if adverse impacts are found, then:
    d. Determine if the misapplication has resulted in "take" and may have exceeded the incidental take statement for that species , designated critical habitat or Distinct Population Segment (DPS)

        i. Notify all FS units, FWS lead and NOAA Fisheries Lead, within the range of that species or the designated population segment, (DPS) that the misapplication has occurred and the extent of the effects.
        ii. Reinitiate consultation if take is exceeded.

iii. Restrict further use of aerial application of retardant in that area where the misapplication occured until the effects assessment is completed.
iv. If necessary, longer term restrictions on the use of aerial application of retardant will be determined in coordination with FWS and NOAA fisheries.

e. Report annually through national coordinator in Fire and Aviation Management and to USFWS/NOAA Fisheries.

2. **To determine if misapplication has occurred, the Forest Service will continue to monitor *all large fires* where aerial retardant is used and avoidance areas exist:**

a. Determine if exception for human life safety was used.
b. If misapplication is found, conduct assessment of impacts to species or habitats; to be done by qualified biological resources personnel; if adverse impacts are found, then:
c. Determine if the misapplication has resulted in "take" and may have exceeded the incidental take statement for that species , designated critical habitat or Distinct Population Segment (DPS)

i. Notify all FS units, FWS lead and NOAA Fisheries Lead, within the range of that species or the designated population segment, (DPS) that the misapplication has occurred and the extent of the effects.
ii. Reinitiate consultation if take is exceeded.
iii. Restrict further use of aerial application of retardant in that area where the misapplication occured until the effects assessment is completed.
iv. If necessary, longer term restrictions on the use of aerial application of retardant will be determined in coordination with FWS and NOAA fisheries.

d. Report annually through national coordinator in Fire and Aviation Management and USFWS/NOAA Fisheries.
e. Report annually through national TES species staff for compliance with Biological Opinions.

3. **In addition, to determine if misapplication has occurred, the Forest Service will monitor 5 percent of *all initial attack fires* less than 300 acres where aerial retardant is used and avoidance areas exist:**

a. Minimum monitoring of one fire per forest where aerial application of fire retardant was used, to determine if a misapplication of aerial fire retardant has occurred in designated avoidance areas or waterways that was not discovered or reported.
b. Determine if exception for human life safety was used.
c. Determine if the misapplication has resulted in "take" and may have exceeded the incidental take statement for that species , designated critical habitat or Distinct Population Segment (DPS)

i. Notify all FS units, FWS lead and NOAA Fisheries Lead, within the range of that species or the designated population segment, (DPS) that the misapplication has occurred and the extent of the effects.
ii. Reinitiate consultation if take is exceeded.

iii. Restrict further use of aerial application of retardant in that area where the misapplication occured until the effects assessment is completed.
iv. If necessary, longer term restrictions on the use of aerial application of retardant will be determined in coordination with FWS and NOAA fisheries.

d. Report annually through national coordinator in Fire and Aviation Management and USFWS/NOAA.
e. Report annually through national TES species staff for compliance with Biological Opinions.

4. **Follow-up Monitoring Process will:**

a. Determine the amount of follow-up monitoring necessary as dictated by the extent of the impacts to species or habitat identified during assessment of the misapplication.
b. Be conducted in coordination with local Forest Service/USFWS/NOAA Fisheries/USGS offices and appropriate state agencies.
c. Determine the type of recovery or restoration of species or habitats:

i. May include salvage of species during BAER activites
ii. May supplement established captive breeding programs until species can be re-introduced to the area impacted by the aerially applied fire retardant.

d. Additional assessment of cumulative effects for some species may need to be coordinated with certain agencies.
e. Reported annually through forest and national TES species staff for coordination with other agencies.

In addition, the Forest Service will:

- In coordination with USGS and NOAA Fisheries, continue existing research on the temporal lethal and sub□lethal effects of currently approved fire retardants on ocean□type chinook, as well as characterizing the temporal sublethal effects on stream-type chinook testing (in process).
- Provide NOAA Fisheries Headquarters' Office of Protected Resources and U.S. Fish and Wildlife Service Headquarters with a biannual summary (every 2 years) that evaluates the cumulative impacts (as the Council on Environmental Quality has defined that term pursuant to the National Environmental Policy Act of 1969) of their continued use of fire retardants including:

  (a) the number of observed retardant drops entering a waterway, in any sub-watershed and watershed;

  (b) whether the observed drops occurred in a watershed inhabited by listed resources;

  (c) an assessment as to whether listed resources were affected by the misapplication of fire retardants within the waterway; and

  (d) the Forest Service's assessment of cumulative impacts of the fire retardant drops within the sub-watershed and watershed and the consequences of those effects on listed resources. The evidence the Forest Service shall use for this evaluation would include, but is not limited to:

(i) the results of consultation with NOAA Fisheries and U.S. Fish and Wildlife Service regional offices and the outcome of the site assessment,

(ii) the results of new fish toxicity, and

(iii) any actions the Forest Service took or intends to take to minimize the exposure of listed fish species to fire retardants, and reduce the severity of their exposure.

The Forest Service will develop an *Implementation Handbook for the Reporting and Monitoring for Misappliactions of Aerially Applied Fire Retardant* providing direction and guidance at the local level.

Index

Document coordination, edit, and design by USDA Forest Service,
Ecosystem Management Coordination, Publishing Arts
http://www.fs.fed.us/emc/pa