Final Environmental Impact Statement
Freds Fire Reforestation

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For Information Contact: Robert Carroll
4260 Eight Mile Road
Camino, CA 95709
(530) 647-5386
www.fs.fed.us/r5/eldorado

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Final Environmental Impact Statement

El Dorado County, California

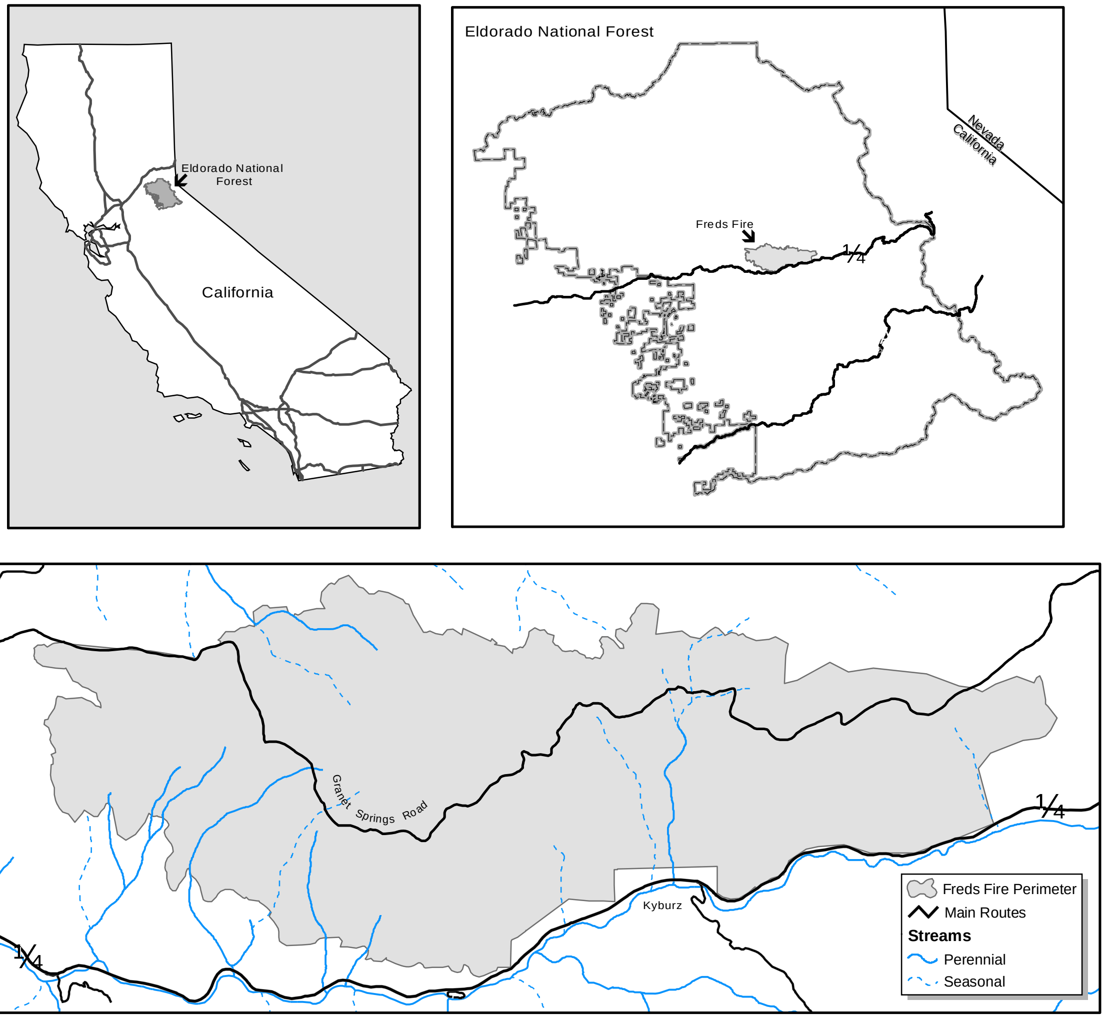
Lead Agency **USDA Forest Service**

Responsible Official **Ramiro Villalvazo, Forest Supervisor**
Eldorado National Forest
100 Forni Road Placerville CA 95667

For Information and Copies of the FEIS, Contact: **Robert Carroll, IDT Leader**
Placerville Ranger District
4260 Eight Mile Road, Camino CA 95709
(530) 647-5386

Abstract: *The Final Environmental Impact Statement (FEIS) documents the analysis of three alternatives for site preparation, planting of trees, release, fuel treatments, and invasive plant treatments on the Freds Fire on the Eldorado National Forest. Alternative 1 proposes site preparation, planting of trees, release, fuel treatments, and invasive plant treatments. Site preparation, release, and invasive plant treatments include the use of herbicides to control vegetation. Alternative 2 proposes no action. Alternative 3 proposes the same activities as Alternative 1, except that hand methods are proposed for site preparation, release, and invasive plant treatments, and fewer acres are proposed for planting and release. Alternative 3 emphaszes non-chemical methods.*

Vicinity Maps



Summary

Introduction

The Freds Fire was reported in the late afternoon of October 13, 2004, on the north side of Highway 50 approximately 1½ miles east of the communities of Silver Fork and Kyburz, in El Dorado County.

After ignition, the fire quickly spread across extremely steep slopes, burning through timber and heavy fuels. The fire burned rapidly in a westerly direction, parallel to Highway 50, driven by strong east winds. Highway 50 was closed immediately, the communities of Silver Fork and Kyburz were evacuated, and suppression efforts focused on protecting the towns and their infrastructure. The fire burned approximately 7,560 acres on the Eldorado National Forest (ENF) and on private timberlands.

The fire burned with varying intensity. Many areas of the fire burned at high and moderate intensity, killing 75%-100% of the trees and burning the duff and litter that protects the soil. In these areas, the fire resulted in high rates of soil erosion, sedimentation to streams, destruction of wildlife habitat for sensitive species, and loss of old forest. Subsequent to the fire, the ENF prepared an environmental impact statement (EIS), the Freds Fire Restoration FEIS and Record of Decision (ROD), signed August 1, 2005, to address long-term fuel loading, dead tree removal, road repair and public safety (USDA 2005a). Dead and dying trees were removed from the project area during the summer and fall of 2005.

Three decision memos were prepared to replant burned Cleveland Fire plantations and to begin initial planting on a portion of the harvested areas. About 1,868 acres have been planted.

The project area for this analysis is the approximeK

Table 1. Land Allocations and Desired Conditions (SNFPA ROD, pgs. 45-48)

Land Allocation	Desired Conditions	Management Intent	Management Objectives
Old Forest Emphasis Areas	Forest structure and function generally resemble pre-settlement conditions. High levels of horizontal and vertical diversity exist within 10,000 acre landscapes. Stands are composed of roughly even-aged vegetation groups, varying in size, species composition, and structure. Individual vegetation groups range from less than 0.5 to more than 5 acres in size. Tree sizes range from seedlings to very large diameter trees. Species composition varies by elevation, site productivity, and related environmental factors. Multi-tiered canopies, particularly in older forests, provide vertical heterogeneity. Dead trees, both standing and fallen, meet habitat needs of old-forest-associated species. Where possible, areas treated for fuels also provide for the successful establishment of early seral stage vegetation.	Maintain or develop old forest habitat in: areas containing the best remaining large blocks or landscape concentrations of old forest and/or areas that provide old forest functions (such as connectivity of habitat over a range of elevations to allow migration of wide-ranging old-forest-associated species). Establish and maintain a pattern of area treatments that is effective in: modifying fire behavior. culturing stand structure and composition to generally resemble pre-settlement conditions. reducing susceptibility to insect/pathogen drought-related tree mortality. Focus management activities on the short-term goal of reducing the adverse effects of wildfire. Acknowledge the need for a longer-term strategy to restore both the structure and processes of these ecosystems.	Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior. Maintain and/or establish appropriate species composition and size classes. Reduce the risk of insect/pathogen drought-related mortality by managing stand density levels. Design economically efficient treatments to reduce hazardous fuels.
WUI *Threat Zones*	Under high fire weather conditions, wildland fire behavior in treated areas is characterized as follows: Flame lengths at the head of the fire are less than 4 feet. The rate of spread at the head of the fire is reduced to at least 50% of pre-treatment levels. Hazards to firefighters are reduced by managing snag levels in locations likely to be used for control in prescribed fire and fire suppression, consistent with safe practices guidelines. Production rates for fire line construction are doubled from pre-treatment levels.	Threat zones are priority area for fuels treatments. Fuels treatments in the threat zone provide a buffer between developed areas and wildlands. Fuels treatments protect human communities from wildland fires as well as minimize the spread of fires that might originate in urban areas. The highest density and intensity of treatments are located within the WUI.	Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior. Design economically efficient treatments to reduce hazardous fuels.

Land Allocation	Desired Conditions	Management Intent	Management Objectives
WUI *Defense Zones*	Stands are fairly open and dominated primarily by larger, fire tolerant trees. Surface and ladder fuel conditions are such that crown fire ignition is highly unlikely. The openness and discontinuity of crown fuels, both horizontally and vertically, result in very low probability of sustained crown fire.	Protect communities from wildfire and prevent the loss of life and property. WUI defense zones have highest priority for treatment (along with threat zones). The highest density and intensity of treatments are located within the WUI.	Create defensible space near communities, and provide a safe and effective area for suppressing fire. Design economically efficient treatments to reduce hazardous fuels.
California spotted owl and northern goshawk PACs	At least two tree canopy layers are present. Dominant and co-dominant trees average at least 24 inches dbh. Area within PAC has at least 60 to 70 percent canopy cover. Some very large snags are present (greater than 45 inches dbh). Levels of snags and down woody material are higher than average.	Maintain PACs so that they continue to provide habitat conditions that support successful reproduction of California spotted owls and northern goshawks.	Avoid vegetation and fuels management activities within PACs to the greatest extent feasible. Reduce hazardous fuels in PACs in defense zones when they create an unacceptable fire threat to communities. Where PACs cannot be avoided in the strategic placement of treatments, ensure effective treatment of surface, ladder, and crown fuels within treated areas. If nesting or foraging habitat in PACs is mechanically treated, mitigate by adding acreage to the PAC equivalent to the treated acreage wherever possible. Add adjacent acres of comparable quality wherever possible.
HRCAs	Within home ranges, HRCAs consist of large habitat blocks having: at least two tree canopy layers. at least 24 inches dbh in dominant and co-dominant trees. a number of very large (>45 inches dbh) old trees. at least 50-70% canopy cover. higher than average levels of snags and down woody material.	Treat fuels using a landscape approach for strategically placing area treatments to modify fire behavior. Retain existing suitable habitat, recognizing that habitat within treated areas may be modified to meet fuels objectives. Accelerate development of currently unsuitable habitat (in non-habitat inclusions, such as plantations) into suitable condition. Arrange treatment patterns and design treatment prescriptions to avoid the highest quality habitat (CWHR types 5M, 5D, and 6) wherever possible	Establish and maintain a pattern of fuels treatments that is effective in modifying wildfire behavior. Design treatments in HRCAs to be economically efficient and to promote forest health where consistent with habitat objectives.

Purpose and Need for Action

The purpose and need for this project is to further the restoration of the area impacted by the Freds Fire of 2004. This fire resulted in adverse effects to forest resources such as soil, riparian areas, and wildlife habitat, and caused extensive tree mortality. Removal of most of the fire-killed trees occurred in 2005. Some live and dead trees remain, distributed across the landscape as described in the Freds Fire Restoration FEIS. Without additional treatment to restore the fire area, additional impacts are likely over the short and long term.

There is a Need to Reestablish a Forested Landscape.

Reforestation programs have many objectives, such as improving timber yields, soil protection, improving visual quality, and improving wildlife habitat. One of the primary objectives of the Freds Fire Reforestation Project is to move the project area from its existing condition toward desired future conditions (Table 1) as defined by the Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement and Record of Decision.

As a result of the fire, much of the project area has reverted from mid- and late-seral forest conditions to early-seral conditions. In the lower elevations, existing oak sprouts have the potential to develop into oak stands or the oak component of mixed conifer/oak stands. Natural regeneration is sparse over the moderate and high intensity burn areas. To achieve the desired conditions described above, it is important to begin the reestablishment of a forested landscape.

Initial tree planting has occurred on about 1,870 acres, however, the seedlings have not been established. Planted trees encounter many barriers to establishment early in their life and cannot be considered established upon planting. Seedling mortality is high, the result of lack of adequate moisture, with third year seedling survival at about 40 percent, and declining. One third (35 percent) of the planted acres are stocked at a level below 100 trees per acre; and mortality is continuing. Thus, establishment needs to be evaluated several years after planting.

There is a Need to Reestablish this Forested Landscape Effectively and Economically

The purpose is to effectively and economically control the establishment and growth of shrubs and other competing vegetation that could persist for the long term, negatively affecting both planted and natural seedling survival and inhibiting tree growth, delaying the achievement of the SNFP desired condition.

In the short term there is a need to insure that sufficient young seedlings of a variety of species survive and grow, to provide for the future attainment these desired conditions. Controlling competing vegetation directly influences the attainment of these objectives by enabling sufficient young conifer seedlings of a variety of species to survive long moisture free summers; and by reducing moisture stress on surviving conifer seedlings so that they grow more vigorously.

The Forest Service in Region 5 has extensive experience, a large body of research and numerous long-term studies (ranging from 10-31 years) that clearly establish the efficacy of herbicide release to improve conifer survival, growth and development. According to the findings of the National Administrative Study: Alternatives Methods of release, herbicides far more cost-effective than hand grubbing or hand cutting, and yield the longest-lasting results on established shrubs (Abstracts of presentations, 26th Forest Vegetation Management Conference, 2005). Prior to 1989, when herbicide use was made available by the Region 5 Vegetation Management for Reforestation FEIS and ROD (USDA 1989), non-chemical methods for reforestation and noxious weed control have been analyzed and utilized in the past on the ENF.

The FEIS for Vegetation Management for Reforestation, pages 1-4 to 1-5 states:

> *Within the forest environment, plants compete with each other for sunlight, soil moisture and nutrients, and space. In California forests, because of the long dry season during late spring, summer, and early fall, the competition is primarily for soil moisture. Root and shoot growth generally is limited by moisture availability within plant tissues, temperature, nutrients, and energy (gained through photosynthesis). The major growth period for roots and shoots usually occurs in the spring because all conditions for growth are met. Growth ceases during the dry season when levels of soil moisture are so low that the plant cannot take up enough moisture to continue growth. Excessive moisture stress in conifers, caused by the long dry period and reductions in available soil moisture by competing plants, is the most frequent cause of insufficient growth and mortality in small conifers. Thus control of competing vegetation is needed in the commercial timber lands of the Region* [including the Eldorado National Forest].

While the above statement was primarily made regarding a timber yield objective, when seedling survival and growth are needed to accomplish other objectives, a seedling's physiological needs for sunlight, soil moisture and nutrients, and space remain the same. As a practical measure, a short-term silvicultural goal is to keep competing vegetation levels below twenty percent (total live ground cover) for a period of two to three years after planting. This objective is based on plantation studies in California which have shown that levels below 20-30 percent crown cover are necessary to maintain seedling survival and growth (refer to McDonald and Fiddler, 1989).

Currently the establishment of grasses, shrubs, and other vegetation, while variable, averages 65 percent cover over the analysis area. Establishment of greater than 20 to 30 percent cover of vegetation presents a potential lethal environment to conifer seedlings as demonstrated by current third year seedling survival rates of 40 percent.

Examination of the areas planted in the project area indicate that adequate survival and growth are threatened by competing vegetation. Management of competing vegetation is essential to assure continued survival and growth of the remaining conifers and to allow planting /interplanting in units currently not meeting the marginal stocking levels needed (100 TPA) to meet desired future conditions.

There is a need to control competing vegetation that greatly affects tree growth rates. Control of competing vegetation would increase conifer growth rates. Increased growth would accelerate the development of key habitat and old forest characteristics and reduce the risk of loss to wildland fire (SNFP ROD, page 49). Annual height growth of planted conifers in the Freds Fire, measured on several representative units, ranges from about 0.3 feet to 0.5 feet per year, while total tree height averages about 0.75 feet on one year old trees to about 1.7 feet for three year old trees, well below the potential for this site.

There is a need to reestablish this forested landscape economically. Treatments in the reforestation process may include, but are not limited to, site preparation, planting, interplanting, and release. Each treatment expends funds and can vary widely by treatment method and site conditions. For example planting in dense brush, if not unfeasible, is much more expensive than planting open ground. Replanting or interplanting, because of plantation failure, can be much more expensive than initial planting, depending on the vegetation type and densities present. Costs vary on the method of release, and the number of times an operation must be repeated. Not only do herbicide methods cost less than hand release/hand cutting methods, but they typically do not need to be repeated as many times.

There is a Need to Reduce Short Term Fuels Loading for the Purpose of Reducing the Intensity and Severity of Future Fires

As a result of the Freds fire, surface fuel loading was reduced to very low levels in areas where the fire intensity was moderate to high. The ensuing establishment of grasses, shrubs, and other vegetation is quite variable over the analysis area, and is expected to reach high levels (70 to 90 percent cover) within two to three years.

Establishment of this brush cover over large areas would increase the ability of wildland fires to become large in the future (> 25 years) as the dead component in the vegetation increases. Vegetation development influences potential fire behavior. Immediately post fire (< 5 year) vegetation is dominated by grass followed by a grass/shrub model (5 to 10 years, near future). These types of vegetation develop fires with high rates of spread, but little resistance to control. After this period, the mid future, woody brush will begin to dominate a majority of the area. The young brush, with small diameters and lack of a dead material component, tends to hinder fire intensity and spread for a 10 to 25 year period. After about 25 years (the future), as the dead component of this vegetation increases with time, the probable rates of spread match those of the grass in early development but with far greater intensity, flame lengths and resistance to control risk of a large wild fire increases. Thus, the risk of a large wild fire increases.

Reducing fuels, within the defense and threat zones, to reduce wildfire spread and intensity is a main goal for the Wildland Urban Intermix (WUI) (SNFP ROD, pg 34). Reducing fuels early, while they are small and have low biomass is the most effective way to change the fuels arrangement and reduce the intensity and severity of a future fire (SNFP ROD, pg.49). Early treatments afford the best opportunity to maintain the current low fuel load over time and provide protection during the early stages of stand development. Promoting tree growth while controlling shrub establishment can shorten the timeframe for stands within the project area to develop into fire resistant stands.

The threat of a large wildfire occurring along Highway 50 in the South Fork American River corridor within 5 to 10 years is high. The potential for a wildfire start is high due to proximity to the large number of travelers along Highway 50, a Pacific Gas and Electric Company (PG&E) distribution line that runs through the canyon, residential development, recreational use, and lightning. Some of these starts develop into large wildfires. The Highway 50 corridor has had four large wildfires within the last 31 years, the Pilliken Fire (1973), Wrights Fire (1981), Cleveland Fire (1992) and Freds Fire (2004). The Freds Fire burned into the Cleveland Fire perimeter on the west side and into the Wrights Fire on the east side.

Many factors contribute to fire size, and many, such as weather, slope, and aspect, can not be controlled. Managing fuels is the only way we have to affect fire behavior. Fuel was managed on the 1992 Cleveland Fire, in conjunction with vegetation management for plantation establishment. In 2002, the St. Pauli Fire burned within the 24,000 acre Cleveland fire and burned relatively few acres (234 Forest Service) before it was controlled. In the St Pauli fire area, the vegetation complex was best characterized as fuel model GR 4. The fire was characterized by high rates of spread, but was controlled on the mid-slope at a relatively small size due to this models' rapid reaction to environmental conditions (increased nighttime humidity) and increased line production rate possible in this fuel model. The St Pauli Fire demonstrates the effectiveness of the fuel treatments implemented in the Cleveland fire area..

Fire behavior modeling of timber stands and fuel types that are representative of potential conditions in the future indicates that high intensity fire with rapid rates of spread and high resistance to control would be likely under moderate weather conditions (temperatures above 80 degrees, light winds, and relative humidity less than 25%). Without additional treatments to reduce brush and other vegetation, and decrease resistance to control, large and difficult to control wildfires will once again threaten the residents of Silverfork and Kyburz, and the other private landowners in this area.

There is a Need to Restore Spotted Owl Travel Corridors Between Owl PACs

The Freds Fire burned at high and moderate severity in over 70 percent of the project area. This resulted in high levels of tree mortality destructing wildlife habitat for spotted owls. Currently early seral vegetation exists in the project area, which hinders spotted owl movement between PACs. Restoring linkages between neighboring PACS would allow for owl dispersal, and would include contiguous habitat of larger trees with moderate to high canopy cover where site conditions allow.

There is a need to control yellow starthistle and eliminate tall white top in the project area to reduce the potential for spread of these invasive plants to other areas of the Forest

The SNFP ROD (page 36) states that the goals for noxious weed management are to manage weeds using an integrated weed management approach including: prevent the introduction of new invaders, conduct early treatment of new infestations, and contain and control established infestations. Two invasive plants are known to occur in the project area; yellow starthistle and tall whitetop.

Tall whitetop occurs in one location in unit 609-41; it occupies less than ¼ acre. There is a need to conduct early treatments of this small infestation of tall whitetop, to eliminate it from the project area.

Yellow starthistle is established along and outward up to 100 feet from some existing Forest roads (11N38, 11N38A, 11N38G, 11N38K, 11N42, and 11N42D) and unnamed trails in Units 609-33 and 613-6, 7, 22, 25, 26, 35, 37, 38, and 47, occupying 72 gross acres in the project area. There is a need to contain and control the established infestation of yellow starthistle to reduce the potential for spread of yellow starthistle to other areas of the Forest.

Public Involvement

The Notice of Intent to prepare an Environmental Impact Statement was published in the Federal Register April 13, 2006. It included an announcement of a Freds Fire Reforestation public meeting, on May 9, 2006. A brief description of the location and type of project was included in the ENF Schedule of Proposed Actions in July 2006. Scoping letters detailing the proposed action and an invitation to a Freds Fire Reforestation open house, on May 24, 2006, were sent to approximately 74 adjacent property owners; potentially affected businesses; federal, state, and local agencies; and special interest groups. As a result of scoping, five individuals responded with comments. Significant issues were raised and an alternative to the proposed action was developed. The Notice of Availability of the Draft Environmental Impact Statement (DEIS) was published in the Federal Register September 11, 2009. The DEIS/project summary was sent to 43 individuals, organizations, tribes, and government agencies. The 45-day comment period ended on October 26, 2009. 21 comment letters were received.

Issues and Alternatives

After reviewing the public scoping comments, the Deciding Officer approved the following significant issues to generate alternatives:

Proposed use of herbicides represents an unknown or unacceptable risk to humans, wildlife, and the environment. Some individuals expressed concerned about the risks associated with the proposed pesticide use to workers and the general public, including Native American plant gatherers. They are very concerned with the hazards created by pesticides in regards to native plants, especially rare and listed flora, amphibians, birds, fish, insects, and soil microorganisms.

Proposed use of herbicide would leave standing dead brush that would pose an immediate fire hazard. Some members of the public were concerned that following herbicide application, much of the existing plant material will die-off and result in substantial dead organic matter on site. This presents a significant fire danger. If the vegetation is left standing, it will become significantly dry and pose an immediate fire hazard. In addition, they are concerned that dead shrubs left standing after spraying, combined with expected cheatgrass proliferation due to herbicide spraying, will mean increased risk of large stand replacing fires that may wipe out reforestation groups and plantations, rendering this project a waste of time and tax payer money. The dead brush, and expected proliferation of cheatgrass and other invasive grasses, could result in fires that would kill the planted seedlings. They suggested an alternative that included cutting unwanted brush, either mechanically, or by hand, leaving it on the ground to discourage new brush growth and noxious weed invasion, and restocking the area the following planting season.

Proposed herbicide use could contaminate water. Some members of the public were concerned about the potential of the proposed action to contaminate water and its effect on water quality.

Proposed use of herbicides could create conditions more hospitable to invasive species and undesirable weeds than were present before the chemicals were applied. McDonald and Everest (1996) found that invasive cheatgrass populations, not observed in the study plots at the beginning of a study, increased more in herbicide-treated plots during a vegetation management study comparing herbicides and non-chemical means of reducing unwanted shrubs. Herbicide treated plots ended the four year study with 743,667 cheatgrass plants per acre with 22% foliar cover, where cheatgrass was 6 times greater in number of plants and more than 7 times greater in foliar cover than in the non-herbicide control plots (130,300 plants per acre, 3% foliar cover). It appears that the invasive cheatgrass was colonizing ground cleared by herbicides.

These issues led the Forest Service to develop alternatives to the proposed action.

Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative.

Alternative 1 is the Proposed Action. Under this alternative about 3,320 acres would be reforested, including initial planting of conifer seedlings on 1,322 acres and replanting or interplanting areas where seedling mortality threatens plantation failure. Currently, about 665 acres would be replanted or interplanted. Herbicides would be used to control vegetation on about 3,320 acres and control or eliminate invasive plants. Herbicides would be applied using ground-based methods, and would include glyphosate, triclopyr, hexazinone, clopyralid, and chlorsulfuron. A combination of broadcast and radial treatments would be used. Oaks would be avoid during planting and protected during release treatments. Non-herbicide zones of varying widths would be implemented adjacent to streams and special aquatic features. Mechanical fuel treatments would be conducted on about 388 acres near the town of Kyburz.

Alternative 2 is the No Action Alternative. Under this alternative no reforestation, release, invasive plant, or fuel treatments would occur. Management activities with existing decision documents would continue to be implemented, which includes 1,868 previously planted acres.

Alternative 3 is similar to Alternative 1 except that 800 fewer acres would be reforested, and non-chemical methods would be used for invasive plant treatments and conifer release.

Comparison of Alternatives: Key Resource Areas

Direct, indirect, and cumulative effects were addressed for each resource area potentially affected by the project. Following is a summary of these effects.

Fire/Fuels

Alternative 1 would create a mosaic of fuel profiles in the project area. Areas treated with herbicides would be maintained into the future (25+ years) at a stage best described by fuel models GR4 and GS2, which are characterized by high to very high rates of spread, and moderate to high flame lengths. While these areas would have a greater spread rate, the resistance to control would be conversely less, meaning that fires would be able to be controlled at a small size. These fuel models also show a greater reaction to live fuel moisture, which means that throughout the majority of the year any fires will be relatively easy to control. The increased ability of fire suppression under this alternative provides the greatest probability of seedling survival. While any small conifer within a likely fire will probably not survive, the ability to contain fires at a smaller size increases the probability of seedling survival across the landscape.

Untreated areas, such as snag patches, low mortality areas, and riparian corridors, would provide areas of least fire spread in the near and mid future (5 to 25 years) as they progressed toward a fuel model SH7, characterized by high spread rates and very high flame lengths. These would aid to limit fire spread in this time period.

Brush would be treated while it is relatively small, so that any contribution to the fuel load of standing dead brush would also be small. These brush skeletons would likely fall over from breakage and/or be crushed by snow during the first or second winter.

Alternative 2 would develop a fuel complex with rapid rates of spread, but little resistance to control (GR4, GS2) across the landscape in the short-term (5-10 years). In the mid future (10-25 years) a fuel complex characterized by low rates of spread and low flame lengths would develop. In the longer term, over a period of 25 years, a fuel complex with rapid rates of spread and a higher resistance to control (SH7) would develop across the landscape. This fuel complex would make the deployment of suppression resources on ridgetops dangerous and ineffective. It would also decrease the effectiveness of suppression resources behind the town of Kyburz, putting this community at risk.

Fire history shows that the area would likely experience a disturbance in the form of a large fire within the next 25 years. Given the fuel conditions in this alternative the effects of this fire would be stand replacing. These circumstances could allow the shrub stages persist indefinitely

Alternative 3 would develop, across the landscape, fuel complexes similar to Alternative 2. Hand treatments around seedlings would have little, if any, effect on the fuels and their development over time as changes to fuels from hand grubbing would be discontinuous and over such a small percentage of the area that these treatments would not change fire behavior substantially from Alternative 2. Thus, this alternative has the same effects as Alternative 2.

Vegetation:

Alternative 1 would result in the establishment of a forested landscape on 80 to 90 percent of the 3,320 acres proposed for treatment. Stand growth would be the highest under this alternative, with trees reaching 75 feet in height and 20 inches in diameter by age 50, reducing the probability of fire-induced mortality associated with smaller trees. Large trees (> 24 inches) would develop in 80-90 years.

Species and structural diversity within stands would be conserved as heritage resource, sensitive plant areas, areas that burned with low intensity in the Freds Fire, and snag patches left untreated in the Freds Fire Restoration EIS would not be reforested or released. Small patches of early seral vegetation within stands would provide diversity. Hardwoods would be protected and become part of the tree species mix. Areas with a high concentration of surviving or sprouting oaks would maintain a large abundance of oaks. Natural variations such as surviving conifers, rock outcrops, and riparian areas contribute to diversity, as would small patches of early seral vegetation within units. In addition, there would be no herbicide treatment zones for varying widths adjacent aquatic features. Species in the outer part of these zones, especially along ephemeral and seasonal streams, would resemble those of the rest of the unit and would contribute to structural diversity. In the inner portion of these zones, adjacent to live streams, species with high moisture requirements, such as alder, dogwood and willow, would not be treated, contributing to species diversity.

Over the short-term, plant abundance, including culturally important plants, may be affected by herbicide treatments, but no plant species would

Alternative 3 would protect documented occurrences of sensitive plants through avoidance. Direct effects may occur to undiscovered individuals or occurrences of sensitive species located outside the flagged boundaries. However, effects would be on fewer acres than Alternative 1, and is not likely to lead toward a loss of viability or possible federal or state listing for those sensitive plant species. Short term indirect effects from increased competition with invasive plants would be reduced due to greater cover of native vegetation reducing spread of invasive pants. Longer term indirect effects would be similar to Alternative 2.

Economics

Alternative 1 is expected to have $762 per acre in reforestation costs and produce about 4,900 person days of employment opportunities. Alternative 2 would have no reforestation cost and produce no employment opportunities. Alternative 3 is expected to have $1,906 per acre in reforestation costs, and produce about 15,600 days of employment opportunities, for 800 less acres reforested.

Soils

Soil quality standard would be met under all the alternatives. Herbicide treatments in Alternative 1 would decrease vegetative growth in the short term, but soil cover would be sufficient to protect against soil loss. Short persistence times for herbicides would prevent accumulation of these chemicals in the soil profile. Alternative 2 would produce more vegetative growth and have higher soil cover than Alternative 1. Soil cover and soil loss under Alternative 3 would be similar to Alternative 1, as soil disturbance from hand grubbing would affect a small area, with higher soil cover over the remaining area.

Hydrology, Aquatics

Total water yield may decrease more slowly under Alternatives 2 and 3, the result of faster forest growth under Alternative 1. Alternatives 1 and 3 may physically disturb western pond turtles in suitable habitat through crushing during planting and mastication activities. Potential effects from a large wildfire, a higher risk in Alternatives 2 and 3, include a short term degradation of water quality and aquatic habitat, depending on the severity and extent of a fire.

Wildlife

Alternative 1 will potentially start to provide foraging habitat for spotted owls sooner than the other alternatives. Faster development of oaks and conifers will provide roosting habitat for bats in the long term. Reduction in shrubland habitat will reduce habitat for fox sparrows in the short term. Mountain quail habitat will benefit from increase in early and mid seral coniferous habitat in the short term, but reduced habitat long term as stands mature.

Alternative 2 will delay the development of foraging habitat for spotted owls in already planted areas. Unplanted areas may not provide foraging habitat within 150 years. Foraging habitat for bats will be reduced as montane chaparral matures, reducing prey species associated with open ground. Oaks will provide roosting habitat for bats in the long term. Shrubland habitat will be maintained for fox sparrows. There will be no effects on early and mid seral coniferous habitat associated with Mountain quail.

Alternative 3 will delay the development of foraging habitat for spotted owls in planted areas. Areas remaining unplanted would develop as in Alternative 2. Foraging habitat for bats would be maintained longer than Alternative 1. Oaks and conifers will provide roosting habitat for bats in the long term. Shrubland habitat will be reduced for fox sparrows, but to a lesser extent than Alternative 1. Early and mid seral coniferous habitat associated with Mountain quail would develop on fewer acres than Alternative 1.

Comparison of Alternatives

Indicator Measure		Alternative 1 Proposed Action	Alternative 2 No Action	Alternative 3
Purpose and Need				
Reestablish a forested landscape				
Acres certified with adequate stocking by age five to ten		2,650-3,000	350-600	600-1,100
Reestablish this forested landscape effectively and economically				
Acres with competing vegetation levels below twenty percent (total live ground cover) for a period of two to three years after planting		Would meet goal on about 3,320 acres	None	Would meet goal within critical 5-foot circle around trees on about 2,460 acres, but would not meet short-term goal in units as a whole.
Growth (height and diameter (DBH)) at age 15 and 50	Age 15	Height - 22 feet Diameter - 6.4 inches	Height - 10 feet Diameter - 2.7 inches	Height - 11 feet Diameter - 3.1 inches
	Age 50	Height - 74 feet Diameter - 20 inches	Height - 35 feet Diameter - 9.4 inches	Height - 40 feet Diameter - 10.8 inches
Cost (total and per acre)		$2,530,000 or $762 per acre.	0	$4,688,000 or $1,906 per acre.
Reduce short term fuels loading				
Flame lengths in 90th percentile weather conditions.		0-5 years – 7.3 feet 5-10 years – 5.4 feet 10-25 years - 5.4 feet 25+ years – 5.4 feet	0-5 years – 7.3 feet 5-10 years – 5.4 feet 10-25 years -5.5 feet 25+ years – 15.1 feet	Same as Alternative 2
Percentage of the area in grass or grass/shrub fuel model		Age 0-5 Grass Fuel model over 100% Age 5- 25+ Grass/shrub Fuel model over 85%	Age 0- 5 Grass Fuel model over 100% Age 5- 10 Grass/shrub Fuel model over 100% Age 10-25+ Shrub Fuel model over 100%	Same as Alternative 2
Restore spotted owl travel corridors between owl PACs				
Years to achieve spotted owl foraging and nesting habitat as described by CWHR types 4M/4D/5M/5D, where site conditions allow		Planted acres 4M/4D – 50 years 5M – 80 years 5D - 80 years	Planted acres 4M/4D - 150 years 5M - 150 years 5D - >150 years Unplanted acres unlikely to achieve 4M/4D/5M/5D within 150 years due to < 40% crown closure	Planted acres 4M/4D - 110 years 5M – 115 years 5D - >150 years Unplanted acres unlikely to achieve 4M/4D/5M/5D within 150 years due to < 40% crown closure

Indicator Measure	Alternative 1 Proposed Action	Alternative 2 No Action	Alternative 3
Control yellow starthistle and eliminate tall white top			
Containment of current yellow starthistle population or decreasing in size	Yes	No - yellow starthistle would continue to spread limited only by environmental factors.	No - hand methods are unlikely to be successful because of the size of the yellow starthistle infestation
Elimination of tall whitetop population	Yes	No	Yes
Issues			
Herbicides represents an unknown or unacceptable risk to humans, wildlife, and the environment.			
Risk to human health and safety, based primarily on Hazard Quotients (HQ), measured by comparing the estimated level of exposure (dose) to the Reference dose (RfD) or some other index of acceptable exposure	**Workers**: Low risk to workers. **Public:** Low risk to public. Under normal conditions, members of the general public should not be exposed to substantial levels of any of these herbicides.	No risk from herbicide use	No risk from herbicide use
Risk to wildlife, aquatic, and plant species, based primarily on Hazard Quotients (HQ), measured by comparing the estimated level of exposure (dose) to the No Observed Effect Level (NOEL), No Observed Effect Concentration (NOEC) or some other index of acceptable exposure	Culturally Important Plants		
	Plant abundance may be affected short-term, but no plant species would be eliminated, except tall whitetop. Long-term, culturally important plants that favor open conditions would be enhanced	Plant abundance would be unaffected short-term. Long-term, culturally important plants that favor open conditions could be negatively affected	Plant abundance would be unaffected short-term. Long-term, culturally important plants that favor open conditions could be negatively affected
	Wildlife, Aquatic, and Plant Species		
	Plant species -Little or no damage to sensitive plants from herbicide drift or runoff expected **Aquatic and Terrestrial Species -** Low overall risk (HQ<1) using project design features **Accidental Spill** –Some risk to surrogate species and algae. Project design features (BMPs) prevent or reduce effects of a spill	No risk from herbicide use	No risk from herbicide use

Indicator Measure	Alternative 1 Proposed Action	Alternative 2 No Action	Alternative 3
Proposed use of herbicide would leave standing dead brush that would pose an immediate fire hazard			
Fuel model in immediate future (< 5 years)	GR4 – standing dead brush contribution to fuel load would be small because of relatively small size when treated and would be short-term (1-2 years)	GR4 – no standing dead brush	GR4 – no standing dead brush
Proposed herbicide use could contaminate water			
Levels of herbicides that may be detected as compared to existing guidelines	Short-term: Herbicides (and surfactants and additives) may reach streams under several worse-case scenarios. These concentrations would be below Maximum Contaminant Levels for humans. Long-term: No herbicides in streams **Aquatic and Terrestrial Species -** Low overall risk (HQ<1) using project design features **Accidental Spill** –Some risk to surrogate species and algae. Project design features (BMPs) prevent or reduce effects of a spill	None - no herbicide use	None - no herbicide use
Proposed use of herbicides could create conditions more hospitable to invasive species and undesirable weeds than were present before the chemicals were applied			
Risk of increasing spread of invasive plants in the project area	Short-term: (<5 years) Increased risk of invasive plant invasion with broadcast herbicide treatments. Reduced risk of invasive plant invasion on 510 acres of radial treatments around documented infestations of yellow starthistle and cheatgrass. Long-term: (> 20-25 years) Reduced risk of invasive plant spread with the establishment of a forested landscape.	Short-term: Persistence in openings, but spread unlikely due to shrubs dominating site Long-term: A higher risk of a large-scale high severity fire would potentially facilitate invasion plant expansion in open ground created such a fire.	Short-term: Persistence in openings and radial treatment areas, but spread unlikely due to shrubs dominating site Long-term: Similar to Alternative 2.

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Chapter 1
Purpose, Need, and Proposed Action

Introduction

The Freds Fire was reported in the late afternoon of October 13, 2004, on the north side of Highway 50 approximately 1 1/2 miles east of the communities of Silver Fork and Kyburz, in El Dorado County. After ignition, the fire quickly spread across extremely steep slopes, burning through timber and heavy fuels. The fire burned rapidly in a westerly direction, parallel to Highway 50, driven by strong east winds. Highway 50 was closed immediately, the communities of Silver Fork and Kyburz were evacuated, and suppression efforts focused on protecting the towns and their infrastructure. The fire burned approximately 7,560 acres on the Eldorado National Forest (ENF) and on private timberlands.

The fire burned with varying intensity. Many areas of the fire burned at high and moderate intensity, killing 75%-100% of the trees and burning the duff and litter that protects the soil. In these areas, the fire resulted in high rates of soil erosion, sedimentation to streams, destruction of wildlife habitat for sensitive species, and loss of old forest. Subsequent to the fire, the ENF prepared an environmental impact statement, the Freds Fire Restoration Final Environmental Impact Statement (FEIS) and Record of Decision (ROD), signed August 1, 2005, to address long-term fuel loading, dead tree removal, road repair and public safety (USDA 2005a). Dead and dying trees were removed from the project area during the summer and fall of 2005.

Three decision memos were prepared to replant burned Cleveland Fire plantations and to begin initial planting on a portion of the harvested areas. About 1,868 acres have been planted.

The project area for this analysis is the approximately 4,320 acre portion of the Freds Fire that is within the Placerville and Pacific Ranger District administrative boundaries of the ENF, in El Dorado County, California.

The Sierra Nevada Forest Plan Amendment Record of Decision (SNFPA ROD, USDA 2004b) land allocations within the Freds Fire boundary include defense zone, threat zone, and general forest. In addition, there are two protected activity centers (PACs) for spotted owls; spotted owl home range core areas (HRCAs); and riparian conservation areas (RCAs) adjacent to perennial, seasonal, and ephemeral streams within the Freds Fire boundary. Highway 50 is a state designated Scenic Highway. The South Fork American River was found to be eligible as a Wild and Scenic Recreation River in 1990. A suitability study has not been completed for the river and it has not been proposed for congressional designation. In addition, the Pony Express Trail, a National Recreation and Historic Trail, bisects the project and is a linear feature that parallels Highway 50.

The goal of this project is to move the area toward desired future conditions as defined by the Sierra Nevada Forest Plan Amendment (SNFPA ROD, pgs. 36-48). Desired conditions, management intents, and management objectives for fuels and vegetation management activities within each land allocation are described in detail in Table 1-1. There is a need to develop these desired conditions over the long term in the burned areas where site capability allows. In the short term, burned areas would be managed for young forest dependent species.

Table 1-1: Land Allocations and Desired Conditions (SNFPA ROD, pgs. 45-48)

Land Allocation	Desired Conditions	Management Intent	Management Objectives
Old Forest Emphasis Areas	Forest structure and function generally resemble pre-settlement conditions. High levels of horizontal and vertical diversity exist within 10,000 acre landscapes. Stands are composed of roughly even-aged vegetation groups, varying in size, species composition, and structure. Individual vegetation groups range from less than 0.5 to more than 5 acres in size. Tree sizes range from seedlings to very large diameter trees. Species composition varies by elevation, site productivity, and related environmental factors. Multi-tiered canopies, particularly in older forests, provide vertical heterogeneity. Dead trees, both standing and fallen, meet habitat needs of old-forest-associated species. Where possible, areas treated for fuels also provide for the successful establishment of early seral stage vegetation.	Maintain or develop old forest habitat in: areas containing the best remaining large blocks or landscape concentrations of old forest and/or areas that provide old forest functions (such as connectivity of habitat over a range of elevations to allow migration of wide-ranging old-forest-associated species). Establish and maintain a pattern of area treatments that is effective in: modifying fire behavior. culturing stand structure and composition to generally resemble pre-settlement conditions. reducing susceptibility to insect/pathogen drought-related tree mortality. Focus management activities on the short-term goal of reducing the adverse effects of wildfire. Acknowledge the need for a longer-term strategy to restore both the structure and processes of these ecosystems.	Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior. Maintain and/or establish appropriate species composition and size classes. Reduce the risk of insect/pathogen drought-related mortality by managing stand density levels. Design economically efficient treatments to reduce hazardous fuels.
WUI *Threat Zones*	Under high fire weather conditions, wildland fire behavior in treated areas is characterized as follows: Flame lengths at the head of the fire are less than 4 feet. The rate of spread at the head of the fire is reduced to at least 50% of pre-treatment levels. Hazards to firefighters are reduced by managing snag levels in locations likely to be used for control in prescribed fire and fire suppression, consistent with safe practices guidelines. Production rates for fire line construction are doubled from pre-treatment levels.	Threat zones are priority area for fuels treatments. Fuels treatments in the threat zone provide a buffer between developed areas and wildlands. Fuels treatments protect human communities from wildland fires as well as minimize the spread of fires that might originate in urban areas. The highest density and intensity of treatments are located within the WUI.	Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior. Design economically efficient treatments to reduce hazardous fuels.

Land Allocation	Desired Conditions	Management Intent	Management Objectives
WUI *Defense Zones*	Stands are fairly open and dominated primarily by larger, fire tolerant trees. Surface and ladder fuel conditions are such that crown fire ignition is highly unlikely. The openness and discontinuity of crown fuels, both horizontally and vertically, result in very low probability of sustained crown fire.	Protect communities from wildfire and prevent the loss of life and property. WUI defense zones have highest priority for treatment (along with threat zones). The highest density and intensity of treatments are located within the WUI.	Create defensible space near communities, and provide a safe and effective area for suppressing fire. Design economically efficient treatments to reduce hazardous fuels.
California spotted owl and northern goshawk PACs	At least two tree canopy layers are present. Dominant and co-dominant trees average at least 24 inches dbh. Area within PAC has at least 60 to 70 percent canopy cover. Some very large snags are present (greater than 45 inches dbh). Levels of snags and down woody material are higher than average.	Maintain PACs so that they continue to provide habitat conditions that support successful reproduction of California spotted owls and northern goshawks.	Avoid vegetation and fuels management activities within PACs to the greatest extent feasible. Reduce hazardous fuels in PACs in defense zones when they create an unacceptable fire threat to communities. Where PACs cannot be avoided in the strategic placement of treatments, ensure effective treatment of surface, ladder, and crown fuels within treated areas. If nesting or foraging habitat in PACs is mechanically treated, mitigate by adding acreage to the PAC equivalent to the treated acreage wherever possible. Add adjacent acres of comparable quality wherever possible.
HRCAs	Within home ranges, HRCAs consist of large habitat blocks having: at least two tree canopy layers. at least 24 inches dbh in dominant and co-dominant trees. a number of very large (>45 inches dbh) old trees. at least 50-70% canopy cover. higher than average levels of snags and down woody material.	Treat fuels using a landscape approach for strategically placing area treatments to modify fire behavior. Retain existing suitable habitat, recognizing that habitat within treated areas may be modified to meet fuels objectives. Accelerate development of currently unsuitable habitat (in non-habitat inclusions, such as plantations) into suitable condition. Arrange treatment patterns and design treatment prescriptions to avoid the highest quality habitat (CWHR types 5M, 5D, and 6) wherever possible	Establish and maintain a pattern of fuels treatments that is effective in modifying wildfire behavior. Design treatments in HRCAs to be economically efficient and to promote forest health where consistent with habitat objectives.

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Purpose and Need for Action

The purpose and need for this project is to further the restoration of the area impacted by the Freds Fire of 2004. This fire resulted in adverse effects to forest resources such as soil, riparian areas, and wildlife habitat, and caused extensive tree mortality. Removal of most of the fire-killed trees occurred in 2005. Some live and dead trees remain, distributed across the landscape as described in the Freds Fire Restoration FEIS. Without additional treatment to restore the fire area, additional impacts are likely over the short and long term.

- There is a need to reestablish a forested landscape.
- There is a need to reestablish this forested landscape effectively and economically**.**
- There is a need to reduce short term fuels loading for the purpose of reducing the intensity and severity of future fires:
- There is a need to restore spotted owl travel corridors between owl PACs.
- There is a need to control yellow starthistle and eliminate tall white top in the project area to reduce the potential for spread of noxious weeds to other areas in the forest.

Indicator Measures, or ways to quantitatively or qualitatively gauge the effects of the alternatives in relation to a need or issue, are also identified under each need and issue.

There is a Need to Reestablish a Forested Landscape.

Reforestation programs have many objectives, such as improving timber yields, soil protection, improving visual quality, and improving wildlife habitat. One of the primary objectives of the Freds Fire Reforestation Project is to move the project area from its existing condition toward desired future conditions (Table 1-1) as defined by the Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement and Record of Decision.

As a result of the fire, much of the project area has reverted from mid- and late-seral forest conditions to early-seral conditions. It will take at least 100 years to reestablish large trees (>24" dbh) and at least 250 years to develop old trees with decadence features beneficial to wildlife (SNFPA FEIS Vol. 1, Ch. 2, pg. 138). In the lower elevations, existing oak sprouts have the potential to develop into oak stands or the oak component of mixed conifer/oak stands. Natural regeneration is sparse over the moderate and high intensity burn areas. To achieve the desired conditions described above, it is important to begin the reestablishment of a forested landscape.

The Pacific Southwest Region of the Forest Service has developed specific stocking standards for successful reforestation (R-5 FSH 2409.26b, 1991). These standards describe the specified minimum and recommended numbers of trees per acre (TPA) needed to establish a growing forest. These standards reflect the knowledge that not every seedling has the genetic potential to thrive on the micro-site they were planted in. It also requires that the seedlings be well-distributed and growing under conditions that will allow them to “persist into the future” .

A certified silviculturist can approve lower stocking levels than the Regional recommendations, if the change meets the test that the levels will “persist into the future” (R-5 FSH 2409.26b, 1991). This was the conclusion of the Freds Fire project silviculturist who, based on site-specific conditions, determined that project objectives could be met with a minimum of 100 established trees per acre. The site-specific factors used include the defense zone desired future condition of fairly open stands with a discontinuity of crown fuels, the southern aspect of the project area which is drier than other aspects, providing for small patches of early seral vegetation, and the likelihood of being able to meet the desired future conditions for other land allocations at this stocking level.

Planted trees encounter many barriers to establishment early in their life and cannot be considered established or expected to persist into the future upon planting. Initial tree planting has occurred on about 1,870 acres, however, the seedlings have not been established. Seedling mortality is high, the result of lack of adequate moisture, with third year seedling survival at about 40 percent, and declining. Thus, reforestation success needs to be evaluated after trees are established, and when there is reasonable assurance that seedlings will persist in the expected future under prescribed management practices. Certification for adequate stocking can take place after three years or anytime thereafter that established seedlings meet the regional certification requirements. (R-5 Reforestation Handbook).

Forest cover is not necessary over the entire landscape to meet desired future conditions. Forested cover is not desirable or may not be achievable on areas such as archaeological sites, sensitive plant areas, poor sites and rock outcrops. In addition, small inclusions without trees in other areas provide for structural and vegetative diversity.

Indicator Measure: Acres certified with adequate stocking by age five to ten.

There is a Need to Reestablish this Forested Landscape Effectively and Economically

There is a need to effectively and economically control the establishment and growth of shrubs and other competing vegetation that could persist for the long term, negatively affecting both planted and natural seedling survival and inhibiting tree growth, delaying the achievement of the SNFP desired condition.

In the short term there is a need to insure that sufficient young seedlings of a variety of species survive and grow, to provide for the future attainment these desired conditions. Controlling competing vegetation directly influences the attainment of these objectives by enabling sufficient young conifer seedlings of a variety of species to survive long moisture free summers; and by reducing moisture stress on surviving conifer seedlings so that they grow more vigorously.

The Forest Service in Region 5 has extensive experience, a large body of research and numerous long-term studies (ranging from 10-31 years) that clearly establish the efficacy of herbicide release to improve conifer survival, growth and development. According to the findings of the National Administrative Study: Alternatives Methods of Release, herbicides far more cost-effective than hand grubbing or hand cutting, and yield the longest-lasting results on established shrubs (Abstracts of presentations, 26th Forest Vegetation Management Conference, 2005). Prior to 1989, when herbicide use was made available by the Region 5 Vegetation Management for Reforestation FEIS and ROD (USDA 1989), non-chemical methods for reforestation and noxious weed control have been analyzed and utilized in the past on the ENF.

The FEIS for Vegetation Management for Reforestation, pages 1-4 to 1-5 states:

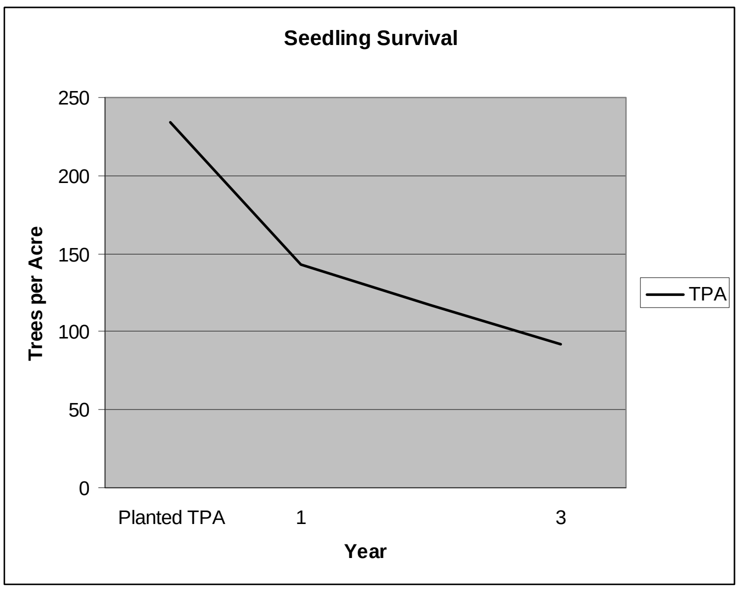
> *Within the forest environment, plants compete with each other for sunlight, soil moisture and nutrients, and space. In California forests, because of the long dry season during late spring, summer, and early fall, the competition is primarily for soil moisture. Root and shoot growth generally is limited by moisture availability within plant tissues, temperature, nutrients, and energy (gained through photosynthesis). The major growth period for roots and shoots usually occurs in the spring because all conditions for growth are met. Growth ceases during the dry season when levels of soil moisture are so low that the plant cannot take up enough moisture to continue growth. Excessive moisture stress in conifers, caused by the long dry period and reductions in available soil moisture by competing plants, is the most frequent cause of insufficient growth and mortality in small conifers. Thus*

control of competing vegetation is needed in the commercial timber lands of the Region [including the Eldorado National Forest].

While the above statement was primarily made regarding a timber yield objective, when seedling survival and growth are needed to accomplish other objectives, a seedling's physiological needs for sunlight, soil moisture and nutrients, and space remain the same. As a practical measure, a short-term silvicultural goal is to keep competing vegetation levels below twenty percent (total live ground cover) for a period of two to three years after planting. This objective is based on plantation studies in California which have shown that levels below 20-30 percent crown cover are necessary to maintain seedling survival and growth (refer to McDonald and Fiddler, 1989).

Currently the establishment of grasses, shrubs, and other vegetation, while variable, averages 65 percent cover over the analysis area. Establishment of greater than 20 to 30 percent cover of vegetation presents a potential lethal environment to conifer seedlings as demonstrated by current third year seedling survival rates of 40 percent (refer to Figure 1-1).

Figure 1-1 Freds Fire Seedling Survival



Each unit on the project was evaluated and a Release Evaluation Form was completed. The Release Evaluation Form was developed on the ENF in 1991 by a group of certified silviculturists and culturists as a method to evaluate plantations as to the need for herbicides as a release tool, and to prioritize the need for release. A key component of the Release Evaluation Form is to identify vegetative situations where the use of herbicides is considered essential to meeting the objective of successful reforestation. The evaluation as to the need for herbicides in a given unit is based upon factors such as competing species, stocking of conifer seedlings, relationship between conifer condition and competing vegetation condition, and the presence or absence of pocket gophers. This evaluation and risk-rating system is further discussed in the instructions for the Release Evaluation Form in Appendix B – Silvicultural Information.

Each unit has been assigned to one or more situation categories on the Release Evaluation Form. If a unit currently meets the criteria for a situation this was noted. If a unit did not currently meet the criteria for a situation, but is predicted to meet a situation in the near future, based on current vegetation and predicted growth, the situation and the predicted date of meeting the situation was noted. Based on the situation and other criteria, such as surviving trees per acre and the presence of pocket gophers, each unit has been assigned a priority for treatment.

There are six identifiable situations described in the Release Evaluation Form where the use of herbicides is considered essential to meeting the objective of successful reforestation. Briefly, these six situations are:

Bearclover/grass: Both types of vegetation (bearclover and/or annual or perennial grasses) are very competitive with conifers for water and nutrients, and are difficult to control, often with very poor results in terms of conifer release. Bearclover is not a fast invader, but grasses are, therefore when bearclover is eliminated, grasses generally reinvade.

Lupine, grasses, forbs, thistle and/or bracken fern in association with pocket gophers: The challenges facing conifers in this situation are twofold. As the plant population increases, the pocket gopher population also increases. Conifer survival drops off quickly due to both mortality from pocket gopher damage and moisture stress.

Chinquapin and/or greenleaf manzanita: Both chinquapin or greenleaf manzanita species are difficult to control, especially once established on a site. Manzanita is a fast invader, chinquapin is not.

Low conifer stocking with competition: In plantations with stocking below recommended regional standards (otherwise known as marginal stocking), competition is especially critical because of the chance of plantation failure with continued mortality. There is also a need for effective site preparation for interplanting (or replanting) efforts. For this project 100 trees per acre is used as a measure of marginal stocking.

High volume of woody brush: Even though the individual species of competing vegetation may not be considered highly competitive, the sheer number and volume of competing vegetation presents a difficult control situation and a potentially lethal combination to the conifer. Some species are difficult to control (such as chinquapin), others are difficult to adequately treat using hand methods of control when found in dense stands (such as whitethorn).

High levels of herbaceous vegetation: High levels of herbaceous vegetation is often difficult to control for any length of time due to its ability to rapidly reinvade.

Any unit that doesn’t fit into one of the above categories is considered currently feasible for mechanical or hand treatments (such as hand cutting or grubbing treatments), although herbicides might still be prescribed due to the potential for these units to become classified under one of the described scenarios, even after mechanical or hand treatments. Most of the units contain elements of many of the above release need situations, either scattered over an entire unit or as inclusions within a unit.

Of the primary competitive species, bearclover, the grasses, lupine, chinquapin, and bracken fern are very difficult to control at any age, whereas deerbrush , bitter cherry, and manzanita present control problems once they become established (based on regional and local experience). Bearclover, grasses, and manzanita are considered plants able to compete very successfully against conifers and dominate a site. The *ceanothus* species and bitter cherry are considered less of a competitor then those previously mentioned, however in large numbers, these species can also dominate a site (refer to Appendix B, of the FEIS for Vegetation Management for Reforestation).

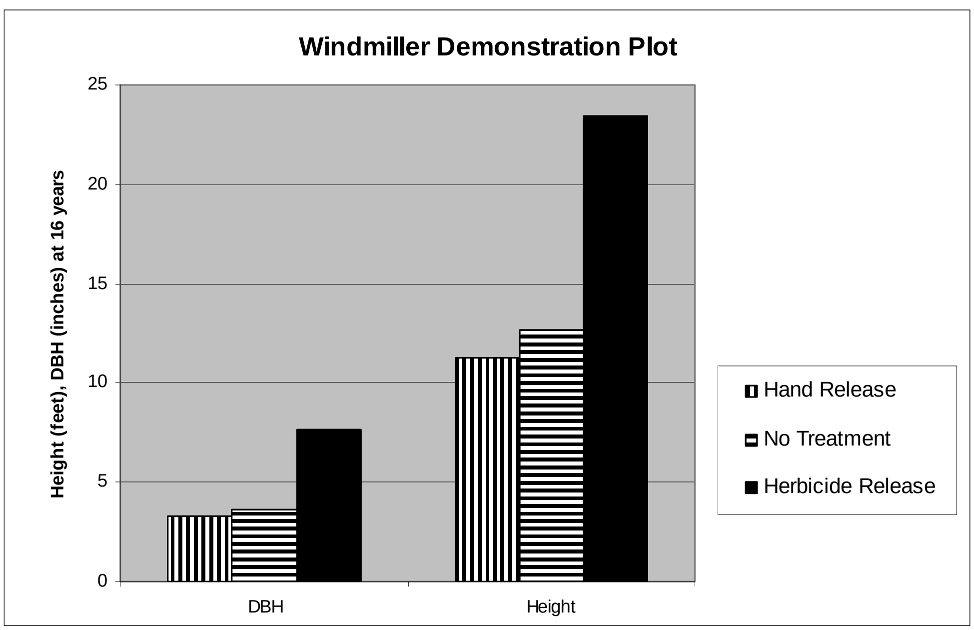
Examination of the areas planted in the project area indicate that adequate survival and growth are threatened by competing vegetation. Management of competing vegetation is essential to assure continued survival and growth of the remaining conifers and to allow planting /interplanting in units currently not meeting the stocking levels needed (100 TPA) to meet desired future conditions.

Indicator Measure: Acres with competing vegetation levels below twenty percent (total live ground cover) for a period of two to three years after planting.

Competing vegetation also greatly affects tree growth rates. Control of competing vegetation would increase conifer growth rates. Increased growth would accelerate the development of key habitat and old forest characteristics and reduce the risk of loss to wildland fire (SNFP ROD, page 49). A study near Mt. Shasta (USDA, 1997), measured the growth of planted trees during the 31 year study and found statistically different height and diameter values for each of the four shrub density regimes (no, light, medium, and heavy shrub). The average tree height after 31 years in the no shrub category was almost 3.4 times that of the "heavy shrub" average tree height, while the average tree height in the light shrub category was about 2 ½ times that of the "heavy shrub" average tree height. Similarly, the no shrub average tree diameter was almost 3.7 times that of the "heavy shrub" environment, and the light shrub average tree diameter was about 2.8 times that of the "heavy shrub" environment. The study concluded that after 31 years, the differences in tree height were still widening.

Trees were measured on a 16-year old local field demonstration plot in the Cleveland Fire near the Freds Fire (Figure 1-2). Trees in the demonstration plot, representing herbicide, hand release, and control plots, were measured. Both herbicide and hand release plots received two release treatments. The plot where trees were released with herbicides, were much taller and had a larger DBH than both the control plot and the plot where trees were hand released.

Figure 1-2. Tree Height and Diameter from Two Treatments and No Treatment



Annual height growth of planted conifers in the Freds Fire, measured on several representative units, ranges from about 0.3 feet to 0.5 feet per year, while total tree height averages about 0.75 feet on one year old trees to about 1.7 feet for three year old trees, well below the potential for this site.

Indicator Measure - Growth (height and diameter) at age 15 and 50

There is a need to reestablish this forested landscape economically. Treatments proposed include invasive plant treatments, site preparation, planting, interplanting, release, and mastication. Costs vary by the method of treatment, and the number of times a treatment must be repeated. Not only do herbicide methods cost less than hand release/hand cutting methods, but they typically do not need to be repeated as many times. Additional treatments, such as replanting or interplanting because of plantation failure, increase per acre and total costs.

Indicator measure - Cost (per acre and total)

There is a Need to Reduce Short Term Fuels Loading for the Purpose of Reducing the Intensity and Severity of Future Fires

As a result of the Freds Fire, surface fuel loading was reduced to very low levels in areas where the fire intensity was moderate to high. The ensuing establishment of grasses, shrubs, and other vegetation is expected to reach high levels (70 to 90 percent cover) within two to three years.

Establishment of this brush cover over large areas would increase the ability of wildland fires to become large in the future (> 25 years) as the dead component in the vegetation increases. Vegetation development influences potential fire behavior. Immediately post fire (< 5 year) vegetation is dominated by grass followed by a grass/shrub model (5 to 10 years, near future). These types of vegetation develop fires with high rates of spread, but little resistance to control. After this period woody brush will begin to dominate a majority of the area. The young brush, with small diameters and lack of a dead material component, tends to hinder fire intensity and spread for a 10 to 25 year period. After about 25 years (the future), as the dead component of this vegetation increases with time, the probable rates of spread match those of the grass in early development, but with far greater intensity, flame lengths and resistance to control, resulting in an increased risk of a large wild fire.

Reducing fuels, within the defense and threat zones, to reduce wildfire spread and intensity is a main goal for the Wildland Urban Intermix (WUI) (SNFP ROD, pg 34). Reducing fuels early, while they are small and have low biomass is the most effective way to change the fuels arrangement and reduce the intensity and severity of a future fire (SNFP ROD, pg.49). Early treatments afford the best opportunity to maintain the current low fuel load over time and provide protection during the early stages of stand development. Promoting tree growth while controlling shrub establishment can shorten the timeframe for stands within the project area to develop into fire resistant stands.

The threat of a large wildfire occurring along Highway 50 in the South Fork American River corridor within 5 to 10 years is high. The potential for a wildfire start is high due to proximity to the large number of travelers along Highway 50, a Pacific Gas and Electric Company (PG&E) distribution line that runs through the canyon, residential development, recreational use, and lightning. Some of these starts develop into large wildfires. The Highway 50 corridor has had four large wildfires within the last 31 years, the Pilliken Fire (1973), Wrights Fire (1981), Cleveland Fire (1992) and Freds Fire (2004). The Freds Fire burned into the Cleveland Fire perimeter on the west side and into the Wrights Fire on the east side.

Many of the factors that contribute to fire size, such as weather, slope, and aspect, can not be controlled. Managing fuels is the only way we have to affect fire behavior. Fuel was managed on the 1992 Cleveland Fire, in conjunction with vegetation management for plantation establishment. In 2002, the St. Pauli Fire burned within the 24,000 acre Cleveland Fire and burned relatively few acres (234 acres of NFS land) before it was controlled. In the St Pauli Fire area, the vegetation complex was best characterized as fuel model GR 4 (moderately coarse continuous grass, with very high fire spread rates and high flame lengths). The St Pauli Fire was characterized by high rates of spread, but was controlled on the mid-slope at a relatively small size due to this fuel models' rapid reaction to environmental conditions (increased nighttime humidity) and increased line production rate possible in this fuel model. The St Pauli Fire demonstrates the effectiveness of the fuel treatments implemented in the Cleveland fire area.

Fire behavior modeling of timber stands and fuel types that are representative of potential conditions in the future indicates that high intensity fire with rapid rates of spread and high resistance to control would be likely under moderate weather conditions (temperatures above 80 degrees, light winds, and relative humidity less than 25%). Without additional treatments to reduce brush and other vegetation, and decrease resistance to control, large and difficult to control wildfires will once again threaten the residents of Silverfork and Kyburz, and the other private landowners in this area.

Indicator measure - Flame lengths in 90th percentile weather conditions.

Indicator measure - Percentage of the area in grass or grass/shrub fuel model

There is a Need to Restore Spotted Owl Travel Corridors Between Owl PACs

The Freds Fire burned at high and moderate severity in over 70 percent of the project area. This resulted in high levels of tree mortality destroying habitat for spotted owls. Currently early seral vegetation exists in the project area, which hinders spotted owl movement between protected activity centers (PACs). Restoring linkages between neighboring PACS would allow for owl dispersal, and would include contiguous habitat of larger trees with moderate to high canopy cover where site conditions allow.

Indicator measure - Years to achieve spotted owl foraging and nesting habitat as described by California Wildlife Habitat Relations (CWHR) types 4M/4D/5M/5D, where site conditions allow.

There is a need to contain and control yellow starthistle and eliminate tall white top in the project area to reduce the potential for spread of these invasive plants to other areas of the Forest

The SNFP ROD (page 36) states that the goals for noxious weed management are to manage weeds using an integrated weed management approach including: prevent the introduction of new invaders, conduct early treatment of new infestations, and contain and control established infestations. Two invasive plants are known to occur in the project area; yellow starthistle and tall whitetop.

Tall whitetop occurs in one location in unit 609-41; It occupies less than ¼ acre. There is a need to conduct early treatments of this small infestation of tall whitetop, to eliminate it from the project area.

Yellow starthistle is established along and outward up to 100 feet from some Forest roads (11N38, 11N38A, 11N38G, 11N38K, 11N42, and 11N42D) and unnamed trails in Units 609-33 and 613-6, 7, 22, 25, 26, 35, 37, 38, and 47, occupying 72 gross acres in the project area. There is a need to contain and control the established infestation of yellow starthistle to reduce the potential for spread of yellow starthistle to other areas of the Forest.

Indicator measure – Containment of current yellow starthistle population or decreasing in size

Indicator measure - Elimination of tall whitetop population

Proposed Action

The Placerville Ranger District of the ENF proposes to plant trees, perform chemical and manual treatments to ensure their survival and growth and reduce fuels, and control or eliminate invasive plants using chemical and manual methods, consistent with other objectives, on approximately 3,320 acres of the area burned in the Freds Fire as described in detail in Chapter 2. Approximately 1,000 acres of the fire area on National Forest System lands are not proposed for treatment in this EIS.

The Interdisciplinary Team (IDT) used aerial photos and field sampling to determine areas in need of reforestation. Large areas of contiguous low intensity burn are excluded from any proposed action. Other areas of the fire excluded from the proposed action are PAC "core" areas, large patches of dead and dying trees, and rock outcrops.

Compliance with the ENF Land and Resource Management Plan as amended by the SNFPA Standards and Guidelines

Following are the Sierra Nevada Forest Plan Amendment Record of Decision (SNFPA ROD Final Supplemental Environmental Impact Statement) standards and guidelines applicable to this proposal and a discussion of how they were addressed in developing the proposed action:

Where young plantations (generally Pacific Southwest Region size classes 0x, 1x, 2x) are included within area treatments, apply the necessary silvicultural and fuels reduction treatments to: (1) accelerate the development of key habitat and old forest characteristics, (2) increase stand heterogeneity, (3) promote hardwoods, and (4) reduce risk of loss to wildland fire (SNFPA ROD, pg. 49).

Promote shade intolerant pines (sugar and Ponderosa) and hardwoods (SNFPA ROD, pg. 52).

Include hardwoods in stand examinations. Encourage hardwoods in plantations. Promote hardwoods after stand-replacing events. Retain buffers around existing hardwood trees by not planting conifers within 20 feet of the edge of hardwood tree crowns (SNFPA ROD, pg. 53).

Follow the designations for riparian conservation areas (RCA) in the SNFPA as shown in Table 3 (SNFPA ROD, pg. 42):

Table 1-2 -SNFPA RCA Designation based on Stream Type

Stream Type	Width of RCA
Perennial streams	300' each side, measured from bank full edge
Seasonally flowing streams	150' each side, measured from bank full edge
Streams in inner gorge	Top of inner gorge
Special aquatic features	300' from edge of feature or riparian vegetation, whichever is greater
Other hydrologic or topographic depressions without defined channel	RCA width and protection measures determined through project level analysis

Within RCAs, the type and level of management is determined by assessing how proposed activities measure against the Riparian Conservation Objectives (RCOs) and their associated standards and guidelines (refer to SNFP ROD 62-66).

Limit pesticide applications to cases where project level analysis indicates that pesticide applications are consistent with riparian conservation objectives(SNFPA ROD, pg. 63)

Within 500 feet of known occupied sites for the California red-legged frog, Cascades frog, Yosemite toad, foothill yellow-legged frog, mountain yellow-legged frog, and northern leopard frog, design pesticide applications to avoid adverse effects to individuals and their habitats (SNFPA ROD, pg. 42).

Use screening devices for water drafting pumps….Use pumps with low entry velocity to minimize removal of aquatic species, including juvenile fish, amphibian egg masses and tadpoles, from aquatic habitats (SNFPA ROD, pg. 64).

As part of project planning, conduct a noxious weed risk assessment to determine risks for weed spread associated with different types of proposed management activities (SNFPA ROD, pg. 55).

Consult with American Indians to determine priority areas for weed prevention and control where traditional gathering areas are threatened by weed infestations (SNFPA ROD, pg. 55).

As outlined in the Regional Noxious Weed Management Strategy, when new, small weed infestations are detected, emphasize eradication of these infestations while providing for the safety of field personnel (SNFPA ROD, pg. 55).

Following are the Eldorado National Forest Land and Resource Management Plan (USDA 1989a) standards and guidelines applicable to this proposal.

Management Practice 73 - Artificial Stand Establishment

...reduce competing vegetation to insure stand reestablishment of conifers, but accept some competing brush and oaks. Reduce surface ground cover to permit successful artificial regeneration while meeting soil protection standards. Apply hand, mechanical and chemical treatments.

Management Practice 77 - Release and Weeding

Manage conifer stocking and control competing vegetation. Maintain conifer height and diameter growth commensurate with site, as per appropriate yield tables. Use all available release and weeding methods.

Decision to be Made

The Deciding Officer will decide whether to adopt and implement the proposed action, an alternative to the proposed action, or take no action to reforest areas damaged by the Freds Fire in the project area.

The proposed action is consistent with the Eldorado National Forest Land and Resource Management Plan as amended by the Sierra Nevada Forest Plan Amendment Record of Decision.

Public Involvement

The Notice of Intent to prepare an Environmental Impact Statement was published in the Federal Register April 13, 2006. It included an announcement of a Freds Fire Reforestation public meeting, on May 9, 2006. A brief description of the location and type of project was included in the ENF Schedule of Proposed Actions (SOPA) in July 2006. Approximately 74 letters were mailed out to adjacent property owners; potentially affected businesses; federal, state, and local agencies; and special interest groups. The letter contained the detailed proposed action, map, methods for participation, and an invitation to a Freds Fire Reforestation open house, on May 24, 2006. The mailing list is included in the project record. Approximately seven people attended either the public meeting or open house, including local residents and adjacent property owners. Meeting notes are included in the project record. Five individuals responded with comments at the meetings or to the scoping. Significant issues were raised and an alternative to the proposed action were developed.

The Notice of Availability of the Draft Environmental Impact Statement (DEIS) was published in the Federal Register September 11, 2009 (Vol. 74, No. 175) and copies of the DEIS/project summary mailed to 43 individuals, organizations, tribes, and government agencies. The comment period ended on October 26, 2009. 19 individuals responded during the comment period. Two comments were received from federal, State, and local agencies, and elected officials. Appendix F contains the comments letters and Appendix G contains the response to comments.

Consultation with Indian Tribes and interested Native Americans has been ongoing throughout the planning process. Phone calls and correspondence have been made with Federally recognized tribes (Washoe Tribe of Nevada and California and Nevada, and the Shingle Springs Rancheria), and non-recognized tribes and groups.

Issues

An issue is a point of debate, dispute, or disagreement regarding anticipated effects of the proposed action. Issues may be “significant” or “non-significant.” Issues may be non-significant for any of four reasons: 1) the issue is outside the scope of the proposed action; 2) the issue is already decided by law, regulation, or Forest Plan; 3) the issue is irrelevant to the decision being made; or 4) the issue is conjectural and not supported by scientific or factual evidence. Significant issues are used to develop reasonable alternatives to the proposed action that respond to the argument or controversy presented in the issue and substantially accomplish the purpose and need. All the issues and scoping comments from the public are displayed and addressed in the Project File.

The following discussion documents the significant issues (developed from scoping comments) that led to the development of alternatives to the proposed action.

Several members of the public cited the paper “Wildfire and Salvage Logging; Recommendations for Ecologically Sound Post-Fire Salvage Management and Other Post-Fire Treatments on Federal Lands in the West,” R.L. Beschta et al. 1995, and the statement in that paper, "The use of pesticides, herbicides and fertilizers should generally be prohibited. Spot-specific hand application of herbicides only for the removal of exotics may occasionally be considered if there is evidence that such action is likely to lead to long term reclamation of the site" in support of their concerns regarding the use of pesticides.

Both the No Action Alternative (Alternative 2) and Alternative 3, included under Alternatives Considered in Detail (Chapter 2), meet the intent of the Bestchta report to generally prohibit pesticides. No pesticides are proposed for use under these alternatives.

Some members of the public questioned whether there is a need to do anything at all to promote reforestation of the Freds Fire Area, asserting that the need for the project does not exist as an ecological necessity, but only for plantation and timberlands needs. They assert that “the forest should be given a chance to regenerate naturally” or that “reseeding and replanting efforts are all the Forest really needs to be considering.” They further state that, although stand replacing fires were anything but typical in pre-European times, stand replacing fires did occur and the landscape was allowed to recover slowly over time. Finally, they assert that the naturally recovering forest after wildfire, is the rarest type of forest today and will provide the most value for wildlife for 30 years. The No Action Alternative is included under alternatives considered in detail and responds to this issue.

After reviewing the public scoping comments, the Deciding Officer approved the following significant issues to generate alternatives:

Proposed use of herbicides represents an unknown or unacceptable risk to humans, wildlife, and the environment. Some individuals expressed concern about the risks associated with the proposed pesticide use to workers and the general public, including Native American plant gatherers. They are very concerned with the hazards created by pesticides in regards to native plants, including culturally important plants and rare and listed flora, amphibians, birds, fish, insects, and soil microorganisms. They suggested the project should contain analysis of a non-chemical Integrated Pest Management (IPM) alternative.

Alternative three was created to address this concern. Alternative three proposes hand planting of conifer seedlings, hand grubbing/cutting of vegetation in a 4-5 foot radius around planted seedlings, hand pulling/cutting/tarping of invasive plants, and mechanical fuel treatments of shrubs after 5 years.

Indicator Measure: Risk to human health and safety, based primarily on Hazard Quotients (HQ), measured by comparing the estimated level of exposure (dose) to the Reference dose (RfD) or some other index of acceptable exposure.

Indicator Measure: Risk to wildlife, aquatic, and plant species, based primarily on Hazard Quotients (HQ), measured by comparing the estimated level of exposure (dose) to the No Observed Effects Level (NOEL), No Observed Effect Concentration (NOEC) or some other index of acceptable exposure.

Proposed use of herbicide would leave standing dead brush that would pose an immediate fire hazard. Some members of the public were concerned that following herbicide application, much of the existing plant material will die-off and result in substantial dead organic matter on site. This presents a significant fire danger. If the vegetation is left standing, it will become significantly dry and pose an immediate fire hazard. In addition, they are concerned that dead shrubs left standing after spraying, combined with expected cheatgrass proliferation due to herbicide spraying, will mean increased risk of large stand replacing fires that may wipe out reforestation groups and plantations, rendering this project a waste of time and tax payer money. The dead brush, and expected proliferation of cheatgrass and other invasive grasses, could result in fires that would kill the planted seedlings. They suggested an alternative that included cutting unwanted brush, either mechanically, or by hand, leaving it on the ground to discourage new brush growth and noxious weed invasion, and restocking the area the following planting season.

Alternative 3 was created to address this concern. Alternative 3 proposes hand planting of conifer seedlings, hand grubbing/cutting of vegetation in a 4-5 foot radius around planted seedlings, and hand pulling/cutting/tarping of invasive plants, and mechanical fuel treatments of shrubs in 5 years.

Indicator Measure: Fuel model in immediate future (< 5 years)

Proposed herbicide use could contaminate water. Some members of the public were concerned about the potential of the proposed action to contaminate water and its effect on water quality.

Alternative 3 was created to address this concern. Alternative 3 proposes hand planting of conifer seedlings, hand grubbing/cutting of vegetation in a 4-5 foot radius around planted seedlings, hand pulling/cutting/tarping of invasive plants, and mechanical fuel treatments of shrubs in 5 years.

Indicator Measure: Levels of herbicides that may be detected in water compared to existing guidelines.

Proposed use of herbicides could create conditions more hospitable to invasive species and undesirable weeds than were present before the chemicals were applied. McDonald and Everest

(1996) found that invasive cheatgrass populations, not observed in the study plots at the beginning of a study, increased more in herbicide-treated plots during a vegetation management study comparing herbicides and non-chemical means of reducing unwanted shrubs. Herbicide treated plots ended the four year study with 743,667 cheatgrass plants per acre with 22% foliar cover, where cheatgrass was 6 times greater in number of plants and more than seven times greater in foliar cover than in the non-herbicide control plots (130,300 plants per acre, 3% foliar cover). It appears that the invasive cheatgrass was colonizing ground cleared by herbicides. They suggested the project should contain analysis of a non-chemical IPM alternative.

Alternative 3 was created to address this concern. Alternative 3 proposes hand planting of conifer seedlings, hand grubbing/cutting of vegetation in a 4-5 foot radius around planted seedlings, hand pulling/cutting/tarping of invasive plants, and mechanical fuel treatments of shrubs in 5 years.

Indicator Measure: Risk of increasing the spread of invasive plants in the project area.

Chapter 2
Alternatives Considered

Minor changes to the proposed action alternative have been made since the proposed action was mailed out to the public for scoping comments, based on field verification and meetings with adjacent private property owners. Changes include: addition of the herbicide chlorsulfuron for treatment of the invasive plant weed tall whitetop, the substitution of radius treatments for broadcast treatments along portions of some roads, an increase in the non-herbicide buffers along perennial streams (including those used as a domestic water source for the town of Kyburz), elimination of gopher control activities, a reduction in initial planting acres to reflect acres planted under Decision Memos, brush cutting to access several units, a reduction in acres of shrub and excess tree mastication treatments, and refinement of planting and release treatments near meadows. Best Management Practices listed in the design criteria have been updated to address proposed activities.

Alternative 1 (Proposed Action and Preferred Alternative)

Alternative 1 is the Forest Service's preferred alternative. The proposed action includes the following activities:

Reforestation

Plant by hand a mixture of conifer species (ponderosa pine, Jeffrey pine, sugar pine, Douglas fir, incense cedar, white fir, and red fir) as displayed in Table 2-1, below, on approximately 1,322 acres. Trees would be planted in groups of two or three, with group centers approximately 17 feet (+/- 25%) apart. Planting sites (14"-24" diameter) would be scalped, if needed, to expose mineral soil for planting.

No conifer planting would occur on approximately 350 acres, including

- Snag retention patches (as described in the Freds Fire Restoration FEIS)
- Granite Springs Wildlife Water Development Restoration Area
- Heritage resource sites
- Sensitive plant sites
- Areas with groups of natural conifer regeneration greater than 6" tall
- Low intensity burn areas where live tree stocking exceeds 50 trees per acre (including oaks)
- Within riparian vegetation
- For 100 feet below the Sugarloaf rock formation
- Within 20 feet of the crown dripline of mature live, or sprouting, hardwoods, including 125 acres of oak stands.
- Areas adjacent to special aquatic features (refer to Resource Protection Measures, below)

About 1,868 acres within the project area have been planted between 2005 and 2009.

Conifer planting on about 925 acres of oak or mixed conifer/oak type in stands 609-027, 609-030, 609-033, and 609-046, would occur at a reduced density by not planting within 20 feet of the dripline of a mature live, or sprouting, oak crown.

Where seedling mortality threatens plantation failure (less than 100 trees per acre and less than 60 percent stocked) replant or interplant by hand a mixture of conifer species (ponderosa pine, Jeffrey pine, sugar pine, Douglas fir, incense cedar, white fir, and red fir) on approximately the project area (3,320 acres). Currently, about 665 acres would be replanted or interplanted. Trees would be planted in groups of two or three, with group centers approximately 17 feet (+/- 25%) apart. Planting sites (14"-24" diameter) would be scalped, if needed, to expose mineral soil for planting. Evaluate opportunities to provide patches (<1 acre) of early seral vegetation, potentially by limiting interplanting on some sites with high seedling mortality.

Seedlings grown from seed of local origin would be used. When seed of local origin is unavailable, seed would be transferred in compliance with seed transfer rules based on California Tree Seed Zones, (J. Buck et al. 1971; also refer to R-5 FSH 2409.26, Section 42.2).

Site Preparation and Release

Hand apply herbicides (glyphosate, triclopyr, and/or hexazinone) to shrubs and grass by broadcast method or within a 5 feet radius of trees (refer to Table 2-1). Prior to herbicide application, brush may be cut on portions of units 613-6, 25, 26, 35, 37, 38, and 42 for access.

Initial Treatments: Glyphosate is proposed as an initial treatment. This type of application can be used to treat grass and forb species, and shrub species such as bear clover, manzanita, cherry, and *ceonothus*. In unplanted areas, the initial treatment would be applied by hand the year prior to planting (site prep) to control vegetation and make the area accessible for planting. On previously planted areas, the initial treatment would be a release treatment.

Most areas would receive a broadcast application of herbicides. Radius treatments would occur adjacent to Cleveland Fire units, along portions (estimated 122 acres) of roads 11N38, 11N38A, 11N38G, 11N38K, 11N42, 11N42A, 11N42D, 11N99, and 11N99F and within ¼ mile of Highway 50 (estimated 388 acres) to limit the potential for invasive plant spread.

Follow-up Treatments: Hand apply glyphosate, triclopyr, or hexazinone as a follow-up treatment on about 3,320 acres. Triclopyr is proposed for treatment of woody brush species such as bearclover, manzanita, and chinquapin. Extensive resprouting is usually eliminated with this type of treatment. Hexazinone is proposed for treatment of grasses and forbs. This type of treatment can affect seed germination, with decreasing effectiveness, for two to three seasons after application. In all other units, glyphosate would be used as a follow-up treatment. Table 2-2 displays acres by proposed treatment type.

Follow-up treatments of glyphosate or triclopyr would be applied in a radius around planted trees, with selected shrubs targeted outside of this radius to reduce live cover outside this five foot radius to 20 percent. The herbicide applications are intended to facilitate tree survival by reducing competition, maintaining vegetation in a grass/shrub type fuel model, and allowing some shrub and herbaceous vegetation development interspersed between the groups of trees.

Chemical applications would be restricted to ground-based applications. Additives in the form of colorants and adjuvants would be added to the herbicide mixtures. Table 2-3 displays the herbicides, application rates, and additives proposed for use.

Hand grubbing in a radius around trees in lieu of herbicides would be used within no-spray buffers of seasonal streams (refer to resource protection measures, below).

Invasive Plant Control

Hand apply clopyralid or glyphosate for yellow starthistle (estimated 72 acres) and chlorsulfuron or glyphosate for tall whitetop (estimated ¼ acre). Application of clopyralid would be made to plants or to the ground where yellow starthistle plants exist or are expected to geminate. Clopyralid would be applied while starthistle plants are primarily in the rosette to bolting stage, prior to the spiny stage. A glyphosate herbicide labeled for aquatic use (such as Rodeo), would be substituted for clopyralid within portions of streamside zones, and would be applied as a contact herbicide. It is anticipated that multiple treatments would be necessary to treat missed or recently germinated, plants. Follow-up treatments, based on herbicide effectiveness monitoring, would consist of chemical treatment using the herbicide glyphosate, used as a spot application. Individual sites may be treated up to two times in one year (one clopyralid application and one glyphosate or two glyphosate applications), depending on the efficacy of treatments. Mechanical methods, such as hand pulling or grubbing, would also be employed. Treatments may continue for up to ten years.

Application of chlorsulfuron to tall whitetop would be made while plants are primarily in the flower bud stage. Follow-up treatments may be repeated yearly, based on herbicide effectiveness monitoring. Application of glyphosate to tall whitetop would be made to the plant. Follow-up treatments may be repeated yearly, based on herbicide effectiveness monitoring Mechanical methods, such as hand pulling or tarping, would also be employed. Treatments may continue for up to ten years.

Table 2-1 Proposed Treatments by Stand – Alternative 1

STAND	Approx Stand Acres	Approx Treatment Acres	Planted Acres to Date[1]	Initial Plant Acres	Herbicide Treatment[2]	Comment
503-006	3	0	0		None	
503-008	40	3	3		glyphosate	
503-009	4	4	4		glyphosate	
503-027	36	2	2		glyphosate	
503-111	5	5	5		glyphosate	
503-112	55	0	0		None	Snag Patch[4]
503-113	23	0	0		None	
609-010	76	76	76		glyphosate/triclopyr	
609-025	71	71	71		glyphosate	
609-026	32	32	32		glyphosate	
609-027	254	254	78	170	glyphosate	oak[3]
609-029	36	36	36		glyphosate	
609-030	373	373	47	304	glyphosate	oak
609-031	60	0	0		None	Snag Patch
609-032	47	0	0		None	Snag Patch
609-033	763	763	48	645	glyphosate	oak
609-034	20	20	20		glyphosate/triclopyr	
609-035	123	0	0		None	
609-036	28	28	28		glyphosate/hexazinone	
609-037	54	54	54		glyphosate	
609-038	21	21	21		glyphosate/hexazinone	
609-039	22	22	22		glyphosate/hexazinone	
609-040	27	27	27		glyphosate/hexazinone	
609-041	29	29	29		glyphosate	
609-042	66	66	66		glyphosate	
609-043	49	49	49		glyphosate	

STAND	Approx Stand Acres	Approx Treatment Acres	Planted Acres to Date[1]	Initial Plant Acres	Herbicide Treatment[2]	Comment
609-044	37	37	37		glyphosate	
609-046	280	280	70	203	glyphosate	oak
613-005	120	120	120		glyphosate	
613-006	96	96	96		glyphosate	
613-007	17	17	17		glyphosate	
613-010	6	6	6		glyphosate	
613-022	28	28	28		glyphosate	
613-025	89	89	89		glyphosate	
613-026	19	19	19		glyphosate	
613-031	1	0	0		None	
613-035	150	150	150		glyphosate	
613-037	113	113	113		glyphosate	
613-038	51	51	51		glyphosate	
613-042	40	40	40		glyphosate	
613-047	32	32	12		glyphosate	
613-050	55	55	55		glyphosate	
613-051	90	90	90		glyphosate	
613-052	76	76	76		glyphosate	
613-053	153	38	38		glyphosate	Balance of unit green
613-054	43	43	43		glyphosate	
Total	3,816	3,319	1,868	1,322		

[1] Planted under existing Decision Memos

[2] glyphosate-initial and follow-up treatments, glyphosate/triclopyr–glyphosate initial treatment, triclopyr follow-up treatment, glyphosate/hexazinone – glyphosate initial treatment, hexazinone follow-up treatment

[3] Oak- Stands with portions that are oak, or where oak is a component of a mixed conifer/oak type

[4] Snag Patch – Unharvested stand

Table 2-2 Acres of Proposed Treatments by Treatment Type

	Glyphosate, with glyphosate follow-up	Glyphosate, with triclopyr follow-up	Glyphosate, with hexazinone follow-up
Acres	3,120	97	99

Fuel Reduction

Five years following planting, masticate shrubs in the defense zone within ¼ mile of Highway 50 (maximum estimated 388 acres) to reduce surface and ladder fuels to reduce wildfire spread and intensity. Mastication would be limited to slopes generally less than 35%,

Resource Protection Measures

Standard procedures for resource protection would be adhered to during project implementation. These requirements come from standards and guidelines in the Eldorado National Forest Land

and Resource Management Plan (LRMP), as amended by the Sierra Nevada Forest Plan Amendment Record of Decision (2004); standard policies and guidelines included in the Forest Service Handbook; compliance with laws and regulations; and Best Management Practices (BMPs) as defined by the State of California, and input provided by the interdisciplinary team for this project. These resource protection measures include the following:

Chemical application would be restricted to ground-based applications. Additives in the form of colorants and adjuvants would be added to the herbicide mixtures. An adjuvant that acts as a surfactant would be added to help the herbicide mixture absorb into the plant. Surfactants proposed for use include nonylphenol polyethoxylate based (NPE) surfactants, methylated seed oil (MSO) based surfactants, and a silicone/modified vegetable oil blend. A colorant or dye would be added to liquid formulations to determine location of coverage. The application rates for each of the herbicides and adjuvants proposed for use would be in accordance with each material's label instructions. Table 2-3 displays the herbicides, application rates, and additives proposed for use.

Table 2-3 - Herbicide Formulations, Application Rates and Additives

Herbicide Formulation	Application Rate (pounds/acre)	Additives
Site Preparation and Release Treatments		
glyphosate (Accord or equivalent formulation)	2.7 - 4.8 lbs/acre (ae)	NPE-based or silicone/MSO blend surfactant, Colorfast Purple dye
hexazinone (granular - Pronone or equivalent formulation)	2.0 - 3.0 lbs/acre (ae)	none
triclopyr (Garlon 4 or equivalent formulation)	1.6 - 2.4 lb./acre (ae)	MSO-based or silicone/MSO blend surfactant, Colorfast Purple dye
Invasive Plant Treatments		
glyphosate (Accord or equivalent formulation)	2.7 lbs/acre (ae)	NPE-based or silicone/MSO blend surfactant, Colorfast Purple dye
glyphosate (Rodeo or equivalent formulation)	2.7 lbs/acre (ae)	MSO-based surfactant, Hi-Light blue dye
clopyralid (Transline)	0.25 lbs/acre (ae)	NPE-based or silicone/MSO blend surfactant, Colorfast Purple dye
chlorsulfuron (Telar)	0.047–0.14 lbs/acre (ai)	NPE-based or silicone/MSO blend surfactant, Colorfast Purple dye

ae – acid equivalent, ai – active ingredient

All appropriate laws and regulations governing the use of pesticides, as required by the U.S. Environmental Protection Agency, the California Department of Pesticide Regulation, and Forest Service policy pertaining to pesticide use, would be followed. Coordination with the appropriate County Agricultural Commissioners would occur, and all required licenses and permits would be obtained prior to any pesticide application. In addition to existing laws and regulations, several additional practices would be employed to increase safety. These include restrictions location of equipment and additional personal protective equipment. A site-specific safety and spill plan would be developed to address site-specific attributes of proposed units.

To inform the public of pesticide applications: Each treatment unit would be posted with a clearly visible sign along likely access points that the unit has been treated with pesticides. The specific pesticide would be identified, the treatment date specified, and the name and phone number of the appropriate Forest Service contact would be identified.

To protect archaeological resources at risk from ground disturbing project activities: Cultural resource sites would be flagged or otherwise designated. Tree planting and hand pulling of invasive plants would not take place within these sites.

To prevent introduction of invasive plants: Prior to entering ENF lands equipment must be free of material that may contain seeds of invasive plants. Unless the prior location of operation is known to be free of invasive plants as documented in a Weed Risk Assessment, Forest Service may assume that the equipment is contaminated with invasive plant seeds and cleaning/washing will be required.

To protect sensitive plants: Conduct field surveys in the spring to verify the suitability of potential habitat for sensitive plants. Known occurrences of Pleasant Valley mariposa lily (*Calochortus clavatus)* would be flagged or otherwise designated by a trained Botanist. Tree planting and chemical treatments would not take place within these occurrences. Hand treatments (hand pulling or cutting) of invasive plants would be allowed after sensitive plant flowering and seed set. Any new occurrences of sensitive species within the project area will be flagged and protected by avoidance.

To protect perennial streams and special aquatic features:

- Meadow adjacent to a tributary of Fry Creek (within Unit 613-35 and 613-37) - No planting or release treatments within 150 feet of the edge of the meadow.
- Granite Springs Area– No planting or release treatments within 75 feet of meadows in the vicinity of Granite Springs (*exception*: 50 foot no planting or release treatment along the south and east edge of Granite Springs Meadow/Spring complex).
- Conifers would be planted at a reduced density in the portion of Unit 615-50 north and west of Granite Springs Meadow/Spring complex. Trees would be planted in groups of two or three, with group centers 40 to 50 feet apart.
- Perennial streams – No conifer release treatments (hand or herbicide) or brush cutting would occur within 50 feet of the edge of the stream channel. Between 50 and 100 feet from the edge of the stream channel, conifer release treatments would maintain at least 50 percent live ground cover.

To protect sensitive wildlife species:

- Maintain a limited operating period (LOP), prohibiting activities within ¼ mile of known spotted owl nest sites during the breeding season (March 1 to August 31) unless surveys confirm that California spotted owls are not nesting.
- Use screening devices for water drafting pumps. Use pumps with low entry velocity to minimize removal of aquatic species, including juvenile fish, amphibian egg masses, and tadpoles, from aquatic habitats.
- Maintain sufficient trees following thinning to quickly achieve 70 percent crown closure to meet desired conditions east of Granite Springs Meadow (portions of unit 613-50 and 613-51). Evaluate opportunities to interplant to create multi-layered stand conditions.
- **To protect oaks:** Oaks would not be intentionally sprayed, including seedlings, sprouts, and larger trees. Hexazinone would not be applied within the dripline of sugar pine or incense cedar greater than 5 inches diameter.

Transportation: No road construction is proposed.

To protect soils: Region 5 Soil Quality Standards would be met. Within 100 feet of perennial streams a minimum of 75% ground cover, where it currently exists, would be retained thru all release treatments.

To protect water quality: Compliance with the Clean Water Act is demonstrated through the implementation of Best Management Practices (BMPs) certified by the state, and then monitoring to determine if the appropriate Central Valley Regional Water Quality Control Board standards are met. These BMPs are designed to prevent degradation of downstream water quality. Water Quality Management for Forest Service Lands in California - Best Management Practices (2000) describes the BMPs that are referenced in the Land and Resource Management Plan. BMPs that are pertinent to the use of pesticides are BMPs 5-7, 5-8, 5-9, 5-10, 5-11, 5-12, and 5-13; they are described below

Practice 5-7 – Pesticide Use Planning Process

A hydrologist, fisheries biologist soil scientist, silviculturist, fuels specialist, geologist, archeologist and wildlife biologist are members of the ID team for this project. They have evaluated soil and watershed responses to the proposed herbicide applications and provided criteria for identifying sensitive areas to be avoided or needing additional protection. They identified specific mitigation measures for these areas as documented in the FEIS and the following BMPs. They also evaluated soil and watershed responses to proposed activities. (ID Team - During Planning and Analysis Process)

Practice 5-8 - Pesticide Application According to Label Directions and Applicable Legal Requirements

All pesticide applications are required to follow label instructions and restrictions for use to avoid water contamination by complying with all label instructions and restrictions for use. Pesticide label directions for application rates and methods, mixing, and container disposal will be followed. Representative soil samples would be taken on units proposed for hexazinone treatments to determine application rate. Label directions will be followed on all pesticides, dyes, and adjuvants. All pesticide applications will adhere to all appropriate laws and regulations governing the use of pesticides, as required by the U.S. Environmental Protection Agency, the California Department of Pesticide Regulation, CalEPA regulations and safety regulations, and Forest Service policy pertaining to pesticide-use. Coordination with the appropriate County Agricultural Commissioners will occur, and all required licenses and permits would be obtained prior to any pesticide application. All Forest Service personnel in charge of projects involving pesticide application will be Qualified Applicator Certified. All contract applicators will be appropriately licensed by the state. These actions will effectively avoid the misuse of the herbicides used in this project and thus decrease the risk of contaminating water or applying to non-target areas. (Silviculturist, Culturist & Contract Representative responsible for application of pesticides)

Practice 5-9 - Pesticide Application Monitoring and Evaluation

Treatments are monitored and evaluated during application by the contract officer or representative to determine whether pesticides have been applied safely, restricted to intended target areas, and have not resulted in unexpected non-target effects. All spray equipment would be calibrated to insure accuracy of delivered amounts of pesticide. Periodically during application, equipment would be rechecked for calibration. Colorants or dyes would be added to the herbicide mixture to determine placement. A site-specific water quality monitoring plan will be prepared for this project prior to project implementation. It would be implemented prior to application to determine baseline conditions. The forest hydrologist, soil scientist, and district silviculturist would evaluate the results of the monitoring. This monitoring would determine if herbicides have moved off-site into water after application, through overland flow, leaching, or subsurface flow and would determine the amount of herbicide residue reaching water. This information would be critical to evaluating other protection measures. Post-project monitoring would determine the effectiveness of treatment in meeting the project objectives.

Practice 5-10 - Pesticide Spill Contingency Planning

To reduce contamination of water by accidental pesticide spills, a spill plan (project file) will be developed for this project. A copy will be retained onsite. It will be reviewed by all Forest Service personnel involved in the project, as well as by the contractor and the appropriate forest and district staff and line officers. Any herbicide application contract will contain clauses that will minimize the chances of herbicide spills (such as designating routes of travel and mixing sites, minimizing herbicide mix in tanks while traveling between units, requiring a separate water truck from the batch truck) and, if a spill occurs, outlining responses required by the contractor. Spill kits will be required in Forest Service and contractor vehicles on site and where contractor-supplied pesticides are stored. These actions would reduce the risk of contamination of water by accidental spills.

Practice 5-11 - Cleaning and Disposal of Pesticide Containers and Equipment

To prevent water contamination resulting from cleaning or disposal of pesticide containers all pesticide and adjuvant containers would be triple rinsed, with clean water, at a site approved by the Contracting Officer or Representative, or, in the case of application by Forest Service personnel, approved by the project director. The rinsate would be disposed of by placing it in the batch tank for application. Used containers would be punctured on the top and bottom to render them unusable after rinsing. Disposal of containers would be at legal dumpsites; certification of such disposal would be required prior to final payment on contract applications. Equipment would not be cleaned and personnel would not bathe in a manner that allows contaminated water to enter any body of water on the national forest.

Practice 5-12 - Streamside Wet Area Protection During Pesticide Spraying

To minimize the risk of pesticides reaching surface water and ground water, as well as altering the riparian area adjacent to aquatic features, areas of no herbicide use will be employed as described in Table 2-4. Buffer strip locations and width are based partly on results from water monitoring from previous years' pesticide application projects on the ENF. Monitoring showed that the size of those buffer strips was adequate to prevent degradation of downstream beneficial uses. Buffer width sizes are also based on the chemical properties and the labeled use of the herbicides being proposed. Using these two criteria, we estimate that these buffer strips would provide adequate protection for downstream beneficial uses.

Buffer strip boundaries would be flagged or otherwise designated on the ground. The contractor or project employees would be informed of the location and extent of each of the strips prior to treatment. Applications would be monitored by the Contracting Officer or project director to determine accurate placement. Spray application personnel would not be allowed into these buffers.

Table 2-4. Untreated Buffer Strips Adjacent to Aquatic Features

Pesticide(s)	Buffer width on each side of perennial streams[1]	Buffer width on each side of all other streams[1, 4]	Buffer width for special aquatic features[2]	Buffer width for domestic water source[1]
Glyphosate	50 feet	0 feet–stream not flowing. 25 feet -stream is flowing.	25 feet	50 feet
Glyphosate[3] (aquatic label)	0 feet	0 feet	0 feet	50 feet
Triclopyr/ Clopyralid	50 feet	25 feet	50 feet	50 feet
Hexazinone	100 feet	100 feet	100 feet	NA

[1] As measured from the edge of the stream channel. If a defined channel is not present (draws do not have defined channels), measurement is from the bottom of the feature.
[2] As measured from the edge of the wet area surrounding the special aquatic feature. Special aquatic feature includes springs, seeps, bogs, fens, wet meadows, and all other wet areas.
[3] When used as treatment for yellow starthistle control.
[4] Including roadside ditches with water present.

Practice 5-13 - Controlling Pesticide Drift During Spray Applications

To minimize the risk of pesticide falling directly into water or non-target areas protection measures will be placed into the contract and project plans This includes: 1) using ground application equipment; 2) ceasing application when weather parameters exceed label requirements, precipitation, or forecast of greater than a 70% chance of precipitation in the next 24 hours (except hexazinone); 3) requiring a spray nozzle that produces a relatively large droplet; 4) requiring low nozzle pressures (15 psi); 5) requiring the spray nozzle be kept within 24 inches of vegetation being sprayed; 6) requiring a pressure gauge or pressure regulator on the backpack sprayers; 7) requiring a directed spray away from conifer seedlings and oaks as well as the use of physical barriers; and 8) requiring the use of a seedling wash-down solution for accidentally oversprayed seedlings.

BMP's that are pertinent to the use of mechanical equipment will be implemented. This includes: BMP’s 1-6, 1-19, 2-12, 5-1, 5-2, 5-3, and 5-6.

Practice 1-6 – Protection of Unstable lands

To provide appropriate erosion and sedimentation protection for unstable areas there would be no ground-based entry of mastication equipment within 100 feet of any identified landslides, landslide prone lands or instabilities (such as mining ditches) or as determined by a geologist/soil scientist. This action would reduce the risk of triggering mass slope failure with resultant erosion and sedimentation.

Practice 1-19 - Streamcourse and Aquatic Protection

To control sediment and other pollutants from entering streamcourses, ground based entry of mastication equipment would not be allowed within 100 feet of perennial streams, lakes and reservoirs, meadows and springs, and 50 feet on each side of seasonal and ephemeral streams. Riparian vegetation would not be masticated.

Practice 2-12 - Servicing and Refueling of Equipment

To prevent pollutants from being discharged into streamcourses, all mechanized equipment will be refueled outside of Riparian Conservation Areas, if possible.

Practice 5-1 -Soil Disturbing/Treatments on the Contour

Sediment production and stream turbidity would be protected by minimizing the disturbance associated with turning of the equipment within the Riparian Conservation Areas.

Practice 5--2 - Slope Limitations for Mechanical Equipment Operation

To reduce gully and sheet erosion and associated sedimentation mechanical equipment will be restricted to slopes generally less than 35 percent. Within Riparian Conservation Areas, mechanical treatments would be minimized on moderate slopes (15-30 %) and restricted to slopes less than 30%.

Practice 5-3 - Tractor Operation is Limited in Wetlands and Meadows

To limit sedimentation in wetlands and meadows, mastication equipment would not be allowed within 50 feet of meadows, springs, and wetlands.

Practice 5-6 - Soil Moisture Limitations for Mechanical Equipment Operations

To prevent compaction, rutting, and gullying mechanical treatment activities would be restricted and/or controlled during high soil moisture conditions.

Alternative 2 (No Action)

Under the No Action alternative current management plans would continue to guide the management of the project area. No reforestation or release would occur. No fuel treatments would occur. No invasive plant treatments would occur. Management activities with existing decision documents would continue to be implemented, which includes 1,868 previously planted and hand released acres.

Alternative 3

Alternative 3 was designed to address the issues brought forward by the public during scoping. Specifically, Alternative 3 addresses concerns that proposed use of herbicides could pose an unknown risk to humans, wildlife, and the environment, including Native American plant gatherers; proposed use of herbicides would leave standing dead brush that would pose an immediate fire hazard; proposed herbicide use could contaminate water; and proposed use of herbicides could create conditions more hospitable to invasive species. Alternative 3 is the same as Alternative 1 except as described below:

Reforestation

Approximately 592 acres would be planted under this alternative, using the same methods as Alternative 1. In addition to the approximately 350 acres of no planting areas under Alternative 1, no planting would occur on about 800 acres where bearclover as competing vegetation exceeds approximately 40% ground cover (refer to Table 2-5).

About 1,868 acres within the project area have been planted from 2005 to 2009.

Replanting/interplanting would occur as in Alternative 1, when seedling mortality threatens plantation failure (less than 100 trees per acre and less than 60 percent stocked). Currently, about 665 acres would be replanted or interplanted.

Site Preparation and Release

Initial Treatments: In unplanted areas, the initial treatment would be hand cutting of shrubs in approximately 4-5 feet radius the year prior to planting (site prep) to create planting spots make the area accessible for planting. On previously planted areas, the initial treatment of hand cutting/hand grubbing would be a release treatment, hand cutting/hand grubbing shrubs, forbs, and grass approximately 4-5 feet radius around planted trees.

Follow-up Treatments: Hand cut or hand grub annually up to 4 more years depending on the results of monitoring tree survival and shrub growth (refer to Monitoring section). The hand cutting/hand grubbing prescription is intended to facilitate tree survival by reducing competition from grasses, forbs, and shrubs while allowing shrub development interspersed among the groups of trees.

Invasive Plants

Employ mechanical methods, such as hand pulling or grubbing, to control yellow starthistle. It is anticipated that multiple treatments would be necessary to treat missed or recently germinated, plants. Follow-up treatments may be repeated yearly, based on effectiveness monitoring. Treatments may continue for up to ten years.

Employ mechanical methods, such as hand pulling or tarping, to control tall whitetop. It is anticipated that multiple treatments would be necessary to treat missed or recently germinated, plants. Follow-up treatments may be repeated yearly, based on effectiveness monitoring. Treatments may continue for up to ten years.

Fuel Reduction

Five years following planting, masticate shrubs in the defense zone within ¼ mile of Highway 50 (maximum estimated 388 acres) to reduce surface and ladder fuels which would reduce wildfire spread and intensity. Mastication would be limited to slopes generally less than 35%.

Table 2-5 Proposed Treatments by Stand – Alternative 3

STAND	Approx Stand Acres	Approx Treatment Acres	Planted Acres to Date[1]	Initial Plant Acres[2]	Release Treatment	Comment
503-006	3	0	0		None	
503-008	40	3	3		hand cut/hand grub	
503-009	4	4	4		hand cut/hand grub	
503-027	36	2	2		hand cut/hand grub	
503-111	5	5	5		hand cut/hand grub	
503-112	55	0	0		None	Snag Patch[4]
503-113	23	0	0		None	
609-010	76	76	76		hand cut/hand grub	
609-025	71	71	71		hand cut/hand grub	
609-026	32	32	32		hand cut/hand grub	
609-027	254	96	78	12	hand cut/hand grub	oak[3]
609-029	36	36	36		hand cut/hand grub	
609-030	373	247	47	178	hand cut/hand grub	oak
609-031	60	0	0		None	Snag Patch

planting, hand release, and hand pulling of invasive plants would not take place within these sites.

- **To protect sensitive plants:** Conduct field surveys in the spring to verify the suitability of potential habitat for sensitive plants. Known occurrences of Pleasant Valley mariposa lily (*Calochortus clavatus)* would be flagged or otherwise designated by a trained Botanist. Tree planting and hand release treatments would not take place within these occurrences. Hand treatments (hand pulling or cutting) of invasive plants would be allowed after sensitive plant flowering and seed set. Any new occurrences of sensitive species within the project area will be flagged and protected by avoidance.
- **To manage perennial streams:** No conifer release treatments would occur within 50 feet of the edge of stream channels. Between 50 and 100 feet from the edge of stream channels, conifer hand release treatments would maintain a minimum of 50 percent live ground cover.
- **To protect water quality:** Compliance with the Clean Water Act is demonstrated through the implementation of Best Management Practices (BMPs) certified by the state, and then monitoring to determine if the appropriate Central Valley Regional Water Quality Control Board standards are met. These BMPs are designed to prevent degradation of downstream water quality. Water Quality Management for Forest Service Lands in California - Best Management Practices (2000) describes the BMPs that are referenced in the Land and Resource Management Plan. The BMPs that are pertinent to the use of mechanical equipment will be implemented. This includes: BMP's 1-6, 1-19, 2-12, 5-1, 5-2, 5-3, and 5-6.

Practice 1-6 – Protection of Unstable lands

To provide appropriate erosion and sedimentation protection for unstable areas there would be no ground-based entry of mastication equipment within 100 feet of any identified landslides, landslide prone lands or instabilities (such as mining ditches) or as determined by a geologist/soil scientist. This action would reduce the risk of triggering mass slope failure with resultant erosion and sedimentation.

Practice 1-19 - Streamcourse and Aquatic Protection

To control sediment and other pollutants from entering streamcourses, ground based entry of mastication equipment would not be allowed within 100 feet of perennial streams, lakes and reservoirs, meadows and springs, and 50 feet on each side of seasonal and ephemeral streams. Riparian vegetation would not be masticated.

Practice 2-12 - Servicing and Refueling of Equipment

To prevent pollutants from being discharged into streamcourses, all mechanized equipment will be refueled outside of Riparian Conservation Areas, if possible.

Practice 5-1 -Soil Disturbing/Treatments on the Contour

Sediment production and stream turbidity would be protected by minimizing the disturbance associated with turning of the equipment within the Riparian Conservation Areas.

Practice 5--2 - Slope Limitations for Mechanical Equipment Operation

To reduce gully and sheet erosion and associated sedimentation mechanical equipment will be restricted to slopes generally less than 35 percent. Within Riparian Conservation Areas, mechanical treatments would be minimized on moderate slopes (15-30 %) and restricted to slopes less than 30%.

Practice 5-3 - Tractor Operation is Limited in Wetlands and Meadows

To limit turbidity and sediment production in wetlands and meadows mastication equipment would not be allowed within 50 feet of meadows, springs, and wetlands.

Practice 5-6 - Soil Moisture Limitations for Mechanical Equipment Operations

To prevent compaction, rutting, and gullying mechanical treatment activities would be restricted and/or controlled during high soil moisture conditions.

Monitoring (all Action Alternatives)

BMP monitoring: To provide further protection for beneficial uses of water, the validity of these assumptions is subject to verification through the Best Management Practices Evaluation Program (BMPEP). This program is designed for evaluating the implementation and effectiveness of BMPs in management activities.

Water quality monitoring: A water quality monitoring plan (BMP 5.9) is developed specifically for pesticide treatments. It would be implemented prior to application to determine baseline conditions. A hydrologist, soil scientist, and silviculturist would evaluate and interpret the results of the monitoring. This monitoring would determine if herbicides have moved off-site into water after application, through overland flow, leaching, or subsurface flow and would determine the amount of herbicide residue reaching water. This information would be critical to evaluating other protection measures.

Seedling survival and shrub monitoring*:* Survival monitoring will be conducted in the first and third years following planting and as needed thereafter to determine survival of planted conifer seedlings and needed follow-up treatment. Shrub monitoring will be conducted 5 years following planting to assess the fuel loading and need for follow-up fuel reduction treatments.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need.

An alternative that uses a variety of non-chemical methods to meet the purpose and need was proposed by the public. Non-chemical invasive plant control methods proposed include goat grazing, mowing, manual removal, burning, and biological control. Non-chemical site preparation and release methods proposed included mechanical, goat grazing, prescribed fire, hand grubbing, mechanical removal, mulching /covers, and torching/flaming.

Some non-chemical methods for site preparation, release, invasive plant control, and fuel reduction are included under Alternative 3. Alternative 3 proposes hand grubbing and hand cutting methods for site preparation and rel

Non chemical methods not considered in detail

Invasive plant control

Biological control: The goal of a biological control program is not to eradicate the target plant. Biological control can reduce densities and subsequent damage by invasive plants as part of an Integrated Pest Management program. While biological control may reduce spread because of reduced seed production, they do not contain invasive plants. The El Dorado County Agricultural Commissioner has an active Biological Control program for yellow starthistle in El Dorado County. Six species have been released into El Dorado County, five of which are routinely found in county traps. These include the bud weevil (*Bangasternus orientalis*); hairy weevil (*Eustenopus villosus*); flower weevil (*Larinus curtus*); the peacock fly (*Chaetorellia australis*); gall fly (*Urophora sirunaseva*); and yellow starthistle rust (*Puccinia jaceae*). Many of these insects are thought to be established on the ENF, although trapping in not routinely done in that vicinity (L. Mila, personal communication, 2008). This method was considered but dropped from detailed analysis because this method would not meet the project purpose and need to contain and control yellow starthistle and eliminate tall whitetop in the project area.

Mowing: Mowing as a weed control tool along trails and roadways is hampered by terrain limitations. Rocks, logs, and other native materials scattered through the treatment areas create additional difficulties for mowing. Based on the items listed, mowing could not be fully implemented and was therefore eliminated from detailed study in this analysis.

Goat grazing: Goats are not selective on the vegetation they eat. At a site on the Stanislaus National Forest, goats preferentially ate black oak, to the point of girdling them by eating their bark, reducing our ability to protect hardwoods. Goats also readily consumed the conifer species sugar pine and Douglas fir, reducing species heterogeneity (observation on a visit to a plantation being grazed by goats on the Stanislaus NF). Based on the potential that goats could remove conifer species and hardwoods while eating invasive species (not meeting the purpose and need) this method was eliminated from detailed study in this analysis

Prescribed Fire: The use of prescribed fire was suggested as a means of controlling yellow starthistle. Areas outside of the ENF have been burned for yellow starthistle control. The time of year the burn would take place (late June to early July), following seed dispersal and senescence of desirable grasses and forbs but prior to viable starthistle seed production, would be well after the start of fire season on the ENF, which is generally between May 1st and June 1st. Because of the summer timing requirement, prescribed burning is perhaps the riskiest option for yellow starthistle management. Any escaped fire would be difficult to control in this area due to slopes, resulting in a high likelihood of conifer seedling mortality. In addition, with a major interstate at the bottom of the canyon it is highly unlikely that broadcast burning would be used. Broadcast burning would put large volume of smoke on the highway, threatening public safety. The mitigation for this would be to close the highway for the burning. This method was considered but dropped from detailed analysis because it could lead to high mortality of conifers and would not meet the project purpose and need to reestablish a forested landscape.

Reforestation and Site Preparation and Release

Where and when non-chemical treatments are effective has been well established through scientific methods (e.g. Click, et al., 1988; Fiddler and McDonald, 1983; McDonald and Fiddler, 1989) and extensive experience by the ENF (refer to Silviculture Report). Prior to 1989, when herbicide use was made available by the Region 5 Vegetation Management for Reforestation FEIS and ROD (USDA 1989b), non-chemical methods for reforestation and invasive plant control have been analyzed and utilized in the past on the ENF. Non-herbicide methods have been implemented primarily in limited areas within larger reforestation projects. For example, hand cutting and grubbing has been used for release and invasive plant work within non-herbicide streamside zones. The lack of effectiveness of non-pesticide methods is a major concern. In some vegetation types (such as bearclover), reforestation without herbicide methods would have a high likelihood of failure to achieve both survival and growth objectives. Other vegetation types (such as sprouting shrubs, grasses and forbs) have more promise in achieving some degree of survival, but only at a high cost associated with replanting and repeated release treatments. Even if survival was achieved, projected growth of seedlings in these vegetation types would delay meeting objectives to accelerate the development of key habitat and old forest characteristics and reduce the risk of loss to wildland fire (SNFP ROD, page 49).

Mulching/covers: The use of mulch collars/mats around the trees can be effective on grasses and forbs, but are expensive to install and maintain. They have not proven to be effective on the species and size of vegetation (woody brush) most common in these units. This method was considered but dropped from detailed analysis because mulch collars/mats have not proven to be effective on the woody brush most common in these units, not meeting the project purpose and need to reestablish a forested landscape.

Mowing/Mechanical removal: Mowing as a conifer release tool is hampered by terrain these heights would increase herbicide drift, potentially impacting streams and other non-spray areas, requiring extensive untreated buffer strips to protect water quality. Based on the items listed, aerial application methods could not be fully implemented and was therefore eliminated from detailed study in this analysis.

Table 2-6. Comparison of Alternatives

Indicator Measure	Alternative 1 Proposed Action	Alternative 2 No Action	Alternative 3
Purpose and Need			
Reestablish a forested landscape			
Acres certified with adequate stocking by age five to ten	2,650-3,000	350-600	600-1,100
Reestablish this forested landscape effectively and economically			
Acres with competing vegetation levels below twenty percent (total live ground cover) for a period of two to three years after planting	Would meet goal on about 3,320 acres	None	Would meet goal within critical 5-foot circle around trees on about 2,460 acres, but would not meet short-term goal in units as a whole.
Growth (height and diameter (DBH)) at age 15 and 50 – Age 15	Height - 22 feet Diameter - 6.4 inches	Height - 10 feet Diameter - 2.7 inches	Height - 11 feet Diameter - 3.1 inches
Growth (height and diameter (DBH)) at age 15 and 50 – Age 50	Height - 74 feet Diameter - 20 inches	Height - 35 feet Diameter - 9.4 inches	Height - 40 feet Diameter - 10.8 inches
Cost (total and per acre)	$2,530,000 or $762 per acre.	0	$4,688,000 or $1,906 per acre.
Reduce short term fuels loading			
Flame lengths in 90th percentile weather conditions.	0-5 years – 7.3 feet 5-10 years – 5.4 feet 10-25 years - 5.4 feet 25+ years – 5.4 feet	0-5 years – 7.3 feet 5-10 years – 5.4 feet 10-25 years -5.5 feet 25+ years – 15.1 feet	Same as Alternative 2
Percentage of the area in grass or grass/shrub fuel model	Age 0-5 Grass Fuel model over 100% Age 5- 25+ Grass/shrub Fuel model over 85%	Age 0- 5 Grass Fuel model over 100% Age 5- 10 Grass/shrub Fuel model over 100% Age 10-25+ Shrub Fuel model over 100%	Same as Alternative 2
Restore spotted owl travel corridors between owl PACs			
Years to achieve spotted owl foraging and nesting habitat as described by CWHR types 4M/4D/5M/5D, where site conditions allow	Planted acres 4M/4D – 50 years 5M – 80 years 5D - 80 years	Planted acres 4M/4D - 150 years 5M - 150 years 5D - >150 years Unplanted acres unlikely to achieve 4M/4D/5M/5D within 150 years due to < 40% crown closure	Planted acres 4M/4D - 110 years 5M – 115 years 5D - >150 years Unplanted acres unlikely to achieve 4M/4D/5M/5D within 150 years due to < 40% crown closure
Control yellow starthistle and eliminate tall white top			
Containment of current yellow starthistle population or decreasing in size	Yes	No - yellow starthistle would continue to spread limited only by environmental factors.	No - hand methods are unlikely to be successful because of the size of the yellow starthistle infestation
Elimination of tall whitetop population	Yes	No	Yes

Indicator Measure	Alternative 1 Proposed Action	Alternative 2 No Action	Alternative 3
Issues			
Herbicides represents an unknown or unacceptable risk to humans, wildlife, and the environment.			
Risk to human health and safety, based primarily on Hazard Quotients (HQ), measured by comparing the estimated level of exposure (dose) to the Reference dose (RfD) or some other index of acceptable exposure	**Workers**: Low risk to workers. **Public:** Low risk to public. Under normal conditions, members of the general public should not be exposed to substantial levels of any of these herbicides.	No risk from herbicide use	No risk from herbicide use
Risk to wildlife, aquatic, and plant species, based primarily on Hazard Quotients (HQ), measured by comparing the estimated level of exposure (dose) to the No Observed Effect Level (NOEL), No Observed Effect Concentration (NOEC) or some other index of acceptable exposure	Culturally Important Plants		
	Plant abundance may be affected short-term, but no plant species would be eliminated, except tall whitetop. Long-term, culturally important plants that favor open conditions would be enhanced	Plant abundance would be unaffected short-term. Long-term, culturally important plants that favor open conditions could be negatively affected	Plant abundance would be unaffected short-term. Long-term, culturally important plants that favor open conditions could be negatively affected
	Wildlife, Aquatic, and Plant Species		
	Plant species -Little or no damage to sensitive plants from herbicide drift or runoff expected **Aquatic and Terrestrial Species** - Low overall risk (HQ<1) using project design features **Accidental Spill** –Some risk to surrogate species and algae. Project design features (BMPs) prevent or reduce effects of a spill	No risk from herbicide use	No risk from herbicide use
Proposed use of herbicide would leave standing dead brush that would pose an immediate fire hazard			
Fuel model in immediate future (< 5 years)	GR4 – standing dead brush contribution to fuel load would be small because of relatively small size when treated and would be short-term (1-2 years)	GR4 – no standing dead brush	GR4 – no standing dead brush
Proposed herbicide use could contaminate water			
Levels of herbicides that may be detected as compared to existing guidelines	Short-term: Herbicides (and surfactants and additives) may reach streams under several worse-case scenarios. These concentrations would be below Maximum Contaminant Levels for humans.	None - no herbicide use	None - no herbicide use

Indicator Measure	Alternative 1 Proposed Action	Alternative 2 No Action	Alternative 3
	Long-term: No herbicides in streams. **Aquatic and Terrestrial Species** - Low overall risk (HQ<1) using project design features **Accidental Spill** –Some risk to surrogate species and algae. Project design features (BMPs) prevent or reduce effects of a spill		
Proposed use of herbicides could create conditions more hospitable to invasive species and undesirable weeds than were present before the chemicals were applied			
Risk of increasing spread of invasive plants in the project area	Short-term: (<5 years) Increased risk of invasive plant invasion with broadcast herbicide treatments. Reduced risk of invasive plant invasion on 510 acres of radial treatments around documented infestations of yellow starthistle and cheatgrass. Long-term: (> 20-25 years) Reduced risk of invasive plant spread with the establishment of a forested landscape.	Short-term: Persistence in openings, but spread unlikely due to shrubs dominating site Long-term: A higher risk of a large-scale high severity fire would potentially facilitate invasion plant expansion in open ground created such a fire.	Short-term: Persistence in openings and radial treatment areas, but spread unlikely due to shrubs dominating site Long-term: Similar to Alternative 2.

Chapter 3

Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in Chapter 2.

Past, Present, and Foreseeable Future Actions Considered in Cumulative Effects

"Cumulative impact" is defined (40 CFR 1508.7) as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of the source. An individual action when considered alone may not have a significant effect, but when its effects are considered together with the effects of other past, present, and reasonably foreseeable future actions, the effects may be significant. Cumulative impacts (effects) can result from individually minor but collectively significant actions taking place over a period of time. If the action has some direct or indirect effect on any given resource, no matter how minor, then a cumulative effects analysis for that resource is necessary.

The cumulative effects analysis in this Final Environmental Impact Statement is consistent with Forest Service National Environmental Policy Act (NEPA) Regulations (36 CFR 220.4(f)) (July 24, 2008), which state, in part:

> "CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decisionmaking. (40 CFR 1508.7)"

The projects listed below either overlap the Freds Fire Reforestation Project area or are adjacent it. Each resource has identified which of these projects (and others depending on the resource cumulative effects analysis area) that contribute cumulative impacts and analyzed those effects.

The following is a list of projects that are within or adjacent to the Freds Fire:

By far the greatest impact on the environment has been from the Freds Fire and subsequent salvage of fire killed trees. The Freds Fire affected, and has the potential to continue to affect soils, water quality, wildlife habitat, cultural resources, and vegetation.

Past fire occurrences in the South Fork of American River Canyon have impacted the environment in and adjacent the Freds Fire. Historic fire occurrences within 2.5 miles of the South Fork of American River, from Riverton to Horsetail Falls (23 miles) show 5 large (> 3,000 acres) stand-replacing fires have occurred since 1959 (Ice House 1959 -19,000 acres, Pilliken 1973 – 10,000 acres, Wrights 1981- 3,800 acres, Cleveland 1992 – 24,000 acres, and Freds).

Sierra Pacific Industries (SPI) and four individuals own land within the fire area (see Figure 1-1 in Chapter 1). A total of 2,850 acres of SPI land burned within the Freds Fire perimeter. SPI has completed logging and is in the reforestation process. SPI has planted trees on approximately 2,526 acres. These planted acres on SPI land have had herbicide treatments with hexazinone (1,000 acres) and glyphosate (1,526 acres) (Barr, personal communication, 2009).

The Eldorado National Forest has planted about 1,868 acres within the project area. These planted trees were hand released the year of planting.

Invasive Plants - The Yellow Starthistle Project involves treatments to control yellow starthistle on the Forest. In the vicinity of the Freds fire, treatments are ongoing along Webber Mill road (11N38) from Soda Springs–Riverton Road (17N12) and into the Freds fire area. Herbicides being used are clopyralid and glyphosate. Tall whitetop is currently being tarped.

Roadrunner Fuels Reduction project – fuels reduction activities on approximately 192 acres in the vicinity of Highway 50 on the Placerville Ranger District. The activities include removal of dead and dying hazard trees, understory thinning involving the cutting and removal of both commercial and non-commercial sized trees, mastication, tractor piling and pile burning, hand felling and piling, and pruning.

Misnomer Fuels Reduction project – located near Atherton Flat in T11N, T12N; R15E and R16E, MDB&M. This project includes fuel reduction activities include a combination of understory burning, understory thinning involving the cutting and removal of both commercial and non-commercial sized trees, mastication, tractor piling and pile burning on approximately 989 acres. Harvest is complete and tractor piling has been completed on about 800 acres. Remaining tractor piling, pile burning, and follow-up prescribed burning is scheduled for completion within 1 to 4 years.

Ongoing recreation use of portions of the fire area include:

Construction, reconstruction, maintenance and use of the Pony Express Trail by non-motorized recreationists.

Continued use of recreation residence tracts just south of the fire (29, 30, 31, 33, and 34 Milestone Tracts).

Dispersed camping, especially near Granite Springs.

State managed hunting opportunities (Dear Hunt Zone D5) and fishing in the South Fork of the American River.

Public firewood gathering.

Fire and Fuels

Affected Environment

The project area is primarily within the upper- and mid-montane zones. There are approximately 1,143 acres of upper montane, which varies from pure red fir to mixtures of red fir and white fir or lodgepole pine. Rocky areas are more prevalent than in other zones and are typically dominated by Jeffrey pine and various amounts of evergreen shrubs. Greenleaf manzanita, huckleberry oak and pinemat manzanita are the prevalent shrub species. There are approximately 2,381 acres of mid-montane zone, which consists of a narrow band above 5,000 feet elevation dominated by white fir and Jeffrey pine between the lower montane and upper montane zones. The vegetation varies considerably from mixed conifer to pure white fir forests, with the common element that white fir is generally a co-dominant or dominant. Sugar pine and incense cedar are commonly present. Douglas-fir is absent or present in low amounts. Red fir may be present in low amounts. Extensive areas, particularly with rocky or shallow soils may be dominated by or intermixed with evergreen shrubs. Huckleberry oak and greenleaf manzanita are the primary shrubs.

The remaining 288 acres of the project area are in the lower montane zone. This zone is characterized by ponderosa pine, black oak, and live oak forests with interspersed chaparral. Above 4,000 feet, white fir occurred historically intermixed with Douglas-fir. Large areas with black oak as a dominant or co-dominant occur in this zone, particularly on ridges or upper slopes or south or west aspects. In this zone, as elevation increases, historic fires increasingly varied with aspect and/or topographic position.

Fire risk is the chance, or probability, that a wildfire will start, either from natural or human causes, based on recent fire history. Fire hazard is determined by the characteristics of fuels combined with the influences of topography and weather. The fuels characteristics apply to both dead and live fuels, and include loading (tons per acre), size and shape, compactness, horizontal continuity, vertical arrangement, fuel moisture content, and chemical properties. Topographic and weather influences, combined with fuels characteristics, determine the rate of forward sprea and grea9litecs,-u7l898 90

Fire history from the Caribou wilderness of the Lassen National Forest and Lassen National Park, in Jeffrey pine-white fir forests (Solem 1995), is generally representative of conditions in the project area. Fire return intervals there ranged from 23 to 32 years. Precipitation at the Lassen sites is less than 100 centimeters per year. Precipitation in the northern Sierra is greater than 150 centimeters per year, which may better represent precipitation in the project area. The fire return intervals in upper montane forests that have more similar precipitation are most often greater than 40 years (Solem 1995, Taylor and Halpern 1991). For the project area, fire return intervals were probably somewhere in between and tending to the higher end.

Research on historic fire intensity and severity is lacking in this zone but white fir dominated types are thought to burn with mixed severity, like the similar upper montane red fir, but with a greater component of low severity fires. The pattern would be mostly low intensity fires that are often patchy. At varied intervals associated with dry years, more intense fires likely occurred that resulted in a patchwork of low, medium, and high severity areas across the landscape. It is difficult to find much research on historic patterns of fire extent and spread for the Sierra Nevada. Wildland fire use in the upper montane portion of Yosemite National Park suggests that fires were often limited in size by recent adjacent burned patches.

Historic fire occurrence data exists for this area of the Eldorado National Forest (ENF). The fireshed for this analysis is defined as: a strip of land paralleling the South Fork American River and extending north and south 2.5 miles on either side. It extends from the west where the river begins to parallel Highway 50 to approximately 23 miles east to the area of Horsetail Falls. This area encompasses approximately 78,642 acres. This analysis is summarized in Table 3-1.

Table 3-1. Fire Summary of Recent Fire History

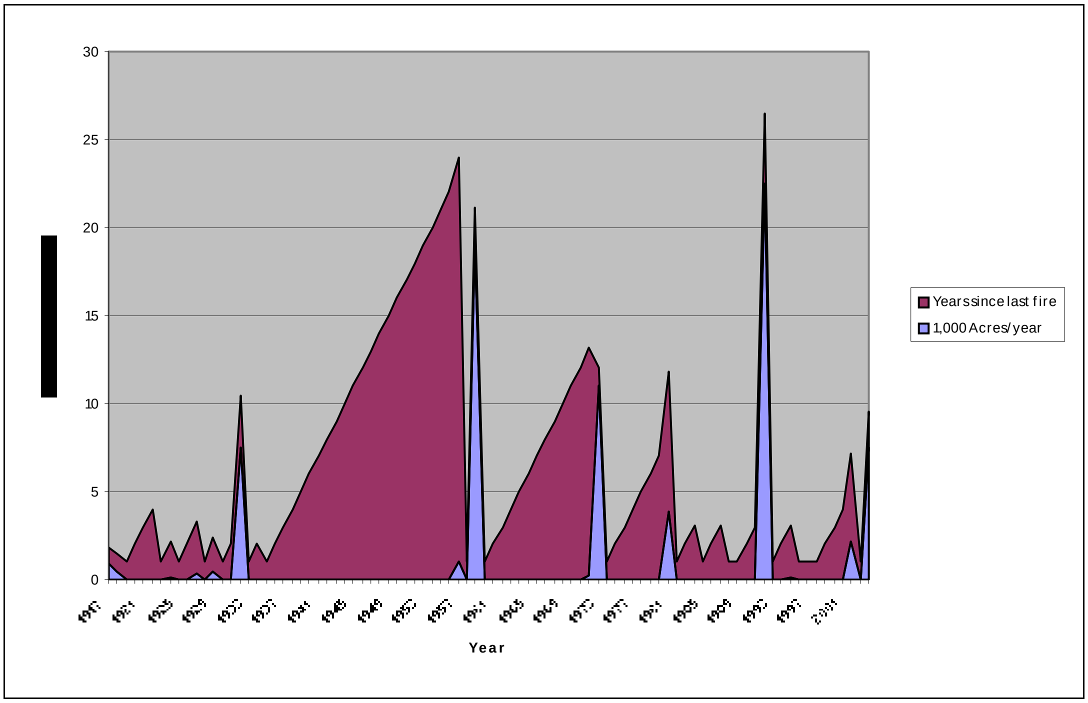
Size Class	Class C +	Class D +	Class E +	Class F +	Class G +
Acreage Range	10 acres or more	100 acres or more	300 acres or more	1,000 acres or more	5,000 acres or more
Fire Return Interval	4 year	7 years	8 years	10 years	18 years
Number of years with multiple fire occurrence	10 years	5 years	2 years	No	No
Percent Chance of Occurrence	41%	20%	13%	8%	5%

Note: Only the acreage burned within the fire shed was counted and may have reduced the size class of the actual fire.

Records for Class C (10 acres or larger) fires start in 1908. The first year with a recorded Class C fire in the American River Canyon is 1916 (refer to Figure 3-1). There were two fires, with acreages of approximately 30 acres and 775 acres. The period ends in 2004 with the Freds Fire. During this time period 40 Class C or greater fires have burned in the canyon. Approximately 61 percent of the fireshed has burned at least once during this time period and 12 percent has burned at least twice. On average, 805 acres burn each year. Based on fire history for this time period there is a 41 percent chance that there will be a C class or larger fire in this canyon in any given year. Since 1959, there have been at least 5 class E (300 acres or larger) fires that have had a significant portion of them burn as a stand-replacing event. This time period can also be used to determine recent fire return intervals for different size classes of fires.

Records for Size Class A and B (less than 10 acres) exist for the period from 1970 to 2003. During this time period there were 399 Class A or Class B fires and 17 Class C fires in the area. Based on this data there are an average of 12 fire starts per year. There is one Class C or larger fire every two years.

Figure 3-1. Historic Fire Intervals and Acres (1,000) Burned per Year



Recent fire history indicates that C Class and larger fires can be broken into three periods: During the first period, 1916 to 1934, the average fire return interval is 2.4 years; the period averaged 553 acres burned per year with an average fire size of approximately 1,200 acres.

During the second period, 1935 to 1981, the average fire return interval is 9.4 years; 750 acres per year burned and the average fire size was 7,047 acres. Between 1935 and 1957 no C Class or larger fires are recorded. After this twenty-three year break there was a fire that burned over one thousand acres in the fireshed; it was followed two years later by the Ice House fire, which burned approximately nineteen thousand acres. The next C Class fires occurred after 13 years, in 1972 and 1973. They burned 200 and 11,000 acres, respectively. The next C Class fire to occur was the Wrights fire, eight years later (1981).

In the third period, 1982 to the present, the average fire return interval is three years, the average acres burned per year is 1,408, and the average fire size is 3,597 acres.

Highway 50 has been a relatively heavily used section of road for more than 100 years. There have been roadhouses and stage stops located in the canyon through out this time period. In the 1930’s when the Civilian Conservation Corps began work on the forest, it provided a readily deployable fire suppression force. Little evidence of the logging history in the canyon could be found, but it can be surmised that, given the steepness of the terrain, little logging occurred except along the ridges and flatter areas on the slope. These flatter areas were probably intensively harvested. Given this history the change in periodicy generally fits the theory that the effects of fire suppression have altered fire return intervals. The first period can be viewed as one of fairly frequent fires. The second period can be viewed as one of fairly effective fire control, with fewer fires reaching the Class C and greater size and those occurring at greater intervals. The third period can be viewed as a breakdown in the system.

After the completion of salvage on the Freds Fire Restoration Project, surface fuels present were predicted to consist of the following approximate tonnage in each of the size classes (Table 3-2):

Table 3-2. Approximate Residual Fuel after Completion of Freds Fire Restoration Project

Fuel Type	Fuel Size	Fuel Quantity (tons per acre)
1-hour	0" to ¼"	0.4
10-hour	¼" to 1"	1.15
100-hour	1" to 3"	1.5
1,000-hour	> 3"	5.0 (not including snags/logs left for old forest structure and wildlife)

The fuels were distributed as evenly as practical, providing sufficient ground cover (50%-60%) for soil protection purposes. This combination is low enough so that the accumulation of additional surface fuels from the predicted snag fall of the snags left standing for wildlife and watershed purposes would not present a large fuels buildup over time and contribute to fire suppression difficulties.

Following the fire deer brush (*Ceanothus integerrimus*), bearclover (*Chamaebatia foliolosa*), manzanita (*Arctostaphylus spp*), whitethorn (*Ceanothus cordulatus*) and various grasses have become the major species established. These brush species have the potential to almost fully occupy the site as evidenced from portions of the Cleveland fire (e.g. untreated drainages, untreated blocks, treatment demonstration areas, south of the American River canyon).

The Fire Effects Information System (USDA 2008a) described plant response to fire as follows:

"After soil-stored seed is scarified by fire, deer brush seedlings establish in great numbers. Most seedlings establish in the first postfire growing season. Natural thinning reduces seedling density as the stand ages. After a July 1942 wildfire consumed a deer brush stand on the El Dorado National Forest, deer brush density was about 300,000 seedlings per acre at postfire year 1; 10,000 per acre at postfire year 10; 2,500 at postfire year 20; and less than a few hundred seedlings at postfire year 30."

Bearclover recovers rapidly from disturbance and tends to form dense stands, its very presence tends to lower species richness quickly (McDonald et al 2004). In areas where bearclover is present it may out-compete grass and other brush species.

Environmental Consequences

Direct, indirect and cumulative effects for fire behavior and fuels consider the impacts of the alternatives when combined with the following past, present, and foreseeable future actions and events: Vegetative and fuel bed changes resulting from the fire. The actions contributing to cumulative effects were selected because they have caused or have the potential to cause changes in fire intensity and severity, fire hazard and resistance to control. The geographic scope of the cumulative effects analysis was selected because impacts to fuels and fire behavior accumulate at a given location on the ground, irrespective of actions in surrounding areas. The temporal scope was selected because the impacts to fuels and fire behavior at a given location can accumulate over time from different activities or events.

Alternative 1 (Proposed Action)

Direct Effects

Based on First Order Fire Effects Model analysis, small conifers have little fire resilience, even under mild burning conditions (flame lengths of four feet or less). It isn't until they reach 6 to 10 inches diameter at breast height (DBH) that the probability of mortality is 50 percent or less (Tables 3-3a, 3-3b, 3-3c).

Table 3-3a. Predicted of Mortality for a 2 Foot Flame Length

DBH (in) (cm)	Ponderosa Pine	Jeffery Pine	Sugar Pine	Douglas Fir	Incense Cedar	White Fir	Red Fir
2 5.1	98%	98%	98%	98%	98%	98%	98%
4 10.2	63%	61%	59%	63%	64%	70%	74%
6 15.2	49%	46%	43%	49%	51%	59%	65%
8 20.3	36%	33%	30%	36%	39%	48%	56%
10 25.4	27%	24%	21%	27%	29%	39%	48%

Table 3-3b. Predicted of Mortality for a 4 Foot Flame Length

DBH (in) (cm)	Ponderosa Pine	Jeffery Pine	Sugar Pine	Douglas Fir	Incense Cedar	White Fir	Red Fir
2 5.1	100%	100%	100%	100%	100%	100%	100%
4 10.2	100%	100%	100%	100%	100%	100%	100%
6 15.2	97%	97%	97%	97%	98%	98%	99%
8 20.3	52%	48%	45%	52%	54%	63%	70%
10 25.4	27%	24%	21%	27%	29%	39%	48%

Table 3-3c. Predicted of Mortality for a 6 Foot Flame Length

DBH (in) (cm)	Ponderosa Pine	Jeffery Pine	Sugar Pine	Douglas Fir	Incense Cedar	White Fir	Red Fir
2 5.1	100%	100%	100%	100%	100%	100%	100%
4 10.2	100%	100%	100%	100%	100%	100%	100%
6 15.2	100%	99%	99%	100%	100%	100%	100%
8 20.3	99%	99%	99%	99%	99%	99%	100%
10 25.4	92%	91%	90%	92%	93%	95%	97%

This is confirmed by the study done on Blodgett Forest Reserve (Stephens and Moghadas 2005). In this study the average DBH for plantation trees was less than 10 inches and the probability of mortality for these size classes were greater than 90 percent for all weather sets. Thus, the issue with the survivability of plantations is not the probability of mortality, as it will be high for most any fire, but the ability to control the fire at a small size. By keeping fires smaller until trees reach a size of greater fire resistance more trees will survive across the project area. It should be noted that all the plantations in the Stephens and Moghadas study were treated with herbicides. The fuel loading data from this study was used to compare the fire behavior of their treatments with fuel models (Scott and Burgan, 2005) that would develop in the project area (Table 3- 4) and the probability of mortality in a 10 inch DBH ponderosa pine.

Alternative 1 would create a mosaic of fuel profiles. Untreated areas, such as snag patches, low mortality areas, and riparian corridors, would provide areas of least fire spread in the near and mid future (5 to 25 years) as they progressed toward a fuel model SH7. These would aid to limit fire spread in this time period. The treated areas would be maintained at the stage where they can be best described by fuel models GR4 and GS2. While these areas have a greater spread rate the resistance to control is conversely less (Figures 3-2 to 3-5). The GR4 and GS2 fuel models also show a greater reaction to live fuel moisture (Table 3-5). This influence of live fuel moisture indicates that these fuel types will not readily burn until the live fuel has began to enter dormancy at live fuel moistures of less than 100 percent. This means that through the majority of the year any fires will be relatively easy to control. Since Alternative 1 will treat brush while it is relatively small, any contribution to the fuel load of standing dead brush would also be small.

Further, these brush skeletons would likely fall over from breakage and/or be crushed by snow during the first or second winter.

Table 3-4. Fire Behavior for Various Treatments and Fuel Models under 90th Percentile Weather

	Treatment	Rate of Spread (chains/hr)	Fire Line Intensity (Btu/ft/s)	Flame Length (feet)	Fire Area After 1 hr. (acres)	Probability of Mortality of a 10 inch DBH Ponderosa Pine
Stephens and Moghadas 2005	Sprayed and unthinned	4.6	45	2.6	0.7	25
Stephens and Moghadas 2005	Sprayed and thinned w/chainsaw	5.3	34	2.3	1.0	25
Stephens and Moghadas 2005	Sprayed and thinned w/masticator	3.2	13	1.5	0.3	25
Freds Fire Fuel Models	Fuel Model GR4*	51.4	428	7.3	126	99
Freds Fire Fuel Models	Fuel Model GS2*	25.5	221	5.4	63	47
Freds Fire Fuel Models	Fuel Model SH2*	9.6	234	5.5	23	57
Freds Fire Fuel Models	Fuel Model SH7*	49.1	2,083	15.1	120	99

***GR4:** Moderately coarse continuous grass, average depth about 2 feet. Spread rate very high; flame length high.
***GS2:** Shrub cover up to 50% and is 1 to 3 feet high, moderate grass load. Spread rate high; Flame length moderate.
***SH2:** Moderate fuel load , shrubs cover at least 50% of the site, depth about 1 foot, no grass fuel present. Spread rate low; flame length low.
***SH7:** Very heavy shrub load, depth 4 to 6 feet. Spread rate high, flame length very high.

The increased ability of fire suppression under this alternative provides the greatest probability of seedling survival. While any small conifer within a likely fire will probably not survive, the ability to contain fires at a smaller size increases the probability of seedling survival across the landscape. This alternative would also provide the communities of Silver Fork and Kyburz with the greatest protection from wild fire through the increased suppression capabilities.

Table 3-5. Expected Fire Behavior in 90th Percentile Weather and 50 Percent Slope

Fuel Model 80 percent Live Fuel Moistures	Rate of Spread (chains/hr)	Fire Line Intensity (Btu/ft/sec)	Flame Length (feet)	Fire Area After 1 hr. (acres)
Fuel Model GR4	51.4	428	7.3	98.9
Fuel Model GS2	25.5	221	5.4	24.2
Fuel Model SH2	9.6	234	5.5	3.3
Fuel Model SH7	49.1	2,083	15.1	88.1
100 Percent Live Fuel Moistures				
Fuel Model GR4	11.4	30	2.2	4.9
Fuel Model GS2	14.1	85	3.5	7.4
Fuel Model SH2	6.4	124	4.1	1.5
Fuel Model SH7	40.6	1673	13.7	60.3
120 Percent Live Fuel Moistures				
Fuel Model GR4	1.2	1	0.5	0.1
Fuel Model GS2	4.3	10	1.3	0.7
Fuel Model SH2	2.2	17	1.6	0.2
Fuel Model SH7	34.7	1403	12.6	44.0

Indirect Effects

This alternative would allow a fuel complex to develop so that future treatments could be applied to the ridge tops and canyon bottom. These treatments would require less impact, as the amount of brush would be greatly reduced over that of Alternatives 2 and 3. It is highly unlikely the mid-slopes would have fuel treatments in the future because the slopes (generally greater than thirty-five percent) preclude mechanical treatments and hand treatments could be cost prohibitive. This alternative would result in a fuel complex that would make future treatment less necessary.

Cumulative Effects

Alternative 1 would, in conjunction with the expected actions to be taken by the private landowners in the project area, enable effective fire suppression action to be conducted on both private and National Forest System (NFS) lands treated. Coordinated fire suppression tactics would be easier to implement across all ownerships. The opportunity to apply prescribed fire to the upper portions of the area in the future would also be facilitated by this alternative due to the relatively low fuel loadings anticipated, the exception being the snag retention clumps. Alternative 1 serves to enhance the opportunity to achieve the overall goal in the Sierra Nevada Forest Plan Amendment to reintroduce fire and reestablish the fire regimes that maintain ecological systems and processes. Alternative 1 would serve to reduce fire suppression difficulties in the area as a whole.

Alternative 1 may also enable the future development of strategically placed landscape area treatments (SPLATs) within the project area. SPLATS are areas treated with the overall objective of reducing uncharacteristically severe wildland fire effects across the landscape. The SPLATS, in conjunction with the Roadrunner Fuels Reduction Project, Jane Doe Fuels Reduction Project, and private land treatments, would provide an opportunity to achieve these objectives.

The Freds Fire landscape in its pre-fire condition was outside the historical ranges of variability for its Fire Regime Condition Class (FRCC) because of tree density and fuel loading (ENF Forest Condition Class Layer). Following the fire this same area is still outside the historical ranges of variability in its FRCC in amounts and sizes of brush fields (LANDFIRE Rapid Refresh FRCC layer). Implementation of Alternative 1 would move the project area towards maintaining fuel loading within the historical range of variability, reducing the probability of an “intense reburn” situation into the future, given the high probability of fire starts in the American River Canyon. The “intense reburn” assumption is based on the physics of fire behavior: the greater the amount of available fuel the greater the fire line intensity and the difficulty of fire suppression (Rothermal 1983).

Alternative 2 (No Action)

Direct Effects

In the first years following the fire grasses will predominate. Now, deer brush, bear clover and other brush species are beginning to dominate the site. The fire behavior of these fuels complexes can be best described with the standard fuel models defined by Scott and Burgan (2005). The initial grass stage is defined as a moderate load, dry climate grass model (GR4). As brush begins to take over the site it is modeled as a moderate load, dry climate grass-shrub model (GS2). When brush takes over the site but is still young with little dead material in it, it is modeled as a moderate load, dry climate shrub (SH2). When the deer brush has matured and accumulated a significant dead fuel component it is modeled as a very high load, dry climate shrub (SH7). Barring disturbance, the grass and grass-shrub stages should be fairly short lived as brush will rapidly dominate the site. The moderate load shrub stage should persist for as long as twenty years. Barring any future disturbance the final shrub stage would persist until it is eventually over topped and shaded out by trees. Due to competition from brush species the survival and growth rates of planted and naturally recruited seedlings would be low (refer to Chapter 3 - Vegetation Management) resulting in a canopy closure of trees that is largely ineffective in shading out brush. Thus, the time frame for this to occur could be in the order of centuries. However, fire history shows that the area would likely experience a disturbance in the form of a large fire within the next 25 years. Given the fuel conditions in this alternative the effects of this fire would be stand replacing. These circumstances could allow the shrub stages persist indefinitely.

Table 3-6. Expected Fire Behavior in 90th Percentile Weather and 50 Percent Slope

Fuel Model	Rate of Spread (chains/hr)	Fire Line Intensity (Btu/ft/sec)	Flame Length (feet)	Fire Area After 1 hr. (acres)	Line Production Rate for a Type I crew (chains/hr)
Fuel Model GR4 (near future)	51.4	428	7.3	98.9	24
Fuel Model GS2 (early mid future)	25.5	221	5.4	24.2	24
Fuel Model SH2 (mid future)	9.6	234	5.5	3.3	6
Fuel Model SH7 (future)	49.1	2,083	15.1	88.1	6

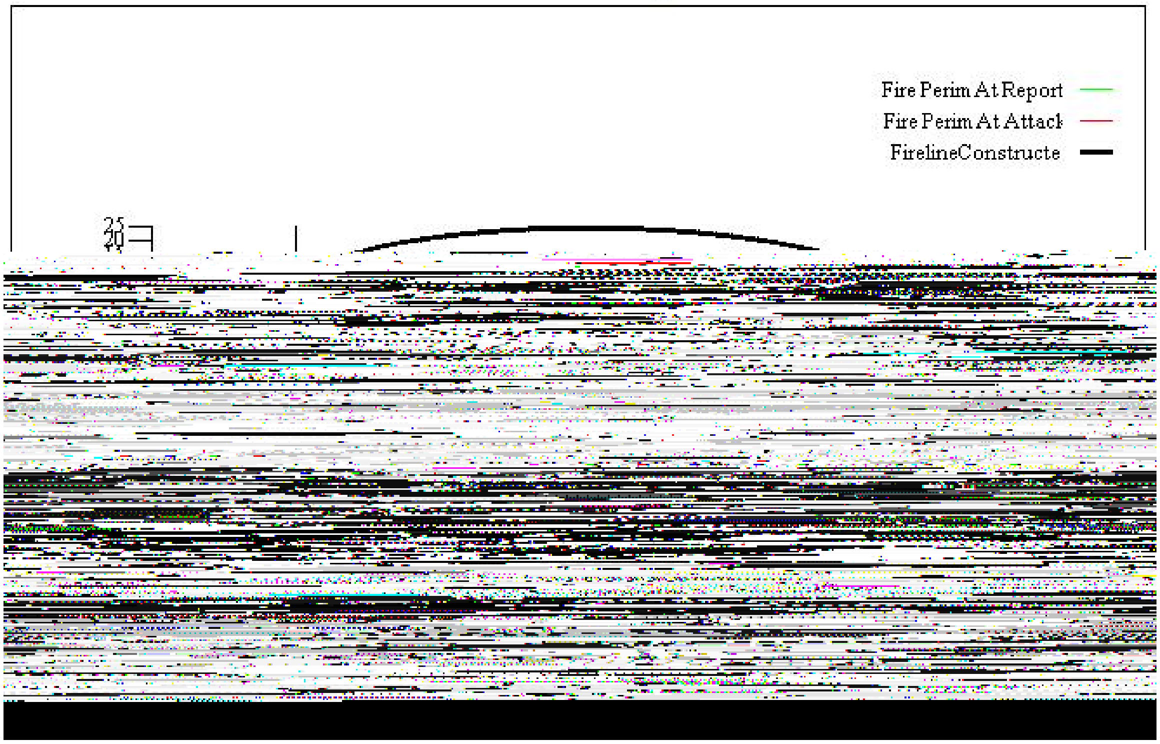
BehavePlus3 (Andrews et al 2005) was used to model the ability to contain fires in the fuel models expected to develop under the alternatives. They were modeled with the 90th percentile weather (Table 3-7) and a fifty percent slope (Table 3-6). A total of 5 engines and 1 bulldozer were used for this modeling. These resources are generally available within the area. The maximum elapsed time for this model is ten hours.

Table 3-7. 90th Percentile Weather

Dispatch Level	Moderate
1-hour fuel moisture	4 to 5 percent
10-hour fuel moisture	5 to 6 percent
100-hour fuel moisture	7 to 8 percent
1,000-hour fuel moisture	8 to 10 percent
20-foot wind speed	7.8 to 9.8 miles/hour
Live herbaceous fuel moisture	80 percent
Live woody fuel moisture	80 percent

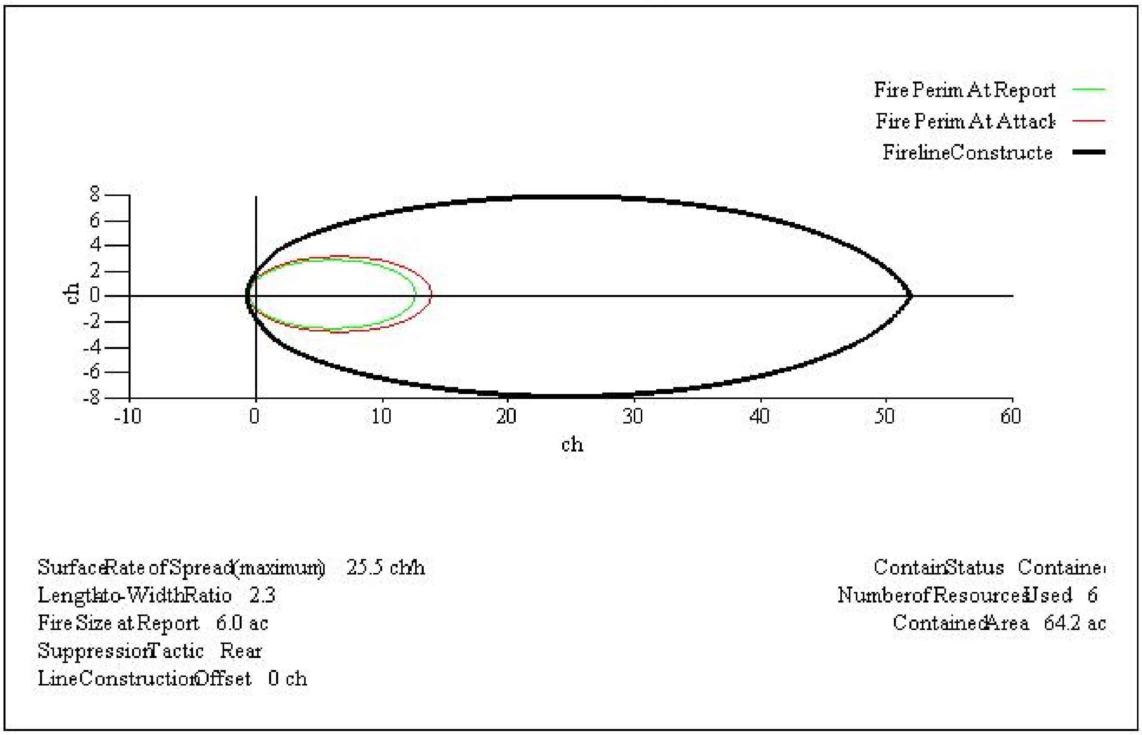
Fuel Model GR4 (Figure 3-2) – This fuel model is characterized by moderately coarse continuous grass, average depth about 2 feet. The fire spread rate is very high and the flame length is high. This model produced a relatively large fire that was contained in 3.8 hours. Line production rates in this model are the highest. The dozer can cut between eight to thirty chains per hour and the engine crews can produce twenty-five chains of wet line per hour each.

Figure 3-2. Fuel Model GR4



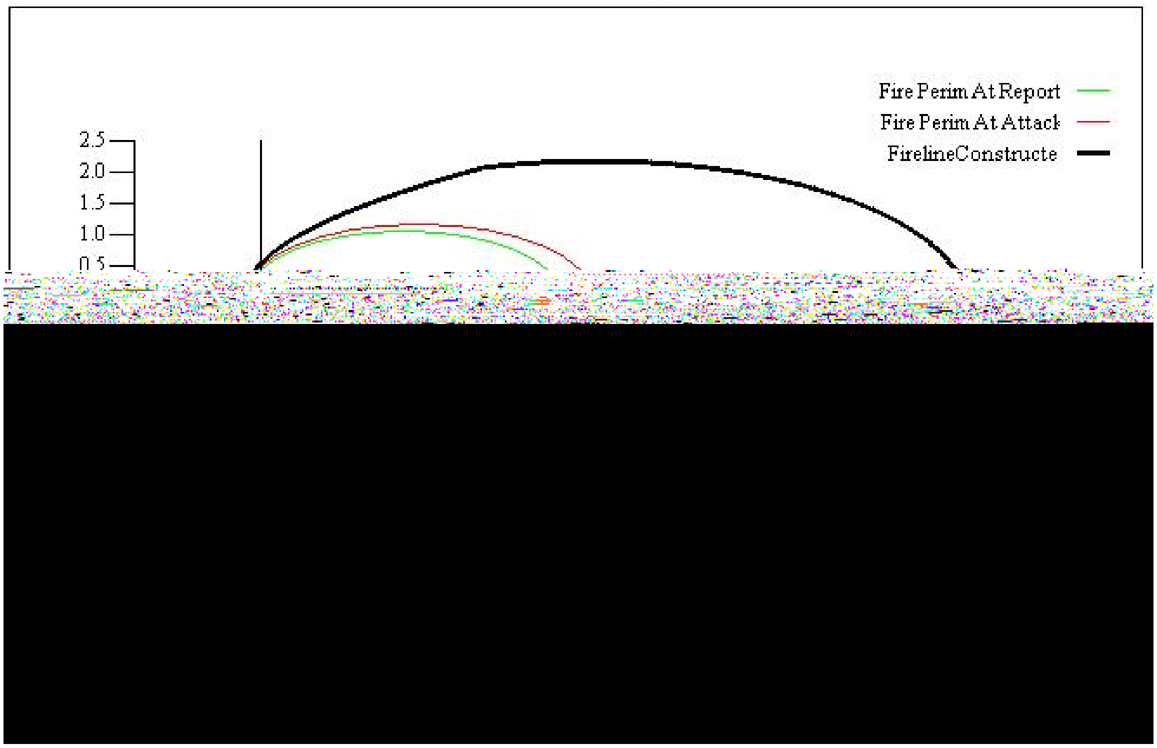
Fuel Model GS2 (Figure 3-3) – This fuel model is characterized by up to 50% shrub cover 1 to 3 feet high and a moderate grass load. The fire spread rate is high and the flame length is moderate. This model also produced a relatively large fire that was contained in 1.5 hours. The slightly smaller size can be attributed the dampening effects of the young brush. Line production rates in this model are only slightly less than those of the previous model. The dozer can cut between two to twenty-five chains per hour and the engine crews can produce twenty chains of wet line per hour each.

Figure 3-3. Fuel Model GS2



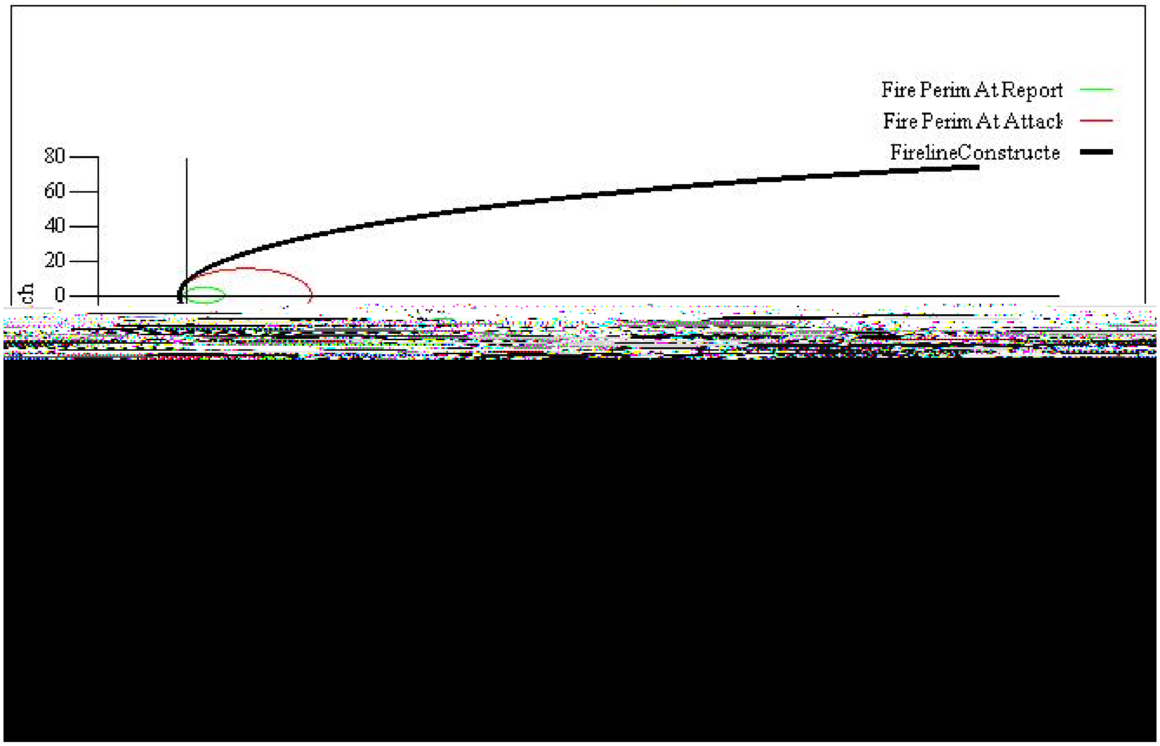
Fuel Model SH2 (Figure 3-4) – This fuel model is characterized by a moderate fuel load where shrubs cover at least 50% of the site, 1 feet deep. No grass is present. The fire spread rate is low and the flame length is low. This model produced the smallest fire which was contained in 0.7 hours. The smaller size can be attributed the dampening effects of the young brush that has fully occupied the sight. Line production rates in this model are only are similar to those of the previous model. The dozer can cut between two to twenty-five chains per hour and the engine crews can produce twenty chains of wet line per hour each.

Figure 3-4. Fuel Model SH2



Fuel Model SH7 (Figure 3-5) – This fuel model is characterized by a very heavy shrub load, 4 to 6 feet deep. The fire spread rate is high and the flame length is very high. This model produced the largest fire and the resources failed to contain it within the ten hour time period. The failure to contain this fire can be attributed its rapid spread rates (similar to the grass model) and the effect of large decadent brush to line production rates. The dozer can only cut between zero to fifteen chains per hour and the engine crews can still produce twenty chains of wet line per hour each.

Figure 3-5. Fuel Model SH7



The effects of the no action alternative would be to allow a fuel complex with rapid rates of spread, but little resistance to control (GR4, GS2), to develop over a period of 25 years into a fuel complex with rapid rates of spread and a higher resistance to control (SH7). This fuel complex would make the deployment of suppression resources on ridgetops dangerous and ineffective. It would also decrease the effectiveness of suppression resources behind the town of Kyburz, putting this community at risk.

Indirect Effects

As this fuel complex develops future mechanical treatments could be applied to the ridge tops and canyon bottom. It is highly unlikely the mid-slopes would be treated because these slopes are generally greater than thirty-five percent, precluding mechanical treatments. The cost of hand treatments on these slopes could be prohibitive. With a major interstate at the bottom of the canyon it is highly unlikely that broadcast burning would be used. Broadcast burning would put large volume of smoke on the highway threatening public safety. The mitigation for this would be to close the highway for the burning period.

Since many of these brush species are active basal sprouters, treatments utilizing hand, mechanical, and prescribed fire would only have a short-term effect.

Cumulative Effects

The no action alternative would lessen the effectiveness of the current and expected actions to be taken by the private landowners in the project area. It would negatively affect effective fire suppression action that could be conducted on both private and NFS lands treated. Coordinated fire suppression tactics would be more difficult to implement on all ownerships. The opportunity to apply prescribed fire, to the upper portions of the area, in the future would also be lessened. This alternative does not serve to enhance the opportunity to achieve the overall goal in the Sierra Nevada Forest Plan Amendment to reintroduce fire and reestablish the fire regimes that maintain ecological systems and processes. Alternative 2 would serve to increase fire suppression difficulties in the area as a whole.

This alternative will also hamper the future development of strategically placed landscape area treatments (SPLATs) within the project area.

The Freds Fire landscape in its pre-fire condition was outside the historical ranges of variability in tree density and fuel loading (ENF Forest Condition Class Layer). Under Alternative 2 this same area would be outside the historical ranges of variability in amounts and sizes of brush fields.

This would create in the canyon a large area dominated by brush, connecting the brush dominated portions in the inner gorge of the Wrights fire of 1982 and the Cleveland fire of 1992. This would leave the canyon in a condition that would support another catastrophic fire in the future. Given the probability of occurrence and the fire return interval, another stand replacing fire would be likely within 25 years.

Alternative 3

Direct, Indirect, and Cumulative Effects

This alternative has the same effects as Alternative 2 except that conifers may become established sooner over a broader area (Chapter 3 -Vegetation Management).

Hand grubbing in a four to five foot radius around seedlings would have little, if any, effect on the fuels and their development over time as changes to fuels from hand grubbing would be discontinuous and over such a small percentage of the area that these treatments do not change fire behavior substantially from Alternative 2. Thus, this alternative has the same effects as Alternative 2. Table 3-8 summarizes the effects to fire suppression for each alternative through time.

Table 3-8. Comparison of Alternatives –Fire and Fuels

Time Period	Parameters*	Alt 1 – treated acres	Alt 2, 3 and untreated acres in alternative 1
Post fire (0-5 yrs)	Fuel Model	GR4	GR4
	Flame Length (ft)	7.3	7.3
	Size after 1 hr. (ac)	99	99
	Probability of Mortality in a 10 inch DBH Ponderosa Pine	99	99
Near Future (5 -10 yrs)	Fuel Model	GS2	GS2
	Flame Length (ft)	5.4	5.4
	Size after 1 hr. (ac)	24	24
	Probability of Mortality in a 10 inch DBH Ponderosa pine	47	47
Mid Future (10-25 yrs)	Fuel Model	GS2	SH2
	Flame Length (ft)	5.4	5.5
	Size after 1 hr. (ac)	24	3.3
	Probability of Mortality in a 10 inch DBH Ponderosa pine	47	57
Future (25+yrs.)	Fuel Model	GS2	SH7
	Flame Length (ft)	5.4	15.1
	Size after 1 hr. (ac)	24	88
	Probability of Mortality in a 10 inch DBH Ponderosa pine	47	99

*Under 90th Percentile Weather and 50 Percent Slope

Vegetation Management

Affected Environment

The Freds Fire Reforestation Project consists of 46 units covering about 3,820 acres. Treatments are proposed on about 3,320 acres. No reforestation treatments are proposed on the remaining 1,000 acres within the fire perimeter. These areas include areas burned at low intensity or unharvested snag patches.

About 2,630 of the 3,820 acres in the project were classified as conifer dominated prior to the fire (ENF existing vegetation layer). These areas are located primarily in the north and west portion of the project area, in the higher elevations. Hardwoods, primarily oak, are located in the lower elevations. Prior to the fire about 125 acres were classified as hardwood, and about 1,060 acres as a hardwood/conifer mix. These areas of hardwood and hardwood/conifer mix are located mainly in the south and southeast portion of the project area. Following a fire, top-killed oaks typically basal sprout, forming clumps.

Current Vegetation Conditions

Since the fire several decision memos were implemented to begin reforesting the fire area. About 1,870 acres have been planted with conifer seedlings (2005-2009). The ground was scalped as part of the planting process and competing vegetation was removed through manual grubbing within a small radius (1.5 - 3 feet) of trees the same year.

Unit data were obtained from the stand records, fixed plot survival exams, and walk through exams in 2005 through 2008. Foliar cover of competing vegetation was based on ocular estimation taken from fixed plot or walk thru exams. Data on other vegetative characteristics, including live larger softwoods and hardwoods, and natural conifer regeneration, were also collected. Other data were obtained from district and forest records.

Vegetative cover averages about 65 percent and consists of a variety of grasses, forbs and woody brush (refer to Silvicultural Information, Appendix B). While grasses and forbs occur throughout the project area, averaging about 25 percent cover, woody brush has developed in a more distinctive pattern, reflective of the range in physical characteristics in the area, as well as different plant physiologies. Deerbrush, which resprouted from undamaged rootstock, is the major woody brush in the area of the Cleveland fire, on the western end of the fire area. Whitethorn and greenleaf manzanita, along with smaller amounts of bearclover, cherry, and gooseberry, occupy the flatter northern and eastern sections of the fire. Bearclover is the dominant woody brush species south of Granite Springs Road in the southern portion of the area. Deerbrush, whitethorn, and greenleaf manzanita occur along with bearclover.

Planted trees encounter many barriers to establishment early in their life and cannot be considered established upon planting. Currently, these conifer seedlings are exhibiting loss of vigor and mortality caused by competing vegetation. Current conifer stocking, which is the latest stocking available, regardless of year, ranges from 8 to 278 trees per acre (TPA), with an average of 98 TPA. Measured by seedling age first year survival is about 143 TPA, and third year survival is 40 percent, or about 92 TPA (Figure 1-1). Both of these measures show a steep decline in conifer stocking from initial planting levels. Current conifer stocking percent, based on the latest data, is about 61 percent. Based on the latest exams, 55 percent of the planted acres are stocked at a level below 100 TPA, and mortality is continuing.

Annual height growth, measured on several representative units, ranges from about 0.3 feet to 0.5 feet per year, while total tree height averages about 0.75 feet on one year old trees and about 1.7 feet for three year old trees (Figure 1-3). Natural regeneration of conifers is highly variable and sparse overall, averaging about 14 trees per acre.

Mortality from pocket gophers is low, and gopher activity is generally low, although small pockets of heavy gopher activity are present in the area.

As described in Chapter 1, the Forest Service in Region 5 has extensive experience, a large body of research and numerous long-term studies (ranging from 10-31 years) that clearly establish the efficacy of herbicide release to improve conifer survival, growth and development. Based on research findings and local conditions on the ENF, in 1991, a methodology (Release Evaluation Form, Appendix B) was developed on the ENF by a group of certified silviculturists and culturists to evaluate plantations as to the need for herbicides as a release tool and to prioritize the need for release. A key component of the Release Evaluation Form is to identify vegetative situations where the use of herbicides is considered essential to meeting the objective of successful reforestation. A Release Evaluation Form for each stand was completed. Each unit was assigned to one or more situations on the Release Evaluation Form (Table 3-9). If a unit currently met the criteria for a situation this was noted. If a unit did not currently meet the criteria for a situation, but was predicted to meet a situation in the near future, based on current vegetation and predicted growth, the situation and the predicted date of meeting it was noted. Each unit was then assigned a priority for treatment, based on the situation and other criteria, such as surviving trees per acre and the presence of pocket gophers.

Most of the units contain elements of many of the release need situations, either scattered over an entire unit or as inclusions within a unit. Units were classified in primary release need situation that occurred over the majority of the unit. These other release need situations were also noted.

Table 3-9. Units By Primary Release Need Situation and Priority

Situation	Total Acres	Priority 1 Acres	Priority 2 Acres	Priority 3 Acres	Units
#1 Bearclover/grass	1,518	627	853	37	609-27, 30, 33, 44; 613-51
#2 Lupine, grass, forbs, thistle, or fern with gophers	0	0	0	0	
#3 Chinquapin and/or manzanita	137		2	135	503-27; 609-34, 42, 43
#4 Low Conifer Stocking with Competition	684	684			503-8; 609-10; 613-5, 6, 22, 25, 26, 38, 47, 50, 52, 53
#5 High Volume of Woody Brush	658		250	408	503-111; 609-25, 29, 36, 37, 38, 39, 40, 41, 46; 613-42, 54
#6 High Levels of Herbaceous Vegetation	321	315	6		503-9; 609-26; 613-7, 10, 35, 37
#8 Mechanical Treatment Feasible	0				

The Pacific Southwest Region of the Forest Service has developed specific stocking standards for successful reforestation ((USDA, FS, R-5 FSH 2409.26b 1991). These standards describe the specified minimum and recommended numbers of trees per acre needed to establish a growing forest. For the mixed conifer forest type, the minimum and recommended stocking is 150 and 200 trees per acre, respectively. These standards reflect the knowledge that not every seedling has the genetic potential to thrive on the micro-site they were planted in. It also requires that the seedlings be well-distributed and growing under conditions that will allow them to "persist into the future".

A certified silviculturist can approve lower stocking levels than the Regional recommendations, if the change meets the test that the levels will "persist into the future" (FSH 2409.26b, Sec. 4.11a). The conclusion of the Freds Fire project silviculturist was that stocking standards could be set at a minimum of 100 trees per acre and "persist into the future".

The primary risk of a lower stocking standard involves establishing sufficient trees to meet the minimum standard, accounting for seedling mortality due to competing vegetation, animals, insects, disease, and drought, and to allow for the natural processes of selection of the best-adapted trees to that site. This means early stand management activities are critical to meet objectives for survival and growth to ensure there are sufficient seedlings across the landscape to meet the minimum standard into the future.

The silvicultural prescription for each unit is located in the project file. Reforestation would take an estimated eight years under Alternatives 1 and 3. Deviations from the proposed schedule could occur due to the changes in funding, contractor availability, nursery stock availability, and unpredicted weather conditions that disrupt the treatment windows for mechanical and chemical treatments. In general, variations in timing result in longer time periods and breaking up large areas into smaller ones.

Environmental Consequences

Direct, indirect and cumulative effects for conifers, hardwoods and competing vegetation consider the impacts of the alternatives when combined with the following past, present, and foreseeable future actions and events: Vegetative changes resulting from the fire and effect of future management actions. The actions contributing to cumulative effects were selected because they have caused or have the potential to cause changes in seedling survival and growth, species present, and stocking levels. The geographic scope of the cumulative effects analysis was selected because impacts to these factors are limited to a given location on the ground, irrespective of actions in surrounding areas. The temporal scope was selected because the impacts to seedling survival and growth, stocking and species at a given location can accumulate over time from different activities or events.

Alternative 1 (Proposed Action)

Direct Effects

There will be no effects to vegetation in areas where activities are not proposed. These areas are primarily unharvested snag patches and areas that burned at low intensity during the Freds fire and cover about 1,000 acres.

Vegetative competition: Initial site preparation/release treatments would use glyphosate. Competing vegetation in areas treated would experience a dramatic reduction in percent cover, to below 20% cover. Since glyphosate is a contact herbicide that has no pre-emergent effect, competing vegetation would begin to re-establish the year following treatment. Over time, the woody brush component would gradually re-establish itself, and grow. The plants would develop from seed in the soil and/or recovery of plants surviving initial treatments.

Follow-up treatment would occur, if needed, in 1 to 3 years, based on monitoring. Follow-up glyphosate treatments (3,125 acres) would again reduce competing vegetation levels below 20%, meeting the project objective. Triclopyr follow-up treatments in two units (97 acres) would reduce competing vegetation levels below 20% and would be most effective on woody brush. Triclopyr would have little effect on grasses. After an initial glyphosate treatment, competing vegetation within four units (99 acres) would be treated with hexazinone and would experience a reduction in percent cover, to below 20% cover. Hexazinone, because it is a pre-emergent herbicide, would keep grass and forb levels below 20% cover for a period of 2-3 years. The effects on sprouting woody brush would be more sporadic.

This alternative would meet the short-term silvicultural goal to keep competing vegetation levels below twenty percent (total live ground cover) for a period of two to three years after planting.

Direct effects to culturally important plants that exist within treatment units could occur through death of plants or through non-lethal exposure to herbicides which may render them unusable or unacceptable by gatherers. Herbicide treatments could result in plants being dead, dying, chlorotic, brittle or deformed and, hence, undesirable to consume in the long-term. Throughout treatment units some plants would survive herbicide treatment by either being located in excluded areas (untreated buffer strips, sensitive plant areas) or through skips during application, receiving a less than lethal dose, or not being targeted during application. Individual plants killed during herbicide treatments would be eliminated from the site and not available to gatherers. Signs, posted at likely access points for each treatment unit, would alert the public of the specific herbicide and date the unit was treated and would reduce potential for exposure to herbicides. As previously described, there will be no direct effects, including culturally important plants, on about 1,000 acres where no herbicide treatments are proposed.

Hardwoods: Direct effects to hardwoods would be minor, as they would be protected during reforestation activities. Where oak densities, including resprouting oaks, preclude planting of conifers (conifers would not be planted within 20 feet of the crown dripline of mature live, or sprouting, hardwoods), these stands would develop as oak stands. This would cover an estimated 125 acres. Where more scattered, planting of conifer would result in mixed conifer/oak stands. This would cover an estimated 1,060 acres. Scattered oaks would also be present in some conifer dominated stands.

Oaks would not be intentionally sprayed, including seedlings, sprouts, and larger trees, during herbicide treatments and would remain a part of the stand's species composition. Application with hexazinone can severely damage or kill oaks and it is possible some oaks may die as a result of hexazinone application. There are very few oaks within areas proposed for hexazinone treatment. Results of monitoring of two stands in the Cleveland Fire area treated with hexazinone in a manner similar to this proposal, showed that oaks can, and do, survive hexazinone treatment. In these stands, results showed 3.0 and 3.9 oak clumps per acre, based on a 100 percent survey. Only one dead oak clump was found in the entire survey area of 39 acres. The cause of death is unknown (USDA, 2004a). Thus, the majority of oaks will survive, be promoted, and become part of the stand, adding to stand stocking levels.

Conifer survival/species composition: By meeting competing vegetation levels objectives, and by interplanting, conifer survival levels would be sufficient to meet minimal stocking requirement of 100 established seedlings per acre by age five to ten years. While some additional mortality may occur, it is expected that the prescribed treatments would maintain survival near this level. Interplanting or replanting would be possible and would be prescribed, based survival and stocking criteria (Chapter 2), from on future exams and to meet project objectives, including evaluating opportunities to provide patches (<1 acre) of early seral vegetation. Currently, about 665 acres would be replanted or interplanted. By providing for patches of early seral vegetation, 80 to 90 percent of planted acres (2,650- 3,000 acres) would meet the minimal stocking requirement of 100 seedlings per acre and be certified as adequately stocked by age ten or sooner.

Effective vegetation control is particularly critical for the establishment of non ponderosa/Jeffrey pine conifers, such as red fir, white fir, Douglas fir, sugar pine, and incense cedar. These species typically have much lower early survival success than ponderosa/Jeffrey pine. Treatments under this alternative would be reflected in greater survival percentages of all of the mixed conifers species in the project area, resulting in the establishment of a mixed conifer forest.

Sugar pine and incense cedar are susceptible to hexazinone. Application in the rooting zone may cause mortality of some trees. Design features under this alternative (large no herbicide buffers in streamcourses and not applying hexazinone within the dripline of sugar pine or incense cedar greater than 5 inches diameter) would greatly reduce mortality to sugar pine and incense cedar on the 99 acres of the project where it is proposed.

Aquatic features: Within the buffered areas adjacent aquatic features throughout the project area, varying widths of herbicide release/hand release/no release zones are proposed. The effects on conifer survival and growth in hand released areas would be similar to Alternative 3, although the availability of water to conifers proximate to these streams may increase conifer survival. Where no release is proposed, the effects on conifers would be similar to the no action alternative. These areas would develop into zones of dense woody vegetation with slower growing conifers.

There would be little to no effect to riparian species, as these species would be protected by no herbicide spray buffer strips . Sprouting plants, such as alders, dogwoods, maples, or willows, would be the dominate species in riparian areas. These species primarily grow adjacent to streams, springs, seeps, or other areas with water. The scattered individuals of these species that may be growing beyond these buffer strips could be killed, but this would constitute few individuals. Riparian species within hand release zones could be cut, but there would be little mortality as they would resprout and grow.

Growth: Results of a long-term study, measurements in the local area, and two modeling programs (SYSTUM-1 and Forest Vegetation Simulator) were used to estimate future growth in the project area.

As previously stated, the Forest Service in Region 5 has extensive experience, a large body of research and numerous long-term studies (ranging from 10-31 years) that clearly establish the efficacy of herbicide release to improve conifer survival, and accelerate growth and development. Increased growth would accelerate the development of key habitat and old forest characteristics and reduce the risk of loss to wildland fire (SNFPA ROD, page 49).

In a study near Mt. Shasta (McDonald and Abbott 1997), foliar cover of grasses corresponded well to the trend in shrub density. The paper looked at four different shrub density regimes- no, light, medium, and heavy shrubs. The Mt. Shasta study measured the growth of planted trees during the 31 year study and found statistically different height and diameter values for each of the four shrub density regimes. The no shrub or light shrub categories in the study most closely resembles what Alternative 1 would be in terms of competing vegetation. The average tree height after 31 years in the no shrub category was almost 3.4 times that of the “heavy shrub” average tree height, while the average tree height in the light shrub category was about 2 ½ times that of the “heavy shrub” average tree height. Similarly, the no shrub average tree diameter was almost 3.7 times that of the “heavy shrub” environment, and the light shrub average tree diameter was about 2.8 times that of the “heavy shrub” environment (Table 3-10). The study concluded that after 31 years, the differences in tree height were still widening.

Table 3-10. Diameter and Height of 31 Year-old Trees

Shrub Density	None	Light	Medium	Heavy
DBH (inches)	7.85	6.11	4.56	2.14
Height (feet)	30.4	21.6	15.2	9.0

*From Table 9 (McDonald/Abbott: PSW Research Paper 231, 1997)

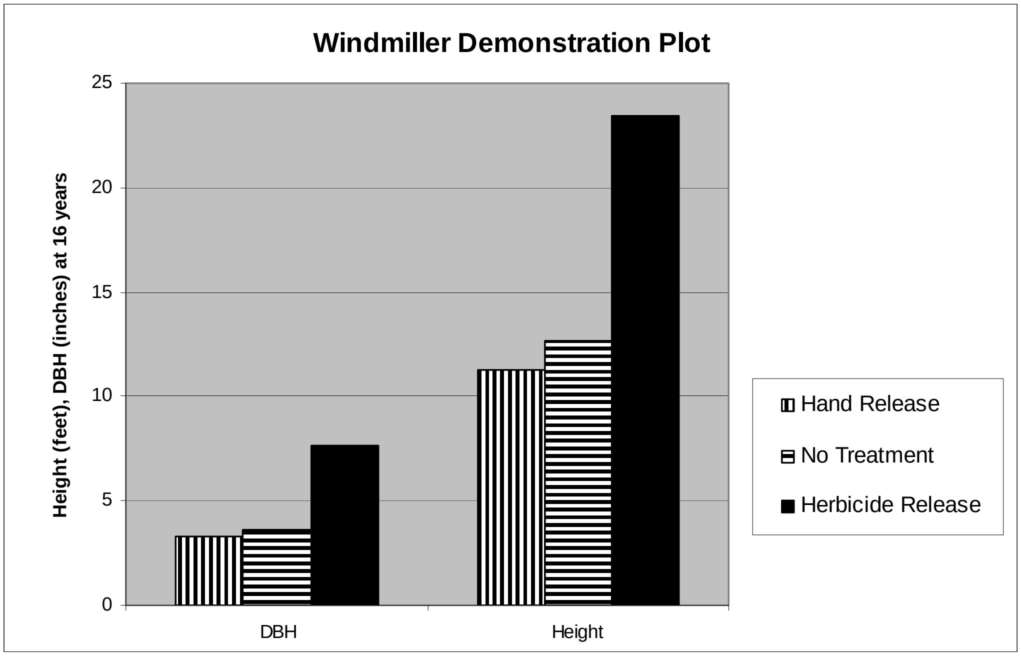
Powers et al (2004), on a site near Georgetown, found the influence of shrubs on growth lasted much longer on poorer sites than on more productive sites. By age 37, 28 years after treatments, growth rates on a poorer Mariposa soil increased following brush removal and continued to separate from the control. By contrast, on a more productive Cohasset soil, differences were less striking and plateaued about a decade after release. Following that, growth patterns for treated and untreated plots were essentially parallel. However, even in treated plots on better sites, stands remain at high risk to ground fire as a persistent fuel ladder connected the ground to the canopy.

Local results

Height and diameter were measured locally on trees planted and herbicide released after the Cleveland Fire. On a good site off of the Raincoat Road, ponderosa pine averaged about 34 feet in height (range 26-44) and 9.6 inches DBH (range 6.6-12.1) at 16 years old. Other vegetation on the site consisted of grasses, forbs, and small brush (deerbrush and manzanita) forming close to 100 % ground cover. On good sites in the Freds Fire similar diameter and height growth could be expected.

Trees were measured on a 16-year old local field demonstration plot in the Cleveland Fire near the Freds Fire. This site was of lower site quality than the Raincoat site. Trees in the demonstration plot, representing herbicide, hand release, and control plots, were measured. Both herbicide and hand release plots received two release treatments. Results for Jeffrey pine trees are shown in Figures 3-6. Heights and DBH averages for all species combined showed similar results. The hand release plot totaled 44 trees per acre; the control plot totaled 56 trees per acre. The trees in the herbicide plot had been precommercially thinned. As on the Raincoat road site, grasses, forbs and small brush occupied the herbicide treated plots, while brush 5-6 feet tall (whitethorn, greenleaf manzanita) dominated the hand release and control plots (Figures 3-7 and 3-8).

Figure 3-6. Tree Height and Diameter from Two Treatments and No Treatment



SYSTUM-1 small tree growth simulator (Richie and Powers 1993) was used to predict future growth and development of trees, forest attributes, and competing vegetation in the project area to age 50. SYSTUM-1 is more applicable to this area, meaning that the data collected and vegetation types coincide better with the vegetation types in the Freds Fire, than a newer model (Conifers) whose applicability is primarily in the North coast of California and into Oregon (Richie, M. personal communication, 2008). SYSTUM-1 was originally intended for stands between the ages of 3 and 20, although there are no specific age constraints in the simulator.

Projections beyond age 50 were made using the Forest Vegetation Simulator (FVS) to estimate the age where average stand diameters reached 12 and 24 inches, and the age where canopy closure reached 40 and 60 percent. Input was taken from the 50 year averages for diameter and height from Table 3-11. Site Index was set at Forest Survey Site Class 3, an average site for the project area. Growth was not suppressed for any alternative, assuming the growth suppression effects of shrubs will have ceased. If suppression effects from shrubs do continue beyond 50 years, using default values in the projection would result in an overestimation of growth in Alternative 2 and 3 for a number of years, until growth suppression ceased.

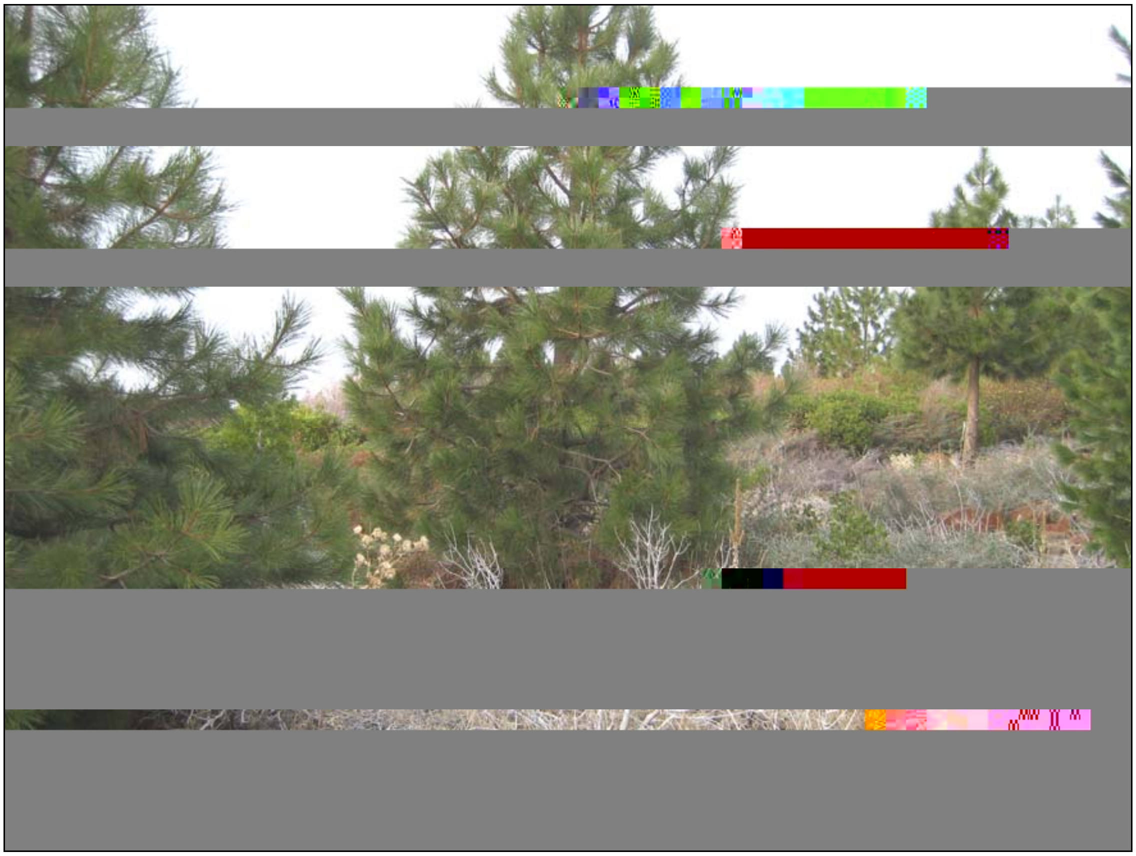
A summary of the above information is displayed in Table 3-11, below. The averages for 15 and 50 years coincide closely with the Windmiller site and the SYSTUM-1 model. The Raincoat Road Site and the Mt Shasta Study results display the range of what could be expected on higher and lower sites.

Table 3-11. Projected Diameter and Height of Conifers at 15 and 50 Years (Alternative 1)

Range of Data	15 years		50 years		Age for
	DBH	Height	DBH	Height	24 inch trees
Raincoat Road Site	9.0	31.6	30.0	105	
Windmiller	6.2	19.8	20.6	66	
SYSTUM-1	6	21.4	17.2	76	
Mt. Shasta	4.2	14.7	12.7	49	107
FVS					80
Average	6.4	21.9	20.1	74	

Figure 3-7. Windmiller Demonstration Plot (Hand Release Plot at 16 Years)

Figure 3-8. Windmiller Demonstration Plot (Herbicide Release Plot at 16 Years)



By 15 years (Table 3-11) conifers would average about 22 feet in height (range 15 to 32) and have a diameter breast height (DBH) of about 7 inches (range 4-9). These estimates coincide well with planted conifers established under the Cleveland Fire Area Vegetation Management Program for Conifer Plantation Establishment Environmental Assessment (USDA 1994a) that survived the Freds Fire, which are currently about 12-20 feet tall, and have a DBH of about 5-7 inches (13 years after planting). Average oak height would be somewhat taller than conifers because they sprouted from established root systems, although on good sites conifers are likely to be as tall as oaks. Their average diameter would be smaller than conifers due to the large stem numbers in a clump. By age 50 conifers would average about 74 feet in height (range 49 to 105) and have a diameter breast height (DBH) of about 20 inches (range 13 to 30).

Fuel Reduction Treatments: Masticating shrubs within ¼ mile of Highway 50 (about 388 acres) would have little to no effect on tree growth as most of these shrubs would resprout and recover, using water and nutrients as prior to the treatment. Mechanical damage by the masticating machine or flying debris could cause damage or mortality to trees, but is expected to be minor. Heavily damaged trees could be removed.

Indirect Effects

Over the short-term, plant abundance may be affected by herbicide treatments, but no plant species would be eliminated from treatments units. Plants that survive herbicide treatment would recover and grow. Plants outside the treatment units would serve as seed sources for recruiting into treatment units. The existing seed banks within treatment units would also be sources for recruitment within the units. Contact herbicides (glyphosate and triclopyr) would not affect seeds in the ground, which could germinate and grow following application. Clopyralid, a contact herbicide with a short residual effect on seeds, would prevent germination of seed for the growing season. It is selective and its effects would only be seen on several members of the sunflower family (*Asteraceae)*, legume family (*Fabaceae*), nightshade family (*Solanaceae*), and some species in the knotweed and carrot families. Hexazinone would affect seed germination, with decreasing effectiveness, for two to three seasons after application.

In mixed forests in Canada, Sutton (1993) found no detectable effect on species composition ten years after herbicide treatments. DiTomaso et al. (1997) in northern California found no long-term detrimental effect on vegetative cover or species evenness with herbicide use. They also found that, in areas without herbicide treatment, biodiversity and to a lesser extent species evenness had not recovered after 14 years, in contrast with herbicide treated areas.

Over the longer-term, culturally important plants that favor early seral, open conditions would be enhanced, as activities under this alternative would maintain units in this condition for a longer period of time as compared to the other two alternatives.

Species and structural diversity within stands would be conserved as heritage resource, sensitive plant areas, areas that burned with low intensity in the Freds Fire, and snag patches left untreated in the Freds Fire Restoration EIS would not be reforested or released. Areas with a high concentration of surviving or sprouting oaks would maintain a large abundance of oaks. Natural variations such as surviving conifers, rock outcrops, and riparian areas contribute to diversity, as would small patches of early seral vegetation within units. In addition, there would be no herbicide treatment zones for varying widths adjacent aquatic features. Species in the outer part of these zones, especially along ephemeral and seasonal streams, would resemble those of the rest of the unit and would contribute to structural diversity. In the inner portion of these zones, adjacent to live streams, species with high moisture requirements, such as alder, dogwood and willow, would not be treated, contributing to species diversity.

To analyze age class and structural diversity requires a logical discussion of the future. The planted trees in the Mt. Shasta study in the “no shrub” environment would take approximately 105 years to develop into large trees (≥ 24 inches DBH) assuming a consistent rate of growth beyond the life of the study. It is estimated that the trees under Alternative 1 would take 80-90 years to develop into large trees (CWHR size class 5 (≥ 24 inches DBH)) due to more productive site conditions in the project area (Table 3-12a). Based on FVS projections, large trees would develop in about 80 years.

Canopy closure is expected to reach 60 percent in 60 years, based on FVS modeling (Table 3-12b). Canopy closure had reached 40 percent at year 50 under SYSTUM-1 modeling. From the time the stand canopy closes, individual trees would continue to differentiate into size classes based on the resources available to each individual tree and the genetic make up of each tree. A portion of the trees would maintain their height advantage over their shorter neighbors, resulting in a range of tree heights and diameters. After the tree crowns touch, there would be an opportunity to manage the stands to provide a variety of canopy densities, including openings. A variety of individual tree growth rates, and therefore sizes, would result in an increased vertical structural diversity. The exact structure goals would depend on direction from management plans at that future date.

Table 3-12a. Estimated Age at Maturity (Trees > 24 inches DBH) by Alternative

Alternative	Age at Maturity (study)[1]	Age at Maturity(Freds Fire)[2]
1	107	80-90
2	390	200-250
3	184	140-160

[1] Assuming same rates of growth as last 13 years of PSW Research Paper 231 study
[2] The site conditions in the McDonald study are slightly lower than those represented in the Freds Fire and therefore the values were adjusted to reflect those differences

Table 3-12b. Estimated Age to meet Stand Parameters - FVS

	Alt 1	Alt 2 (planted)	Alt 3 (planted)
>12 inches (CWHR4)	< 50	57	54
>24 inches (CWHR5)	80	112	115
>40 Percent CC (CWHR M)	<50	150	110
>60 percent CC (CWHR D)	60	>150	>150

Risk of loss to wildland fire: Small trees by nature are susceptible to low intensity fires. Most of the 7-8 year old trees in the St. Pauli fire were killed. The few trees that are still alive probably survived from a combination of light vegetation and topography (gentler slopes, ridges). As trees increase in height and diameter the probability of fire-induced mortality declines. Under this alternative diameter and height growth would be the fastest, with trees reaching a DBH of 10 inches in an estimated 20-27 years (refer to Tables 3-3a,b,c).

Cumulative Effects

This alternative would contribute about 3,320 acres with sufficient oak and mixed conifer stocking and growth to allow eventual attainment of the desired future conditions as defined by the SNFPA ROD (p 49). The project area landscape is a combination of private timberlands and public lands. The private timberlands are managed for timber production and therefore will likely develop these levels in less than 80-90 years. There are no effects on the development of forest structure on ENF lands as a result of private land activities.

The loss of individual culturally important plants or their undesirability for gathering and use on about 3,320 acres proposed for herbicide treatment on this project could result in short-term cumulative effects. These effects would be temporary, lasting until herbicide residues were eliminated from plants (potentially up to 2 ½ years for hexazinone) and surviving plants recover or seed in from surrounding areas or untreated portions of treatment units.

Alternative 2 (No Action)

Direct Effects

There would be no direct effects from this alternative since no activities would take place. No release or invasive plant treatments would take place. This alternative would have no direct effects on culturally important plants from herbicides as plants would not be exposed to herbicides.

Indirect Effects

Vegetative competition: In the absence of any further activities, the area would continue to be occupied by competing vegetation, and densities would quickly approach 100 percent cover (Figures 3-9). Woody brush, would begin to dominate, overtopping conifer seedlings. A continuous horizontal woody brush layer would develop in units, limited only by environmental factors. The woody brush layer would also expand vertically up to its potential, resulting in brush heights of two feet (bearclover) to 10 feet and higher (deerbrush, cherry). This alternative would not meet the short-term silvicultural goal to keep competing vegetation levels below twenty percent (total live ground cover) for a period of two to three years after planting.

Figure 3-9. Deerbrush in Untreated Area of the Cleveland Fire at Five Years

Hardwoods: Oaks, which were top-killed in the Freds fire, have resprouted from rootstock and exist in clumps. Established rootstocks have provided resources which allowed stems to grow in height quickly. Oak clumps would continue to grow in full sun and become locally dominant over competing vegetation. This dominance will continue into the future, and oaks will survive, and become part of the stand overstory. Stands classified as oak in ENF Forest vegetation layer would develop into stands of oak woodland. This is estimated to cover about 125 acres in the project area. Stands classified as mixed conifer/oak would develop into low density stands of oak. Any conifer component of these stands would slowly develop from scattered natural regeneration. This would cover an estimated 1,060 acres.

Conifer survival/species composition: Planted trees, currently averaging about 100 trees per acre (TPA) after 1 to 4 years, would continue to die from moisture stress from competing vegetation on these harsh, south facing slopes. Conifer survival rates would continue to decline, and the resultant stand would contain fewer trees and a sparser canopy cover than the proposed action or alternative three. Competing vegetation would be able to survive and grow under this relatively sparse canopy cover. Overall, low conifer survival would result in large areas of plantation failure. Acres that are currently stocked below 100 TPA would not meet minimal stocking requirement of 100 TPA. Most of the other plantations, currently stocked at over 100 TPA, would suffer enough conifer mortality to fall below the minimum stocking standard of 100 TPA, leaving an estimated 350-600 acres (25-40 percent of the acres currently over 100 TPA and 125 acres of oak) meeting the minimal stocking requirement of 100 seedlings per acre and be certified as adequately stocked by age ten or sooner.

Natural regeneration would be the source of conifer stocking in areas where trees have not been planted. Some conifers have seeded in (average 14 TPA) and would continue to seed in from scattered mature trees that survived the Freds fire. Seed germinating from these sources into the future would encounter greater competition for moisture than current conditions as the temporary reduction in competing vegetation as a result of the fire have dissipated. Conifer survival would be low due to moisture competition and a vegetative overstory of grasses and shrubs, resulting in a sparse conifer component within a 100 percent cover of shrubs. Shade tolerant conifer species (incense cedar, Douglas fir, and white fir) would be more likely to eventually be established under a brush understory, however overall tree cover would be low due to a lack of nearby seed sources and vigorous competition. The eventual species composition in these areas, as a result, would have low percentages of shade intolerant conifers (such as ponderosa and Jeffrey pine and sugar pine).

Growth: Early stand development (50 years and less) would be considerably slower, and less dense, than the proposed action. Estimates of growth for this alternative were determined using data from FVS, SYSTUM -1, Windmiller demonstration plot, and the Mt. Shasta Study and are displayed in Table 3-13. These projections assume wildfire can be excluded in the vegetation that develops under this alternative, which is an unlikely scenario (refer to Chapter 3- Fire and Fuels). A stand replacing wildfire within the project area could "reset" the vegetative conditions back to early seral conditions, dominated by shrubs.

Table 3-13. Projected Diameter and Height of Conifers at 15 and 50 years (Alternative 2)

Range of Data	15 years old		50 years old		Age for
	DBH	Height	DBH	Height	24 inch trees
Windmiller	3.1	11.1	10.3	35	
SYSTUM-1	3.9	14.5	14.4	55	
Mt. Shasta	1.1	4.4	3.5	14.5	391
FVS					112
Average	2.7	10	9.4	35	

At 15 years conifers would average about 10 feet in height (range 4 to 15) and have a diameter breast height (DBH) of about 3 inches (range 1 to 4). Average oak height would be taller than conifers, result of early growth from sprouting from established root systems. Their average diameter would about the same as the conifers due to the large stem numbers in a clump. By 50 years conifers would average about 35 feet in height (range 15 to 55) and have a diameter breast height (DBH) of about 9 inches (range 4 to 14).

Areas with a high concentration of surviving or sprouting oaks would maintain a large abundance of oaks. This alternative would not maintain the early seral open conditions that some plants favor for as long a time period, as compared to the proposed action alternative. Those plants would likely become less abundant under this alternative, existing primarily in naturally occurring open areas such as low sites, and rock outcrops.

There is considerable variability in projections of diameter beyond 50 years because of the assumptions used. Projections from the Mt.Shasta study assume growth rates would continue as in the final 13 years of the study, where growth suppression effects of competing vegetation are still widening. The FVS projections use the default growth rates, which assume effects of growth suppression beyond 50 years are no longer evident. Thus, these projections frame the range of growth beyond fifty years.

The trees in the Mt. Shasta study in the "heavy shrub" categories in the study most closely resembles what Alternative 2 would be in terms of competing vegetation. The trees in this study would take approximately 390 years to develop into large trees ($\geq$ 24 inches DBH) assuming a consistent rate of growth beyond the life of the study. It is estimated that the trees under Alternative 2 would take 200-250 years to develop into large trees due to higher site conditions in the project area (Table 3-12a).

Based on FVS projections, large trees would develop in about 110-115 years A 40 percent canopy closure in already planted areas would be achieved in about 150 years. A 60 percent canopy level would be unlikely from the planted trees, due to the sparse tree cover (Table 3-12b).

Where trees have already been planted, the treatments proposed under this alternative will result in a landscape of 30-40 trees per acre with average diameters of 24 inches and canopy closure of 40 percent in about 150 years (range 150-250). Unplanted areas would depend on natural regeneration and would take longer than planted areas to develop because of a longer time for trees to become established and their slower growth while under a brush overstory. Here, the landscape would consist of scattered trees with a sparse canopy. Under this sparse tree canopy, vegetation would persist, with little shading out of vegetation expected. Oak stands would develop as in all the alternatives.

Over the short-term, plant abundance would be unaffected. Over the longer-term, culturally important plants that favor early seral, open conditions could be negatively affected by the continuous horizontal woody brush layer that develops under this alternative.

Risk of loss to wildland fire: Small trees are susceptible to mortality from low intensity fires. This alternative would result in the shortest, smallest diameter trees of any alternative, with trees reaching a DBH of 10 inches in an estimated 35-40 years.

Cumulative Effects

The project area landscape is a combination of private timberlands and public lands. The private timberlands are managed for timber production and therefore will likely develop a mature forest in less than 80-90 years. There are no effects on the development of forest structure on ENF lands as a result of private land activities. The combined effect of these approaches on the landscape will result in a varying pattern of forest structure over the long term. Widespread cumulative effects to culturally important plants are not expected due to the abundance and region-wide distribution of these species.

Alternative 3

Direct Effects

Vegetative competition: Hand grubbing or hand cutting would occur within 4-5 feet of seedlings. Within this radius competing vegetation would initially drop to below 20 percent cover. Removing all shrubs within a 5-foot radius around each planted seedling during the year of planting will reduce the competing vegetation for each year of treatment. The benefits of reduced competition will not be substantial since the shrubs are established prior to tree planting, and with a large root system already in place, will be poised to utilize much of the available moisture. Competing vegetation would begin to re-establish quickly. In the case of sprouting shrubs, this re-invasion, or recovery from stem damage, would begin immediately and would essentially negate any conservation of soil moisture for conifer use (i.e. moisture stress to conifers would continue). Such shrubs would include bearclover, bitter cherry, greenleaf manzanita, and deerbrush, a vigorous resprouter. For other plants, competing vegetation would likely begin to re-establish the year following treatment, from seed. Such vegetation would include grasses, forbs, whitethorn, and *Ribes spp.* (Click et al 1988).

Through repeated follow-up treatments, competing vegetation levels, although exceeding the 20 percent objective in the unit as a whole, would meet the objective within the critical radius around the tree, at least through this decade.

Direct effects to culturally important plants that exist within treatment units could occur to plants located within the hand release radius around seedlings. Some severed plants would resprout. Outside of the hand release circles in treatment units, and in areas of no planting there would be no direct effect on culturally important plants.

Hardwoods: Direct effects on hardwoods would be minor, as they would be protected during reforestation. Where oak densities, including resprouting oaks, preclude planting of conifers (conifers would not be planted within 20 feet of the crown dripline of mature live, or sprouting, hardwoods), these stands would develop as oak stands. Where oak is more scattered planting of conifers would result in mixed conifer/oak stands.

Conifer survival/species composition: Current survival in areas previously planted averages about 100 trees per acre, a 40 percent survival rate. This reflects the effects of one hand release on conifer survival. Survival of three year old trees is lower, averaging about 92 trees per acre. It is expected that even with repeated hand grubbing treatments, conifer mortality would continue to drop because, as described above, moisture stress to conifers would continue. Additional mortality could occur from physical damage to tree seedling's roots near the soil surface, especially with repeated treatments. Most of the units would suffer enough conifer mortality to fall below the 100 TPA stocking requirement. The Windmiller demonstration plot, located near the Freds fire and described above, has 44 trees per acre at 16 years in the hand release plot.

Because of the density of vegetation outside of the release circles there would be little to no opportunity to interplant or replant. Within the release circles interplanting or replanting could occur. Moving between release circles for grubbing, planting, or survival surveys would be physically difficult where deerbrush, whitethorn, manzanita, and cherry are dominant, increasing costs. Conifer survival on subsequent initial planting and interplanting acres would likely be lower than previously planted acres as the live ground cover of competing vegetation has increased since the fire. Trees planted into the current levels of competing vegetation in the project area would face immediate competition, with survival at age three estimated to be below the current third year survival rate of 40 percent.

Over most of the project area, with repeated hand grubbing and interplanting, conifer survival will continue to drop, threatening plantation failure. The Region 5 FEIS for Vegetation Management for Reforestation (USDA 1989b, table 4-3) estimated 30-60% of the red fir and mixed conifer acres would be stocked with at least recommended levels at age three under a no herbicide management scenario. Currently, 50 percent of the acres with third year survival exams are stocked below 100 TPA. With continued expected mortality from high competing vegetation levels, and limited interplanting opportunities, it is expected that 600-1,100 acres will meet the minimal stocking requirement of 100 trees per acre and be certified as adequately stocked by age ten or sooner (a 60-80 percent of plantations failure rate).

While effective vegetation control is critical for the seedling establishment, it is particularly critical for the establishment of non ponderosa/Jeffrey pine conifers, such as red fir, white fir, Douglas fir, and sugar pine. These species typically have much lower early survival success than ponderosa/Jeffrey pine. The hand release treatments under this alternative would favor the establishment of ponderosa and Jeffrey pine, and the resultant stands would contain high percentages of these pines, with low survival percentages of the other mixed conifer species.

On 800 acres with no reforestation proposed, the effects of this alternative would be similar to the no action alternative.

Aquatic Features: Where planting and hand release are proposed the effects on conifer survival would be similar to upland areas of this alternative, although the availability of water to conifers proximate to these streams may increase conifer survival. Where no release is proposed, the effects on conifers would be similar to the no action alternative. These areas would develop into zones of dense woody vegetation with slower growing conifers.

There would be little to no effect to riparian species, as these species would be protected by no hand release zones along stream courses. Sprouting species such as alders, dogwoods, maples, or willows would continue to recover in riparian areas. These species primarily grow adjacent to streams, springs, seeps, or other areas with water. Riparian species within hand release zones could be cut, but there would be little effect as they would resprout and grow.

Growth: Early stand development (50 years and less) would be considerably slower, and would be less dense than the proposed action. Height and diameter growth would not be substantially different from Alternative 2, although stocking would be higher than Alternative 2. Estimates of growth for this alternative are displayed in Table 3-14, below: Alternative 3 would be similar to the medium shrub category in the Mt. Shasta research paper. As under Alternative 2, these projections assume wildfire can be excluded during each of the time periods. A wildfire within the project area would result in the same effects as Alternative 2.

Table 3-14. Projected Diameter and Height of Conifer at 15 and 50 years (Alternative 3)

Range of Data	15 years old		50 years old		Age for
	DBH	Height	DBH	Height	24 inch trees
Windmiller	2.9	10.2	9.7	34	
SYSTUM-1	4.1	14.8	15.4	60	
Mt. Shasta	2.4	7.8	7.4	24.5	184
FVS					115
Average	3.1	11	10.8	40	

Based on Table 3-14, at the end of 15 years conifers would average about 11 feet in height (range 8 to 15) and have a diameter breast height (DBH) of about 3 inches (range 2 to 4). Average oak height would be taller than conifers, result of early growth from sprouting from established root systems. Their average diameter would about the same as the conifers due to the large stem numbers in a clump. At the end of 50 years conifers would average about 40 feet in height (range 15 to 60) and have a diameter breast height (DBH) of about 11 inches (range 7 to 15).

As discussed under Alternative 2, there is considerable variability in projections beyond 50 years. The trees in the Mt. Shasta study would take approximately 185 years to develop into large trees (≥ 24 inches DBH) assuming a consistent rate of growth beyond the life of the study. It is estimated that the trees under Alternative 3 would take 140-160 years to develop into large trees, due to higher site conditions in the project area.

Under the FVS modeling program, large trees would develop in about 115 years. In planted areas canopy closure is expected to reach 40 percent in about 110 years. A 60 percent canopy level would take slightly longer than 150 years, due to the sparse tree cover (Table 3-12b). The effects conifer growth in unplanted areas would depend on natural regeneration would be the same as unplanted areas under the no action alternative. There would be 800 more unplanted acres than under Alternative 1.

Fuel Reduction Treatments: Masticating shrubs within ¼ mile of Highway 50 (about 388 acres) would have little to no effect on tree growth as most of these shrubs would resprout and recover, using water and nutrients as prior to the treatment. Mechanical damage by the masticating machine or flying debris could cause damage or mortality to trees, but is expected to be minor. Heavily damaged trees could be masticated, which would contribute to lower stocking levels.

Indirect Effects

No plant species will be eliminated from the project area. Within treatment units, all species will persist. Within hand release circles the balance will be shifted toward a greater representation of grasses and forbs in the short-term, followed by an increase of woody shrubs encroaching into the circles. Eventually, conifers will develop and express dominance over the site. Outside of the hand release circles, woody species such as deerbrush, whitethorn, greenleaf manzanita, or bearclover would form a dense closed canopy, dominated by a single species, or a few species. Opportunities for regeneration of other species under this canopy is limited.

Species and structural diversity within stands would be conserved as heritage resource and sensitive plant areas would not be reforested or released. An additional 800 acres would not be reforested under this alternative. Areas with a high concentration of surviving or sprouting oaks would maintain a large abundance of oaks. Natural variations such as surviving conifers, rock outcrops, and riparian areas contribute to diversity. In addition, there would be no hand release zones for varying widths along streamcourses. Species in the outer part of these zones, especially ephemeral and seasonal streams, resemble those of the rest of the unit and would contribute to structural diversity. In the inner portion of these zones, adjacent to live streams, species with high moisture requirements, such as alder, dogwood and willow, would not be treated, contributing to species diversity.

Over the short-term, plant abundance would be unaffected. Over the longer-term, culturally important plants that favor early seral, open conditions would be negatively affected by the horizontal woody brush layer that develops under this alternative, although hand release circles would provide open conditions, at least through the end of the decade.

Risk of loss to wildland fire: Small trees are susceptible to mortality from even the lowest intensity fires. This alternative would result in trees reaching 10 inches DBH in an estimated 29-33 years.

Cumulative Effects

The project area landscape is a combination of private timberlands and public lands. The private timberlands are managed for timber production and therefore will likely develop a mature forest in less than 80-90 years. There are no effects on the development of forest structure on ENF lands as a result of private land activities. The combined effect of these approaches on the landscape will result in a varying pattern of forest structure over the long term. Widespread cumulative effects to culturally important plants are not expected due to the abundance and region-wide distribution of these species.

Climate Change

Affected Environment

This section addresses climate change scenarios as they relate to the severity and frequency of insect outbreaks, and droughts, and their effects on the success of reforestation efforts and adaptive forest management.

The Environmental Protection Agency developed a "State of Knowledge" paper (EPA 2007a) that outlines what is known and what is uncertain about global climate change. The following elements of climate change are known with near certainty:

- Human activities are changing the composition of Earth's atmosphere. Increasing levels of greenhouse gases like carbon dioxide (CO_2) in the atmosphere since pre-industrial times are well-documented and understood.
- The atmospheric buildup of CO_2 and other greenhouse gases is largely the result of human activities such as the burning of fossil fuels.
- An "unequivocal" warming trend of about 1.0 to 1.7 F occurred from 1906-2005. Warming occurred in both the Northern and Southern Hemispheres and over the oceans (IPCC, 2007).
- The major greenhouse gases emitted by human activities remain in the atmosphere for periods ranging from decades to centuries. It is therefore virtually certain that atmospheric concentrations of greenhouse gases will continue to rise over the next few decades.
- Increasing greenhouse gas concentrations tend to warm the planet.

According to EPA (2007), however, it is uncertain how much warming will occur, how fast that warming will occur, and how the warming will affect the rest of the climate system including precipitation patterns.

The Intergovernmental Panel on Climate Change (EPA 2007b) concluded that, for North American forests as a whole:

- Climate change is expected to increase the growth of forests modestly (by 10-20 percent) over the next century. However, extreme and/or long-term climate change scenarios also create the potential for widespread forest decline.
- Disturbances such as wildfires and insect outbreaks are increasing and likely to intensify in a warmer climate with drier soils and longer growing seasons. The forest fire season is likely to lengthen, and the area subject to high fire danger is likely to increase significantly.
- The long-term effects of fire will depend heavily on changes in human fire management activities.

Environmental Consequences

Given what is and is not known about global climate change, the following discussion outlines the effects of this project on carbon sequestration and effects of climate change on reforestation, precipitation, and forest insect and diseases.

Carbon Sequestration: Carbon sequestration was estimated using the Forest Vegetation Simulator using the growth estimates, above. Alternative 1 yields the highest amount of carbon sequestered at all ages modeled (Table 3-15). Carbon sequestration amounts associated with this project are extremely small in the global context, making it impossible to measure the incremental cumulative impact on global climate from carbon sequestration associated with this project.

Table 3-15. Projected Carbon Sequestration (tons per acre) at 50, 100, and 150 Years

	Age 50		Age 100		Age 150	
	Aboveground Live	Total Stand Carbon	Aboveground Live	Total Stand Carbon	Aboveground Live	Total Stand Carbon
Alternative 1	46.1	66.1	80.1	134.5	90.6	157.6
Alternative 2	2.3	6.9	25.0	36.6	50.7	71.3
Alternative 3	5.2	11.3	37.3	53.9	47.9	97.2

Reforestation: Rapid climate change over the next century would likely render many species and local varieties less genetically suited to the environment in which they are currently found. Establishing regeneration may become more difficult since seedlings are often more sensitive to environmental conditions than mature trees (Skinner 2007).

Reforestation under Alternative 1 relies on both national regeneration and planting. Planting prescriptions specify a high diversity of tree species including ponderosa, Jeffrey, and sugar pine, red and white fir, Douglas fir, and incense cedar. The use of seedlings grown from seed of local origin or transferred in compliance with seed transfer rules based on California Tree Seed Zones, (J. Buck et al. 1971; also refer to R-5 FSH 2409.26, Section 42.2) insures high genetic diversity of seedlings. As seedlings will be grown from seed collected from this, or adjacent seed zones, they have the potential to be of higher genetic diversity than seedlings from the immediate project area and may be better suited to the new local environment (Skinner 2007). Replanting diverse species with high genetic diversity means that, overall, reforested stands would have the potential to better adapt to changing conditions over time. Reductions in genetic diversity would likely result from relying fewer acres of planted trees (Alternative 3) or entirely on natural regeneration (Alternative 2).

Precipitation: Variations in yearly precipitation have the potential to affect seedling survival in the short term and growth rates in the longer term. Short term droughts, which are not infrequent in the project area, reduce the total amount of soil moisture on a site. It is the soil moisture available to trees that is the limiting factor affecting seedling survival and growth. Effective control of competing vegetation of during seedling establishment is the key to increasing available soil moisture to trees. Estimates of seedling survival and growth, above, show that Alternative 1 has higher survival and growth rates than Alternative 2 or 3 in the current climate of long moisture free summers. The effect of drought is more likely to affect seedling survival under

Alternatives 2 and 3 due to excessive moisture stress caused by reductions in available soil moisture to seedlings from competing plants.

Changing precipitation regimes in the longer term may result in changes in forest or tree productivity. The productivity of forests for timber in general is estimated to decline on a statewide basis, but some species and in some locations timber production may increase (CAT 2009), while for North America climate change is expected to increase the growth of forests modestly (by 10-20 percent) over the next century (EPA 2007b). Decreased precipitation, in the form of drought, results in higher stress levels within trees as they are not able to obtain the resources necessary for vigorous growth. Established, mature trees are often able to withstand a wide range of environmental conditions and will be able to survive for many years with effects primarily appearing as altered levels of productivity (Skinner 2007). Once established and free to grow, precipitation variability would likely affect tree growth rates under all alternatives more or less, equally.

Forest Insect and Diseases: Factors which improve a stands' ability to better withstand insect and disease outbreaks include a diverse mix of species, high genetic diversity within species, vigorously growing trees, and stocking levels low enough to allow trees to have access to full site resources. Vigorous, healthy trees have a greater ability to successfully ward off insect attacks, and resist diseases. As described above, diverse mix of species, high genetic diversity within species, and vigorously growing trees would be better met under Alternative 1 than Alternatives 2 and 3. Maintaining appropriate stocking levels to resist insect and disease outbreak beyond the implementation of this project is beyond the scope of the EIS.

Invasive Plants

Affected Environment

The current inventory invasive plants in and around the Freds project boundaries include yellow starthistle (*Centaurea solstitialis*), skeletonweed (*Chondrilla juncea*), tall whitetop (*Lepidium latifolium*), and exotic annual grasses, including cheatgrass (*Bromus tectorum)*. Numerous other invasive exotics, which are not thought to form permanent monocultures, such as bull thistle (*Circium vulgare*), Klamathweed (*Hypericum perforatum*), and wooly mullein, are widely scattered in the project area.

Yellow starthistle exists primarily in the western portion of the Freds Fire, especially along Weber Mill Road and its spurs. This infestation is scattered along approximately 5 miles of roadsides. It is being treated under the 2001 Yellow Starthistle Project (USDA 2001c) and has been greatly reduced in size. Yellow starthistle also exists along Granite Springs Road. Three sensitive plant occurrences are located in the vicinity of the yellow starthistle and have been protected by flag and avoid methods.

Cheat grass (*Bromus tectorum)* is widespread on the ENF where it has established itself as a minor component in many plant communities. Cheatgrass is a significant problem throughout the West, including Sierra Nevada foothills and low to mid elevation forests, where it creates fine, flashy fuels that ignite easily resulting in a fast moving fire that can kill established plantations (i.e. St. Pauli Fire July 2002). Surveys in 2006 documented cheatgrass along several roads within the Freds Fire. Twenty two locations were mapped along NFS roads within the fire area.

Skeletonweed and tall whitetop are also documented on or near Granite Springs Road.

The access routes into the Freds Fire begin along Highway 50. Highway 50 west of the Freds Fire is heavily infested with yellow starthistle, scotch broom (*Cytisus scoparius*), skeletonweed, cheat grass and other brome grasses (*Bromus spp.)*, bull thistle, Klamathweed, goat grass (*Aegilops* *triuncialis*), and other weedy species (ENF noxious weed database, 2005; personal observations). The Noxious Weed Assessment can be found in the Project file.

Environmental Consequences

Alternative 1 (Proposed Action)

Direct, Indirect, and Cumulative Effects

In line with one of the objectives of this project, this alternative would contain and control yellow starthistle and eliminate tall whitetop from the project area. The use of the herbicide clopyralid would effectively kill yellow starthistle plants and prevent germination of yellow starthistle seeds where it is applied. The use of the herbicide chlorsulfuron would effectively kill tall whitetop plants and prevent the germination of tall whitetop seeds where applied. Spot treatments with glyphosate would kill any missed plants. Hand treatments would also kill yellow starthistle plants but would be less effective for tall whitetop since plants can resprout from root fragments. This method of control is very time consuming, and would supplement chemical treatments for infestations of yellow starthistle and tall whitetop.

Proposed herbicide treatments for invasive plants will occur in open disturbed areas such as roadsides, landings, and openings areas within plantations. These areas tend to be dominated by non-native grasses and non-native ruderal species, which will limit the potential damage of herbicide use to native non-target vegetation. There is a limited possibility that some native, non-target vegetation would be damaged or killed due to the proposed herbicide treatments. Clopyralid is a selective herbicide; it is only effective on several members of the sunflower family *(Asteraceae*), legume family (*Fabaceae)*, nightshade family (*Solanaceae*), and some species in the knotweed and carrot families. Thus, the effects of clopyralid on non-target vegetation would be minor, as few plant species are affected. Glyphosate is non-selective and can damage or kill sprayed plants. Its use as primarily a spot treatment would reduce damage to non-target vegetation. As a contact herbicide, glyphosate would only affect existing plants. Plants germinating from seeds after a glyphosate treatment would be unaffected. The effects of become established (many species form monocultures) they can adversely effect native plant communities, including sensitive plant species, by crowding, shading, and robbing soil of nutrients and water necessary for growth and survival.

Over the short-term (<5 years) it is expected that there will be an increased risk of invasive plant spread resulting from the reduction in native vegetation cover after broadcast herbicide treatments. The radial treatments proposed where infestations of yellow starthistle and cheatgrass have been documented (about 510 acres) are designed to limit the potential for invasive plant spread. This configuration will allow for continued growth of shrubs and other native vegetation outside the radial pattern. To the degree that vegetation outside the radial spray pattern shades the ground and robs cheatgrass of sunlight, cheatgrass expansion will be inhibited. which may over a few years, reduce density and eventually shade out cheatgrass, which has little tolerance for shade.

Longer-term indirect effects could result from a reduced risk of invasive plant spread with the establishment of a forested landscape. In the event of another fire within the project area in the foreseeable future (25+ years), the project activities under this alternative will be more effective at containing a fire at a smaller size, increasing the probability of seedling survival across the landscape (Chapter 3 - Fire and Fuels). To the extent that the proposed action will limit the potential scale of future wildfires within the proposed project area, the probability of a mature forested landscape, which are relatively resilient to invasive plant spread, developing across a majority of the project area will increase.

Vectors (vehicles, dispersed recreation, water, wind, wildlife) and disturbances (roads, timber harvest, fuel treatment) would continue to be present on NFS land. These factors have contributed in the past and currently to the establishment of invasive plants on the Forest. Weed risk assessments have been conducted on the ENF since 2001 to “determine risks for weed spread … associated with different types of proposed management activities” (SNFPA Record of Decision, Appendix A, page A-55 and FSM 2080). Project-specific mitigations, incorporated into all new projects on the Forest, should reduce the potential spread of invasive into the project area in the future.

There are private lands within and adjacent to the proposed project area. Since it is unknown what measures are in place to prevent the spread and introduction of invasive plants it should be assumed that present and future activities by the public and adjacent landowners could facilitate the spread of invasive plants into the proposed project area

Alternative 1 will mitigate potential cumulative effects from this project by 1) containing known infestations of starthistle 2) eliminating known infestations of tall whitetop 3) establishing radial treatments within areas infested with cheatgrass to reduce the potential spread of this annual grass, and 4) developing a mature forested landscape that is relatively resilient to invasive plant spread. These measures will reduce the potential for cumulative effects in the project area. To the extent Alternative 1 is successful in developing a forested landscape, it is expected to have less cumulative effects overall than Alternative 2 or 3. New infestations within the project area will be subject to additional environmental analysis prior to implementing control strategies.

Alternative 2 (No Action)

Direct, Indirect, and Cumulative Effects

There will be no direct effects to invasive plants. In portions of the project area, yellow starthistle is being treated and treatment would continue, limiting spread. Tall whitetop would remain tarped and plants that emerge from under the tarp would continue to be hand pulled. Elsewhere, yellow starthistle and tall whitetop, introduced during past activities, would continue to grow and spread limited only by environmental factors, potentially negatively affecting native vegetation. One of the most immediate effects of weed invasion is the displacement of native plants (USDA, 2001b). This alternative would not meet the project objective of containing and controlling yellow starthistle. It is unlikely that the tall whitetop infestation would be eliminated under this alternative. Tall whitetop possesses a vigorously creeping, deep root system that reproduces vegetatively from roots. These vigorously creeping root systems would continually sprout from around the edges of the tarped area, requiring ongoing maintenance to be effective. Cheatgrass would likely continue to persist in open areas where it is dominant and along roadsides. Eventually dense growth of native shrubs and other plants may shade-out small, dispersed infestations of this annual grass.

In the short-term (<25 years) there will be a reduced risk for both introduction and spreading of weeds within the project area. Invasive plants will persist in openings, but without disturbance they are unlikely to spread within the project area because of the dense cover of native shrubs (Bossard, 2000). Longer-term (> 25 years), the risk of high intensity crown-fires is believed to increase as mature shrubs senescence. To the extent that the no action alternative increases the risk of large-scale high severity fire, there could be indirect impacts to invasive plants. Fire suppression activities during large uncontrolled wildfires may increase the spread of invasive plant species. The open ground created by an intense wildfire could potentially facilitate invasive plant expansion.

Existing infestations will continue to spread unchecked, gaining increasing dominance over the long term, contributing significantly to the cumulative effects of past and present weed infestations. A higher risk of a large uncontrolled wildfire could facilitate invasive plant expansion, contributing to cumulative effects. New and existing infestations within the project area will be subject to additional environmental analysis prior to implementing control strategies.

Alternative 3

Direct, Indirect, and Cumulative Effects

This alternative would treat yellow starthistle in the project area by hand methods. Various locations on the ENF have had yellow starthistle hand pulled, including sites along Webber Mill Road, Traverse Creek and Peavine Ridge Road. It is difficult to quantify the benefit, but it appears to be rather small, based on post-treatment observations. Hand treatments are highly labor intensive and very time consuming. Germination of starthistle plants later in the year would require more than one, probably two to three treatments on a yearly basis, until the seedbank was exhausted. Hand methods for controlling yellow starthistle are primarily recommended for small areas or low densities (see, for example, Callihan 1998, University of California 1996, Province of British Columbia 1998, in USDA, 2001c). While hand methods appear successful when applied intensively and correctly on a small scale, applying hand treatments alone, considering the size of the yellow starthistle infestation in the project area, is unlikely to meet the project objective of containing and controlling yellow starthistle. While the vegetation complex that develops under this alternative – a nearly continuous expanse of brush interspersed by grubbing circles - would slow yellow starthistle spread, it would also hinder access to plants by hand pullers. If an intense fire occurred in the future, it would provide open ground for starthistle expansion from plants inhabiting open areas, such as roadsides and openings.

This alternative would treat tall whitetop in the project area with hand methods (hand pulling, tarping). Since this infestation is small, both hand pulling and tarping methods are expected to meet the project objective of eliminating this plant. Tall whitetop possesses a vigorously creeping, deep root system that reproduces vegetatively from roots or root fragments. Continued growth from remaining root fragments after hand pulling treatments would require more than one, probably two to three treatments on a yearly basis, until the plants exhausted their food reserve. Similarly, vigorously creeping root systems would sprout from around the edges of a tarped area, requiring ongoing maintenance to be effective. Monitoring for several years will determine the status of the tall whitetop infestation.

In the short-term (<25 years) there will be a reduced risk for both introduction and spreading of weeds within the project area, especially cheatgrass, although the ground disturbance adjacent to planted trees is likely to create ideal growing conditions for weed seeds present in the scalped area. The potential for weed expansion outside of the planted tree radius will be diminished due to a greater cover of native plants that shade the ground thus inhibiting the germination and growth of invasive plants.

The risk of longer-term indirect effects for invasive plants would be similar to Alternative 2 as the expected increase in long-term (>25 year) risk for high severity fire is expected to be similar to Alternative 2 (no action).

Alternative 3 will mitigate potential cumulative effects from this project by 1) eliminating known infestations of tall whitetop and 2) utilizing radial treatments, reducing the potential spread of cheatgrass. The potential for cumulative effects from hand treatments of yellow starthistle would remain as this method would be ineffective in containing known infestations of yellow starthistle, allowing further spread. The increased long-term risk of high severity wildfire could potentially facilitate invasive plant expansion, contributing to cumulative effects. New and existing infestations within the project area will be subject to additional environmental analysis prior to implementing other control strategies.

Botanical Resources

Affected Environment

Elevations within the project area range from 3,900 to 6,800 feet. The vegetation within the project area consists primarily of a mid-montane mixed conifer forests with white fir dominating at the higher elevations in the north and ponderosa pine dominant in the lower elevations to the south. The lowest elevations are characterized by ponderosa pine, black oak and scattered areas of open, rocky ground with live oak interspersed. In the western portion where the Freds Fire overlapped with the 1992 Cleveland Fire, plantations of ponderosa pines with a significant resprouted black oak component are dominant.

The botanical resources of the analysis area are incompletely known. Sensitive plant surveys of the general area have been occurring since the early 1990’s. These surveys, for the most part, have been focused on one sensitive species, Pleasant Valley mariposa lily (*Calochortus clavatus* var. *avius*).

It is possible, perhaps likely, that sensitive plant locations remain undiscovered on both NFS and private lands within the Freds Fire analysis area. In the following discussion on effects of the alternatives, analysis area refers only to NFS lands.

Federally Listed Plant Species

No Federal proposed, threatened or endangered plant species are documented in the analysis area (USDI Fish and Wildlife Service, 2009). The Biological Evaluation (BE) for Plants can be found in the Project file.

Sensitive Plant Species

There are 22 sensitive plant species currently listed by the Regional Forester for the Eldorado National Forest. A pre-field evaluation determined that five sensitive species, Pleasant Valley mariposa lily (*Calochortus clavatus* var. *avius*), Kellogg's lewisia (*Lewisia kelloggii*), mountain lady's slipper (*Cypripedium montanum*), two mosses (*Meesia* spp.), and the moonwort complex (*Botrychium* spp.), had potentially suitable habitat in the analysis area. Subsequent surveys of potential habitat for these species located no new occurrences.

Potential habitat surveys for mountain lady's slipper and the moonwort complex were found to be unsuitable. Potential habitat surveys for two mosses (*Meesia* spp.) were marginally suitable at best.

Pleasant Valley mariposa lily

Suitable habitat for Pleasant Valley mariposa lily consists of openings in mixed conifer and ponderosa pine forests, on canyon slopes, spurs, and ridges with southerly aspects, at elevations of 2,800 to 5,800 feet. These openings typically have rocky soils with surface rocks and cobbles readily apparent.

With a single exception in Calaveras County, Pleasant Valley mariposa lily is endemic to the ENF and adjoining private lands in the area between Union Valley Reservoir and the North Fork of the Mokelumne River and is currently known to occur at 124 locations within this roughly 420 square-mile area (Forest maps/Sensitive Plant files 2006). Of these 124 occurrences, 12 are located on private lands, 4 are located on both private and Forest Service lands and the remaining 108 occur entirely on federal lands. Four known occurrences of Pleasant Valley mariposa lily are documented within the fire area.

Kellogg's Lewisia

Kellogg's lewisia is restricted to a specialized habitat usually on ridgetops or relatively flat open areas with widely spaced trees in partial to full sun. Site elevations range from 5,100 to 7,000 feet. Most soils are reported to be sandy granitic to erosive volcanic with granitic boulders. Plants are often visible during June and July and then seem to dry up and disappear later in the summer. The reason for the apparent disappearance has not been resolved. Either the plants may be subject to poaching, are desirable forage for wildlife or they simply dry up and shrivel beyond the point of recognition.

Kellogg's lewisia is known from at least 30 occurrences in four National Forests from Plumas County to Madera County. The northern most occurrence is known from the Lassen National Forest but the number of plants was not clearly noted. The largest occurrence (about 2,000) is on the ENF, but most other occurrences range in number from 50 to 250 plants. No occurrences of Kellogg's lewisia are documented within the fire area.

Special Interest Species (Watchlist)

Three Forest special interest species, lace orchid (*Piperia leptopetala*), mariposa phacelia (*Phacelia vallicola*), and woolly violet (*Viola tomentosa*) are suspected to occur within the analysis area. Special interest species make up a Forest watch list of plants that are not currently rare, but may become increasingly so as a result of project activities. Current Forest Service policy does not require formal tracking of special interest species; therefore, data for these species are not always available or up-to-date.

Environmental Consequences

There are no Federal proposed, threatened or endangered plant species documented in the analysis area. Therefore, there would be no impacts from any of the alternatives in this project to such species. The BE has determined that there would no effect to mountain lady's slipper (*Cypripedium montanum*), two mosses (*Meesia* spp.), and the moonwort complex (*Botrychium* spp.), as there is no suitable habitat or their habitat will be protected from project activities (Alternative 1 and 3) by buffers created around aquatic features such as meadows, fens, and along riparian corridors will serve to protect riparian vegetation. There would be no effect on these species from Alternative 2 (no action).

Alternative 1 (Proposed Action)

Direct Effects

There will be no direct effects to known occurrences of Pleasant Valley mariposa lily as they will be flagged for avoidance and monitored after planting and herbicide applications. Little or no damage from herbicide drift or runoff is expected when applying glyphosate by backpack herbicide application (SERA 2003a). In addition, past conifer release and invasive plant herbicide treatments have occurred on the ENF adjacent to Pleasant Valley Mariposa lily without any observed effects to the sensitive species.

There will be no direct effects to any new occurrences of sensitive species found during subsequent surveys, or any time prior to or during project implementation, as they will be documented and flagged for avoidance.

Although sensitive plant occurrences will be protected by avoidance, potentially suitable habitats for Pleasant Valley mariposa lily and Kellogg's lewisia may be adversely affected by proposed management activities under this alternative. Small, inconspicuous seedlings of Pleasant Valley mariposa lily and Kellogg's lewisia may inadvertently be killed by spray treatments in unprotected suitable habitat. While these activities will not be sufficient to affect the overall viability of these sensitive species, they can reduce opportunities for enhancing species viability treatments. Indirect effects resulting from competition (shading, loss of nutrients and water) from invading weeds can reduce populations and/or displace sensitive plants such as Pleasant Valley marisposa lily and Kellogg's lewisia. The project activities and design features, treating yellow starthistle, modified treatment areas for the cheatgrass infestations, and monitoring of current and future project activities that can introduce new weeds or cause expansion of existing infestations, will serve to reduce the likelihood that indirect effects to sensitive plant habitats or occurrences will occur.

Longer-term indirect effects could result from a reduced risk of invasive plant spread with the establishment of a forested landscape. In the event of another fire within the project area in the foreseeable future (20+ years), the project activities under this alternative will be more effective at containing a fire at a smaller size, increasing the probability of seedling survival across the landscape (Chapter 3 -Fire and Fuels). To the extent that the proposed action will limit the potential scale of future wildfires within the proposed project area, the probability of a mature forested landscape developing across a majority of the project area will increase. Since mature forested landscapes are relatively resilient to invasive plant spread the above reduction in fuel loading may indirectly benefit sensitive plants within the project area in the long-term.

Cumulative Effects

Cumulative effects for sensitive plant species consider the impacts of the Alternative 1 when combined with the following past, present, and foreseeable future actions and events within the project area: soil disturbance and compaction resulting from past salvage logging, firelines, and existing road conditions. The actions contributing to cumulative effects were selected because they have caused or have the potential to adversely affect either sensitive plant species themselves or their suitable habitat. The geographic scope of the cumulative effects analysis was selected because impacts to sensitive plant species accumulate at a given location on the ground, irrespective of actions in surrounding areas. The temporal scope was selected because impacts to sensitive plant species at a given location can accumulate over time from different activities or events.

Cumulative effects also include past fire suppression and BAER activities and the actions taken by the private landowners in the project area. The cumulative effects also consider impacts from private industry's salvage and reforestation; past fire suppression (Wrights Fire, Cleveland Fire, Freds Fire) including application of retardant, the emergency BAER treatments, reforestation of burned over plantations on public lands; effects of invasive plants and ongoing treatments; past timber and fuels project (Freds Fire Salvage Sales, Algorythym Roadside Hazard, 4 Corners, Misnomer and Jane Doe Understory thinning); planned or recent thinning/timber sales (Roadrunner Fuels treatment); and vegetation management in Cleveland Fire plantations.

Because of previous survey efforts, protection measures, and weed abatement projects on NFS lands these activities are not expected to have significant cumulative effects on the sensitive plant species occurring in the Freds Fire nor lead toward a loss of viability or possible federal or state listing for those sensitive plant species. Direct effects from Alternative 1 will be mitigated, in a large part, by protection of documented occurrences of sensitive plants through avoidance. Direct effects may occur to undiscovered individuals or occurrences of sensitive species located outside the flagged boundaries of documented sites on NFS land and those found on private land within the project area. Because of the relatively small size of the affected area, indirect and cumulative effects of Alternative 1 will not reduce the viability of the sensitive species that are present in the fire area although project activities may eliminate or reduce opportunities for enhancing and increasing their viability within the fire. In summary, the Proposed Action Alternative may affect individuals but is not likely to result in a trend toward federal listing for Pleasant Valley mariposa lily and Kellogg's lewisia.

The three Forest special interest species within the Freds Fire have evolved in fire-prone landscapes. Although the effects of the Freds Fire and Alternative 1 may reduce the presence of these species in the fire area, it is not expected to reduce their range-wide viability as they are broadly distributed within California.

Alternative 2 (No Action)

Direct, Indirect, and Cumulative Effects

There will be no direct effects sensitive plants and Forest special interest species as no activities are proposed under this alternative. Vegetation succession to continue within the analysis area without further disturbance from management activities. 1,868 acres have been planted with conifers since the fire. While these plantations began the successional process “fully stocked” with conifers, conifer survival and growth are expected to be reduced when compared to Alternative 1, based on current trends.

Sensitive plants within the project area occur in natural openings defined by rocky, low-productive soils. These sites are not dominated by dense shrub cover and are unlikely to be negatively effected by encroaching shrubs. Undocumented sensitive species found in riparian habitats are also unlikely to be impacted by the expected dominance of native shrub species within the project area. If present in the analysis area special interest species are expected recover from effects of the wildfire and salvage disturbances. These species evolved in fire-prone landscapes.

Short-term indirect effects to sensitive plants and Forest special interest species are not expected. For the short-term (<5 years) the risk of invasive plant spread within the proposed project area is expected to be less under this alternative than under Alternative 1. Invasive plants will persist in openings, but are unlikely to spread within the project area because of the dense cover of native shrubs (Bossard, 2000). The percent cover of native vegetation is expected to remain high across the project area for the foreseeable future, thereby reducing the risk of invasive plant spread, unless another large-scale fire occurs.

Initially the plant community will be dominated by native shrubs with native and non-native grasses in the understory. This plant community would produce a moderate fire, with expected flame lengths of 5.5 feet (Chapter 3 – Fire and Fuels). Once these native shrubs mature, dead woody material is expected to accumulate in the shrub canopy and will support higher severity fire with expected flame lengths of 15.1 feet. This transition from moderate to severe fire severity is expected to take approximately 20 years.

Longer-term indirect effects could result in an increased risk of invasive plant spread and changes to habitat in the event of a high severity wildfire. After 20 years, the risk of high intensity crown-fires is believed to increase as mature shrubs senescence. In the event of another high severity wildfire in the project area it is expected that there could be some indirect effects to sensitive plant species. High intensity crown-fires in the Sierra Nevada tend to result in homogenous conditions post-fire with less diversity of understory plant species when compared to low-intensity underburns (Knapp and Keeley, 2006). High-intensity wildfires also result in accelerated erosion, sedimentation, and altered hydrologic processes, all of which could negatively affect habitat quality for sensitive plant species (Neary et al, 2005). In addition, fire-suppression activities during large uncontrolled wildfires may increase the spread of invasive plant species which could negatively impact potential and occupied habitat for sensitive plants (Zouhar et al, 2008). Together, these studies suggest that uncontrolled high-intensity wildfires would likely impact many sensitive plant species by altering habitat quality and potentially facilitating the spread of invasive plants. To the extent that the no action alternative increases the risk of large-scale high severity fire, there could be indirect impacts to sensitive plants in the future (>20 years).

It is likely that sensitive plant species that occur on private forest land owned by Sierra Pacific Industries have been impacted by salvage logging, planting and release treatments. The ENF has no documentation of sensitive plant locations on Sierra Pacific Industries land within the Freds Fire area nor is aware of any sensitive plant mitigation measures taken by Sierra Pacific Industries during Freds Fire salvage or planting projects.

Alternative 3

Direct, indirect, and cumulative effects to sensitive and Forest special interest plants and their habitats under this alternative would be similar to the proposed action except as follows.

Direct Effects

The potential for direct effects to undocumented sensitive plants in potential habitat is significantly reduced compared to Alternative 1 due to 800 fewer acres planted/released and the subsequent reduction in area included in release treatments.

Release treatments in this alternative are limited to the disturbance caused by hand grubbing a 4-5 foot radius around planted trees. Inconspicuous seedlings of sensitive plants outside of a 4-5 foot radius from planted trees are much less likely to be injured or killed by release activities.

This alternative would provide for enhanced species viability and potential expansion (recruitment) within the analysis area.

Indirect Effects

Short-term indirect effects to sensitive plants could result from increased competition with invasive plants, however they would likely be limited to the hand release radius around planted trees. Within the 5 foot hand release radius around planted trees certain early maturing annual weeds, such as cheatgrass, may increase due to enhanced germination opportunities caused by the disturbed soil.

The potential for indirect effects to sensitive plants from weed expansion outside of the planted tree radius will be diminished due to a greater cover of native plants that shade the ground thus inhibiting the germination and growth of invasive weeds, including cheatgrass.

The risk of longer-term indirect effects for sensitive plant species would be similar to those described under Alternative 2 as the expected increase in long-term (>20 year) risk for high severity fire is expected to be similar to Alternative 2 (Chapter 3- Fire and Fuels).

Cumulative Effects

Cumulative effects to sensitive species will be somewhat reduced due to a reduction of 800 acres being planted and released. This diminishes the opportunities for direct and indirect effects to potentially undiscovered plants. Radial hand release treatments reduce the total acres impacted by release treatments when compared to broadcast herbicide treatments prescribed under Alternative 1. This may allow sensitive plants to potentially expand into adjacent suitable habitat of poorer productivity (low site index) as this habitat typically supports fewer plants and shrubs. In summary, the Alternative 3 may affect individuals but is not likely to result in a trend toward federal listing for Pleasant Valley mariposa lily and Kellogg's lewisia.

Economic Analysis

Affected Environment

The Eldorado National Forest's economic area of impact consists of Alpine, Amador, El Dorado, and Placer Counties. The project area is wholly within El Dorado County, on the Placerville and Pacific Ranger Districts. El Dorado County's economic base includes tourism, recreation, lumber and wood products, and agriculture. Placerville and Pacific Ranger Districts contribute to the regional economy in two primary ways: through generation of income and employment for residents in the immediate area, and through direct and indirect contributions to local county revenues. The Districts also contribute in secondary ways, such as through the production of commodities that are consumed in local and regional markets. The proposed forest management activities most directly impact this county's residents in terms of local social and economic impacts. Relative to the local economy, employment opportunities would be created from this project from tree planting, site preparation and release, invasive plant treatments, and fuel reduction treatments. Furthermore, indirect and induced economic employment and monies would be generated when income received by contractors is spent within the local economy.

Environmental Consequences

The economic consequences are a measure of the overall value of alternatives for managing the project area. The level and mix of goods and services available to the public varies by alternative, which creates impacts on the social and economic environment. The impacts discussed in this section include estimated government expenditures and revenues, as well as monetary impacts on local communities.

The direct monetary impacts are discussed in terms of net cash value to the U.S. Treasury, including the direct, indirect, and induced job opportunities. In general, the monetary value of the alternatives depends on the amount and method planned for fuels reduction, site preparation, release, invasive plant, and reforestation treatments.

Employment

Employment effects on the local economy can be defined in terms of direct, indirect, and induced. Direct effects are associated with the primary producer. On this project, mechanical and chemical treatments have a direct effect on employment by contractors spending money at hotels, restaurants, parts and equipment, supply and retail stores. Indirect effects account for employment in these service industries, which serve the contractor. These service industries in turn would spend money to other service industries or suppliers and pay wages to employees. Wages paid to workers by the direct and indirect industries are then circulated through the local economy for food, housing, transportation, and other living expenses, which is an induced economic effect. The sum of direct, indirect, and induced effects is the total economic impact in terms of jobs.

Treatment Costs

The primary factors affecting costs are: reforestation costs, based on the method and amount of site preparation, planting and release required, invasive plant treatment costs, based on the method and amount of treatments required, fuels reduction costs, and monitoring requirements; depending on the method and amount of projects. Costs to implement each alternative differ because of the method and amount of activities under each alternative. An economic analysis provides a means to rank the relative economic cost/value of the vegetation management alternatives within the Freds Fire area.

Non-Priced Costs and Benefits

Assessing economic value is complex, since vegetation management can yield many long-term benefits that are not easily quantifiable in monetary terms, e.g., wildlife habitat associated with late successional forests, protection of soils and water resources from the effects of large-scale wildfire, scenic values, etc. Thus, this analysis does not include monetary values assigned to resource outputs such as wildlife, watershed, soils, recreation, timber outputs, controlling invasive plants, firefighting costs, and fisheries. It is intended only as a relative measure of differences between alternatives based on those direct costs and values used. Other values are discussed in the appropriate section of this document. It should be noted that all costs and values are not represented in the analysis. The calculations do not include costs and values for those items that cannot be estimated in dollar terms. Examples of costs not estimated in dollar terms are the reduction in scenic value in the early years of reforestation treatments or the decrease in water production as forests are re-established. Examples of benefits not estimated include the accelerated restoration of a forested ecosystem; reduction of fuels and fire hazards; improved habitat for wildlife dependent on forested environments; improved visual quality and aesthetic values; and an improved environment for recreational use within the project area.

For a discussion of these non-priced benefits and costs, refer to the sections of the document where the effects by alternative are described. These non-priced benefits and costs must be considered along with the net economic value of each alternative in order to make a judgment as to which alternative offers the best overall mix of costs and benefits to society.

Alternative 1 (Proposed Action)

Direct Effects

Implementation of the reforestation, fuels reduction, and invasive plant treatments for this alternative is estimated to cost $2,530,000 (Appendix E). As described above, this economic analysis does not take into account non-priced benefits. The cost on an acre basis is approximately $762 per acre. This dollar value per acre includes the cumulative or multiple treatments (i.e., site preparation, planting, release, invasive plants) being completed on the same acres.

Site preparation, planting, release, and fuel reduction activities would generate 4,903 person days worth of employment opportunities. The use of herbicide application has higher rates of production, but requires more contract supervision. It would require fewer days to accomplish, but with more people involved in contract supervision.

Indirect Effects

Additional employment opportunities would be created in service industries that serve the reforestation and fuel reduction contractors, such as tractor supply companies, fuel supplies, and so forth. Induced effects, wages that are paid to workers by the primary (4,903 person days) and service industries would be circulated through the local economy for food, housing, transportation, and other living expenses.

Cumulative Effects

On the Placerville and Pacific Ranger Districts, there are no active reforestation projects. The Freds Fire Reforestation Project would continue to contribute to the local economy. Reforestation activities on the Georgetown Ranger District and on the Amador Ranger District, have contributed recently, and may continue to contribute to the local economy. Reforestation activities on private land in the analysis area are primarily Sierra Pacific Industries, which is in the process of reforesting about 2,526 acres. These activities have contributed recently, and may continue to contribute to the local economy.

Alternative 2 (No Action)

Direct Effects

This alternative would not reforest or reduce the fuels in the project area. No employment opportunities would be generated from reforestation and fuel reduction activities. Monies spent on reforestation efforts to date would cease. Any future treatments would also be at higher cost than at present.

Indirect Effects

No additional employment opportunities or wages paid to the primary and service industries employees would be circulated through the local economy.

Cumulative Effects

With no direct or indirect effects, there are no cumulative effects.

Alternative 3

Direct Effects

Implementation of the reforestation, fuels reduction, and invasive plant treatments for this alternative would cost $4,688,000 (Appendix E). The economic analysis does not take into account the non-priced benefits. The cost on a acre basis is approximately $1,906 per acre, for 800 less acres reforested. This dollar value per acre includes the cumulative or multiple treatments (i.e., planting, release) being completed on the same acres.

Planting, release, and fuel reduction activities would generate 15,600 person days worth of employment opportunities. The use of hand release, which has lower rates of production, but requires less contract supervision, would more days to accomplish, but with fewer people involved in contract supervision.

Indirect Effects

Additional employment opportunities would be created in service industries that serve the reforestation and fuel reduction contractors, such as tractor supply companies, fuel supplies, and so forth. Induced effects, wages that are paid to workers by the primary (15,600 person days) and service industries would be circulated through the local economy for food, housing, transportation, and other living expenses.

Cumulative Effects

On the Placerville and Pacific Ranger Districts, there are no active reforestation projects. The Freds Fire Reforestation Project would continue to contribute to the local economy. Reforestation activities on the Georgetown Ranger District and on the Amador Ranger District, have contributed recently, and may continue to contribute to the local economy. Reforestation activities on private land in the analysis area are primarily Sierra Pacific Industries, which is in the process of reforesting about 2,526 acres. These activities have contributed recently, and may continue to contribute to the local economy.

Heritage Resources

Affected Environment

Heritage resources, the remains of past human activity, provide a record of human activity within the ecosystem and provide a meaningful context for resource managers to assess the existing condition of a landscape. The Fred's Fire analysis area contains evidence of human activity over a long period of time, with the heaviest use occurring within the last 4,000 years. Materials from the surrounding forest indicate that people have been visiting the general vicinity for at least 7,000 years.

By 5,000 years ago, permanent villages were well established on the western Sierran slopes at elevations generally below the snow line. Inhabitants of those villages, as well as people from the east side of the Sierra, were visiting the higher elevations of the forest to procure resources not available in the lower elevations. Three different groups were using the resources of the forest. Two of them, the Nisenan (Southern Maidu) and the Northern Sierra Miwok, had their winter villages below the snow line on the west slope of the Sierra. The Washoe had their permanent villages east of the Sierra, in the Reno and Markleeville area. All three groups may have used the area. One area near Sugarloaf, in Kyburz, was used as a meeting ground for Big Times. During the summer and fall these groups traveled through the area to acquire a variety of resources, some through trade. Archaeological evidence confirms seasonal use due to the presence of temporary camps containing bedrock milling features and lithics.

Historic activities also left important remains on the landscape within the analysis area. During the late 1840s through the 1850s, the rush for gold brought thousands of immigrants from around the world to the Sierra Nevada. Homesteads, cabins and other structures; ranches, corrals and other ranching features; mines and hydraulic pits; ditches; dams; trails and wagon roads; toll stations; hotels, hostelries, and way stations; historic refuse scatters associated with this era have been identified within the project vicinity.

Past surveys have been adequate to assess the effects of the proposed actions. Since 1980, archaeological surveys have resulted in coverage of the majority of the public land within the analysis area. In addition, new survey was completed after the Fred's Fire (documented in Archaeological Reconnaissance Report No. R-2005-0503-60001.) All archaeologically sensitive terrain has been surveyed. Some areas have not been surveyed due to steepness of terrain. However, it is not likely that these areas contain significant heritage resources. These surveys have resulted in the identification of a total of 20 sites. Of this total, 10 sites are prehistoric (Native American), 9 are historic, and one site contains both Native American and historic artifacts. At present, none of these sites have been evaluated for inclusion into the National Register of Historic Places. In order for a heritage resource to be considered for inclusion, its significance and integrity need to be determined.

The Freds Fire considerably affected the integrity of these sites. The effects from the wildfire ranged from charring, spalling, discoloring, melting, and destroying individual artifacts to complete destruction of wooden features.

These sites will continue to experience negative effects from the wildfire as the areas that suffered a loss of vegetation and damage to the soil structure will be susceptible to higher erosion rates, changes in drainage patterns and slide activity. Additionally, in heavily forested areas, damage from falling dead trees is likely.

Environmental Consequences

All Alternatives

Direct and Indirect Effects

Implementation of this project is not expected to have any direct effects on known cultural resource sites located within the analysis area. Ground-disturbing activities associated with Alternatives 1 and 3 have the potential to disturb or destroy heritage resources. Twenty heritage resource sites within the Freds Fire perimeter are located within areas of proposed ground-disturbing activities. However, protection of heritage resource sites is included as part of the project design.

Activities associated with this alternative will comply with the National Historic Preservation Act (NHPA) of 1966, as amended and it’s implementing regulations 36 CFR 800. Tribal communities will continue to be consulted for any concerns regarding this project.

Protection of cultural resource sites will comply with the Programmatic Agreement among the USDA Forest Service, Pacific Southwest Region, California State Historic Preservation Officer, and Advisory Council on Historic Preservation Officer Regarding the Identification, Evaluation and Treatment of Historic Properties Managed by the National Forest of the Sierra Nevada, California dated 1996. Protection measures outlined in the Programmatic Agreement will be followed throughout the duration of project activities.

Cumulative Effects

Past events, both natural and human caused, have had varying levels of cumulative effects on the archaeological sites in the project area. These effects, ranging from moderate to extensive, have resulted from logging, road construction, wildfires, erosion, and exposure to the elements. No predicted future management activities will affect heritage resources. However, future wildfires will continue to degrade the integrity of these fragile heritage resources.

Without management intervention there is a concern for future high severity fires within the sites due to increased fuel loading from downed fire killed trees and the presence of dense brush fields, which tend to replace timber after stand replacing fire events.

Human Health and Safety of Herbicide Use

Affected Environment

Alternatives 2 and 3 do not propose to use herbicides, therefore this section on Human Health and Safety of Herbicide Use is only discussed in terms of Alternative 1 (Proposed Action).

The risk of adverse health effects from the use of any of the five herbicides proposed for use on the level and duration of exposure and the inherent toxicity of the herbicide. Possible short-term adverse health effects include nausea, headache, dizziness, eye irritation, and coughing.

A comprehensive analysis of human health risks was conducted to analyze the potential for adverse health effects in workers and members of the public from the proposed use of herbicides. This analysis examines a range of potential exposures to herbicides, from routine operations involving workers, to accidents involving workers and the public. Assumptions regarding rates of use range from average (or typical) rates of use to very high rates of use, representing worst-case scenarios. Appendix D presents the complete risk assessment. The following summary of herbicide effects is taken from that risk assessment.

This risk assessment examines the potential health effects on all groups of people who might be exposed to any of the five herbicides proposed to be used. Those potentially at risk fall into two groups: workers and members of the public. Workers include applicators, supervisors, and other personnel directly involved in the application of herbicides. The public includes other forest workers, forest visitors, and nearby residents who could be exposed through the drift of herbicide spray droplets, through contact with sprayed vegetation, or by eating, or placing in the mouth, food items or other plant materials, such as berries or shoots growing in or near treated areas, by eating game or fish containing herbicide residues, or by drinking water that contains such residues.

The analysis of the potential human health effects of the use of chemical herbicides was accomplished using the methodology generally accepted by the scientific community (National Research Council 1983, United States Environmental Protection Agency 1986). In essence, the risk assessment consists of comparing doses, based on site-specific herbicide use levels, that people might receive from applying the herbicides (worker doses) or from being near an application site (public doses) with the United States Environmental Protection Agency's (U. S. EPA) established Reference Doses (RfD), a level of exposure considered protective of lifetime or chronic exposures. The site-specific risk assessment also examines the potential for these treatments to cause synergistic effects, cumulative effects, and effects on sensitive individuals, including women and children.

Different types of possible effects were considered in the assessment, including acute and chronic systemic effects, cancer and mutations, and reproductive effects. These effects were evaluated using the appropriate animal test data. General systemic effects were evaluated that could range from nausea and headaches at low doses to organ damage, reproductive problems, birth defects, or even mortality at extreme doses. This risk assessment also examined acute toxic effects from accidental exposure scenarios. For each type of dose assumed for workers and the public, a hazard quotient (HQ) was computed by dividing the dose by the RfD. In general, if HQ is less than or equal to 1, the risk of effects is considered negligible. Because HQ values are based on RfDs, which are thresholds for cumulative exposure, they subsume acute exposures. This aspect is discussed below in the evaluations of possible effects.

One of the primary uses of a risk assessment is risk management. Decision makers can use the risk assessment to identify those herbicides, application methods, or exposure rates that pose the greatest risks to workers and the public. Specific mitigation measures can then be employed where the decision maker believes the risks to be unacceptably high. Because the risk assessment is based on a number of assumptions, risk values are not absolute. If assumptions change, the risk values change. However, the relative risk among herbicides or methods would remain valid. Of course, if new toxicity data became available that indicated more adverse response(s) than previous data indicated, the risk assessment would need to be revised.

To facilitate decision making, acceptable risk levels must be established. EPA has established a significant cancer risk level of 1 chance in 1 million; the State of California, through Proposition 65, has established a standard of 1 chance in 1 hundred thousand. The RfD is also an EPA-established measure of acceptable risk for non-carcinogen exposures. This assessment uses the standards of 1 chance in 1 million for cancer risk and the RfD for non-carcinogen exposures.

Hazard Analysis

The hazards associated with using each of the herbicides were determined by a thorough review of available toxicological studies, which are referenced in Appendix D on pages 3 to 28. The reviews are contained in other documents and are referenced here as needed. A considerable body of information has been compiled in a group of risk assessments completed by Syracuse

Environmental Research Associates, Inc. (SERA 2003a, 2003b, 2004a, 2004b, 2005), authored by Dr. Patrick Durkin, PhD, under contract to the Forest Service, the risk assessment contained in the programmatic Region 5 Final EIS Vegetation Management for Reforestation (USDA 1989b), and the risk assessment contained in the Herger-Feinstein Quincy Library Group Forest Recovery Act Final Supplemental EIS (USDA, 2003b). Another source of information on toxicity are the background statements contained in Forest Service Agricultural Handbook No. 633 (USDA 1984). Current peer-reviewed articles from the open scientific literature, as well as recent U. S. EPA documents are also used to update the information contained in these documents. Toxicity information for the surfactants being considered for use are summarized in USDA, 2003a and USDA, 2007a. Additional information on toxicity is contained in Williams, et al (2000). Current peer-reviewed articles from the open scientific literature, as well as recent U.S. EPA documents are also used to update information contained in these documents. All of these documents are incorporated by reference into this risk assessment.

The toxicological database for each herbicide was reviewed for acute, subchronic, and chronic effects on test animals. Because of the obvious limitations on the testing of chemicals on humans, judgments about the potential hazards of pesticides to humans is necessarily based in large part on the results of toxicity tests on laboratory animals. Where such information is available, information on actual human poisoning incidents and effects on human populations supplement these test results. For a background discussion of the various toxicological tests and endpoints, refer to USDA (1989b, pages F-7 to F-18).

Impurities and Metabolites

Virtually no chemical synthesis yields a totally pure product. Technical grade herbicides, as with other technical grade products, undoubtedly contain some impurities. The U. S. EPA defines the term impurity as "…any substance … in a pesticide product other than an active ingredient or inert ingredient, including un-reacted starting materials, side reaction products, contaminants, and degradation products" (40 CFR 158.153(d)). To some extent, concern for impurities in technical grade products is reduced by the fact that the existing toxicity studies on these herbicides were conducted with the technical grade product. Thus, if toxic impurities are present in the technical grade product, they are likely to be encompassed by the available toxicity studies on the technical grade product. An exception to this general rule involves carcinogens, most of which are presumed to act by non-threshold mechanisms. Because of the non-threshold assumption, any amount of a carcinogen in an otherwise non-carcinogenic mixture may pose a carcinogenic risk. As with contaminants, the potential effect of metabolites on a risk assessment is often encompassed by the available *in vivo* toxicity studies under the assumption that the toxicological consequences of metabolism in the species on which toxicity studies are available will be similar to those in the species of concern (humans in this case). Uncertainties in this assumption are encompassed by using an uncertainty factor in deriving the RfD and may sometimes influence the selection of the study used to derive the RfD. Unless otherwise specifically referenced, all data and test results are from the references listed at the herbicide heading.

Inert Ingredients

Issues concerning inert ingredients, additives, and the toxicity of formulations is discussed in USDA 1989b (pages 4-116 to 4-119). The approach used in USDA 1989b, the SERA Risk Assessments, and this site-specific analysis to assess the human health effects of inert ingredients and full formulations has been to: (1) compare acute toxicity data between the formulated products (including inert ingredients) and their active ingredients alone; (2) disclose whether or not the formulated products have undergone chronic toxicity testing; and (3) identify, with the help of EPA and the chemical companies, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients.

Researchers have studied the relationships between acute and chronic toxicity and while the biological end-points are different, relationships do exist and acute toxicity data can be used to give an indication of overall toxicity (Zeise, et al. 1984). The court in NCAP v. Lyng, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decisionmaker to make a reasoned decision. In SRCC v. Robertson, Civ.No. S-91-217 (E.D. Cal., June 12, 1992), and again in CATS v. Dombeck, Civ. S-00-2016 (E.D. Cal., Aug 31, 2001), the district court upheld the adequacy of the methodology used in USDA 1989b for disclosure of inert ingredients and additives.

The EPA has categorized approximately 1200 inert ingredients into four lists. Lists 1 and 2 contain inert ingredients of toxicological concern (USDA 1989b, 4-116). List 3 includes substances for which EPA has insufficient information to classify as either hazardous (List 1 and 2) or non-toxic (List 4). List 4 contains non-toxic substances such as corn oil, honey and water. Use of formulations containing inert ingredients on List 3 and 4 is preferred on vegetation management projects under current Forest Service policy.

Since most information about inert ingredients is classified as "Confidential Business Information" the Forest Service asked EPA to review thirteen herbicides for the preparation of USDA 1989b (includes glyphosate, triclopyr, and hexazinone) and the commercial formulations and advise if they contain inert ingredients of toxicological concern (Inerts List 1 or 2)(USDA 1989b, Appendix F, Attachment B). The U.S. EPA determined that there were no inerts on List 1 or 2, with the exception of kerosene in certain formulations triclopyr. Kerosene has since been moved to List 3. In addition, the CBI files were reviewed in the development of most of the SERA risk assessments. Information has also been received from the companies who produce the herbicides and spray additives.

Butoxyethanol (or EGBE) has been assessed for human health risk as an impurity in the Garlon 4 formulation of triclopyr (Borrecco and Neisess 1991). In that risk assessment, the addition of butoxyethanol did not substantially increase the risk to human health over the risk of using the active ingredient of triclopyr. The amount of butoxyethanol in Garlon 4 is listed as 0.3% in that assessment.

Comparison of acute toxicity (LD_{50} (lethal dose) values) data between the formulated products (including inert ingredients) and their active ingredients alone shows that the formulated products are generally less toxic than their active ingredients (USDA 1989b, USDA 1984, SERA risk assessments).

While these formulated products have not undergone chronic toxicity testing like their active ingredients, the acute toxicity comparisons, the EPA review, and our examination of toxicity information on the inert ingredients in each product leads us to conclude that the inert ingredients in these formulations do not significantly increase the risk to human health and safety over the risks identified for the active ingredients.

Environmental Consequences

Worker Exposure Analysis

Pesticide applicators are the individuals most likely to be exposed to a pesticide during application. Two types of worker exposure assessments are considered: general and accidental/incidental. The term general exposure assessment is used to designate those exposures that involve estimates of absorbed dose based on the handling of a specified amount of a chemical during specific types of applications. The accidental/incidental exposure scenarios involve specific types of events that could occur during any type of application.

In past risk assessments for the USDA Forest Service, exposure rates were by the estimated dermal absorption rate, typically using 2,4-D as a surrogate chemical when compound-specific data were not available (USDA 1989b). In 1998, SERA conducted a detailed review and re-evaluation of the available worker exposure studies that can be used to relate absorbed dose to the amount of chemical handled per day (SERA 1998). This review noted that there was no empirical support for a dermal absorption rate correction. Two factors appear to be involved in this unexpected lack of association: 1) algorithms for estimating dermal absorption rates have large margins of error; and, 2) actual levels of worker exposure are likely to be far more dependent on individual work practices or other unidentified factors than on differences in dermal absorption rates.

Thus, in the absence of data to suggest an alternative approach, no corrections for differences in dermal absorption rate coefficients or other indices of dermal absorption seem to be appropriate for adjusting occupational exposure rates. Although pesticide application involves many different job activities, exposure rates can be defined for three categories: directed foliar applications (including cut surface, streamline, and direct sprays) involving the use of backpacks or similar devices, broadcast hydraulic spray applications, and broadcast aerial applications. While these may be viewed as crude groupings, the variability in the available data does not seem to justify further segmenting the job classifications - e.g., hack-and-squirt, injection bar.

General Exposures - As described in SERA (2007), worker exposure rates are expressed in units of milligrams (mg) of absorbed dose per kilogram (kg) of body weight per pound of chemical handled (mg/kg/lb applied). The exposure rates used in this risk assessment are based on worker exposure studies on nine different pesticides with molecular weights ranging from 169 to 416 and the base-10 log of the octanol water coefficient (log K_{ow}) values at pH 7 ranging from –2.90 to 6.50 (SERA 1998, Table 1). The estimated exposure rates (Table 3-16) are based on estimated absorbed doses in workers as well as the amounts of the chemical handled by the workers (SERA 1998, Table 5). Exposure rates are shown as milligrams of chemical per kilogram of body weight per pound of active ingredient (ai) applied. The molecular weight and log K_{ow} of the five herbicides considered in this risk assessment are within the range of pesticides studied in SERA (1998). Although the molecular weight of NP9E is outside this range, the values derived in SERA (1998b), should be conservative for this use, because larger molecules would tend to be absorbed at lower rates. As described in SERA (2007), the ranges of estimated occupational exposure rates vary substantially among individuals and groups, (i.e., by a factor of 50 for backpack applicators). It seems that much of the variability can be attributed to the hygienic measures taken by individual workers (i.e., how careful the workers are to avoid unnecessary exposures).

Table 3-16. Estimated Exposure Rates from Herbicides Proposed on the Freds Fire

Job Category	Typical (mg/kg/lb ai)	Lower (mg/kg/lb ai)	Upper (mg/kg/lb ai)
Ground Application	0.003	0.0003	0.01

Source: SERA 1998, Table 5.

The estimated number of acres treated per hour is taken from recent experiences (1991-2004) on the ENF. Experience on the ENF for work similar to what is proposed indicates typical production rates of 2.0 acres per day per worker for backpack application. Crew sizes are expected to range from 8 to 12 workers when applying these herbicides. The number of hours worked per day is expressed as a range, 6-8 hours per day in activities that actually involve herbicide exposure.

The range of acres treated per hour and hours worked per day is used to calculate a range for the number of acres treated per day. For this calculation as well as others in this section involving the multiplication of ranges, the lower end of the resulting range is the product of the lower end of one range and the lower end of the other range. Similarly, the upper end of the resulting range is the product of the upper end of one range and the upper end of the other range. This approach is taken to encompass as broadly as possible the range of potential exposures. The central estimate of the acres treated per day is taken as the arithmetic average of the range. Because of the relatively narrow limits of the ranges for backpack spray workers, the use of the arithmetic mean rather than some other measure of central tendency, like the geometric mean, has no marked effect on the risk assessment.

The application rates are based on the planned application rates for each of these herbicides under the proposed action (Alternative 1) and are based on previous experience using these herbicides on the ENF (refer to Table 3-17). Rates are expressed as either acid equivalents (ae) or active ingredient (ai). Similarly, the application rates are based on ENF experience. The typical application rate is 20-25 gallons per acre of herbicide mixture applied, with the lowest dilution being 10 gallons per acre, and the highest being 30 gallons per acre. For hexachlorobenzene, the application rate is based on the application rate for clopyralid and the percentage of hexachlorobenzene in clopyralid.

Table 3-17. Herbicide and Nonylphenol Polyethoxylate Application Rates to be used on the Freds Fire (Including the Incidental Rate of Application of the Impurity Hexachlorobenzene in Clopyralid)

Herbicide	Application Rate Typical (lb/ac)	Application Rate Lowest (lb/ac)	Application Rate Highest (lb/ac)
Chlorsulfuron	0.14 ai	0.047 ai	0.14 ai
Clopyralid	0.25 ae	0.10 ae	0.25 ae
Glyphosate	3.2 ae	2.7 ae	4.8 ae
Hexazinone	3.0 ae	2.0 ae	3.0 ae
Triclopyr (BEE)	2.0 ae	1.6 ae	2.4 ae
Nonylphenol polyethoxylate	1.3 ai	1.1 ai	2.0 ai
Hexachlorobenzene	0.000000625 ai	0.00000025 ai	0.000000625 ai

Accidental Exposures - Typical occupational exposures may involve multiple routes of exposure (i.e., oral, dermal, and inhalation); nonetheless, dermal exposure is generally the predominant route for herbicide applicators. Typical multi-route exposures are encompassed by the methods used on general exposures. Accidental exposures, on the other hand, are most likely to involve splashing a solution of herbicides into the eyes or to involve various dermal exposure scenarios.

The available literature does not include quantitative methods for characterizing exposure or responses associated with splashing a solution of a chemical into the eyes; furthermore, there appear to be no reasonable approaches to modeling this type of exposure scenario quantitatively. Consequently, accidental exposure scenarios of this type are considered qualitatively in the risk characterization.

There are various methods for estimating absorbed doses associated with accidental dermal exposure. Two general types of exposure are modeled: those involving direct contact with a solution of the herbicide and those associated with accidental spills of the herbicide onto the surface of the skin. Any number of specific exposure scenarios could be developed for direct contact or accidental spills by varying the amount or concentration of the chemical on or in contact with the surface of the skin and by varying the surface area of the skin that is contaminated.

For this risk assessment, two exposure scenarios are developed for each of the two types of dermal exposure, and the estimated absorbed dose for each scenario is expressed in units of mg chemical/kg body weight.

Exposure scenarios involving direct contact with solutions of the chemical are characterized by immersion of the hands for 1 minute or wearing contaminated gloves for 1 hour. Generally, it is not reasonable to assume or postulate that the hands or any other part of a worker will be immersed in a solution of an herbicide for any period of time. On the other hand, contamination of gloves or other clothing is quite plausible. For these exposure scenarios, the key element is the assumption that wearing gloves grossly contaminated with a chemical solution is equivalent to immersing the hands in a solution. In either case, the concentration of the chemical in solution that is in contact with the surface of the skin and the resulting dermal absorption rate are essentially constant. Exposure scenarios involving chemical spills on to the skin are characterized by a spill on to the lower legs as well as a spill on to the hands. In these scenarios, it is assumed that a solution of the chemical is spilled on to a given surface area of skin and that a certain amount of the chemical adheres to the skin.

Summaries of the worker exposure scenarios for both general and accidental exposure for each herbicide (including NPE and hexachlorobenzene) are shown in Appendix D.

Public Exposure Analysis

Under normal conditions, members of the general public should not be exposed to substantial levels of any of these herbicides. Nonetheless, any number of exposure scenarios can be constructed for the general public, depending on various assumptions regarding application rates, dispersion, canopy interception, and human activity. Several highly conservative scenarios are developed for this risk assessment.

There are permanent residences or second homes within a ¼ mile of some of the proposed treatment areas, containing an estimated 250 residents. These residences are located along the South Fork of the American River. All other treatment areas are greater than ¼ mile from permanent human habitation. Any exposure from an herbicide spray project, due to drift, to residents living beyond ¼ mile from treatment sites would be negligible (USDA 1989b, pages F-79 to F-81). According to recent work completed by the Department of Pesticide Regulation (DPR), exposure to native plant material collectors can be essentially eliminated if they remain at least 100 feet from the treated areas (Goh, K., as referenced in Bakke, 2000). In DPR's study (Segawa et al, 2001), herbicides were detected in 19 of 227 (8%) samples taken outside both aerial and ground-based herbicide application units, the majority of these positive samples (90%) were within 70 feet of the sampled unit edge, and all positive samples had concentrations of herbicides less than or equal to 2.68 parts per million. This study did not determine whether these detected amounts were due to drift or errors in application. This would indicate that with ground-based applications, negligible amounts of off-site movement due to drift would be expected beyond 75 to 100 feet from the unit edge.

The proposed units are near or within parts of the ENF used for dispersed recreation, which might include activities such as hiking, hunting, fishing, woodcutting, berry-picking, or collection of plant materials for basket weaving. The public generally will pass through or near these units while participating in these activities. This dispersed use is estimated to be around 10-30 people per year on any given unit. Assuming each of the units could have people in them at the same time would represent 400 to 1,200 people per year.

The two types of exposure scenarios developed for the general public includes acute exposure and longer-term, or chronic, exposure. All of the acute exposure scenarios are primarily accidental. They assume that an individual is exposed to the compound either during or shortly after its application. Specific scenarios are developed for direct spray, dermal contact with contaminated vegetation, as well as the consumption of contaminated fruit, vegetation, water, and fish. Most of these scenarios should be regarded as extreme, some to the point of limited plausibility. The longer-term, or chronic exposure scenarios parallel the acute exposure scenarios for the consumption of contaminated fruit, vegetation, water, and fish but are based on estimated levels of exposure for longer periods after application. A summary of the general public exposure scenarios can be found in Appendix D.

Direct Spray

For direct spray scenarios, it is assumed that during a ground application, a naked child is sprayed directly with the herbicide. The scenario also assumes that the child is completely covered (that is, 100% of the surface area of the body is exposed), which makes this an extremely conservative exposure scenario that is likely to represent the upper limits of plausible exposure. An additional set of scenarios are included involving a young woman who is accidentally sprayed over the feet and legs. For each of these scenarios, some standard assumptions are made regarding the surface area of the skin and body weight.

For the scenario for dermal exposure from contaminated vegetation, it is assumed that the herbicide is sprayed at a given application rate and that an individual comes in contact with sprayed vegetation or other contaminated surfaces at some period after the spray operation. For these exposure scenarios, some estimates of dislodgeable residue and the rate of transfer from the contaminated vegetation to the surface of the skin must be available. No such data are directly available for these herbicides, so estimation methods are used.

Contaminated Water

Water can be contaminated from runoff, as a result of leaching from contaminated soil, from a direct spill, or from unintentional contamination from applications. For this risk assessment, two types of estimates made for the concentration of these herbicides in ambient water are considered: (1) acute/accidental exposure from an accidental spill and (2) longer-term exposure to the erroneous applications. For glyphosate the lower estimate is taken as zero. The SERA estimate was used for the upper estimate of triclopyr, and the central and upper estimate for glyphosate. For the other chemicals concentrations of these herbicides in water used levels derived from the SERA Risk Assessments.

The scenario for chronic exposure to these herbicides from contaminated water assumes that an adult consumes contaminated ambient water for a lifetime. There are some monitoring studies available on many of these herbicides that allow for an estimation of expected concentrations in ambient water associated with ground applications of the compound over a wide area (glyphosate, hexazinone, and triclopyr). For the others, such monitoring data does not exist. For those herbicides without monitoring data, for this component of the exposure assessment, estimates of levels in ambient water were made based on the *Groundwater Loading Effects of Agricultural Management Systems* (GLEAMS) model. GLEAMS is a root zone model that can be used to examine the fate of chemicals in various types of soils under different meteorological and hydro-geological conditions. The specific estimates of longer-term concentrations of these herbicides in water that are used in this risk assessment are summarized in Table 3-18b.

It is important to note that water monitoring conducted in the Pacific Southwest Region since 1991, involving glyphosate, triclopyr, and hexazinone has not shown levels of water contamination as high as these for normal (i.e., not accidental) applications (USDA, 2001a). This indicates that, at least for these herbicides, the assumptions in this risk assessment provide for a conservative (i.e. protective) assessment of risk. In addition, water monitoring involving clopyralid and hexachlorobenzene conducted on the ENF between 2002 and 2006 have not shown levels of water contamination as high as these for normal (i.e., not accidental) applications (USDA 2003c, 2006). Based on these samples, the assumptions in this risk assessment provide for a conservative (i.e. protective) assessment of risk for these two chemicals.

Table 3-18a. Short-Term Water Contamination Rates (WCR) of Herbicides, Nonylphenol Polyethoxylate, and the Hexachlorobenzene Impurity (in mg/L per lb applied)

Herbicide	Typical WCR	Low WCR	High WCR
Chlorsulfuron	0.1	0.01	0.2
Clopyralid	0.02	0.005	0.07
Glyphosate	0.02	0.0	0.4
Hexazinone	0.005	0.003	0.1
Triclopyr	0.003	0.0	0.4
Nonylphenol Polyethoxylate	0.012	0.0031	0.031
Hexachlorobenzene	0.09	0.001	0.3

Table 3-18b. Longer-Term Water Contamination Rates (WCR) of Herbicides, Nonylphenol Polyethoxylate, and the Hexachlorobenzene Impurity (in mg/L per lb applied)

Herbicide	Typical WCR	Low WCR	High WCR
Chlorsulfuron	0.0006	0.0001	0.0009
Clopyralid	0.007	0.001	0.013
Glyphosate	0.001	0.0001	0.008
Hexazinone	0.02	0.00001	0.07
Triclopyr	0.03	0.008	0.05
Nonylphenol Polyethoxylate	0.007	0.0	0.014
Hexachlorobenzene	0.0005	0.00003	0.001

Many chemicals may be concentrated or partitioned from water into the tissues of animals or plants in the water. This process is referred to as bio-concentration. Generally, bio-concentration is measured as the ratio of the concentration in the organism to the concentration in the water. For example, if the concentration in the organism is 5 mg/kg and the concentration in the water is 1 mg/L, the bio-concentration factor (BCF) is 5 L/kg. As with most absorption processes, bio-concentration depends initially on the duration of exposure but eventually reaches steady state. Most of the herbicides in this risk assessment have BCF values for fish of 1 or less. There are three with BCF values greater than 1: hexazinone (1-2), chlorsulfuron (1-12), and hexachlorobenzene (10,000).

For both the acute and longer-term exposure scenarios involving the consumption of contaminated fish, the water concentrations of the herbicides used are identical to the concentrations used in the contaminated water scenarios. The acute exposure scenario is based on the assumption that an adult angler consumes fish taken from contaminated water shortly after an accidental spill into a pond. No dissipation or degradation is considered. Because of the available and well-documented information and substantial differences in the amount of caught fish consumed by the general public and Native American subsistence populations, separate exposure estimates are made for these two groups. The chronic exposure scenario is constructed in a similar way.

Contaminated Vegetation

Under normal circumstances and in most types of applications, it is extremely unlikely that humans will consume, or otherwise place in their mouths, vegetation contaminated with these herbicides. Nonetheless, any number of scenarios could be developed involving either accidental spraying of crops, the spraying of edible wild vegetation, like berries, or the spraying of plants collected by Native Americans for basketweaving or medicinal use. These scenarios assume that vegetation is directly sprayed and that no washing of vegetation occurs. In most instances and particularly for longer-term scenarios, treated vegetation would probably show signs of damage from herbicide exposure, thereby reducing the likelihood of consumption that would lead to significant levels of human exposure. Notwithstanding that assertion, it is conceivable that individuals could consume contaminated vegetation.

Two sets of exposure scenarios are provided: one for the consumption of contaminated fruit and the other for the consumption of contaminated vegetation. One of the more plausible scenarios involves the consumption of contaminated berries after treatment along a road or some other area in which wild berries grow. A second scenario is the consumption of contaminated vegetation after treatment. The two accidental exposure scenarios developed for each exposure assessment include one scenario for acute exposure and one scenario for longer-term exposure. In these scenarios, the concentration of herbicide on contaminated vegetation is estimated using an empirical relationship between application rate and concentration on vegetation.

Summaries of the public exposure scenarios for each herbicide (including NPE and hexachlorobenzene) are shown in Appendix D.

Dose-Response Assessment

In evaluating the doses received under each scenario, the doses are evaluated against RfDs, as previously discussed. If all the exposures are less than the RfDs (HQ less than or equal to 1) the assumption is that the herbicide presents very little risk of use to either the public or workers. If any exposure exceeds the RfD, a closer examination of the various studies and exposure scenarios must be made to determine whether a toxic response is expected from the exposure. The risk assessment (Appendix D) describes the RfDs and their basis. For those scenarios that involve doses exceeding RfDs, it provides an analysis of various studies and further refines the risk thresholds. Table 3-19 displays the acute and chronic RfDs used in the risk assessment.

Table 3-19. Reference Doses (RfD) of Herbicides (including Nonylphenol Polyethoxylate and Hexachlorobenzene)

Herbicide	Reference Dose (mg/kg/day)	
	Acute	Chronic
Chlorsulfuron	0.25	0.02
Clopyralid	0.75	0.15
Glyphosate	2.0	2.0
Hexazinone	4.0	0.05
Triclopyr	1.0	0.05
Nonylphenol Polyethoxylate	0.1	0.1
Hexachlorobenzene	0.008[1]	0.0008

[1] Acute Minimal Risk Level (MRL)

Risk Characterization

A quantitative summary and narrative description of risks to workers and the public from herbicide exposure is presented in the section. The quantitative risk characterization is expressed as the hazard quotient, which is the ratio of the estimated exposure doses to the RfD. Tables 3-20a-1 through 3-20g-4 provide a summary of risk characterization for workers and the general public.

The only reservation attached to this assessment is that associated with any risk assessment: Absolute safety cannot be proven and the absence of risk can never be demonstrated. No chemical has been studied for all possible effects and the use of data from laboratory animals to estimate hazard or the lack of hazard to humans is a process that contains uncertainty. Prudence dictates that normal and reasonable care should be taken in the handling of these herbicides.

Chlorsulfuron

Workers -Given the very low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios approach a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 5,000 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects.

The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limit of the hazard quotients (HQ=0.2) is below the level of concern **-** i.e., a hazard quotient of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of chlorsulfuron that are regarded as unacceptable. Under typical application conditions, levels of exposure will be far below levels of concern.

Mild irritation to the skin and eyes can result from exposure to relatively high levels of chlorsulfuron- i.e., placement of chlorsulfuron directly onto the eye or skin. From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling chlorsulfuron. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of the compound.

General Public –None of the acute scenarios exceed a level of concern. The consumption of contaminated vegetation has a hazard quotient of 0.8, at the upper level. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially.

The longer-term consumption of contaminated vegetation after application of the highest dose yields a hazard quotient that is greater than unity (HQ= 4) at the highest dose. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. This scenario may be extremely conservative in that it does not consider the limited projected use of this herbicide on this project or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Table 3-20a-1. Summary of Risk Characterization for Workers – Chlorsulfuron

Chronic RfD = 0.02 mg/kg/day Acute RfD = 0.25 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.04	8E-04	0.2
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	1E-06[2]	2E-07	3E-06
Contaminated Gloves - 1 Hour	6E-05	1E-05	2E-04

Clopyralid

Workers - Given the very low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous; none of the exposure scenarios approaches a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 1,000 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects. The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limit of the hazard quotients for backpack application is below the level of concern - i.e., a hazard index of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of clopyralid that are regarded as unacceptable. Under typical application conditions, levels of exposure will be far below levels of concern.

Irritation and damage to the skin and eyes can result from exposure to relatively high levels of clopyralid - i.e., placement of clopyralid directly onto the eye or skin. From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling clopyralid. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of clopyralid.

General Public –For the acute/accidental scenarios, the exposure resulting from the consumption of contaminated vegetation is the scenario with the highest hazard quotient (HQ = 0.5) at the upper level. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially.

For the other acute/accidental scenarios, the exposure resulting from the consumption of contaminated water by a child is the scenario with the highest hazard quotient (HQ = 0.1), a factor of 10 below a level of concern. It must be noted that the exposure scenario for the consumption of contaminated water is an arbitrary scenario: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of clopyralid, all of the hazard quotients would be a factor of 10 less. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For clopyralid, such scenarios involve oral (contaminated water) rather than dermal (spills or accidental spray) exposure.

For chronic scenarios, the consumption of contaminated vegetation has a hazard quotient slightly above unity (HQ = 1.2). At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously described, this scenario may be extremely conservative in that it does not consider the limited projected use of this herbicide on this project or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term. However, this scenario points out the importance of directing the herbicide onto the targeted vegetation and avoiding non-target deposition through overspray.

Table 3-20b-1. Summary of Risk Characterization for Workers – Clopyralid

Chronic RfD = 0.15 mg/kg/day Acute RfD = 0.75 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.01	2E-04	0.05
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	5E-07	1E-07	2E-06
Contaminated Gloves - 1 Hour	3E-05	8E-06	1E-04
Spill on Hands - 1 Hour	1E-04	2E-05	5E-04
Spill on Lower Legs - 1 Hour	2E-04	5E-05	1E-03

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Table 3-20b-2. Summary of Risk Characterization for the Public – Clopyralid

Chronic RfD = 0.15 mg/kg/day Acute RfD = 0.75 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	4E-03	8E-04	0.02
Direct Spray, Lower Legs, Woman	4E-04	8E-05	2E-03
Dermal Exposure, Contaminated Vegetation	5E-04	4E-05	2E-03
Contaminated Fruit	4E-03	2E-03	0.06
Contaminated Vegetation	0.05	5E-03	0.5
Contaminated Water, Spill	0.09	0.06	0.1
Contaminated Water, Stream	5E-04	3E-05	3E-03
Consumption of Fish, General Public	3E-03	3E-03	3E-03
Consumption of Fish, Subsistence Populations	0.01	0.01	0.01
Chronic/Longer Term Exposures			
Contaminated Fruit	8E-03	3E-03	0.2
Contaminated Vegetation	0.1	7E-03	**1.2**
Consumption of Water	3E-04	1E-05	7E-04
Consumption of Fish, General Public	2E-06	1E-07	3E-06
Consumption of Fish, Subsistence Population	1E-05	8E-07	3E-05

Glyphosate

Workers - Given the low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios exceed a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 500 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects. The hazard quotients for these acute occupational exposures are based on a chronic RfD. This adds an additional level of conservatism and, given the very low hazard quotients for these scenarios, reinforces the conclusion that there is no basis for asserting that systemic toxic effects are plausible.

The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limits of the hazard quotients are below the level of concern **-** i.e., a hazard index of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of glyphosate that are regarded as unacceptable. Under typical backpack application conditions, levels of exposure will be at least 100 times below the level of concern.

Glyphosate and glyphosate formulations are skin and eye irritants. Quantitative risk assessments for irritation are not normally derived, and, for glyphosate specifically, there is no indication that such a derivation is warranted.

General Public - For chronic scenarios, the consumption of contaminated vegetation has a hazard quotient above unity (HQ = 1.8) at the upper level. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously described, this scenario may be extremely conservative in that it does not consider the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term. However, this scenario points out the importance of directing the herbicide onto the targeted vegetation and avoiding non-target deposition through overspray. While this is an unacceptable level of exposure, it is far below doses that would likely result in overt signs of toxicity. As detailed in SERA (2003a), a dose of 184 mg/kg as Roundup – i.e., glyphosate plus surfactant – was not associated with any overt signs of toxicity in humans – and mild signs of toxicity were apparent at doses of 427 mg/kg, over 100 times higher than the dose associated with this scenario (3.55 mg/kg).

None of the other longer-term exposure scenarios approach a level of concern. Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard quotients are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to glyphosate.

For the acute/accidental scenarios, the exposure resulting from the consumption of contaminated vegetation is the scenario with the highest hazard quotient (HQ = 3) at the upper level. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. As described above, while this is an unacceptable level of exposure, it is far below doses that would likely result in overt signs of toxicity, and is over 50 times lower than doses where mild signs of toxicity were apparent (427 mg/kg).

For the other acute/accidental scenarios, the exposure resulting from the consumption of contaminated water by a child, at the highest application rates, approaches the level of concern. At the exposure level for a child drinking water, as per the discussion in Section 4, no effects would be anticipated for doses up to 20 mg/kg/day. It is important to realize that the exposure scenarios involving contaminated water are arbitrary scenarios: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of glyphosate, all of the hazard quotients would be a factor of 10 less. A further conservative aspect to the water contamination scenario is that it represents standing water, with no dilution or decomposition of the herbicide. This is unlikely in a forested situation where flowing streams are more likely to be contaminated in a spill, rather than a standing pond of water. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are substantially below 1. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For glyphosate, such scenarios involve oral (contaminated water) rather than dermal (spills or accidental spray) exposure.

Table 3-20c-1. Summary of Risk Characterization for Workers – Glyphosate

RfD = 2.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.01	5E-04	0.07
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	3E-06	6E-07	1E-05
Contaminated Gloves - 1 Hour	2E-04	4E-05	7E-04
Spill on Hands - 1 Hour	4E-04	1E-04	9E-04
Spill on Lower Legs - 1 Hour	9E-04	2E-04	2E-03

Table 3-20c-2. Summary of Risk Characterization for the Public – Glyphosate

RfD = 2.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	0.01	4E-03	0.03
Direct Spray, Lower Legs, Woman	1E-03	4E-04	3E-03
Dermal Exposure, Contaminated Vegetation	3E-03	5E-04	7E-03
Contaminated Fruit	0.03	0.02	0.4
Contaminated Vegetation	0.4	0.05	**3**
Contaminated Water, Spill	0.5	0.3	0.8
Contaminated Water, Stream	4E-03	0	0.1
Consumption of Fish, General Public	6E-03	5E-03	6E-03
Consumption of Fish, Subsistence Populations	0.03	0.03	0.03
Chronic/Longer Term Exposures			
Contaminated Fruit	0.02	9E-03	0.2
Contaminated Vegetation	0.2	0.02	**1.8**
Consumption of Water	7E-05	3E-06	7E-04
Consumption of Fish, General Public	1E-07	7E-09	1E-06
Consumption of Fish, Subsistence Population	1E-06	6E-08	8E-06

Hexazinone

Workers - At the lower and typical application rates, a hazard quotient of 1 is not exceeded for general exposures. At the upper estimate of projected exposures, a hazard quotient of 1 is exceeded (HQ=1.8) at the maximum application rate of 3 lbs a.i./acre. The simple interpretation of these hazard quotients is that worker exposures to hexazinone are likely to exceed exposures that would generally be regarded as acceptable if workers do not follow prudent handling practices that will minimize exposure.

For accidental scenarios, no scenarios result in HQ values exceeding 1. While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. The highest hazard quotient for any of the accidental exposures is a factor of about 10 below the level of concern. The hazard quotients for these acute occupational exposures are based on a chronic RfD. This adds an additional level of conservatism to the risk assessment.

As stated, hexazinone is a severe eye irritant. Quantitative risk assessments for irritation are not usually derived, and, for hexazinone specifically, the available data do not support any reasonable quantitative dose-response modeling. Nonetheless, human experience with this compound (Spencer et al. 1996) indicates that such effects are clearly plausible for granular formulations. As described in Appendix D, workers applying Pronone 10G [on the Eldorado National Forest] using a belly grinder exhibited transient eye irritation and upper respiratory tract irritation (reported burning sensations in mouth, nose and throat, coughing, spitting) at the highest operational levels of exposure. These effects did not persist after exposure was terminated. It is important to recognize that the product applied in this study was recognized as defective, with excessive dustiness. As a result of this study, the USFS, Region 5 established additional requirements for protective equipment when applying granular hexazinone formulations via belly grinder. In addition, this direction instructs applicators not to continue applications if excessive dustiness is seen.

While skin irritation could also occur, it would probably be less severe than effects on the eyes.

General Public - For the acute/accidental scenarios, none exceed a level of concern. The consumption of contaminated water after a spill by a child or by consuming fish found in such contaminated waters, at the upper dose estimates equals the level of concern (HQ=1). The exposure scenarios involving contaminated water are arbitrary scenarios: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of hexazinone, all of the hazard quotients would be a factor of 10 less. A further conservative aspect to the water contamination scenario is that it represents standing water, with no dilution or decomposition of the herbicide. This is unlikely in a forested situation where flowing streams are more likely to be contaminated in a spill, rather than a standing pond of water. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are well below 1 (HQ = 0.008). The greatest practical consequence of a direct spray probably would be eye irritation, which could be severe

Of the longer-term scenarios, the consumption of unwashed vegetation after application of the highest dose yields a hazard quotient of 1.4. This scenario may be extremely conservative in that it does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Table 3-20d-1. Summary of Risk Characterization for Workers – Hexazinone

Chronic RfD = 0.05 mg/kg/day Acute RfD = 4.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.4	0.01	1.8
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	6E-04	4E-04	1E-03
Contaminated Gloves - 1 Hour	0.04	0.02	0.06
Spill on Hands - 1 Hour	Not applicable to granular formulations		
Spill on Lower Legs - 1 Hour	Not applicable to granular formulations		

Table 3-20d-2. Summary of Risk Characterization for the Public – Hexazinone

Chronic RfD = 0.05 mg/kg/day Acute RfD = 4.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	Not applicable to granular formulations		
Direct Spray, Lower Legs, Woman	Not applicable to granular formulations		
Dermal Exposure, Contaminated Vegetation	1E-04	4E-05	3E-04
Contaminated Fruit	4E-04	2E-04	6E-03
Contaminated Vegetation	5E-03	2E-03	0.04
Contaminated Water, Spill	0.3	0.08	**1.0**
Contaminated Water, Stream	3E-04	7E-05	8E-03
Consumption of Fish, General Public	0.01	4E-03	0.02
Consumption of Fish, Subsistence Populations	0.05	0.02	0.1
Chronic/Longer Term Exposures			
Contaminated Fruit	0.01	8E-03	0.2
Contaminated Vegetation	0.2	0.07	**1.4**

triclopyr that are regarded as unacceptable. If triclopyr is not applied at the highest application and concentration rate or if appropriate steps are taken to ensure that workers are not exposed to the maximum plausible rates (i.e., worker hygiene practices) the risk to workers would be substantially reduced.

General Public – As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on acute RfD of 1.0 mg/kg/day and the hazard quotients for chronic exposures are based on the chronic RfD from U.S. EPA of 0.05 mg/kg/day. For women of childbearing age, the acute RfD is 0.05 mg/kg/day.

One acute/accidental scenario (the consumption of contaminated vegetation) exceeds a level of concern at all levels of exposure (HQ = 1 to 65). These findings suggest that in the unlikely event that someone had a vegetable garden growing in proximity to a treatment area that triclopyr was applied, especially at the typical or maximum application rates, adult females who consume the vegetables from such gardens could be at risk. At the typical level of exposure, the consumption of contaminated vegetation could lead to acute exposures where the nature and severity of effects are uncertain. At the upper level of exposure, the consumption of contaminated vegetation could lead to a one-time dose of 3.2 mg/kg which could result in overt signs or symptoms of toxicity after acute exposures. The plausibility of the existence of this scenario is limited by several important factors. First, the areas proposed for treatment with triclopyr are well removed (> 1 mile) from private residences, and hence, vegetable gardens. Secondly, unless the triclopyr contamination were to occur immediately before picking, it is plausible that the accidental contamination would kill the plants or diminish their capacity to yield consumable vegetation. Thirdly, this scenario is extremely conservative in that it does not consider the effects of washing contaminated vegetation in reducing doses. Finally, signs at likely access points informing the public that an area has been sprayed and the presence of dye on vegetation would reduce the potential that freshly sprayed material would be consumed.

In the other acute/accidental scenarios involving triclopyr, based on the high exposure assumptions, four of the acute/accidental scenarios reach or slightly exceed a level of concern (i.e., child sprayed, woman sprayed on lower legs, exposure to sprayed vegetation, and consumption of contaminated fruit). Based on the dose-severity relationship for triclopyr, at these levels of acute exposure (≤1.8 mg/kg), it is unlikely that there would be any adverse health effects associated with a one-time exposure.

Two longer term scenarios exceed a level of concern - the consumption of unwashed fruit and the consumption of unwashed vegetation. While the consumption of fruit slightly exceeds a hazard quotient of 1 at only the upper level of exposure, the consumption of vegetation exceeds a level of concern at both the typical and upper exposure level. At the highest application rate, the estimated dose at the upper level of exposure could be about 2.1 mg/kg/day. This value is in the range that, with longer term exposure, could result in effects on kidneys or offspring. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. This is a standard scenario used in all Forest Service risk assessments and is extremely conservative – i.e., it assumes that vegetation that has been directly sprayed is harvested and consumed for a prolonged period of time. In addition, this scenario does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Table 3-20e-1. Summary of Risk Characterization for Workers – Triclopyr

Chronic RfD = 0.05 mg/kg/day Acute RfD = 1.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.3	1E-02	1.4
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	0.02	8E-03	0.03
Contaminated Gloves - 1 Hour	0.9	0.5	**1.7**
Spill on Hands - 1 Hour	0.04	2E-04	0.06
Spill on Lower Legs - 1 Hour	9E-02	6E-04	0.1

Table 3-20e-2. Summary of Risk Characterization for the Public – Triclopyr

Chronic RfD = 0.05 mg/kg/day Acute RfD = 1.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	**1.4**	9E-03	**2**
Direct Spray, Lower Legs, Woman	**3**	0.02	**5**
Dermal Exposure, Contaminated Vegetation	**3**	0.02	**4**
Contaminated Fruit	0.1	0.1	**1.7**
Contaminated Vegetation	**8**	**1.1**	**65**
Contaminated Water, Spill	0.5	0.3	0.8
Contaminated Water, Stream	5E-04	00	0.1
Consumption of Fish, General Public	1E-03	1E-03	1E-03
Consumption of Fish, Subsistence Populations	5E-03	5E-03	5E-03
Chronic/Longer Term Exposures			
Contaminated Fruit	0.07	0.04	**1.1**
Contaminated Vegetation	**4**	0.4	**43**
Consumption of Water	0.04	5E-03	0.08
Consumption of Fish, General Public	1E-05	2E-06	2E-05
Consumption of Fish, Subsistence Population	1E-04	2E-05	2E-04

Nonylphenol Polyethoxylate

Workers - Given the low hazard quotients for accidental exposure, the risk characterization is reasonably unambiguous. None of the accidental exposure scenarios exceed a level of concern. While the accidental exposure scenarios are not the most severe one might imagine (e.g., complete immersion of the worker or contamination of the entire body surface for a prolonged period of time) they are representative of reasonable accidental exposures. Confidence in this assessment is diminished by the lack of information regarding the dermal absorption kinetics of NP9E in humans. Nonetheless, the statistical uncertainties in the estimated dermal absorption rates, both zero-order and first-order, are incorporated into the exposure assessment and risk characterization.

The upper limit of general worker exposure scenarios approach, but don't exceed, a level of concern (HQ = 0.7). The simple verbal interpretation of this quantitative characterization of risk is that under the most conservative set of exposure assumptions, workers should not be exposed to levels of NP9E that are regarded as unacceptable.

NP9E can cause irritation and damage to the skin and eyes. Quantitative risk assessments for irritation are not derived; however, from a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling NP9E. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of NP9E.

General Public –Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard indices are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to NP9E.

For the acute/accidental scenarios, exposure resulting from the consumption of contaminated water from a spill is of greatest concern. Exposure resulting from the consumption of contaminated vegetation is of somewhat less concern. None of the other acute exposure scenarios represent a risk of effects to the public from NP9E exposure.

Acute or accidental exposure scenarios involving consumption of contaminated water or consumption of contaminated vegetation represent some risk of effects. None of the other acute exposure scenarios represent a risk of effects to the public from NP9E exposure. At typical rates of application, the drinking of contaminated water after a spill (HQ = 4.6) approaches the level that could present a risk of subclinical effects to the liver and kidney (HQ values between 5 and 10). The upper HQ of 6.8 represents an increasing risk of clinical effects to the kidney, liver, and other organ systems. The exposure scenario for the consumption of contaminated water is an arbitrary scenario: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of NP9E, all of the hazard quotients would be a factor of 10 less. This scenario involving water contamination assumes that a small pond is affected, rather than a creek or river as would be more likely in this forested setting. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are substantially below one

At high application rates only (HQ = 3.7) the short-term consumption of fruit also approaches the level that could present a risk of subclinical effects to the liver and kidney (HQ values between 5 and 10). At the typical rate of application, the HQ is less than one. Signing and the presence of dye on vegetation would reduce the potential of freshly sprayed material to be consumed.

The public exposure scenario involving the consumption of fruit, both short-term (above) and long-term, most closely proxies the use of native material by basketweavers. The highest estimated HQ value for the long-term exposure scenario is 0.7. Plant materials in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable and very unlikely to be selected for basketweaving, medicine or food (Segawa, R., et al, 2001), reducing the likelihood of additive doses.

Table 3-20f-1. Summary of Risk Characterization for Workers – Nonylphenol Polyethoxylate

RfD = 0.10 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.12	0.0048	0.7
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	0.0017	0.0006	0.004
Contaminated Gloves - 1 Hour	0.1	0.037	0.26
Spill on Hands - 1 Hour	0.0005	8 E-5	0.007
Spill on Lower Legs - 1 Hour	0.0013	0.0002	0.017

Table 3-20f-2. Summary of Risk Characterization for the Public – Nonylphenol Polyethoxylate

RfD = 0.10 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	0.02	3E-03	0.26
Direct Spray, Lower Legs, Woman	2E-03	3E-04	0.03
Dermal Exposure, Contaminated Vegetation	4E-03	4E-04	0.05
Contaminated Fruit	0.24	0.16	3.7
Contaminated Water, Spill	4.6	2.8	6.8
Contaminated Water, Stream	9E-03	1E-03	0.04
Consumption of Fish, General Public	0.14	0.14	0.14
Consumption of Fish, Subsistence Populations	0.67	0.67	0.67
Chronic/Longer Term Exposures			
Contaminated Fruit	4E-03	3E-03	0.06
Consumption of Water	2E-03	0	5E-03
Consumption of Fish, General Public	1E-05	0	2E-05
Consumption of Fish, Subsistence Population	8E-05	0	2E-04

Hexachlorobenzene

Workers –For general worker exposures, the hazard quotients associated with hexachlorobenzene are approximately two to three orders of magnitude below the corresponding hazard quotients for clopyralid. Similarly, hazard quotients associated with accidental scenarios are consistently lower for hexachlorobenzene than the corresponding scenarios for clopyralid. Thus, for the reasonably diverse exposure scenarios covered in this risk assessment, the amount of hexachlorobenzene in technical grade clopyralid is not toxicologically significant.

The cancer risks presented in Table 3-20g-3 are presented as the estimated exposure divided by the lifetime dose associated with a cancer risk of 1 in one million. Thus, the interpretation of these hazard quotients is identical to that of hazard quotients for toxicity – i.e., if the hazard quotient is below unity, the cancer risk is below 1 in one million. As indicated in Table 3-20g-3, none of the cancer risks in workers exceed 1 in one million.

While there are substantial uncertainties involved in any cancer risk assessment, the verbal interpretation of the numeric risk characterization derived in this risk assessment is relatively simple. Using the assumptions and methods typically applied in Forest Service risk assessments, there is no plausible basis for asserting that the contamination of clopyralid with hexachlorobenzene will result in any substantial risk of cancer in workers applying clopyralid under normal circumstances.

While the chronic cancer potency could be scaled linearly and the cancer risk associated with short term exposures could be calculated, this sort of extrapolation is highly uncertain and, more importantly, ignores the normal background exposures to hexachlorobenzene from other sources. For example background levels of exposure to hexachlorobenzene are in the range of 0.000001 mg/kg/day or 1×10^{-6} mg/kg/day. As summarized in Table 3-20g-3, even the upper range general worker exposure values are below this background dose – i.e., 1.9×10^{-8} mg/kg/day. As discussed in the next section, the upper range of the longer term exposure scenarios for the general public are substantially below the background dose – i.e., about 5×10^{-9} to 2×10^{-11}. Thus, there is no basis for asserting that the presence of pentachlorobenzene or hexachlorobenzene in clopyralid will impact substantially the cancer risk under conditions characteristic of applications made in this project.

As indicated in Section 2, all of these risk characterizations are based on the typical or average 2.5 ppm concentration of hexachlorobenzene in technical grade clopyralid. This is the upper range of hexachlorobenzene that may be expected in technical grade clopyralid and thus the actual risks are probably much lower than those given in these tables.

While there are substantial uncertainties involved in any cancer risk assessment, the verbal interpretation of the numeric risk characterization derived in this risk assessment is relatively simple. Using the assumptions and methods typically applied in Forest Service risk assessments, there is no plausible basis for asserting that the contamination of clopyralid with pentachlorobenzene or hexachlorobenzene will result in any substantial risk of cancer in workers applying clopyralid under normal circumstances.

The above discussion is not to suggest that general exposures to hexachlorobenzene – i.e., those associated with normal background exposures that are not related to Forest Service applications of clopyralid – are acceptable. At background exposure levels of about 1×10^{-6} mg/kg/day, the background risk associated with exposure to hexachlorobenzene would be 0.0000016 or about 1 in 625,000.

General Public –As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on the short-term MRL of 0.008 mg/kg/day and the hazard quotients for chronic exposures are based on the U.S. EPA RfD of 0.0008 mg/kg/day.

All exposure scenarios result in hazard quotients that are below unity - i.e., the level of exposure is below the RfD for chronic exposures and below the MRL for acute exposures. In addition, all of the acute exposure scenarios result in hazard quotients that are substantially below the corresponding hazard quotient for clopyralid. The highest acute hazard quotient for hexachlorobenzene is about 0.006, the upper range of the hazard quotient associated with the consumption of contaminated fish by subsistence populations. The consumption of fish contaminated with hexachlorobenzene is a primary exposure scenario of concern because of the tendency of hexachlorobenzene to bio-concentrate from water into fish. For chronic exposures, the highest chronic HQ is about 0.00002, the upper range of the hazard quotient associated with the consumption of fish by subsistence populations. This is also consistent with the general observation that exposure to hexachlorobenzene occurs primarily through the consumption of contaminated food.

As with worker exposures, none of the hazard quotients for cancer risk levels of 1 in 1-million exceed unity. As indicated in Table 3-20g-4, the highest longer-term exposure rate associated with Forest Service programs is 1.45×10^{-8} mg/kg/day – i.e., the upper range of exposure for the consumption of contaminated fish by subsistence populations. This is below the typical background exposure by a factor of about 70.

No explicit dose response assessment is made for the potential carcinogenic effects of pentachlorobenzene, another impurity in clopyralid. Based on the comparison of apparent toxic potencies and the relative amounts of both hexachlorobenzene and pentachlorobenzene in clopyralid, a case could be made for suggesting that pentachlorobenzene may double the cancer risk over that associated with hexachlorobenzene. Given the extremely low levels of estimated cancer risk, this has essentially no impact on the risk characterization.

The simple verbal interpretation of this risk characterization is that, in general, the contamination of clopyralid with hexachlorobenzene and pentachlorobenzene does not appear to pose a risk to the general public. This is consistent with the conclusions reached by the U.S. EPA (1995a, as referenced in SERA 1999).

As indicated in Section 2, all of these risk characterizations are based on the typical or average 2.5 ppm concentration of hexachlorobenzene in technical grade clopyralid. This is the upper range of hexachlorobenzene that may be expected in technical grade clopyralid and thus the actual risks are probably much lower than those given in these tables.

Table 3-20g-1. Summary of Risk Characterization for Workers – Hexachlorobenzene

Chronic RfD = 0.0008 mg/kg/day Acute MRL = 0.008 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	5E-06	1E-07	2E-05
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	6E-05	2E-05	2E-04
Contaminated Gloves - 1 Hour	4E-03	1E-03	1E-02
Spill on Hands - 1 Hour	8E-07	2E-07	3E-06
Spill on Lower Legs - 1 Hour	2E-06	4E-07	8E-06

Table 3-20g-2. Summary of Risk Characterization for the Public – Hexachlorobenzene

Chronic RfD = 0.0008 mg/kg/day Acute MRL = 0.008 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	3E-05	6E-06	1E-04
Direct Spray, Lower Legs, Woman	3E-06	6E-07	1E-05
Dermal Exposure, Contaminated Vegetation	9E-07	9E-08	2E-06
Contaminated Fruit	2E-06	7E-07	1E-05
Contaminated Water, Spill	2E-05	1E-05	3E-05
Contaminated Water, Stream	5E-07	1E-09	3E-06
Consumption of Fish, General Public	1E-03	1E-03	1E-03
Consumption of Fish, Subsistence Populations	6E-03	6E-03	6E-03
Chronic/Longer Term Exposures			
Contaminated Fruit	6E-07	6E-08	6E-06
Consumption of Water	1E-08	2E-10	3E-08
Consumption of Fish, General Public	1E-06	3E-08	2E-06
Consumption of Fish, Subsistence Population	9E-06	2E-07	2E-05

Table 3-20g-3. Summary of Cancer Risk Assessment for Workers – Hexachlorobenzene – Relative to Risk Level of 1 in 1 Million

Adjusted Cancer Potency Parameter = 6.26 E-5 $(mg/kg/day)^{-1}$			
Scenario	Cancer Risk Divided by 1 in 1 Million		
	Typical	Lower	Upper
General Exposures			
Backpack Application	6E-03	1E-04	3E-02

Table 3-20g-4. Summary of Cancer Risk Assessment for Public – Hexachlorobenzene Relative to Risk Level of 1 in 1 Million

Adjusted Cancer Potency Parameter = 6.25 E-7 $(mg/kg/day)^{-1}$			
Scenario	Cancer Risk Divided by 1 in 1 million		
	Typical	Lower	Upper
Chronic/Longer Term Exposures			
Contaminated Fruit	8E-04	8E-05	7E-03
Consumption of Water	1E-05	2E-07	3E-05
Consumption of Fish, General Public	1E-03	3E-05	3E-03
Consumption of Fish, Subsistence Population	1E-02	3E-04	2E-02

Additives, Synergistic Effects, and Sensitive Individuals

Additives (Adjuvants)

The use of the NPE-based surfactants (such as R-11®) is analyzed in this risk assessment, and its use under typical conditions should result in acceptable levels of risk to workers and the public. As with the herbicides, eye and skin irritation may be the only manifestations of exposure seen in the absence of spills and accidents. The exposure to ethylene oxide as a contaminant of NPE-based surfactants should also be at acceptable levels of risk.

Colorfast Purple Colorant (SERA 1997b)

The active ingredients in Colorfast Purple are acetic acid, dipropylene glycol, and Basic Violet 3. The exact amounts of the ingredients in this product are considered proprietary. Acetic acid, a major component of vinegar, is on the EPA's list 4A of inerts. Dipropylene glycol is on EPA's list 3 of inerts. None of the ingredients in this product are known to be on EPA List 1 or 2. Basic Violet 3 dye is the colorant in Colorfast Purple. Most of the information about its toxicological effects are attributed to the chloride salt, commonly referred to as Gentian Violet. Gentian Violet is used as an antifungal agent, a treatment for oral infections, and as laboratory reagent and stain (SERA 1997b). Based on the MSDS no toxic chemicals are present that are subject to the reporting requirement of the Emergency Planning and Community Right-to-Know Act (EPCRA, also referred to as SARA Title III) and 40CFR372 (Toxic Chemical Release Reporting: Community Right-to-Know). In a Study by Littlefield et al (in SERA 1997b) marked carcinogenic activity was observed in mice, and is the basis for a qualitative cancer risk assessment in SERA (1997b). Based on SERA 1997b, risk characterization leads to typical cancer risks for workers of 4.7×10^{-7} or 1 in 2.1 million. For the public, the consumption of sprayed berries yielded an estimated single exposure risk of 1 in 37 million to 1 in 294 million. For public exposures, it is expected that the dye would reduce exposures both to itself and to the other chemicals it might be mixed with (herbicide and other adjuvants) as the public would be alerted to the presence of treated vegetation.

Hi-Light® Blue (USDA, 2007a)

Hi-Light® Blue dye is not required to be registered as a pesticide; therefore it has no signal word associated with it. It is mildly irritating to the skin and eyes. It would likely be considered a Category III or IV material and have a Caution signal word if it carried one.

Hi-Light® Blue is a water-soluble dye that contains no listed hazardous substances. It is considered to be virtually non-toxic to humans. The dye used in Hi-Light® Blue is commonly used in toilet bowl cleaners and as a colorant for lakes and ponds (SERA 1997b).

MSO-based and Silicone/MSO blend surfactant (USDA, 2007a)

Surfactants consisting of vegetable oil and a blend of silicone-based surfactant and vegetable oil are proposed for use. A brief discussion of silicone-based and oil-based surfactants is below. An analysis of the ingredients in these adjuvants did not identify any of specific toxic concern with the exception of the ingredients discussed in this risk assessment (ibid). None were on U.S. EPA Inerts Lists 1 or 2.

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

Silicone-Based Surfactants

Also known as organosilicones, these are increasing in popularity because of their superior spreading ability. This class contains a polysiloxane chain. Some of these are a blend of non-ionic surfactants and silicone while others are entirely silicone. The combination of non-ionic surfactants and silicone surfactants can increase absorption into a plant so that the time between application and rainfall can be shortened. This is known as rainfastness. The surfactants extreme spreading ability may lead to droplet coalescence and subsequent runoff if applied at inappropriately high rates.

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

Vegetable Oils

The methylated seed oils are formed from common seed oils, such as canola, soybean, or cotton. They act to increase penetration of the herbicide. These are comparable in performance to crop oil concentrates. In addition, silicone-seed oil blends are also available that take advantage of the spreading ability of the silicones and the penetrating characteristics of the seed oils.

The U.S. Food and Drug Administration (FDA) considers methyl and ethyl esters of fatty acids produced from edible fats and oils to be food grade additives (CFR 172.225). Because of the lack of exact ingredient statements on these surfactants, it is not always clear whether the oils that are used in them meet the U.S. FDA standard.

Synergistic Effects

Synergistic effects (multiplicative) are those effects resulting from exposure to a combination of two or more chemicals that are greater than the sum of the effects of each chemical alone (additive). See pages 4-111 through 4-114 in USDA 1989b, for a detailed discussion on synergistic effects. Instances of chemical combinations that cause synergistic effects are relatively rare at environmental exposure levels. Reviews of the scientific literature on toxicological effects and toxicological interactions of agricultural chemicals indicate that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects (US EPA 2000c; ATSDR 2004; Kociba and Mullison 1985, Crouch et al. 1983, EPA 1986).

Synergism generally has not been observed in toxicological tests involving combinations of commercial pesticides. The herbicide and additives proposed for this project have not shown synergistic effects in humans who have used them extensively in forestry and other agricultural applications. However, synergistic toxic effects of herbicide combinations, combinations of the herbicides with other pesticides such as insecticides or fertilizers, or combinations with naturally occurring chemicals in the environment are not normally studied. Based on the limited data available on pesticide combinations involving these herbicides, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis.

It is not anticipated that synergistic effects would be seen with the herbicides and the adjuvants that might be added to them. Based on a review of several recent studies, there is no demonstrated synergistic relationship between herbicides and surfactants (Abdelghani et al 1997; Henry et al 1994; Lewis 1992; Oakes and Pollak 1999, 2000 as referenced in USDA 2007a). Synergistic effects are not expected from multiple exposures to NP, NPEs, and their breakdown products (Payne et al 2000, Environment Canada 2001, as referenced in USDA 2003b).

However, even if synergistic or additive effects were to occur as a result of the proposed treatment, these effects are dose responsive (Dost 1991). This means that exposures to the herbicide plus any other chemical must be significant for these types of effects to be of a biological consequence. Based on the very low exposure rates estimated for this alternative, synergistic or additive effects, if any, are expected to be insignificant.

Although the combination of surfactant and herbicide might indicate an increased rate of absorption through the skin, a review of recent studies indicates this is not often true (USDA 2007a). For a surfactant to increase the absorption of another compound, the surfactant must affect the upper layer of the skin. Without some physical effect to the skin, there will be no change in absorption as compared to the other compound alone. The studies indicate that in general non-ionic surfactants have less of an effect on the skin, and hence absorption, then anionic or cationic surfactants. Compound specific studies indicate that the alkylphenol ethoxylates generally have little or no effect on absorption of other compounds. In several studies, the addition of a surfactant actually decreased the absorption through the skin. It would appear that there is little support for the contention that the addition of surfactants to herbicide mixtures would increase the absorption through the skin.

Herbicide-Specific Interaction Data

The manufacturers recommend that chlorsulfuron formulations be mixed with a non-ionic surfactant. There is no published literature or information in the US EPA files that would permit an assessment of toxicological effects or risk assessment of chlorsulfuron mixed with a surfactant (SERA, 2004a).

Clopyralid may be applied in combination with other herbicides, particularly in combination with picloram. There are no data in the literature suggesting that clopyralid will interact, either synergistically or antagonistically with this or other compounds (SERA 1999).

There is very little information available on the interaction of glyphosate with other compounds. The available data do not suggest a synergistic interaction between glyphosate and the POEA surfactant found in some formulations (e.g., Roundup) from plausible routes of exposure (SERA 1996a).

There is very little information available on the interaction of triclopyr with other compounds. The available data do not suggest a synergistic interaction between the triclopyr active ingredient and the other components in the commercial triclopyr formulations of Garlon 4 (SERA 1996b).

There is very little information available on the interaction of hexazinone with other compounds. The available data suggest that hexazinone may be metabolized by and may induce cytochrome P-450 (SERA 1997a). This is a very important enzyme in the metabolism of many endogenous as well as xenobiotic compounds. Thus, it is plausible that the toxicity of hexazinone may be affected by and could affect the toxicity of many other agents. The nature of the potential effect (i.e., synergistic or antagonistic) would depend on the specific compound and perhaps the sequence of exposure.

Sensitive Individuals

The uncertainty factors used in the development of the RfD takes into account much of the variation in human response. The uncertainty factor of 10 for sensitive subgroups is sufficient to ensure that most people will experience no toxic effects. *Sensitive* individuals are those that might respond to a lower dose than average, which includes women and children. The National Academy of Sciences report entitled Pesticides in the Diets of Infants and Children (NAS 1993) found that quantitative differences in toxicity between children and adults are usually less than a factor of approximately 10-fold. An uncertainty factor of 10 may not cover individuals that may be sensitive to herbicides because human susceptibility to toxic substances can vary by two to three orders of magnitude. Factors affecting individual susceptibility include diet, age, heredity, preexisting diseases, and life style. Individual susceptibility to the herbicides proposed in this project cannot be specifically predicted. Unusually sensitive individuals may experience effects even when the HQ is equal or less than 1.

There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of chlorsulfuron. Due to the lack of data in humans, the likely critical effect of chlorsulfuron in humans cannot be identified clearly. In animals the most sensitive effect of chlorsulfuron appears to be weight loss. There is also some evidence that chlorsulfuron may produce alterations in hematological parameters. However, it is unclear if individuals with pre-existing diseases of the hematological system or metabolic disorders would be particularly sensitive to chlorsulfuron exposure. Individuals with any severe disease condition could be considered more sensitive to many toxic agents.

The 1996 Food Quality Protection Act requires that U.S. EPA evaluate an additional 10X safety factor, based on data uncertainty or risks to certain age/sex groupings. U.S. EPA has evaluated chlorsulfuron against this standard and has recommended a 3X additional safety factor be used for the protection of infants and children. This additional 3X safety factor is factored into the acute and chronic RfD's of this risk assessment as it applies to chlorsulfuron.

The likely critical effect of clopyralid in humans cannot be identified clearly (SERA 2004b). Clopyralid can cause decreased body weight, increases in kidney and liver weight, deceased red blood cell counts, as well as hyperplasia in gastric epithelial tissue (*ibid*). These effects, however, are not consistent among species or even between different studies in the same species (*ibid*). Thus, it is unclear if individuals with pre-existing diseases of the kidney, liver, or blood would be particularly sensitive to clopyralid exposures, although individuals with any severe disease condition could be considered more sensitive to many toxic agents. There are no data or case reports on idiosyncratic responses to clopyralid (*ibid*).

No reports were encountered in the glyphosate literature leading to the identification of sensitive subgroups. There is no indication that glyphosate causes sensitization or allergic responses, which does not eliminate the possibility that some individuals might be sensitive to glyphosate as well as many other chemicals (SERA 2003a).

Because triclopyr may impair glomerular filtration, individuals with pre-existing kidney diseases are likely to be at increased risk (SERA 1996b). Because the chronic RfD for triclopyr is based on reproductive effects, women of child-bearing age are an obvious group at increased risk (SERA 2003b). This group is given explicit consideration and is central to the risk characterization.

Because hexazinone was demonstrated to induce fetal resorptions, pregnant women are an obvious group at increased risk (SERA 2005). This group is given explicit consideration and is central to the risk characterization. There are no other reports in the literature suggesting subgroups that may be sensitive to hexazinone exposure. There is no indication that hexazinone causes sensitization or allergic responses (*ibid*).

NP9E can cause increases in kidney and liver weight, and effects to kidney function and structure. Thus, individuals with pre-existing conditions that involve impairments of the kidney or liver may be more sensitive to this compound. There is some indication that sensitive individuals may develop contact allergies. People with a history of skin allergic reactions to soaps and detergents may be especially sensitive to dermal exposures of NP9E-based surfactants.

The potential of NP9E to induce reproductive effects (described in section 2 of Appendix D) should be considered low. Based on the available dose/duration/severity data, it appears that exposure levels below those associated with the most sensitive effect (i.e., kidney effects) are not likely to be associated with reproductive toxicity. However, as shown in the exposure scenarios, there is the potential for acute exposures to be in the range (considering a 100X safety factor) where effects to the developing fetus may occur, therefore women of child-bearing age could be considered a sensitive population.

Cumulative Effects

The proposed use of herbicides could result in cumulative doses of herbicides to workers or the general public. Cumulative doses to the same herbicide result from (1) additive doses resulting from various routes of exposure from this project and (2) additive doses if an individual is exposed to other herbicide treatments.

Additional sources of exposure include: use of herbicides on adjacent private lands, use of herbicides on adjacent NFS lands, or home use by a worker or member of the general public. Reported past use of glyphosate, hexazinone, chlorsulfuron, triclopyr, and clopyralid (1999-2006) in El Dorado County is displayed in Table 3-21, below, by total use and Forestland use. Hexazinone is used primarily for forestland. Glyphosate is primarily used in forestland (41%), other crops, right-of-way, and landscape maintenance. Chlorsulfuron is primarily used in right-of-way and landscape maintenance. Triclopyr is primarily used in forestland (28%), right-of-way, and landscape maintenance. Clopyralid is primarily used for forestland (14%), rangeland, landscape maintenance, and right-of-way. We assume that there would not be any extensive changes in these use patterns into the near future.

Table 3-21. Reported Herbicide Use (lbs active ingredient) in El Dorado County (1999-2006)

Forestland Total									
Chemical	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
Chlorsulfuron	0	0	0	0	0	0	0	0	0
Glyphosate	7,881	5,324	7,231	3,709	3,183	2,561	6,471	6,271	42,631
Clopyralid	51	0	89	88	14	51	24	18	335
Hexazinone	3,081	2,569	3,778	3,554	1,772	5,549	1,474	4,895	26,672
Triclopyr	541	770	633	978	69	67	532	50	3,640
All Reported Uses									
Chemical	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
Chlorsulfuron	3	3	4	7	3	8	23	46	97
Glyphosate	13,054	9,482	11,113	9,596	10,640	14,927	15,508	19,921	104,241
Clopyralid	178	103	376	400	468	222	224	372	2,343
Hexazinone	3,154	2,695	3,826	3,559	1,559	5,673	1,523	4,935	26,924
Triclopyr	1,336	1,504	1,521	1,904	2,101	1,076	1,900	1,438	12,780

Source - California Department of Pesticide Regulation, Annual (1999-2006) Pesticide Use Reports for El Dorado County, accessed on line at http://www.cdpr.ca.gov/docs/pur/purmain.htm on 7/31/2008).

Additional sources of exposure on National Forest Lands – Past use on the ENF (1999-2005) of glyphosate, hexazinone, triclopyr, and clopyralid are displayed in Table 3-22, below. Chlorsulfuron hasn't been used on the ENF. R-11 surfactant is assumed to have been used in all glyphosate and clopyralid applications. There is the potential for exposure from projects on the ENF involving the herbicides proposed for use on this project. They include the Yellow Starthistle Control Project (clopyralid and glyphosate), Spotted Knapweed Control Project (glyphosate), PGE/SMUD Transmission line (clopyralid), Star Fire Reforestation Project (glyphosate), 2004 Vegetation Management in Conifer Plantations (glyphosate, clopyralid, and hexazinone) and Bosworth Forest Health project (glyphosate and triclopyr). This project would add an estimated maximum of 33,000 lbs (AI) of glyphosate, 280 lbs (AI) of hexazinone and 25 lbs (AI) of clopyralid, 240 lbs (AI) triclopyr, and < 1 lb. of chlorsulfuron over the life of the project. We assume that there would not be any extensive changes in these use patterns into the near future, with the following exception. Use of glyphosate and triclopyr on NFS land may increase over 1999-2005 levels for due to its possible use for reforestation on the Power Fire and the Big Grizzly Fuel Reduction Project.

Table 3-22. Herbicide Use (lbs active ingredient) Eldorado National Forest (1999-2005)

Year	Clopyralid	Glyphosate	Triclopyr	Hexazinone
1999	0	8,017	0	122
2000	0	3,315	395	180
2001	1	2,979	0	0
2002	46	940	612	0
2003	11	770	31	0
2004	27	4,978	0	0
2005	13	2,370	27	0

Eldorado National Forest includes portions of Alpine, Amador, El Dorado, and Placer Counties.

It is conceivable that workers or members of the public could be exposed to herbicides as a result of treatments on surrounding private forestlands (glyphosate and hexazinone) or treatments on NFS Lands. Where individuals could be exposed by more than one route, the risk of such cases can be quantitatively characterized by adding the hazard quotients for each exposure scenario. For example, using glyphosate as an example, the typical levels of exposure for a woman being directly sprayed on the lower legs, staying in contact with contaminated vegetation, eating contaminated fruit, and consuming contaminated fish leads to a combined hazard quotient of 0.04. Similarly, for all of the chronic glyphosate exposure scenarios, the addition of all possible pathways lead to hazard quotients that are substantially less than one. Similar scenarios can be developed with the other herbicides. This risk assessment specifically considers the effect of repeated exposure in that the chronic RfD is used as an index of acceptable exposure. Consequently, repeated exposure to levels below the toxic threshold should not be associated with cumulative toxic effects.

Since these herbicides persist in the environment for a relatively short time (generally less than 1 year), do not bio-accumulate, and are rapidly eliminated from the body, additive doses from re-treatments in subsequent years are not anticipated. According to recent work completed by the California Department of Pesticide Regulation, some plant material contained hexazinone residues for up to 2.5 years after treatment, triclopyr residues up to 1.5 years after treatment, and glyphosate up to 66 weeks after treatment; however, these levels were less than 1 part per million (Segawa et al. 2001). Since repeat treatments in this project are at one or more years into the future, it is likely that any residue from an application would be substantially degraded between applications. It is possible that residues from the initial herbicide application could still be detectable during subsequent re-treatments, but these plants would represent a low risk to humans as they would show obvious signs of herbicide effects as so would be undesirable for collection.

The information in Table 3-22 indicates that these herbicides are also used outside of forestlands in El Dorado County. In order to consider the cumulative effects of these other uses, U.S. EPA has developed the theoretical maximum residue contribution (TMRC). The TMRC (Table 3-23) is an estimate of maximum daily exposure to chemical residues that a member of the general public could be exposed to from all published and pending uses of a pesticide on a food crop. Adding the TMRC to this project’s dose estimate can be used as an estimate of the cumulative effects of this project with theoretical background exposure levels of these herbicides. The result of doing this doesn’t increase the HQ values appreciably.

Table 3-23. Theoretical Maximum Residue Contribution

Herbicide	TMRC (mg/kg/day)	% of RfD	Data Source
Chlorsulfuron	0.00386	19.3	US EPA 2002f
Clopyralid	0.00903	6.0	US EPA 1999
Glyphosate	0.02996	1.5	US EPA 2000a
Hexazinone	0.0035	7.0	US EPA 1994

hexazinone have supported such a link. These two herbicides, while having some commonality in chemical structure, are dissimilar enough chemically that common toxic action is not expected.

The primary metabolite of triclopyr is 3,5,6-trichloro-2-pyridinol (TCP). TCP is also the primary metabolite of an insecticide called chlorpyrifos. U.S. EPA (1998, 2002a) considered exposures to TCP from both triclopyr and chlorpyrifos in their general dietary and drinking water exposure assessments. Based on this assessment, the U.S. EPA (1998) concluded that:

> *...the existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic dietary risks from TCP. Based on limited available data and modeling estimates, with less certainty, the Agency concludes that existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic drinking water risks from TCP. Acute and chronic aggregate risks of concern are also unlikely to result from existing uses of triclopyr and chlorpyrifos.* – U.S. EPA (1998, p. 34).

This conclusion, however, is based primarily on the agricultural uses of triclopyr – i.e., estimated dietary residues – and does not specifically address potential exposures from forestry applications. In forestry applications, the primary concern would be the formation of TCP as a soil metabolite. TCP is more persistent than triclopyr in soil and TCP is relatively mobile in soil (U.S. EPA 1998) and could contaminate bodies of water near the site of application. In order to assess the potential risks of TCP formed from the use of triclopyr, the TCP metabolite was modeled in the SERA risk assessment (SERA 2003b) along with triclopyr.

Because triclopyr and chlorpyrifos degrade at different rates, maximum concentration in soil, and hence maximum runoff to water, will occur at different times. Thus, in order to provide the most conservative estimate of exposure to TCP, the maximum concentrations reflect applications of triclopyr and chlorpyrifos spaced in such a way as to result in the maximum possible concentrations of TCP in water. As modeled, concentrations of TCP in a small stream could reach up to 11 ppb from the use of triclopyr at a rate of 1 lb/acre and up to 68 ppb in a small stream from the use of triclopyr at a rate of 1 lb/acre and chlorpyrifos at a rate of 1 lb/acre.

The current RfD for TCP used by U.S. EPA (2002a) is 0.012 mg/kg/day for chronic exposure and 0.025 mg/kg/day for acute exposure. The child is the most exposed individual, consuming 1L of water per day at a body weight of 10 kg. Thus, based on the chronic RfD of 0.012 mg/kg/day, the associated concentration in water would be 0.12 mg/L or ppm [0.012 mg/kg/day × 10 kg/1 L/day] which is in turn equivalent to 120 ppb. Since the peak exposure to TCP in water is below the concentration associated with the chronic RfD, there is no basis for asserting that the use of triclopyr with or without the use of chlorpyrifos will result in hazardous exposures of humans to TCP.

Recent studies have shown drift of chlorpyrifos, and other insecticides, from agricultural lands in the Sacramento/San Joaquin Valley to the Sierra Nevada range (McConnell et al. 1998). In El Dorado County, chlorpyrifos use in 2004 totaled 181 pounds, primarily used in wine grapes, landscape maintenance, and structural pest control. Levels of chlorpyrifos have been measured in watercourses in the Sierra Nevada as high as 13 ng/L (0.013 μg/L or ppb). These upper levels have been measured in the southern Sierra. As a comparison, the use of chlorpyrifos in Fresno County was over 291,000 pounds, 1,600 times higher in 2004 than El Dorado County. This would indicate that it is unlikely that such high aquatic levels of chlorpyrifos would be found in the ENF area as a result of atmospheric movement. Assuming that 100% of measured chlorpyrifos would degrade to TCP (an over-exaggeration of the rate of degradation), this would add 0.013 ppb of TCP. If this amount is added to the modeled peak exposure of 68 ppb, it would not result in any appreciable increase in risk

Estrogenic effects (a common toxic action) can be caused by additive amounts of NP, NPE, and their breakdown products. In other words, an effect could arise from the additive dose of a number of different xenoestrogens (estrogens from outside the body), none of which individually have high enough concentrations to cause effects. This can also extend out to other xenoestrogens that biologically react the same. Additive effects, rather than synergistic effects, are expected from combinations of these various estrogenic substances.

Other sources of exposure to NP and NPEs include personal care products (skin moisturizers, makeup, deodorants, perfumes, spermicides), detergents and soaps, foods, and from the environment away from the forest herbicide application site. In addition to xenoestrogens, humans are exposed to various phytoestrogens, which are hormone-mimicking substances naturally present in plants. In all, more than 300 species of plants in more than 16 families are known to contain estrogenic substances, including beets, soybeans, rye grass, wheat, alfalfa, clover, apples, and cherries. Adding together the contributions from the worst-case background environment and consumer products, there would be a background dose to a female worker of 27.034 mg/kg/day (assuming 100% dermal absorption) or 0.304 mg/kg/day (assuming 1% dermal absorption). Using a derived NP human NOEL (no observed effects level) of 0.10 mg/kg/day (as described in USDA, 2003b) these exposure estimates result in hazard quotients of 270 to 3. In terms of this risk assessment, the non-acute contribution of NP9E (backpack workers exposure ranged from 0.01 to 0.07 mg/kg/day) would contribute up to 0.7 to any hazard quotient. At typical application rates, the worker exposure would add 0.1 to the HQ. For the public chronic exposures at the upper range of application, the doses of NP9E would add 0.00002 to 0.06 to any HQ. These may be negligible depending upon the background exposures, lifestyles, absorption rates, and other potential chemical exposures that are used to determine overall risk to environmental xenoestrogens.

Soil Quality

Affected Environment

Soils within the planting area for this project are derived from granitic, gabbroic, and volcanic parent materials. Maps showing the type and arrangement of soils found in the project area are found in the Eldorado National Forest Soil Survey (Mitchell and Silverman, 1985). Field work in the project area by the BAER team soil scientist, and the Freds Fire project soil scientists (USDA 2005b) verified the existing soil survey information, investigated soil conditions and effects of the fire, and management capabilities. Further field visits were made in summer 2006 for observations of post-harvest conditions. The soils are described in this section by bedrock (parent material) type.

Soils Developed from Granitic Materials

Some of the soils found in the project area developed from granitic parent materials. These soils are located primarily on the steep north slopes of the South Fork American River. The Chaix and Pilliken soil series are the dominant granitic-derived soils. The Chaix is moderately deep, somewhat excessively drained, and has coarse sandy loam texture throughout. The Pilliken soil is deep, well drained, and has a coarse sandy loam texture throughout.

Soils Developed from Volcanic Materials

Some of the soils in the project area are formed in volcanic extrusive rock. The Waca and McCarthy series are the dominant volcanic-derived soils. The Waca soil is moderately deep and well drained. It has a cobbly sandy loam surface layer over a very cobbly sandy loam subsurface.

The McCarthy series is moderately deep and well drained. It has a gravelly sandy loam surface over very gravelly loam subsoil. Both soils have relatively high organic matter contents and rock fragment contents as influenced by their volcanic parent materials.

Soils Developed from Gabbroic Materials

Some of the soils found in the project area are formed in gabbro, an intrusive igneous rock. The Holland series is the dominant gabbro derived soil. The Holland series is very deep and well drained, and has loam and sandy loam textures throughout the soil profile.

Existing Soil Cover Conditions

The 2004 Freds Fire initially reduced ground cover immediately following the fire to an average 9 percent in high severity burned areas and 17 percent in moderate severity burned areas. The prospective soil cover after needlecast following the fire was estimated during the post fire field work based on the existing brown needles on the trees. The average projected ground cover with needle cast was 19 percent cover in high severity burns and 46 percent in moderate severity burns. Natural vegetative recovery has increased cover with resprouting of some brush and trees species, regrowth of bear clover over significant areas, and growth of grass and forbs. Salvage harvesting in 2005 and 2006 further modified conditions, roughening the surface and loosening soils, laying down skid trails, and adding slash cover from tops and limbs. The target ground cover for the salvage harvest was set at 50%.

Existing cover was measured during silvicultural surveys from 2006 to 2008. Data from these surveys show that cover from live vegetation increased to an average of 60-65 percent by 2007-2008. Ground cover including duff, litter, slash, and rock fragments increases cover, with overlap between the layers. By the time of the first herbicide application, soil cover will consist of dead vegetative cover of grasses, forbs, dead leaves from shrubs, duff and litter that survived the fire, needlecast, harvest slash, and rock fragments. Average soil cover at that point is projected at 70 to 80 percent.

Erosion Risk

This project will potentially affect the soil erosion risk in the short term by both the clearing planting circles and reducing vegetative growth through herbicide use. The risk can be evaluated in the consideration of erosion factors and the general erosion hazard in the project area. The Revised Universal Soil Loss Equation, a common method of assessing erosion hazard, uses five factors in assessing erosion risk: rainfall erosivity, soil erodibility, slope steepness, slope length, and soil cover.

Rainfall erosivity on the west slope of the Sierras ranges from relative values of 80 at a 3000 foot elevation to 10 in the high country, and in the project area varies from around 40 at the lower elevations to 10 at the ridge top elevations where more of the precipitation is snowfall. Rainfall erosivity varies according to the form of precipitation (rain or snow), storm intensity, and total annual precipitation. Total precipitation (rainfall and snow) in the project area is in the 47 to 51 inch range. The 2 year 6 hour storm is about 2 inches.

Soil erodibility is a measure of soil susceptibility to erosion and is given as the soil k factor. The k factor values for the surface horizons of major soils in the burned area are as follows: Holland (0.32), Chaix (0.24), Pilliken (0.20), Waca (0.17), Windy (0.17), Cohasset (0.17), and McCarthy (0.10). The soil erodibility is proportional to the k factor value with Holland at 0.32 as more erodible and McCarthy at 0.10 as least erodible. The soils developed from igneous parent material (Holland, Chaix, and Pilliken) have the greater erodibility. The soils with volcanic parent material and a sandy loam texture are less erodible.

The slope steepness and slope length erosion factors are interrelated. The product of these factors ranges from 6.7 at 70 percent slope to 1.0 at 10 percent slope, assuming a 50-foot slope length and using the Revised Universal Soil Loss Equation slope factor equations. Thus, the Revised Universal Soil Loss Equation predicts a six-fold increase in erosion as slope increases from 10 to 70 percent assuming everything else equal.

The soil cover factor varies in the project area as a function of burn severity, vegetative recovery, timber harvest method, and fuel treatment. High burn severity decreased cover and often delays the vegetative recovery. Harvest method has affected cover. The steeper slopes harvested by helicopter have higher residual cover from limbs and branches than tractor-harvested areas. Some vegetation recovers fast, where bear clover is present there is fast vegetative recovery and nearly 100% cover two years after the fire. The proposed project would modify the soil cover mainly by reducing vegetative regrowth as a result of herbicide use, and potentially reducing plant litter and soil cover in subsequent year.

Environmental Consequences

Alternative 1 (Proposed Action)

Effects of Herbicide Use

The proposed herbicide characteristics vary, particularly in their soil binding coefficient and movement ratings (an adjective ranking, based on pesticide persistence and sorption in soil) The herbicide proposed for widest use, glyphosate, has a very high soil adsorption coefficient, a very low pesticide movement rating, and therefore a low risk of delivery to surface waters. Hexazinone has a low soil adsorption coefficients and very high movement rating. Triclopyr BEE has a moderately low soil adsorption coefficient and low movement rating. Clopyralid has a low soil adsorption coefficient and a very high movement rating. Chlorsulfuron has a low soil adsorption coefficient and a high movement rating (Table 3-24).

The very high movement ratings of hexazinone and clopyralid, and the high movement rating for chlorsulfuron do not necessarily imply that there will be delivery to ground or surface waters in detectable amounts. The amount applied, the breakdown of the herbicides between application and precipitation, and streamside buffers ameliorate the potential for delivery. California’s dry summer climate means that there is significant breakdown of the chemicals in the time between spring application and fall rains.

The use of these herbicides is not expected to affect soil biology. The herbicides break down or are broken down by soil microbes over time. As described in Busse, et al (2004), “nearly all studies conducted in forest or nursery soils have found no detrimental effects of assorted herbicides on mycorrhizal formation (Smith and Ferry, 1979; Trappe, 1983; Harvey *et al*., 1985, Marks and Becker, 1990; Sidhu and Chakravarty, 1990)”. The list of compounds showing no damage to ectomycorrhizal formation in soil include glyphosate, hexazinone, and triclopyr (and others not proposed for use). Busse added., “In comparison, herbicide effects have been limited to pure cultures studies with high herbicide concentrations (Kelley and South, 1980; Chakravarty and Sidhu, 1987; Chakravarty and Chatarpaul, 1990) or pot studies in which inoculated seedlings are grown in artificial media (Chakravarty and Sidhu, 1987; Sidhu and Chakravarty, 1990).”

Glyphosate is readily metabolized by soil bacteria and many species of soil microorganisms can use glyphosate as sole carbon source. While microorganisms have the same pathway as higher plants for the production of aromatic amino acids, and since glyphosate inhibits this pathway, toxicity to microorganisms may be expected and glyphosate has been considered as an antimicrobial agent for human pathogens. Nonetheless, there is very little information suggesting that glyphosate will be harmful to soil microorganisms under field conditions and a substantial body of information indicating that glyphosate is likely to enhance or have no effect on soil microorganisms (SERA, 2003a). There were some studies (Sidhu and Chakravarty, 1990) that showed reduced growth and reduced numbers of mycorrhizal infections of pine roots in laboratory experiments with recovery over time. Under field conditions, the same study reported less intense effects, and only at high (4 kg/ha) application rates. It appears that glyphosate effects on microbial populations depend on whether studies are done with laboratory media or with soil media or in field studies. Busse et al. (2001) studied affects of glyphosate under field and laboratory conditions. Under laboratory conditions and using culture media, glyphosate reduced microbial populations and respiration. However, in soil media there was no reduction in respiration and there was instead a stimulation of respiration at high concentrations of glyphosate. The authors conclude that glyphosate applied at recommended field concentrations had no consequential effect on microbial populations of pine plantations.

Little data is available from the Triclopyr Risk Assessment (SERA 2003b) regarding the effects of triclopyr on soil organisms. "Laboratory studies involving responses in artificial growth media suggest that responses in soil microorganisms may be highly variable among species, with growth unaffected at concentrations of up to 1,000 ppm in growth medium, but inhibited in other species in concentrations as low as 0.1 ppm. The applicability of these studies to assessing the risk of soil organisms from exposures to triclopyr in soil is questionable but these are the only data available." Additionally, "If the laboratory studies are used to characterize risk, transient inhibition in the growth of some bacteria or fungi might be expected. This could result in a shift in the population structure of microbial soil communities but substantial impacts on soil – i.e., gross changes in capacity of soil to support vegetation – do not seem plausible. This is consistent with the field experience in the use of triclopyr to manage vegetation."

Busse et al (2004) found that triclopyr was not suppressive to ectomycorrhizae formation in a variety of forest soil types.

There have been studies done that deal with the effects of herbicides on mycorrhizae (Chakravarty and Sidhu, 1987) that have shown some short term reductions in mycorrhizae due to high levels of herbicides in the soil profile. The study showed triclopyr to be more toxic to mycorrhizae than glyphosate. The studies have dealt with rather high concentrations of herbicides in the soil profile -- levels that are generally higher than those found in soil monitoring data collected on the ENF within the past few years (USDA 1998a).

Standard laboratory culture bioassays show that hexazinone can inhibit microbial growth (Chakravarty and Chatarpaul 1990; Estok et al. 1989; Litten et al. 1985; Krause 1975; Laatinkainen and Heinonen-Tanski 2002, in SERA, 2005). While artificial media studies can be useful in identifying relative sensitivities among species, the most directly relevant studies are those that follow microbial populations after field applications. Field studies conducted by Chakravarty and Chatarpaul (1990, in SERA, 2005) noted no effects on mixed fungal and bacterial populations after application rates of up to 8 kg/ha (about 7 lbs/acre), more than twice the proposed application rate of this project.

Little data is available from the Clopyralid Risk Assessment (SERA 2004b) regarding the toxicity of clopyralid to terrestrial microorganisms. At concentrations of 1 or 10 ppm soil, clopyralid had no effect on nitrification, nitrogen fixation, or degradation of carbonaceaus material (McCall et al. 1979, in SERA, 2004b). While the available toxicity data on soil organisms are limited to two studies, the projected maximum concentrations of clopyralid in soil from this project are far below potentially toxic levels. The available information on soil organisms does not provide any basis for asserting that adverse effects on soil organisms are plausible.

Limited data are available on the toxicity of chlorsulfuron to soil invertebrates and soil microorganisms. Soil microorganisms do not appear to be sensitive to chlorsulfuron (NOEC (No Observed Effects Concentration) of 10 mg/kg) based on cellulose and protein degradation reported by Rapisarda et al. (1981a, in SERA 2004a). These projected maximum concentrations in soil from this project are far below concentrations that appear to be toxic. Thus, there is no basis for asserting that chlorsulfuron is likely to cause adverse effects in soil microorganisms under from project applications.

Table 3-24. Soil Adsorption and Persistence Characteristics for Herbicides

Common Name [1]	Pesticide Movement Rating	Sorption Coefficient (K_{oc})	Persistence
Chlorsulfuron	High	40	Moderately persistent
Clopyralid	Very High	6	Moderately persistent
Glyphosate	Extremely Low	24,000	Moderately persistent
Hexazinone	Very High	54	Moderately persistent
Triclopyr ester (BEE)	Low	780	Moderately persistent

Source: P.A. Vogue, E.A. Kerle, and J.J. Jenkins. The Oregon State University Extension Pesticide Properties Database http://ace.orst.edu/info/npic/ppdmove.htm

Analysis and Soil Quality Standards

The effects of a project on soils can be evaluated in terms of the Soil Quality Standards of Forest Service Region 5 (FSH R5 Supplement No. 2509.18-95-1). The standards define desirable conditions for soil characteristics and threshold levels of detrimental soil disturbance that may result in reductions in soil productivity, soil hydrologic function, and soil environmental health. The soil characteristics are: 1) soil cover, 2) soil porosity 3) organic matter content, including soil organic matter and large woody material, 4) soil hydrologic function and soil buffering capacity. The Eldorado National Forest Land Management Plan directs that no more than 15% of a unit should be detrimentally disturbed. Potential actions that could affect soil quality include clearing planting spots to mineral soil prior to planting each tree, herbicide use in the first year to control competing vegetation, follow-up herbicide use, and mastication of shrubs.

Soil Cover and Soil Loss: The soil loss standard requires the maintenance of sufficient soil cover to avoid detrimental accelerated erosion. Herbicide use has the potential effect of reducing soil cover. There would also be some effect on cover because of the scalping of planting circles (14” – 24” diameter).

Soil Porosity: The soil standard requires maintenance of soil porosity with no more than a 10% loss. The traffic of masticating equipment has some potential for decreasing porosity.

Soil Organic Matter: The standard for organic matter requires maintenance of amounts of organic matter sufficient to prevent significant short or long-term nutrient cycle deficits, and to avoid detrimental physical or biological soil conditions. The proposed project could affect organic matter as a result of herbicide use which would decrease vegetative growth for one season with glyphosate, triclopyr, clopyralid, or chlorsulfuron, and with some residual effects for two to three years with hexazinone.

Soil Hydrologic Function: The standards provide for maintenance of soil hydrologic function. The cleared planting circles around trees would have a small effect on infiltration within the circle. Infiltration may be affected at the scale of the planting circle, but should not be affected at the landscape scale. Masticating equipment use at five to ten years would also have an effect on porosity. Ameliorating factors include the high permeability of the project soils, the low rainfall energy, and the capacity for infiltration outside the planting circles. The small increase in runoff from the planting circles should infiltrate in the matrix so that total runoff at the project site scale is not expected to increase. There is potential for planting circles to intercept concentrated flows from road or skid trail drainage.

Cumulative Effects: Cumulative effects for soils could include the impacts of the proposed project combined with the following past, present, and foreseeable future actions and events: soil disturbance and compaction from past management activities, the Freds Fire, fire suppression activities, salvage harvest, reforestation, and the affect of runoff from roads and skid trails on soil productivity in the project area. The actions were selected because they have caused or have the potential to cause changes in soil quality with ultimate effects on soil productivity. The geographic scope of the cumulative effects analysis is the project area, because impacts to soils accumulate at a given location on the ground, irrespective of actions in surrounding areas. The temporal scope was selected to include impacts to soils that can accumulate over time, considering also the natural recovery rate from impacts.

Direct and Indirect Effects

Soil Cover and Soil Loss: The proposed herbicide use would decrease vegetative growth of grasses, forbs, and shrubs for up to two herbicide treatments. As was determined in silvicultural field surveys, existing vegetative cover in 2007-2008 was averaging 60-65 percent. This did not include duff, litter, slash from timber harvest, and rock fragments. There would be some additional fresh growth of annuals before herbicide application.

Based on the existing vegetative cover, the other components of cover, and expected growth, the average cover of each unit is reasonably projected to be 70 to 80% in 2009. On steeper units where soil cover is more important, there is more slash cover on the ground because helicopter harvesting did not remove as much of the tops and limbs as did ground harvest on lower slopes. The steeper slopes are therefore more protected than the average.

Based on the current cover and growth projections, soil cover should be sufficient to meet soil quality standards and protect against soil loss. Existing ground cover (litter and duff) could be reduced slightly if shrub canopy is reduced but would continue to provide an adequate amount of ground cover. Vegetative killed by herbicides would continue to provide a canopy cover until the leaves fall. Leaf fall would add to the existing ground cover. Project design criteria moreover call for the retention of 75% cover within 100 feet of perennial streams.

Monitoring efforts addressing soil concerns for accelerated erosion and herbicide persistence has taken place on previously implemented herbicide treatment projects in 1991 to 1996. The results of these monitoring efforts are summarized in the following discussion:

In the fall of 1992, a Forest-wide soil quality monitoring effort showed that soil cover standards are being met on 91 percent of the treatment areas monitored (Soil Quality Standards Monitoring-Results for 1992 Field Season-Eldorado National Forest). Additional soil cover monitoring on 1991 and 1992 herbicide-treated units showed that soil cover is maintained at adequate levels after herbicide treatments to prevent accelerated erosion (USDA 2004a). All units are expected to meet soil cover standards after treatment.

Soil Porosity: There will be no effects to soil porosity from herbicide application based on the use on hand treatments. In year 5, there will be masticating equipment traffic for fuel management on about 388 acres of defense zone near Highway 50. The masticating equipment bearing on the soil would have some affect on porosity. The masticating equipment would operate under soil moisture limitations to prevent compaction (refer to BMP 5-6, Chapter 2). Masticating equipment also operates over previously masticated material and tracks over any point but one or two times. Under these conditions, masticating equipment is not expected to increase compaction on any units to the point of noncompliance with the land management plan standards.

Soil Organic Matter: The application of herbicides would decrease the vegetative growth of grasses, forbs, and shrubs in the short term. There would therefore be a near term reduction in the addition of litter to the soil surface and turnover of plant roots below ground. For forest soils the above ground litter and below ground roots turnover and decay relatively fast without making much of an addition in any year to the total inventory of soil organic matter. The total of soil organic matter is so much greater that two years loss of vegetative growth would not have detectable effects. Fires of course have a larger effect on surface organic matter when they burn off a thick layer of duff and litter, yet this too does not significantly affect the long term inventory of soil organic matter. Herbicide use could cause a short-term decrease in nitrogen fixation by removing N-fixing brush species if present.

Soil Hydrologic Function: Clearing small planting circles would be expected to have an effect on infiltration and soil hydrologic function within the circle itself. The planting circles, because they lie in a mosaic with more soil cover, would not be expected to have an affect on hydrologic function of the project area as a whole.

Cumulative Effects

The project area has been disturbed by the Freds Fire, fire suppression activities, salvage harvest, the affect of runoff from roads and skid trails, and would be affected by the reforestation project. The proposed project together with the effects of past projects is not expected to have a significant cumulative effect on soil productivity in the project area.

Soil cover and surface organic matter have already recovered through needlecast, addition of timber harvest slash, and natural vegetative recovery so that cover is adequate. The proposed project is not expected to change that. Monitoring efforts have shown that soil cover is maintained at adequate levels after herbicide treatments to prevent accelerated erosion.

Soil porosity was not found to be a significantly impacted during analysis for the salvage harvest of the project area (USDA 2005). The proposed planting and ground-based hand herbicide applications will not affect it. The masticating equipment, because it makes few passes over any area and travels over masticated debris, will have negligible effects.

Soil organic matter is a relatively long term and stable resource that would not be affected by the short term modifications to vegetative growth caused by the project.

Soil hydrologic function has been affected by the wildfire and the loss of duff and litter. However, with the naturally high infiltration capacity of the forest soils, the effects of fire are ameliorated to a large degree in 2 or 3 years. Planting, site preparation/release, and mastication should not affect the recovery of the site hydrologic function.

Short persistence times of glyphosate and clopyralid would prevent the accumulation of these chemicals in the soil profile from repeated treatments. Persistence monitoring has shown that glyphosate persistence is similar to the information disclosed in the Regional FEIS (USDA 1989b). Persistence of clopyralid is soil is variable with documented half-lives ranging from 10 days to 10 months depending on soil type and climate. Although clopyralid does not bind readily to soil, it dissipates rapidly in some common soil conditions and typically is not expected to leach appreciably in non-sandy, low-to-moderate rainfall conditions. Relatively short persistence times of hexazinone in the soil profile, combined with the lack of repeat hexazinone treatment would prevent the accumulation of hexazinone in the soil profile. Hexazinone can persist for months in soil, ground water and streams in detectable concentrations. Soil and aquatic metabolism produces several metabolites. The limited available information on the environmental fate of metabolites of hexazinone suggest that their disposition parallels that of hexazinone. Hexazinone is mobile in most soils and can leach to depths approximating one meter under heavy rainfall conditions

Alternative 2 (No Action)

Direct and Indirect Effects

Taking no action would not have direct effects on the soils and soil quality. There would be more vegetative growth under this alternative than under Alternative 1 during the years of herbicide use under Alternative 1. In the longer term, vegetation would fill in to occupy the site, and there would be more shrubs and less tree growth than in Alternative 1. Soil cover would be somewhat higher under Alternative 2 than in Alternative 1 during the years of herbicide use. Soil porosity would be similar under Alternatives 1 and 2. Soil organic matter, a long term resource, would be similar under Alternatives 1 and 2. Soil hydrologic function would be similar under Alternatives 1 and 2.

Cumulative Effects

Cumulative effects to soil are based on the exiting soil conditions plus the effects of this alternative and any other potential future events or actions. Fires are predicted to return to this landscape every 15-30 years. In event of another fire, the consequences of this alternative is that the higher fuel levels conditions (grass in the early year and brush in the later year) created will produce flame length, rate of spread and fireline intensity that are higher than Alternative 1. A reburn of the fire would cause the lost of the existing groundcover over a larger area and the potential for accelerated erosion will increase. A high percentage of the down woody material remaining on the site will be consumed and effective ground cover and soil organic materials (downed logs) will be lost.

Alternative 3

Direct and Indirect Effects

Soil Cover and Soil Loss: Soil cover and soil loss would be expected to be similar to Alternative 1. For this alternative, hand cutting and grubbing would clear a 4-5’ radius around each planting group of 2 or 3 trees, 151 groups per acre, with about 27% of each acre cleared. There would be more disturbance and removal of cover in a planting circle in Alternative 3, but no disturbance by herbicide and therefore more vegetation and cover in the matrix on the remaining 73% of the surface area. On the scale of several planting circles or an acre or a unit, this alternative should be comparable to Alternative 1 in terms of cover and soil loss, and no significant differences or negative effects are expected of either.

Soil Porosity: Masticating would occur as in Alternative 1. As in Alternative 1, no detrimental effects on soil porosity are predicted.

Soil Organic Matter: Soil organic matter would be disturbed and redistributed in the process of scalping the planting circles and this would occur over the multiple repetitions of scalping. Surface organic matter would not, however, be moved offsite, and would be available for maintaining overall site productivity. The scalping would reduce vegetative growth in the planting circle as much as in Alternative 1, but in the matrix there would be less or no effect on vegetative growth. The matrix would therefore in the short term produce more duff and litter, but over the course of a few years the difference would be minor.

Soil Hydrologic Function: Clearing the 4-5 foot radius planting circles, amounting to about 27% of the area, would be expected to have an effect on infiltration and soil hydrologic function within the circle itself. The planting circles, because they lie in a mosaic with more soil cover, would not be expected to have an effect on hydrologic function of the project area as a whole. The effects of Alternative 3 should be minimal and similar to Alternative 1.

Cumulative Effects

The cumulative effects of Alternative 3 on soil processes would be expected to be similar to Alternative 1, excepting the 800 acres that would not be planted under Alternative 3. This alternative would result higher fuel levels conditions, similar to Alternative 2. In the event of wildfire, the effects would be similar to Alternative 2.

Hydrology and Watershed Resources

Affected Environment

Most of the project area occurs in the 7th field watersheds of Fry Creek and Kyburz. Streams in the project area in these two watersheds flow to the south and into the South Fork American River (Figure 3-10). The landscape of the project area mostly consists of steep, south-facing slopes. Three recent events have influenced the current appearance and hydrologic function of the landscape in the project area.

The Freds Fire of October 2004. Prior to the Freds Fire, much of the project area was covered with a pine-dominated conifer forest. The Freds Fire burned approximately 69 percent of the project area at a high and/or moderate severity. The riparian areas of a number of perennial streams, such as those in the vicinity of Granite Springs and the town of Kyburz, were largely consumed by the fire. The riparian areas of other perennial streams, such as Fry Creek and its tributaries, were mostly not burned or burned at a low severity.

Salvage logging in 2005. On both NFS and private land, most of the areas burned at a high and moderate severity by the Freds Fire were salvage logged in 2005. Most of the fire-killed trees were removed within 25 feet of perennial streams. For seasonally flowing streams, most of the fire-killed trees were removed up to edge of the channel.

The wet winter of 2005 and spring of 2006. Approximately 80 to 100 inches of precipitation fell on the project area in the seven month period between November 2005 and May 2006; this is nearly 150 percent of the long-term average annual precipitation.

Many of the streams in the project area have experienced some degree of channel erosion and deposition of fine-grained material since the Freds Fire. These impacts are not unexpected, given that erosion rates following a large wildfire are often several orders of magnitude greater than pre-fire erosion rates (Robichaud and Brown 1999; Dissmeyer 2000). In addition, erosion rates in the project area are still high and probably have not returned to pre-fire levels. This conclusion is supported by the high levels of turbidity (Table 3-27) of several streams - particularly Granite Springs Creek and Fry Creek - during the rain event of March 3, 2009. Turbidity is frequently used to make qualitative inferences concerning the amount of sediment being transported by streams and the erosion of the surrounding landscape.

Several of the perennial streams in the project area have more vegetation bordering these streams than in 2005/2006 and active channel erosion is less obvious. This is particularly evident for several streams on the north side of the town of Kyburz.

Physical characteristics of the project area are summarized in Tables 3-25, 3-26, and 3-27. Photographs of the landscape and aquatic features are shown in Figures 3-11 through 3-14. The turbidity of streams is illustrated in Figures 3-15 through 3-17. Additional water quality information is in Appendix C. Appendix C includes:

- Characteristics of the herbicides.
- Water quality standards and objectives.
- Monitoring Plan.
- Best Management Practices.
- Summary from herbicide monitoring report, Stanislaus National Forest.
- Summary of herbicide monitoring, Eldorado National Forest.
- Turbidity data for streams in the Freds Fire Reforestation project area.

Figure 3-10. Watersheds and Aquatic Features in the Vicinity of the Freds Reforestation Project

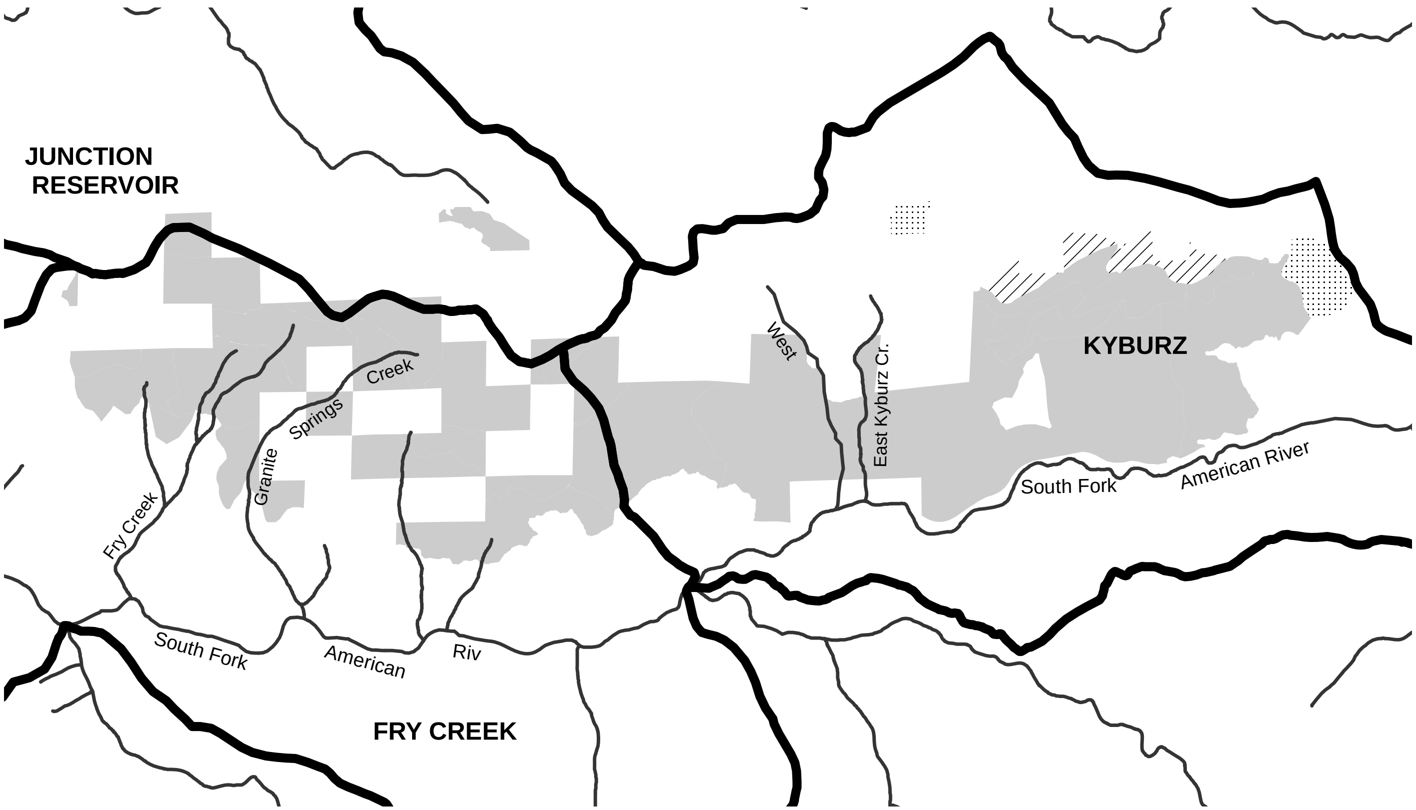


Table 3-25. Physical Characteristics of the Freds Fire Reforestation Project Area.

Watersheds	Most of the project area is located in two 7th field watersheds: Fry Creek (7,842 acres) and Kyburz (6,748 acres). A small portion of the project area is in the Junction Reservoir 7th field watershed (11,520 acres). The watersheds are a mixture of National Forest and private land. 8th field watersheds (contained within the 7th field watersheds) include East Kyburz Cr. (1025 acres), West Kyburz Cr. (389 acres), Granite Springs Cr. (867 acres) and Fry Cr. (1288 acres).
Climate	Average annual precipitation ranges between 45 inches at lower elevations (falling mostly as rain and snow) to 65 inches at higher elevations (falling mostly as snow). Most of the precipitation falls between October and April, although localized thunderstorms can occur in the summer. In the winter, rain-on-snow events can occur. The 24-hour storm event for 2, 10, 25, and 100 years is 4.6, 7.3, 9.1, and 11.0 inches, respectively.
Streams and aquatic features[1]	There are 10 known perennial streams in the project area with a total length of 3.7 miles. The riparian areas adjacent to the perennial streams are fairly narrow, but a number of these riparian areas contain abundant vegetation. The flow of the perennial streams is not regulated, and the baseflow of these streams ranges between 0.1 and 1.0 cubic feet per second (cfs.). Water quality during baseflow conditions appears to be good - pH ranged between 7.1 and 7.9 (slightly alkaline), electrical conductivity ranged between 86 and 205 uS/cm (fairly low dissolved solids), and turbidity is less than 5 NTU (clear water - low sediment load).[1] Several perennial streams transport considerably more sediment during storm events than during baseflow conditions (Figure 3-15). Three wet meadow/spring areas, which total 16.8 acres, are located near Granite Springs and the headwaters of Fry Creek. These wet areas are vegetated with willow and cattails. Nearly all of the streams flow to the south and into the South Fork American River. Nearly all of the streams are non-sinuous. This means that the channel has little or no meandering and water flows in nearly a straight line. Most of the streams have a gradient greater than 4 percent and some stream segments have a gradient of greater than 10 percent. This means that these streams do not store sediment in channels and floodplains, but rather transport sediment quickly to the South Fork American River during large storm events. The structure of channels is largely controlled by boulders and cobbles, although outcrops of bedrock occur at a few locations. This means that vertical and lateral erosion of the stream channel can occur - all of the surveyed streams show recent evidence of such.
Beneficial uses of water	Beneficial uses of water (as designated by the Central Valley Regional Water Quality Control Board) include: water supplies for domestic, municipal, industrial, and agricultural use; hydroelectricity; contact and non-contact recreation; coldwater fish; and wildlife. The Kyburz Mutual Water Company has a water right on two perennial streams - East Kyburz Creek and West Kyburz Creek - in order to supply drinking water to approximately 115 residences in Kyburz. The Kyburz Mutual Water Company is currently only diverting water from East Kyburz Creek, but could also divert water West Kyburz Creek as needed. Water is withdrawn from Granite Springs Creek for the 29 milestone summer home tract. The El Dorado Irrigation District uses water from the South Fork American River to supply much of El Dorado County with its drinking water supply. Pacific Gas and Electric (PG&E), Sacramento Municipal Utility District, and El Dorado Irrigation District utilize water from the South Fork American River for hydroelectric power generation.
Aquatic life	There are no known fish or sensitive amphibian species present within the fire area. Streams are habitat for aquatic macro invertebrate species as well as common amphibians such as tree frogs. Refer to the Aquatic Biology Section for additional information.
Geology	Intrusive igneous rocks - quartz granodiorite, granodiorite, diorite, and gabbro - are exposed at the surface throughout much of the project area. The approximate age is 60 to 100 million years. Extrusive igneous rocks - volcanic mudflows - are found along Peavine Ridge and Atherton Flat. These are the youngest rocks in project area, 2 to 24 million years old. Metamorphic rocks - primarily slate - are found in the western margin of the project area. These are the oldest rocks of the project area, 345 to 500 million years old, and were formed by contact metamorphism when molten igneous rock intruded into older sedimentary rock. Landslides (both deep and shallow) and debris flows occur in the project area.

[1] Additional information on water quality is in Appendix C.

Figure 3-11. Landscape at Granite Springs, Shortly after Salvage Logging. ***May 2005.***

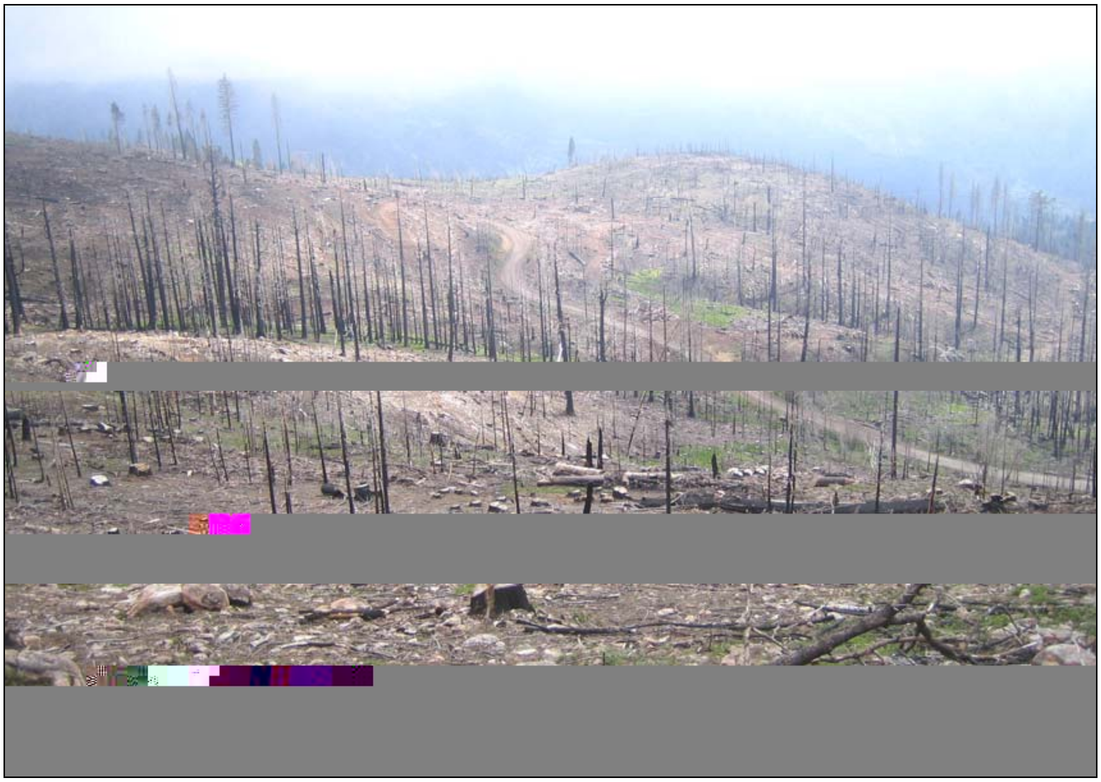


Figure 3-12. Landscape at the Headwaters of Fry Creek. ***July 2006.***

Table 3-26. Summary of Selected Aquatic Features in the Freds Fire Reforestation Project Area[1,2,3,4,5,6]

Feature and location	Overall condition	Summary description	Additional comments
Unnamed tributary of Fry Creek 0.4 miles east of road 11N38E.	Good	Stream channel is in the process of recovering from past land disturbances (predominately fire and logging). Abundant riparian vegetation has stabilized eroded stream channel and created a cool microclimate next to the stream.	Stream temperatures of 54 - 56^{o} F even when upland air temperatures exceed 85^{o} F.
Fry Creek at road 11N38 (Weber Mill Road)	Good		
Meadow near road 11N42D	Very good	Abundant riparian vegetation (willow, cattails) with wet soils, areas of standing water, and no visible evidence of surface disturbance.	Entire meadow (600 feet in length) sits in the sun - no shading by trees.
Granite Springs Creek	Fair	Streams have not recovered from past land disturbances (predominately fire and salvage logging). Segments of the stream channel are still actively eroding and contain abundant fine-grained material and or sand/gravel. Riparian vegetation and large woody debris is present, but is less abundant than in other streams in the surveyed area where the stream channels are stable.	Summer stream temperature of 62 to 65^{o}F is approximately 10^{o}F warmer than Fry Creek and its tributaries.
East Kyburz Creek	Fair		Source of drinking water for the town of Kyburz.
Unnamed stream near road 11N99F	Fair		

[1] All features occur on south-facing slopes.
[2] All surveyed streams are perennial; the baseflow of each stream is between 0.1 and 1.0 cubic feet per second.
[3] The channels of the surveyed stream segments are mostly controlled by boulders and cobbles.
[4] The overall condition is based on ratings/measurements of a number of parameters of the aquatic feature and its adjacent Riparian Conservation Area. None of the streams were given an overall condition *very good* or *poor*. For a stream, an overall condition of *very good* would require little or no recent evidence of channel erosion or instability (none of the surveyed streams are naturally unstable). An overall condition of *poor* would require that little or no riparian vegetation exists in a stream channel where abundant riparian vegetation should exist (none of the surveyed streams are naturally devoid of riparian vegetation).
[5] The condition of aquatic features was initially surveyed in July/August 2006. Approximately 50 percent of the surveyed stream segments contained one or more of the following to some degree: active downcutting of the channel, sheet erosion, rill erosion, and headcuts. A field visit to the area in February 2009 showed that the condition of streams was similar to the initial survey in 2006. However, several of the perennial streams in the project area have more vegetation bordering these streams in 2009 than in 2005/2006 and active channel erosion is less obvious. This is particularly the case for several streams on the north side of the town of Kyburz.
[6] Small slope failures and other erosional features are prevalent throughout the project area.

Figure 3-13. East Kyburz Creek (lower left of photo). ***February 2009.***

Figure 3-14. Wet Meadow (middle of photo) near the Headwaters of Fry Creek. ***August 2006.***

Table 3-27. Turbidity of Perennial Streams in the Freds Fire Reforestation Project Area[1]

Definition and characteristics of turbidity	Numerical measurement of the clarity (or cloudiness of) water. The most common units are Nephelometric Turbidity Units (NTU). An indicator of the amount of sediment eroding into a water body, as well as the concentration of suspended sediment in the water body. All land disturbing activities have the potential to increase the amount of sediment delivered to streams. High levels of suspended sediment in a stream can directly affect the health and reproduction of fish. An indirect effect is the degradation of habitat for aquatic species, such as the filling in of pools with fine-grained sediment.

	West Kyburz Creek East Kyburz Creek	**Fry Creek Granite Springs Creek**
Turbidity during periods of low streamflow[2] (Late spring through early fall; extended periods of low rainfall)	Streams appear "clear" during extended periods of low streamflow Turbidity is usually less than 5 NTU for all streams. East and West Kyburz Creeks tend to be slightly clearer in appearance than Fry Creek and Granite Springs Creek. The turbidity of East and West Kyburz Creeks has been measured at less than 2 NTU.	
Turbidity during and immediately after moderate rainfall events[3]	Streams appear clear to slightly cloudy. Turbidity of 7 - 10 NTU on the storm event of Feb. 23, 2009.[4]	Streams appear slightly to moderately cloudy. Turbidity of 24 -25 NTU on the storm event of Feb. 23, 2009.[4]
Turbidity during and immediately after large rainfall events[3]	Streams appear slightly to moderately cloudy. Highest measured turbidity of 21 and 56 NTU during the storm event of March 2, 2009.[5]	Streams appear moderately to extremely cloudy. Highest measured turbidity of 285 and 365 NTU during the storm event of March 2, 2009.[5]
Conclusions	The Freds Reforestation project area is currently experiencing high rates of erosion during large rainfall events. It is difficult to establish a trend in erosion rates since there is no turbidity data of streams before the Freds Fire of 2004 and the turbidity data immediately after the Freds Fire involved only moderate rainfall events. The 8th field watersheds that contain Fry Creek and Granite Springs Creek produce considerably more sediment large during storm events than the 8th field watersheds that contain East and West Kyburz Creeks.	

[1] Observations and conclusions are based on measurements from 2005 through 2009.

[2] Low streamflow for these streams is generally less than 3.0 cubic feet per second (cfs.).

[3] Moderate rainfall events would generally be less than 2.0 inches in 24 hours, or the precipitation event occurs as snow over a large portion of the contributing drainage areas. Large rainfall events are greater than 2.0 inches in 24 hours and rain (not snow) occurs over most or all of the contributing drainage areas.

[4] Approximately 1.9 inches of rain fell in the 24-hour period prior to the turbidity measurements of Feb. 23, 2009. Turbidity measurements were taken near the peak of the hydrograph, but streamflow was only somewhat elevated as the snow on the ground (approx. 1 ft.) may have absorbed much of the rain. The snow level was greater than 6,000 feet, which means that all of the precipitation fell as rain in the watersheds that contain the streams.

[5] Approximately 2.5 inches of rain fell in the 24-hour period prior to the turbidity measurements of March 2, 2009. The turbidity measurements were taken on the rising limb of the hydrograph - just before the peak - and all perennial streams in the project area were flowing vigorously. Approx. 1.0 inches of rain fell in the 4-hour period prior to the turbidity measurements, and it was raining hard during the measurements and for several hours afterwards. The snow level was greater than 6,000 feet - all of the precipitation fell as rain in the contributing drainage areas.

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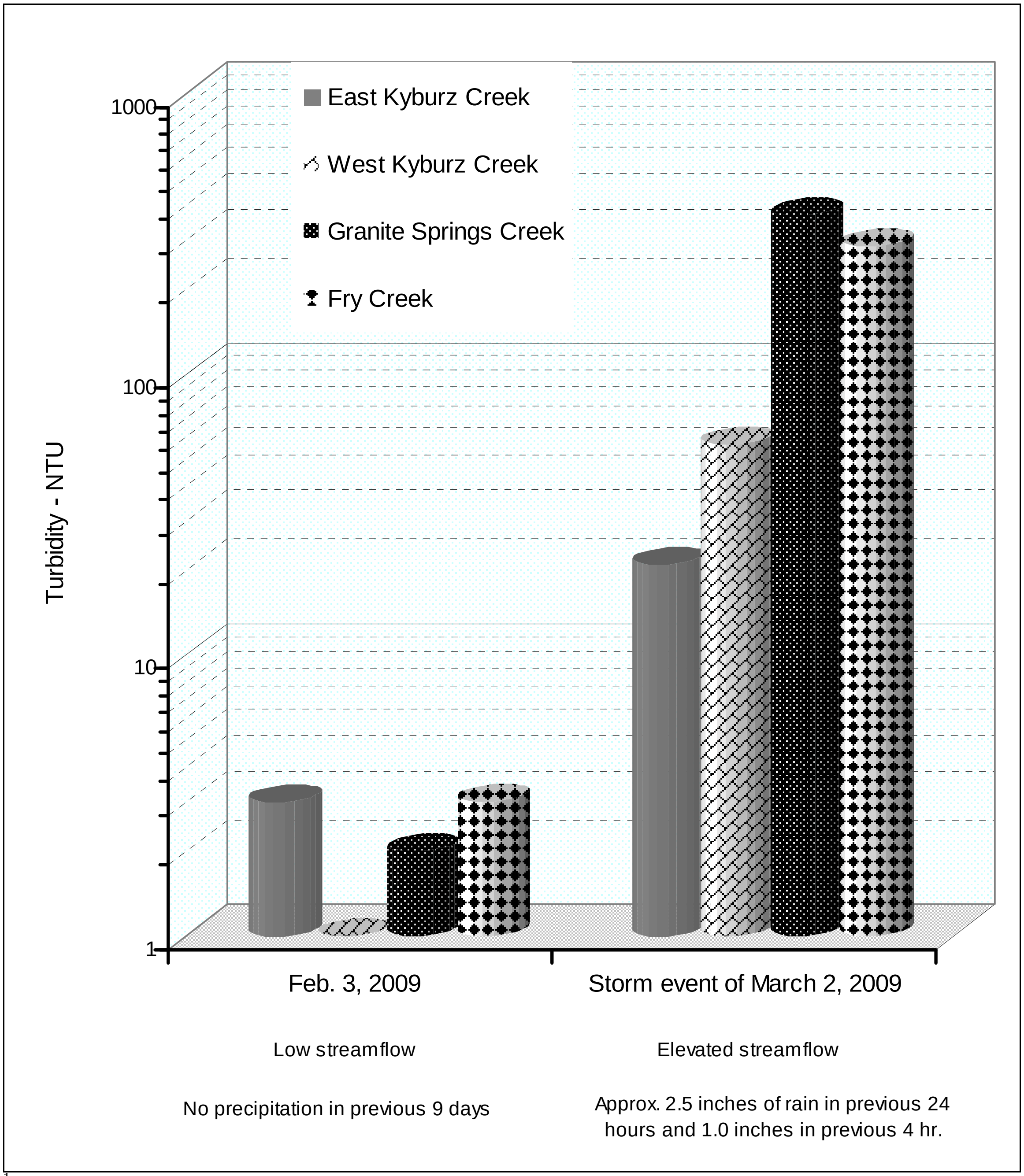
Figure 3-15. Turbidity of four Streams in the Freds Fire Reforestation Project Area.[1,2,3]



[1] Turbidity is a numerical measure of the clarity (or cloudiness) of water, and is frequently used to make qualitative inferences concerning the amount of sediment being transported by streams and the erosion of the surrounding landscape. Turbidity is measured in Nephelometric Turbidity Units (NTU).

[2] During the storm event of March 2 of 2009, all of the precipitation in the Freds Fire area fell as rain - the snow level was greater than 6,000 feet.

[3] Note that the vertical scale is logarithmic, not arithmetic.

Figure 3-16. Turbidity of Streams in the Freds Fire Reforestation project area on March 2, 2009. (NTU = Nephelometric Turbidity Units).

0.1 NTU	**21** NTU	**56** NTU	**285** NTU	**365** NTU
	East Kyburz Creek	West Kyburz Creek	Fry Creek	Granite Springs Creek

Drinking water from a residence as a comparison.

Approximately 2.5 inches of rain fell in the 24-hour period prior to the turbidity measurements of March 2, 2009.
The turbidity measurements were taken on the rising limb of the hydrograph - just before the peak - and all streams in the project area were flowing vigorously.
Approximately 1.0 inches of rain fell in the 4-hour period prior to the turbidity measurements, and it was raining hard during the measurements and for several hours afterwards.
The snow level was greater than 6,000 feet - all of the precipitation fell as rain in the contributing drainage areas.

Figure 3-17. Fry Creek during the Storm Event of March 2, 2009.

Environmental Consequences

Effects Common to All Alternatives

Direct and Indirect Effects

The use of streams as a source of drinking water will not be adversely affected. The reasons for this conclusion are different for each alternative, and are discussed in detail in the sub-sections for each alternative. Other beneficial uses of water, such as for aquatic wildlife and terrestrial wildlife, are addressed in other sections in Chapter 3.

Sediment delivery to streams, turbidity levels of streams, and the rate of the recovery of degraded stream channels is similar for all the alternatives - both in the short-term (less than 10 years) and the long-term (greater than 10 years). There are three major reasons for this conclusion.

Over four years have passed since the Freds Fire of October 2004. The available research indicates that erosion rates commonly decrease several orders of magnitude within four years following a large wildfire (Figure 3-18), and that it may take more than 10 years for erosion rates and sediment delivery to streams to return to pre-fire levels (Dissmeyer 2000). This is likely to be the case under all the alternatives. It should be noted that erosion rates in the project area currently high - particularly in the 8^{th} field watersheds that contain Fry Creek and Granite Springs Creek - as indicated by the turbidity levels of streams during a recent large rainfall event.

The design criteria under Alternative 1 (Proposed Action) creates “buffer zones” next to streams and aquatic features where there is no herbicide spraying, limited herbicide spraying, and ground cover requirements. The available research indicates that “buffer zones” next to aquatic features greatly reduces the amount of sediment reaching those features (Parkyn 2004; Dissmeyer 2000).

Several of the perennial streams in the project area have shown noticeable recovery as of February 2009. Vegetation bordering these streams is thicker and active channel erosion is less obvious than in 2005.

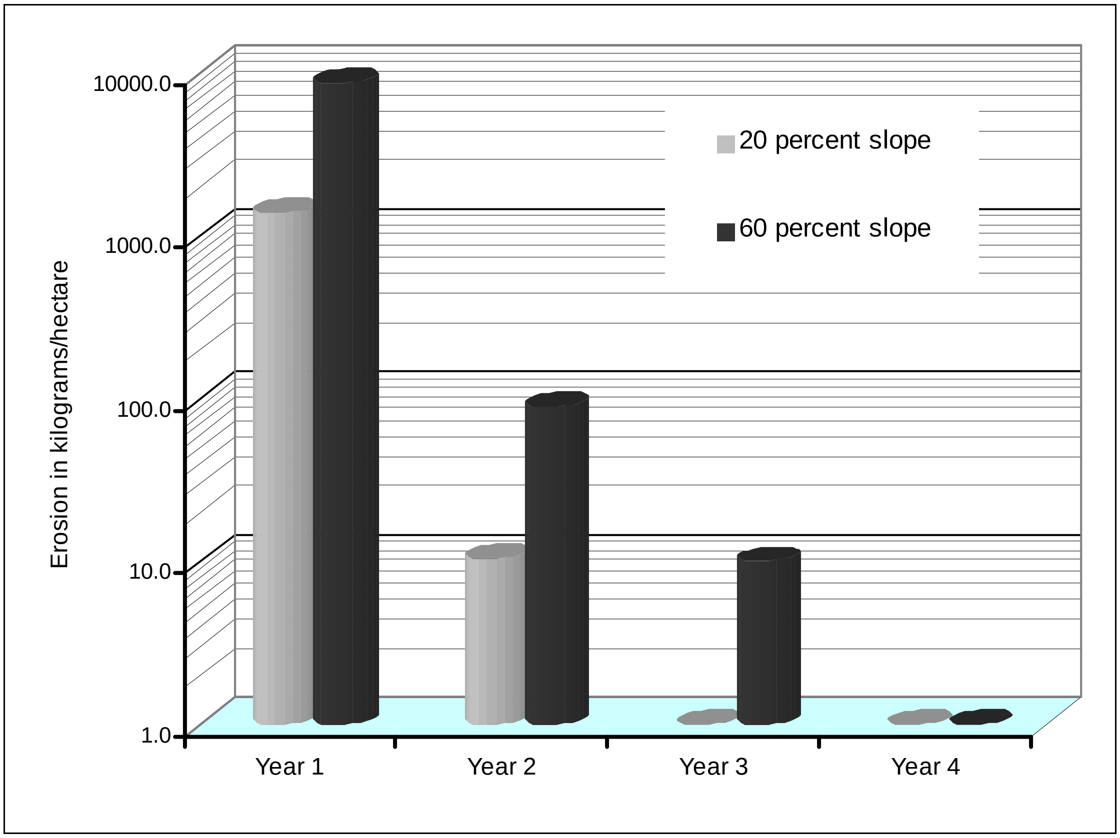
The total water yield from the project area may decrease slightly in the long-term (starting in 20 to 30 years) as trees near streams consume ground-water that would otherwise reach stream channels. This would likely result in a slight reduction in the flow of streams and the size of meadows. This means that the amount of water available for all beneficial uses would be slightly less than at the present time, assuming no long-term changes in the amount of precipitation. There are two reasons for the above conclusions.

The research has generally shown that water yield in upland coniferous forests decreases by 1.5 to 2.0 percent for every 10 percent of a watershed that is afforested (Cannell 1999), and also that water yield starts to decrease in 20 to 30 years after the planting of conifers (Dunne and Leopold 1978).

Approximately 29 percent of the project area would be planted with conifers under Alternatives 1 and 3. Even if Alternative 2 (No Action) is selected, approximately 41 percent of the project area in the ENF has already been planted with conifers.

In the long-term (greater than 10 years), the temperature of perennial streams may decrease slightly in the summer as growing conifers provide additional shade to the surface of streams. It should be noted, however, that a number of the perennial streams in the project area are currently well-shaded by existing vegetation. This suggests that any reductions in stream temperature would at most be minor. Table 3-28 summarizes the Likely Direct/Indirect impacts to Hydrology and Watershed Resources for each alternative.

Figure 3-18. Erosion rates following a wildfire in eastern Oregon (Robichaud and Brown 1999).



NOTE: Erosion rates represent hillslope erosion, not the amount of sediment delivered to streams. The vertical scale is

Table 3-28. Summary of the Likely Direct/Indirect Impacts to Hydrology and Watershed Resources for each Alternative.[1,2]

	Alternative 2 - No Action (Natural recovery - no planting of conifers; no release) **Alternative 3** (Planting of conifers; no use of herbicides)	**Alternative 1 - Proposed Action** (Planting of conifers and use of herbicides)
Beneficial uses of water	Short-term and long-term: The use of streams as a domestic water source will not be adversely affected.[2]	
Herbicide concentrations in streams	Short-term and long-term: There will be no herbicides in streams under Alternatives 2 and 3.	Short-term: Herbicides (and their surfactants and additives) may reach streams under several worse-case scenarios. However, the concentrations would be below Maximum Contaminant Levels for humans. Long-term: No herbicides in streams.
Sediment delivery to streams **Turbidity levels of streams**	Short-term: Similar for all alternatives. Long-term: Negligible difference between the alternatives.	
Temperature of perennial streams	Short-term. No increase or negligible increase under all alternatives. Long-term: No increase under any alternative. Minor decrease may occur under all alternatives.	
Water yield and the flow regime of streams	Short-term: Negligible difference in the flow of streams for all alternatives. Long-term: All alternatives may result in a decrease in the flow of streams - this would likely start in 20 to 30 years. This may occur slightly faster under Alternative 1.	
Meadows	Short-term: Negligible change in the size and wetness of meadows under all alternatives. Long-term: Size and wetness of meadows may decrease slightly in 20 to 30 years under all alternatives.	
Watershed recovery	Short-term: Recovery of degraded stream channels is similar for all alternatives. Long-term: Recovery of degraded stream channels is similar for all alternatives. In terms of restoring the forest, recovery is the slowest under Alt. 2 (No Action), slightly quicker under Alternative 3, and the quickest under Alternative 1 (Proposed Action).	

[1] Short-term impacts are less than 10 years and long-term impacts are greater than 10 years, unless specified otherwise.
[2] Impacts to aquatic species and terrestrial wildlife are addressed in other sections in Chapter 3 of this Final Environmental Impact Statement.

Alternative 1 (Proposed Action)

Two scenarios are considered in order to assess the potential impacts to the domestic use of water as a result of herbicides.

Probable scenario. This is the reasonable expected concentrations of herbicides in a stream or water body that might be encountered following herbicide application.

Worst-case scenarios. This includes a) the spraying or spill of herbicides into a stream or water body, and b) a large thunderstorm that quickly erodes sediment containing herbicides directly into a stream or water body.

Domestic Uses of Water- Town of Kyburz

The only herbicide that will be used near East and West Kyburz Creeks is glyphosate. There is a low risk that glyphosate (including additives and surfactants) will reach East or West Kyburz Creeks. If glyphosate does reach those two streams, the concentrations of the herbicide will be below the Maximum Contaminant Level (MCL) of 700 micrograms per liter (ug/l) or parts per billion (ppb) for human health as established by the EPA (CEPA 2003). The reasons for these conclusions are described below.

Modeling results using the SERA risk assessments - even assuming worse-case conditions - show that the concentration of glyphosate of East and West Kyburz Creeks, as well as all perennial streams in the project area), is less than the MCL of 700 ppb. This is depicted in Figure 3-18 and summarized below.

The modeled concentration of glyphosate decreases to less than 1.0 ppb at a distance of 500 feet downstream of the herbicide application site.

The modeled concentration of glyphosate decreases one order of magnitude as the flow increases from 0.1 to 0.5 cubic feet per second (cfs). A flow of 0.1 cfs represents the lowest measured streamflow of any perennial stream in the project area from 2004 through 2009; several of the streams usually had a baseflow of 0.5 cfs or greater during that time period.

All of the modeled scenarios assume that 10 percent of the length of the streams that border herbicide units are accidentally sprayed with glyphosate at the maximum application rate of 4.7 pounds/acre (i.e. the “no-spray” buffer widths next to streams are not completely implemented and occasional spraying of the stream surface does occur). The SERA risk assessments are discussed in detail in the Site Specific Human Health Risk Assessment (Appendix D).

Monitoring results over the past 15 years consistently show that glyphosate, when applied by ground application, seldom reaches surface water, even with “no spray” buffer widths as narrow as 10 feet (USDA 2001a; Frazier and Grant 2003). This conclusion is based on over 150 samples taken from surface water at many locations in National Forests in California between 1991 and 2002 following the application of glyphosate. The highest concentration of glyphosate measured by the US Forest Service in Region 5 since 1991 was less than 30 ug/L. In addition, approximately 99 percent of the stream samples tested had concentrations less than the laboratory detection limit. The few instances where glyphosate has been detected in surface water have almost always been traced to accidental spills directly into a stream, the intentional spraying of the stream surface, or the spraying of vegetation on the streambank or on gravel bars in the channel (USDA 2001a).

Project design specifies that glyphosate will not be sprayed within 50 feet of the two streams used for the water supply for the town of Kyburz.

The reason that glyphosate is seldom detected in surface water is related to the properties of the herbicide. Glyphosate tends to bind readily and strongly to soil particles and does not leach through most soil types (SERA 1997c). Glyphosate could still reach East and West Kyburz Creeks through erosion - particles of sediment with attached glyphosate being transported into those streams. However, the increase in the amount of sediment delivered to East and West Kyburz Creeks as a result of Alternative 1 (Proposed Action) should be negligible or slight for two reasons.

Within 100 feet of the of the two streams, a minimum of 50% ground cover would be retained through all release treatments, and the existing vegetation within 50 feet of each stream would be completely maintained by the 50 foot wide no herbicide zone.

Any sediment, along with attached glyphosate, should be largely removed from the drinking water at the treatment plant in Kyburz. The water diverted from East and West Kyburz Creeks is sent to a treatment plant and nearly all of the sediment is removed in a multi-step filtration process. Specifically, the water is required by law to have a 30-day average turbidity of less than 1.0 Nephelomentric Turbidity Units (NTU). If the turbidity exceeds 5.0 NTU for more than two consecutive days, the treatment plant automatically shuts down. Turbidity is a relative measure of the clarity (or cloudiness) of water, and water with a turbidity of less than 1.0 NTU is extremely clear and practically devoid of particulate matter.

There are two “worst-case” scenarios - unlikely but possible - where glyphosate would likely reach East and West Kyburz Creeks.

An accidental spill of glyphosate directly into the stream. In such an event, the concentration of glyphosate in the stream could be greater than the MCL of 700 ppb at the spill site. However, the concentration of glyphosate should decrease greatly within 500 feet downstream of the spill site. This conclusion is supported by the modeling results in Figure 3-10. The Best Management Practices (Chapter 2) describe the actions that would be taken in the event of an accidental spill.

A large thunderstorm that directly hits the drainage areas that feed East and West Kyburz Creeks within a few months after herbicide application (the herbicides would be applied in late spring or summer, which typically receives little rainfall); erosion could carry particles of sediment (with glyphosate attached) to the streams. Exacerbating this scenario is that the site conditions next to the two streams at a number of locations are conducive to the transport of sediment to the streams. The soils next to the stream are easily eroded – the slopes are steep (30 to 70 percent) and the soils are primarily granitic in composition. In addition, the slopes of the stream channels themselves are fairly steep (greater than 4 percent) and the travel distance to Kyburz fairly short (less than 1 mile). However, this worst-case “thunderstorm” scenario is largely mitigated by the filtration of the drinking water at the treatment plant as previously described.

There is evidence that suggests that even the two “worse-case” scenarios described above still pose a low risk to water quality. In one extreme simulated worst-case scenario, conducted in western Oregon by the US Geological Survey, runoff from the shoulder of a road sprayed with glyphosate at 1.5 pounds/acre with a rainfall of 0.3 inches/hour for several hours resulted in glyphosate concentrations of 323 to 736 ug/L on the first day of application and 16 to 21 ug/L two weeks after application (Wood 2001). The MCL for glyphosate is 700 ug/L.

Hexazinone will not occur in the two perennial streams - East and West Kyburz Creeks - that serve as the drinking water supply for the town of Kyburz. There are two reasons for this conclusion.

Hexazinone will not be used in the 8th field watershed that contains West Kyburz Creek.

Hexazinone will be used in only 6.5 acres in the 8th field watershed that contains East Kyburz Creek. The area of hexazinone application, which borders the eastern edge of the watershed, is located more than 1,000 feet from the nearest intermittent stream and 4,000 feet from East Kyburz Creek.

Clopyralid will not occur in East and West Kyburz Creeks. This is because clopyralid will not be used in the 8th field watersheds that contain those two streams.

It is unlikely that triclopyr will be detected in East and West Kyburz Creeks. There are two reasons for this conclusion.

Triclopyr will not be used in the 8th field watershed that contains West Kyburz Creek.

Triclopyr will be used in only 20 acres in the 8th field watershed that contains East Kyburz Creek. The area of triclopyr application borders one intermittent stream that drains into West Kyburz Creek. Modeling results using the SERA risk assessments - even assuming worse-case conditions - show a concentration of triclopyr of 0.1 ppb at a distance of 500 feet downstream of herbicide application.[1]

A number of Best Management Practices (Chapter 2) will be employed to minimize degradation of water quality from herbicides and sediment. These BMP's cover the accidental spill of herbicides directly into the stream.

Domestic Use of Water - South Fork American River

Herbicide applications will not impair the South Fork of the American River as a drinking water supply for several reasons.

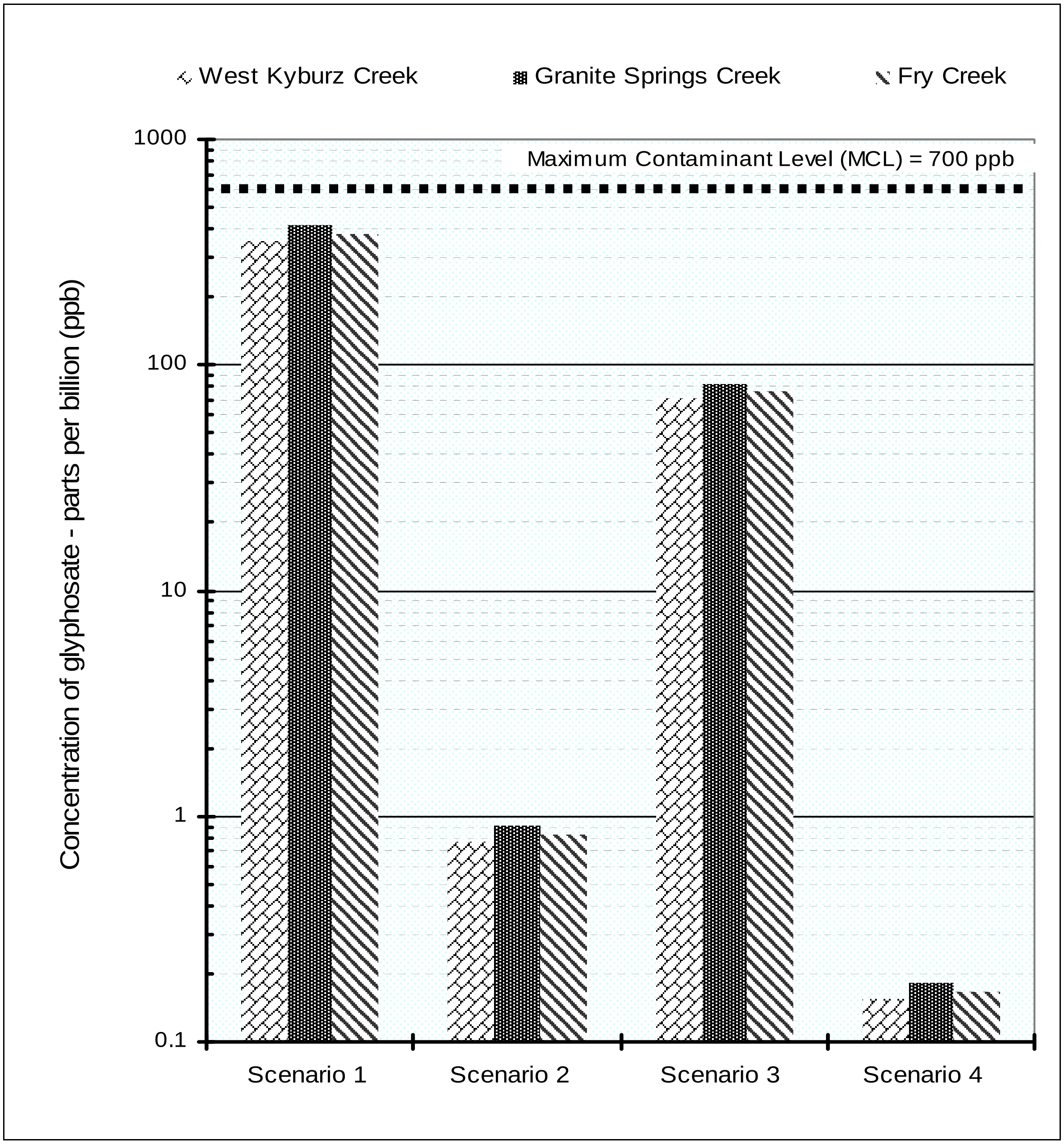
Herbicide monitoring results from over 1,100 water samples in Region 5 of the U.S. Forest Service since 1991 strongly suggests that the application of herbicides - when "no-spray" buffer widths are applied next to streams and other aquatic features - results in either no detection of herbicides in downstream surface water or concentrations far below that known to cause harm to humans (USDA 2001a; Frazier and Grant 2003). This conclusion is well supported for glyphosate, triclopyr, and hexazinone. This conclusion is less certain for clopyralid because of the small amount of monitoring data for that herbicide.

The majority of the areas that will be sprayed with herbicides will be sprayed with glyphosate. Glyphosate binds strongly to most soils types, is fairly non-mobile, and mostly decomposes to its natural components within six months. As a result, monitoring results over the past 15 years consistently show that glyphosate, when applied by ground application, seldom reaches surface water even with "no spray" buffer widths as narrow as 10 feet (USDA 2001a; Frazier and Grant 2003).

For all perennial streams in the project area that drain into the South Fork American River, the modeled concentration of glyphosate decreases to less than 1.0 ppb at a distance of 500 feet downstream of the herbicide application site (Figure 3-10). The South Fork American River ranges between 600 and 5,400 feet from all areas where glyphosate would be used.

[1] The assumptions in the modeling of triclopyr are: a.) 10 percent of the length of the stream that borders the herbicide unit is accidentally sprayed with triclopyr at the maximum application rate of 2.4 pounds/acre (i.e. the "no-spray" buffer widths next to streams are not completely implemented and occasional spraying of the stream surface does occur), and b.) the flow of the stream is 0.05 cubic feet per second.

Figure 3-18. Theoretical Concentration of Glyphosate of Three Perennial Streams.1



Distance downstream	0 **feet**	500 **feet**	0 **feet**	500 **feet**
Streamflow in cubic feet per second (cfs)	0.1	0.1	0.5	0.5

[1] It is assumed than 10 percent of the length of the streams that border herbicide Units is accidentally sprayed with glyphosate at the maximum application rate of 4.7 pounds/acre. The results for West and East Kyburz Creeks are nearly the same. The results for Fry Creek and a perennial tributary of Fry Creek are nearly the same.

The areas that would be sprayed with hexazinone and triclopyr are more than 1,000 feet from the nearest perennial stream and more than 5,000 feet from the South Fork American River. Chlorsulfuron will be applied at only one site - the nearest perennial and seasonal streams are more than 1,500 and 600 feet from the site, respectively.

The flow of the South Fork American River is usually at least one order of magnitude greater than the combined flow of all of the streams from the project area that drain into the South Fork American River. This means that the water quality of the streams that drain into the South Fork American River from the project area would likely have at most a minor effect on the water quality of the South Fork American River itself.

The treatment of invasive plants may introduce a small amount of glyphosate/surfactant into streams at a number of locations. The locations that have been identified thus far include: Fry Creek and two of its tributaries where they cross road 11N38; the unnamed stream draining from Granite Springs where it crosses road 11N38; and a short segment of a perennial tributary of Fry Creek upstream of road 11N38. Based on the existing monitoring results previously described, the likely concentrations of glyphosate in streams would be well below the MCL of 700 ug/L.

In terms of the amount of sediment delivered to streams during storm events and the resulting levels of turbidity and suspended sediment, increases are expected to be negligible or slight and do not pose a risk to the use of water as a drinking water supply. The reasons for this conclusion are discussed below under the heading **Sediment Delivery to Streams**.

Other Beneficial Uses of Water

Two of the beneficial uses of water - recreation and hydropower generation - are located on the South Fork American River outside of the project area. The beneficial uses of water for coldwater fisheries and wildlife are discussed in the sections of this document that pertain to those subjects.

Sediment Delivery to Streams

In the short-term (less than 10 years), there may be a negligible or slight increase in the amount of sediment delivered to streams during and immediately after storm events. All State standards for suspended sediment and turbidity - both narrative and numerical as listed in Appendix C - will be met. There are several reasons for these conclusions.

The total amount of ground disturbance near streams from tree planting and the use of herbicides will be small. It is estimated that roughly five to ten percent of the ground surface within the Riparian Conservation Areas (RCAs) of streams will be disturbed. The RCA is 300 feet on each side of perennial streams and 150 feet on each side of intermittent and ephemeral streams (USDA 2004b).

The ground disturbance in the RCAs will not be concentrated in a few large areas where surface runoff can accelerate and cause erosion that may result in an increase in the amount of sediment delivered to streams. In contrast, the ground disturbance from tree planting will be fairly evenly scattered in the form of many small 5 to 6-foot diameter areas – this will tend to minimize accelerated surface runoff which in turn should minimize the increase in the amount of sediment delivered to streams.

Within 100 feet on each side of perennial streams, live ground cover of 50 percent will be maintained through all release treatments.

Mastication equipment would not be allowed within 100 feet of perennial streams, springs, and meadows. Mastication equipment would not be allowed within 50 feet of intermittent and ephemeral streams.

The current amount of sediment delivered to streams during large storm events - which is high as discussed under the *Affected Environment* - would likely overshadow any slight increase in sediment delivery to streams that would result from Alternative 1.

In the long-term, the difference between the three alternatives is negligible. Once the use of herbicides (Alternative 1) or hand-grubbing around trees (Alternative 3) is completed, the amount of vegetation in disturbed areas will increase - this will minimize erosion and sediment delivery to streams.

The numerical amount of sediment that would be delivered to streams has not been calculated or modeled for several reasons.

Modeling of erosion has large margins of error. For example, the predicted erosion from the commonly used Watershed Erosion Prediction Project has at least a 50 percent error even if all of the input parameters are accurate (Elliot, et. al. 2000). In many cases, however, most or all of the input parameters are estimated because they are not accurately known. This means that the true error on the output from the model is unknown and cannot be accurately estimated.

Erosion models such as Watershed Erosion Prediction Project predict hillslope erosion and not the amount of sediment that will actually reach aquatic features. There are two major reasons for this. First, some or all of the factors that affect sediment delivery to streams may not be known and difficult to accurately estimate. Second, there can be great variability in the amount of sediment delivered to streams of similar characteristics from the same land disturbance.

Research has shown that the actual amount of eroded soil that is delivered to surface water is generally 2 to 10 percent of the erosion occurring in the watershed, and measured hillslope erosion rates do not imply that eroded soil is reaching a stream channel (Dissmeyer 2000).

Water Yield

Total water yield - which translates to a decrease in streamflow and the size of meadows - may decrease slightly faster under Alternative 1 (Proposed Action) than under Alternative 2 (no action) and Alternative 3 (no herbicides). This is because Alternative 1 (Proposed Action) is expected to accelerate the reforestation of the project area. Changes in water yield as a result of the rate of reforestation has been previously discussed under *Effects Common to All Alternatives.*

Watershed Recovery

In terms of restoring the forest, the recovery of watersheds is the slowest under Alternative 2 (No Action), slightly quicker under Alternative 3, and the quickest under Alternative 1 (Proposed Action). This is because Alternative 2 relies solely on the natural regeneration of conifers, Alternative 3 relies on natural regeneration + planting of conifers + hand release of conifers, and Alternative 1 (Proposed Action) relies on natural regeneration + planting of conifers + use of herbicides to reduce vegetation that competes with the survival of conifer seedlings.

Riparian Conservation Objectives

Alternatives 1 and 3 have been developed so as to meet all of the Riparian Conservation Objectives (RCOs) in the 2004 Sierra Nevada Forest Plant Amendment, Record of Decision (USDA 2004b). This is described in Appendix C, Hydrologic Information.

Alternative 2 (No Action) and Alternative 3

The effects are similar to Alternative 1 (Proposed Action), with the following exception: the concentration of herbicides in streams will be zero because no herbicides will be used under Alternatives 2 and 3.

Total water yield - which translates to a decrease in streamflow and the size of meadows - may decrease more slowly under Alternatives 2 and 3 than under Alternative 1 (Proposed Action). This is because Alternatives 2 and 3 will result in a slower regrowth of the forest in the project area than Alternative 1 (Proposed Action). Changes in water yield as a result of the rate of reforestation has been previously discussed under *Effects Common to All Alternatives.*

The risk of a large wildfire in the project area might be greater under Alternatives 2 and 3 than under Alternative 1 (Proposed Action). The potential effects of a large wildfire include a short-term (generally less than five years) degradation of water quality and aquatic habitat in the project area - this in turn can impair downstream beneficial uses of water. The severity and extent of such impacts from large wildfires is highly variable and depends on many factors; some large wildfires result in negligible impacts to water quality, aquatic habitat, and beneficial uses of water.

Cumulative Effects

Background

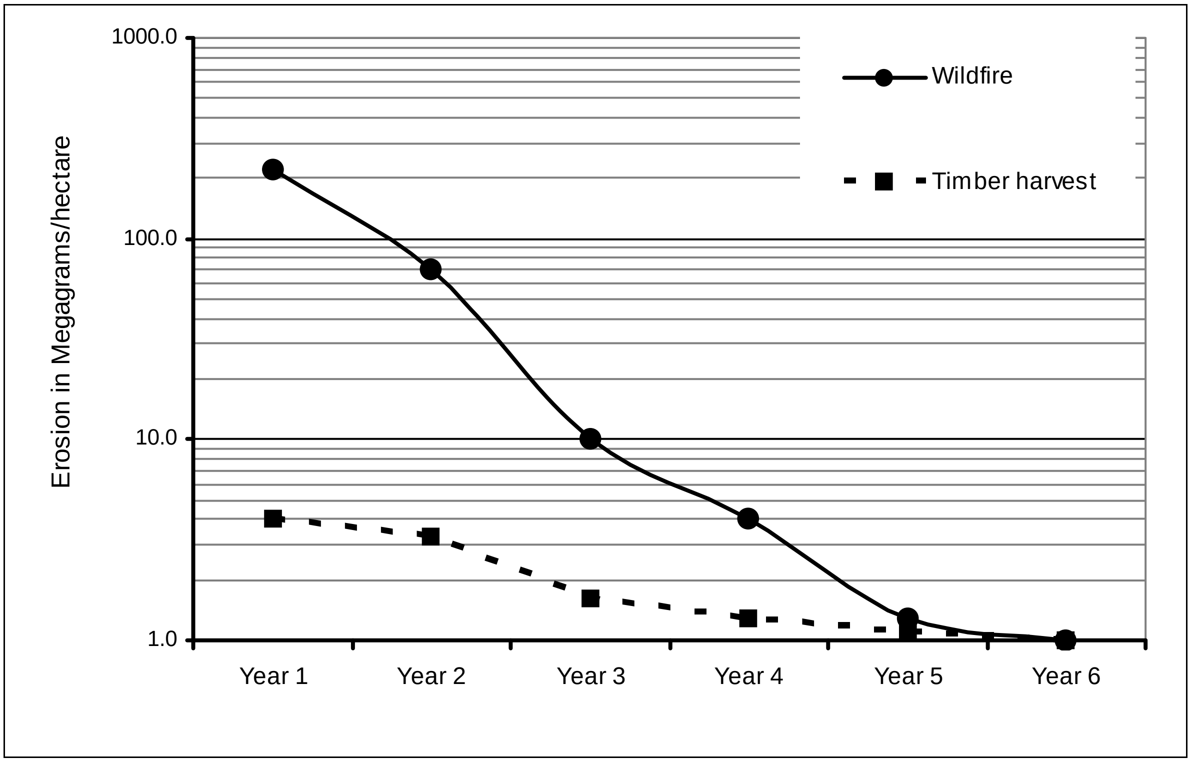
Cumulative watershed effects (CWE) considers all past, present, and likely future land disturbances in a given drainage area. In the ENF, the major potential cumulative watershed effect is the degradation of habitat for aquatic and riparian species. This can result when land disturbances - roads, timber harvest, wildfire, etc. - increase the amount of sediment delivered to aquatic features. The geographic scope of the analysis of cumulative effects includes the three 7th field watersheds that contain the Freds Fire Reforestation project. These 7th field watersheds are: South Fork American River - Kyburz, South Fork American River - Fry Creek, and Junction Reservoir. Most of the project area is contained in the first two watersheds (Figure 3-10).

Cumulative effects have occurred to some degree in all of the surveyed streams in the project area in the form of channel erosion and deposition of fine-grained material since October 2004; this is described in the *Affected Environment*. The two most likely causes of the stream channel degradation are two large recent land disturbances in the project area - the Freds Fire of 2004 and salvage logging in 2005. The research indicates that erosion rates are extremely high for several years following wildfires and then decline dramatically; erosion from timber harvest is less than from wildfires (Figure 3-19). Additional past timber harvest activities may also be a contributing factor to the current stream channel degradation in the project area.

Method

In the ENF, the risk of the occurrence of cumulative watershed effects (CWE) for each 7th field watershed is assigned to one of the following four categories: *low*, *moderate*, *high*, or *very high*. The assignment of the risk of CWE is based on a quantitative evaluation of the land disturbances in the watershed using the method of Equivalent Roaded Acres (ERA). A detailed explanation of the ERA method is contained in Appendix C.

Figure 3-19. Modeled Erosion Rates for a Wildfire and Timber Harvest in the Cascade Range of Western Oregon (Adapted from Elliot and Robichaud 2001).



Limitations

The ERA method, as well as a number of other methods that are commonly used to assess the risk of CWE, contain a number of limitations Most of the methods of analyzing Cumulative Watershed Effects assess the risk of CWE at the watershed scale.

The risk of degradation of habitat for aquatic and riparian is species assessed at the 7th field watershed scale. Most of the 7th field watersheds in the ENF are between 2,000 and 15,000 acres in size.

The risk of CWE at the 7th field watershed scale may or may not reflect the risk of CWE of an individual aquatic feature. For example, the risk of CWE of a watershed may be *low* or *moderate*, but the risk of CWE of a specific segment of a stream in the same watershed may be *very high* as a result of several types of disturbances next to that one stream segment.

The method cannot quantitatively predict the amount of sediment delivered to streams, the distance downstream that the sediment load will travel, or point in time and the duration when an increase in sediment delivery to aquatic features will occur. The reasons for this include the large variability in the magnitude of direct effects from a given land disturbance, inability to predict secondary or indirect effects, lack of data on recovery rates for land disturbances, difficulty of validating predictive models on-the-ground, and the uncertainty of future events such as the size and timing of large storms. As a result, an assessment of CWE is frequently reported as an indicator of the overall *risk* of cumulative effects occurring in a watershed (Reid 1993).

The magnitude or severity of CWE following land disturbance depends largely on an event that cannot be prevented and the exact timing of which cannot be accurately predicted. It is whether a “large storm event” occurs within several years after land disturbances when the ground surface is vulnerable to erosion. If a large storm event does not occur within several after the land disturbance, the CWE to aquatic features will be minor, negligible, or absent. As a result of the importance of large storm events in determining actual erosion, sediment delivery to streams, turbidity and suspended sediment levels of streams, the land disturbances themselves in the watersheds play only a partial role in the severity of impacts to aquatic resources.

The method is not a substitute for an on-the-ground evaluation of the condition of an aquatic feature. For example, a segment of a stream may be severely degraded on-the-ground in a watershed that is considered to be at a *moderate* risk of CWE. This can occur when severe disturbance, such a large number of skid trails and roads, are constructed next to one segment of a stream.

Results

A number of land disturbances have occurred or are expected to occur in the watersheds that contain the Freds Fire Reforestation Project.

A number of roads, both paved and unpaved, are present. Other miscellaneous impervious areas, such as buildings and parking lots, are also present.

The Freds Fire of October 2004 burned approximately 70 percent of the project area at a high and moderate severity.

Most of the areas burned at a high and moderate severity by the Freds Fire were salvage logging on both ENF and on private lands owned by Sierra Pacific Industries in 2005 and 2006.

Past timber harvest - prior to 2009 - has occurred on both private land and in the ENF.

The Silver Saddle Forest Health Project will occur in the Kyburz watershed on the south side of the South Fork American River. The Silver Saddle Forest Health Project will involve fuels reduction activities over a period of six years, starting in 2010.

The Freds Fire Reforestation Project would occur on approximately 3,320 acres of the ENF.

Sierra Pacific Industries will continue to use herbicides on private land to maintain timber stands that were planted in areas salvage logged in 2005. Approximately 1,000 acres of timber stands are being maintained with hexazinone and 1,526 acres with glyphosate.

The above land disturbances have resulted in the following conclusions concerning the risk of Cumulative Watershed Effects (CWE). The risk of CWE for each watershed is illustrated in Figure 3-20.

The Kyburz 7th field watershed will be at a *very high risk* of CWE in 2011 under Alternative 1 (Proposed Action). The risk of CWE is *high* under Alternatives 2 (No Action) and 3 (No use of herbicides).

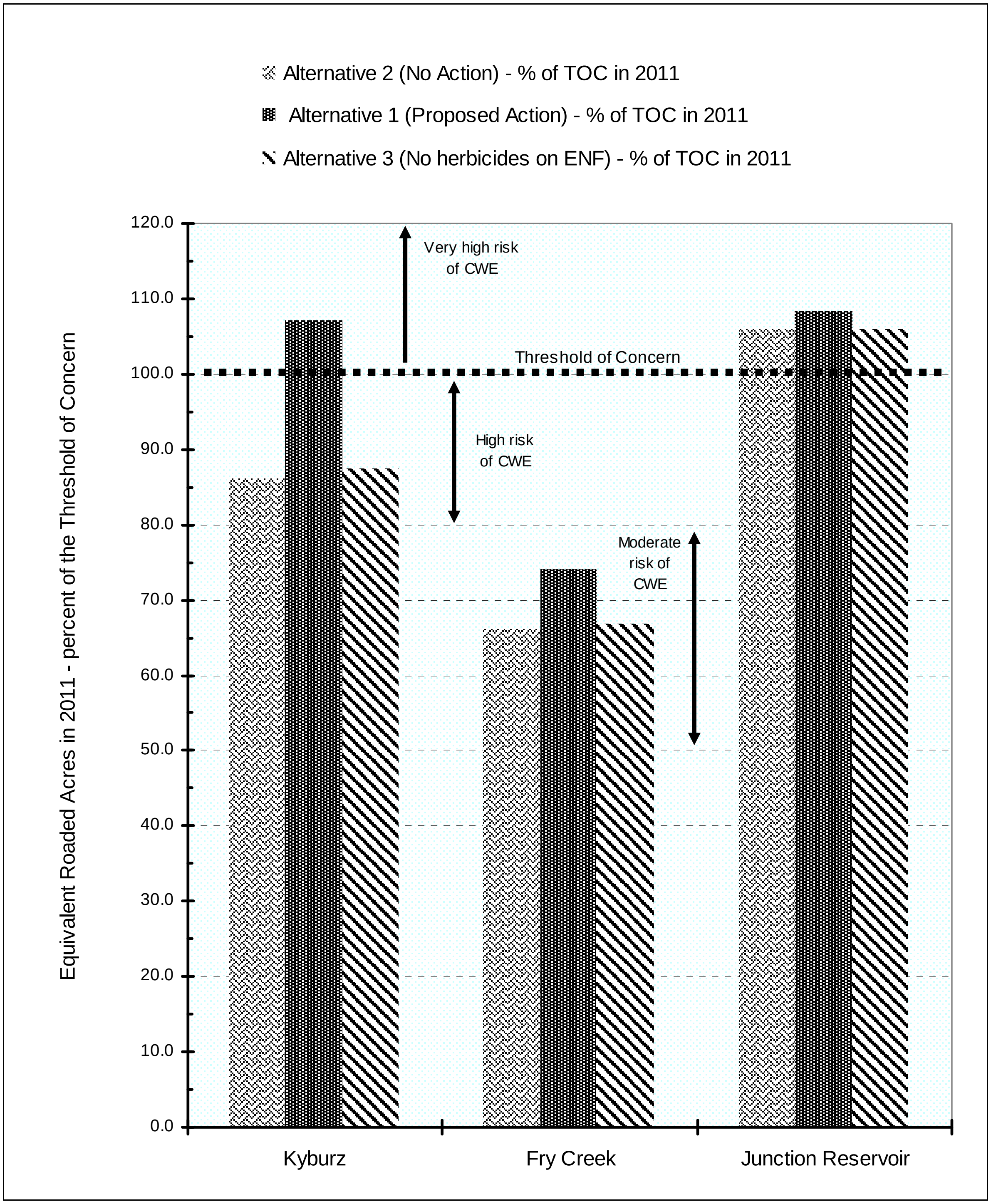
The Fry Creek 7th field watershed is at a *moderate risk* of CWE in 2011 under all alternatives.

The Junction Reservoir 7th field watershed is at a *very high risk* of CWE under all alternatives.

The risk of CWE is the same for 2010, 2011, and 2012 for all three watersheds. This is because the Equivalent Roaded Acres (ERA) for all three watersheds is similar for 2010 through 2012.

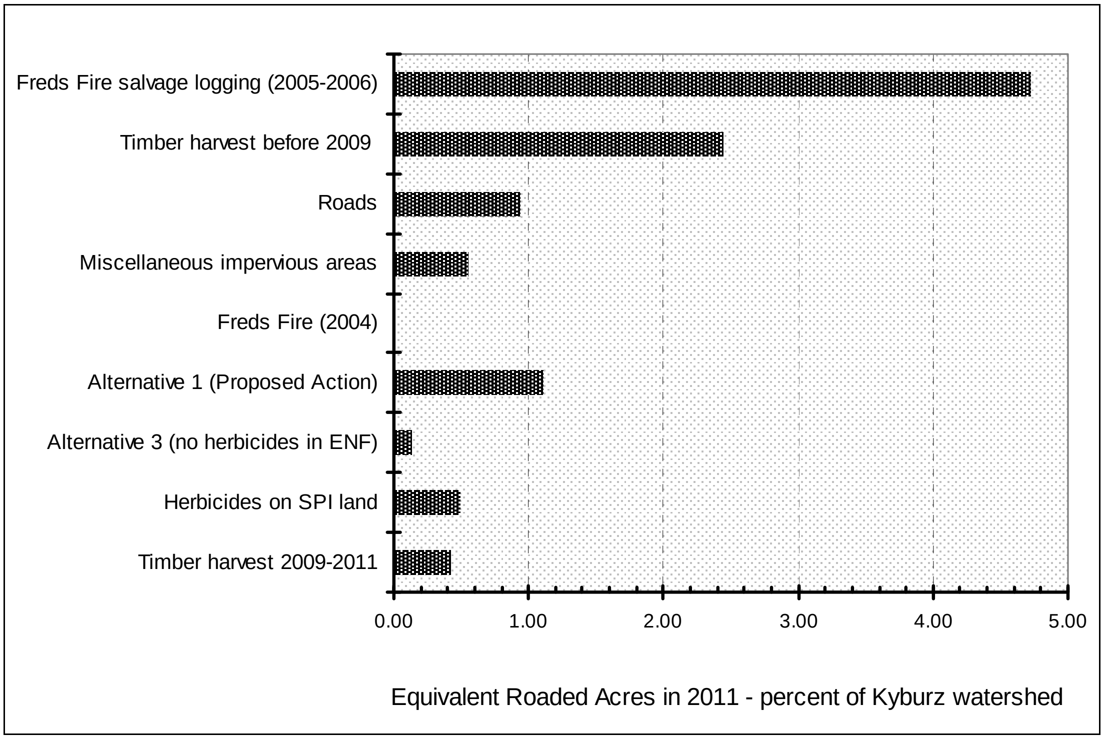
The risk of CWE for each watershed is largely the function of the salvage logging of the Freds Fire in 2005/2006, other past timber harvest, and roads. Alternative 1 (Proposed Action) is a small portion of the risk of CWE. This is illustrated in a comparison of the ERA generated from the individual land disturbances for each watershed (Figures 3-21 through 3-23).

Figure 3-20. Equivalent Roaded Acres (ERA) in 2011 – Expressed as Percent of the Threshold of Concern – for the Junction Reservoir, Fry Creek, and Kyburz Watersheds.



CWE = cumulative watershed effects. TOC = threshold of concern. The percent ERA displayed in this figure is similar in 2010 and 2012.

Figure 3-21. Land disturbances in the Kyburz watershed.



(ENF = Eldorado National Forest. SPI = Sierra Pacific Industries)

Figure 3-22. Land disturbances in the Fry Creek watershed.

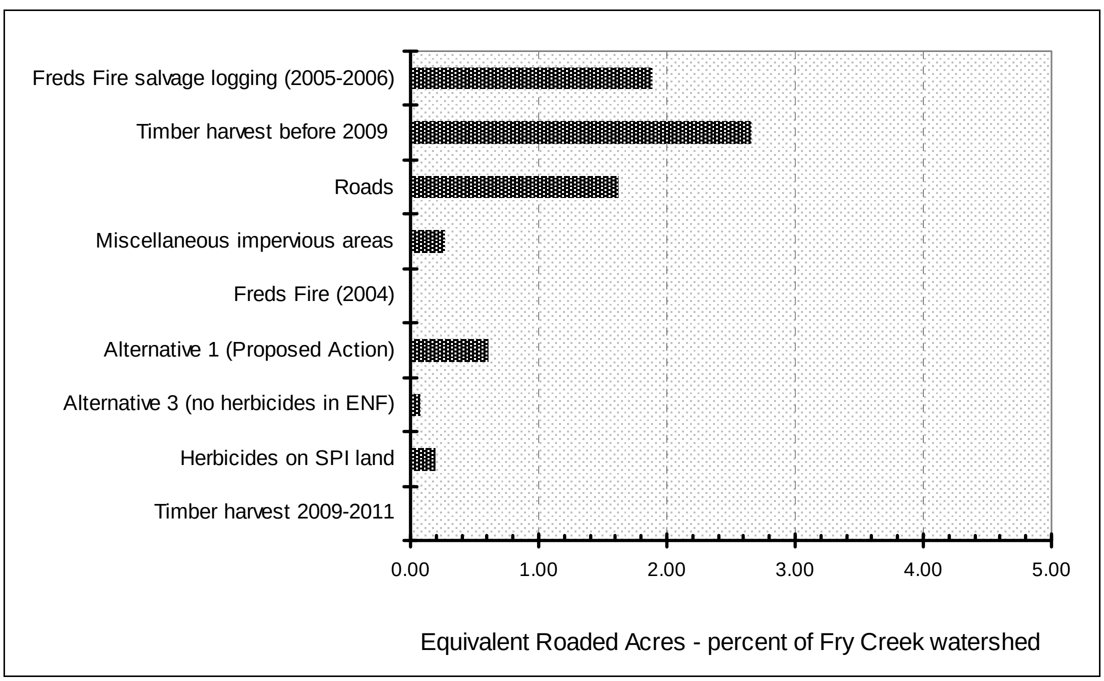
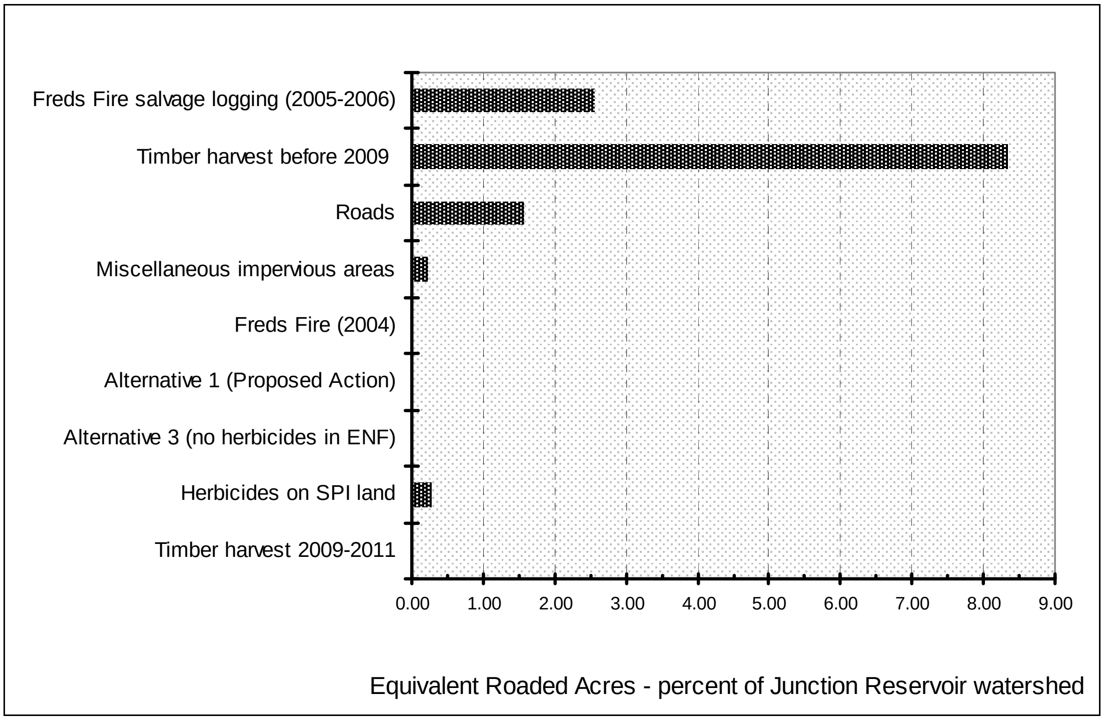


Figure 3-23. Land disturbances in the Junction Reservoir watershed.



Water quality - herbicides

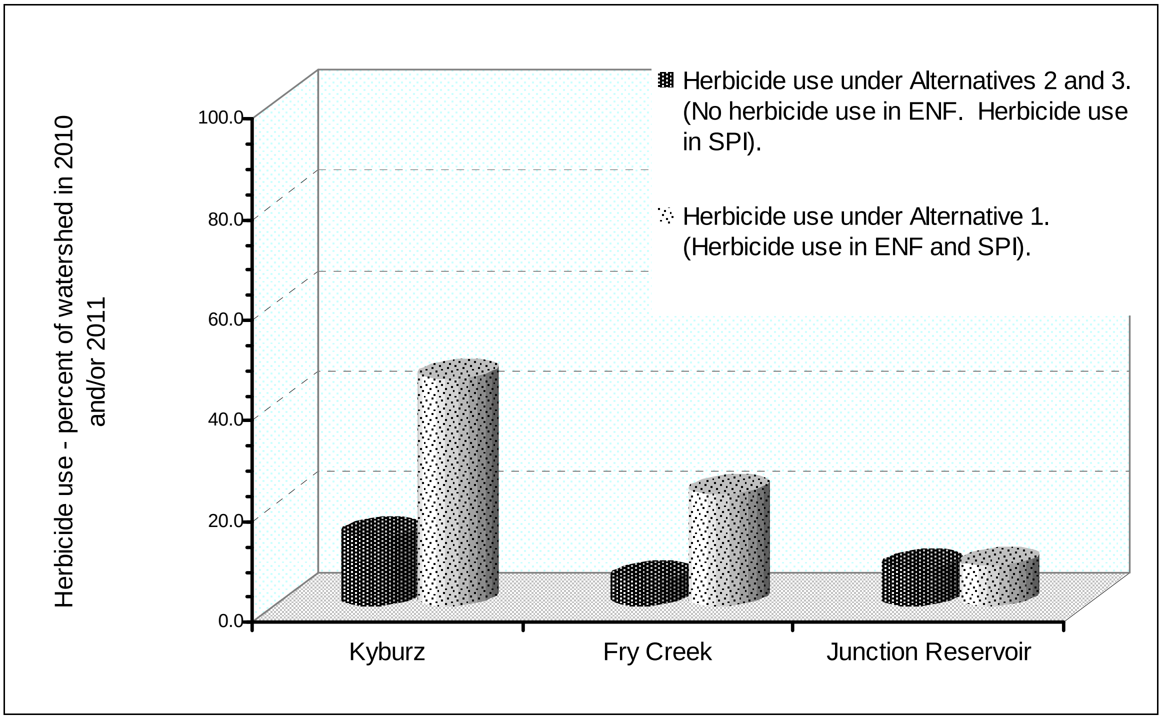
The analysis area for CWE (the 7th field watersheds of Kyburz, Fry Creek, and Junction Reservoir) contains private lands owned by Sierra Pacific Industries (SPI). Herbicides will be used on SPI land under all alternatives, and the SPI lands bordering the ENF.

Alternatives 2 (No Action) and 3 do not involve the use of herbicides in the ENF; therefore, cumulative impacts to water quality from the use of herbicides under those two alternatives will not occur. Cumulative impacts to water quality from herbicides are not expected under Alternative 1 (Proposed Action), despite the fact that the use of herbicides on lands owned by SPI increases the percent of the Kyburz and Fry Creek watersheds that will be sprayed with herbicides (Figure 3-24). There two reasons for this conclusion.

There will be "no spray" buffer widths of at least 50 feet next to live water on SPI land (Stapleton 2006). As a result, the risk of the contamination of surface water by herbicides on lands owned by SPI borders on negligible. The effectiveness of "no spray" buffer widths in protecting water quality has been previously described in detail in the section describing *Domestic Use of Water*.

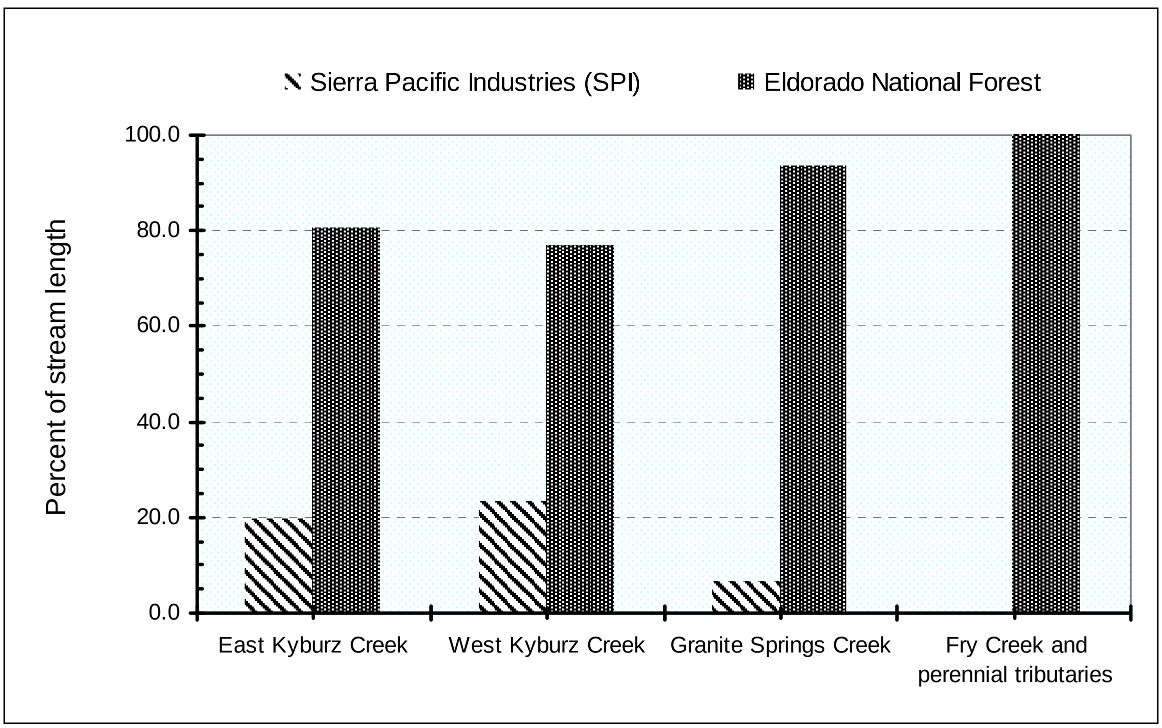
Lands owned by SPI border a small portion of the length of perennial streams in the project area. The ENF borders all of Fry Creek and much of Granite Springs Creek, East Kyburz Creek, and West Kyburz Creek (Figure 3-25).

Figure 3-24. Herbicide Use by Watershed for each Alternative in 2010 and/or 2011.



(ENF = Eldordo National Forest. SPI = private land owned by Sierra Pacific Industries).

Figure 3-25. Land Ownership Adjacent to Perennial Streams.



Aquatic Biology

Affected Environment

The elevation range of the Freds Fire area is approximately from 3,900 to 6,800 feet; the elevation range of the affected segment of the South Fork American River, immediately adjacent and south of the project area, is approximately 3,600 to 5,000 feet. Within the proposed project area, both perennial and seasonal streams can best be characterized as high gradient bolder and cobble controlled transport channels that have sand and gravel components. The predominant aquatic habitats are the perennial streams, including Fry Creek and two of its tributaries, two unnamed streams north of Twenty-nine Mile Guard Station that flow into one channel just north of Highway 50, East and West Kyburz Creeks, and two unnamed perennial streams north and east of Kyburz. Perennial stream within the project area all have gradients that exceed two percent. . Within the project area, south facing slopes are dominant; however, spur ridges generally tend to have a north-south orientation with east and west aspect. Similarly, most drainages tend to have a north-south orientation. Tables 3-25 and 3-26 provide a description of aquatic habitats.

Post-fire ecosystem recovery is directly linked to burn intensity, slope location (e.g. mid-slope vs. ridge top; convex vs. concave), anthropogenic disturbance (e.g., road building, salvage harvest), precipitation, and ground water discharge. In the vicinity of Fry Creek, the fire burned ridgetops and left riparian vegetation essentially unscathed. This vegetation is presently providing a high level of stream shading along many streams, affecting both water temperatures and primary production (Table 3-26).

The Freds Fire has also influenced ground water discharge rates. Throughout the fire area, springs have surfaced, sometimes creating, enhancing, and enlarging aquatic features. Vegetation in these aquatic features often includes willows, cattails, rushes, sedges, and horsetail (*Equisetum spp*.). Several landslide complexes exist within the project area that include large deep-seated landslides. Because of their size and depth (usually 30 feet and deeper), the role of vegetation in helping stabilize these features is minimal except along the margins of the slide mass where the landslide depth diminishes to 3 feet or less (Koler 2007). Water movement within these landslides varies; however, on August 25, 2006 a discharge rate of approximately 30 gallons per minute was measured on one landslide situated on an unnamed stream channel that was classified as an ephemeral stream prior to the fire (Figure 3-26).

The Granite Springs meadow/spring complex, a special aquatic feature that contains meadows and/or springs, covers 10.5 acres and was surveyed as part of Riparian Conservation Objective analysis. Small rills and some sheet erosion were noted upslope of the aquatic feature; however, lush riparian vegetation within the feature was providing soil stability. Three other meadow/spring complexes were mapped for inclusion in the overall analysis, including a 2.5 acre feature near Forest Road 11N42D and two meadow/spring complexes (3.6 acre and 0.25 acre) near the junction of Forest Roads 11N42 and 11N99. Anthropogenic disturbance in these meadows was greater than observed disturbance in the meadow selected for the Riparian Conservation Objective analysis; most notable was a diversion of streamflow in the perennial channel north of Forest Road 11N99 in the Granite Springs complex.

None of the streams in the project area are known to support fish. The fish species known to occur in the South Fork American River adjacent to and downstream of the project area are: Sacramento sucker (*Catostomus occidentalis*), riffle sculpin (*Cottus gulosus*), rainbow trout (*Oncorhynchus mykiss*), and brown trout (*Salmo trutta*). Hardhead (*Mylopharodon* conocephalus), a USDA Forest Service Sensitive Species, is not present in the project area but is known to occur 17 miles downstream of the project area in the South Fork American River below the Silver Creek confluence (FERC 2003).

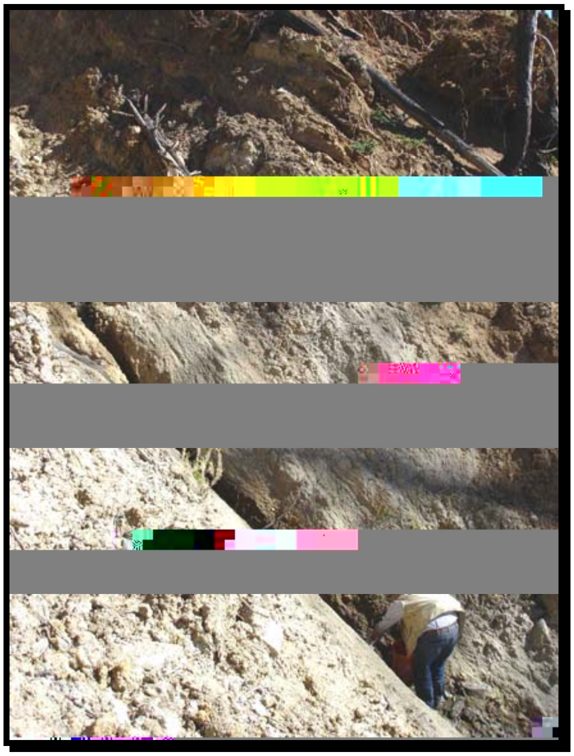


Figure 3-26. Measuring water discharge on an active landslide north of the confluence of the South Fork American River and the Silver Fork American River.

Forest Service Manual (FSM) 2672.42 directs that a biological assessment be prepared for all proposed projects that may have effects upon United States Fish and Wildlife Service listed threatened, endangered, and proposed species. This document is to ensure that project decisions do not adversely affect Federally listed species or result in the loss of species viability. FSM 2670.32 directs that a biological evaluation be prepared to determine project effects upon Forest Service designated sensitive species. This document is to ensure that project decisions do not create significant trends towards Federal listing for sensitive species. The Biological Assessment/ Biological Evaluation (BA/BE) for Aquatic species can be found in the Project file.

Pursuant to Section 7(c) of the Endangered Species Act of 1973 as amended, the US Fish and Wildlife Service is contacted to obtain a current list of threatened, endangered, proposed, and candidate species that may be present on the Eldorado National Forest. The most recent quarterly species list for the Eldorado National Forest was dated January 29, 2009 and obtained from the US Fish and Wildlife Service website (http://sacramento.fws.gov/es/spp_lists/NFFormPage.htm on March 3, 2009. Table 3-29 lists the threatened, endangered, or sensitive aquatic species that that may be present in Eldorado National Forest, their preferred habitats, and whether, based on the activities the project proposes, the species has the potential of being adversely affected by any activities of the proposed project. Species that may be affected by activities proposed by this project are shaded.

Table 3-29. Threatened, Endangered, or Sensitive Aquatic Species that may be Present in Eldorado National Forest

Species	TES Status	Elevation Range of Habitat	Preferred Habitat	Potential for Alternative 1 to Affect this Species
California red-legged frog and proposed critical habitat	threatened	Below 5,000 feet	Ponds and slow-moving streams	Although within the elevational range, it has been determined that regulated flows and spring releases from impoundments negate the potential for reproduction on the only low-gradient reaches found below 5,000 feet on the South Fork American River immediately downstream of the proposed project. The proposed units are not within critical habitat.
Central Valley spring-run Chinook salmon	threatened	N/A	Central Valley delta and up rivers to man-made and natural barriers	None. Design Criteria and BMPs will prevent adverse effects downstream.
Central Valley steelhead	threatened	N/A	Central Valley delta and up rivers to man-made and natural barriers	None. Design Criteria and BMPs will prevent adverse effects downstream.
delta smelt	threatened	N/A	Sacramento-San Joaquin delta	None. Design Criteria and BMPs will prevent adverse effects downstream.
foothill yellow-legged frog	FS sensitive	Below 6,000 feet	Low gradient streams with cobbles, riffles, and open areas	Suitable habitat exists within and immediately adjacent to the project area. Implementation of the Proposed Action may affect individuals but is not likely to result in a trend toward federal listing.
hardhead	FS sensitive	30-4,800 feet	Sacramento-San Joaquin delta, S. Fork American River	Design Criteria and BMPs will prevent adverse affects where they reside approximately 17 miles downstream.
Lahontan cutthroat trout	threatened	N/A	High elevation and east slope streams and lakes	None. No known populations have the potential to be affected by the proposed project.
Sierra Nevada yellow-legged frog	FS sensitive	Above 5,000 feet	High elevation low-gradient streams and small ponds	Suitable habitat exists within the project area. Design Criteria and BMPs will prevent adverse effects.
northern leopard frog	FS sensitive	From sea level-7,000 feet	Perennial streams and ponds	None. Incidental historical occurrence for this species on Forest at Riverton and off-Forest in the Lake Tahoe Basin.
western pond turtle	FS sensitive	Below 5,000 feet	Ponds and slow moving streams	Suitable habitat exists within the project area. Implementation of the Proposed Action may affect individuals but is not likely to result in a trend toward federal listing.
winter-run chinook salmon	endangered	N/A	Central Valley delta and up rivers to man-made and natural barriers	None. Design Criteria and BMPs will prevent adverse effects downstream.
Yosemite toad	FS sensitive	Above 6,400 feet	High elevation wetland areas and meadows	None. No known populations have the potential to be affected by the proposed project. Outside of species' known range.

California Red-legged Frog -Threatened

There has been an occurrence of this species adjacent to the ENF approximately 12.2 miles west-southwest of the Freds Fire Reforestation area in the North Fork Weber Creek drainage. Here, on

Bureau of Land Management land, egg masses and adults have been detected in Spivey Pond between 1998 and 2005. In addition, one female was detected in a pond on Ralston Ridge on the powerline transmission corridor, on June 18, 2001; this location is approximately 22.5 miles northeast of the project area.

There are no California Red-legged Frog Critical Habitat Units within the proposed Freds Fire Reforestation area. However, since the US Fish and Wildlife Service (2003a) defined suitable habitat for the California red-legged frog as low-gradient streams (two percent or less in gradient) below 5,000 foot in elevation, a GIS analysis of the Freds Fire Reforestation area for streams meeting that criteria was performed. That analysis indicated that the only perennial stream that met these criteria was the South Fork American River, immediately outside the project area.

Surveys for California red-legged frog habitat were conducted in 2002 and 2003 during the Sacramento Municipal Utility District's (SMUD) hydropower re-licensing process downstream of the project area on the South Fork American River in suitable habitat (SMUD 2004). The SMUD visual encounter survey effort focused on post-metamorphic frogs; egg mass and/or tadpole surveys were not conducted. No California red-legged frogs were observed.

California red-legged frog surveys were also c

Sierra Nevada Yellow-legged Frog

The Sierra Nevada yellow-legged frog is listed as a sensitive species for the ENF. In the Sierra Nevada, the Sierra Nevada yellow-legged frog (*Rana muscosa*) is found from approximately 5,000 feet to over 12,000 feet in elevation; the historic range of this species frog extends from Plumas County to Tulare County (Jennings and Hayes 1994). This frog is seldom far from water and prefers well illuminated, sloping banks of meadow streams, riverbanks, isolated pools, and lake borders with vegetation that are continuous to the water's edge (Martin 1992, Zeiner and others 1988). Sierra Nevada yellow-legged frogs have also been observed using a variety of habitats, including grassy streambanks, large boulders adjacent to deep stream pools, fallen trees extending into lakes, and along rocky lake shorelines adjacent to deeper water (Elliott pers. comm. 2000). Shallows along stream and lake margins are used by tadpoles to absorb heat to enhance metabolic rate (Jennings and Hayes 1994).

Approximately 2.4 miles of perennial stream is located in the Freds Fire area above 5,000 feet in elevation; approximately 1.4 miles of perennial stream above 5,000 feet is located on NFS lands which could potentially be Sierra Nevada yellow-legged frog. Four ponds are located within the fire area; however, they are all located on private lands.

ECORP Consulting Inc, (2002) performed an analysis of surveys performed by the California Department of Fish and Game in proximity of the proposed Freds Fire Restoration; ECORP was contracted by the El Dorado Irrigation District to survey for amphibians, including Sierra Nevada yellow-legged frogs, in the Project 184 area that included the South Fork American River and several of its tributaries. Both the ECORP analysis and an analysis of the Eldorado National Forest Herpetofauna GIS layer indicated that there no reported observations of Sierra Nevada yellow-legged frogs in the project area; however, there is a known population of Sierra Nevada yellow-legged frogs approximately 1.5 miles south of the project area along Middle Creek. First observed in 1993, more than 625 individuals in various life stages have been observed along this stream between the confluence of Silver Fork American River and the Forest Road 11N18 crossing.

Foothill Yellow-legged Frog

The foothill yellow-legged frog is listed as a sensitive species for the ENF. The foothill yellow-legged frog was common in the Sierra Nevada historically; thus, almost every Sierran creek below 6,000 foot elevation has the potential to be inhabited by this species. Within the Freds Fire area, there are 3.69 miles of perennial stream, all of which have gradients that exceed 2 percent in gradient. Within the analysis area that includes the South Fork American River from the Freds Fire area to its confluence with Silver Creek, approximately 13 miles of the 21 miles of the South Fork American River has gradients that are ≤ 2 percent; these lower gradient reaches would provide potentially suitable habitat for the foothill yellow-legged frog. The nearest known sighting of foothill yellow-legged frogs to the Freds Fire Project area was in the South Fork American River in 2002 approximately 5.4 miles downstream of the proposed project area; there have been several additional foothill yellow-legged frog sightings downstream of this observation.

ECORP Consulting, Inc. (2002, 2004) performed surveys in and adjacent to the proposed project; they were contracted by the El Dorado Irrigation District to survey for amphibians, including yellow-legged frogs, in the Project 184 area that included the South Fork American River and several of its tributaries. Twelve ECORP survey sites corresponded to the drainages adjacent to the proposed project; at four of these sites foothill yellow-legged frogs were observed (ECORP 2002, 2004). Foothill yellow-legged frog surveys were also conducted along the South Fork

American River by Garcia and Associates in 2005. Both survey results by site location and life stage observed are displayed in Table 3-30.

Table 3-30. ECORP Foothill Yellow-legged Frog Surveys along the South Fork American River between the Confluence of the South Fork American River with Silver Creek and Sand Flat Campground (ECORP 2002, 2004, Garcia and Associates 2005).

Location	Sightings? (Y/N)	Life stages – numbers observed			
		Adults	Juveniles	Larvae	Eggmasses
South Fork American River upstream of Silver Creek					
ECORP	Y	4	6	-	-
GANDA	Y	4	2	63	2
South Fork American River at old Blackbird Campground	Y	1	1	-	-
South Fork American River at Grays Canyon Creek	Y	2	-	2	-
South Fork American River at Pacific House	N	-	-	-	-
South Fork American River at Ogilby Creek					
ECORP	Y	-	7	-	-
GANDA	N	-	-	-	-
South Fork American River upstream of Ogilby Creek					
GANDA	Y	2	-	-	1
South Fork American River at 29-mile Guard Station	N	-	-	-	-
South Fork American River at Indian Creek Campground	N	-	-	-	-
South Fork American River upstream of Bull Creek	N	-	-	-	-
South Fork American River downstream of Alder Creek	N	-	-	-	-
South Fork American River upstream of Fry Creek	N	-	-	-	-
South Fork American River downstream of Carpenter Creek	N	-	-	-	-
South Fork American River upstream of Carpenter Creek	N	-	-	-	-
Totals		**13**	**16**	**65**	**3**

Note: All survey protocols and survey results can be found in the Fisheries Department located in the Supervisor's Office of the Eldorado National Forest.

Within the Freds Fire Reforestation Project, Fry Creek and its tributaries were surveyed during the 2004 field season by ENF fisheries personnel. No observations of foothill yellow-legged frogs were reported.

Western Pond Turtle

Western pond turtles are habitat generalists, occurring in a wide variety of permanent and intermittent aquatic habitats; however, they prefer to have pools nearby to escape from predators and basking sites such as large logs and boulders. Most populations currently exist in smaller streams, usually in montane environs. Habitat needs can be varied; western pond turtles are not restricted to any certain type of habitat and could potentially be found in most streams below

5,000 feet in elevation. Within the analysis area that includes the South Fork American River from the Freds Fire area to its confluence with Silver Creek, approximately 13 miles of the 21 miles of the South Fork American River has gradients that are ≤ 2 percent; these lower gradient reaches would have a higher probability of providing suitable habitat for the western pond turtle than the higher gradient bedrock-controlled stream reaches within the fire area. A GIS analysis of south and southwest facing slopes with a slope angle of 15 degrees or less, adjacent to perennial streamcourses, indicates that approximately 76 acres of nesting and overwintering habitat for western pond turtles exists in the proposed project area. Although the Federal Energy Regulatory Commission (FERC 2003, p. 136) analysis of the South Fork American River determined that "[the] gradient on the SFAR [South Fork American River] and tributaries is higher than that of optimum pond turtle habitat," one adult western pond turtle was observed 1.3 miles south of the project area along the Silver Fork American River in July 1993. No western pond turtles were observed during the special-status amphibian surveys conducted by ECORP (2002) for the hydroelectric re-licensing of the El Dorado Hydroelectric Project, FERC No. 184-065.

Environmental Consequences

The geographic scope of the direct, indirect, and cumulative effects analysis is confined to the streams and water channels within the watersheds affected by Freds Fire and the South Fork American River downstream of its confluence with Silver Creek (approximately 21 miles).

Effects of all Alternatives on California Red-legged Frog

Direct and Indirect Effects

The species and habitat account for California Red-legged Frog indicated that there were no streams within the proposed Freds Fire Reforestation area that contained the basic essential elements for long-term California red-legged frog occupancy, i.e., breeding and foraging habitat combined with dispersal habitat and associated upland habitat for forage, shelter, and water quality maintenance. The South Fork American River, immediately adjacent to the proposed project, was the only perennial low-gradient stream that could potentially be affected by the proposed project. California red-legged frogs would not be observed in a large riverine environment such as the South Fork American River according to the US Fish and Wildlife Service (2003a). Therefore, there would be no direct or indirect effects.

Cumulative Effects

There are no streams within the proposed Freds Fire Reforestation area that contained the basic essential elements for long-term California red-legged frog occupancy; therefore, there would be no cumulative effects.

Determination of Effects

Alternatives 1, 2, and 3 will not affect the California red-legged frog or its habitat.

Effects of all Alternatives on Sierra Nevada Yellow-legged Frog

Direct, Indirect and Cumulative Effects

The existing stream habitat for Sierra Nevada yellow-legged frogs within the project area is higher gradient than where these frogs are typically found. They would not be expected to be seen in these streams as they have never been observed in any streams nearby. Also, the stream habitat downstream in the South Fork American River is unsuitable for them to be residing there because of high winter flows and a generally larger river than they are usually found. Because they would not be expected to be residing there, none of the alternatives would cause effects to them or their habitat.

Determination of Effects

Project design criteria and Best Management practices will prevent adverse effects. Therefore, Alternatives 1, 2, and 3 would have no effect on the Sierra Nevada yellow-legged frog.

Alternative 1 (Proposed Action)

Effects common to all species

Direct and Indirect Effects

Potential direct and indirect effects to the aquatic system resulting from the implementation of Alternative 1 generally tend to fall into three primary categories:

Herpetofauna mortality due to crushing during tree planting (e.g., scalping) and fuels reduction activities (e.g., mastication).

Hillslope erosion due to removal of vegetation by herbicides.

Effects to herpetofauna populations and their aquatic habitats due to exposure of herbicides, surfactants, and dyes.

Effects from Planting and Fuels Reduction Activities

Given the paucity of past herpetofauna observations, the recent fire, and that most channels within the proposed project area are high gradient boulder and cobble controlled transport channels, it is not likely that populations of herpetofauna are present within the proposed project area. The foothill yellow-legged frog is highly aquatic and generally found within 33 feet of water, while the western pond turtle is not. Thus, the potential for herpetofauna mortality due to planting activities would be minimal and generally confined to western pond turtle individuals. Similarly, because of stream buffers, mortality from mastication activities would be limited to western pond turtles.

Hillslope Erosion due to Removal of Vegetation by Herbicides

As described in the Hydrology and Watershed Resources Section (Chapter 3), in the short-term (less than 10 years), there will likely be only a slight increase in sediment delivery to streams during and immediately after storm events because ground disturbance from tree planting and herbicide use will be small, ground disturbance within RCAs will not be concentrated in a few large areas where surface runoff can accelerate and cause erosion, and stream buffers are adequate for conifer release (hand or herbicide) and mastication equipment treatments.

Effects to Herpetofauna Populations and Aquatic Habitats from Exposure to Herbicides, Surfactants, and Dyes

Given the Resource Protection Measures for the aquatic features (Chapter 2), the main project action that would be a concern for aquatic and aquatic-dependent species is the direct or indirect effects to these species and their habitats from herbicide application. Herbicide treatments have the potential to affect the aquatic environment and aquatic/aquatic-dependent species through contamination, misapplication (directly to the water surface), spray drift, precipitation-related overland flow, a spill, and/or leaching or percolation into groundwater.

Two factors determine the degree of adverse affects of herbicide application on aquatic and aquatic-dependent species: 1) the likelihood that an organism would be exposed to toxic levels of the herbicide, and 2) the toxicity of the herbicide to an organism.

Exposure

Direct exposure: Direct exposure of aquatic species could occur from an accidental spill, through contamination of water from misapplication (directly to the water surface), or through direct application, spray drift, precipitation-related overland flow, and/or leaching or percolation into groundwater.

An accidental spill would constitute the greatest potential for an acute event. An accidental spill incident involving chemical transport, mixing, and storage would be very unlikely as procedures and requirements are designed to prevent such an event (BMP 5-10: Pesticide Spill Contingency Planning.) and have been shown to be effective. The likelihood of exposure from a herbicide spill is low due to BMP 5-10, which includes measures to reduce the risk of contamination of water by accidental spills.

Contamination of surface water and ground water would be minimized due to the width of the no spray/no plant buffer strips along streams and special aquatic features (Table 2-4), and by the implementation of BMP 5-13 (Controlling Pesticide Drift During Spray Applications), which includes 1) using ground application equipment; 2) ceasing application when weather parameters exceed label requirements, precipitation, or forecast of greater than a 70 percent chance of precipitation in the next 24 hours (except hexazinone); 3) requiring a relatively large droplet; 4) requiring low nozzle pressures; 5) requiring the spray nozzle be kept within 24 inches of vegetation being sprayed; and 6) requiring a pressure gauge or pressure regulator on the backpack sprayers.

Thus, the possibility of herbicide mobilization in ephemeral stream channels is for the most part reduced, being largely dependent on the herbicide and the proximity of the herbicide to water. Mobilization of herbicides would be dependent on a number of factors including juxtaposition of the unit relative to seasonal and perennial channels, the amount of rain, the flow of the stream, the chemical used, and soil type.

There are no known populations of foothill yellow-legged frog or western pond turtle in the project area. However, potentially suitable habitat for these species exists within the analysis area, which includes the South Fork American River. A known sighting of foothill yellow-legged frog was is the South Fork American River, 5.4 miles downstream of the project area. Given the paucity of past herpetofauna observations, the recent fire, and that most channels within the proposed project area are high gradient boulder and cobble controlled transport channels, it is not likely that populations of herpetofauna are present within the project area. Thus, the potential for direct exposure is low.

Food Supply: As algae are a source of food to tadpoles, exposure of algae to herbicides could indirectly affect tadpoles. Algae could be exposed to herbicides through contamination, misapplication (directly to the water surface), spray drift, precipitation-related overland flow, a spill, and/or leaching or percolation into groundwater. No herbicide buffers around aquatic features will reduce the risk of exposure. Spot applications of glyphosate to invasive plants have no buffer next to streams. Applications in these areas, totaling an estimated seven acres, would result in a greater risk of exposure to algae.

Habitat: Adjacent to several perennial streams terrestrial riparian plants are providing shade, regulating microclimates, and reducing water temperatures that create and enhance habitat complexity. Exposure of theses riparian habitats to herbicides has the potential to affect these habitats. With the no herbicide buffers around aquatic features employed for most herbicide treatments (Table 2-4), the integrity of the existing riparian condition should be maintained in the short-term (<25 years).

Toxicity

The direct adverse effects to an organism is dependent upon the toxicity of the chemical and the dose received. Factors influencing adverse effect include, but are not limited to, the likelihood of receiving a dose and the magnitude of dose (in terms of amount and duration). Magnitude of dose is responsible for acute, chronic, and subchronic toxicities.

Acute toxicity is a measure of a chemical’s effect based on a short exposure. Acute exposure is a contact with a chemical that occurs for only a short period of time. Acute exposure can occur at a lethal (inducing death) or sublethal level (inducing behavioral changes, i.e. decreased avoidance response). Acute toxicity is commonly reported as a time-concentration relationship, whereby a test organism is subjected to a given concentration of a substance over a period of time. A typical endpoint is the death of 50 percent of the test organisms (lethal concentration = LC_{50}).

An accidental spill would constitute the greatest potential for an acute event. An accidental spill incident involving chemical transport, mixing, and storage would be very unlikely as procedures and requirements are designed to prevent such an event, and have been shown to be effective. An accidental spill incident during application could also occur. Best Management Practices provide guidance for emergency spill procedures and are designed to minimize the magnitude of effect resulting from a spill

In chronic and subchronic toxicity, the organism is subjected to continuous or repeated exposures at lower concentrations over a longer period of time. The response of the organism to the chemical may be slight or delayed, with effect manifested over a range of temporal scales, including the life span of the individual to multiple generations. These exposures are most likely if chemical was present in ground water and subsequently entered surface flow, or if rain events created overland flow and mobilized residual herbicide from leaf surfaces or soil. Chronic and subchronic exposure can adversely affect individual growth or the function of certain organs and can have systemic effects with neurological, immunological, endocrine function, reproductive, teratogenic (birth defect), carcinogenic, and mutagenic implications

Potential roles of toxicants (Carey and Bryant 1995) include: a) affecting the susceptibility of herpetofauna young to disease; b) retarding growth and development of herpetofauna young; c) affecting the ability of larvae to avoid predation; d) affecting the development of physiological, morphological, or behavioral processes in a manner that subsequently impairs the ability of the young for future reproduction; and e) directly causing mortality of young. Additionally, recent research on Ranid frogs indicates that standard toxicology testing for certain pesticides may underestimate the power of pesticides when combined with other stressors such as predators (Renner 2004). However, these issues are not well understood, and more studies are needed before the roles of environmental xenobiotics in amphibian declines are fully understood.

A summary of the general chemical characteristics of the herbicides proposed for use indicates that, with the exception of triclopyr ester (BEE), these herbicides have a low toxicity rating for most aquatic species. In terms of these ratings, it should be noted that toxicity ratings are based on studies where one species often times serves as a benchmark for certain groups of similar organisms. However, in the case of some vertebrates, toxicity to a specific species could vary by life stage. In addition, different vertebrate species within the same genus can be affected differently by the same chemical concentrations and toxicity within a group of organisms (e.g. aquatic macroinvertebrates, algae and macrophytic biomass) generally varies by species. Thus, although the general toxicity rating for a specific herbicide may range from low toxicity to practically non-toxic, it doesn't necessarily mean that all aquatic species in that group (e.g., freshwater aquatic macrophytes, amphibians, etc.) will react in the same manner to the herbicide. Consequently, for species other than those studied, the toxicity ratings noted below should be viewed as general guidelines

Estimated exposure doses for aquatic species are based on the planned herbicide application rates for this project and are located in the project file. They follow the same methodology as the Site-Specific Human Health Risk Assessment (Appendix D). They are based on USDA (2003) and the SERA Risk Assessments.

To quantitatively characterize risk to aquatic species a hazard quotient was calculated. The quantitative risk characterization is expressed as the hazard quotient, which is the ratio of the estimated exposure doses to the NOEC, LC_{50}, EC_{50}, or some other an index of acceptable exposure. Tables 3-31 through 3-35 provide a summary of risk characterization for aquatic species. Worksheets are in the Project File.

Clopyralid

Application of clopyralid would be limited to scattered occurrences of yellow starthistle. Clopyralid is not as readily degraded as glyphosate. Clopyralid degradation is driven by microbial processes only; environmental factors that affect microbial activity, such as soil moisture and temperature, also affect the degradation of clopyralid. Clopyralid persisted in 95% of the soils less than 69 days, with a range of 8 to 250 days (19 soils tested) (DowElanco 1997). Clopyralid does not bind tightly to soil and thus would seem to have a high potential for leaching (SERA 2004b). While there is little doubt that clopyralid will leach under conditions that favor leaching—sandy soil, a sparse microbial population, and high rainfall, the potential for leaching or runoff is functionally reduced by the relatively rapid degradation of clopyralid in soil. A number of field lysimeter studies and a long-term field study indicate that leaching and subsequent contamination of ground water are likely to be minimal (SERA 2004b).

There is no data regarding the toxicity of clopyralid to amphibian species (SERA 2004b), therefore fish data will be used as a surrogate. Clopyralid has low toxicity to fish and invertebrates. For acute exposures of 96 hours, an acute LC_{50} value of 103.5 mg/L is used to characterize risk for trout (SERA 2004b). Prolonged 21-day LC_{50} for rainbow trout is 321 mg/L (DowElanco 1997). A standard chronic reproduction study on *Daphnia magna* reports an NOEC of 23.1 mg a.e./l (SERA 2004b), which is the value used in SERA to characterize longer term risk. Clopyralid appears to have a very low potential to cause any adverse effects in any aquatic species, although confidence in this risk characterization is reduced by the lack of chronic toxicity studies in fish (SERA 2004b). As some fish species may be more sensitive to clopyralid than daphnids, a lower chronic NOEC of 10 mg a.e./l is used to characterize long-term risk in sensitive fish (SERA 2004b).

Chronic exposure to low concentrations of herbicides over longer periods of time can cause "sublethal stress" which can lower the immune system of organisms and cause them to be more susceptible to changes in their environment (Cary 1993).

Technical grade clopyralid contains hexachlorobenzene and pentachlorobenzene as contaminants. Nominal or average concentrations of hexachlorobenzene and pentachlorobenzene are less than 2.5 ppm and 0.3 ppm, respectively. Hexachlorobenzene is ubiquitous and persistent in the environment. Virtually all individuals are exposed to hexachlorobenzene and virtually all individuals have detectable concentrations of hexachlorobenzene in their bodies (SERA 2004b).

Hexachlorobenzene is classified as a potential carcinogen by the U.S. EPA, and has shown carcinogenic activity in three mammalian species. Hexachlorobenzene may be readily absorbed across the skin and will bioconcentrate in fish (ATSDR 1998, SERA 2004b) and is very persistent in the environment. Although the amount of hexachlorobenzene in technical grade clopyralid is relatively low, the potential for a proportion of the exposure dose that might be absorbed, is higher than that for clopyralid itself (SERA 2004b). Because of the persistence of hexachlorobenzene, the possibility exists that it would remain in the soil and could be transferred to surface waters by rainfall in the autumn where it would be bound to sediments or bioconcentrated in aquatic organisms (ATSDR 1998).

The Site-Specific Risk Assessment worksheets for clopyralid for an application rate of 0.25 lbs/acre, shows modeling results with hazard quotients for fish as being 0.009 for a worst case scenario with an accidental spill. Any number under 1 is considered as being not a significant hazard. The highest hazard quotient at the Peak Estimated Environmental Concentration for sensitive fish is 0.0002. Amphibians were not included in the SERA risk assessment worksheets for clopyralid, and the risk assessment worksheet for hexachlorobenzene did not incorporate either fish or amphibians. In summary, the toxicity of clopyralid is very low, and the quantity of hexachlorobenzene in clopyralid is small. With buffers protecting areas with water, effects on frogs would not be expected.

In general, there is risk for clopyralid to adversely affect algae, which is food for tadpoles. Table 3-31 shows the hazard quotients for accidental spill and Estimated Environmental Concentration for algae, which is food for tadpoles. Both hazard quotients are below 1 and considered as not being a significant hazard.

Table 3-31. Summary of Hazard Quotients for Aquatic Species – Clopyralid

Summary of Concentration in Water						
		Concentrations (mg/L)				
	Scenario	Central	Lower	Upper		
	Accidental Spill	0.9084	0.9084	0.9084		
	Peak EEC	0.005	0.00125	0.0175		
	Longer-term EEC	0.00175	0.00025	0.00325		
Summary of Risk Characterizations at Highest Application Rate (0.25 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Fish						
Sensitive Species						
	Accidental Spill	9E-03	9E-03	9E-03	103	LC_{50}
	Peak EEC	5E-05	1E-05	2E-04	103	LC_{50}
	Longer-term EEC	2E-04	3E-05	3E-04	10	NOEC
Aquatic invertebrate						
	Accidental Spill	4E-02	4E-02	4E-02	23.1	NOEC
	Peak EEC	2E-04	5E-05	8E-04	23.1	NOEC
	Longer-term EEC	8E-05	1E-05	1E-04	23.1	NOEC
Macrophyte, aquatic						
	Accidental Spill	**9**	**9**	**9**	0.1	NOEC
	Peak EEC	5E-02	1E-02	0.2	0.1	NOEC
	Longer-term EEC	2E-02	3E-03	3E-02	0.1	NOEC
Algae						
Sensitive Species						
	Accidental Spill	0.1	0.1	0.1	6.9	EC_{50}
	Peak EEC	7E-04	2E-04	3E-03	6.9	EC_{50}
	Longer-term EEC	3E-04	4E-05	5E-04	6.9	EC_{50}

Glyphosate

Studies on the effects of glyphosate indicate there is a low toxicity to aquatic organisms (Bidwell and Gorrie 1995, USDA 1984). Glyphosate readily adheres to soil particles in the soil and water and would be quickly bound onto them and not likely to be in concentrations to adversely affect amphibians (Monsanto 1997). This adhesion quality and lack of mobility makes glyphosate the best herbicide to use for dry ephemeral drainages. When these drainages are rewet by rain at a later time after application, it is less likely for this herbicide to become re-suspended into the stream or into the groundwater.

A separate dose-response assessment for amphibians was not conducted in the SERA (2003a) risk assessment. Most of the available toxicity data suggest that amphibians are no more sensitive to glyphosate than fish. Data on herbicide toxicity for western pond turtles is lacking. Therefore, for the direct spray and contaminated vegetation scenarios, a small mammal is used as a surrogate species.

For longer term exposures to glyphosate, the most relevant study remains the life cycle toxicity studies done in fathead minnow. In this study, the NOEC was 25.7 mg/L. No effect on mortality or reproduction was observed at this concentration.

Sub-lethal studies on carp were conducted over 14-days of exposure to concentrations of 2.5, 5, 10 mg a.e./L. At 10 mg/L abnormal histopathologic changes were noted in the gills and liver. At 5 mg/L, abnormal histopathologic changes were noted only in the gills. These changes were accompanied by increased alkaline phosphatase activity. While these effects cannot be directly associated with potential longer term effects on fish populations, the histologic changes in the gills and liver would be classified as adverse. While it is conceivable, based on this study, that the some at least transient histopathologic effects could occur at the NOEC was 25.7 mg/L, in terms of the risk assessment, the life cycle NOEC of 25.7 mg/L remains the most appropriate basis for risk characterization (SERA 2003a).

The dose-response assessment for fish is substantially complicated by information indicating that some fish species such as salmonids (which includes native trout) are more sensitive to glyphosate than other species of fish and by information indicating that some surfactants are very toxic to fish and may substantially increase to the toxicity of glyphosate to fish. The SERA risk assessment (SERA 2003a) estimated a chronic NOEC of 2.57 mg/L for technical grade glyphosate in sensitive species of fish based on an observed NOEC value of 25.7 mg/L in tolerant species of fish. This is based on a relative potency method where acute effects to sensitive fish occurred at a dose that was 10 times lower than acute effects to more tolerant fish.

There is no scientific basis that glyphosate causes specific toxic effects on the nervous system, immune system, or endocrine function (SERA, 2002).

The Site-Specific Risk Assessment worksheets for glyphosate for an application rate of 4.8 lbs/acre (Table 3-32), shows modeling results with hazard quotients for fish as being 1.4 for a worst case scenario accidental spill. Any number over 1 is considered as being a significant hazard. An accidental spill could expose an aquatic organism to a possibly harmful dose of pesticides. The Site Specific Human Health Risk Assessment (Appendix D) described a spill scenario in a pond that resulted in a concentration of glyphosate of 14.4 mg/l. For juvenile frogs (*Crinia insignifera)* the 48-hour LC_{50} was 83.6 mg/l for glyphosate (Bidwell and Gorrie 1995). In a spill scenario, besides the chance of a spill occurring being very low, the dilution factor in a stream would result in low risk of direct effects to frogs.

The highest hazard quotient at the Peak Estimated Environmental Concentration for sensitive fish is 0.2. There are no risk quotients for algae, which is food for tadpoles. Based on the studies described in SERA (section 4.1.3.4 and Appendix 11) they conclude that (Page 4-41) “glyphosate appears to be about equally toxic to both algae and macrophytes.” The Hazard Quotient for aquatic macrophytes is: 5 for spill, 0-0.6 for peak EEC, 0.0002-0.01 for longer term EEC.

Table 3-32. Summary of Hazard Quotients for Aquatic Species – Glyphosate

Summary of Concentration in Water						
		Concentrations (mg/L)				
	Scenario	Central	Lower	Upper		
	Accidental Spill	14.383	14.383	14.383		
	Peak EEC	0.096	0	1.92		
	Longer-term EEC	0.0048	0.00048	0.0384		
Summary of Risk Characterizations at Highest Application Rate (4.8 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Fish						
Sensitive Species						
	Accidental Spill	**1.4**	**1.4**	**1.4**	10	LC_{50}
	Peak EEC	1E-02	0	0.2	10	LC_{50}
	Longer-term EEC	2E-03	2E-04	1E-02	2.57	NOEC
Aquatic invertebrate						
	Accidental Spill	2E-02	2E-02	2E-02	780	LC_{50}
	Peak EEC	1E-04	0	2E-03	780	LC_{50}
	Longer-term EEC	1E-04	1E-05	8E-04	50	NOEC
Macrophyte, aquatic						
	Accidental Spill	**5**	**5**	**5**	3	NOEC
	Peak EEC	3E-02	0	0.6	3	NOEC
	Longer-term EEC	2E-03	2E-04	1E-02	3	NOEC
Small Mammal						
	Direct Spray - 100 percent Absorption	0.7	0.7	0.7	175	NOAEL
	Direct Spray - First Order Absorption	7E-03	2E-03	2E-02	175	NOAEL

Hexazinone

Hexazinone would be applied on units 609-036, 038, 039, and 040. One ephemeral stream is located within 100 feet of units 609-036, 038, 39; unit 609-040 has a short segment of another ephemeral stream running through it and has another ephemeral stream immediately adjacent to its eastern boundary. As noted in Table 2-4, hexazinone would not be applied within 100 feet of these channels.

Since hexazinone is relatively mobile and can persist in ground water for years, there is a fairly high potential for off-site movement (Frazier and Grant 2003). Surface water monitoring results from the ENF for 1991 and 1992 indicated there was surface water contamination from spring snowmelt runoff with hexazinone concentrations ranging from 1.1-15.0 ppb (USDA 2001a). These monitoring efforts also indicated hexazinone could be detected more than five years after application at levels up to 1.0 ppb. Hexazinone is considered practically non-toxic to fish and amphibians. However, it is slightly toxic to some crustaceans, and toxic to certain algae and photoplankton at low concentrations. Thus, there is potential for chronic effects from hexazinone.

Based on the water monitoring data from the ENF studies, potential for surface water contamination and the expected concentrations of hexazinone, any direct or indirect affects would likely include effects to algae and amphibian larvae such as tadpoles who feed on algae. The risk characterization for amphibians is severely limited by the lack of data on the toxicity of hexazinone to amphibians. A concentration of 100 mg/L has been reported to cause transient reduced avoidance in newly hatched tadpoles (Berrill et al. 1994 in SERA 2005). This is essentially the only relevant information that is available on the toxicity of hexazinone to amphibians.

Based on 96-hour NOEC values, there is relatively little difference in sensitivity among fish species. The lowest and highest acute NOEC values come from the study by Sleight (1973 in SERA 2005): 160 mg/L for fathead minnows and 370 mg/L for trout. A single egg-and-fry study in fathead minnows (Pierson 1990a in SERA 2005) defines a NOEC of 17 mg/L. A much greater range of sensitivities is apparent in aquatic invertebrates than in fish. Based on standard acute (48 hour) bioassays, the most sensitive species is *Daphnia magna* with an NOEC of 20.5 mg/L .

The Site-Specific Risk Assessment worksheets for hexazinone at an application rate of 3 lbs/acre (Table 3-33), shows hazard quotients for fish as being 0.2 for a worst case scenario with an accidental spill. The highest hazard quotient for fish under the highest dose without stream buffers at the 3 lbs/acre application rate is 0.008. There is no data on amphibians in the risk assessment worksheets, therefore fish shall be used as a proxy. For algae at an application rate of 3 lbs/acre, shows hazard quotients of 9,072 for a worst case scenario with an accidental spill. The highest hazard quotient for algae under the highest dose without stream buffers at the 3 lbs/acre application rate is 300. The hazard quotient for the longer-term environmental effect concentration for algae is 53. Thus, if hexazinone reaches the streams in sufficient quantities, there are likely to be effects to algae growth, which is food for tadpoles. The NOEC for sensitive algae is 4 ppb. About 85 percent of 574 samples water monitoring samples for hexazinone in USFS Region 5 were below 4 ppb (USDA 2001a). Very wide stream buffers (Table 2-4) and the location of hexazinone application, over 1,000 feet from the nearest intermittent or perennial stream, reduces the risk that hexazinone would be present in streams at a level that would adversely effect algae.

Table 3-33. Summary of Hazard Quotients for Aquatic Species – Hexazinone

Summary of Concentration in Water						
		Concentrations (mg/L)				
	Scenario	Central	Lower	Upper		
	Accidental Spill	18.144	7.2576	36.288		
	Peak EEC	0.015	0.009	0.3		
	Longer-term EEC	0.06	0.00003	0.21		
Summary of Risk Characterizations at Highest Application Rate (3.0 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Fish						
Sensitive Species						
	Accidental Spill	0.1	5E-02	0.2	160	NOEC
	Peak EEC	9E-05	6E-05	2E-03	160	NOEC
	Longer-term EEC	4E-03	2E-06	1E-02	17	NOEC
Aquatic invertebrate						
Sensitive Species						
	Accidental Spill	0.9	0.4	**1.8**	20.5	NOEC
	Peak EEC	7E-04	4E-04	1E-02	20.5	NOEC
	Longer-term EEC	6E-03	3E-06	2E-02	10	NOEC
Macrophyte, aquatic						
	Accidental Spill	**1,512**	**605**	**3,024**	0.012	NOEC
	Peak EEC	**1.3**	0.8	**25**	0.012	NOEC
	Longer-term EEC	**5**	3E-03	**18**	0.012	NOEC
Algae						
Sensitive Species						
	Accidental Spill	**4,536**	**1,814**	**9,072**	0.004	NOEC
	Peak EEC	**4**	**2**	**75**	0.004	NOEC
	Longer-term EEC	**15**	8E-03	**53**	0.004	NOEC

Triclopyr

Triclopyr BEE would be used in stands 609-010 and 609-034. One formulation of triclopyr BEE (Garlon 4) has been observed to cause behavioral (neurological) changes that may affect survivability in frog tadpoles when exposed to ¼ to ½ of lethal levels. This acute toxic level (LC_{50}) for tadpoles is greater than 1.2 ppm. (Berrill et al. 1994). Triclopyr BEE, which is more toxic to aquatic organisms than triclopyr acid, degrades in less than 1 day into the acid form of triclopyr. The half-life of triclopyr (acid form) is less than 2 days, and usually cannot be detected after 7 days. There is no scientific basis for asserting that triclopyr causes specific toxic effects on the nervous system, immune system, or endocrine function (SERA, 2002).

In a review of forest water quality monitoring region-wide from 1991 to 1999 (USDA 2001a), a few positive detections occurred from normal applications. All were at low levels (highest 2.4

ppb) and below any aquatic levels of concern according to SERA (2003c) and US EPA (1998). The width of stream buffers used when 2.4 ppb was detected was only ten to fifteen feet. The detection that resulted in the highest level of triclopyr (82 ppb) was the result of an absence of buffers on an ephemeral stream.

The Site-Specific Risk Assessment worksheets for an application rate of 2.4 lbs/acre (Table 3-34) shows hazard quotients for fish as being 29 for a worst case scenario with an accidental spill. The highest hazard quotient for fish under the highest dose without stream buffers at the 2.4 lbs/acre application rate is 4. There is no data on amphibians in the risk assessment worksheets, therefore fish shall be used as a proxy.

To reduce the risk that triclopyr would reach streams at levels that would result in effects to aquatic organisms, stream buffer were used in the project design. Region 5 monitoring results show that employing untreated buffers on streams reduces the rate of water contamination to near zero. One ephemeral stream runs through unit 609-10; the nearest perennial stream is over 3,000 feet south of the stand. One seasonal stream is located approximately 100 feet west of stand 609-034. This stream transitions to a perennial steam approximately 2,000 feet south of the stand. Using these buffers for triclopyr, the expected contamination is expected to be at or below that found in past water monitoring. Such a level of water contamination with triclopyr would represent a low risk of adverse effects to fish and amphibians.

TCP is a major metabolite of triclopyr and is found in both soil and water. TCP is substantially more toxic in fish than either triclopyr acid or triclopyr TEA, with acute LC_{50} values in the range of about 2 to 10 ppm, similar to the toxicity of triclopyr BEE. One longer term study, an early life-stage study in rainbow trout had a NOAEL of 0.0808 mg/L. The most sensitive endpoint involved growth – i.e., length and weight. For assessing the acute hazards of exposure to TCP, the lowest acute LC_{50} value (1.8 ppm from a Coho salmon study) is used. For longer term exposures, the early life-stage study in rainbow trout is used, with a NOEC of 0.0808 mg/L.

The risk characterization for TCP is considered quantitatively only for fish because toxicity data are available only for fish (SERA 2003b 2003c). For applications of triclopyr alone at a rate of 1 lb/acre, the highest peak concentration modeled using GLEAMS is about 0.011 ppm (on a small stream at rainfall rates of 150 to 200 inches per year) and the highest longer term average concentration is about 0.0005 ppm (on a small stream at rainfall rates of 100 to 250 inches per year). The worst case hazard quotients are about 0.006 for both short-term and long-term exposures. At the highest application rate proposed on this project (2.4 lbs/acre) hazard quotients for TCP would be 2.4 times higher (HQ = 0.015), below the level of concern by a factor of 65 (1/0.015 = 66.67). The use of chlorpyrifos in the same area would not increase exposure to TCP to concentrations that are anticipated to be toxic (SERA 2003b).

Table 3-34. Summary of Hazard Quotients for Aquatic Species – Triclopyr

Summary of Concentration in Water-Triclopyr						
		Concentrations (mg/L)				
	Scenario	Central	Lower	Upper		
	Accidental Spill	7.2672	7.2672	7.2672		
	Peak EEC	0.0072	0	0.96		
	Longer-term EEC	0.072	0.0192	0.12		
Summary of Risk Characterizations at Highest Application Rate (2.4 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Fish						
	Accidental Spill	**29**	**29**	**29**	0.25	LC_{50}
	Peak EEC	0.03	0	**4**	0.25	LC_{50}
	Longer-term EEC	7E-04	2E-04	1E-03	104	NOEC
Aquatic invertebrate						
	Accidental Spill	0.8	0.8	0.8	8.55	LC_{50}
	Peak EEC	8E-04	0	0.1	8.55	LC_{50}
	Longer-term EEC	9E-04	2E-04	1E-03	80.7	NOEC
Macrophyte, aquatic						
	Accidental Spill	**104**	**104**	**104**	0.07	NOEC
	Peak EEC	0.1	0	**14**	0.07	NOEC
	Longer-term EEC	**1.0**	0.3	**1.7**	0.07	NOEC
Algae						
	Accidental Spill	**104**	**104**	**104**	0.07	NOEC
	Peak EEC	0.1	0	**14**	0.07	NOEC
	Longer-term EEC	**1.0**	0.3	**1.7**	0.07	NOEC

Chlorsulfuron

The Site-Specific Risk Assessment worksheets for an application rate of 3 ounces/acre shows only algae and aquatic macrophytes with hazard quotients exceeding 1. This occurs in the event of a spill and at peak EEC. These hazard quotients assume no buffer. However, the small acreage and the infestations' location, at least 1,500 feet from the nearest perennial and 600 feet from the nearest seasonal stream, reduces the risk that chlorsulfuron would reach a stream at levels to produce adverse effects to algae.

Surfactants and Dyes

Surfactants proposed for use in the Freds Fire Reforestation Project include nonylphenol polyethoxylate based (NPE) surfactants, methylated seed oil (MSO) based surfactants, and a silicone/modified vegetable oil blend.

NPE-based Surfactants (USDA 2003a)

The primary active ingredient in the NPE surfactant proposed for use is a component known as nonylphenol polyethoxylate (NPE). NP9E, the most common NPE used in surfactants for pesticide is a mixture that has, as a majority, 8-10 ethoxylate groups attached (NP9E is a standard shorthand for a NPE with an average of 9 ethoxylate groups (USDA 2003a)). An average of 8-10 ethoxylate groups makes these surfactants highly water-soluble. NPE surfactants may contain small amounts of un-reacted nonylphenol from the production process. Nonylphenol (NP) is a material recognized as hazardous by the U.S. EPA (currently on U.S. EPA's inerts list 2). Both NP and NPE exhibit estrogen-like properties, although they are much weaker than the natural estrogen estradiol.

In the forested environment, very little NP would be expected to arise in the environment as a result of the application of NPE, and what little NP might arise would be largely bound to soil or sediments and remain immobile while being biodegraded through microbial action. The more likely compounds to be formed in a forested environment would be the short chain carboxylates. Based on this pattern of breakdown, the compounds of concern are the short-chain carboxylates (NP1EC, NP2EC), rather than NPE, NP or the short-chain ethoxylates. NP1EC and NP2EC would remain in an aqueous state until they too are ultimately broken down.

Although NP is of higher toxicity to aquatic organisms than NPE or NPEC, there is sufficient information in the literature to make the assumption that in a forested environment, contamination of surface water is more likely to involve NPE in the short-term and short-chain carboxylates (NP1EC, NP2EC) in the longer-term. As such, indicators of risk will be based upon these two compounds, not NP.

Toxicity to Aquatic Organisms

Lapurga (1996, in SERA 1997c) describes studies of the aquatic toxicity of R-11®. The acute 96-hour LC_{50} (nominal concentration, static exposure conditions) in juvenile Bluegill sunfish (*Lepomis macrochirus*) was 4.2 mg/L, and in juvenile Rainbow trout (*Oncorhynchus mykiss*), 3.8 mg/L. The acute 48-hour LC_{50} in *Daphnia magna* was 19 mg/L.

Trumbo (2002, in SERA 2003a) reported the application of Rodeo® (1.5%) and the surfactant R-11® (0.5%) to three sites for the control of purple loosestrife. Water samples were collected from water near the application. At one site, glyphosate was monitored at 0.85 mg/L and the surfactant was monitored at 0.4 mg NPE/L and 0.0125 mg/L. When fathead minnows were exposed to this water in the laboratory, 30% mortality was noted after 96 hours and this mortality was significantly ($p<0.05$) greater than control mortality. As discussed by Trumbo (2002, in SERA 2003a), it is unlikely that the mortality was associated directly with glyphosate but the 96-hour LC_{50} for R-11 is about 4 mg/L or one-tenth of the monitored concentration of NPE and it is likely that the mortality was attributable to the surfactant.

A 96-hour toxicity test with the Rodeo®/R-11® mixture using Rana pipiens produced LC_{50} values of 6.5 mg/L for glyphosate and 1.7 mg/L for NPE, indicating that the mixture is moderately toxic to amphibians (Trumbo 2005). A comparison of toxic units for the herbicide and surfactant in the mixture indicated that the toxicity to larval frogs was likely due to R-11® and not Rodeo®.

A review of USDA 2003 showed that various NPEs have been acutely tested in on fish, aquatic invertebrates, and aquatic plants. To assess risk, the following values were used in USDA, 2003, and this risk assessment:

Dose-Response Assessment for Acute Exposures – NPE

Fish - 1,000 ppb, based on the aquatic acute no-effect level, is the 7-day NOEC (growth) for minnows (Dorn et al, 1993; Staples et al 1998, in USDA, 2003). This value will be used, with the assumption that acute toxicity tests involving NP9E includes a small percentage of the short-chain ethoxylates, as well as small amounts of NP.

Aquatic invertebrates – 10 mg/L, based on the 7-day NOEC of NP9E for *Daphnia* spp. (Dorn et al, 1993, in USDA, 2003) will be used for acute exposures

Aquatic plants – 8 mg/L based on the 96-hour NOEC (growth) of NP9E for green algae (Dorn et al 1993; Naylor 1995, in USDA, 2003.

Dose-Response Assessment for Chronic Exposures – NP1EC, NP2EC

Fish - 100 ppb, based on the NOEC of 1,000 ppb in fathead minnows. This value is divided an interspecies factor of 10.

Aquatic invertebrates – 0.024 mg/L, based on a 21-day NP NOEC for *Daphnia magna.* NP was used because no testing has been done using NP1EC-NP2EC.

Aquatic plants – The acute value of 8 mg/L will be used because there are no chronic exposure studies for aquatic plants.

Based on the limited data it appears that frogs are similar or somewhat less sensitive than fish species. Levels of exposure that result in low levels of risk to fish should, therefore, also be similarly protective of frogs.

Risk Characterization – For normal operations, none of the exposure scenarios approach a level of concern to aquatic organisms (Table 3-35). The highest hazard quotient (0.58) results from the chronic exposure to aquatic invertebrates at the upper level of exposure. These upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially.

A risk assessment for the NPE surfactant or overspray onto still water and a spill into a pond was analyzed in USDA (2003a). The overspray scenario could result in instantaneous highest concentration of 1.5 ppm NP9E (range 0.15 to 4.9 ppm), while the spill scenario would result in levels of NP9E of 6.1 ppm. This surfactant shall be used when there is a stream buffer included.

Both the overspray and the spill scenarios involve levels of NP9E that could represent a risk of toxic effects. The overspray scenario exceeds the acute NP9E threshold for fish by a factor of 1.5 (typical rate), up to a factor of 4.9 (highest rate). The overspray scenario should not represent an acute risk to aquatic invertebrates. With a spill, the NP9E threshold for acute effects to fish is exceeded by a factor of 6.1 (central estimate), up to a factor of 15.1 (highest rate), while for aquatic invertebrates, the threshold for acute effects is exceeded at the highest concentration rate, by a factor of 1.5. Aquatic plants would have values intermediate between fish and invertebrates. In a stagnant small pond or stream reach, there could be effects seen to aquatic organisms. In a live stream, the more realistic scenario would be a short-term pulse of concentrated NP9E moving downstream, mixing with water and being broken down into NP1EC-NP2EC and/or partitioning into sediments. The effects of a short pulse should be minor on aquatic organisms as the short exposure time would result in lower doses than are discussed here.

The spill exposure scenario is an arbitrary scenario. Scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of NPE, all of the hazard quotients would be a factor of 10 less. This scenario involving water contamination assumes that a small pond is affected, rather than a creek or river as would be more likely in this forested setting. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream. Even here, the use of stream buffers would reduce the likelihood of this scenario being realized during normal operations.

Table 3-35. Summary of Hazard Quotients for Aquatic Species – NPE-based Surfactants

Summary of Concentration in Water						
		Concentrations (mg/L)				
Scenario		Central	Lower	Upper		
	Acute	0.0125	0.0031	0.0312		
	Chronic	0.007	0	0.014		
Summary of Risk Characterizations at Highest Application Rate (2.0 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Fish						
	Acute	0.013	3E-03	0.03	1	NOEC
	Chronic	0.07	0	0.14	0.1	NOEC
Aquatic invertebrate						
	Acute	1E-03	3E-04	3E-03	10	NOEC
	Chronic	0.29	0	0.58	0.024	NOEC
Plants, aquatic						
	Acute	1E-03	4E-04	4E-03	8	EC_{50}
	Chronic	9E-04	0	2E-03	8	EC_{50}
Small Mammal						
	Direct Spray - 100 percent Absorption	**4.8**	**4.8**	**4.8**	10	NOAEL
	Direct Spray – First Order Absorption	8E-03	1E-03	0.1	10	NOAEL

Methylated seed oil (MSO) surfactants (USDA, 2007a)

Methylated seed oil surfactants are proposed with aquatic formulations of glyphosate. Methylated seed oil is formed from common seed oils, such as canola, soybean, or cotton. The U.S. Food and Drug Administration (FDA) considers methyl and ethyl esters of fatty acids produced from edible fats and oils to be food grade additives. There is little toxicity testing done on these surfactants. Standard acute toxicity testing on aquatic species is limited. The LC_{50} for aquatic species with one methylated seed oil (Hasten®) is 74 mg/l for 96 hours with rainbow trout and the EC_{50} is >50 mg/l for 48 hours with *Daphnia magna*.

Silicone/MSO blend surfactants (USDA, 2007a)

Silicone/modified vegetable oil blends (such as Syl-Tac®) includes silicone-based surfactants (USDA 2007a) and vegetable oils. Silicone/MSO blend surfactants would be used with herbicides when there are stream buffers included. There is little information in the scientific literature on effects of seed oils and silicone-based surfactants on aquatic organisms (USDA, 2007a). There is some information on a brand name, Syl-Tac®. In USDA (2007a), the 96 hour LC_{50} for rainbow trout and the 48 hour EC_{50} for Daphnia magna is >5 mg/l. No studies on amphibians with Syl-Tac® were found.

There is no indication that silicone/modified vegetable oil blend is carcinogenic or mutagenic and there is very little information regarding the environmental fate of silicone/modified vegetable oil blend. Thus, no reasonable inference on the potential risk to aquatic species resulting from the chronic exposure to silicone/modified vegetable oil blend can be made (USDA 2007a). However, as none or very little herbicide is expected to reach streams due to stream buffers, and in comparison to some herbicides, the effects from exposure are expected to be small.

Colorfast Purple (SERA 1997b)

The colorant dye Colorfast Purple does not require pesticide registration. As described in Chapter 3 (Human Health and Safety of Herbicide Use) a mouse study by Littlefield et al (in SERA 1997b) is the basis for a qualitative cancer risk assessment. In rats, there is an indication that the dye accelerates the development of leukemia; however, the effect is less remarkable than that observed in mice. Turkeys exposed to Basic Violet 3 in drinking water contracted occlusive laryngotracheitis (Clark et al. 1993, in SERA 1997b). A marker solution containing the dye, dihydroxyacetone, and acetone was associated with contact dermatitis, although the dye itself did not cause an allergic reaction (Cox et al. 1989, in SERA 1997b). In patch tests, concentrations between 0.01% and 5% of Crystal Violet lactone [CAS 1552-42-7] used in carbonless copy paper were associated with the development of contact dermatitis (Shehade et al. 1987, in SERA 1997b).

There is very limited information available on the environmental fate of Colorfast Purple. No reasonable inference on the other potential risks to aquatic species resulting from the chronic exposure to Colorfast Purple can be made. Colorfast Purple would be used with herbicides with stream buffers. Exposure to herpetofauna of herbicides, surfactants, and dyes are not expected by this project as stream buffer widths shall be applied, and the stream flow is expected to dilute the water, even if slight amounts of herbicides, surfactants, and dyes did enter streams.

Hi-Light Blue

The ingredients in Hi-Light Blue are considered proprietary. None of the ingredients are hazardous, and the dye contains no toxic chemicals (SERA 1997b). There is extremely little information available to use to select dyes to use as markers on vegetation. Although dyes are used extensively in many industrial and agricultural applications, their use is virtually unregulated and there is almost no guidance regarding the selection of dyes based on their efficacy or potential hazard.

The assessment of these risks is severely limited by the proprietary nature of dye formulations. For most of the available dyes, neither the colorants nor adjuvants in the dye formulation are disclosed by the manufacturers. Unless the compound is classified as hazardous by the U.S. EPA, the manufacturer is not required to disclose its identity. The U.S. EPA is increasing the testing requirements on new inerts; however, many of the inerts currently in use were not tested rigorously and their toxicity is not well characterized (SERA 1997b). Thus, when a colorant or other adjuvant in a dye formulation is not listed as hazardous and therefore not identified on the product label or MSDS it should not be concluded that the dye or adjuvant is not toxic (SERA 1997b).

Hi-Light® Blue dye is not required to be registered as a pesticide; therefore it has no signal word associated with it. It is mildly irritating to the skin and eyes. It would likely be considered a

Category III or IV material and have a Caution signal word if it carried one. Hi-Light® Blue is a water-soluble dye that contains no listed hazardous substances (USDA 2007a). It is considered to be virtually non-toxic to humans. Its effect on non-target terrestrial and aquatic species is unknown, however its use has not resulted in any known problems (USDA 2007a).

Synergism: A synergistic effect is a situation is which the combined effects of two chemicals is much greater than the sum of the effect of each agent given alone, such as a herbicide and a surfactant. Surfactants, by their very nature, are intended to increase the effect of a pesticide by increasing the amount of pesticide that is in contact with the target (by reducing surface tension). This is not synergism, but more accurately is a reflection of increased dose of the herbicide active ingredient into the plant. Although there is not much data in the technical literature, the references included in USDA, 2007a indicate a lack of synergistic effects between surfactants and pesticides.

Foothill Yellow-legged Frog

Direct and Indirect Effects

It is possible that foothill yellow-legged frogs could reside in the tributary streams of the South Fork American within this project as this area is within their known elevation range, although this is unlikely, as the nearest foothill yellow-legged frog sighting occurred 5.4 miles downstream.

The analysis of herbicide treatments, above, concludes that little herbicide is expected to enter tributary streams and the South Fork American River using the proposed stream buffers. The aquatic glyphosate treatments for yellow starthistle without stream buffers is expected to have very small amounts of herbicide, surfactant, and dye potentially enter the streams. Thus, it is possible, although unlikely, foothill yellow-legged frogs could be affected by herbicide exposure. If foothill yellow-legged frogs were exposed, the hazard quotients for normal operations are well below a threshold of concern for frogs. Amphibians breathe through their skin, these aquatic animals are very susceptible to water quality.

Indirect effects could occur to algae, which is food for tadpoles, by a herbicide spill that washed downstream (HQ=5) or from invasive plants treatments using glyphosate on an estimated seven acres on unbuffered streams. Foothill yellow-legged frogs reproduce in the South Fork American River 5.4 miles downstream, and an unlikely spill could affect algae, food for tadpoles. Invasive plant treatments may have a localized effect on aquatic plant and macroinvertebrate assemblages. The higher discharge of the South Fork American River would dilute herbicide concentrations, reducing the likelihood of effects to macroinvertebrates.

Western Pond Turtle

Direct and Indirect Effects

Individual western pond turtles (usually males) may have large home ranges and may wander within a given watercourse for several kilometers on a regular basis (Reese and Welsh 1997). Western pond turtle nests have been found as far as 435 yards from a stream (Reese and Welsh 1997) in open sunny areas on hillslopes, generally with a south to southwest facing aspect. It should be noted, however, that various studies have recorded considerable variances in distances western pond turtles travel overland away from the stream channel. According to Holland (1994, p.28), “The majority of nest sites discovered to date have been found on dry, well-drained soils with significant clay/silt content and low (<15 degree) slope. Most have been in open areas dominated by grasses or herbaceous annuals, with few shrubs or trees in the immediate vicinity.” Thus, plantations or skid roads could provide an ideal location for a western pond turtle to lay its eggs, especially those located on south facing slopes. However, individuals have been found on northwest to north facing slopes that are >15 degrees during either nesting or overwintering overland movements (Holst 2001).

Approximately 76 acres in the project area are nesting and overwintering habitat; therefore, individuals may be subject to anthropogenic disturbance when western pond turtles travel overland from outside the project area to lay their eggs between May and July; nests could be uncovered and eggs crushed (Table 3-36). Threats to nests and hatchlings would occur from May through March during the incubation period for western pond turtles.

Table 3-36. Seasonal Movements of Western Pond Turtles and Potential Disturbance

Month	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Disturbance to:												
Nesting individuals					shaded	shaded	shaded					
Eggs	shaded	shaded	shaded		shaded	shaded	shaded	shaded	shaded	shaded	shaded	shaded
Overwintering individuals		shaded	shaded	shaded	shaded	shaded			shaded	shaded	shaded	

Shading indicates months when seasonal movement are likely.

Western pond turtle also move into upland slopes while overwintering. Overwintering movements are poorly understood. In the Sierra Nevada, the most likely time for western pond turtle overwintering movements is during the fall/late fall and early spring and would represent movements to and from upland overwintering sites.

Under normal operations in a stream setting, as described under the risk characterization for NPE-based surfactants, none of the exposure scenarios approach a level of concern to aquatic organisms. Western pond turtles are less likely to be affected by herbicide in a stream because of the dilution factor, their tough skin limits the absorption of herbicide into the body, and because they also spend time outside of water.

Changes in aquatic vegetation could affect individuals, as western pond turtles are omnivorous, eating both plants, insects, worms, fish, and carrion. Large scale effects to aquatic vegetation, such as from a spill, could effect the food of western pond turtles, which would affect them indirectly.

Cumulative Effects

The cumulative effects analysis common to all species includes Riparian Conservation Areas in the Freds Fire Restoration Project area and the South Fork American River downstream to its confluence with Silver Creek (approximately 21 miles). The area of cumulative effects analysis was bounded in this manner because the greatest potential for aquatic community degradation downstream and outside of the proposed project area would be associated with sediment delivery to stream channels. Silver Creek is the first major downstream drainage that has the potential to alter sediment delivery regimes in the South Fork American River due to the volume of water it contributes to the South Fork.

The proposed project includes treatment acres shown on Table 2-1 on NFS land within the Fry Creek, Junction Reservoir, and Kyburz watersheds. Past, present, and reasonably foreseeable site preparation and conifer release projects on privately owned lands within the affected watersheds will affect an additional 2,526 acres of land.

In assessing cumulative effects, impacts of past actions were included for actions implemented since 1992. Actions preceding that date were included only if they had the potential to influence species population dynamics, species habitat (e.g. in-channel large woody debris, and/or sediment delivery to streams), or general watershed condition. Similarly, impacts of reasonably foreseeable future actions were included within the next 10 to 15 years were considered based on their probability of influencing species populations and/or aquatic community components, particularly riparian vegetation, vegetation in and adjacent to special aquatic features, and sediment delivery to streams. The temporal scope was selected because, as demonstrated by Gresswell (1999), depending on the characteristic being considered, alterations in aquatic community components due to wildfire are generally the greatest for five to ten years although large woody debris levels may remain higher than normal for 15 years or more. The Aquatic Species BA/BE contains past, present, and reasonably foreseeable future actions and the effects of those actions (project file).

In the discussion below, it is acknowledged that region-wide (e.g., population isolation and decline with consequent extirpation could occur due to the decreased size of potential source populations, the increased distance from source populations, and direct predation on dispersing individuals [Hanski 1989, Sjogren 1991]) and worldwide influences (e.g., effects of acid precipitation, ultraviolet radiation, viruses, pesticides, habitat destruction, predation, global climate change, and synergistic interactions among these factors) may have or are continuing to have an adverse affect on aquatic and aquatic-dependent herpetofauna populations. Understanding the extent to which these factors may have affected local herpetofauna populations in the Freds Fire Reforestation Project area is beyond the scope of this analysis, so too is an analysis determining the extent to which these factors will continue to effect local herpetofauna populations.

Past Land Disturbances: Timber harvest has occurred throughout the Peavine Ridge/Highway 50 corridor vicinity since the late 1800s (Coulter pers. comm.). During the past decade protective measures for streamside zones in timber harvest areas have become more restrictive. And, although timber harvest plans on private land during the past decade have had stream buffer requirements that protect the streams, the intensity and size of these activities on private land vary; in many cases, such harvest has resulted in fragmentation of habitat for many species. Additionally, harvest activities had the potential to decrease and degrade the amount of aquatic suitable habitat (Dunham et al 2003).

In the Freds Fire area, past timber harvest and associated road/skid trail building is evident. In many instances such harvest and road building have adversely influenced aquatic habitats by increasing sediment delivery to streams and reducing large woody debris levels and recruitment. It is unknown to what extent these anthropogenic activities affected specific aquatic and/or aquatic-dependent populations or habitat. Additionally, many of the effects from past anthropogenic disturbance may have been minimized by the Freds Fire.

Watersheds within and immediately adjacent the project area have also been affected by the 1981 Wright’s Fire, the 1992 Cleveland Fire, and the 2002 St. Pauli Fire. Salvage timber harvest and reforestation took place on NFS and private lands subsequent to both the Wrights and Cleveland fires. The extent to which each of these events and the ensuing timber harvest affected specific aquatic and/or aquatic-dependent populations or habitat was described in the NEPA analyses for these project areas.

Observations made during the Riparian Conservation Objective analysis for this project indicate that downcutting has occurred along 60 percent of the surveyed reaches (Table 3-26). Sediment delivery from sources within the Riparian Conservation Area were observed on all the perennial reaches surveyed for the analysis, as well as on the majority of seasonally flowing tributaries to these streams. Sheet erosion, rill erosion, and headcuts were observed on 60 percent of the surveyed channels and gulling was observed on 40 percent of the channels. Quite frequently, erosion and sediment delivery to stream channels was associated with old skid trails from salvage harvest activities and Maintenance Level 1 and 2 NFS roads.

Anthropogenic disturbance has occurred in and along the Granite Springs Road near the Granite Springs Meadow Complex. In the past, such disturbances included off-highway vehicle use and dispersed camping. Prior to the Freds Fire on NFS land above Forest Road 11N99, streamflow in the perennial channel northeast of Granite Springs was diverted. Presently, the most prominent disturbances in the Granite Springs area are associated with salvage harvest, both on privately owned and NFS lands. This is particularly evident along the same perennial channel described above (Figure 3-27).

Figure 3-27. Stream channel alteration due to salvage harvest on privately owned lands in the vicinity of Granite Springs. ***May 24, 2006***

Subsequent to the salvage timber harvest on NFS lands within the Freds Fire Reforestation Project area approximately 1,870 acres were planted.

Salvage harvest also occurred on private lands within the Freds Fire. Acres harvested by logging system on private lands are unknown. Similarly, the extent of transportation system improvements and new road construction on privately owned lands is unknown. However, timber harvest on private lands is regulated by the California Department of Forestry and Fire Protection under the provisions of the California Forest Practice Act and additional rules enacted by the State Board of Forestry and Fire Protection. Streamcourse protections measures afforded under state forest practice rules are generally less restrictive than those governing timber harvest on NFS lands. Under State rules, harvest may occur within 50 feet of streams that maintain aquatic habitat for non-fish aquatic species (CDF 2005), whereas under the SNFPA (USDA 2004b), no harvest zones may be as much as three to four times greater, thus reducing the potential for sediment delivery to streams from harvest activities.

Present Land Disturbances: Present land disturbance projects would not necessarily have a localized affect on the stream channels in the project area. However, any anthropogenic land disturbance affecting the stream corridor upstream from the project could potentially contribute to cumulative effects that could adversely affect aquatic and aquatic-dependent species populations on NFS lands, e.g., increased sediment delivery and turbidity.

Across the landscape, the effects to the aquatic habitats within the project area due to dispersed recreation are low, although localized hillslope erosion with a consequent sediment delivery to aquatic features has been observed. Recreation use within the project area is limited and confined to specific locations. Dispersed camping and off-highway vehicle use generally occur in specific areas along the Granite Springs Road. During hunting season, there is an increase in dispersed camping and off-highway vehicle use, although such use is still generally characterized as low. Other recreation use within and adjacent to the project area includes rock climbing which is confined to Sugarloaf and Phantom Spires; the use at Sugarloaf is low whereas, the climbing use at Phantom Spires would be characterized as moderate (Valdes pers. comm.).

Foreseeable Future Land Disturbances: Foreseeable future land disturbances that have the potential to affect herpetofauna include anthropogenic disturbances such as dispersed recreation, introduction of exotic species, and land management activities.

Sierra Pacific Industries applied glyphosate and hexazinone for conifer release on their lands within the Freds Fire area; they will not be applying any herbicides within 50 feet of live water.

As noted in the Hydrologic Analysis, the increase in the amount of sediment delivered to streams will likely be slight and the recovery of streams in the project area that are currently degraded (primarily as a result of the Freds Fire of 2004 and salvage logging in 2005) should continue.

Overall, dispersed camping and off-highway vehicle use could generally be characterized as low (Schroeder pers. comm.). However, because vegetation is lacking and skid trails are still visible from system roads, there is the potential that off-highway vehicle use may exacerbate existing erosion problems within the project area.

In terms of introductions of exotic species, bullfrogs (*Rana catesbeiana*) are an introduced species that have been implicated in declining populations of a number of native Californian frog species; adult bullfrogs prey on native frog species and reach population densities that potentially have adverse affects on other amphibian populations (Alford and Richards 1999, Jennings 1996). Bullfrogs have been observed in the South Fork American River approximately 7.5 miles downstream of Fry Creek. No bullfrogs are known to be present within the project area.

Conclusions

As noted above, Sierra Pacific Industries applied glyphosate and hexazinone for conifer release on their lands within the Freds Fire area. However, they will not be applying any herbicides within 50 feet of live water. Thus, there is little likelihood that chemical conifer release treatments on Sierra Pacific Industries lands will contribute to cumulative effects within the Freds Fire Reforestation Project area.

Based on the above discussions, the likely cumulative effects of primary concern on NFS lands from an aquatic ecosystem perspective are:

- Maintenance or restoration of (1) the geomorphic and biological characteristics of special aquatic features; (2) streams; and, (3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.
- Enhancement or maintenance of physical and biological characteristics associated with aquatic- and riparian-dependent species and their habitats.
- Restoration and enhancement of special aquatic features to provide the ecological conditions and processes needed to recover or enhance viability of species that rely on these areas.

Sierra Nevada Ecosystem Project found that aquatic, riparian, and meadow ecosystems are the most degraded of all habitats in the Sierra Nevada, although much of this problem was related to lower elevation dams and diversions (USDA 2004b). Historical data on changes in meadow ecosystems and special aquatic features are incomplete; however, available information suggests that both the number and size of these types of features has declined due to several reasons, including fire exclusion and conifer encroachment.

In terms of physical and biological characteristics associated with aquatic- and riparian-dependent species and their habitats – currently within several of the Riparian Conservation Areas adjacent to perennial streams, terrestrial riparian plants are providing shade, regulating microclimates, and reducing water temperatures that create and enhance habitat complexity. Riparian plant species are also providing organic materials that serve as food for aquatic organisms such as macroinvertebrates (Welsh et al 1998). Recent research has demonstrated that inputs of terrestrial detritus plays a critical role in the food web of forested headwater streams because "…headwater food webs are largely supported by inputs of allochthonous detritus…" (England and Rosemond 2004). Data from research on seven headwater streams in Georgia "…suggest that riparian deforestation, even over a narrow range, can result in decreased terrestrial support of headwater stream food webs (England and Rosemond 2004). Similarly, Kiffney et al (2003) demonstrated that that periphyton and aquatic insects in headwater streams were highly sensitive to forest harvest. Their results showed "…that abiotic and biotic attributes were even higher in the 30-m (98-ft) buffer treatment compared with controls during some seasons (Kiffney et al 2003)." This is consistent with the conclusion reached by Welsh et al (1998) that condition and functionality of Class II and III streams can determine downstream habitats. Thus, it is apparent that past fires, subsequent timber harvest, and reforestation activities adjacent to streams in the project area had and still have the potential to affect aquatic habitats and the presence/absence of aquatic and aquatic-dependent species both within and adjacent to the project, but also downstream of the proposed project.

Foothill Yellow-legged Frog

Cumulative Effects Unique to this Species

As there is little likelihood that chemical conifer release treatments on Sierra Pacific Industries lands will contribute to cumulative effects within the Freds Fire Reforestation Project area, there are no anticipated cumulative effects.

Determination of Effects

Alternative 1 may impact individuals, but is not likely to cause a trend toward Federal listing or a loss of viability for the foothill yellow-legged frog.

Western Pond Turtle

Cumulative Effects Unique to this Species

One of the major causes in the decline of western pond turtle populations, based on historic accounts, was extensive commercial harvest of the species as a food source. From approximately the 1870s to the 1930s, western pond turtles were harvested commercially; millions were sold in San Francisco markets (Ashton et al 1997). And, although there has been a ban on the sale and/or exhibition of native reptiles and amphibians since the 1980s, illegal collection of turtles has occurred (Ashton et al 1997). The extent to which these activities have affected western pond turtle populations in the analysis area is unknown.

Western pond turtle nests have been found as far as 435 yards from streams, far exceeding traditionally protected buffer zones afforded under the provisions of the California Forest Practice Act (and additional rules enacted by the State Board of Forestry and Fire Protection) or the Riparian Conservation Area widths established by the SNFPA. Thus, because western pond turtles travel into upland environs frequently and oftentimes for prolonged periods of time, they are more susceptible ground disturbing activities.

Crushing of individual western pond turtles by vehicles is also suspected of contributing significantly to mortality (Ashton et al 1997, Gibbs and Shriver 2002). As suggested in recent studies, as road densities increase, the potential for individual western pond turtle mortality due to crushing by vehicles also increases, particularly in those areas where roads such as Highway 50 parallel streams (Ashton et al 1997).

Given the amount and juxtaposition of nesting and overwintering habitat for western pond turtles within the project area, it is unlikely that the cumulative effects resulting from the Proposed Action will affect western pond turtle populations.

Determination of Effects

Alternative 1 may impact individuals, but is not likely to cause a trend toward Federal listing or a loss of viability for western pond turtle.

Alternative 2 (No Action)

Direct and Indirect Effects

Implementation of Alternative 2 would result in natural recovery. There would be no direct or indirect effects to aquatic and/or aquatic-dependent species. The risk of a large wildfire in the project area might be greater under Alternatives 2 than under Alternative 1 (Proposed Action). The potential effects of a large wildfire include a short-term (generally less than five years) degradation of water quality and aquatic habitat in the project area - this in turn can impair downstream beneficial uses of water. The severity and extent of such impacts from large wildfires is highly variable and depends on many factors; some large wildfires result in negligible impacts to water quality, aquatic habitat, and beneficial uses of water.

Cumulative Effects

Presently within the Freds Fire Reforestation Project area, aquatic features are recovering from two recent disturbances, the Freds Fire of October 2004 and the subsequent salvage timber harvest. A Riparian Conservation Objectives analysis indicated that the surveyed streams are presently recovering. Implementation of Alternative 2 would:

Facilitate natural recovery of aquatic features.

Extend the period of time Riparian Conservation Areas would remain in an early seral stage.

Reduce the rate of conifer encroachment into special aquatic features such as meadow/spring complexes.

Foothill Yellow-legged Frog and Western Pond Turtle

Direct, Indirect, and Cumulative Effects

No action is expected to have no effects on the foothill yellow-legged frog and western pond turtle.

Determination of Effects

This alternative would have no effect on the foothill yellow-legged frog or western pond turtle.

Alternative 3

Direct and Indirect Effects

In areas where no planting occurs (800 more acres than Alternative 1), there would be no effect to aquatic and aquatic-dependent species with implementation of Alternative 3. On the remainder of the project area, direct and indirect effects to the aquatic environment would generally be associated with site preparation and release, which would be limited to hand cutting/hand grubbing of shrubs, forbs, and grasses around planted trees. Mechanical methods, such as hand pulling or tarping, would be used to control tall whitetop. Similarly, hand pulling or grubbing, would be used to control yellow starthistle.

The direct and indirect effects to the aquatic system resulting from the implementation of Alternative 3 would generally be limited to herpetofauna mortality due to crushing or smashing during tree planting and release and from mastication equipment in about 388 acres.

With the exception of western pond turtles, aquatic and aquatic-dependent species such as the foothill yellow-legged frog are generally found within 33 feet of water. Thus, in view of the paucity of past herpetofauna observations within the proposed project area, the potential for herpetofauna mortality due to planting activities would minimal, western pond turtles being the exception. Similarly, it is doubtful that hand cutting/hand grubbing would result in herpetofauna mortality. Stream buffers from mastication equipment would reduce the likelihood of crushing within the RCA.

The risk of a large wildfire is the same as Alternatives 2. The potential effects of a large wildfire include a short-term (generally less than five years) degradation of water quality and aquatic habitat in the project area - this in turn can impair downstream beneficial uses of water. The severity and extent of such impacts from large wildfires is highly variable and depends on many factors; some large wildfires result in negligible impacts to water quality, aquatic habitat, and beneficial uses of water.

Cumulative Effects

The hydrologic analysis for the Freds Fire Reforestation Project has determined that in the short-term (<10 years) the recovery of degraded stream channels is slower under Alternatives 1 and 3 than under Alternative 2. In the long-term (>10 years), recovery of degraded stream channels within the project area is nearly the same for all alternatives.

Sediment delivery to stream channels will be slightly greater under Alternatives 1 and 3 during and immediately after storm events in the short-term. In the long-term, there will be a negligible difference between the alternatives.

Under Alternative 3 in some meadow/spring complexes such as Granite Springs, the size of the meadow and the water table may decrease after 25 years.

Foothill Yellow-legged Frog

Direct, Indirect, and Cumulative Effects

Under this alternative, no herbicides would be used, therefore there would not be any expected downstream effects from planting and mastication using stream buffers.

Determination of Effects

Alternative 3 would have no effect on the foothill yellow-legged frog.

Western Pond Turtle

Direct, Indirect, and Cumulative Effects

Direct and indirect effects would generally be limited to mortality due to crushing or smashing during tree planting and release and from mastication equipment on about 388 acres. Stream buffers from mastication equipment would reduce the likelihood of crushing within the RCA

Determination of Effects of Alternative 3

Alternative 3 may impact individuals, but is not likely to cause a trend toward Federal listing or a loss of viability for the western pond turtle.

Aquatic Management Indicator Species

Affected Environment

Management Indicator Species (MIS) for the Eldorado NF are identified in the 2007 Sierra Nevada Forests Management Indicator Species Amendment (USDA 2007b). The MIS Analysis can be found in the Project file. The habitats and ecosystem components and associated MIS analyzed for the project were selected from this list of MIS, as indicated in Table 3-37 (species analyzed for this project are shaded). Category 3 MIS in (aquatic macroinvertebrates), whose habitat would be either directly or indirectly affected, are carried forward and evaluated for direct, indirect, and cumulative effects on the habitat of these species.

Table 3-37. Selection of Aquatic MIS for Project-Level Habitat Analysis for the Fred's Fire Reforestation Project

Habitat or Ecosystem Component	CWHR Type(s) defining the habitat or ecosystem component	Sierra Nevada Forests Management Indicator Species	Category for Project Analysis [1]
Riverine & Lacustrine	lacustrine (LAC) and riverine (RIV)	aquatic macroinvertebrates	3
Wet Meadow	Wet meadow (WTM), freshwater emergent wetland (FEW)	Pacific tree frog *Pseudacris regilla*	2

[1] **Category 1:** MIS whose habitat is not in or adjacent to the project area and would not be affected by the project.
Category 2: MIS whose habitat is in or adjacent to project area, but would not be either directly or indirectly affected by the project.
Category 3: MIS whose habitat would be either directly or indirectly affected by the project.

Habitat/Species Relationship. Aquatic or Benthic Macroinvertebrates have been demonstrated to be very useful as indicators of water quality and aquatic habitat condition (Resh and Price 1984; Karr et al. 1986; Hughes and Larsen 1987; Resh and Rosenberg 1989). They are sensitive to changes in water chemistry, temperature, and physical habitat.

Current Condition of the Habitat Factor(s) in the Project Area: Current conditions are described in Tables 3-25 and 3-26 and "Affected Environment" in Chapter 3 - Aquatic Biology.

Environmental Consequences

Alternative 1 (Proposed Action)

Direct and Indirect Effects to Habitat

The direct and indirect effects to aquatic macroinvertebrates that are considered pertain to flow, sedimentation, changes in temperature regime, and changes in water quality.

Flow: Streamflows down streams flowing into the South Fork American River are not expected to significantly increase as a result of herbicide treatments, hand release, and mastication. Stream buffers should prevent any loss of riparian vegetation along the banks which protect stream flow and bank stability, although herbicide treatments of tributaries shall have smaller buffers or no buffers on ephemerals. This loss of riparian vegetation combined with steep gradient may slightly increase flow during heavy rainfall periods. Where no stream buffers are used for seven acres of yellow-starthistle treatments, the amount of treatment is not expected to increase streamflow significantly.

Sedimentation: Sedimentation is not expected to increase significantly on streams flowing into the South Fork American River as a result of the herbicide treatments, hand release, and mastication. Any change in sedimentation is expected to be minor, and only in the first year with high winter flows. Stream buffers should prevent any loss of riparian vegetation along the banks which protect stream flow and bank stability. Herbicide treatments of tributaries have smaller buffers, or no buffers on ephemerals and on seven acres of yellow-starthistle treatments. These smaller buffers increase the likelihood of riparian vegetation being affected. Combined with their steep stream gradient, herbicide treatment near these smaller tributaries may cause an increase sedimentation during the heavy rainfall periods, especially during the first winter after treatment.

Temperature: Temperature is not expected to increase as a result of the herbicide treatments on the streams flowing into the South Fork American River. Stream buffers should prevent any loss of riparian vegetation along the banks; the riparian vegetation provides shade which prevents the water from warming. Herbicide treatments of tributaries shall have smaller buffers or no buffers. This loss of riparian vegetation combined with steep gradient may warm water temperatures over small stretches. These sections are short and not expected to warm streams significantly. Where no stream buffers are used for seven acres of yellow-starthistle treatments, the amount of treatment is not expected to reduce stream shade.

Water Quality: Water quality is not expected to change significantly as a result of the herbicide treatments on the streams flowing into the South Fork American River. Stream buffers should prevent any contamination of these streams by herbicides moving off-site, being mobile, or flushing during rainstorms (refer to Tables 3-31 through 3-35, and the narratives thereafter for each herbicide, surfactant, and dye describing effects to aquatic species, including invertebrates). Where no stream buffers are used for seven acres of yellow-starthistle treatments, the herbicide, surfactant, and dye to be used is of the lowest toxicity available, and not expected to have significant direct effects and reduce macroinvertebrate populations in the adjacent streams. If herbicide were to enter streams, it is possible that reductions in algae may reduce food supply and indirectly affect those macroinvertebrates that depend on grazing of algae. These aquatic invertebrates would quickly recolonize the following year from upstream locations when algae returned to the stream. Water quality is not expected to change as a result of mastication and hand release treatments because of stream buffers, unless petroleum products leaked from heavy equipment use, which is not likely. Fueling of equipment shall not occur near streams (BMP 2-12).

Cumulative Effects to Habitat in the Project Area

The cumulative effects analysis for aquatic macroinvertebrates considers the effects of this project when combined with past, present, and foreseeable future actions and events. Past land disturbances within the proposed project area were considered if they had the potential to influence species population dynamics and/or potential habitat. Similarly, future land disturbances were considered based on their probability of influencing species populations and/or aquatic community components. Due to the uncertainty regarding future anthropogenic disturbance in the affected watershed, the temporal scale for this analysis is limited to approximately 10 years.

Refer to past, present, and foreseeable future cumulative effects for herpetofauna in Chapter 3 - Aquatic Biology. Most of these cumulative impacts also pertain to aquatic invertebrates.

Alternative 2 (No Action)

Direct and Indirect Effects to Habitat

There would be no direct or indirect effects to aquatic and/or macroinvertebrates. The risk of a large wildfire in the project area might be greater under Alternative 2 than under Alternative 1 (Proposed Action). The potential effects of a large wildfire include a short-term (generally less than five years) degradation of water quality and sedimentation, and an increase in streamflow and water temperature in the project area - this in turn can impair downstream beneficial uses of water. The severity and extent of such impacts from large wildfires is highly variable and depends on many factors; some large wildfires result in negligible impacts to water quality, aquatic habitat, and beneficial uses of water.

Cumulative Effects

Presently within the Freds Fire Reforestation Project area, aquatic features are recovering from two recent disturbances, the Freds Fire of October 2004 and the subsequent salvage timber harvest. A Riparian Conservation Objectives analysis indicated that the surveyed streams are presently recovering. Implementation of Alternative 2 would facilitate natural recovery of aquatic features and extend the period of time Riparian Conservation Areas would remain in an early seral stage.

Alternative 3

Direct and Indirect Effects to Habitat

Direct and indirect effects to the aquatic system from tree planting and release and from mastication equipment is not expected to significantly change streamflow, water quality, sedimentation or water temperature. Any increase in sedimentation is expected to be minor. The stream buffers of heavy equipment from the streams should prevent any adverse effects downstream. The risk and effects of a large wildfire is the same as Alternative 2.

Cumulative Effects

The hydrologic analysis has determined that the recovery of degraded stream channels, both short and long term, is similar for all alternatives. Sediment delivery to stream channels may be slightly greater under Alternatives 1 and 3 during and immediately after storm events in the short-term. There will be a negligible difference between the alternatives in the long-term.

Summary of Aquatic Macroinvertebrate Status and Trend at the Bioregional Scale

The ENF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale Index of Biological Integrity (IBI) and Habitat monitoring for aquatic macroinvertebrates. This information is drawn from the detailed information on habitat and population trends in the Sierra Nevada Forests Bioregional MIS Report (USDA 2008b), which is hereby incorporated by reference. The data collected at the Bioregional scale indicate that the IBI metrics for macroinvertebrates are stable.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Aquatic Macroinvertebrates Habitat Trend

The Fred's Fire Reforestation Project would not alter the existing trend in the habitat or aquatic macroinvertebrates across the Sierra Nevada bioregion. Changes in sedimentation are expected to be very minor, and only in the first year. Water quality could be slightly affected if herbicides enter streams and caused a reduction in algae, which is food for grazing aquatic invertebrates. The aquatic invertebrates would quickly recolonize the following year when algae returned to the stream. There is not expected to be a significant change in streamflow or shade because of the BMPs used in the project design. Thus, the project would not alter the existing trend in the habitat or aquatic macroinvertebrates across the Sierra Nevada bioregion.

Terrestrial Wildlife

Affected Environment

Wildlife species are discussed in detail in the terrestrial Biological Evaluation (BE), Biological Assessment (BA), and Management Indicator Species (MIS) Report. These documents can be found in the project file. This section summarizes these documents.

The wildlife habitat in the project area will be discussed utilizing California wildlife habitat relationship (CWHR) types described in "A Guide to Wildlife Habitats of California" (Mayer and Laudenslayer 1988). The Freds Fire Reforestation Project area is predominately comprised of Sierra mixed conifer in a variety of seral stages with pockets of hardwood-conifer, montane hardwood, Jeffrey pine, red fir and montane chaparral dispersed throughout the areas. Stringers of montane riparian CWHR type are found along perennial creeks and tributaries.

The Freds Fire created a mosaic of dead and live trees; resulting in early seral habitat dominated by standing dead trees, particularly in high intensity burn areas. Areas of moderate and high fire intensity had significant tree mortality, and these areas changed from mid- and late-seral forest conditions to early-seral forest conditions. Areas of low fire intensity had very little tree mortality and reflect conditions of an understory burn in which ground fuels were removed but canopy cover remained relatively unchanged.

In stands that experienced low to moderate fire intensities, a live conifer overstory remains; however, some large trees may continue to die due to cambial kill. In these areas, the CWHR type remained the same, but the tree size and/or canopy closure designation changed. For example, in stands that were estimated to be CWHR type Sierran Mixed Conifer (SMC) 5M (Table 3-38) before the fire; after the fire they may be measured as SMC 4P because the loss of large trees lowered the average DBH and canopy closure of the stand. In areas where canopy closure fell below 40%, a shrub understory continues to develop.

Table 3-38. California Wildlife Habitat Relationship (CWHR) Types

CWHR Size Class*	CWHR Size Class Description	
	DBH (inches)*	Percent Canopy Closure
3P	6-12	20-40
3M	6-12	40-60
3D	6-12	>60
4P	12-24	20-40
4M	12-24	40-60
4D	12-24	>60
5P	>24	20-40
5M	>24	40-60
5D	>24	>60
6	>24	>60%, multi-layer canopy

*defined by average tree size

Over time, post-fire habitats develop through a variety of successional stages. During the first five years following a fire, herbaceous habitats tend to dominate in areas where fire intensities were high (Mayer and Laudenslayer 1988). Forbs and sprouting shrubs form a mosaic, with areas of open ground with remaining post-fire salvage snags providing structural diversity. Two-thirds of the remaining post-fire snags less than 10” DBH may have fallen by year five, but most larger snags remain standing. Within 15 years, shrubfields (montane chaparral CWHR type) dominate the area (USDA 2001b). Shrubs form a relatively dense canopy, shading out most forbs. Most snags less than 16” dbh will typically have fallen, along with about one-half of snags 16”-24” dbh (Barnhart 2002). Small openings in the shrub cover may be created where snags fall and inhibit growth. Montane chaparral will likely persist for at least 50 years before conifers begin to shade out the brush (Mayer and Laudenslayer 1988) and hardwoods, dependent on site conditions. At that time, most post-fire salvage snags will have fallen, with the exception of about one-half of those greater than 40” dbh (Barnhart 2002).

Snags will continue to be recruited over time as remaining trees that were weakened by the fire continue to die. Mixed Hardwood Conifer (MHC) and Montane Hardwood Woodlands (MHW) are expected to continue to increase in number and size of trees due to the open canopy and lack of current competition with large conifers. However, once conifers re-establish themselves, oaks will start to be shaded out, as the canopy increases in density.

Federally Endangered, Threatened, or Proposed Species

Pursuant to Section 7(c) of the Endangered Species Act of 1973 as amended, the USFWS has provided a list of threatened, endangered, proposed, and candidate species that may be present on the ENF (USDI, 2009). The latest species list for the Eldorado National Forest was dated January 29, 2009 and obtained on April 2, 2009. The updated USDI Fish and Wildlife list for the ENF is available for review at http://sacramento.fws.gov/es/spp_lists/NFActionpage.cfm. No critical habitat for any terrestrial wildlife species has been identified on the Forest (Ibid). The valley elderberry longhorn beetle (threatened) is the only terrestrial species provided by the USFWS as potentially occurring on the ENF. Based on the existence of suitable habitat within the analysis area, this section considers the potential effects of the proposed Freds Fire Reforestation Project on the federally listed threatened wildlife species shown in Table 3-39.

No federally threatened, endangered or proposed species or their habitat would be impacted by the project. The project is above the elevational range for the threatened valley elderberry longhorn beetle (Table 3-40).

Sensitive Species

Thirteen species have been identified for the ENF from the Regional Forester's list of Sensitive Species for Region 5 (Table 3-39) (USDA 1998b).

Table 3-39. Federally Listed or Region 5 Designated Sensitive Terrestrial Species on the ENF

Federally Listed and Proposed Species	
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	Threatened
Region 5 Sensitive Species	
California spotted owl (*Strix occidentalis occidentalis*)	Pallid bat (*Antrozous pallidus*)
Northern goshawk (*Accipiter gentilis*)	Townsend's big-eared bat (*Corynorhinus townsendii*)
American peregrine falcon (*Falco peregrinus*)	Western red bat (*Lasiurus blossevilli*)
Great gray owl (*Strix nebulosa*)	Willow flycatcher (*Empidonax trailli*)
Sierra Nevada red fox (*Vulpes vulpes necator*)	Pacific fisher (*Martes pennanti pacifica*)
American marten (*Martes americana*)	California wolverine (*Gulo gulo luteus*)
American bald eagle (*Haliaeetus leucocephalus*)	

The Freds Project analysis area is defined as the project boundary, associated project units and a 1.5 mile buffer from the project boundary (as part of the cumulative effects analysis area) for species that may be in the area and that have a potential to be impacted by the proposed project. The project area has been evaluated for threatened and sensitive wildlife by consulting the Forest geographic information system (USDA 2009a) and considering literature in the species information files (USDA 2009b). Based on the existence of suitable habitat within the analysis area, Table 3-40 examines the potential for occurrence of the Region 5 sensitive species, and identifies the species that will be further analyzed. Species that may be affected by activities proposed by this project are shaded.

Direction to maintain the viability of Region 5 sensitive species is provided by the National Forest Management Act, the Code of Federal Regulations (219.19), the Forest Service Manual (2672), and the Eldorado National Forest Land and Management Plan (LRMP). The Sierra Nevada Forest Plan Amendment (SNFPA) Final Supplementary Environmental Impact Statement (SEIS) Record of Decision (USDA 2004b) amends the Eldorado National Forest LRMP. The BE determined that for the northern goshawk, great gray owl, American peregrine falcon, willow flycatcher, Sierra Nevada red fox, Pacific fisher, American marten, California wolverine, and American bald eagle, the project area is either outside the elevational range or lacks habitat for those species and, therefore, will not be affected by the proposed project (Table 3-40).

Table 3-40. Project Assessment for Species Occurrence

Species	Potentially Affected Suitable Habitat Within the Project Area	Suitable Habitat Not Available or Not Affected within the Analysis Area	Potential for Disturbance	Considered for Further Analysis
Valley elderberry longhorn beetle	No	Project units are above 3,000 feet in elevation, above the species elevational range. No habitat will be affected.	No	No
California Spotted Owl	Though remnant habitat occurs for spotted owls within the Freds Fire boundary no suitable habitat in the form of late seral habitat components (snags, down logs, large trees) will be treated under this project.	Suitable habitat will not be affected by project activities; however; indirect effects will be analyzed in regards to future habitat development.	No - Mitigations in the form of Limited Operating Periods (LOPs) will avoid or minimize disturbance to nesting spotted owls.	Yes
Pallid Bat, Townsend's Big-Eared Bat	Project area contains mixed age conifer and hardwood forest, brush, large snags and down logs	N/A	Yes	Yes
Western Red Bat	Project area contains riparian areas primarily along stream courses.	Project is above 3,000 feet in elevation (above species elevation range previously considered for the Forest) however, new information indicates may occur up to 8,000 feet for the Sierra Nevada.	Yes	Yes
Northern Goshawk	No Protected Activity Centers (PACs) or areas of habitat large enough to support nesting goshawks occur within the project area.	N/A	No. No known pairs of goshawks are in the project area or within 1/4 mile of the Freds Fire boundary. If goshawks or other TES occur during project activities, contract clauses will enable Limited Operating Periods to be established.	No
Pacific Fisher, American Marten and Sierra Nevada Red Fox	No areas of habitat large enough to support denning habitat occurs within the project area. Project is in early seral habitat and species prefers higher canopy conditions.	N/A	No	No
American bald eagle	No	Wintering habitat occurs along the American River but not in project	No	No

Species	Potentially Affected Suitable Habitat Within the Project Area	Suitable Habitat Not Available or Not Affected within the Analysis Area	Potential for Disturbance	Considered for Further Analysis
American Peregrine Falcon	Sugarloaf rock formation provides potential nesting habitat. No cliff habitat will be affected.	N/A	No	No
Great gray owl	No	Project area does not contain suitable large meadow habitat characteristics	No	No
California wolverine	No	Sub-alpine habitat absent from project area. High human disturbance. High level of roads/campsites/ fragmentation.	N/A	No
Willow flycatcher	No	Wet meadow complexes preferred by this species, absent within the project area.	No	No

Source: USDA 2009b

California Spotted Owl

The ENF occurs in the central portion of the species range and represents about 16 percent of the known population in the Sierra Nevada. There is a relatively uniform distribution of owl sites across the Forest and adjoining the Tahoe National Forest to the north and Stanislaus National Forest to the south. The 2001 SNFPA FEIS, (USDA 2001b, Vol. 3, Ch. 3, part 4.4, pg. 69-82), and the 2004 SNFPA FSEIS, (USDA 2004b Vol. I, Ch. 3, pg. 142-147), summarizes the information regarding the biology and status of the California spotted owl. Since then, the ENF species account and the ENF MIS report for spotted owls have been updated (USDA, 2007c, Lipton et al. 2007). These reports were reviewed for this analysis and are incorporated by reference.

On February 14, 2003, the USFWS announced its finding that listing of the California spotted owl was not warranted at this time (Federal Register 2003). The USFWS found that “there is no substantive information that indicates that there are significant or immediate threats to California spotted owl viability because of the lack of regulatory mechanisms.” On June 21, 2005, the USFWS announced that the California spotted owl is being reviewed for potential listing, primarily based on habitat loss and competition with the barred owl, which has expanded its range (Federal Register 2005); however, the May 24, 2006 USFWS decision was not to warrant the California spotted owl for listing (Federal Register 2006). Their finding was based on the following factors: 1) best available data (Blakesley et al. 2006, in Federal Register 2006) indicate populations are stationary throughout the Sierra with no strong evidence of declining trend; 2) planned and currently implemented fuels reduction projects will benefit owl habitat in the long-term by reducing risk of loss due to catastrophic wildfire; 3) survey data for the San Bernardino spotted owl population do not show statistically significant declines and barred owls represent only 2 percent of spotted owl numbers in the Sierras; and 4) the largest private land owner, Sierra

Pacific Industries, offers protection of spotted owls by surveying for the species, implementing a no cut buffer around territory centers, and no harvest of units with nesting owls. The USFWS recognized that there are short term risks of effects of fuels treatments on spotted owl habitat to gain the long term benefit of reduced wildfire and that potential threats of wildfire and barred owl range expansion still exist, therefore, the agency will continue to monitor the status of the species (Federal Register 2006).

A recent meta-analysis of demographic study results for California spotted owl populations in the Sierras was conducted to perform a status review of the species by the USDI Fish and Wildlife Service in 2005 and early 2006. This review found that most populations (including the population studied on the ENF) demonstrated an increasing or stationary trend and that there was no strong evidence for decreasing trends on any of the study areas (Federal Register 2006). The ENF currently manages habitat for over 200 spotted owl territories, but the proportion of these territories that are occupied at any one point in time is unknown with the exception of the Eldorado study area demographic work research. The Eldorado Density Study (63% on ENF, 37% on private) and a portion of the Regional Study Area (58% of the owl territories) occur on the ENF, in El Dorado and Placer Counties, overlapping the Pacific and Georgetown Ranger Districts. The 2007 Annual Results reported "after two poor reproductive years on the Eldorado study area in 2005 and 2006, reproduction rebounded sharply this past breeding season" (Gutierrez, et al. 2008). Though milder weather conditions have provided better nesting success and fledgling survival, the study also indicated that "the population rate of change on the Eldorado Density Study Area indicated that lambda for population of territorial owls has gradually declined over the course of our study" (Ibid 2008). The conclusion for the report mentions monitoring should continue to enable research to assess "if changes in owl populations are the result of natural events or management-induced changes in forest composition and structure as the Forest Service moves forward in implementing fuels treatments under the 2004 Sierra Nevada Amended Framework" (Ibid 2008).

The reproductive season for spotted owls occurs between mid-February and August with most young fledging by August 31 (Verner et al. 1992). According to the literature regarding productivity and survivorship of spotted owls, there is a direct relationship between the amount of high quality habitat (greater than 50% canopy closure) in close proximity to the nest stand and reproduction (Verner et al. 1992). There are currently two Protected activity Centers (PACs) within the project area boundary.

PAC ED_139 only had a portion of the PAC burned by the fire. The historic activity center for this PAC was unaffected by the Freds Fire due to its location south of the American River, outside the fire perimeter. PAC habitat lost for ED_139, within the fire area, has been replaced with available Home Range Core Area (HRCA) acreage south of the river, outside the fire, and closer to the historic activity center. PAC ED_103 had the majority of the PAC and HCRA burned. Portions of the habitat occur outside the burn area and within residual live tree pockets in the burn area. PAC_103 and HRCA has been redrawn to incorporate remaining habitat near the historic activity center and also outside the burn area.

Surveys were conducted to relocate owls found in the Freds Fire area in 2005. Table 3-41 gives the status of those owl territories directly affected by the fire, as well as current and historical survey efforts. Surveys will be conducted in late spring/early summer in 2009 to assess current spotted owl occupancy status associated with PACs ED-103, and ED-139.

Table 3-41. Spotted Owl Protected Activity Centers within the Freds Fire Area

PAC	Best Status/Year	Last Status/Year
ED_103	Pair, 2 Young/2000	Adult male, 2007
ED_139	2 Young, 2005	Pair, 2006

Source: USDA 2009

Habitat Relationships

Suitable spotted owl habitat in the Sierra Nevada consists of dense, multi-layered mature forested stands with greater than 70% canopy closure preferred for nesting and greater than 50% canopy closure for foraging (Verner et al. 1992). Also important is availability of large snags and down logs, which are utilized for nesting and support the owl's prey base of mainly flying squirrels and woodrats (Laymon 1988). On the Forest, spotted owls are known to occur between 2,000 feet and 7,200 feet in elevation, with most of the nesting pairs found in the Sierra mixed conifer habitat type.

Approximately 84% of 292 California spotted owl nest vegetation plots were classified as CWHR classes 6, 5D, 5M, 4D, and 4M (USDA 2001b). These CWHR types are also rated as providing high and moderate suitability foraging habitat for California spotted owls based on the expert opinion habitat relationship models contained in the CWHR database. The majority of spotted owl nest sites have been documented to occur in CWHR classes 6, 5D, and 5M. It would be expected, therefore, that CWHR classes 6, 5D, and 5M would have the highest probability of providing stand structures associated with preferred nesting, roosting, and foraging (USDA 2001b).

Historical and current spotted owl habitat conditions within the Freds Fire

Spotted owl habitat remains broadly distributed on the ENF, however, temporary habitat gaps have been created in the areas burned by the Cleveland, Fred's and Star Fires on the ENF. A geographic area of concern, mapped as the large areas of intermixed and checkerboard land ownership on the Georgetown and Pacific Ranger Districts, has been identified as an area where suitable habitat appears to be fragmented and in low abundance as the result of past and ongoing timber harvest. Within this area, the lower density of spotted owl pairs increases the uncertainty of successful mate finding and replacement of vacated territories (Verner, et al. 1992).

The impacts of catastrophic fire on spotted owl survival and reproduction is unclear. From what we do know about spotted owl biology of preferring unfragmented areas with large trees and dense canopies centered around their activity center (Verner et al 1992, Bart 1995), one could infer that destruction of these elements by wildfire would have a negative effect on owl survival and reproduction. The loss of habitat due to catastrophic fire was listed as one of the major threats to spotted owl habitat in the Sierra Nevada (Verner et al. 1992). Gaines et al. (1997) reported that northern spotted owls were not observed returning after Hatchery Complex fires in Washington. In the Marble-Cone fire in California and following the 1994 fires on the Yakima Indian Reservation in south-central Washington, spotted owls either abandoned their habitat or avoided areas that experienced stand-replacement fire (Elliott 1985, Bevis et al. 1997, in Smith 2000).

Research from spotted owl demography study areas throughout the species range (northern, California, and Mexican subspecies) attempted to determine the short-term (1-year) effects of fire on four factors: 1) minimum survival, 2) site fidelity, 3) mate fidelity, and 4) reproductive success (Bond et al. 2002). The study looked at fires greater than 1,340 acres in which known owl nest and roost sites from one of three Demographic Studies were burned. Out of greater than 300 territories, eleven met the criteria (4 northern, 3 California, and 4 Mexican). Fire severities were mapped at 8 of the 11 territories, with half of the eight burning primarily at low to moderate severity. In the remaining four territories, 36-88% of the territory burned at high severity. Both minimum survival (defined as surviving at least one year after the fire) and site fidelity were found to be similar to overall estimates for the three sub-species for spotted owl (Bond et al. 2002). Four of the seven owl pairs found produced young the year following the fire (Bond et al. 2002). Caution should be exercised when making conclusions about reproduction because differences could be from year-to-year variation and not as a result of the fire (Bond et al. 2002).

Telemetry studies in the Timbered Rock Fire in 2004, in southwestern Oregon, showed use of post-fire habitat by owls in moderate to high severity burn areas (Andrews and Anthony 2004). The ENF assumes that the type of habitat utilized by spotted owls would be similar before and after a fire, with foraging habitat occurring in forested habitat with greater than 50% canopy closure and nesting habitat having greater than 70% canopy closure. However, preliminary results from the Timbered Rock Fire, documented approximately 19% of all owl locations were within high-severity burned areas during the winter season one year post-fire (Andrews and Anthony 2004). Given that owls appeared to be using moderately to heavily burned forests, they suggested a cautious approach to salvage on the study area, but due to the small sample size and uncertainty about the accuracy of the fire severity mapping, the authors considered their results "exploratory and preliminary. The Timbered Rock Fire telemetry study states that fire severity ratings were not field verified and would be done as part of an expanded study effort. It was unclear if BAER severity ratings for watershed were used or intensity ratings in regard to tree mortality to determine the severity ratings for the Timbered Rock Fire, and due to this, comparisons to the Freds Fire were limited. However, it does show more information is needed from these and future studies, on where and for how long owls may utilize post-burn areas, as well as a consistent approach to mapping post-burn habitat and tree mortality.

Suitable habitat has been mapped for spotted owls on the forest, based on vegetation that meets the suitable habitat described in the Sierra Nevada Forest Plan Amendment (USDA 2001b). Habitat is represented by CWHR types 4M, 4D, 5M, and 5D. Mortality of the partial green stands in the project area was split into three categories based on residual green trees. High mortality was defined as stand replacing, or stand replacing with inclusions of scattered clumps of green trees under 10 acres. Moderate intensity was not stand replacing, had green residual remaining, and had a mosaic of variable burn intensities. Low mortality had minimal mortality within the stands and exhibited conditions similar to that of an understory burn. Based on mortality estimates (Smith 2001), approximately 332 acres (>75% mortality class) remain scattered across the landscape, based on green tree mapping, within the moderate and high intensity burn areas. This is an over-estimate of live trees remaining to contribute to suitable or potential future habitat as trees may continue to die from the fire or insect damage within 1-2 years. It is unlikely that the scattered remaining habitat would provide long-term support to a breeding pair of owls; however, it may be important for dispersal in the future. Low mortality had minimal mortality within the stands and exhibited conditions similar to that of an understory burn and still provides habitat, primarily within PAC ED_139 (Table 3-42).

Table 3-42. Existing Suitable Habitat in Freds Project Area Boundary still Available for Owl Use

Existing Habitat within Freds Fire	Existing Acres	Suitable Habitat Acres Proposed for Treatment	Affected Acres of Existing Habitat	Existing Habitat Post-Project	PAC Overlap	HCRA Overlap
Low Intensity Burn	285 acres	0 acres	0	285 acres	ED-139	ED-139
Moderate and High Intensity Burn	332 acres, scattered	0 acres	0	332 acres, scattered	ED-103	ED-103

Pallid Bat

Throughout California, the pallid bat is usually found in low to middle elevation habitats below 6,000 feet (Philpott 1997); however, the species has been found up to 10,000 feet in the Sierra Nevada (Sherwin 1998). Pallid bats are most common in open, dry habitats that contain rocky areas for roosting. They are a yearlong resident in most of their range and hibernate in winter near their summer roost (Zeiner et al. 1990). Day roosts may vary but are commonly found in rock crevices, tree hollows, mines, caves and a variety of human-made structures. Tree roosting has been documented in large conifer snags, inside basal hollows of redwoods and sequoias, and bole cavities in oaks (Sherwin 1988). There is a strong association with roosting in black oak cavities (Pierson 1996) for pallid bats. Maternal roosts are typically colonies (usually between 20 to several hundred individuals). Breeding occurs between May and July, with young weaned in mid-late August USDA 2009b) and maternity colonies breaking up by mid-October (Barbour and Davis 1969, in USDA 2009b). Little is known about the winter habits of this species although it is thought to winter near the summer roost sites (Ibid). Pallid bats forage near and at ground level. Pallid bats are known to feed predominately on ground-dwelling arthropods, such as scorpions and Jerusalem crickets (USDA 2001b). Foraging occurs over open ground, where pallid bats are more often found along edges and open stands, particularly hardwoods (USDA 2001b).

Townsend's Big-Eared Bat

The Townsend's big-eared bat occurs throughout the west. In California, the species is typically found in low desert to mid elevation montane habitats, although sightings have been reported up to 10,800 feet (Philpott 1997, Sherwin 1998, in USDA 2009b). Habitat associations include desert, native prairies, coniferous forests, mid-elevational mixed conifer, mixed hardwood-conifer forests, riparian communities, active agricultural areas and coastal habitat types (Kunz and Martin 1982, Brown 1996, Sherwin 1998, in USDA 2009b). Populations have incurred serious declines over the past 40 years in parts of California (Brown 1996, in USDA 2009b). Foraging usually begins well after dark (Kunz and Martin 1982, in USDA 2009b). Foraging associations include edge habitats along streams and areas adjacent to and within a variety of wooded habitats (Sherwin 1998, in USDA 2009b). In California, the species is shown to forage preferentially in association with native vegetation (Brown 1996, in USDA 2009b). Flight is slow and maneuverable, with the species capable of hovering (Zeiner et al. 1990) and gleaning insects off foliage (Brown 1996, in USDA 2005b). The Townsend's big-eared bat is a moth specialist, with over 90% of its diet composed of lepidopterans (Sherwin 1998, in USDA 2009b).

Western Red Bat

The species is found primarily in riparian and wooded habitats, particularly in willows, cottonwoods and sycamores (Bolster 1998, in USDA 2009b). Red bats are highly migratory between their summer and winter range, although migratory patterns are not well documented and winter behavior is poorly understood. However, it is known to winter in the San Francisco area and to the south, has been observed hibernating in leaf litter (Brown 1996, in USDA 2009b). The timing of migration for males and females seems to differ, although groups tend to migrate together (Bolster 1998, in USDA 2009b). Western red bats are typically solitary. Roosting has been observed in caves, but generally red bats roost singly within tree foliage or shrubs, and often along edge habitat adjacent to streams or open fields. Colonies of red bats are not formed. Roost sites are generally hidden from view from all directions except from below. The lack of obstruction from below allows the bat to drop downward for flight. Roost sites usually have dark ground cover to minimize solar reflection, have nearby vegetation to reduce wind and dust, and are generally located on the south or southwest side of a tree (Bolster, in USDA 2009b). Western red bats prefer to roost in deciduous trees within riparian zones.

Current Bat Habitat

Pallid bats and Townsend’s big-eared bats are associated with oak woodlands, snags, rock outcrops, caves, bridges, abandoned mines, and riparian habitat. Western red bats are associated with deciduous trees in riparian zones.

The Freds Fire created open habitats and large snags (162 acres in snag patches and additional snags scattered over the project area), including oak, which are favored by bat species as habitat. Habitat quality on both private and public lands in the Freds Fire is considered low in regards to roosting for bats because of the low snag levels retained after fire salvage.

Large live trees that succumbed to the fire after fire salvage provide suitable roosting habitat for bats, currently in the form of snags and in the future as down logs. Remaining green trees serve as potential recruitment snags. These categories of trees aid in replacing or contributing to the existing standing snag and down log component, across the landscape as part of natural snag cycling. Conifer snag species include ponderosa pine, sugar pine, incense cedar, Douglas-fir, white fir, Jeffrey pine and red fir. Insects invading dead trees may provide some prey for these bat species; however, pallid bats favor ground-dwelling insects. Additional areas within the project area, may serve as foraging habitat dependent on the existing shrub cover and associated invertebrate prey base.

Hardwoods, in the form of individual trees and scattered clumps provide potential habitat. Large diameter black oak snags occur randomly throughout the mixed conifer hardwood and montane hardwood CWHR stand types that experienced fire. Within oak woodland habitat types, live hardwoods primarily occur in the low intensity burn areas, however, some individual trees occur mixed in with the residual green stands that experienced higher intensity burns. The Freds Project area is comprised of primarily a mix of conifer types; however; oaks do occur within stands designated as SMC.

No species specific surveys for the three bat species have been conducted, and the distribution of these species on the Forest is unknown with the exception of 2001 and 2002 bat inventories. Pallid bats have been captured in mist nets along the Silver Fork of the American River as a result of the monitoring efforts. No Townsend’s big-eared bats or western red bats were captured during any of the survey efforts. All three bat species are assumed to be present based on suitable habitat provided by riparian habitat, black oak, large snags, and rock outcrops scattered throughout the project area. It is likely that some of these habitat features may hold either or all: hibernaculum, maternity or basic roost sites for bat species RCAs containing larger deciduous trees also occur within the project area. Areas containing large deciduous trees are variable within the length of the RCAs.

Environmental Consequences

Federally Endangered, Threatened, or Proposed Species

No federally listed threatened, endangered, or proposed terrestrial wildlife species or their habitat will be affected by this project. Therefore, there would be no impacts from any of the alternatives in this project to such species.

Alternative 1 (Proposed Action)

Toxicological Effects- All Species

As previously described, the BE determined that the valley elderberry longhorn beetle (threatened), and sensitive species northern goshawk, great gray owl, American peregrine falcon, willow flycatcher, Sierra Nevada red fox, Pacific fisher, American marten, California wolverine, and American bald eagle will not be affected by the proposed project. Potential exposure to herbicides to terrestrial wildlife species considered for further analysis includes California spotted owl, pallid bat, Townsend's big-eared bat, and western red bat.

Five herbicides are proposed under this alternative: Glyphosate, triclopyr BEE, hexazinone, clopyralid, and chlorsulfuron. The Final Environmental Impact Statement for Reforestation (USDA 1989b) (page 4-43) describes the following risks to bird and mammal species associated with use of glyphosate, triclopyr, and hexazinone, along with 8 other herbicides:

"Comparison of the bird and mammal doses to the laboratory lethal levels indicates that there is little chance of any direct mortality from herbicide exposures in the Region 5 program for these 11 herbicides. They are all far lower than the 1/5 LD_{50} criterion of EPA (1986). Under worst case circumstances where an individual animal is sprayed and consumes only contaminated diet items, there would be a risk of fatality or severe effects from the herbicides, but this is highly unlikely. Only under extremely rare circumstances would an animal be likely to be seriously affected in a spraying operation."

The ecological risks of various formulations of glyphosate, triclopyr, hexazinone, clopyralid, and chlorsulfuron; are described in ecological risk assessments prepared for the Forest Service by Syracuse Environmental Research Associates, Inc. (SERA 1996a, 1997a, 1999, 2003a, 2003b, 2004a, 2004b, and 2005). Assessments have also been completed for the use of dyes and Nonylphenol Polyethoxylate-based (NPE) surfactants (SERA 1997b, USDA 2003a). These assessments and a more detailed discussion of toxicological effects presented in the project environmental analysis are incorporated by reference and form the basis for the following analysis. The Herger-Feinstein Quincy Library Group Supplemental EIS (USDA 2003b) provides detailed information on the effects of herbicide use on terrestrial wildlife and is also incorporated by reference, as is USDA 2007a, updated information in regards to surfactants.

Estimated exposure doses for terrestrial species are based on the planned herbicide application rates for this project and are located in the project file. They follow the same methodology as the Site-Specific Human Health Risk Assessment (Appendix D). They are based on USDA (2003) and the SERA Risk Assessments.

Studies on surrogate species were utilized when species specific information was not available. For this project, a surrogate species for bats, a small mammal, is used as a surrogate for direct spray. A small bird eating contaminated insects is used as a surrogate for a bat eating contaminated insects. A carnivorous bird eating a small mammal is used as a surrogate for a spotted owl eating contaminated prey.

To quantitatively characterize risk a hazard quotient is calculated. The quantitative risk characterization is expressed as the hazard quotient, which is the ratio of the estimated exposure doses to the NOAEL. Tables 3-43 through 3-47 provide a summary of the risk characterization.

Clopyralid

Clopyralid has been tested on a limited number of species and under conditions that may not well-represent populations of free-ranging non-target animals. However, clopyralid appears to be relatively non-toxic to terrestrial animals, and the weight of evidence suggest that no adverse effects in terrestrial animals are plausible using typical or even very conservative worst case exposure assumptions (SERA 2004b). For terrestrial mammals, the dose-response assessment for clopyralid is based on the same data as used in the human health risk assessment (i.e. an acute NOAEL (no observed adverse effects level) of 75 mg/kg/day and a chronic NOAEL of 15 mg/kg/day). None of the exposure scenarios, acute or longer term, resulted in exposure estimates that exceed this NOAEL. The very limited data on toxicity to birds suggest that birds may be somewhat more sensitive than mammals. Nonetheless, there is no indication that clopyralid is highly toxic to birds (SERA 1999). A comparison of gavage studies between mammals and birds suggest that birds may be more sensitive than mammals. However, based on a comparison of short-term dietary NOAELs, birds appear to be somewhat less sensitive, with an acute dietary NOAEL of about 670 mg/kg/day. Since most of the exposure assessments developed in this risk assessment involve gradual intake during the day,

Table 3-43. Summary of Hazard Quotients for Terrestrial Wildlife – Clopyralid

Summary of Risk Characterizations at Highest Application Rate (2.4 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Acute/Accidental Exposures						
Direct Spray						
first-order absorption	Small mammal	1E-03	3E-04	6E-03	75	NOAEL
100% absorption	Small mammal	0.08	0.08	0.08	75	NOAEL
100% absorption	Honey Bee	0.04	0.04	0.04	909	NOAEL
Contaminated Insects						
	Small Bird	0.01	0.01	0.042	670	NOAEL
Consumption of contaminated small mammal						
	Carnivorous bird	1E-03	1E-03	1E-03	670	NOAEL
Chronic/Longer-term Exposures						
Consumption of contaminated fish						
chronic	Fish-eating bird	1E-05	8E-07	3E-05	15	NOAEL

Glyphosate

A risk assessment was completed for the use of glyphosate by the Forest Service in vegetation management in 2003 (SERA 2003a). The analysis reviewed available studies for any "specific toxicities that would occur in birds as compared to mammals and found suggestive evidence that glyphosate may inhibit phosphorylation and consequently reduce food conversion efficiency" in mammals and birds; however; they also found glyphosate has an apparent lack of teratogenic activity in birds (SERA 2003a).

This herbicide is generally not known to bioaccumulate in an animal's fatty tissue (SERA 2003a), therefore, secondary adverse impacts to a species preying on an animal that had been directly exposed to glyphosate is not expected.

Based on the available field studies of the effects of glyphosate on terrestrial animals, at the application levels proposed "direct toxic effects are unlikely. The effects on terrestrial animals appear to be secondary to changes in habitat resulting from toxic effects on vegetation (SERA 1996a)." Glyphosate was characterized in the HGQLG Supplemental EIS (USDA 2003b) as "practically non-toxic to mammals, birds, bees, aquatic invertebrates; slightly toxic to fish." A summary of SERA 2003a for terrestrial organisms shows that, at the typical application rate of 2 lbs a.e./acre, none of the hazard quotients for acute or chronic scenarios reach a level of concern, eliminate the possibility of any animal actually consuming this vegetation over a prolonged period (SERA 2003a). The direct spray of a honey bee at an application rate of 7 lbs a.e./acre corresponds to a dose of 1120 mg/kg bw. It is unclear is this would be associated with detectable toxic effects. Based on the study by Palmer and Krueger (2001a, in SERA 2003a), a dose of 100µg/bee, corresponding to about 1080 mg/kg bw, was associated with 5% mortality (3/60). It should also be noted that this risk characterization applies only to bees that are directly sprayed at the maximum application rate (7 lbs/acre) and does not consider the effects of foliar interception. Thus under actual field conditions, substantial mortality in bees would not be expected (SEAR 2003a).

The Site-Specific Risk Assessment analysis conducted for the Freds Fire Reforestation Project (Table 3-44) showed that effects to birds, mammals and invertebrates are similar to SERA 2003a. The highest rate proposed on this project (4.8 lbs/acre (versus 7 lbs/acre in SERA 2003a)). reduces risk. As bats have the potential to be exposed through direct exposure or through eating contaminated insects, a surrogate species for bats, a small mammal, is used as a surrogate for direct spray. A small bird eating contaminated insects is used as a surrogate for a bat eating contaminated insects. The small mammal being sprayed is below a level of concern, even under a 100 percent absorption scenario. A small bird eating contaminated insects modestly exceeds the level of concern (HQ =1) at the upper level of exposure. This scenario may be extremely conservative as it assumes that 100% of the insects consumed by the bird on the day of exposure (i.e, no dissipation is assumed) were directly sprayed. As spotted owls have the potential to be exposed through eating contaminated prey, a carnivorous bird eating a small mammal is used as a surrogate. This acute scenario is well under the level of concern (HQ = 0.03). The acute dose received (15.5 mg/kg bw) is also a factor of 6 below the chronic NOAEL of 100 mg/kg/bw/day.

Table 3-44. Summary of Hazard Quotients for Terrestrial Wildlife – Glyphosate

Summary of Risk Characterizations at Highest Application Rate (4.8 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Acute/Accidental Exposures						
Direct Spray						
first-order absorption	Small mammal	7E-03	2E-03	0.02	175	NOAEL
100% absorption	Small mammal	0.7	0.7	0.7	175	NOAEL
100% absorption	Honey Bee	**1.4**	**1.4**	**1.4**	540	NOAEL
Contaminated Insects						
	Small Bird	0.3	0.3	**1.0**	562	NOEC
Consumption of contaminated small mammal						
	Carnivorous bird	0.03	0.03	0.03	562	NOAEL
Chronic/Longer-term Exposures						
Consumption of contaminated Fish						
chronic	Fish-eating bird	2E-06	1E-07	3E-05	100	NOAEL

Hexazinone

Effects to animals from hexazinone is dependent on the formulation utilized (granular or liquid) according the risk assessment on hexazinone conducted for the Forest Service (SERA 2005).).

Under this project, only granular formulations are proposed. The toxicity of hexazinone to terrestrial wildlife, particularly invertebrates, is not well characterized. Therefore, the assessment of effects on terrestrial species is based primarily on the available data on experimental mammals. "Based on dietary toxicity values, birds seem less sensitive than mammals" (SERA 2005). The acute toxicity is low, with oral LD_{50} values in experimental mammals ranging from approximately 500 to 3500 mg/kg. The effects observed in mammals after subchronic or chronic exposure to hexazinone are generally limited to decreases in body weight, increases in liver weight, and changes in blood enzyme levels associated with liver toxicity. Based on the available toxicity data and the estimated levels of exposure, there is very little indication that granular hexazinone is likely to cause adverse effects in terrestrial animal species (SERA 2005). An exception involves an exposure scenario in which birds consume hexazinone granules immediately after application. In this instance, reproductive effects and possibly overt signs of toxicity are possible. The plausibility of this risk for birds, however, is questionable. There is no data indicating that birds will consume any of the granular formulations that contain hexazinone. Thus, a lower limit on the exposure assessment is zero. If birds were to consume these granules preferentially, exposure levels could be much higher. In such a case, toxic effects, including mortality could occur. Without additional information, with which to improve the exposure assessment, the risk cannot be characterized further (SERA 1997a). The risk assessment (SERA 2005) anticipated potential adverse effects to mammals (based on the range of applications rates used by the Forest Service) that ate the impacted vegetation over a long period of time. "Adverse impacts to reproduction did not appear to be plausible and insufficient data whether weight loss would occur" over this period, though not a substantial number would be affected to detect any impacts from weight loss to the overall population (ibid).

The SERA risk assessment indicated that effects from hexazinone to birds and mammals would more likely be the result of effects to vegetation which would be a secondary effect due to reduction in food or prey base or potentially an increase in other vegetation and associated prey base (SERA 2005).

The Site-Specific Risk Assessment analysis conducted for the Freds Fire Reforestation Project showed that no exposure scenarios at any level (acute or chronic) exceed the NOAEL (USDA 2009).

Table 3-45. Summary of Hazard Quotients for Terrestrial Wildlife – Hexazinone

Summary of Risk Characterizations at Highest Application Rate (3 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Acute/Accidental Exposures						
Direct Spray						
first-order absorption	Small mammal	1E-02	5E-03	2E-02	400	NOAEL
100% absorption	Small mammal	0.2	0.2	0.2	400	NOAEL

100% absorption

Exposure of triclopyr to terrestrial animals can occur via direct spraying or through the consumption of vegetation or prey species that have been exposed. The effects of exposure based on application rates used by the Forest Service is expected to be minimal based on results on experimental mammals and the lack of minimal bioconcentration in aquatic species (DFG 1994, SERA 1996b, Woodburn 1996, SERA 2003b). The application rate proposed under Alternative 1 takes potential risks from inadvertent exposure into consideration as well as taking measures to reduce spray drift. In addition stream buffers will be implemented to avoid any direct spray to water sources in the project area.

The risk characterization conducted in SERA (2003b) found that, for terrestrial mammals, the central estimates of hazard quotients do not exceed the level of concern for any exposure scenarios. At the upper range of exposures, the hazard quotients exceed the level of concern for large mammals and large birds consuming contaminated vegetation exclusively at the application site. At higher application rates, concern for exposure scenarios involving the consumption of contaminated vegetation is augmented substantially. At the maximum application rate of 10 lbs a.e./acre, the central estimate of the hazard quotient exceed the level of concern for several acute exposure scenarios: the direct spray of a small mammal assuming 100% absorption, a large mammal consuming contaminated vegetation, and a small bird consuming contaminated insects. The central estimates of the hazard quotients for the chronic consumption of vegetation is exceeded for a large mammal and a large bird and the upper range on the hazard quotients are also increased by a factor of 10: i.e., to 60 for a large mammal and 50 for a large bird.

Thus, the SERA 2003b risk assessment is consistent with the risk characterization given by U.S. EPA indicating that contaminated vegetation is primary concern in the use of triclopyr and that high application rates will exceed the level of concern for both birds and mammals in longer term exposure scenarios.

The Site-Specific Risk Assessment analysis conducted for the Freds Fire Reforestation Project at the highest application rate of triclopyr BEE proposed on this project (2.4 lb/acre) substantially reduces the potential for triclopyr-related effects from the maximum application rates (10 lbs/acre) analyzed in SERA 2003b. Furthermore, the limited use of triclopyr on the project (97 acres) reduces the potential for exposure. For species with potential for exposure on this project (Table 3-46), the three bat species and spotted owls, the site-specific analysis showed that none of the scenarios involving surrogate species, representing bats and owls, exceed a level of concern (HQ <1).

Table 3-46. Summary of Hazard Quotients for Terrestrial Wildlife – Triclopyr BEE

Summary of Risk Characterizations at Highest Application Rate (2.4 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Acute/Accidental Exposures						
Direct Spray						
first-order absorption	Small mammal	0.4	4E-03	0.5	100	NOAEL
100% absorption	Small mammal	0.6	0.6	0.6	100	NOAEL
100% absorption	Honey Bee	0.4	0.4	0.4	1075	LD_{50}
Contaminated Insects						
	Small Bird	0.2	0.2	0.7	388	NOAEL
Consumption of contaminated small mammal						
	Carnivorous bird	0.02	0.02	0.02	388	NOAEL
Chronic/Longer-term exposures						
Consumption of contaminated Fish						
chronic	Fish-eating bird	6E-04	8E-05	1E-03	10	NOAEL

Chlorsulfuron

The Site-Specific Risk Assessment analysis conducted for the Freds Fire Reforestation Project showed that no exposure scenarios at any level exceed the NOAEL (Project File).

Additives

There has been little toxicity testing done on these additives, however additional effects may occur from exposure to ingredients used as dyes and surfactants in the herbicide mixtures. This project would use a MSO-based, a silicone/MSO blend, or a NPE-based surfactant, and Colorfast Purple or Hi-Light Blue dye. Risk quotients were developed for NPE-based surfactants, but not for the other surfactants or dyes, although some discussion of these substances is included in the project's Human Health risk assessment (Chapter 3- Human Health and Safety of Herbicide Use).

Colorfast Purple dye is intended to reduce the risk to humans by clearly marking sprayed vegetation, but would not necessarily be identified and avoided by animals. Basic Violet 3 dye is the colorant in Colorfast Purple. Most of the information about its toxicological effects is attributed to the chloride salt, commonly referred to as Gentian Violet. Gentian Violet is a suspected carcinogen, known mutagen, and skin and eye irritant (SERA 1997b). Gentian Violet has a moderate acute toxicity (LD_{50} of 96 mg/kg) (USDA 2007). Because the formulation of Colorfast Purple is proprietary, the concentration of the components is unknown, and the risk of potential exposure rates is difficult to determine (Ibid). However, colorants are expected to pose a minimal risk to wildlife at proposed application rates

Hi-Light Blue dye is not a registered pesticide and carries no signal word. It would carry a Caution signal word if one were to be assigned due to it being an irritant to the skin and eyes (USDA 2007). Hi-Light Blue is a water-soluble dye, is virtually non-toxic to humans and often used as a colorant for both toilet bowl cleaners and lakes and ponds. The effect on terrestrial and aquatic species is unknown, though the use of the dye has not created any known issues (USDA 2007).

A silicone/MSO blend surfactant (such as Syl-Tac®) is a blend of a vegetable oil and a silicon-based surfactant. Syl-Tac® has a Caution signal (practically non-toxic to slightly toxic). Syl-tac® is thought to be relatively low risk, but may be a skin or eye irritant. There is little information in the scientific literature based on effects of seed oils and silicone-based surfactants on mammals beyond some basic acute testing results. Standard mammalian acute toxicity results for Syl-Tac® were summarized as practically non-toxic at Oral LD_{50} (> 5 g/kg) and slightly toxic at Dermal LD_{50} (> 5g/kg) (USDA 2007).

Methylated seed oils are low acute oral and dermal toxicity. (USDA 2007). Most carry a Caution signal word for potentially slight irritant to eyes and skin.

The Human Health and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications (USDA 2003a) summarizes the risk to terrestrial wildlife species. The active ingredient in NPE- based surfactants, nonylphenol polyethoxylate, has been linked to estrogenic effects in wildlife.

Based on the expected chronic exposure levels, there is little risk to terrestrial wildlife at any application rate (.25% to 2.5%, with the typical dilution of 1%) considered in that risk assessment.

In the Freds Fire Reforestation Site-Specific risk assessment (Table 3-47), based on the hazard quotients for the surrogate species of species of concern (bats, spotted owl), several of the scenarios represent a potential risk of effects to terrestrial wildlife. With typical application rates (2.0 lbs/acre), two of the acute scenarios result in hazard quotients that exceed unity (direct spray of a small mammal, assuming 100% absorption, and a small bird eating contaminated insects). Acute doses from 10 to 40 mg/kg/day may not represent a risk to mammals, in which case these typical scenarios may be of low risk, even though the hazard quotient exceeds unity. At the highest application rates, the small bird eating contaminated insect acute exposure scenario represents a high risk of effects (HQ=22). At exposures between 100 and 250 mg/kg/day, effects are uncertain in terms of seriousness, with inconsistent results in the various studies.

Both of these scenarios are unlikely. Given the assumptions, combined with typical animal behaviors, the actual exposure rate for a directly sprayed small mammal is likely somewhere in between the two scenarios (first order absorption and 100% absorption). The small bird eating contaminated insects scenario, used as a surrogate for a bat eating contaminated insects, may also be extremely conservative as it assumes that 100% of the insects consumed by the bird on the day of exposure (i.e, no dissipation is assumed) were directly sprayed.

The dose of herbicide received by a small mammal is estimated at 1 mg (Site-specific worksheets). Consumption by a owl, with an average weight of 3 lbs, would result in a dose to the owl of .67 mg/kg, well below the NOAEL of 10 mg/kg. indicating a low risk of effects.

Table 3-47. Summary of Hazard Quotients for Terrestrial Wildlife – NPE-based Surfactants

Summary of Risk Characterizations at Highest Application Rate (2 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Acute/Accidental Exposures						
Direct Spray						
first-order absorption	Small mammal	8.1E-03	1.2E-03	0.1	10	NOAEL
100% absorption	Small mammal	**4.8**	**4.8**	**4.8**	10	NOAEL
Contaminated Insects						
	Small Bird	**7.5**	**7.5**	**22**	10	NOAEL
Contaminated fish						
	predatory bird	0.06	0.03	0.09	10	NOAEL
Chronic/Longer-term exposures						
Consumption of contaminated Fish						
chronic	Fish-eating bird	7.0E-05	0	2.1E-04	10	NOAEL

Sensitive Species

California Spotted Owl

Alternative 1 (Proposed Action)

Direct and Indirect Effects

Toxicological Effects: Herbicide use is expected to have no to minimal effects upon spotted owls as described under the Toxicological Effects Section, above.

Disturbance Effects: Limited Operating Periods are in place to prevent disturbance to nesting spotted owls, therefore, it is not anticipated that there will be disturbance-related effects.

Habitat Effects: Initially, planting trees and vegetation control will increase the number of seedlings, as well as enhance seedling survival and growth. The resultant plantations will, in the long term, aid in accelerating the area towards old forest characteristics, benefiting terrestrial threatened, endangered, and sensitive wildlife. Vegetation treatments with herbicides are also aimed at removing two invasive plants to prevent further spread and to enable native vegetation to return to the currently infested locations.

Within the Freds Fire area boundary, about 332 acres of green trees remain scattered across the landscape, based on green tree mapping in moderate and high intensity burn areas. These acres do not include individual trees scattered in the burn, which are primarily within the moderate intensity burn areas. Although these partially green stands provide some habitat for owls, their suitability as owl habitat will likely be reduced over time as fire-weakened trees continue to die and canopy cover is reduced further. Reforestation efforts will potentially start to provide foraging habitat for spotted owls, with 4M/4D conditions occurring potentially in <50 years, and 5M/5D conditions in 80 years.

Verner et al. 1992, found an average of 15 to 30 square feet of basal area in snags within owl foraging habitat. Planning for 2 or 3 snags per acre of larger diameter snags, that would remain standing in 30 to 50 years, would provide this level of snag basal area within newly developed foraging habitat. As snags fall, they will contribute to down logs, and as prey move out from the core areas of the PACs, spotted owls should see higher densities and improved foraging success in developing habitat. Because of the variety of size class of snags left in the RCAs (minimum of 2 per acre in the threat zone), many of the snags will have fallen within 20 years and would have already decomposed to levels below what is considered optimal for spotted owl by the time foraging habitat develops. This would be offset, however, by the snag retention clumps which provide some of the larger diameter snags (CWHR 4 and 5). There are approximately 162 acres within three snag patches in the project area. These areas are not planned for planting or vegetation control and will take longer to develop into denser canopied stands, even if natural regeneration occurs within these sites. Even if no natural regeneration occurs, these gaps still provide habitat diversity for prey species adjacent to developing planted stands.

Cumulative Effects

An analysis of cumulative effects to California spotted owls will consider the impacts of this alternative when combined with past, present, and foreseeable future actions and events that have affected or may affect the quantity or quality of spotted owl habitat within the analysis area. The cumulative effects analysis area has been established as a 27,000 acre area that encompasses both NFS and private lands within 1.5 miles of the project area (fire area) boundary. The geographic scope of the cumulative effects analysis was selected considering the home range of the spotted owl (4,500 acres) and multiplied by the number of owl PACs that fell within the 1.5 miles of the fire boundary. The PACs and HCRAs of a number of neighboring spotted owls (an additional 4 PACs) occur within this 1.5 mile distance, allowing an evaluation of the project's cumulative effects upon nesting, foraging and dispersal capabilities of spotted owls (6 PACs) within and adjacent to the project area.

The magnitude of changes from projects, which have effects for the six spotted owl PACs within the cumulative effects analysis area is derived from past disturbance information. This information is based upon the Forest's existing vegetation data (1997) which, through acres in plantations, shows regeneration harvest that has occurred on National Forest System and private lands since the mid-1960's; the fire history layer for the ENF, the FACTS database which shows fuels treatments that have occurred on National Forest lands since 1990 (few treatments occurred prior to 1995); and Cumulative Watershed Effects Reports which provide additional effects analysis information for the Freds Fire and surrounding area. Habitat in plantations, planted in post 1975, as well as high severity wildfire acres that have occurred within the past few decades, is assumed to be unsuitable. Commercial thinning treatments, and low to moderate severity wildfires, are assumed to have degraded spotted owl habitat, but not to have been rendered habitat unsuitable for owl foraging.

The project area overlaps a portion of the Freds Fire Restoration Project (which overlapped the Freds Fire boundary) in which fire salvage was completed on approximately 2,936 acres.

Within the 1.5 mile distance from the Freds Fire boundary, have been several wildfires that have removed suitable spotted owl habitat and created areas of fragmentation between spotted owl PACs. Specific projects for this cumulative analysis includes past large wildfires, including the Freds, Cleveland Wrights Pilliken, and the Icehouse Fire. Within the Freds, Cleveland, Wrights and Pilliken Fire areas, vegetation changes prior to the fires are not relevant to the cumulative effects analysis as the fires altered vegetative structure to the date they occurred. Outside of these fire areas timber harvest, fuels treatments, and hazard tree removal projects have altered the quantity and quality of spotted owl habitat. These include the planting in the Freds Fire area, the

Jane Doe and Roadrunner Fuels Reduction thinning and mastication projects, and fire salvage in the Freds Fire Restoration project. Other projects include the Algorythym Roadside Hazard Project and private fire salvage. The Algorythym Project overlaps that of salvage acres so the acres won't be duplicated for this analysis.

Tree planting may accelerate the development of future suitable spotted owl habitat faster than natural regeneration in the Freds Fire area. Maintenance of existing plantations from past fires outside the Freds Fire will aid in achieving mature forest faster than if left untreated, providing future habitat for spotted owls, as well as re-establishing connectivity between forested areas, including plantations treated in the Middle Creek area under the planned Silver Saddle Sale Forest Health Project.

Another aspect that could impact the development of owl habitat in the Freds Fire is a future wildfire. The project areas lies in both defense and threat zone allocations due to the urban-wildland interface created by Highway 50, summer home tracts, local businesses, other facilities, and high public use. The American River Canyon has had large wildfires for the past few decades. This combined with private land has fragmented suitable habitat for spotted owls across the landscape, particularly for the two remaining PACs in the Freds Fire area. The Freds Fire adds to this fragmentation, as well as increasing the nearest neighbor distance between remaining PACs.

The threat of another large wildfire occurring along Highway 50 in the South Fork American River corridor within 10 years is high (Chapter 3 - Fire and Fuels). The Highway 50 corridor has had four large wildfires within the past 31 years (Wrights, Cleveland, St. Pauli and Freds). Other large fires on the Eldorado within the past five years include the Star, Plum Complex, and Power Fire. The potential for a wildfire start is high due to proximity to the large number of travelers along Highway 50, a PG and E distribution line that runs through the canyon, residential development, summer home tracts, recreational use, and lightning.

Predicted fire behavior modeling of timber stands and fuel types that are representative of current conditions, indicates that high intensity fire with rapid rates of spread would be likely under moderate weather conditions (Chapter 3 – Fire and Fuels). Regardless of the type of fuel loading, the area has a high risk of wildfire repeating across the landscape, risking the development of late seral habitat features and future habitat for mature forest species. Repeat wildfire through the area, should it happen, would maintain the area in "early seral" conditions favored by sensitive species or their prey that utilize that type of habitat. The effects of this alternative compared to the No Action Alternative with regards to fire risk is that, with the proposed treatments, a fuel complex with rapid rates of spread and little resistance to control it is less likely develop within 25 years. This alternative would also create conditions more favorable to enable deployment of suppression resources that would be more efficient in reducing damage caused by wildfire (Chapter 3 – Fire and Fuels).

The majority of the suitable spotted owl habitat in the analysis area occurs within the current PAC designation for PAC ED-103 and ED-139. The indirect effects of Alternative 1 do not contribute to past or future reductions in the amount of current suitable spotted owl habitat, but may increase the quality of future habitat by enhancing site conditions to speed the development of planted and naturally regenerated seedlings across the landscape. As no suitable habitat is affected, no expected increase in negative cumulative effects from this alternative is expected. In the long run, the project may improve habitat capability for this species, when considered with other present and foreseeable projects. This is based on remaining suitable habitat being retained, and that the alternative is expected to help provide for future habitat connectivity which will aid in the reduction of fragmentation between PACs and HRCAs.

Alternative Conclusion

Alternative 1 may affect individuals but will not lead to a trend towards federal listing or a loss of viability for the California spotted owl. This conclusion is based on:

Mitigations in the form of Limited Operating Periods will aid in preventing disturbance to nesting spotted owls.

No to minimal risk to owls from herbicide applications.

No reduction of existing suitable spotted owl habitat.

Planting of seedlings and vegetation control will accelerate tree growth within the area to aid in restoring late seral habitat and connectivity between PACs; thereby providing a beneficial effect to spotted owls.

Alternative 2 (No Action)

Direct, Indirect and Cumulative Effects:

Toxicological Effects: As no herbicide application is planned under this alternative, there will be no toxic effects to spotted owls from herbicides.

Disturbance Effects: As no activities are proposed, there will be no disturbance-related effects to spotted owls.

Habitat Effects: Without managed reforestation, habitat on forest lands would progress through successional changes, taking up to 150 years in already planted stands (Chapter 3 – Vegetation Management) to develop into conifer forest SMC 4M/4D/5M or better and over 150 years to develop into 5D stands. In unplanted areas, it is unlikely for stands to reach 40% or greater canopy closure within 150 years, resulting in potential lack of foraging habitat preferred by spotted owls.

Salvage of dead trees has been completed on private and public lands. Reforestation has started on both private and public lands and private landowners have utilized herbicides to control competing vegetation. Montane chaparral has been reduced on private land through the use of herbicides. Tree dominated habitat will recover quickly through growth of planted and natural regenerating conifer seedlings, and typically reach CWHR size class 3 (6-12 inches DBH) within 20 years on private lands. Adjacent private lands will exhibit a more managed even-aged SMC or Ponderosa Pine (PPN) conifer habitat for the next 50 years. Habitat within the Freds Fire area on NFS land will be a mosaic of hardwoods, brush, grass and conifers in varying age sizes and classes. The size and location of these habitat components will be dependent on the intensity of the fire in a particular area and the survival of individual or small clumps of large trees, as well as survival of seedlings that have been planted in the area.

By far, the greatest impact to the spotted owl and its habitat was the Freds Fire itself. Areas of high intensity burn provide no suitable habitat for the spotted owl. Early-seral conditions would persist in stands with greater than 75% mortality for at least 50 years under this alternative. Assuming natural succession, it is estimated that it would take at least 150 years to develop habitat conditions suitable for spotted owls (i.e. SMC 4M or better) and up to 250 years to develop "old-forest" conditions (SMC 6) that spotted owls most prefer. Most of the snags created by the fire and that remain post-fire salvage, (even the largest) will have fallen by the time mature forest conifer habitat develops (Morrison and Raphael 1993). Based on the decay rate used for the SNFP most of these fallen snags will be in advanced stages of decay in 100 years. Few of these may persist as down logs, which are an important element for quality spotted owl habitat (Verner et al. 1992).

Prey species preferred by spotted owl (woodrats and flying squirrels) will likely avoid the burn area (Smith 2000) until habitat conditions become favorable to them. As Montane chaparral (MCP) stands mature, woodrats may recolonize this habitat at elevations below 5,000 feet (Mayer and Laudenslayer 1988). Flying squirrels will likely be absent in high intensity burn areas until mature conifer habitat or large diameter oak develops.

The small patches of currently suitable habitat within the fire area would persist over the short-term, which may provide dispersal habitat from areas unaffected by the fire. These areas will provide legacy elements of late seral habitat (large trees, snags, logs) within stands that have been planted or naturally regenerated, on both private and public lands. The suitability of these stands will diminish somewhat in the short term, as green trees weakened by the fire or other environmental conditions continue to die, thereby reducing canopy closure.

Habitat will likely be present sooner with reforestation and some form of treatment of competing brush on private lands. Habitat that develops there could be utilized by owls, which would be important for dispersal between unburned areas north and south of the fire. In addition, existing live trees will provide small remnant patches of mature forest structure and add to snag recruitment over the long term on NFS land. Oak that was killed by the fire will continue to stump sprout and develop a canopy, possibly within ten years, depending on site conditions. Large oaks that survived the fire will continue to provide canopy cover, primarily in the low intensity burn areas. On Sierra Pacific Industries lands treated after the Freds Fire, stands that develop will likely be even-aged and would not provide the multi-canopy structure that spotted owls prefer, though it could still provide foraging habitat or security and thermal cover.

Existing yellow starthistle infestation areas would continue to expand into open or disturbed areas, including areas that are currently being treated on private land and adjacent NFS land within the historic Cleveland Fire area, reducing habitat value for wildlife.

Alternative Conclusion and Summary

This alternative will not affect the suitability of existing habitat within the project area and will have no indirect, direct or cumulative effect on spotted owls, and therefore, would not lead to a trend toward federal listing or loss of viability.

Alternative 3

Direct, indirect and cumulative effects:

Toxicological Effects: No toxic effects upon spotted owls are expected as no herbicides are proposed for use.

Disturbance Effects Limited Operating Periods are in place to prevent disturbance to nesting spotted owls, therefore, it is not anticipated that there will be disturbance-related effects.

Habitat Effects: Effects to spotted owl habitat would be similar to that described under Alternative 1 based on silvicultural modeling with the exception of 800 acres that would not be planted or have vegetation treatment. These 800 acres would develop as described under the No Action Alternative and would delay spotted owl habitat from developing, where site conditions allow, within those acres as compared to managed acres under Alternative 1. Under this alternative development of spotted owl habitat within planted acres may take 110 years to reach 4M/4D, 115 years to reach 5M and >150 years to reach 5D, based on silvicultural modeling. Unplanted acres are unlikely to achieve >40% crown closure within 150 years.

Cumulative effects would be similar to that described for Alternative 1 with the exception of reduced acreage under tree planting (800 acres) and no herbicide applications. Effects from future fire risk would be similar to the No Action Alternative because hand grubbing in a radius around planted trees will not diminish the brush component to the extent that it would alter the fuel loading to change predicted fuel modeling (Chapter 3 - Fire and Fuels).

Alternative Conclusion and Summary

Alternative 3 may affect individuals but will not lead to a trend towards federal listing or a loss of viability for the California spotted owl. This conclusion is based on:

Mitigations in the form of Limited Operating Periods will aid in preventing disturbance to nesting spotted owls.

No reduction of existing suitable spotted owl habitat.

Planting of seedlings and vegetation control will accelerate tree growth within the area to aid in restoring late seral habitat and connectivity between PACs; thereby providing a beneficial effect to spotted owls.

Pallid, Townsend's Big-Eared and Western Red Bat

Alternative 1 (Proposed Action)

Direct and Indirect Effects

Toxicological Effects: Herbicide use is expected to have no to minimal effects upon bat species as described under the Toxicological Effects Section for all species in regards to mammals and also invertebrates (prey species in regards to bioaccumulation).

Disturbance Effects: In the absence of surveys, it is assumed that individual roost sites may occur in large hardwoods, snags, and rock outcrops scattered throughout the project area. It is likely that some of these habitat features may hold either or all: hibernaculum, maternity or basic roost sites for bat species. There is minimal risk of breeding disturbance as roost features will not be directly affected by project activities. It is possible that if a roost tree exists within or immediately adjacent to a treatment unit, human activity at the base of the tree may cause some disturbance, however, as individual roost trees are unknown, it is impossible to assess the likelihood of this occurring. As oaks would not be intentionally sprayed, including seedlings, sprouts and larger trees, it is not expected that there would be contact with large trees (no planting within 20 feet). The potential for disturbance would be limited by human presence outside that 20 foot zone. BMPs that protect RCAs, as well as no removal of riparian deciduous trees will aid in protecting western red bat roost habitat. These avoidance measures, as well as the short duration of activities and timing across the project area, further reduces the risk of disturbance to bat populations.

Habitat Effects: Effects to habitat (trees) would be similar to that described for spotted owls in regards to both late and early seral habitat. In the short-term, existing roosting habitat will not be removed within the project area. Planting of seedlings and vegetation control will promote faster development of trees, both oak and conifer, to provide roosting habitat for bat species in the long term. In Montane Hardwood and Montane Hardwood-Conifer stands that burned in the fire, oaks will regenerate through stump sprouting but will likely not mature for at least 80 years. Project treatments under this alternative will shorten that timeframe, as well as enable oaks to increase across the landscape by the reduction in competition with brush.

A study of post-fire herbicide spraying by DiTomaso et al (1997) indicated very low shrub cover (1, 7 and 11 percent cover) in three sprayed areas after 2, 8 and 12 years following fire, respectively, compared to 75, 44, and 103 percent cover in the same respective areas not treated with herbicides. It is unclear whether similar results would occur on the treatment units since there seems to be a high degree of variability in the efficiency of herbicide treatments. Assuming project objectives are met, however, shrub cover would be reduced from between 40 to 100 percent, and in some areas, at least below 20 percent for a minimum of 5 years. The DiTomaso study involved hexazinone. Under this project about 100 acres would be treated with hexazinone; therefore; it is anticipated that the results would not be as severe as those in the DiTomaso study.

Herbaceous vegetation and some amount of shrub cover or re-growth would be likely to remain on the treated units, but bat prey habitat provided by these units would decline over five to ten years. Proposed shrub removal through mastication or herbicides has the potential to displace invertebrate prey species both from disturbance and alteration of prey habitat structure (forage and host plants). Leaving pockets of untreated areas will reduce this effect. Prey availability may be less than the No Action Alternative for invertebrate species that utilize brush or grasses; however, additional openings will increase oak and conifers and invertebrates associated with this habitat type for the pallid bat.

Acres within units that overlap RCAs are variable due to noncontiguous deciduous tree component, however, RCA objectives will aid in protecting roosting habitat for the red bat and foraging habitat for all three species.

Cumulative Effects

Given the changes in forest vegetation that have been described within the Sierra Nevada over the last 100 years, it is likely that there are less mature hardwoods, and denser conifer vegetative conditions less than eight feet high, within mid-elevation stands than there were historically. This would suggest a historic reduction in foraging habitat availability and quality. It is unclear what the cumulative effect of past actions may have been on sensitive bat species in the Freds Project analysis area. Timber harvest may have removed existing and future snags that could have been utilized by bats for roosting, and may have also opened the understory up for foraging opportunities. Other cumulative effects in regards to tree or snag removal and/or plantation treatments would have similar effects as described under the spotted owl under Alternative 1. The reduction in risk of future wildfires, promotion of future hardwood habitat, and maintaining open understory over the long term meets several of the conservation measures suggested for bats in the SNFPA (USDA 2004b).

Alternative Conclusion

The Proposed Action Alternative may affect individuals, but is not likely to lead to a trend towards federal listing or loss of viability for the pallid bat, Townsend's big-eared bat or the western red bat. This determination is based upon the following factors:

The Proposed Action Alternative maintains habitat characteristics believed to be important for the pallid, Townsend's big-eared and western red bat. Prescriptions are designed to retain and improve the current and future number of large diameter trees, snags, and down logs, and protect riparian corridors.

Treatment of brush through herbicides as well as mastication will alter invertebrate prey habitat (host plants), primarily that of lepidopterans, a favored prey species of the Townsend's big-eared bat.

An increase of hardwoods within stands will improve habitat, primarily pallid bat, in regards to black oak improvement, as the species has been detected utilizing the Silverfork of the American River corridor.

Alternative Two (No Action)

Direct and Indirect Effect:

Toxicological Effects: No toxic effects upon pallid bat, Townsend's big-eared bat or western red bat are expected as no herbicides are proposed for use.

Disturbance Effects: As no activities are proposed under this alternative, there will be no disturbance-related effects to pallid bat, Townsend's big-eared bat or western red bat.

Habitat Effects: The Freds Fire created open habitats and large snags (162 acres in snag patches and additional snags scattered over the project area), including oak, which are favored by bat species as habitat. Large live trees that succumbed to the fire after fire salvage provide suitable roosting habitat for bats, currently in the form of snags and in the future as down logs. Remaining green trees serve as potential recruitment snags. These categories of trees aid in replacing or contributing to the existing standing snag and down log component, across the landscape as part of natural snag cycling. Conifer snag species include ponderosa pine, sugar pine, incense cedar, Douglas-fir, white fir, Jeffrey pine and red fir. Insects invading dead trees may provide some prey for these bat species; however, pallid bats favor ground-dwelling insects. As montane chaparral matures and forms a closed canopy, foraging habitat quality will be reduced for pallid bat as openings are filled in, reducing invertebrate prey species associated with open ground. Invertebrates associated with shrub species will still provide a prey base for all three bat species.

Oaks burned by the fire have stump sprouted in these areas, but may still take up to 80 years provide the structure to support habitat for roosting bats in hollow limbs, trunks or tops as well as cracks within the bark.

Habitat quality on both private and public lands in the Freds Fire is considered low in regards to roosting for bats because of the low snag levels retained. However, bats roosting on adjacent forest lands may forage on the more open Freds Fire project until the oak canopy begins to close in the short term (15 to 20 years) and when conifers reach a size to develop a closed canopy in the long term (refer to spotted owl discussion).

Natural regeneration would reduce habitat suitability in the long term for bats, as they tend to prefer more open habitat types for foraging. However, the growth of large conifers and oaks will provide future recruitment of snags in the long term. If a high intensity wildfire returned and re-burned the area, most snags providing roost sites for this species would be lost before new snags could be recruited from mature conifer and oak stands.

Additional effects under this alternative would be similar to that described for the spotted owl.

Cumulative Effects

As there are no indirect or direct effects, there are also no cumulative effects associated with this project under the No Action Alternative. The No Action Alternative would not directly affect nor add to any adverse cumulative effects for the pallid, Townsend's big eared or western red bat or their existing habitats.

Alternative Conclusion

No activities are occurring under this alternative. The No Action Alternative will not affect the suitability of existing habitat within the project area and will have no indirect, direct or cumulative effect on pallid bat, Townsend's big-eared bat or western red bat, and therefore, would not lead to a trend toward federal listing or loss of viability.

Alternative 3

Direct, Indirect and Cumulative Effect:

Toxicological Effects: No toxic effects upon pallid bat, Townsend's big-eared bat or western red bat are expected as no herbicides are proposed for use.

Disturbance Effects: In the absence of surveys, it is assumed that individual roost sites may occur in large hardwoods, snags, and rock outcrops scattered throughout the project area. It is likely that some of these habitat features may hold either or all: hibernaculum, maternity or basic roost sites for bat species. There is minimal risk of breeding disturbance as roost features will not be directly affected by project activities. It is possible that if a roost tree exists within or immediately adjacent to a treatment unit, human activity at the base of the tree may cause some disturbance, however, as individual roost trees are unknown, it is impossible to assess the likelihood of this occurring. As oaks would not be intentionally removed, including seedlings, sprouts and larger trees, it is not expected that there would be contact with large trees (no planting within 20 feet). The potential for disturbance would be limited by human presence outside that 20 foot zone. BMPs that protect RCAs, as well as no removal of riparian deciduous trees will aid in protecting western red bat roost habitat. These avoidance measures as well as the short duration of activities and timing across the project area, further reduces the risk of disturbance to bat populations.

Habitat Effects: Effects to bat habitat would be similar to that described under Alternative 1 with the exception of 800 acres that would not be planted or have vegetation treatment, which would develop as described under the No Action Alternative. Alternative 3 would retain foraging habitat longer (invertebrate host plants) within those acres as compared to Alternative 1. Cumulative effects under Alternative 3 would be similar to that described for Alternative 1 except that vegetation management will be occurring within a 5 foot radius around trees, retaining shrub component and prey habitat, outside these circles, tree planting would be reduced, and there would be no herbicide applications.

Alternative Conclusion and Summary

This alternative may affect individuals, but is not likely to lead to a trend towards federal listing or loss of viability for the pallid bat, Townsend's big-eared bat or the western red bat. This conclusion is based upon the following factors:

Alternative 3 maintains habitat characteristics believed to be important for the pallid, Townsend's big-eared and western red bat.

Prescriptions are designed to retain and improve the current and future number of large diameter trees, snags, and down logs, and protect riparian corridors

Treatment of brush through hand grubbing and mastication will alter invertebrate prey habitat (host plants), primarily that of lepidopterans, a favored prey species of the Townsend's big-eared bat.

An increase of hardwoods within stands will improve habitat, primarily pallid bat, in regards to black oak improvement, as the species has been detected utilizing the Silver Fork of the American River corridor.

Terrestrial Management Indicator Species

Affected Environment

Management Indicator Species (MIS) for the Eldorado NF are identified in the 2007 Sierra Nevada Forests Management Indicator Species Amendment (USDA 2007b). The habitats and ecosystem components and associated MIS analyzed for the project were selected from this list of MIS, as indicated in Table 3-48 (species analyzed for this project are shaded). In addition to identifying the habitat or ecosystem components , the CWHR type(s) defining each habitat/ecosystem component, and the associated MIS, Table 3-48 discloses whether or not the habitat of the MIS is potentially affected by the Fred's Fire Reforestation Project. The MIS in Category 3 (fox sparrow, mountain quail), whose habitat would be either directly or indirectly affected, are evaluated for direct, indirect, and cumulative effects.

Effects of Proposed Project on the Habitat for the Selected Project-Level MIS

The analysis of the effects of the Freds Project on the MIS habitat for the selected project-level MIS is conducted at the project scale. Habitat has been identified utilizing CWHR classification (Mayer and Laudenslayer 1988) that was obtained utilizing the 1997 Forest Vegetation Inventory. Detailed information on the MIS is documented in the SNF Bioregional MIS Report (USDA Forest Service 2008b), which is hereby incorporated by reference. Cumulative effects at the bioregional scale are tracked via the SNF MIS Bioregional monitoring, and detailed in the SNF Bioregional MIS Report (USDA Forest Service 2008b).

Shrubland- West-Slope Chaparral (Fox Sparrow)

Habitat/Species Relationship: The fox sparrow was selected as the MIS for shrubland (chaparral) habitat on the west-slope of the Sierra Nevada, comprised of montane chaparral (MCP), mixed chaparral (MCH), and chamise-redshank chaparral (CRC) as defined by the California Wildlife Habitat Relationships System (CDFG 2005). Recent empirical data indicate that, in the Sierra Nevada, the fox sparrow is dependent on open shrub-dominated habitats for breeding (Burnett and Humple 2003, Burnett et al. 2005, Sierra Nevada Research Center 2007).

Project-level Effects Analysis - Shrubland (West-Slope Chaparral) Habitat

Habitat Factors for the Analysis: (1) Acres of shrubland (chaparral) habitat [CWHR montane chaparral (MCP), mixed chaparral (MCH), and chamise-redshank chaparral (CRC)]. (2) Acres with changes in shrub ground cover classes (Sparse=10-24%; Open=25-39%; Moderate=40-59%; Dense=60-100%. (3) Acres with changes in CWHR shrub size class Seedling Shrub (seedlings or sprouts (<3 years); Young shrub (no crown decadence); Mature Shrub (crown decadence 1-25%); Decadent Shrub (>25%).

Current Condition of the Habitat Factors in the Project: There are 714 acres comprised of shrubland habitat within the project treatment areas. Shrub age varies across similar acres from mature shrubs to young plants in created gaps, dependent on the intensity of burning the areas received during the Freds Fire.

Table 3-48. Selection of Terrestrial MIS for Project-Level Habitat Analysis for the Fred's Fire Reforestation Project

Habitat or Ecosystem Component	CWHR Type(s) Defining the Habitat or Ecosystem Component[1]	Sierra Nevada Forests Management Indicator Species Common and *Scientific Name*	Category for Project Analysis[2]
Shrubland (west-sloped chaparral types)	Montane chaparral (MCP), mixed chaparral (MCH), chamise-redshank chaparral (CRC)	Fox Sparrow *Passerella iliaca*	3
Sagebrush	Sagebrush (SGB)	Greater Sage-Grouse *Centrocercus urophasianus*	1
Oak-associated Hardwood and Hardwood/Conifer	Montane Hardwood (MHW), Montane Hardwood-Conifer (MHC)	Mule Deer *Odocoileus hemionus*	2
Riparian	Montane Riparian (MRI), Valley Foothill Riparian (VRI)	Yellow warbler *Dendroica petechia*	2
Early Seral Coniferous Forest	Ponderosa Pine (PPN), Sierran Mixed Conifer (SMC), White Fir (WFR), Red Fir (RFR), Eastside Pine (EPN), tree sizes 1, 2, and 3, all canopy closures.	Mountain Quail *Oreortyx pictus*	3
Mid Seral Coniferous Forest	Ponderosa Pine (PPN), Sierran Mixed Conifer (SMC), White Fir (WFR), Red Fir (RFR), Eastside Pine (EPN), tree size 4, all canopy closures.	Mountain Quail *Oreortyx pictus*	3
Late Seral Open Canopy Coniferous Forest	Ponderosa Pine (PPN), Sierran Mixed Conifer (SMC), White Fir (WFR), Red Fir (RFR), Eastside Pine (EPN), tree size 5, canopy closures S and P.	Sooty (blue) grouse *Dendragapus obscurus*	2
Late Seral Closed Canopy Coniferous Forest	Ponderosa Pine (PPN), Sierran Mixed Conifer (SMC), White Fir (WFR), Red Fir (RFR), Eastside Pine (EPN), tree size 5 (canopy closures M and D) and tree size 6.	California Spotted Owl *Strix occidentalis occidentalis* American Marten *Martes americana* Northern Flying Squirrel *Glaucomys sabrinus*	2 2 2
Snags in Green Forest	Medium and Large Snags in Green Forest	Hairy Woodpecker *Picoides villosus*	2
Snags in Burned Forest	Medium and Large Snags in Burned Forest (Stand Replacing Fire)	Black-Backed Woodpecker *Picoides arcticus*	2

[1] CWHR size classes and canopy (refer to Table 3-38). In addition, **canopy closure**: S=10-20% canopy closure); **Tree size classes**: 1 (Seedling <1" dbh); 2 (Sapling 1"-5.9" dbh).

[2] **Category 1:** MIS whose habitat is not in or adjacent to the project area and would not be affected by the project.
Category 2: MIS whose habitat is in or adjacent to project area, but would not be either directly or indirectly affected by the project.
Category 3: MIS whose habitat would be either directly or indirectly affected by the project.

Environmental Consequences

Alternative 1 (Proposed Action)

Direct and Indirect Effects to Habitat: There are approximately 714 acres have scattered acreage of CWHR montane chaparral in varying ages and size classes occurring within treatment areas. The remaining habitat falls within conifer, hardwood or riparian designations, which have scattered components of shrubs in the understory where conditions allow.

Change in Acres of Shrubland Habitat, Ground Cover Classes and CWHR Size Classes: Fox sparrows prefer burned-over forest land at a stage of recovery with heavy growth of brush (Austin 1968). At post-fire sites in the Sierra Nevada fox sparrow densities change as brushy fields of chaparral mature (Bock and Kynch 1970, Bock et al. 1978). Approximately 10 years after a fire, montane chaparral reached a density sufficient to support the species. After the Freds Fire, shrubs in the area expanded and are currently at least 4 years of age in areas that received high intensity burning. In areas of light or moderate burning, shrubs may have survived intact, re-sprouted, or expanded into newly created openings with the reduction in overstory tree canopy. Based upon this information, Alternative 1 will reduce habitat for fox sparrows for approximately 10 years (until shrubs provide dense mature fields) following treatments, in areas with shrub removal. This will come from herbicide treatment on roughly 714 acres, though portions of these acres won't be treated due to buffers, radial treatments and avoidance areas. Shrubs across an additional 388 acres will be affected through mastication. It is expected that some untreated patches of shrubs will remain in the project treatment units as well as in adjacent areas within in the original Freds Fire burn boundary that aren't within treatment units. Based on this it is anticipated that the area and will continue to support fox sparrows over this 10 year period.

Cumulative Effects to Habitat in the Analysis Area: Approximately up to 714 acres of shrubland habitat would be treated under Alternative 1. The reduction of shrub ground cover and creation of early seral size classes from the Freds project will reduce habitat quality for fox sparrows for up to 10 years.

The project area overlaps a portion of the Freds Fire Restoration Project (which overlapped the Freds Fire boundary) in which fire salvage was completed on approximately 2,936 acres. This opened up areas for further shrub establishment. This alternative would manage approximately 3,320 acres within the Freds Fire boundary as plantations (conifer dominated), reducing the potential for increasing or maintaining fox sparrow shrubland habitat in these areas.

Another aspect that could impact the development of fox sparrow habitat in the Freds Fire is the possibility of future wildfire. The American River Canyon has had large wildfires for the past few decades and the threat of another large wildfire occurring along Highway 50 in the South Fork American River corridor within 10 years is high (Chapter 3-Fire and Fuels). Predicted fire behavior modeling of timber stands and fuel types that are representative of current conditions, indicates that high intensity fire with rapid rates of spread would be likely under moderate weather conditions. Regardless of the type of fuel loading, the area has a high risk of wildfire repeating across the landscape, risking the development of late seral shrub habitat if future fire were to remove shrubs retained after the Freds Fire (and associated projects) occurred. However, fire occurring within the area again would maintain the area in an early seral condition, benefiting fox sparrow in other areas where trees are removed and shrub habitat is not only enhanced or increased but retained.

Cumulative Effects Conclusion: There will be a reduction in shrub habitat types as 714 acres will be converted to early seral conifer vegetation, altering the existing trend in the amount of habitat type in the project units. Though the acreage, quality of size class, and cover class shrub habitat will be altered, the acres of shrubland habitat in untreated areas as well as pockets within treated areas, in the project boundary will be retained and provide both nesting and dispersal corridors for the fox sparrow.

Alternative 2 (No Action)

Direct and Indirect Effects to Habitat: This alternative will not result in any direct or indirect effects to shrubland habitats.

Cumulative Effects to Habitat in the Analysis Area: As there are no direct or indirect changes in existing circumstances, there will be no cumulative effects associated with this project under this alternative in regards to change in acres of: shrubland habitat; shrub ground cover classes; or CWHR shrub size class.

Cumulative Effects Conclusion: There will be no changes in habitat from current conditions under the No Action Alternative.

Alternative 3

Direct, Indirect and Cumulative Effects to Habitat: Effects on fox sparrow habitat under Alternative 3 would be the same as described in Alternative 1 with the exception of 800 additional acres that won't be treated, including 162 acres of snag patches which are now brush dominated. These additional acres would continue to develop into mature shrubs where site conditions allow, increasing the suitability of habitat for fox sparrow within six or less years (dependent on current age of the shrub component in an area).

Cumulative Effects Conclusion: Shrub habitat types over 552 acres will be converted to early seral conifer vegetation in terms of acres of habitat and therefore will alter the existing trend in the amount of habitat type in the project units. Though the acreage, quality of size class, and cover class shrub habitat will be altered, the acres of shrubland habitat in untreated areas as well as pockets within treated areas, in the project boundary will be retained and provide both nesting and dispersal corridors for the fox sparrow.

Summary of Fox Sparrow Status and Trend at the Bioregional Scale

The ENF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale habitat and distribution population monitoring for the fox sparrow; hence, the shrubland effects analysis for the Freds Fire Project must be informed by both habitat and distribution population monitoring data. The sections below summarize the habitat and distribution population status and trend data for the fox sparrow from the Sierra Nevada Forest Bioregional MIS Report (USDA 2008b).

Habitat Status and Trend: There are currently 922,000 acres of west-slope chaparral shrubland habitat on NFS lands in the Sierra Nevada. Within the last decade the trend is stable.

Population Status and Trend. The fox sparrow has been monitored in the Sierra Nevada at various sample locations by avian point counts and breeding bird survey protocols. These data indicate that fox sparrows continue to be present at these sample sites, and current data at the rangewide, California, and Sierra Nevada scales indicate that, although there may be localized declines in the population trend, the distribution of fox sparrow populations in the Sierra Nevada is stable.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Fox Sparrow Trend

Though the quality of size class and cover class shrub habitat will be altered, the change in acres of shrubland habitat on the 714 acres of shrubland habitat occurring in the Freds Project area will not alter the existing trend in the amount of habitat acres, nor will it lead to a change in the distribution of fox sparrows across the Sierra Nevada bioregion.

Early and Mid Seral Coniferous Forest Habitat (Mountain Quail)

Habitat/Species Relationship: The mountain quail was selected for early and mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat in the Sierra Nevada. Early seral coniferous forest habitat is comprised of primarily seedlings (<1" dbh), saplings (1"-5.9"), and pole-sized trees (6"-10.9" dbh). Mid seral coniferous forest habitat is comprised primarily of small-sized trees (11"-23.9" dbh). The mountain quail is found particularly on steep slopes, in open, brushy stands of conifer and deciduous forest and woodland, and chaparral; it may gather at water sources in the summer, and broods are seldom found more than one half mile from water (CDFG 2005).

Project-level Effects Analysis - Early and Mid Seral Coniferous Forest Habitat

Habitat Factors for the Analysis: (1) Acres of early (CWHR tree sizes 1, 2, and 3) and mid seral (CWHR tree size 4) coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat [CWHR ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree sizes 1, 2, 3, and 4, all canopy closures]. (2) Acres with changes in CWHR tree size class. (3) Acres with changes in tree canopy closure. (4) Acres with changes in understory shrub canopy closure.

Current Condition of the Habitat Factors(s) in the Project Area: There are 3,320 acres of early seral to mid seral coniferous forest in the project area. Shrubs of varying ages and size classes are scatted over the 3,816 acres within the treatment unit boundaries.

Alternative 1 (Proposed Action)

Direct and Indirect Effects to Habitat: The effects of the Freds Fire increased habitat for the mountain quail by removing late seral size trees and creating gaps for natural regeneration of conifer seedlings and brush to develop. There are currently 3,320 acres of early seral coniferous forest habitat that occur within project units that will be managed as conifer plantations under Alternative 1. The removal of competing vegetation will move stands into mature forest sooner, reducing the habitat capability for quail in these areas in the long term. In the short term, cover in the form of stands of seedlings (newly planted) and young trees (11" dbh and under) will increase. This will aid in maintaining early-mid seral conifer habitat, until shrub management is no longer implemented for plantation survival (3-5+ years) and increasing mid seral habitat on these acres as early seral habit develops into larger diameter trees.

Change in Acres of CWHR Tree Sizes and Tree Canopy Closure: No tree removal will occur therefore there will be no change in tree canopy closure or CWHR size class changes in relation to removal of trees. CWHR size changes over treated areas will occur, from areas lacking trees to an increase in early seral habitat, through an increase in seedlings (<1"dbh) and saplings (1-5.9" dbh) from planting.

Acres with Change in Understory Shrub Canopy Closure: After the Freds Fire, shrubs expanded and are currently at least 4 years of age in the areas that received high intensity burning.

In areas of light or moderate burning, shrubs may have survived intact, re-sprouted, or expanded into newly created openings with the reduction in overstory tree canopy. Based upon this information, the Freds Project will reduce habitat for mountain quail following treatments, in areas with shrub removal within the treatment units. This will come from herbicide treatment over roughly 3,319 acres, though portions of these acres won't be treated due to buffers, radial treatments and avoidance areas. Shrubs across an overlap of 388 acres will be affected through mastication. It is expected that some untreated patches of shrubs will remain in the project treatment units, as well as in adjacent areas within in the original Freds Fire burn boundary that aren't within treatment units.

Cumulative Effects to Habitat in the Project Area: The project area overlaps a portion of the Freds Fire Restoration Project (which overlapped the Freds Fire boundary) in which fire salvage was completed on approximately 2,936 acres within a year. This opened up areas for further shrub establishment. This alternative would manage approximately 3,320 acres within the Freds Fire boundary as plantations (conifer dominated), increasing early and mid-seral habitat for quail, but reducing the understory shrub component within those planted areas

The possibility of a future wildfire could impact the development of mountain quail habitat in the Freds Fire Area (refer to Alternative 1 Cumulative Effects discussion for California spotted owl). Regardless of the type of fuel loading, the area has a high risk of wildfire repeating across the landscape. Treatments under this alternative would lessen the effects of wildfire. Any fire (regardless of acreage) occurring within the area project boundary that maintains areas in early seal habitat would benefit mountain quail by maintaining that area in an early seral condition.

Cumulative Effects Conclusion: Planting and vegetation control to enhance tree survival would benefit mountain quail in the short term by increasing early seral stage habitat and maintaining mid seral habitat across the 3,320 acres of areas managed as plantations. Shrub habitat types that fall within treatment unit boundaries as well as the 388 acres proposed for mastication will be converted to early seral conifer vegetation in terms of acres of habitat and, therefore, will alter the existing trend in the amount of habitat type in the project units. Although the understory shrub habitat will be altered, acres of shrubland habitat in untreated areas, as well as pockets within treated areas, in the project boundary will be retained and provide both nesting and dispersal corridors for the mountain quail.

Alternative 2 (No Action)

Direct and Indirect Effects to Habitat: This alternative will not result in any direct or indirect effects to early or mid seral coniferous habitat.

Cumulative Effects to Habitat in the Analysis Area: As there are no direct or indirect changes in existing circumstances, there will be no cumulative effects associated with this project under this alternative in regards to change in acres of early and mid seral coniferous habitat; CWHR tree sizes; tree canopy closure; or understory shrub canopy closure.

Cumulative Effects Conclusion: As there are no changes in habitat from current conditions, the No Action Alternative will not affect the existing early or mid seral coniferous habitat, nor will it lead to a change in the distribution of mountain quail across the Sierra Nevada bioregion.

Alternative 3

Direct and Indirect Effects to Habitat: Effects on mountain quail early seral coniferous habitat under Alternative 3 would be the same as described in Alternative 1 as the difference between the two alternatives is the no use of herbicides and no treatment of an additional 800 acres. This would enable understory shrub growth to be retained or develop as site conditions allow within those 800 acres, as well as outside the circular hand grubbed areas. This, however, would not create any additional acres of early seral habitat for quail unless conifers naturally regenerate within those 800 acres.

Cumulative Effects Conclusion: Planting and vegetation control to enhance tree survival would benefit mountain quail in the short term by increasing early seral stage habitat and maintaining mid seral habitat across the areas managed as plantations. Shrub habitat types that fall within treatment unit boundaries, as well as those acres proposed for mastication, will be converted to early seral conifer vegetation in terms of acres of habitat and therefore will alter the existing trend in the amount of habitat type in the project units. Although understory shrub habitat will be altered, the acres of shrubland habitat in untreated areas and as pockets within treated areas in the project boundary will be retained and provide both nesting and dispersal corridors for the mountain quail.

Summary of Mountain Quail Status and Trend at the Bioregional Scale

The ENF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale habitat and distribution population monitoring for the mountain quail; hence, the early and mid seral coniferous forest effects analysis for the Freds Project must be informed by both habitat and distribution population monitoring data. The sections below summarize the habitat and distribution population status and trend data for the mountain quail from the Sierra Nevada Forest Bioregional MIS Report (USDA 2008b).

Habitat Status and Trend: There are currently 546,000 acres of early and mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat on NFS lands in the Sierra Nevada. Within the last decade, the trend for early seral is slightly decreasing (from 9% to 5% of the acres on NFS lands) and the trend for mid seral is slightly increasing (from 21% to 25% of the acres on NFS lands).

Population Status and Trend: The mountain quail has been monitored in the Sierra Nevada at various sample locations by hunter survey, modeling, and breeding survey protocols. These data indicate that mountain quail continue to be present across the Sierra Nevada, and that the distribution of mountain quail populations is stable.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Mountain Quail Trend. The reduction in understory shrub habitat across the project area and an increase of 3,320 acres of early-mid seral habitat will not alter the existing trend in the habitat, and nor will it lead to a change in the distribution of mountain quail across the Sierra Nevada bioregion.

Short-term Uses and Long-term Productivity

The National Environmental Policy Act requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 Code of Federal Regulations 1502.16).

Maintaining long-term productivity of the land is a central driving concept for National Forest management. Maintaining a diversity of native plant and animal species for the long-term is also a central concept. To this end, all proposed activities in Alternatives 1, 2, and 3 have been considered for their effect on long-term soil productivity, their effects to the beneficial uses of water, short and long-term fire threats and short and long-term effects to native forest plant and animal species, as described and discussed in this Chapter and supporting documentation in the appendices and planning record.

Alternatives 1 and 3 produce short-term effects to vegetation and wildlife habitat from vegetation management. Alternative 1 enhances long-term productivity in terms of movement toward older forest conditions and helping reduce the severity of future wildfires.

Unavoidable Adverse Effects

Implementation of any of the alternatives would result in some unavoidable adverse environmental effects. Although formation of the alternatives and mitigation measures include avoidance of some potential adverse effects, some adverse effects could occur that cannot be completely mitigated. The environmental consequences section for each resource area discusses these effects and they are summarized below.

Unknown occurrences of sensitive or special interest plants could be damaged or destroyed by activities associated with Alternatives 1 and 3, although this will be mitigated to some extent by surveys and will not result in a loss of viability for the species.

There will be a short-term risk of invasive plant spread under Alternative 1 that will be reduced long-term with forest establishment. There will be a long-term risk of invasive plant spread under Alternatives 2 and 3 from open ground potentially created by high severity fire.

No predicted future management activities will affect heritage resources. However, future wildfires will continue to degrade the integrity of these fragile heritage resources. The potential for future high severity fires is greatest under Alternatives 2 and 3.

There may be a negligible or slight short-term increase in sediment delivery to streams during storm events under all the alternatives; State standards for suspended sediment and turbidity will be met.

There will be a short-term loss of shrubland habitat under Alternatives 1 and 3, reducing habitat quality for MIS species that uses this ecosystem component (fox sparrow). Shrubland habitat in untreated areas will provide both nesting and dispersal corridors for the fox sparrow.

There will be a increase in early and mid seral habitat, but a short-term loss of the understory shrub component under Alternatives 1 and 3 for MIS species that uses this ecosystem component (mountain quail). Shrubland habitat in untreated areas will provide both nesting and dispersal corridors for mountain quail.

Animals could be exposed to some level of herbicides. While the use of herbicides has some potential for effects, the risk assessment conducted for this project indicates that the potential for adverse, health-related effects to animals would be low. The use of herbicides could indirectly affect animals to some level of risk through effects to habitat or prey, but these are also expected to be minor.

Alternatives 1 and 3 may affect individuals, but would not likely result in a trend toward Federal listing or a loss of viability for the California spotted owl, pallid bat, Townsend’s big-eared bat, western red bat, western pond turtle, and foothill yellow-legged frog (Alternative 1 only).

Alternatives 2 and 3 are expected to result in unavoidable indirect impacts to resources in the Freds Reforestation area. Both alternatives will delay, to varying degrees, the development of conifer stands with desired old-forest characteristics. Under both Alternative 2 (no vegetation management) and Alternative 3 (radius hand release) fuel loading is expected to increase as brush continues to grow and become decadent over time, thereby extending the period at which conifer seedlings are at risk from a catastrophic stand replacing fire.

Because various elements within ecosystems are linked to each other, activities proposed in this project may affect fungi, bacteria, and a variety of other ecosystem processes, but these effects are expected to be minor. Bacteria are known to break down herbicides into harmless substances without any detrimental effects. The activities included in this project have been conducted for numerous decades without any apparent substantial adverse impacts on those components of the environment.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the loss of timber productivity in forested areas that are kept clear for use as a road.

An irretrievable loss of mature forest would occur if Alternative 2 were selected. This no-action alternative, which defers reforestation and release on the project, would result in delayed establishment of a mixed conifer forest. Related to this, wildlife that favor late seral stage conifer forests are likewise affected.

An irretrievable loss of mature forest would occur if Alternative 3 were selected. This alternative, which reduces reforestation by 800 acres from Alternative 1, and utilizes manual release methods, would result in fewer acres of established forest, and delayed growth of a mixed conifer forest. Related to this, wildlife that favor late seral stage conifer forests are likewise affected.

Cumulative Effects

Cumulative effects are addressed for each resource area in the environmental consequences section.

Other Required Disclosures

Protection of cultural resource sites will comply with the Programmatic Agreement among the USDA Forest Service, Pacific Southwest Region, California State Historic Preservation Officer, and Advisory Council on Historic Preservation Office Regarding the Identification, Evaluation and Treatment of Historic Properties Managed by the National Forest of the Sierra Nevada, California dated 1996 (PA).

No threatened, endangered or proposed species occur within the project area and the project is expected to have no effect on threatened, endangered or proposed species outside of the project area. Formal consultation with the USFWS was therefore unnecessary.

Compliance with the Environmental Justice Act

In February 1994, President Clinton signed an Executive Order on environmental justice, requiring federal agencies to conduct activities related to human health and the environment in a manner that does not discriminate or have the effect of discriminating against low-income or minority populations. Although low-income and minority populations live in the vicinity, activities proposed for the Freds Fire Reforestation project would not discriminate against these groups. Based on the composition of the affected communities and the cultural and economic factors, the activities that are proposed would have no disproportionately adverse effects to human health and safety or environmental effects to minorities, low income, or any other segments of the population. Scoping was conducted to elicit comments on the proposed action from all potentially interested and affected individuals and groups without regard to income or minority status.

Chapter 4
Consultation and Coordination

Preparers and Contributors

Interdisciplinary Team Members

Robert Carroll	Interdisciplinary Team Leader; South Zone Silviculturist, Forest Pesticide Use Coordinator
Sean Ferrell	Placerville District Fuels and Fire Specialist
Judy Rood	Placerville District Archeologist
Katherine Klemic	Placerville District Archeologist
Steve Markman	Hydrologist
Jeff TenPas	Soil Scientist
Susan Yasuda	Placerville District Wildlife Biologist
Eric Holst	Fisheries Biologist
Jann Williams	Fisheries Biologist
Mike Taylor	Forest Botanist
Matt Brown	Forest Botanist

Distribution of the Final Environmental Impact Statement

This final environmental impact statement has been distributed to following Federal agencies, State and local governments, and organizations and individuals who commented during scoping, who requested a copy of the document, or have shown interest on past projects on the Eldorado National Forest.

Federal, State, and Local Agencies

US Environmental Protection Agency
US Department of the Interior
California Department of Fish and Game
California Regional Water Quality Control Board, Central Valley Region
El Dorado County Board of Supervisors
El Dorado County Fire Safe Council
El Dorado Irrigation District

Federally Recognized Tribes

Washoe Tribe of Nevada and California
Shingle Springs Rancheria

Individuals and Groups

Mary Erba
Jim and Pat Slaight
Bob Smith
Tom and Teresa Walker
Leslie Roach
California Native Plant Society
California Indian Basketweavers Association
Californians for Alternatives to Toxics
Steve Brink, California Forestry Association
Vivian Parker, California Native Plant Society
Melba Leal, National Pony Express Association
Sierra Forest Legacy
Chad Hanson, The John Muir Project of Earth Island Institute
Sierra Pacific Industries
Diane Dealey Neill, California Forestry Challenge
Foresthill High School, California Forestry Challenge
Napa New Tech High School, California Forestry Challenge
Franklin High School, California Forestry Challenge
Sacramento New Tech High School, California Forestry Challenge
Livermore High School, California Forestry Challenge
Rio Linda High School, California Forestry Challenge
Grant High School, California Forestry Challenge
Upper Lake High School, California Forestry Challenge
Lincoln High School, California Forestry Challenge
Delta High School, California Forestry Challenge
Shenandoah High School, California Forestry Challenge
Elk Grove High School, California Forestry Challenge
Argonaut High School, California Forestry Challenge
Mike Vedder, California Forestry Challenge
Tessa Levine, California Forestry Challenge

Chapter 5
Glossary

Acronyms

ae: Acid equivalent

ai: Active ingredient

BAER: Burned Area Emergency Response

BE: Biological evaluation

BE/BA: Biological evaluation/ biological assessment

BEE: Butoxyethyl ester

BMP: Best management practice

BW: Bodyweight

BCF: Bioconcentration factor

CWHR: California Wildlife Habitat Relationship

CEQ: Council on Environmental Quality

CFR: Code of Federal Regulations

cfs: Cubic feet per second

CWE: Cumulative watershed effects

DBH: Diameter at breast height

DEIS: Draft environmental impact statement

DPR: (California) Department of Pesticide Regulation

EC_{50}: Environmental concentration for 50% of a population

EEC: Estimated Environmantal concentration

EIS: Environmental impact statement

EID: El Dorado Irrigation District

ENF: Eldorado National Forest

EPA: Environmental Protection Agency

EPCRA: Emergency Planning and Community Right-to-Know Act

ERA: Equivalent roaded acres

FACTS: Forest Service activity tracking system

FEIS: Final environmental impact statement

FSEIS: Final supplemental environmental impact statement

FRCC: Fire regime condition class

FDA: Food and Drug Administration

FS: Forest Service

FSH: Forest Service handbook

ft: feet

FVS: Forest vegetation simulator

GIS: Geographic information system

GLEAMS:Groundwater Loading Effects of Agricultural Management Systems

HQ: Hazard quotient

HFQLG: Herger-Feinstein Quincy Library Group

HRCA: Home range core area

IPM: Integrated Pest Management

kg: kilogram

LC_{50}: Lethal concentration for 50% of population

LD_{50}: Lethal dose for 50% of population

LOP: Limited operating period

MCL: Maximum contaminant level

mg: milligram

mg/kg: milligrams per kilogram

mg/kg/lb: milligrams per kilogram per pound

mg/L: Milligrams per liter

MIS: Management indicator species

MRL: Minimal risk level

MSO: Methylated seed oil

ng: nanogram

NEPA: National Environmental Policy Act

NHPA: National Historic Preservation Act

NF: National forest

NFS: National Forest System

NTU: Nephelometric Turbidity Units

NP: Nonylphenol

NOEC: No observed effects concentration

NOAEL: No observed adverse effects level

NOEL: No observed effects level

NOI: Notice of intent

NPE: nonylphenol polyethoxylate

pH: Acidity

PAC: Protected activity center

POEA: ethoxylated tallow amine surfactant

ppb: Parts per billion

ppm: Parts per million

PGE: Pacific Gas and Electric

RfD: Reference dose

RCA: Riparian conservation area

RCO: Riparian conservation objectives

ROD: Record of decision

TOC: Threshold of concern

ug: microgram

SERA: Syracuse Environmental Research Associates

SMUD: Sacramento Municipal Utilities District

SNFPA: Sierra Nevada Forest Plan Amendment

SPI: Sierra Pacific Industries

SPLAT: Strategically placed landscape area treatment

SOPA: Schedule of Proposed Actions

TCP: 3,5,6-trichloro-2-pyridinol

TES: Threatened and endangered species

TMRC: Theoretical maximum residue concentration

TPA: Trees per acre

USDA: United State Department of Agriculture

USFWS: United States Fish and Wildlife Service

WUI: Wildland urban intermix

WCR: Water contamination rate

Terms

The glossary provides definitions of technical terms and acronyms used in the Freds Fire Reforestation Draft EIS.

Absorption: The process by which the agent is able to pass through the body membranes and enter the bloodstream. The main routes by which toxic agents are absorbed are the gastrointestinal tract, lungs, and skin.

Acid equivalent (a.e.): The acid equivalent of a salt or ester form of the active ingredient of an herbicide is that portion of the molecule that represents the parent acid form of the molecule.

Active ingredient (a.i.): The main ingredient produces the desired effect.

Acute exposure: A single exposure or multiple exposures occurring within a short time (24 hours or less).

Additive effect: A situation in which the combined effects of two chemicals is equal to the sum of the effect of each chemical given alone. The effect most commonly observed when two chemicals are given together is an additive effect.

Adjuvant(s): Formulation factors used to enhance the pharmacological or toxic agent effect of the active ingredient.

Adsorption: The tendency of one chemical to adhere to another material.

Adverse-effect level (AEL): Signs of toxicity that must be detected by invasive methods, external monitoring devices, or prolonged systematic observations. Symptoms that are not accompanied by grossly observable signs of toxicity. In contrast to Frank-effect level.

Assay: A kind of test (noun); to test (verb).

Affected Environment: The physical, biological, social, and economic environment where human activity is proposed.

Age class: One of the intervals, usually 10 to 20 years, into which the age range of vegetation is divided for classification or use.

Alternative: In forest planning, a given combination of resource uses and mix of management practices that achieve a desired management direction, goal, or emphasis.

Annual: A plant species completing its lifespan within one year.

Aquatic ecosystems: The stream channel, lake, or estuary bed, water, biotic communities, and habitat features that occur therein.

Assay: A kind of test (noun); to test (verb).

BehavePlus3: A fire modeling program that describes fire behavior, fire effects, and the fire environment. Its applications for fuel hazard assessment includes modeling the effect of a change in surface and crown fuels on calculated fire behavior under various fuel moisture and wind conditions.

Best Management Practice (BMP): A practice or practices that is the most effective and practical means of preventing or reducing the amount of pollution generated by nonpoint sources. BMPs are contained in *Water Quality Management for Forest System Land in California, USDA Forest Service*, *September 2000* – the BMPs have been approved by the California Water Quality Control Board under the jurisdiction of Section 208 of the Clean Water Act (PL 92-500).

Beneficial uses of water: State law defines the beneficial use(s) of bodies of water. In California, the beneficial uses of a particular body of water may include one or more of the following: domestic; municipal; agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

Bioconcentration factor (BCF): The concentration of a compound in an aquatic organism divided by the concentration in the ambient water of the organism.

Biodiversity: The distribution and abundance of different plant and animal communities and species, habitats, seral stages, and special habitat components in an ecosystem.

California Spotted Owl protected activity center (PAC): A 300-acre, protected area in which California spotted owls find suitable nesting sites and several suitable roosts, and in which they carry out at least half of their nighttime foraging during the breeding season

California wildlife habitat relationship (CWHR): A system of classifying vegetation in relation to its function as wildlife habitat for California’s regularly occurring birds, mammals, reptiles, and amphibians. Tree-dominated habitat is classified according to tree size and canopy closure.

Cancer potency parameter: A model-dependent measure of cancer potency $(mg/kg/day)^{-1}$ over lifetime exposure. [Often expressed as $a_{q1}*$ which is the upper 95% confidence limit of the first dose coefficient ($_{q1}$) from the multistage model.]

Canopy closure: is the proportion of the sky hemisphere obscured by vegetation when viewed by a single point. Closure is affected by tree heights and canopy widths and takes into account light interception and other factors that influence microhabitat

Carbon sequestration: The process through which plant life removes carbon dioxide from the atmosphere and stores it in biomass. Over the course of a year, plants remove and release carbon dioxide. Nnet sequestration results if the rate of removal is higher than the rate of release.

Carcinogen: A chemical capable of inducing cancer.

Carrier: In commercial formulations of insecticides or control agents, a substance added to the formulation to make it easier to handle or apply.

Chronic exposure: Long-term exposure studies often used to determine the carcinogenic potential of chemicals. These studies are usually performed in rats, mice, or dogs and extend over the average lifetime of the species (for a rat, exposure is 2 years).

Conifer: An order of the Gymnospermae, comprising a wide range of trees, mostly evergreens that bear cones and have needle-shaped or scalelike leaves; timber commercially identified as softwood.

Contaminants: For chemicals, impurities present in a commercial grade chemical. For biological agents, other agents that may be present in a commercial product.

Creatine: An organic acid composed of nitrogen. It supplies the energy required for muscle contraction.

Creatinine: The end product of the metabolism of creatine. It is found in muscle and blood and is excreted in the urine.

Cumulative Watershed Effects (CWE) All effects on the beneficial uses of water that occur away from the location of actual land use which are transmitted through the fluvial system.

Cumulative effects: Changes as a result of more than one action that may enhance or degrade a specific site.

Cumulative Impact "… the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes other such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (NEPA, § 1508.7)

Cumulative exposures: Exposures that may last for several days to several months or exposures resulting from program activities that are repeated more than once during a year or for several consecutive years

Dams: Females.

Degraded: Broken down or destroyed.

Dermal: Pertaining to the skin.

Diameter breast height (DBH): Measurement of a tree's diameter, taken at 4.5 feet above the ground.

Dislodgeable residues: The residue of a chemical or biological agent on foliage as a result of aerial or ground spray applications, which can be removed readily from the foliage by washing, rubbing or having some other form of direct contact with the treated vegetation.

Dose-response assessment: A description of the relationship between the dose of a chemical and the incidence of occurrence or intensity of an effect. In general, this relationship is plotted by statistical methods. Separate plots are made for experimental data obtained on different species or strains within a species.

Draft Environmental Impact Statement: The statement of environmental effects required for major Federal actions under Section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review.

Drift: That portion of a sprayed chemical that is moved by wind off a target site.

Draw: A land feature that resembles a stream in some respects, but has a poorly defined channel and shows little or no evidence features that are characteristic of flowing water. Surface flow can occur during rainfall events of high intensity. Draws can develop into streams over geologic time if the climate becomes wetter.

EC_{50}: A concentration that causes 50% inhibition or reduction in a process.

Empirical: Refers to an observed, but not necessarily fully understood, relationship in contrast to a hypothesized or theoretical relationship.

Endocrine: The system in the body consisting of organs that generates compounds that are transported elsewhere in the body and used for regulation of some other part of the body. Examples are the thyroid, the adrenals, and the pituitary glands.

Endogenous: Growing or developing from or on the inside.

Enzymes: A biological catalyst; a protein, produced by an organism itself, that enables the splitting (as in digestion) or fusion of other chemicals.

Ephemeral stream: Strems that have a defined channel throughout much, but not necessarily all of their length. Surface flow exists only during and for a short time following precipitation events. There is little or no riparian vegetation. Non-riparian vegetation, including conifers, may be found on the streambanks and even in the streambeds. Rocks in the channel are generally not covered with green moss.

Epidemiology study: A study of a human population or human populations. In toxicology, a study that examines the relationship of exposures to one or more potentially toxic agent to adverse health effects in human populations.

Equivalent Roaded Acre (ERA) A method of categorizing the amount of soil compaction from land management activities into the common base of a compacted road surface. Roads are assigned an ERA value of 1.0; all other disturbed areas are assigned ERA values less than or equal to one.

Estrogenic: A substance that induces female hormonal activity.

Exposure assessment: The process of estimating the extent to which a population will come into contact with a chemical or biological agent.

Extrapolation: The use of a model to make estimates outside of the observable range.

Fire hazard: Probable fire behavior, based on the characteristics of fuels combined with the influences of topography and weather. The fuels characteristics apply to both dead and live fuels, and include loading (tons per acre), size and shape, compactness, horizontal continuity, vertical arrangement, fuel moisture content, and chemical properties.

Fire regime: The recurring combination of fire occurrence, behavior, effects, and subsequent plant development that is typical of a certain vegetation type.

Fire return interval: The period of time between fires.

Fire risk: The chance (probability) that a wildfire will start, either from natural or human causes, based on recent fire history.

Forest Plan: The Land and Resource Management Plan for the Eldorado National Forest.

Formulation: A commercial preparation of a chemical including any inerts or contaminants.

Fragmentation: The process of reducing the size and continuity of patches of habitat. For purposes of this DEIS, fragmentation is used in reference to forested areas.

Fuel loading: The weight of fuel present at a given site; usually expressed in "tons per acre." This value generally refers to the fuel that would be available for consumption by fire.

Fuel Model; Fuel properties have been organized into standard fuel models for the purpose of estimating fire behavior. Four basic fuels groups (grass, brush, timber, and slash) are broken into several fuel types, which represent the 13 standard fuel models. Mathematical models provide a quantitative basis for predicting fire behavior based on fuel properties of the 13 fuel models.

Fuel profile: The amount and characteristics of live fuel and coarse woody debris in a given area. The amount is referred to as fuel loading, and the characteristics include the horizontal and vertical arrangement and continuity of fuels that affect the spread and intensity of fire.

Fuel treatment: The rearrangement or disposal of fuels to reduce fire hazard or to accomplish other resource management objectives.

Fuels complex: The structure and arrangement of forest fuels.

Gavage: The placement of a toxic agent directly into the stomach of an animal, using a gastric tube.

Geometric mean -- The measure of an average value often applied to numbers for which a log normal distribution is assumed.

Gestation: The period between conception and birth; in humans, the period known as pregnancy.

Half time or half-life: For compounds that are eliminated by first-order kinetics, the time required for the concentration of the chemical to decrease by one-half.

Hazard Quotient (HQ): The ratio of the estimated level of exposure to the RfD or some other index of acceptable exposure.

Hazard identification: The process of identifying the array of potential effects that an agent may induce in an exposed human population.

Hematological: Pertaining to the blood.

Herbaceous: A plant that does not develop persistent woody tissue above the ground (annual, biennial, or perennial, but whose aerial portion naturally dies back to the ground at the end of a growing season. They include such categories as grasses and grass-like vegetation.

Herbicide: A chemical used to control, suppress, or kill plants, or to severely interrupt their normal growth processes.

Herpetofauna: Reptiles and amphibian species as a group

Hibernaculum: The location chosen by an animal for hibernation

Historical range of variability: The distribution of the data values for an environmental indicator over a selected period of time

Histopathology: Signs of tissue damage that can be observed only by microscopic examination.

Home range: The area to which activities of an animal are confined during a defined period of time.

In vivo: Occurring in the living organism.

***In vitro*:** Isolated from the living organism and artificially maintained, as in a test tube.

Inerts: Adjuvants or additives in commercial formulations of Glyphosate that are not readily active with the other components of the mixture.

Invertebrate: An animal that does not have a spine (backbone).

Integrated Pest Management: An ecologically based process for selecting strategies to regulate forest pests to achieve resource management objectives. It is the planned and systematic use of detection, evaluation, and monitoring techniques; and all appropriate silvicultural, biological, chemical, genetic, and mechanical tactics needed to prevent or reduce pest-caused damage and losses to levels that are economically, environmentally, and aesthetically acceptable (FSH 2409.14)

Intermittent or Seasonal stream: Stream that has a well-defined channel throughout the entire length of the stream. Surface flow exists part of the year and may exist most of the year, but not year-round. There is usually some riparian vegetation adjacent to the channel. Green moss on rocks in the channel and adjacent to the channel is often an indicator that a stream is seasonal, not ephemeral.

Irritant effect: A reversible effect, compared with a corrosive effect.

Invasive Plant: An invasive non-native plant that can specified by law as being especially undesirable, troublesome, and difficult to control.

Large woody debris: Dead woody material including as boles (stems), limbs, and large root masses. Type and size of material designated as large or coarse woody debris varies among classification systems.

Lethal Concentration$_{50}$ (LC_{50}): A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

Lethal Dose$_{50}$ (LD_{50}): The dose of a chemical calculated to cause death in 50% of a defined experimental animal population over a specified observation period. The observation period is typically 14 days.

Limited Operating Period (LOP): A seasonal period during which normal forest management operations must be limited to reduce disturbance to wildlife species of concern.

Management Indicator Species: A plant or animal whose presence in a certain situation or location is a fairly certain sign or symptom that particular environmental conditions are also present.

Mechanical treatment: Refers to the use of machinery to remove timber or treat vegetation in an area. Mastication is an example of mechanical treatment.

Metabolite: A compound formed as a result of the metabolism or biochemical change of another compound.

Microorganisms: A generic term for all organisms consisting only of a single cell, such as bacteria, viruses, and fungi.

Minimal Risk Level (MRL): A route-specific (oral or inhalation) and duration- specific estimate of an exposure level that is not likely to be associated with adverse effects in the general population, including sensitive subgroups.

Monitoring: The collection of information over time, generally on a sample basis to measure change in an indicator or variable, for purposes of determining the effects of resource management treatments in the long-term.

Most sensitive effect: The adverse effect observed at the lowest dose level, given the available data. This is an important concept in risk assessment because, by definition, if the most sensitive effect is prevented, no other effects will develop. Thus, RfDs and other similar values are normally based on doses at which the most sensitive effect is not likely to develop.

Mutagenicity: The ability to cause genetic damage (that is damage to DNA or RNA). A mutagen is substance that causes mutations. A mutation is change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

National Environmental Policy Act (NEPA): An Act passed in 1969 to declare a national policy encouraging productive and enjoyable harmony between humankind and the environment. This Act promotes efforts that prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, while enriching the understanding of ecological systems and natural resources important to the nation. The Act established the Council on Environmental Quality.

Non-target: Any plant or animal that a treatment inadvertently or unavoidably harms.

No-Observed-Adverse-Effect Level (NOAEL): The dose of a chemical at which no statistically or biologically significant increases in frequency or severity of adverse effects were observed between the exposed population and its appropriate control. Effects may be produced at this dose, but they are not considered to be adverse.

No-Observed-Effect Level (NOEL): The dose of a chemical at which no treatment-related effects were observed.

Ocular: Pertaining to the eye.

Overstory: Trees that provide the uppermost layer of foliage in a forest with more than one roughly horizontal layer of foliage.

Pathway: In metabolism, a sequence of metabolic reactions.

Perennial: A plant species having a lifespan of more than 2 years.

Perennial Streams: have a well-defined channel throughout the entire length of the stream. Surface flow exists year-round. Riparian vegetation is usually dominant adjacent to the channel, although non-riparian vegetation may also exist.

Permeability: The property or condition of being permeable. The degree to which a substance, especially a fluid, is able to penetrate another.

pH: The negative log of the hydrogen ion concentration. A high pH (>7) is alkaline or basic and a low pH (<7) is acidic.

Precommercial thinning: Cutting in immature stands to improve the quality and growth of the remaining stand.

Prescribed burning: Management-ignited fire in which areas are burned under controlled conditions.

Protected Activity Center (PAC): This refers to areas of delineation around habitat for a specific animal. Protected activity centers are designed to minimize land disturbance within the delineated area.

Reference dose (RfD): Oral dose (mg/kg/day) not likely to be associated with adverse effects over lifetime exposure, in the general population, including sensitive subgroups.

Release: A work done to free desirable trees from competition with overstory trees, less desirable trees or grasses, and other forms of vegetative growth.

Reproductive effects: Adverse effects on the reproductive system that may result from exposure to a chemical or biological agent. The toxicity of the agents may be directed to the reproductive organs or the related endocrine system. The manifestations of these effects may be noted as alterations in sexual behavior, fertility, pregnancy outcomes, or modifications in other functions dependent on the integrity of this system.

RfD: A daily dose that is not anticipated to cause any adverse effects in a human population over a lifetime of exposure. The U.S. EPA derives these values.

Resistance to Control: A measure of the production rate of a resource to construct and hold a fire line. Several factors affect resistance to fire control such as: the type of fuel, the volume of fuel to construct line through, the fire intensity adjacent to the line, steepness of slope, etc.

Riparian Conservation Area (RCA): A land allocation as designated by the SNFPA surrounding an aquatic feature. RCAs are 300 feet on each side of perennial streams and surrounding special aquatic features. The RCA on each side of seasonally flowing streams is 150 feet.

Route of exposure: The way in which a chemical or biological agent enters the body. Most typical routes include oral (eating or drinking), dermal (contact of the agent with the skin), and inhalation.

Scientific notation: The method of expressing quantities as the product of number between 1 and 10 multiplied by 10 raised to some power. For example, in scientific notation, 1 kg = 1,000 g would be expressed as $1 \text{ kg} = 1 \times 10^3$ g and 1 mg = 0.001 would be expressed as $1 \text{ mg} = 1 \times 10^{-3}$.

Sedimentation: The process of sediment deposition, usually resulting from erosion.

Sensitive subgroup: Subpopulations that are much more sensitive than the general public to certain agents in the environment.

Sensitization: A condition in which one is or becomes hypersensitive or reactive to an agent through repeated exposure.

Site preparation: The removal of competition and conditioning of the soil to enhance the survival and growth of seedlings or to enhance the seed germination.

Soil Quality Standards (SQS): Threshold values that indicate when changes in soil properties and soil conditions would result in significant change or impairment of productivity potential, hydrologic function, or buffering capacity of the soil. Detrimental soil disturbance is the resulting condition when threshold values are exceeded.

Special aquatic features: Springs, seeps, bogs, fens, wet meadows, and wet areas other than streams.

Stand: Stands are mapable areas of timber. The criteria used for recognition of a stand depend on the land management objectives. Boundaries may be defined by vegetation, soils, geography, forest uses, or ownership. Size may range from a few acres to hundreds of acres.

Stand replacing fire: A fire with high intensity to cause mortality artilty as compared to the natural range of fire sizes in the fire regime of the geographical area considered. Fires that generally exceed the typical fire size are often of high intensity and may cause profound fire effects.

Stand structure: The horizontal and vertical distribution of components of a forest stand including the height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, snags, and down woody debris.

Stocking: An indication of growing-space occupancy relative to a pre-established standard.

Strategically placed landscape area treatment (SPLAT): Area fuel treatments that treat live and dead fuels, with the objective of reducing uncharacteristically severe wildland fire effects across the landscape.

Sub-chronic exposure: An exposure duration that can last for different periods of time, but 90 days is the most common test duration. The subchronic study is usually performed in two species (rat and dog) by the route of intended use or exposure.

Surface fuels: Fuels located on the ground.

Surfactant: A specific type of additive to a pesticide formulation that is intended to reduce the surface tension of the carrier, to allow for greater efficacy of the pesticide.

Synergistic effect: A situation is which the combined effects of two chemicals is much greater than the sum of the effect of each agent given alone.

Systemic toxicity: Effects that require absorption and distribution of a toxic agent to a site distant from its entry point at which point effects are produced. Systemic effects are the obverse of local effects.

Teratogenic: Causing structural defects that affect the development of an organism; causing birth defects.

Terrestrial: Anything that lives on land as opposed to living in an aquatic environment.

Threshold: The maximum dose or concentration level of a chemical or biological agent that will not cause an effect in the organism.

Threshold of concern (TOC): The point where there a concern that cumulative watershed effects are at a high risk of occurring.

Toxicity: The inherent ability of an agent to affect living organisms adversely.

Threatened and Endangered Species (TES): A plant or animal species identified, defined, and recorded in the *Federal Registe*r, as being in danger of extinction throughout all or a significant portion of its range, in accordance with the Endangered Species Act of 1976.

Uncertainty factor (UF): A factor used in operationally deriving the RfD and similar values from experimental data. UFs are intended to account or (1) the variation in sensitivity among members of the human population; (2) the uncertainty in extrapolating animal data to the case of humans; (3) the uncertainty in extrapolating from data obtained in a study that is less than lifetime exposure; and (4) the uncertainty in using LOAEL data rather than NOAEL data. Usually each of these factors is set equal to 10.

Underburning: Prescribed burning of the forest floor or understory vegetation for botanical or wildlife habitat objectives, hazard reduction, or silviculture objectives.

Understory: The trees and other woody species growing under the canopies of larger adjacent trees and other woody material.

Vegetation management: Activities desgined primarily to promote the health of forest vegetation for multiple-use purposes.

Vertebrate: An animal that has a spinal column (backbone).

Vertical structural diversity: Vertical structure diversity refers to the appearance of vegetation from the forest floor to the tallest plants or trees defined by a limited area. Stands or areas, which have many different heights, and thereby having much of their surface area occupied by several to many layers of vegetation, are thought to have good vertical structural diversity.

Watershed: A region or land area drained by a single stream, river, or drainage network.

Weather conditions, 90th percentile: The severest 10% of the historical fire weather, i.e., hot, dry, windy conditions occurring on mid afternoons during the fire season.

Wildland Urban Interface (WUI): is a zone between established communities and uninhabited forest lands; lands of mixed private and public ownership that experience increased human use.

Xenobiotic – A substance not naturally produced within an organism; substances foreign to an organism.

Xenoestrogen – An estrogen not naturally produced within an organism.

Chapter 6
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Appendix B

Freds Fire Reforestation Project

This appendix contains unit information tables and Instructions for Completing ENF Release Evaluation Form

Table of Contents

APPENDIX B TABLE B-1 - TREATMENTS by ALTERNATIVE and DATE

				ALTERNATIVE ONE															
			Previously							Release Treatment									
	Stand	Treatment	Planted	Plant Acres				Hand cut		Initial[1]					Follow-up				
STAND_NO	Acres	Acres	Acres	Initial	Date	Interplant	Date	Date	Acres	Herbicide	Date	Acres	Date	Acres	Herbicide	Date	Acres	Date	Acres
503-006	3									None					None				
503-008	40	3	3			3	2012			glyphosate	2011	3			glyphosate	2013	3		
503-009	4	4	4							glyphosate	2011	4			glyphosate	2013	4		
503-027	36	2	2							glyphosate	2011	2			glyphosate	2013	2		
503-111	5	5	5							glyphosate	2011	5			glyphosate	2013	5		
503-112	55									None					None				
503-113	23									None					None				
609-010	76	76	76			76	2012			glyphosate	2011	76			triclopyr	2013	76		
609-025	71	71	71							glyphosate	2010	71			glyphosate	2012	71		
609-026	32	32	32							glyphosate	2010	32			glyphosate	2012	32		
609-027	254	254	78	170	2013					glyphosate	2010	78	2012	170	glyphosate	2012	78	2014	170
609-029	36	36	36							glyphosate	2010	36			glyphosate	2012	36		
609-030	373	373	47	304	2012					glyphosate	2010	47	2011	304	glyphosate	2012	47	2013	304
609-031	60									None					None				
609-032	47									None					None				
609-033	763	763	48	645	2012					glyphosate	2011	48	2011	645	glyphosate	2013	48	2013	645
609-034	20	20	20							glyphosate	2010	20			triclopyr	2012	20		
609-035	123									None					None				
609-036	28	28	28							glyphosate	2010	28			hexazinone	2011	28		
609-037	54	54	54							glyphosate	2010	54			glyphosate	2012	54		
609-038	21	21	21							glyphosate	2010	21			hexazinone	2011	21		
609-039	22	22	22							glyphosate	2010	22			hexazinone	2011	22		
609-040	27	27	27							glyphosate	2010	27			hexazinone	2011	27		
609-041	29	29	29							glyphosate	2010	29			glyphosate	2012	29		
609-042	66	66	66							glyphosate	2010	66			glyphosate	2012	66		
609-043	49	49	49							glyphosate	2010	49			glyphosate	2012	49		
609-044	37	37	37							glyphosate	2010	37			glyphosate	2012	37		
609-046	280	280	70	203	2013					glyphosate	2010	70	2012	203	glyphosate	2012	70	2014	203
613-005	120	120	120			120	2012			glyphosate	2011	120			glyphosate	2013	120		
613-006	96	96	96			96	2012	2010	96	glyphosate	2011	96			glyphosate	2013	96		
613-007	17	17	17							glyphosate	2011	17			glyphosate	2013	17		
613-010	6	6	6							glyphosate	2011	6			glyphosate	2013	6		
613-022	28	28	28			28	2010			glyphosate	2010	28			glyphosate	2012	28		
613-025	89	89	89			89	2010			glyphosate	2010	89			glyphosate	2012	89		
613-026	19	19	19			19	2010			glyphosate	2010	19			glyphosate	2012	19		
613-031	1									None					None				
613-035	150	150	150					2010	100	glyphosate	2011	150			glyphosate	2013	150		
613-037	113	113	113					2010	75	glyphosate	2011	113			glyphosate	2013	113		
613-038	51	51	51			51	2012	2010	29	glyphosate	2011	51			glyphosate	2013	51		
613-042	40	40	40							glyphosate	2011	40			glyphosate	2013	40		
613-047	32	32	12			12	2010			glyphosate	2010	12			glyphosate	2012	12		
613-050	55	55	55			55	2012			glyphosate	2011	55			glyphosate	2013	55		
613-051	90	90	90							glyphosate	2011	90			glyphosate	2013	90		
613-052	76	76	76			76	2012			glyphosate	2011	76			glyphosate	2013	76		
613-053	153	38	38			38	2012			glyphosate	2011	38			glyphosate	2013	38		
613-054	43	43	43							glyphosate	2010	43			glyphosate	2012	43		
613-100	502																		
TOTALS	**4319**	**3319**	**1868**	**1322**		**663**			**300**			**1868**		**1322**			**1868**		**1322**

[1] Treatments prior to planting would be a site preparation treatment

APPENDIX B TABLE B-2 TREATMENTS by ALTERNATIVE and DATE

ALTERNATIVE THREE															
							Release Treatment								
	Stand	Treatment	Plant Acres				Initial			Follow-up					
STAND_NO	Acres	Acres	Initial	Date	Interplant	Date	Treatment	Date	Acres	Treatment	Date	Acres	Treatment	Date	Acres
503-006	3	0					None								
503-008	40	3			3	2012	Hand grub	2011	3	Hand grub	2012	3	Hand grub	2013	3
503-009	4	4					Hand grub	2011	4	Hand grub	2012	4	Hand grub	2013	4
503-027	36	2					Hand grub	2011	2	Hand grub	2012	2	Hand grub	2013	2
503-111	5	5					Hand grub	2011	5	Hand grub	2012	5	Hand grub	2013	5
503-112	55	0					None								
503-113	23	0					None								
609-010	76	76			76	2012	Hand grub	2011	76	Hand grub	2012	76	Hand grub	2013	76
609-025	71	71					Hand grub	2010	71	Hand grub	2011	71	Hand grub	2012	71
609-026	32	32					Hand grub	2010	32	Hand grub	2011	32	Hand grub	2012	32
609-027	254	90	12	2013			Hand grub	2010	78	Hand grub	2011	78	Hand grub	2012	96
609-029	36	36					Hand grub	2010	36	Hand grub	2011	36	Hand grub	2012	36
609-030	373	225	178	2012			Hand grub	2010	47	Hand grub	2011	47	Hand grub	2012	225
609-031	60	0					None								
609-032	47	0					None								
609-033	763	380	332	2012			Hand grub	2011	48	Hand grub	2012	380	Hand grub	2013	380
609-034	20	20					Hand grub	2010	20	Hand grub	2011	20	Hand grub	2012	20
609-035	123	0					None								
609-036	28	28					Hand grub	2010	28	Hand grub	2011	28	Hand grub	2012	28
609-037	54	54					Hand grub	2010	54	Hand grub	2011	54	Hand grub	2012	54
609-038	21	21					Hand grub	2010	21	Hand grub	2011	21	Hand grub	2012	21
609-039	22	22					Hand grub	2010	22	Hand grub	2011	22	Hand grub	2012	22
609-040	27	27					Hand grub	2010	27	Hand grub	2011	27	Hand grub	2012	27
609-041	29	29					Hand grub	2010	29	Hand grub	2011	29	Hand grub	2012	29
609-042	66	66					Hand grub	2010	66	Hand grub	2011	66	Hand grub	2012	66
609-043	49	49					Hand grub	2010	49	Hand grub	2011	49	Hand grub	2012	49
609-044	37	37					Hand grub	2010	37	Hand grub	2011	37	Hand grub	2012	37
609-046	280	140	70	2013			Hand grub	2010	70	Hand grub	2011	70	Hand grub	2012	140
613-005	120	120			120	2012	Hand grub	2011	120	Hand grub	2012	120	Hand grub	2013	120
613-006	96	96			96	2012	Hand grub	2011	96	Hand grub	2012	96	Hand grub	2013	96
613-007	17	17					Hand grub	2011	17	Hand grub	2012	17	Hand grub	2013	17
613-010	6	6					Hand grub	2011	6	Hand grub	2012	6	Hand grub	2013	6
613-022	28	28			28	2010	Hand grub	2010	28	Hand grub	2011	28	Hand grub	2012	28
613-025	89	89			89	2010	Hand grub	2010	89	Hand grub	2011	89	Hand grub	2012	89
613-026	19	19			19	2010	Hand grub	2010	19	Hand grub	2011	19	Hand grub	2012	19
613-031	1	0					None								
613-035	150	150					Hand grub	2011	150	Hand grub	2012	150	Hand grub	2013	150
613-037	113	113					Hand grub	2011	113	Hand grub	2012	113	Hand grub	2013	113
613-038	51	51			51	2012	Hand grub	2011	51	Hand grub	2012	51	Hand grub	2013	51
613-042	40	40					Hand grub	2011	40	Hand grub	2012	40	Hand grub	2013	40
613-047	32	32			12	2010	Hand grub	2010	12	Hand grub	2011	12	Hand grub	2012	12
613-050	55	55			55	2012	Hand grub	2011	55	Hand grub	2012	55	Hand grub	2013	55
613-051	90	90					Hand grub	2011	90	Hand grub	2012	90	Hand grub	2013	90
613-052	76	76			76	2012	Hand grub	2011	76	Hand grub	2012	76	Hand grub	2013	76
613-053	153	38			38	2012	Hand grub	2011	38	Hand grub	2012	38	Hand grub	2013	38
613-054	43	43					Hand grub	2010	43	Hand grub	2011	43	Hand grub	2012	43
613-100	502														
TOTALS	**4319**	**2482**	**592**		**663**				**1871**			**2203**			**2469**

APPENDIX B TABLE B-2 continued TREATMENTS by ALTERNATIVE and DATE

ALTERNATIVE THREE									
	Release Treatment								
	Follow-up								
STAND_NO	Treatment	Date	Acres	Treatment	Date	Acres	Treatment	Date	Acres
503-006									
503-008	Hand grub	2014	3						
503-009	Hand grub	2014	4						
503-027	Hand grub	2014	2						
503-111	Hand grub	2014	5						
503-112									
503-113									
609-010	Hand grub	2014	76						
609-025	Hand grub	2013	71						
609-026	Hand grub	2013	32						
609-027	Hand grub	2013	96	Hand grub	2014	12	Hand grub	2015	12
609-029	Hand grub	2013	36						
609-030	Hand grub	2013	225	Hand grub	2014	178	Hand grub	2015	178
609-031									
609-032									
609-033	Hand grub	2014	380	Hand grub	2015	332			
609-034	Hand grub	2013	20						
609-035									
609-036	Hand grub	2013	28						
609-037	Hand grub	2013	54						
609-038	Hand grub	2013	21						
609-039	Hand grub	2013	22						
609-040	Hand grub	2013	27						
609-041	Hand grub	2013	29						
609-042	Hand grub	2013	66						
609-043	Hand grub	2013	49						
609-044	Hand grub	2013	37						
609-046	Hand grub	2013	140	Hand grub	2014	70	Hand grub	2015	70
613-005	Hand grub	2014	120						
613-006	Hand grub	2014	96						
613-007	Hand grub	2014	17						
613-010	Hand grub	2014	6						
613-022	Hand grub	2013	28						
613-025	Hand grub	2013	89						
613-026	Hand grub	2013	19						
613-031									
613-035	Hand grub	2014	150						
613-037	Hand grub	2014	113						
613-038	Hand grub	2014	51						
613-042	Hand grub	2014	40						
613-047	Hand grub	2013	12						
613-050	Hand grub	2014	55						
613-051	Hand grub	2014	90						
613-052	Hand grub	2014	76						
613-053	Hand grub	2014	38						
613-054	Hand grub	2013	43						
613-100									
TOTALS			**2469**			**592**			**260**

APPENDIX B TABLE B-3 - STAND ATTRIBUTES

Stand Number	Stand Acres	Treatment Acres	Previously Planted Acres	Initial Plant Year	Most Recent Survival Exam	Total Trees per Acre[1]	Percent Survival[2]	Percent Stocking[3]	Plants: Sensitive	Plants: Invasives[4]	Streams	Evisting Vegetation, Forest Vegetation Layer: Conifers (acres)	Conifer/Oak (acres)	Oak (acres)	Comment
503-006	3	0									none	3			Cleveland Fire Plantation
503-008	40	3	3	2006	2008	42	18	50			none	40			Cleveland Fire Plantation
503-009	4	4	4	2005	2008	106	45	89			none	4			Cleveland Fire Plantation
503-027	36	2	2	2006	2008	117	50	100			2 E	36			
503-111	5	5	5	2006	2008	138	nt	75		YST	1 E	5			
503-112	55	0									3 E, 1 S	55			Snag Patch
503-113	23	0									1 E	23			
609-010	76	76	76	2007	2007	61	26	53			1 E	73		3	Wright's Fire Plantation
609-025	71	71	71	2006	2006	140	60	80			1 E	71			
609-026	32	32	32	2006	2008	38	16	50		Cheat	2 E	30	2		
609-027	254	254	78	2006	2008	54	23	42		Cheat	6 E, 1 S	177	71	6	oak
609-029	36	36	36	2007	2008	122	40	83			none	36			
609-030	373	373	47	2007	2009	47	nt	39			6 E, 2 S, 1 P	117	234	22	oak
609-031	60	0									2 E, 1 S, 1 P	28	32		Snag Patch
609-032	47	0									1 E		43	4	Snag Patch
609-033	763	763	48	2007	2007	108	43	68		YST, Cheat	Several E, 1 P	249	444	70	oak
609-034	20	20	20	2007	2008	278	nt	100			none	20			
609-035	123	0									3 E	123			
609-036	28	28	28	2007	2007	88	38	54			1 E	28			
609-037	54	54	54	2007	2008	189	78	76			1 E	54			
609-038	21	21	21	2007	2008	92	39	71			1 E	21			
609-039	22	22	22	2007	2007	88	38	75			1 E	22			
609-040	27	27	27	2007	2007	117	47	80			3 E	27			
609-041	29	29	29	2007	2007	78	33	69		TW	2 E	29			
609-042	66	66	66	2007	2007	121	52	82			1 E	66			
609-043	49	49	49	2007	2007	129	55	83		Cheat	1 E	45	4		
609-044	37	37	37	2007	2007	88	31	54		Cheat	2 E	37			
609-046	280	280	70	2007	2007	78	33	69		Cheat	6 E, 1 S	97	176	7	oak
613-005	120	120	120	2006	2008	89	38	44		Cheat	2 E, 1 S, 1 P	120			
613-006	96	96	96	2006, 2007	2008	28	7	6		YST	1 E	96			Cleveland Fire Plantation
613-007	17	17	17	2005	2008	253	nt	76		YST, Cheat	none	17			Cleveland Fire Plantation
613-010	6	6	6	2006	2008	115	45	50			none	6			Cleveland Fire Plantation
613-022	28	28	28	2006	2008	94	34	50		YST	2 E	28			Cleveland Fire Plantation
613-025	89	89	89	2005, 2006	2007	95	26	66	CACLA	YST	7 E, 1 P	89			Cleveland Fire Plantation
613-026	19	19	19	2005	2007	71	29	84		YST	3 E	19			Cleveland Fire Plantation
613-031	1	0									none	1			Cleveland Fire Plantation
613-035	150	150	150	2005	2007	109	39	67		YST	5 E. 2 P	150			Cleveland Fire Plantation
613-037	113	113	113	2005, 2006	2007	109	39	67		YST, Cheat	6 E, 2 P	113			Cleveland Fire Plantation
613-038	51	51	51	2006	2008	55	26	60	CACLA	YST	1 E, 1 P	51			Cleveland Fire Plantation
613-042	40	40	40	2006	2008	108	46	62			1 E, 1 P	40			Cleveland Fire Plantation
613-047	32	32	12	2006	2008	89	47	66	CACLA	YST	none	32			
613-050	55	55	55	2006, 2007	2008	56	79	89		YST, Cheat	3 E, 1 P	55			
613-051	90	90	90	2006, 2007	2008	205	88	80			4 E, 1 P	90			
613-052	76	76	76	2006	2008	50	21	42	CACLA	Cheat	4 E, 1 S, 1 P	76			
613-053	153	38	38	2008	2008	52	17	50		Cheat	9 E, 2 P	88	53	12	oak
613-054	43	43	43	2006	2008	56	24	18		Cheat	2 E, 1 P	43			
613-100	502	0	0									97	378	27	
NFS TOTAL	**4319**	**3319**	**1868**			**98**	**39**	**61**				**2731**	**1437**	**151**	
Private	**3244**	**2526***													
TOTAL	**7563**	**5845**													

Key
[1]Total Trees per Acre - Surviving seedlings per acre, from the latest stocking survey results
[2]Percent Survival - Percent of planted trees that have survived to the date of the latest exam
[3] Percent Stocking - Percent of plots containing a live tree
[4] YST - Yellow Starthistle, TW - Tall Whitetop, Cheat - Cheatgrass
CALCA - pleasant valley tulip
Streams -e=ephemeral, s=seasonal, p=perennial
* Estimate of Sierra Pacific Industries Property

APPENDIX B TABLE B-3 continued - STAND ATTRIBUTES

Stand Number	Primary Vegetation		Vegetation	Release Evaluation Form Situations[6]						
	Major competitors[5]	Total Cover (%)	Height (feet)	Primary Situation	When	Other Situations	When	Other Situations	When	Priority
503-006										
503-008	uguf,ceco	79	1-2	4	C	6	C			1
503-009	uguf,ceco,arpa	88	3-5	6	C					1
503-027	ceco,arpa,uguf	67	2-3	3	C	5	P			2
503-111	ceco,uguf,arpa,riro	91	2-5	5	C	3	P			2
503-112										
503-113										
609-010	ptaq,ceco,case,arpa	65	3-5	4	C	5	C	3	C	1
609-025	ceco,uguf,chfo,prem	63	1-6	5	C	1	C			2
609-026	uguf,chfo,ceco	65	1-3	6	C	4	P	5	P	1
609-027	chfo,uguf,ceco,cein	87	2-4	1	C	4	P	5	P	1
609-029	ceco,uguf,riro,case	61	2-3	5	P					2
609-030	chfo,uguf,cein,prem	80	1-4	1	C	4	C	5	P	1
609-031										
609-032										
609-033	chfo,ceco,arpa,cein	54	1-4	1	C	5	P			2
609-034	ceco,case,arpa	51	2-4	3	P	5	P			3
609-035										
609-036	uguf,chfo,ceco	28	1-3	5	P	4	P	1	P	3
609-037	ceco,uf,arpa,riro	64	2-3	5	P	3	P			2
609-038	uguf,ceco,arpa	52	2-4	5	P	3	P			3
609-039	ceco,arpa	36	2-3	5	P	3	P			3
609-040	uguf,ceco,arpa,riro	3	1-2	5	P	3	P			3
609-041	ceco,uguf,chfo,arpa	36	2-3	5	P	4	P			3
609-042	ceco,chfo,arpa,uguf	26	1-3	3	P	5	P	1	C	3
609-043	uguf,ceco,arpa	44	2-3	3	P	5	P			3
609-044	chfo,ceco,arpa	33	1	3	P	1	C			3
609-046	ceco,uguf,chfo,arpa	36	2-3	5	P	4	P	1	C	3
613-005	ceco,prem,uguf	65	2-6	4	C	5	C			1
613-006	uguf,cein,chfo,ceco	87	3-6	4	C	5	C			1
613-007	uguf,ceco,arpa	85	3-4	6	C	3	P			1
613-010	uguf, ceco	75	2	6	C					2
613-022	uguf,cein,chfo	80	3-5	4	C	6	C	1	C	1
613-025	uguf,cein,chfo	77	4-6	4	C	6	C	5	P	1
613-026	uguf,cein	98	3-4	4	C	6	C	5	P	1
613-031										
613-035	uguf,cein,chfo	90	3-7	6	C	5	P			1
613-037	uguf,cein,chfo	90	3-7	6	C	5	P			1
613-038	cein,uguf	61	4-7	4	C	5	P			1
613-042	cein,uguf,ptaq	83	4-7	5	P	4	P			2
613-047	uguf,cein,chfo	69	1-3	4	P	6	C	1	C	1
613-050	uguf,ceco,cein	62	1-3	4	C	5	P			1
613-051	chfo,ceco,arpa,uguf	71	1-2	1	C	5	P			2
613-052	uguf,chfo,ceco	83	2-4	4	C	6	C			1
613-053	uguf,chfo	87	2-3	4	C	6	C			1
613-054	ceco,prem,chfo,uguf	88	2-4	5	C	4	P			2
613-100										
TOTALS		**64**								

[6]Release Need Situations		
1	Bearclover/grass	
2	Lupine/grass/forbs with gophers	
3	Chinquapin/manzanita	
4	Low stocking with competition	
5	High volume of woody brush	
6	High levels of herbaceous vegetation	
	C-currently	P-predicted

[6]Vegetation codes			
CHFO	Bearclover	CASE	bush chinquapin
ARPA	Greenleaf manzanita	PTAQ	Bracken fern
CECO	Whitethorn	CEIN	Deerbrush
UGUF	Unknown grasses/forbs	PREM	Bitter cherry
RIRO	Sierra gooseberry		

	ALTERNATIVE ONE						ALTERNATIVE THREE					
	Reforestation				Unproductive Forest within Stand (5 Acre Minimun)		Reforestation				Unproductive Forest within Stand (5 Acre Minimun)	
Stand Number	Conifers (acres)	Conifer/Oak (acres)	Oak (acres)	None		Comment[7]	Conifers (acres)	Conifer/Oak (acres)	Oak (acres)	None		Comment[7]
503-006				3		1				3		1
503-008	3			37		2	3			37		2
503-009	4						4					
503-027	2			34		2	2			34		2
503-111	5						5					
503-112				55		3				55		3
503-113				23		4				23		4
609-010	73		3				73		3			
609-025	71						71					
609-026	30	2					30	2				
609-027	177	71	6		20		84	6	6	158	20	5
609-029	36						36					
609-030	117	234	22		24		64	161	22	126	24	5
609-031				60		3				60		3
609-032			4	43		3			4	43		3
609-033	249	444	70		11		60	320	70	313	11	5
609-034	20						20					
609-035				123		4				123		4
609-036	28						28					
609-037	54						54					
609-038	21						21					
609-039	22						22					
609-040	27						27					
609-041	29						29					
609-042	66						66					
609-043	45	4					45	4				
609-044	37						37					
609-046	97	176	7		5		30	110	7	133	5	5
613-005	120						120					
613-006	96				17		96				17	
613-007	17						17					
613-010	6						6					
613-022	28						28					
613-025	89						89					
613-026	19						19					
613-031				1		1				1		1
613-035	150						150					
613-037	113						113					
613-038	51						51					
613-042	40						40					
613-047	12			20		2	12			20		2
613-050	55						55					
613-051	90						90					
613-052	76						76					
613-053	38		12	103		4	38		12	103		4
613-054	43						43					
613-100				502	42	4				502	42	4
TOTALS	**2259**	**931**	**124**	**1004**	**119**		**1857**	**603**	**124**	**1734**	**119**	

[7]Comment	
1	Natural Recovery
2	Adequate Stocking - Existing Plantation
3	Natural Recovery - Snag Patch
4	Adequate Stocking - Low to Medium Intensity Burn
5	Natural Recovery - Bearclover

Instructions for Completing ENF Release Evaluation Form
(Version 5/27/92)

A. Overview

The Release Evaluation Form is intended to document the current condition of a plantation in regards to the need for release as well as the method of release. It should provide, in one location, the necessary information that a silviculturist would need to prepare a release prescription. In fact, the prescription is eventually recorded on the backside of the form, and the signed form then becomes part of the record used for NEPA documentation.

The double-sided form is broken down into 6 parts, including 4 tables. Portions of the form are intended to be completed in the field, others in the office before and after the field work is completed.

This form does not include space for recording vegetation survey plot data; another form is used for recording this data, and is then attached to this form. A complete plantation record will contain the vegetation survey data, stocking survey information, and the completed Release Evaluation Form.

B. Assumptions and Rationales

The determination to develop this form was based upon the need to document on one concise form, the site specific information and key decisions leading to a release prescription. Assumptions and rationales have been built into both Tables 2 and 3 about the levels of specific competition and the levels of conifer stocking needed to trigger decisions. In any case, the final treatment prescription, as documented on this form, will be based upon the professional judgement of the silviculturist.

The rationale behind Table 2 is that there are primarily six identifiable situations on the Eldorado NF where the use of herbicides are considered essential to meeting the objective of successful reforestation (resulting in > R5 minimum stocking and "free-to-grow"). These situations are based upon regional and local experience, combining the factors of species competition, relative levels of difficulty of control, gopher/vegetation complex interactions, and stocking and survivability of conifer stocking.

Table 2 is not intended to reflect the priority of treatment needs; for that reason, levels of key vegetation that trigger the designation of "herbicide essential" may appear low. For example, situation I is triggered at a level of 20% ground cover in bearclover and grass. However, the 20% level includes only the bearclover and grass component; both type of vegetation which are not effectively controlled by other methods when growing together. Therefore, a strong growth loss is occurring in the plantation simply from the bearclover and grass, along with decreased health, increased mortality.

Situations 1, 3, and 6 fall into the category of vegetation difficult to control effectively other than with herbicides, and occurring at levels that begin to appear lethal to conifers. Situation 2 is a category that involves a, vegetation and animal pest (pocket gopher) complex that presents a very lethal combination, especially in the droughty soils of the higher elevations. Situation 4 is a situation that requires interplanting to meet R5 stocking recommendations, but because of vegetative cover from reinvasion, is not possible without vegetative control. It also indicates stocking is marginal and could drop below minimum stocking levels without treatment. Situation 5 is intended to describe a plantation in which aerial application of herbicide is necessary.

Situation 7 is not applicable for plantation establishment. It is primarily for fuels management in established plantations.

Table 3 breaks down the priorities into three levels. Priority I is the highest priority. This priority assumes that the unit requires treatment within a year of survey to avoid loss of stocking that would result in a failed plantation. Current stocking is below recommended stocking standards or is anticipated to get there soon, health is poor, and/or competing vegetation levels are very high. Priority 2 considers the plantation able to survive for another year or two, however, without treatment, the unit would proceed to a priority I after about 2 years. Treating a priority 2 now, could save treatment costs now, due to lower rates of application, lower volumes of brush, less replanting cost, etc. A priority 3 is not anticipated to reach priority I in the next 3 years. A priority 3 currently meets or exceeds stocking standards. Release for growth is included in this priority.

C. Instructions

1. The Header Block

This information is used to identify the stand and some of the physical properties of the stand, as well as who filled out the form. Most of the information in the header block will be recorded from the Stand Record Card (SRC) or SRC Database. The compartment #, stand unit acres, elevation, aspect, slope, and site quality will all come from the SRC. The EHR (Erosion Hazard Rating) is calculated on a separate form, while in the field. If not available, leave blank. Place your name in the "Survey by:" Block and the date the field portions of the form were completed.

2. Table I - Planting and TSI Activities

This table provides information on past treatment activities and the trends in seedling stocking. The information for this table is gathered from the SRC also.

The left side of the table is for recording initial planting information (date planted, trees per acre planted, and the species planted), as well as information from subsequent stocking exams (date the survey was done, the trees per acre (including naturals), and the species (including naturals)).

The right side of the table is for recording any ground-disturbing or vegetation manipulation activities that have occurred, beginning with the site preparation. The codes used under "TSI Activity" are listed in the Legend under "Activities". For "Description" use a word or two that describes the method (for example "tractor pile" or "hand cut/grub"). The completion date is recorded (month/year).

3. Table 2 - Vegetation Condition

Table 2 is intended to determine whether the unit is herbicide dependent, or whether other methods could be used. Because this table utilizes existing conifer stocking and competing vegetation data, it will be necessary to complete the necessary vegetation surveys and stocking surveys first. Prior to completing this table, it will be helpful to summarize the latest stocking survey information, including average seedling height and the presence or absence of gophers, and to come up with the following information from the vegetation surveys:

- Total ground cover of competing vegetation (in percent)
- Ground cover in Manzanita and Chinquapin (in percent) and average height.
- Ground cover in Bearclover and Grass (in percent)
- Ground cover in Bracken fern, grasses, forbs, thistles, and lupine (in percent)
- Ground cover in woody brush (in percent) and average height.

Once the information from the stocking and vegetation surveys is summarized, Table 2 is completed by reviewing the 7 situations that are described. If the unit currently meets one of these situations place a "check" or an "XI' in the appropriate box under the "Now" column. If the unit is close to meeting one of the situations and likely would within a year or two, record the date that this would occur under the "Pred./Date" column (Predicted/Date). If significant portions of a unit differ in which situation applies, go ahead and mark more than one, noting where the different situations apply.

Use the space after the situation description to record the codes for the primary competing species, in order of ground cover. The codes for the more common species are listed in the Legend.

4. Table 3 - Treatment Priority

Once the Situation is determined in Table 2, the priority is determined using the descriptions in this table. These priorities are for all release treatments, not just herbicide release. There are three levels of priority, with #1 being the highest. Start with priority #1 and work down through the descriptions until the appropriate description is encountered.

Circle the appropriate priority number. The phrase "key competing vegetation" in this table would refer to the specific vegetation that determined the Situation in Table 2 (for example, the key competing vegetation in situation 3 is manzanita and chinquapin).

5. Table 4 - Mitigation Factors

This table is used to record site specific information that might affect the eventual treatment prescription. It is divided into two halves, with the left half generally being completed in the field and the right half generally being completed from office records. The following will describe the various items and the units of measure. There isn't much room to write in these blocks. If more needs to be written than can fit into a block utilize the margin or add a separate page.

Field Observations

a. Water - This is a critical item. The unit of measure is the presence of streams, seeps, wells, springs, or lakes, and the distance to them. In the case of streams, the stream class needs to be noted also. (For definitions of stream classes, refer to the booklet Guidelines for Timber & Wildlife Management Coordination in Regeneration Cutting for the Eldorado National Forest, 1979, page 33B). For Class I or 2 streams, reservoirs, or domestic-use water sources, list those within 1/4 mile of the unit. For all others, list those within or adjacent to the unit. An appropriate entry may be "Class 3 along west edge", or "Ice House Reservoir 800 feet downstream of Class 4 in unit". If there is not enough room in this block, use the area in the margin, or attach an extra sheet.

b. Rock Outcrops - This figure is needed to determine the runoff potential associated with the unit. It is an ocular estimate of the percent of the unit that is made up of rock outcroppings. This refers to solid rock, not bouldery or cobbly soil.

c. Snags/Acre - This figure is needed to determine the feasibility of aerial applications of materials, as well as get an idea of the wildlife qualities of the unit. It needs to include all snags greater than 20 feet high, and should include an average height of these snags. This can be accomplished by a simple count. If there are extensive pockets of natural regeneration, also greater than 20 feet high, this too should be noted. Note whether the snags are evenly distributed or clumped in one area. A sample entry may be "2 snags/ac, avg ht 50 feet, even dist.".

d. Key Tree Species - These are species that are sensitive to certain herbicides or are of high interest. Since the commercial conifer species (sugar pine, incense cedar, and giant sequoia) will show up in stocking or survival surveys, a simple statement about presence will be sufficient; numbers and distribution will come from these other sources. For the oaks (primarily black and live oak) and Pacific yew, a statement about number and distribution is needed (TPA or Basal Area). If the oaks are greater than 20 feet high, a note under c. (above) will be needed also. A sample entry may be "SP present, BO 3 tpa, avg 40 feet".

e. Habitation - This does not mean houses only, but campgrounds, dispersed recreation areas, visitor information areas, etc., within 1/4 mile of the unit. The areas don't need to be currently occupied. Briefly describe what and how far from unit: "China Flat CG 1000 feet west".

f. Erosion - Any indicators of active erosion in the unit, such as rills or gullies, or sediment deposition.

<u>Office Records</u>

Each district will have slightly different procedures for collecting the following information. Check with the silviculturist to determine your district's procedures.

a. Threatened, Endangered, or Sensitive Plants - Record whether any species are within or adjacent to the unit, or if unsurveyed, whether suitable habitat for any known sensitive species exists within or nearby the unit. Use genus/species identifier (example, NAPRL, or CACLA)

b. Threatened, Endangered, or Sensitive Animals - Similar to a., above, record presence of animals or, more likely, suitable habitat.

c. Critical Deer Range - List timing of critical use if unit is within critical deer habitat. For example, if the unit is within critical winter deer range, list "Winter", if it is within critical fawning habitat, list "Fawning".

d. Permittees - If there are any apiary (honeybee) permit sites within I mile of the unit, identify the site here. If the unit is within a grazing allotment, list the allotment name, and if active, list the latest On/Off dates. A

e. Arch. Sites - Determine whether sites are within or adjacent to the units. If so record the site number(s).

f. Mines - If an active mining claim exists within or adjacent to the unit, list claimant here.

g. Adj. Private Landowners - List names of all private landowners within 1/4 mile of the unit.

6. <u>Prescription</u>

This section is broken down into two parts; the first dealing with the treatment prescription outside of any buffer zones, the second deals with treatment prescriptions within buffer zones. (These buffer zones could be along drainages, around sensitive tree species, or around other sensitive areas.) Each district will have different procedures for completing this section, primarily dealing with who completes it. In any case, this section needs to be signed by a certified silviculturist and dated.

The following information is the minimum necessary to complete this section:

a. The objective of the treatment, including target vegetation.

b. If an herbicide release is planned, the herbicide proposed for use along with any adjuvants or additives, the rate of application, the timing of application, and the method of application must be included.

c. If a method other than herbicide release is planned, the method of release and the timing must be included.

d. The need for any anticipated followup treatments, such as interplanting, animal control, or further release must be discussed, including timing.

e. If a buffer prescription is being written, the same requirements as listed in a - d apply, as well as the need to describe the purpose of the buffer and the extent of the buffer.

REVISION NOVEMBER 15, 2000
(added situation 7)
RELEASE EVALUATION FORM
ELDORADO NATIONAL FOREST

COMPT	STAND	ACRES	ELEV	ASPECT	SLOPE	SITE	EHR	FUEL MODEL	DATE	SURVEY

TABLE 1-PLANTATION ACTIVITY HISTORY

ACTIVITY	DESCRIPTION	DATE	TPA	SPECIES	ACTIVITY	DESCRIPTION	DATE	TPA	SPECIES

TABLE 2-VEGETATION CONDITION

SITUATION	CATEGORY	NOW	PREDICTED DATE
1. Bearclover and grass > 20% cover with other woody brush.	Herbicide Essential		
2. Pocket gophers present on the site with > 20% ground cover of lupine/grasses/forbs/thistle/fern in any combination, trees < 3’ tall, or trees > 3’ if current gopher-caused mortality is occurring.	Herbicide Essential		
3. Chinquapin and/or manzanita totaling > 20% with other woody brush, tree/brush height ratio < 1.5.	Herbicide Essential		
4. Conifer stocking is < R-5 recommended with signs of continued mortality and competing plants > 20% ground cover.	Herbicide Essential		
5. High volume of woody brush that would be infeasible to effectively treat by hand (> 40% cover, > 4’ tall, tree/brush height ratio < 1.5).	Herbicide Essential		
6. Lupine/grasses/forbs/thistles/fern in any combination > 40% cover and trees are < 3’ tall. Gophers need not be present.	Herbicide Essential		
7. Vegetative structure and levels of woody brush species in plantation results in a fuel model which predicts a tree mortality of > 25% in the event of wildfire.	Herbicide Essential		
8. None of the above.	Alternative Feasible		

TABLE 3-TREATMENT PRIORITY

PRIORITY	DESCRIPTION
1	* Situation 4 as described in Table 2, or * Situation 2 if stocking is < 300 tpa, or there is extensive gopher-caused mortality evident in seedlings or heavy gopher activity in unit, or * Situation 1 or 3 if stocking is < R-5 recommended, mortality is continuing, vigor is poor or key competing vegetation is > 40% cover, or * Situation 5 or 6 if stocking is < R-5 recommended, mortality is continuing, vigor is poor, or key competing vegetation is > 70% cover, or * Regardless of stocking, vigor is poor, survival is poor and total competitive cover exceeds 50 %. * Situation 7 if fuel model predicts > 50% tree mortality in the event of a wildfire.
2	* Does not meet any of priority 1 above, and, * Situations 1 or 3 if key competing vegetation is between 20% and 40% cover, regardless of stocking levels, or * Situation 2 if stocking is > 300 tpa, or * Situations 5 or 6 if key competing vegetation is between 40% and 70% cover, or * Situation 7 if fuel model predicts 25-50% tree mortality in the event of wildfire.
3	* Does not meet any of priority 1 or 2 above.

TABLE 4-MITIGATION FACTORS

FIELD OBSERVATIONS	MEASURE	OFFICE RECORDS	MEASURE
Water-Distance to Streams (class), springs, or seeps.		T,E & S. Plants	
Rock outcrops (% unit)		T,E & S. Wildlife	
Snags/acre (height)		Critical deer range	
Key tree species-Oaks, SP, IC, GS, Pacific Yew		Permittees-Apiaries, Cattle (on/off dates)	
Habitation-(w/i 1/4 mi., include campgrounds, residences, dispersed camps, other developments)		Arch. sites	
Erosion-indicators		Mines	
Other:		Adj. Private Landowners	

PRESCRIPTION:

RX for Buffers

Signed:____

Certified Silviculturist Date

Appendix C

Freds Fire Reforestation FEIS Hydrologic Information

1. Water Quality.

- **a. Characteristics of herbicides.**
- **b. Water quality standards and objectives.**
- **c. Monitoring plan.**
- **d. Best Management Practices.**
- **e. Summary from herbicide monitoring report, Stanislaus National Forest.**
- **f. Summary of herbicide monitoring, Eldorado National Forest.**
- **g. Turbidity data for streams in the Freds Reforestation project area.**

2. Riparian Conservation Objectives (RCOs).

- **a. Background.**
- **b. Analysis of RCOs.**

3. Cumulative watershed effects.

- **a. Background.**
- **b. Summary of the method of Equivalent Roaded Acres (ERA).**
- **c. Effects of individual land disturbances on aquatic features.**

1. Water Quality.

a. Characteristics of herbicides.[1]

	Glyphosate	Triclopyr BEE	Hexazinone	Clopyralid	Chlorsulfuron
Chemical name	N-(phophonomethyl) glycine	[(3,5,6-trichloro-2-pyridinly)oxy]acetic acid	3-cyclohexyl-6-dimethylamino-1-methyl-1,3,5-triazine-2,4(1*H*, 3*H*)-dione	3,6-dichloro-2-pyridinecarboxylic acid	2-chlor-N-[(4-methsy-6-methyl-1,2,5-triazin-2-yl) aminocarbonyl] benezenesulfonaminide
Persistence in the environment	▪ Tends to bind readily and strongly to soil particles; does not leach through most soil types. ▪ 90% decomposition (primarily by microbes) to natural components within 6 months. ▪ Does not bioaccumulate. ▪ Rarely detected in surface water with "no spray" buffer widths near surface water of 10 feet.	▪ Binds weakly to soil particles; some leaching through most soil types. ▪ Triclopyr BEE turns into the acid form of Triclopyr within a few days. ▪ Occasionally detected in surface water with "no spray" buffer widths near surface water of 10-20 feet.	▪ Does not bind to soil particles; readily leaches through most soil types. ▪ Does not bioaccumulate. ▪ Stable at pH of 5 to 9. ▪ Aerobic aquatic sediment half-life of 37-44 days in sunlight and 187-330 days in darkness. ▪ Frequently detected in surface water and ground water at low concentrations for several years after application.	▪ Binds weakly to soil particles; some leaching through most soil types. ▪ Average half-life in soil of 12 to 70 days. ▪ Degrades primarily through microbial processes. ▪ Low potential to bioaccumulate in aquatic organisms.	▪ Does not bind to soil particles; readily leaches through most soil types. ▪ Average half-life in soil of 28 to 56 days. ▪ Average half-life in water of 80 days in sunlight. ▪ No monitoring data, but properties suggest that it may reach and persist in surface water.
Minimum Detection Limit (MDL)2	1 to 25 ug/L (micrograms per liter)	0.3 ug/L (micrograms per liter)	0.1 ug/L (micrograms per liter)	0.5 ug/L (micrograms per liter)	
EPA guidelines for humans[2]	700 ug/L Maximum Contaminant Level	No guidelines or standards	400 ug/L Health Advisory Level	No guidelines or standards	350 ug/L IRIS Reference Dose

[1] Sources of information: SERA 2005; SERA 2004a 2204b; SERA 2003a 2003b; USDA 2001a; USDA 2003a; Siepman 1997.
[2] Micrograms per liter (ug./L.) is approximately equal to parts per billion (ppb).
[3] EPA = Environmental Protection Agency.

b. Water quality standards and objectives.

Assessment of water quality standards and objectives designated by the Central Valley Regional Water Quality Control Board.[1]

Parameter	Narrative standard(s)	Numerical Standard(s)	Assessment with regard to the Action Alternatives: Alternative 1 (Proposed Action)	Assessment with regard to the Action Alternatives: Alternative 3 (No herbicides)
Pesticides	Pesticides shall not be present in concentrations that adversely affect beneficial uses of water. Pesticides shall not be present in concentration of bottom sediments or aquatic life that adversely affects beneficial uses of water. Pesticides shall not exceed those allowable by applicable anti-degradation policies. Pesticide concentrations shall not exceed the lowest levels technically and economically achievable	None.	Expected concentrations of herbicides in surface water and groundwater are expected to be below detection limits and/or far below that known to cause harm to humans. The reasons for this conclusion are described in detail in Chapter 3 of this FEIS under the section *Hydrology and Watershed Resources.* The methods used would lead to the lowest concentrations of herbicides and pesticides in surface water that are achievable and still meet the stated purpose and need of the project. There will be no aerial spraying of herbicides and pesticides. All herbicides and pesticides will be applied by ground-based methods.	No herbicides would be used under Alternative 3. Therefore, beneficial uses of water cannot be affected by herbicides.

			Assessment with regard to the Action Alternatives	
Parameter	**Narrative standard(s)**	**Numerical Standard(s)**	**Alternative 1 (Proposed Action)**	**Alternative 3 (No herbicides)**
Pesticides	Waters designated for domestic or municipal supplies shall not contain concentrations of pesticides in excess of the Maximum Contaminant Levels (MCLs) set forth in California COR, Title 22, Division 4, Chapter 15.	The Maximum Contaminant Level (MCL) for glyphosate for human health is 700 micrograms pr liter (ug./L.) or parts per billion (ppb). This MCL is set by the Environmental Protection Agency.	Waters designated for domestic water supplies shall have contaminant levels either below detection limit or levels far below Maximum Contaminant Levels. The reasons for this conclusion are described in detail in Chapter 3 of this FEIS under the section *Hydrology and Watershed Resources.*	No herbicides would be used under Alternative 3. Therefore beneficial uses of water cannot be affected by herbicides.
Sediment	"The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses."	.	The increase in the suspended sediment levels of streams is expected to be negligible or very minor. The reasons for this conclusion are described in Chapter 3 of this FEIS under the section *Hydrology and Watershed Resources.*	

			Assessment with regard to the Action Alternatives	
Parameter	**Narrative standard(s)**	**Numerical Standard(s)**	**Alternative 1 (Proposed Action)**	**Alternative 3 (No herbicides)**
Turbidity	"Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses."	"Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits: ▪ Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases shall not exceed 1 NTU. ▪ Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent. ▪ Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs. ▪ Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent."	The increase in the turbidity levels of streams is expected to be negligible or very minor. The reasons for this conclusion are described in Chapter 3 of this FEIS under the section *Hydrology and Watershed Resources.*	

			Assessment with regard to the Action Alternatives	
Parameter	**Narrative standard(s)**	**Numerical Standard(s)**	**Alternative 1 (Proposed Action)**	**Alternative 3 (No herbicides)**
Temperature	"The natural receiving water temperature shall not be altered unless it can be demonstrated to the satisfaction of the water board that such alteration does not adversely affect beneficial uses."	"At no time or place shall the temperature of COLD waters be increased more than 5^{o}F above natural receiving water temperature."	Increases in stream temperature are expected to be negligible because the amount of shade reduction on stream surfaces will be minor. The reasons for this conclusion are a) conifers will be planted near streams, not removed b) shrubs and herbaceous vegetation will not be sprayed with herbicides under Alternative A (Proposed Action) within 50 feet of perennial streams, and c.) riparian vegetation next to perennial streams will not be removed under Alternative 3 (No herbicides).	

[1] The Clean Water Act gives the states the authority to set water quality standards. The standards set by the states apply to the National Forest, and the Eldorado National Forest is under the jurisdiction of the Central Valley Regional Water Quality Control Board (CVRWQCB).

c. Monitoring Plan.

The most efficient and direct approach for monitoring the water quality effects of herbicide applications is by taking and analyzing water samples; in most cases, only a few samples need be taken immediately after application (MacDonald 1991). Under Alternative 1 (Proposed Action), the water quality parameters to be tested at all stream sites: glyphosate, turbidity, pH, and electrical conductivity. The discharge of the stream will be estimated.[1,2,3]

Stream	Site ID	Location	Pre-project monitoring	Post-project monitoring	Additional parameters tested[1]
Perennial tributary Fry Creek	FRY_T01	At Weber Mill Road (Forest Road 11N38), approximately 0.3 miles west of Fry Creek.	At least one sample during or immediately after a significant runoff producing event.[2]	Within 90 days of herbicide application, at least one sample during or immediately after a significant runoff producing event.[2,3]	
Fry Creek	FRY_01	At Weber Mill Road (Forest Road 11N38)			Clopyralid.
Fry Creek	FRY_02	Just upstream of confluence with South Fork American River			Clopyralid.
Stream that originates from Granite Springs	GS_01	Downstream of road 11N42 before stream enters private land.			
Stream that originates from Granite Springs	GS_02	At Weber Mill Road (Forest Road 11N38)			
Stream near road 11N99F	US_01	Where stream crosses road 11N99F.			
East Kyburz Creek	EK_01	Just upstream of where the town of Kyburz diverts water from the stream.			Triclopyr, hexazinone.
West Kyburz Creek	WK_01	Where the stream crosses the Pony Express Trail			

[1] A significant runoff producing event would be where precipitation in the project area exceeds 1.0 inches of rain in 24 hours. Precipitation events that produce snow or mostly snow do not produce runoff, and therefore, will not trigger sampling. However, a period of rapid snowmelt could produce a significant runoff event.

[2] Herbicides will mostly be applied in the summer. The most likely precipitation event in the summer would be a localized thunderstorm.

[3] In the event that roads in the project area cannot be driven by a vehicle following a rainfall event, herbicide monitoring of streams can be done downstream near highway 50.

d. Best Management Practices.

Compliance with the Clean Water Act is demonstrated through the implementation of Best Management Practices (BMPs) certified by the state, and then monitoring to determine if the appropriate Central Valley Regional Water Quality Control Board standards are met. These BMPs are designed to prevent degradation of downstream water quality. Water Quality Management for Forest Service Lands in California - Best Management Practices (2000) describes the BMPs that are referenced in the Land and Resource Management Plan. The BMPs that are pertinent to the use of pesticides are described in the Table below.

Best Management Practices pertaining to the use of herbicides	
Practice 5-7 – Pesticide Use Planning Process	A hydrologist, fisheries biologist soil scientist, silviculturist, fuels specialist, archeologist and wildlife biologist are members of the ID team for this project. They have evaluated soil and watershed responses to the proposed herbicide applications and provided criteria for identifying sensitive areas to be avoided or needing additional protection. They identified specific mitigation measures for these areas as documented in the EIS and the following BMPs. They also evaluated soil and watershed responses to proposed activities. (ID Team - During Planning and Analysis Process).
Practice 5-8 - Pesticide Application According to Label Directions and Applicable Legal Requirements	All pesticide applications are required to follow label instructions and restrictions for use to avoid water contamination by complying with all label instructions and restrictions for use. Pesticide label directions for application rates and methods, mixing, and container disposal will be followed. Representative soil samples would be taken on units proposed for hexazinone treatments to determine application rate. Label directions will be followed on all pesticides, dyes, and adjuvants. All pesticide applications will adhere to all appropriate laws and regulations governing the use of pesticides, as required by the U.S. Environmental Protection Agency, the California Department of Pesticide Regulation, CalEPA regulations and safety regulations, and Forest Service policy pertaining to pesticide-use. Coordination with the appropriate County Agricultural Commissioners will occur, and all required licenses and permits would be obtained prior to any pesticide application. All Forest Service personnel in charge of projects involving pesticide application will be Qualified Applicator Certified. All contract applicators will be appropriately licensed by the state. These actions will effectively avoid the misuse of the herbicides used in this project and thus decrease the risk of contaminating water or applying to non-target areas. (Silviculturist, Culturist & Contract Representative responsible for application of pesticides).
Practice 5-9 - Pesticide Application Monitoring and Evaluation	Treatments are monitored and evaluated during application by the contract officer or representative to determine whether pesticides have been applied safely, restricted to intended target areas, and have not resulted in unexpected non-target effects. All spray equipment would be calibrated to insure accuracy of delivered amounts of pesticide. Periodically during application, equipment would be rechecked for calibration. Colorants or dyes would be added to the herbicide mixture to determine placement. A site-specific water quality monitoring plan will be prepared for this project prior to project implementation. It would be implemented prior to application to determine baseline conditions. The forest hydrologist, soil scientist, and district silviculturist would evaluate the results of the monitoring. This monitoring would determine if herbicides have moved off-site

	into water after application, through overland flow, leaching, or subsurface flow and would determine the amount of herbicide residue reaching water. This information would be critical to evaluating other protection measures. Post-project monitoring would determine the effectiveness of treatment in meeting the project objectives.
Practice 5-10 - Pesticide Spill Contingency Planning	To reduce contamination of water by accidental pesticide spills, a spill plan (project file) will be developed for this project. A copy will be retained onsite. It will be reviewed by all Forest Service personnel involved in the project, as well as by the contractor and the appropriate forest and district staff and line officers. Any herbicide application contract will contain clauses that will minimize the chances of herbicide spills (such as designating routes of travel and mixing sites, minimizing herbicide mix in tanks while traveling between units, requiring a separate water truck from the batch truck) and, if a spill occurs, outlining responses required by the contractor. Spill kits will be required in Forest Service and contractor vehicles on site and where contractor-supplied pesticides are stored. These actions would reduce the risk of contamination of water by accidental spills.
Practice 5-11 - Cleaning and Disposal of Pesticide Containers and Equipment	To prevent water contamination resulting from cleaning or disposal of pesticide containers all pesticide and adjuvant containers would be triple rinsed, with clean water, at a site approved by the Contracting Officer or Representative, or, in the case of application by Forest Service personnel, approved by the project director. The rinsate would be disposed of by placing it in the batch tank for application. Used containers would be punctured on the top and bottom to render them unusable after rinsing. Disposal of containers would be at legal dumpsites; certification of such disposal would be required prior to final payment on contract applications. Equipment would not be cleaned and personnel would not bathe in a manner that allows contaminated water to enter any body of water on the National Forest.
Practice 5-12 - Streamside Wet Area Protection During Pesticide Spraying	To minimize the risk of pesticide inadvertently entering waters, or unintentionally altering the riparian area of the wetland, untreated streamside buffers (as designated the Table below) will be employed. Buffer strip locations and width are based partly on results from water monitoring from previous years' herbicide application programs on the Eldorado National Forest. Monitoring showed that the size of those buffer strips was adequate to prevent degradation of downstream beneficial uses. Buffer width sizes are also based on the chemical properties and the labeled use of the herbicides being proposed. Using these two criteria, we estimate that these buffer strips would provide adequate protection for downstream beneficial uses. Buffer strip boundaries would be flagged or otherwise designated on the ground. The contractor or project employees would be informed of the location and extent of each of the strips prior to treatment. Applications would be monitored by the Contracting Officer or project director to determine accurate placement. Spray application personnel would not be allowed into these buffers.
Practice 5-13 - Controlling Pesticide Drift During Spray Applications	To minimize the risk of pesticide falling directly into water or non-target areas protection measures will be placed into the contract and project plans This includes: 1) using ground application equipment; 2) ceasing application when weather parameters exceed label requirements, precipitation, or forecast of greater than a 70% chance of precipitation in the next 24 hours (except hexazinone); 3) requiring a spray nozzle that produces a relatively large droplet; 4) requiring low nozzle pressures (15 psi); 5) requiring the spray nozzle be kept within 24 inches of vegetation being sprayed; 6) requiring a pressure gauge or pressure regulator on the backpack sprayers; 7) requiring a directed spray away from conifer seedlings and oaks as well as the use of physical barriers; and 8) requiring the use of a seedling wash-down solution for accidentally oversprayed seedlings.

Untreated Buffer Strips Adjacent to Aquatic Features

Herbicide(s)	Buffer width on each side of perennial streams[1]	Buffer width on each side of all other streams[1]	Buffer width for special aquatic features[2]	Buffer width for domestic water source[1]
Glyphosate	50 feet	0 feet – stream not flowing. 25 feet - stream is flowing.	25 feet	50 feet
Triclopyr/ Clopyralid	50 feet[3]	25 feet	50 feet	50 feet
Hexazinone	100 feet	100 feet	100 feet	NA

[1] As measured from the edge of the stream channel. If a defined channel is not present (draws do not have defined channels), measurement is from the bottom of the feature.

[2] As measured from the edge of the wet area surrounding the special aquatic feature. Special aquatic feature includes springs, seeps, bogs, fens, wet meadows, and all other wet areas.

Additional Best Management Practices	
Design Feature	To protect soils**:** Region 5 Soil Quality Standards would be met . Within 100 feet of perennial streams a minimum of 75% ground cover would be retained thru all release treatments.
Practice 1-6 – Protection of Unstable lands	To provide appropriate erosion and sedimentation protection for unstable areas there would be no ground-based entry of mastication equipment within 100 feet of any identified landslides, landslide prone lands or instabilities (such as mining ditches) or as determined by a geologist/soil scientist. This action would reduce the risk of triggering mass slope failure with resultant erosion and sedimentation.
Practice 1-19 - Streamcourse and Aquatic Protection	To control sediment and other pollutants from entering streamcourses, ground based entry of mastication equipment would not be allowed within 100 feet of perennial streams, lakes and reservoirs, meadows and springs, and 50 feet on each side of seasonal and ephemeral streams. Riparian vegetation would not be masticated.
Practice 2-12 - Servicing and Refueling of Equipment	To prevent pollutants from being discharged into streamcourses, all mechanized equipment will be refueled outside of Riparian Conservation Areas, if possible.
Practice 5-1 -Soil Disturbing/Treatments on the Contour	Sediment production and stream turbidity would be protected by minimizing the disturbance associated with turning of the equipment within the Riparian Conservation Areas.
Practice 5--2 - Slope Limitations for Mechanical Equipment Operation	To reduce gully and sheet erosion and associated sedimentation mechanical equipment will be restricted to slopes generally less than 35 percent. Within Riparian Conservation Areas, mechanical treatments would be minimized on moderate slopes (15-30 %) and restricted to slopes less than 30%.
Practice 5-3 - Tractor Operation is Limited in Wetlands and Meadows	To limit turbidity and sediment production in wetlands and meadows mastication equipment would not be allowed within 50 feet of meadows, springs, and wetlands.
Practice 5-6 - Soil Moisture Limitations for Mechanical Equipment Operations	To prevent compaction, rutting, and gullying mechanical treatment activities would be restricted and/or controlled during high soil moisture conditions.

e. Summary of herbicide monitoring report, Stanislaus National Forest.

Water Quality Monitoring for Herbicide Residue
Stanislaus National Forest, 1995 – 2002

USDA Forest Service, Pacific Southwest Region
Stanislaus National Forest, Calaveras, Groveland and Mi-Wok Ranger Districts

Prepared by:
James W. Frazier, Forest Hydrologist
Sharon L. Grant, Hydrologic Technician

June 2003

<u>Abstract</u>

Herbicide residue in water was monitored in five restoration projects covering approximately 21,400 acres between 1995 and 2002. These projects followed numerous large wildfires that occurred on the Stanislaus National Forest between 1987 and 1996. Hexazinone, glyphosate and triclopyr was applied to reduce water and nutrient competition between grass/brush and conifer seedlings until the seedlings became established. Hexazinone was applied by aerial and ground methods. Glyphosate and triclopyr were applied by ground.

Approximately 1,100 water samples were collected at 92 monitoring sites during this period. Surface water samples comprised about 90% of all sampling. Groundwater sampling was conducted to monitor hexazinone in subsurface flow. Surface water sampling was conducted using both automated samplers and manual sampling. Groundwater sampling was conducted using shallow wells drilled specifically for applicable the project.

Hexazinone was detected in surface and groundwater. Although 70% of 974 samples of hexazinone showed detection, 99.7% were less than the United States Environmental Protection Agency (USEPA) numerical water quality objective of 200 parts per billion (ppb) used in the reforestation project covered in this report. 96% of the samples were less than 50 ppb. 85% were less than 10 ppb, or 5% of the objective. Hexazinone persistence in water averaged two to three years but ranged from two months to five years among monitoring sites.

Triclopyr sampling results showed detections of 50% of the samples although all were less than 10 ppb and 86% were less than 1 ppb. Detections in trace amounts lasted up to six months.

Glyphosate sampling showed no detections in any of the samples collected.

Herbicide application during the period 1995-2000 was conducted safely and effectively in the largest and most complex herbicide program in the Pacific Southwest Region to date. Water quality was protected without adverse effects on beneficial uses of water.

Summary of herbicide monitoring results from the Stanislaus National Forest, 1995 - 2002 (Frazier and Grant 2003).

	Hexazinone				**Triclopyr**		**Glyphosate**	
Detection amount - parts per billion (ppb)	**Surface water**		**Ground water**		**Surface water**		**Surface water**	
	# of samples	**% of samples**	**# of samples**	**% of samples**	**# of samples**	**% of samples**	**# of samples**	**% of samples**
Not detected	262	29.4	59	70.2	36	50.0	55	100.0
< 1.0	253	28.4	14	16.7	26	36.1	0	0.0
1.0 - 10	246	27.6	11	13.1	10	13.9	0	0.0
11.0 - 50	96	10.8	0	0.0	0	0.0	0	0.0
51 - 100	21	2.4	0	0.0	0	0.0	0	0.0
101 - 200	9	1.0	0	0.0	0	0.0	0	0.0
> 200	3	0.3	0	0.0	0	0.0	0	0.0
Total # of samples	**890**		**84**		**72**		**55**	
MCL or HAL	**400 ppb**						**700 ppb**	
"No spray" buffer zone	50 ft. on live streams and springs, except 100 ft. on San Domingo Creek				10 to 20 feet on all streams and springs		10 ft. on all streams and springs	

MCL = Maximum Contaminant Level.
HAL = Health Advisory Level.

f. Summary of herbicide monitoring, Eldorado National Forest.

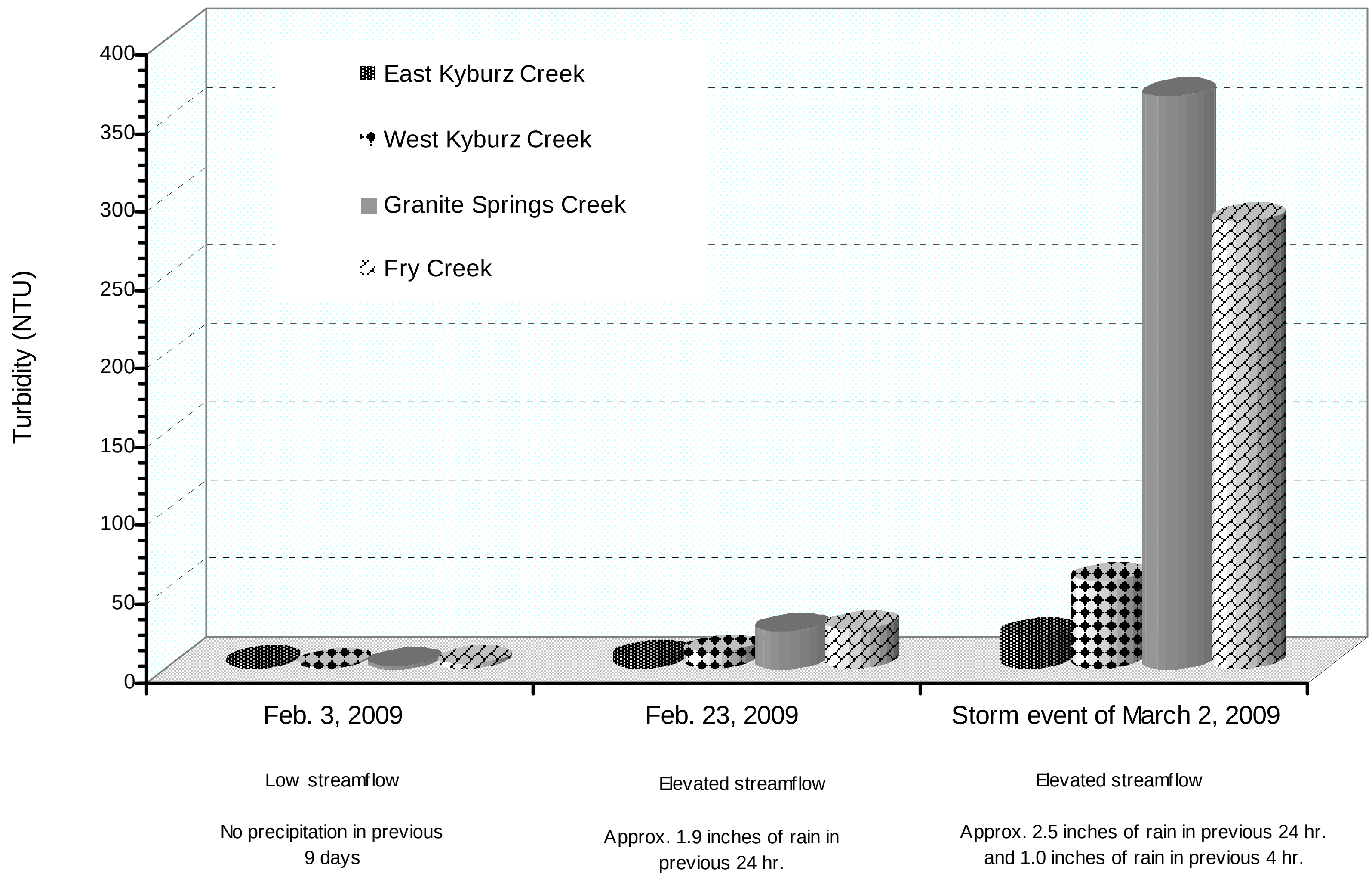
Summary of herbicide and pesticide monitoring for surface water : 1993 - 2006

	Hexazinone		Triclopyr		Glyphosate		Clopyralid		
Detection amount - parts per billion (ppb)	# of samples	% of samples	# of samples	% of samples	# of samples	% of samples	# of samples	% of samples	

g. Turbidity data of streams in the Freds Reforestation project area.

Para-meter	Date	Time	East Kyburz Creek	West Kyburz Creek	Granite Springs Creek	Eastern trib. of Granite Springs Cr.	Fry Creek	Cox Canyon	Flow Conditions	Precipitation / comments
Turbidity (NTU)	Feb. 3, 2009	1000 - 1200	3	1	2		3		Low flow	None in previous 9 days.
Turbidity (NTU)	Feb. 23, 2009	1000 - 1200	7	10	24	25	25	18	Elevated flow	1.9 inches rain in previous 24 hours. on top of 1 ft.. of snow. Snow level >6,000 ft.
Turbidity (NTU)	Feb. 26, 2009	1000 - 1200	2	5	5	6	6	6	Low flow	0.5 inches of rain in previous 24 hours. Snow level 5,000 ft.
Turbidity (NTU)	Storm event of March 2, 2009	1030 - 1200	9	22	129	38	82	120	Elevated flow	2.5 inches of rain in previous 24 hours and 1.0 inches in previous 4 hours Rising limb of hydrograph near peak. Raining hard during measurements and for several hours prior and after. Snow level >6,000 ft.. Fry Creek and Granite Springs Cr. = 20 cfs.
Turbidity (NTU)	Storm event of March 2, 2009	1255 - 1400	21	56	365		285		Elevated flow	

NTU = Nephelometric Turbidity Units



400
350
300
250
200
150
100
50
0
Turbidity (NTU)
East Kyburz Creek
West Kyburz Creek
Granite Springs Creek
Fry Creek
Feb. 3, 2009
Feb. 23, 2009
Storm event of March 2, 2009
Low streamflow
No precipitation in previous 9 days
Elevated streamflow
Approx. 1.9 inches of rain in previous 24 hr.
Elevated streamflow
Approx. 2.5 inches of rain in previous 24 hr. and 1.0 inches of rain in previous 4 hr.

Granite Springs Creek during the storm event of March 2, 2009.

2. Riparian Conservation Objectives.[1]

a. Background.

The Sierra Nevada Forest Plan Amendment Record of Decision (SNFPROD) of 2004 requires that a site specific analysis be conducted in order to determine the type and extent of activities that can occur within Riparian Conservation Areas (RCAs) adjacent to aquatic features (Table 1). Specifically, the SNFPROD contains six Riparian Conservation Objectives (RCOs) that apply to activities within RCAs.[1]

The Freds Fire Reforestation Project (FFRP) is located in the drainage basin of the South Fork American River. Most of the FFRP is located in the two 7th field watersheds of Kyburz and Fry Creek; a small portion of the FFRP is located in the Junction Reservoir 7th field watershed. The largest aquatic feature near to the project area is the South Fork American River, and nearly all of the streams in the project area flow directly into the South Fork American River.

Field surveys were conducted in July/August 2006 on five perennial streams and one wet meadow/spring complex in the project area in support of the analysis of Riparian Conservation Objectives.

Table 1. Riparian Conservation Areas (RCAs) adjacent to aquatic features as designated by the Sierra Nevada Forest Plan Amendment Record of Decision (SNFPROD) of 2004.[1]

Aquatic feature	Riparian Conservation Area
Perennial stream.	300 feet on each side of the stream, measured from the bank full edge of the stream
Seasonally flowing streams (includes intermittent and ephemeral streams).	150 feet on each side of the stream, measured from the bank full edge of the stream.
Special aquatic features (includes lakes, wet meadows, bogs, fens, wetlands, vernal pools, and springs).	300 feet from the edge of the features or riparian vegetation, whichever width is greater.
Perennial streams with riparian conditions extending more than 150 feet from the edge of the streambank or seasonally flow streams extending more than 50 feet from the edge of the streambank.	300 feet from the edge of the features or riparian vegetation, whichever width is greater.
Streams in inner gorge.	Top of inner gorge. (The inner gorge is defined by stream adjacent slopes greater than 70 percent gradient.)

[1] Riparian Conservation Areas (RCAs) are designated on page 42 of the SNFPROD (2004); RCOs are described on pages 33 and 34;.

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[1] Completed by Steve Markman, Hydrologist, Eldorado National Forest.

b. Analysis of Riparian Conservation Objectives and associated Standards and Guidelines.[1]

<u>Riparian Conservation Objective #1</u>

Ensure that identified beneficial uses for the water body are adequately protected.

<table>
<tr><th>Beneficial use(s) for South Fork American River drainage basin[1]</th><th>Beneficial use(s) affected by Alternative 1 (Proposed Action)</th><th>Beneficial use(s) affected by Alternative 3</th><th>Water quality standards set by the Central Valley Regional Water Quality Control Board (CVRWQCB)[1,2,3]</th></tr>
<tr><td>Municipal and domestic water supplies</td><td colspan="2" rowspan="4">√ Beneficial uses of water will be adequately protected in the short-term and long-term.

The reasons for the above conclusion are explained in Chapter 3 of this FEIS under the section Hydrology and Watershed Resources, Environmental Consequences, Direct and Indirect Effects.</td><td rowspan="4"><u>Turbidity</u>
“Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:
▪ Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases shall not exceed 1 NTU.
▪ Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.
▪ Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.
▪ Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.”
<u>Sediment</u>
“The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.”
<u>Suspended Material</u>
“Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.”
<u>Temperature</u>
“At no time or place shall the temperature of COLD or WARM intrastate waters be increased more than 5°F above natural receiving water temperature.”</td></tr>
<tr><td>Hydropower generation</td></tr>
<tr><td>Recreation
(contact, canoeing and rafting, other non-contact)</td></tr>
<tr><td>Cold freshwater habitat, cold-water spawning habitat, and wildlife habitat</td></tr>
</table>

[1] The Clean Water Act gives the states the authority to set water quality standards. The standards set by the states apply to the National Forest, and the Eldorado National Forest is under the jurisdiction of the Central Valley Regional Water Quality Control Board (CVRWQCB).
[2] The water quality standards in this table are from the following document: The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control board, Central Valley Region, Fourth Edition, September 15, 1998. This document can be found on the internet at http://www.swrcb.ca.gov/~rwqcb5/home.html
[3] For streams in the Freds Reforestation Project, the natural turbidity is generally less than 5 NTUs during baseflow conditions and generally greater than 5 NTUs only during rainfall events (Markman 2006).

Analysis of Riparian Conservation Objectives (RCOs) that pertain to riparian conservation areas (RCAs) within the Freds Fire Reforestation Project

	Riparian conservation objective (RCO)[1]	**Alternative 2 -No Action**	**Alternative 1- Proposed Action** **(Planting of conifers and use of herbicides)**	**Alternative 3** **(Planting of conifers and no herbicides)**
1	*Ensure that identified beneficial uses for the water body are adequately protected. Identify the specific beneficial uses for the project area, water quality goals from the Regional Basin Plan, and the manner in which the standards and guidelines will protect the beneficial uses.*	No impact to beneficial uses of water. Current conditions would be maintained.	√ **Beneficial uses of water will be adequately protected in the short-term and long-term.** The reasons for this conclusion are explained in Chapter 3 of this FEIS under the section *Hydrology and Watershed Resources, Environmental Consequences, Direct and Indirect Effects.* The applicable water quality standards and beneficial uses of water are contained in a Table on the preceding page.	
2	*Maintain or restore: (1) the geomorphic and biological characteristics of special aquatic features, including lakes, meadows, bogs, fens, wetlands, vernal pools, springs; (2) streams, including streamflows; and (3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.*	No impacts to special aquatic features. Current conditions would be maintained.	√ **In the short-term and the long-term, will maintain the hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.** There are several meadow/spring complexes near the ridgeline at Granite Springs that separates the Fry Creek and Junction Reservoir watersheds. These meadow/spring complexes (the largest is Granite Springs) provide hydrologic connectivity within and between the two watersheds. Trees will not be planted immediately adjacent to these meadow/spring complexes and there will be a reduced planting density in the general area. This means that the number of conifers near these features will be mostly determined by natural regeneration. The importance of this is that the planting of conifers near wet meadows at high densities encourages the encroachment of conifers into these features at a greater rate than would occur under natural regeneration. As the conifers grow in size, the amount of water that the conifers use results in less water available to the aquatic features; this in turn tends to shrink the size and lower the water table in these aquatic features. The loss of meadow habitat as a result of the encroachment of conifers has occurred in a number of locations in the western United States (USFS 2005). √ **In the short-term, will maintain the geomorphic and biological characteristics of**	

Riparian conservation objective (RCO)[1]	Alternative 2 -No Action	Alternative 1- Proposed Action (Planting of conifers and use of herbicides)	Alternative 3 (Planting of conifers and no herbicides)
		perennial streams. The increase in the amount of sediment delivered to streams will likely be negligible or slight. The reasons for this conclusion are described in Chapter 3 of this FEIS under the section *Hydrology and Watershed Resources, Environmental Consequences, Direct and Indirect Effects*. As result, the recovery of streams in the project area that are currently degraded (primarily as a result of the Freds Fire of 2004 and salvage logging	

	Riparian conservation objective (RCO)[1]	Alternative 2 -No Action	Alternative 1- Proposed Action (Planting of conifers and use of herbicides)	Alternative 3 (Planting of conifers and no herbicides)
4	*Ensure that management activities, including fuels reduction actions, within RCAs and critical aquatic refuges (CARs) enhance or maintain physical and biological characteristics associated with aquatic-and riparian-dependent species*	No impacts to RCAs or aquatic features. Current conditions would be maintained	√ **In the short-term and the long-term, will maintain the geomorphic and biological characteristics associated with aquatic and riparian dependent species.** The buffers next to streams in the project area where no herbicide will occur are expected to prevent effects to foothill yellow-legged frogs that are known to reside 5.4 miles downstream in the South Fork American River. Sierra Nevada yellow-legged frogs are not expected to reside in the streams of the project area. If Sierra Nevada yellow legged frogs do reside in streams in the project area, the buffers next to stream where herbicide use will not occur is expected to prevent negative effects to that specie. Based on the natural history of the western pond turtle, there is a year-round risk for disturbance to western pond turtles or their nests. Data on herbicide toxicity for western pond turtles is lacking; however, overwintering or nesting western pond turtles, as well as their nests, could be exposed to glyphosate. This is described in *Aquatic Species Biological Assessment/Evaluation for the Freds Fire Reforestation Project (Williams 2009.)*	

	Riparian conservation objective (RCO)[1]	Alternative 2 -No Action	Alternative 1- Proposed Action (Planting of conifers and use of herbicides)	Alternative 3 (Planting of conifers and no herbicides)
5	*Preserve, restore, or enhance special aquatic features, such as meadows, lakes, ponds, bogs, fens, and wetlands, to provide the ecological conditions and processes needed to recover or enhance the viability of species that rely on these areas.*	No impacts to special aquatic features; therefore, the current condition of these features would be maintained.	√ **In the short-term and long-term, will preserve or maintain the current condition of three meadow/spring complexes near Granite Springs and the headwaters of Fry Creek.** Trees will not be planted immediately adjacent to meadow/spring complexes and there will be a reduced planting density in the general area between the meadow complexes at Granite Springs. This means that the number of conifers near these aquatic features will be mostly determined by natural regeneration. The importance of this is that the planting of conifers adjacent to wet meadows at high densities encourages the encroachment of conifers into these features at a greater rate than would occur under natural regeneration. As the conifers grow in size, the amount of water that the conifers use results in less water available to the aquatic features; this in turn tends to shrink the size and lower the water table in these aquatic features. The loss of meadow habitat as a result of the encroachment of conifers has occurred in a number of locations in the western United States (USFS 2005). The on-the-ground Riparian Conservation Objective analysis of the Fry Creek meadow/spring complex (of July 2006) determined that conifers should not be planted within 150 feet of the edge of the feature in order to maintain and possibly enhance this feature. A distance of 150 feet was chosen because this is the approximate site potential tree height - trees that are more than that distance from the aquatic feature have at most a minor impact on the feature. Natural encroachment of conifers into the Fry Creek meadow/spring complex would still occur, but at a much slower rate than under Alternatives 1 and 3. Not planting conifers within 150 feet of the Fry Creek aquatic feature will allow natural processes to determine the size and character of this feature. For the spring/meadow complexes at Granite Springs, the no planting zones around these features will be less than 150 feet because of the terrain - outcrops of granitic bedrock at some locations interferes with natural regeneration of conifers, planting of conifers, and the potential impacts of those conifers on the nearby aquatic feature. The aquatic features located near Granite Springs and the headwaters of Fry Creek	

	Riparian conservation objective (RCO)[1]	Alternative 2 -No Action	Alternative 1- Proposed Action (Planting of conifers and use of herbicides)	Alternative 3 (Planting of conifers and no herbicides)
			total roughly 16.8 acres, or only 0.6 percent of the roughly 2,000 acres of conifer forest that may eventually occur under the Proposed Action. These aquatic features - which can best be described as wet meadow/spring complexes - currently contain willow, cattails, and surface water.	

	Riparian conservation objective (RCO)[1]	Alternative 2 -No Action	Alternative 1- Proposed Action (Planting of conifers and use of herbicides)	Alternative 3 (Planting of conifers and no herbicides)
6	*Identify and implement restoration activities to maintain, restore or enhance water quality and maintain, restore, or enhance habitat for riparian and aquatic species.*	No restoration activities would be implemented.	√ **In the short-term, will maintain water quality.** Impacts to water quality are expected to be slight and will not adversely affect beneficial uses of water. The reasons for this conclusion are described in Chapter 3 of this FEIS under the section *Hydrology and Watershed Resources, Environmental Consequences, Direct and Indirect Effect.* √ **In the long-term, will maintain or enhance water quality.** The planting of conifers on roughly 2,000 acres burned by the Freds Fire of October 2004 should accelerate the recovery of the forested landscape that existed before the Freds Fire of 2004 – this in turn should reduced erosion and sediment delivery to streams. √ **In the long-term will preserve or maintain habitat for riparian and aquatic species.** Most of the impacts to the biological characteristics of streams and aquatic- riparian-dependent species are expected to be short-term.[1]	

[1] Impacts to aquatic species are described in detail in: the *Aquatic Species and Biological Assessment and Evaluation for the Freds Fire Reforestation Project (Williams 2009).*

3. Cumulative Watershed Effects.

a. Background.

Cumulative effects consider the impacts of all past, present, proposed, and reasonably foreseeable land disturbances. In the Eldorado National Forest (ENF), the analysis of cumulative effects for hydrology and aquatic resources includes the 7th field watersheds that contain the proposed land uses. Most of the 7th field watersheds in the ENF - generally between 2,000 and 13,000 acres in size - are sensitive to cumulative effects as a result of the land uses typically proposed by the Forest Service. These land uses include timber harvest, building of roads, planting of trees, and vegetation control (such as the use of the herbicides).

There are a number of methods currently used to assess cumulative watershed effects (CWE) where the primary direct impact of concern is an increase in sediment delivery to streams and other aquatic features. None of these methods can quantitatively predict the amount of sediment delivered to streams, the distance downstream that the sediment load will travel, or point in time and the duration when an increase in sediment delivery to aquatic features will occur. The reasons for this include the large variability in the magnitude of direct effects from a given land disturbance, inability to predict secondary or indirect effects, lack of data on recovery rates for land disturbances, difficulty of validating predictive models on-the-ground, and the uncertainty of future events such as the size and timing of large storms. As a result, an assessment of CWE is frequently reported as an indicator of the overall *risk* of cumulative effects occurring in a watershed (Reid 1993; MacDonald 2000).

The method used for CWE analysis in the Eldorado National Forest (ENF) is the method of Equivalent Roaded Acres (ERA). This method was developed by Region 5 of the U.S. Forest Service and adapted by the ENF. The method was specifically developed to assess the *risk* of CWE in forested watersheds where timber harvest and roads are major land disturbances. The ERA method has been used in the ENF for over 15 years, and nearly all of the 150 watersheds in the ENF have been evaluated with this method. This allows all of the watersheds in the ENF to be compared relative to each other in terms of the risk of CWE. The table below provides a summary of the ERA method.

b. Method of Equivalent Roaded Acres (ERA).

Summary

The risk of cumulative watershed effects (CWE) is assessed using the Equivalent Roaded Acre (ERA) method developed by R5 USFS. The process was further refined and adapted for the Eldorado National Forest (Carlson and Christiansen 1993). In this method, an index is calculated for an entire watershed that expresses most land use in terms of the percent of the watershed covered by roads. Based on the ERA and a threshold of concern (TOC), a given watershed is assigned a relative risk – low, moderate, high, or very high - of CWE. The primary cumulative impact of concern is an increase in sediment delivery to streams and degradation of aquatic habitat.

Important aspects of the ERA method

Roads, which are considered to have the greatest potential to increase runoff and sediment to streams, are given a value of 1.0. The number of acres of roads in a watershed is divided by the size of the entire watershed (in acres). This gives the percent of the watershed covered by roads.
For each land disturbance activity other than roads, the number of acres is multiplied by a number less than 1.0. The result (for each land disturbance activity) is then divided by the number of acres of the entire watershed. This gives the percent of the "equivalent roaded acres" in the watershed for each type of land disturbance.
The values for equivalent roaded acres for all of the land disturbance activities are added together. The final number represents the percent of the watershed that is covered by the 'equivalent' of roads.
The threshold of concern (TOC) is usually between 10 and 18 percent. That is, when 10 to 18 percent of a watershed is covered by the equivalent of roads, there is a "high risk" that increased peak flows of streams and sediment delivery to streams will occur. This does not mean these effects will occur precisely when the ERA reaches the TOC, or that an increase in peak flows and sediment delivery to streams will automatically result in a degradation of fish habitat or diminish the experience of recreationists. It is merely a warning that cumulative effects might occur.

Assumptions and limitations of the ERA method

The method is intended for watersheds between 3,000 and 10,000 acres in size, although the method is commonly used for watersheds slightly outside of this range.
ERA values, as well as the TOC, are only indicators of the risk of cumulative impacts occurring. They cannot be used to determine the percent or numerical amount of increase of sediment delivery to streams, stream channel eroded, fish habitat degraded or lost, or any other change in watershed condition. Such quantitative assessments require additional analysis.
The location of land disturbance activities within a watershed is not considered. For example, roads near streams are treated exactly the same as roads that are far from streams. In reality, roads located within or next to riparian areas contribute more sediment to streams than roads in upland areas.
Recovery of the watershed from land disturbing activities occurs with time. For timber harvest activities, hydrologic recovery is assumed to be thirty years (i.e. ERA contribution is zero thirty years after timber harvest.)
The ERA calculations do not take into account site specific BMPs that will be applied.
ERA values start one year after a land use is implemented.

Risk categories

Low risk of CWE - ERA is less than 50% of TOC.
Moderate risk of CWE - ERA is between 50% and 80% of TOC.
High risk of CWE - ERA is between 80% and 100% of TOC.
Very high risk of CWE - ERA is greater than TOC.

Effects of individual land disturbances on aquatic features

The equivalent roaded acres (ERA) and the on-the-ground effects of each past and present individual activity (i.e. each individual past timber sale, each existing and past road, each present and past impervious area, etc.) is not presented here. The primary reason for this is that the science simply does not exist to accurately and precisely determine the effect of each individual prior human action and each past natural event in the watershed on the current condition of a single aquatic feature or a group of aquatic features. The existing condition of each aquatic feature is the result of the aggregate impact of many prior human actions and natural events in the entire watershed over a long period of time. The existing condition of individual aquatic features in the project area is described in the section *Affected Environment and Existing Conditions*. The overall risk of cumulative watershed effects (CWE) for each watershed that contains the Freds Reforestation EIS, the method of equivalent roaded acres (ERA) for assessing that risk, and the ERA contributed for different types of land disturbances, is described in the section *Hydrology and Watershed Resources* of Chapter 3.

Appendix D

Site Specific Human Health Risk Assessment

Freds Fire Reforestation Final
Environmental Impact Statement
Eldorado National Forest

Prepared by:
Robert Carroll, Forest Pesticide-Use Coordinator
10/27/2008

Section 1 – Introduction

The purpose of this analysis is to assess the site-specific risks to human health and safety of using five different herbicides for the control of grasses, forbs, and woody brush, and the control and eradication of the noxious weeds yellow starthistle and tall whitetop on the Eldorado National Forest. The herbicides examined are glyphosate, triclopyr, hexazinone, clopyralid, and chlorsulfuron. This analysis is based on the planned application rates for each of these herbicides that are proposed for ground-based application under the proposed action (Alternative 1). The application methods and application rates are based on silvicultural prescriptions prepared for the treatment units, and are on file at the Placerville Ranger District office. Table D-1 summarizes the herbicide formulations that are planned for use for Alternative 1, the expected rates per acre, and the additives planned for use.

Table D-1 - Herbicide Formulations, Application Rates and Additives

Herbicide Formulation	Application Rate (pounds/acre)	Additives
Site Preparation and Release Treatments		
glyphosate (Accord or equivalent formulation)	2.7 - 4.8 lbs/acre (ae)	NPE-based or silicone/MSO blend surfactant, Colorfast Purple dye
hexazinone (granular - Pronone or equivalent formulation)	2.0 - 3.0 lbs/acre (ae)	none MSO-based or silicone/MSO blend surfactant, Colorfast Purple dye
Noxious Weed Treatments		
glyphosate (Accord or equivalent formulation)	2.7 lbs/acre (ae)	NPE-based or silicone/MSO blend surfactant, Colorfast Purple dye
glyphosate (Rodeo or equivalent formulation)	2.7 lbs/acre (ae)	MSO-based surfactant, Hi-Light blue dye
clopyralid (Transline)	0.25 lbs/acre (ae)	NPE-based or silicone/MSO blend surfactant, Colorfast Purple dye
chlorsulfuron (Telar)	0.047 – 0.14 lbs./acre (ai)	NPE-based or silicone/MSO blend surfactant, Colorfast Purple dye

ae – acid equivalent, ai – active ingredient

Rates for hexazinone vary depending on soil texture and organic matter. The lower rates are for soils with higher sand content and lower organic matter, while the higher rates are for soils with higher silt content and organic matter. In addition to the specific herbicides, an additive (NPE-based surfactant, MSO-based surfactant, or a silicone/MSO blend surfactant), and a colorant (such as Colorfast Purple) may be utilized. NPE-based surfactants, MSO-based surfactants, and silicone/MSO blend surfactants are spreader/activators that improve the activity and penetration of the herbicide by reducing surface tension, allowing the herbicide mixture to spread evenly over the surface of vegetation. A colorant is added to indicate where the herbicide has been applied.

This risk assessment examines the potential health effects on all groups of people who might be exposed to any of the five herbicides proposed to be used. Those potentially at risk fall into two groups: workers and members of the public. Workers include applicators, supervisors, and other personnel directly involved in the application of herbicides. The public includes other forest workers, forest visitors, and nearby residents who could be exposed through the drift of herbicide spray droplets, through contact with sprayed vegetation, or by eating, or placing in the mouth, food items or other plant materials, such as berries or shoots growing in or near treated areas, by eating game or fish containing herbicide residues, or by drinking water that contains such residues.

The analysis of the potential human health effects of the use of chemical herbicides was accomplished using the methodology generally accepted by the scientific community (National Research Council, 1983, United States Environmental Protection Agency, 1986). In essence, the risk assessment consists of comparing doses, based on site-specific herbicide use levels, that people might receive from applying the herbicides (worker doses) or from being near an application site (public doses) with the United States Environmental Protection Agency's (U. S. EPA) established Reference Doses (RfD), a level of exposure considered protective of lifetime or chronic exposures. The site-specific risk assessment also examines the potential for these treatments to cause synergistic effects, cumulative effects, and effects on sensitive individuals, including women and children.

Details regarding the specific methods used to prepare the Syracuse Environmental Research Associates, Inc. (SERA) Human Health Risk Assessments referenced in this document are provided in SERA (2007), while detailed explanations of specific methods used in estimating occupational exposure are provided in SERA (1998). The risk assessment has five major sections: an introduction (Section 1); an identification of the hazards associated with each herbicide and its commercial formulations (Section 2); an assessment of potential exposure to the product (Section 3); an assessment of the dose-response relationships (Section 4); and a characterization of the risks associated with plausible levels of exposure (Section 5).

Risk assessments are usually expressed with numbers; however, the numbers are far from exact. *Variability* and *uncertainty* may be dominant factors in any risk assessment, and these factors should be expressed. Within the context of a risk assessment, the terms *variability* and *uncertainty* signify different conditions.

Variability reflects the knowledge of how things may change. Variability may take several forms. For this risk assessment, three types of variability are distinguished: *statistical*, *situational*, and *arbitrary*. *Statistical variability* reflects, at least, apparently random patterns in data. For example, various types of estimates used in this risk assessment involve relationships of certain physical properties to certain biological properties. In such cases, best or maximum likelihood estimates can be calculated as well as upper and lower confidence intervals that reflect the statistical variability in the relationships. *Situational variability* describes variations depending on known circumstances. For example, the application rate or the applied concentration of a herbicide will vary according to local conditions and goals. As discussed in the following section, the limits on this variability are known and there is some information to indicate what the variations are. In other words, *situational variability* is not random. *Arbitrary variability,* as the name implies, represents an attempt to describe changes that cannot be characterized statistically or by a given set of conditions that cannot be well defined. This type of variability dominates some spill scenarios involving either a spill of a chemical on to the surface of the skin or a spill of a chemical into water. In either case, exposure depends on the amount of chemical spilled and the area of skin or volume of water that is contaminated.

Variability reflects knowledge of or at least an explicit assumption about how things may change, while *uncertainty* reflects a lack of knowledge. For example, the focus of the human health dose-response assessment is an estimation of an “acceptable” or “no adverse effect” dose that will not be associated with adverse human health effects. For most chemicals, however, this estimation regarding human health must be based on data from experimental animal studies, which cover only a limited number of effects. Generally, judgment, not analytical methods, is the basis for the methods used to make the assessment. Although the judgments may reflect a consensus (i.e., be used by many groups in a reasonably consistent manner), the resulting estimations of risk cannot be proven analytically. In other words, the estimates regarding risk involve uncertainty. The primary functional distinction between variability and uncertainty is that variability is expressed quantitatively, while uncertainty is generally expressed qualitatively.

In considering different forms of variability, almost no risk estimate presented in this document is given as a single number. Usually, risk is expressed as a central estimate and a range, which is sometimes very large. Because of the need to encompass many different types of exposure as well as the need to express the uncertainties in the assessment, this risk assessment involves numerous calculations. Most of the calculations are relatively simple, however, some of the calculations are cumbersome. These calculations are contained in worksheets in the project file, and are based on the worksheets contained in the various SERA risk assessments.

Section 2 – Hazard Analysis

The hazards associated with using each of the herbicides were determined by a thorough review of available toxicological studies. The reviews are contained in other documents and are referenced here as needed. A considerable body of information has been compiled in a group of risk assessments completed by SERA (authored by Dr. Patrick Durkin, PhD) under contract to the Forest Service, the risk assessment contained in the programmatic Region 5 Final EIS Vegetation Management for Reforestation (USDA 1989), and the risk assessment contained in the Herger-Feinstein Quincy Library Group Forest Recovery Act Final Supplemental EIS (USDA, 2003b). Another source of information on toxicity are the background statements contained in Forest Service Agricultural Handbook No. 633 (USDA, 1984). Current peer-reviewed articles from the open scientific literature, as well as recent U. S. EPA documents are also used to update the information contained in these documents. Toxicity information for the surfactants being considered for use are summarized in USDA, 2003a and USDA, 2007. Additional information on toxicity is contained in Williams, et al (2000). Current peer-reviewed articles from the open scientific literature, as well as recent U.S. EPA documents are also used to update information contained in these documents. All of these documents are incorporated by reference into this risk assessment.

The toxicological database for each herbicide was reviewed for acute, subchronic, and chronic effects on test animals. Because of the obvious limitations on the testing of chemicals on humans, judgments about the potential hazards of pesticides to humans is necessarily based in large part on the results of toxicity tests on laboratory animals. Where such information is available, information on actual human poisoning incidents and effects on human populations supplement these test results. For a background discussion of the various toxicological tests and endpoints, refer to USDA (1989, pages F-7 to F-18).

A note specific to impurities and metabolites – virtually no chemical synthesis yields a totally pure product. Technical grade herbicides, as with other technical grade products, undoubtedly contain some impurities. The U. S. EPA defines the term impurity as "…any substance … in a pesticide product other than an active ingredient or inert ingredient, including un-reacted starting materials, side reaction products, contaminants, and degradation products" (40 CFR 158.153(d)). To some extent, concern for impurities in technical grade products is reduced by the fact that the existing toxicity studies on these herbicides were conducted with the technical grade product. Thus, if toxic impurities are present in the technical grade product, they are likely to be encompassed by the available toxicity studies on the technical grade product. An exception to this general rule involves carcinogens, most of which are presumed to act by non-threshold mechanisms. Because of the non-threshold assumption, any amount of a carcinogen in an otherwise non-carcinogenic mixture may pose a carcinogenic risk. As with contaminants, the potential effect of metabolites on a risk assessment is often encompassed by the available *in vivo* toxicity studies under the assumption that the toxicological consequences of metabolism in the species on which toxicity studies are available will be similar to those in the species of concern (humans in this case). Uncertainties in this assumption are encompassed by using an uncertainty factor in deriving the RfD and may sometimes influence the selection of the study used to derive the RfD. Unless otherwise specifically referenced, all data and test results are from the references listed at the herbicide heading.

Chlorsulfuron (Reference: SERA, 2004a)

Acute and Chronic Exposures - Although no information is available on the toxicity of chlorsulfuron to humans, the toxicity of chlorsulfuron has been relatively well characterized in mammals. All of this information is contained in unpublished studies submitted to the U.S. EPA as part of the registration process for chlorsulfuron.

In experimental mammals, the acute oral LD_{50} for chlorsulfuron is greater than 5,000 milligrams per kilogram of body weight (mg/kg), which indicates a low order of oral toxicity. Acute exposure studies of chlorsulfuron and chlorsulfuron formulations give similar results, indicating that formulations of chlorsulfuron are not more toxic than chlorsulfuron alone.

Similar adverse effects are observed following both subchronic and chronic exposure to chlorsulfuron in tested mammals. The most common and sensitive signs of acute, subchronic, and chronic toxicity are weight loss and decreased body weight gain. The only other commonly noted effects are changes in various hematological parameters and general gross pathological changes to several organs. None of these changes, however, suggest a clear or specific target organ toxicity. While observations of weight loss and decreased weight gain suggest that chlorsulfuron could be associated with an underlying change in metabolism, studies specifically investigating the effects of chlorsulfuron on metabolism have not been conducted. The U.S. EPA used a 1-year feeding study in rats, with a NOEL of 5 mg/kg/day, to derive an RfD for chlorsulfuron; body weight loss and decreased weight gain were used as the most sensitive effects.

Effects on the Skin and Eyes **-** Chlorsulfuron is classified as a moderate eye irritant, but as a non-irritant to the skin. The results of several acute dermal studies show that formulations containing up to 80% chlorsulfuron produced only mild skin irritation. Dermal application of chlorsulfuron to intact and abraded skin produced mild redness in rabbits that resolved within 4-6 days. Dermal application of chlorsulfuron did not produce skin irritation or a sensitization response in guinea pigs. Application to the eyes of rabbits produced mild irritant effects to the cornea and conjunctiva. Transient, mild corneal clouding and mild to no conjunctival swelling and discharge were observed in rabbits following a single application of 0.1 milliliter (mL) of a 75% formulation. No signs of irritation of the iris were observed. In another study, a single application to the eyes produced transient slight corneal clouding, conjunctivitis, and swelling of the iris. Eyes returned to normal within 4 days. Studies on the systemic toxicity of chlorsulfuron following dermal exposure have been conducted in rabbits. Dermal exposure to doses up to 3,400 mg/kg were not associated with any signs of significant systemic toxicity in rabbits based on standard acute bioassays with 14-day observation periods. The only signs of systemic toxicity reported in these studies were an initial weight loss and diarrhea.

Reproductive and Teratogenic Effects - Two gavage teratogenicity studies have been conducted in rabbits and rats and two dietary reproduction studies have been conducted in rats. Chlorsulfuron is not teratogenic, but is toxic to embryos at high exposure levels. An increase in the number of fetal resorptions and a decrease in fetal viability, indicating embryo toxicity, were observed in rabbits exposed to 75 mg/kg/day. Teratogenic effects were not observed in any dose group. Exposure of rats for three-generations to chlorsulfuron did not result in significant treatment-related effects. The only adverse effect on reproductive function reported was a slightly decreased fertility index in rats exposed to 125 mg/kg/day. The NOEL for reproductive effects in rats is 25 mg/kg/day. Other than weight loss, no significant maternal toxicity was reported in these studies. Thus, chlorsulfuron does not appear to have significant adverse effects on reproductive function. Chlorsulfuron is listed as a developmental toxicant by the state of California under Proposition 65 (the Safe Drinking Water and Toxic Enforcement Act of 1986).

Carcinogenicity and Mutagenicity - Chlorsulfuron has been tested for mutagenicity in a number of different test systems and has been assayed for carcinogenic activity in rats and mice. No evidence of carcinogenic activity was found in any of the chronic toxicity studies conducted on chlorsulfuron. Chlorsulfuron was classified as having ``no evidence of carcinogenicity" based upon lack of evidence of carcinogenicity in rats and mice (U.S. EPA 2002e).

Results of *in vitro* mutagenicity studies in several *Salmonella typhimurium* bacteria strains and in Chinese hamster ovary cells show that chlorsulfuron is not mutagenic, either with or without metabolic activation. Negative results were also obtained from genotoxicity studies in rat liver cell cultures. In addition, *in vivo* studies in rats show that chlorsulfuron at exposure levels up to 250 mg/kg/day for 10 weeks does not produce dominant lethal mutations.

Other Toxic Endpoints – There is very little direct information on which to assess the immunotoxic potential of chlorsulfuron. Results of long-term exposure studies in dogs and mice show that chlorsulfuron may produce changes to immune system function. Increases in lymphocytes and eosinophils (a type of white blood cell that can increase with allergy and other infections) were observed in female dogs exposed for 6 months to 25 or 125 mg/kg/day chlorsulfuron. Effects were not seen at the 5 mg/kg/day dose or in male dogs at any dose. In mice, neutrophilic granulocytes (a type of white blood cell) were decreased and lymphocyte counts were increased in female mice exposed to 250, or 375 mg/kg/day chlorsulfuron for 3 months. These effects were not observed in female mice at lower doses or in male mice at any dose. While results of these studies suggest that exposure to chlorsulfuron may produce changes in immune system parameters, the observations in these studies do not provide conclusive evidence supporting the immunotoxic potential of chlorsulfuron.

Virtually any chemical, including chlorsulfuron, will cause signs of neurotoxicity in severely poisoned animals and thus can be classified as an indirect neurotoxicant. This is the case for chlorsulfuron in that exposure to acute high doses of chlorsulfuron produces lethargy and weakness. This does not, however, implicate chlorsulfuron as a direct neurotoxicant.

Chronic, lifespan, and multigenerational bioassays in mammals and acute and subchronic studies on aquatic organisms and wildlife did not reveal endocrine effects. Any endocrine related effects would have been detected in this definitive array of required tests (U.S. EPA, 2002f). Both weight loss and weight gain are observed in animals treated with chlorsulfuron, implying a change in metabolic status. However, there is no evidence to suggest that changes in weight are due to effects of chlorsulfuron on the endocrine system. Decreased pituitary and thyroid weights were observed in male dogs exposed to chlorsulfuron for

26 weeks. However, these changes were not considered to be treatment related. With the exception of a slight decrease in the fertility index in rats exposed to 125 mg/kg/day chlorsulfuron in a three-generation reproductive study, there is no evidence that chlorsulfuron produces adverse effects on the reproductive endocrine system. Thus, no evidence for chlorsulfuron producing direct effects on the endocrine system was found.

Inhalation Exposures – There is only one inhalation toxicity study of chlorsulfuron. Acute (4 hour) inhalation of chlorsulfuron at relatively high concentration levels (5.9 mg/L) in dust did not results in any systemic adverse effects to rats considered to be treatment related. While no systemic effects were noted from necropsy performed after exposure, microscopic changes to the mucus membrane in the nasal cavity, including atrophy of the secreting cells of the nasal gland and minor changes to the nasal cavity skin cells, were noted in some of the rats. These histological findings were consistent with chronic inflammation of the lining of the nose or with post-injury repair processes.

Impurities – No information has been encountered in the published or unpublished literature on impurities in chlorsulfuron.

Metabolites - The elimination of chlorsulfuron has been studied in rats, goats, dairy cows, and hens. In rats, chlorsulfuron exhibits first order elimination kinetics, with an estimated half-life of <6 hours. In all mammalian species studied, chlorsulfuron and its metabolites are extensively and rapidly cleared by a combination of excretion and metabolism. Most of the chlorsulfuron is excreted in urine or feces in the form of the unchanged compound. Due to its rapid elimination, metabolism of chlorsulfuron in animals is minimal. The major metabolite identified in the urine of rats is 2-chlorobenzenesulfonamide (a hydrolysis product), although other minor metabolites have also been identified in urine. Conjugation products, mainly N-glucuronides, have also been identified in the urine of goats. No studies investigating the toxicity of the chlorsulfuron metabolites produced by mammals were identified in the published literature or unpublished studies. There is no evidence that the metabolites of chlorsulfuron as identified in either the plant, or animal metabolism studies are of any toxicological significance (U.S. EPA, 2002f).

Inerts - The formulation of chlorsulfuron used by the Forest Service contains materials other than chlorsulfuron that are included as adjuvants to improve either efficacy or ease of handling and storage. The identity of these materials is confidential. The inerts were disclosed to the U.S. EPA and were reviewed in the preparation of SERA, 2004a. All that can be disclosed explicitly is that none of the additives are classified by the U.S. EPA as toxic.

Clopyralid (Reference: SERA, 1999, 2004b)

Acute and Chronic Exposures - Although no information is available on the toxicity of clopyralid to humans, the toxicity of clopyralid has been relatively well characterized in mammals. All of this information is contained in unpublished studies submitted to the U.S. EPA as part of the registration process for clopyralid.

Two different manufacturing processes may be used for clopyralid: the penta process and the electrochemical process. The limited available information indicates that technical grade clopyralid samples from the electrochemical process may be somewhat more toxic (median lethal dose (LD_{50}) values in the range of about 3000 mg/kg) than the penta process (LD_{50} > 5000 mg/kg). These differences, however, are not substantial and may be due to random variability.

The available data do not suggest that Transline would be more or less toxic than clopyralid following acute oral exposure. Carreon and New (1981, as referenced in SERA 2004b) reported an LD_{50} >5000 mg/kg for a formulation with no deaths at a dose level of 5000 mg/kg; lethargy was the only treatment-related effect.

Clopyralid also has a low order of chronic toxicity. On chronic or subchronic exposures, no effects have been observed in laboratory mammals at doses of 50 mg/kg/day or less. At doses of 100 mg/kg/day or greater, various effects have been observed in different species and different bioassays. These effects include weight loss, changes in the weight of the liver and kidney, thickening of epithelial tissue, irritation of the lungs, and decreases in red blood cell counts.

Up until 2001, U.S. EPA had used a chronic No Observed Adverse Effect Level (NOAEL) of 50 mg/kg/day to establish the RfD. This was based on a chronic exposure study in rats (Humiston et al, 1977, as referenced in SERA, 1999) that showed decreases in body weight in females at the next highest dose tested (150 mg/kg/day). In 2001, U.S. EPA changed the chronic NOAEL to 15 mg/kg/day (U.S. EPA, 2001), based on another chronic study in rats that also showed effects at 150 mg/kg/day (thickening of epithelial tissue), but a NOAEL of 15 mg/kg/day (Barna-Lloyd et al, 1986, as referenced in SERA, 1999). This second study did not have a 50 mg/kg/day dose level. This change is currently under discussion between the clopyralid registrant and the U.S. EPA. However, for this risk assessment, the value of 15 mg/kg/day will be used as the chronic NOAEL, for the establishment of the RfD.

Effects on the Skin and Eyes - After direct instillation into the eyes, both penta and electrochemical process clopyralid can cause persistent damage to the eyes. The damage is characterized as slight to marked redness, swelling of the conjunctiva, and discharge with reddening of the iris and moderate to marked opacity of the cornea.

Other than signs of transient redness of the skin shortly after application, there is no evidence to suggest that clopyralid is a potent skin irritant. Neither the penta process clopyralid nor electrochemical process clopyralid causes skin sensitization.

Studies on formulations comparable or equivalent to Transline have been conducted for dermal irritation and for ocular irritation. These studies indicate that the irritant effects of Transline are comparable to those of technical grade clopyralid.

The available toxicity studies suggest that dermal exposure to 2000 mg/kg clopyralid was not associated with any signs of systemic toxicity in rabbits based on standard acute/single application bioassays with 14-day observation periods. The available data suggest that the dermal absorption of clopyralid is poor. No systemic effects were reported by a dermal study in which New Zealand white rabbits were exposed to 2000 mg/kg clopyralid for 24 hours.

The systemic effects from dermal exposure to the formulation may be influenced by the presence of other adjuvants which may alter the rate at which the parent chemical moves through the skin. The available data do not suggest that the Transline formulation has greater potential for persistent systemic toxicity than clopyralid, although lethargy was observed following acute dermal exposure.

Reproductive and Teratogenic Effects - Two gavage teratogenicity studies have been conducted in rabbits, one gavage teratogenicity study has been conducted in rats, and four dietary reproduction studies have been conducted in rats. Other than a decrease in maternal body weight, which is consistent with the information on the subchronic and chronic toxicity of clopyralid, these studies report few signs of toxicity in dams or offspring. At doses that cause no signs of maternal toxicity - i.e., doses below about 100 mg/kg/day - no reproductive or teratogenic effects are apparent. The available data suggest that clopyralid does not produce developmental effects at doses that do not produce maternal toxicity. U.S. EPA has established a reproductive NOAEL of >1,500 mg/kg/day (U.S. EPA, 2002b).

Carcinogenicity and Mutagenicity - Several chronic bioassays have been conducted on clopyralid in mice, rats, and dogs and no evidence of carcinogenic activity has been detected. U.S. EPA has placed clopyralid in Group E (no evidence of carcinogenicity). In addition, clopyralid is inactive in several different standard bioassays of mutagenicity.

Although none of the bioassays have shown that clopyralid has carcinogenic potential, technical grade clopyralid does contain low levels of the impurities hexachlorobenzene and pentachlorobenzene. Hexachlorobenzene has shown carcinogenic activity in three mammalian species and has been classified as a potential human carcinogen by the U.S. EPA. Pentachlorobenzene is not classifiable as to human carcinogenicity based on lack of available human and animal data. The risk of cancer from these contaminants is considered qualitatively and quantitatively in this risk assessment.

Other Toxic Endpoints – Clopyralid can be classified as an indirect neurotoxicant but not as a direct neurotoxicant. At high acute doses that produce a broad spectrum of toxicological effects, clinical signs of clopyralid poisoning include neurotoxicity, indicated by ataxia, tremors, convulsions, and weakness. Similar effects at high doses have been seen in birds. These reports, however, do not implicate clopyralid as a direct neurotoxicant. No studies designed specifically to detect impairments in motor, sensory, or cognitive functions in animals or humans exposed to clopyralid have been reported in the open literature or in the studies submitted to the U.S. EPA to support the registration of clopyralid. In addition, none of the studies in the clopyralid database reported histopathologic changes in nervous tissue.

There is very little direct information on which to assess the immunotoxic potential of clopyralid. The only studies specifically related to the effects of clopyralid on immune function are skin sensitization studies. While these studies provide information about the potential for clopyralid to act as a skin sensitizer, they provide no information useful for directly assessing the immuno-suppressive potential of clopyralid. The toxicity of clopyralid has been examined in numerous acute, subchronic, and chronic bioassays. Although many of these studies did not focus on the immune system, changes in the immune system were not observed in any of the available studies.

Clopyralid has not been tested for activity as an agonist (activator) or antagonist of the major hormone systems (e.g., estrogen, androgen, thyroid hormone), nor have the levels of circulating hormones been measured following clopyralid exposures. Thus, all inferences concerning the potential effect of clopyralid on endocrine function must be based on inferences from standard toxicity studies. The available toxicity studies have not reported any histopathologic changes in endocrine tissues that have been examined as part of the standard battery of tests.

Inhalation Exposures - Two relatively detailed inhalation studies have been submitted to U.S. EPA in support of registration of clopyralid. At nominal concentrations of 1 mg/L or greater over 4-hour exposure periods, the only effects noted were labored breathing and red stains around the openings of the nasal cavity. After a two-week recovery period, there was discoloration of the lungs in rats exposed to nominal concentrations of 1.2 mg/L but not in rats exposed to nominal concentrations of 5.5 mg/L. Although the author did not attribute the changes in the lungs to clopyralid exposure, these changes are consistent with effects noted in a one-year dietary study in dogs. In this study, low-dose (100 mg/kg/day), mid-dose (320 mg/kg/day), and high-dose (1000 mg/kg/day) animals evidenced atypical nodules in the lungs. The study authors attributed these findings to the inhalation of food particles containing clopyralid with subsequent irritation of the lungs from direct clopyralid contact.

No occupational exposure criteria have been found for clopyralid. While any effects on the lungs are of substantial concern, such effects have not been seen at lower dietary dose levels in other species. The current RfD for clopyralid is based on a NOAEL of 15 mg/kg/day from a two-year rat feeding study. This NOAEL is a factor of 6 below the lowest dose associated with lung effects in dogs (100 mg/kg/day).

Impurities - Technical grade clopyralid contains hexachlorobenzene and pentachlorobenzene as contaminants. Nominal or average concentrations of hexachlorobenzene are less than 2.5 parts per million (ppm). Nominal or average concentrations of pentachlorobenzene are less than 0.3 ppm. The U.S. EPA has classified hexachlorobenzene as a probable human carcinogen for which the data are adequate to consider risk quantitatively.

Metabolites – Metabolism studies indicate that clopyralid is not extensively metabolized in mammals and birds, with 79-96% of the administered dose being excreted unchanged in the urine during the first 24 hours, and nearly complete elimination within 120 hours. This is similar to the pattern seen in plants that generally suggests that clopyralid is not extensively metabolized, although it may be conjugated to form a methyl ester. U.S. EPA does not consider any clopyralid metabolites to be of toxic significance (U.S. EPA, 1999).

Inerts - The commercial formulation of clopyralid used by the Forest Service (Transline®) is formulated as the monoethanolamine salt – i.e., monoethanolamine is considered part of the active ingredient. Transline® also contains isopropyl alcohol and polyglycol as adjuvants.

No studies specifically mentioning Transline®, were located in the search of the studies submitted to U.S. EPA for product registration. Dow AgroSciences (2003, as referenced in SERA 2004b) provided clarification of this issue and identified the studies submitted to U.S. EPA that were accepted as relevant to Transline®. These studies do not indicate any substantial differences between Transline® and clopyralid. This is consistent with the publicly available information on the three inerts contained in Transline®, two of which are approved for use as food additives (monoethanolamine and isopropyl alcohol).

The other inert in Transline® is Polyglycol 26-2. This compound is classified by the U.S. EPA as a List 3 inert. In other words, there is insufficient information to categorize this compound as either hazardous (Lists 1 or 2) or non-toxic (List 4). Notwithstanding this classification, surfactants such as Polyglycol 26-2 are surface active agents that can disrupt cellular membranes and lead to a number of different adverse effects. In an *in vitro* study on energy production in sub-mitochondrial particles derived from a marine alga, Oakes and Pollak (1999, as referenced in SERA 2004b) noted that Polyglycol 26-2 inhibited oxidative function in the submitochondrial preparations at a concentration of about 0.01%. While this study clearly indicates that Polyglycol 26-2 will impact mitochondrial function *in vitro*, the implications for potential effects in humans at plausible levels of exposure are not apparent.

Glyphosate (References: USDA, 1984; USDA, 1989; SERA, 2003a, Williams, et al, 2000)

Acute and Chronic Exposures - The toxicity of glyphosate is relatively well characterized in both experimental mammals and humans, although the mechanism of action is not clear. The acute toxicity of glyphosate is relatively low, with oral LD_{50} values in rats and mice ranging from approximately 2,000 to 6,000 mg/kg. Most of the human experience with glyphosate involves the consumption of large quantities of glyphosate during attempted suicides. The signs of toxicity are generally consistent with massive mucosal irritation and tissue degeneration. In addition, glyphosate may interfere with normal metabolic biochemical functions.

The chronic toxicity of glyphosate has been well characterized in laboratory mammals. One of the more consistent signs of subchronic or chronic exposure to glyphosate is loss of body weight. This effect has been noted in mice, rats, and rabbits. Other signs of toxicity seem general and non-specific. A few studies report changes in liver weight, blood chemistry that would suggest mild liver toxicity, or liver pathology. Changes in pituitary weight have also been observed. Signs of kidney toxicity, which might be expected based on the acute toxicity of glyphosate, have not been reported consistently and are not severe. As summarized by the National Toxicology Program (NTP) (1992, as referenced in SERA, 2003a), various hematological changes have been observed but are not considered severe and are attributed to mild dehydration.

Effects on the Skin and Eyes - Glyphosate formulations used by the Forest Service are classified as either non-irritating or only slightly irritating to the skin and eyes in standard assays required for product registration. Based on several eye and skin irritation studies submitted to the U.S. EPA as part of the registration process, the U.S. EPA classifies glyphosate as mildly irritating to the eyes (Category III) and slightly irritating to the skin (Category IV). The free acid of glyphosate is severely irritating to the eyes but the isopropylamine (IPA) salt of glyphosate, the form that is in all formulations used by the USDA Forest Service, is nonirritating to the skin and eyes. Although glyphosate is an irritant, there are no data indicating that the compound causes sensitization in animals or humans. POEA and other surfactants used in glyphosate formulations may be severely irritating to the eyes, skin, and other mucosal surfaces, such as the gastrointestinal tract and the lungs.

Carcinogenicity and Mutagenicity – Based on standard animal bioassays for carcinogenic activity *in vivo*, there is no basis for asserting that glyphosate is likely to pose a substantial risk. The Reregistration Eligibility Decision (RED) document (U.S. EPA, 1993) on glyphosate indicates that glyphosate is classified as Group E: Evidence of non-carcinogenicity for humans. Tumors have been observed in some of the earlier chronic toxicity studies. U.S. EPA determined that the studies conducted before 1990 were insufficient for evaluating the potential carcinogenicity of glyphosate because the observed responses were equivocal or the dose levels were inappropriate (i.e., the highest dose used was not the maximum tolerated dose). A recent epidemiology study in Sweden (Hardell and Erikkson, 1999, as referenced in SERA 2003a) reported an increased cancer risk of non-Hodgkin lymphoma (NHL) in individuals in Sweden who have a history of exposure to glyphosate. The increased risk was not statistically significant. A review of the Hardell and Erikkson study was done by U.S. EPA, which concluded that the study does not change their risk assessment for the current uses of glyphosate.

According to the U.S. EPA classification of carcinogens and their assessment of the available data, glyphosate is not carcinogenic to humans. Given the marginal mutagenic activity of glyphosate and the failure of several chronic feeding studies to demonstrate a dose-response relationship for carcinogenicity and the limitations in the available epidemiology study, the Group E classification given by the U.S. EPA appears to be reasonable. As with any compound that has been studied for a long period of time and tested in a large number of different systems, some equivocal evidence of carcinogenic potential is apparent and may remain a cause of concern, at least in terms of risk perception. While these concerns are understandable, there is no compelling basis for challenging the position taken by the U.S. EPA and no quantitative risk assessment for cancer is conducted as part of the current analysis.

A formulation of glyphosate, Roundup®, has been shown to cause an increase in chromosomal aberrations in a plant (*Allium* spp.) associated with cell abnormalities in spindle fiber, DNA adduct formation in mice, and single strand breaks in mice. None of the *in vivo* studies using mammalian species or mammalian cell lines have reported mutagenic activity. Two studies (Vyse and Vigfusson 1979, Vigfusson and Vyse 1980, as referenced in SERA, 2003a) report a significant increase in sister chromatid exchanges in human white blood cells *in vitro*. The authors of these studies conclude from their results that glyphosate is, at most, slightly mutagenic. In addition, some positive assays in the fruit fly have been reported as well as positive results in white blood cell cultures. Based on the weight of evidence of all available studies, U.S. EPA concluded that glyphosate is not mutagenic. More recent studies do not provide data that challenges the U.S. EPA assessment (Williams et al. 2000).

Reproductive and Teratogenic Effects - Glyphosate has been subject to multi-generation reproduction studies as well as teratology studies. There is no indication from these studies that glyphosate induces teratogenic effects (i.e., birth defects) in soft tissues at doses up to 3,500 mg/kg/day. The only abnormal development was delayed bone development (ossification). In the teratology studies, the observed signs of toxicity - respiratory and gastrointestinal effects - were similar to those observed in acute toxicity studies and occurred at dose levels that were also comparable. In a multi-generation reproduction study in rats, effects to the kidney were observed in male pups at 30 mg/kg/day but not at 10 mg/kg/day. This effect is consistent with the acute toxicity of glyphosate rather than a specific reproductive effect. In a subsequent study, no such effects were observed at doses up to 1,500 mg/kg/day. In the glyphosate RED (U.S. EPA, 1993), U.S. EPA concluded that the lack of renal effects in the second study indicated that the effects seen in the first study were not glyphosate-related. Previous to this, the U.S. EPA had based the

RfD for glyphosate on the 10 mg/kg/day NOAEL for this effect. Based on this re-interpretation of results, the NOEL for developmental effects was set at 500 mg/kg/day. The multi-generation reproduction studies found no effect on reproductive capacity. In another study using rabbits, developmental toxicity was not observed at maternal doses up to 350 mg/kg/day, but maternal effects were seen at this dose. The maternal NOEL in this study was 175 mg/kg/day; this is the value U.S. EPA has used to establish the current RfD.

The only other specific and consistent effect of glyphosate involves effects on the testicles. In an NTP study, relative testicular weights in mice were increased. In rats, there was a 20% decrease in sperm counts at the two highest dose levels, 1,678 and 3,398 mg/kg/day. Given the absence of specific testicular pathology in either species, the NTP concluded that there was no evidence of adverse effects on the reproductive system of rats or mice. This finding is consistent with the bulk of other animal studies, in which no adverse effects on the testes are reported, although an increase in testicular weight - relative and absolute - was observed in mice at 3,465–7,220 mg/kg/day. A study by Yousef et al., (1995, as referenced in SERA 2003a) suggests that more serious effects are plausible. Substantial decreases in libido, ejaculate volume, sperm concentrations, semen initial fructose and semen concentration, as well as increases in abnormal and dead sperm were observed in rabbits. In contrast, in multi-generation reproduction studies, no effects on reproductive performance have been observed at dietary levels equivalent to doses of 1,500 mg/kg/day. The basis for the inconsistency between the Yousef et al., 1995 study and all other studies that have assessed the reproductive effects of glyphosate cannot be identified unequivocally. As discussed in Williams, et al, 2000, the authors describe the Yousef study as having serious deficiencies in design, conduct, and reporting, such that “the data from [the Yousef] study cannot be used to support any meaningful conclusions”. In addition, the method of administration of the glyphosate in the Yousef study is not representative of likely human exposures. In a subsequent study, Yousef also demonstrated a reduction in sperm motility after direct exposure of sperm to glyphosate. The mechanism of this effect is not clear, but may nay be related to the ability of glyphosate to inhibit cellular energy production.

Numerous epidemiological studies have examined relationships between pesticide exposures or assumed pesticide exposures in agricultural workers and reproductive outcomes. Very few studies, however, have attempted to characterize exposures, either qualitatively or quantitatively, to specific pesticides. Of those studies that have specifically addressed potential risks from glyphosate exposures, adverse reproductive effects have not been associated with glyphosate exposure.

Other Toxic Endpoints – No neurotoxic effects have been seen in any *in vivo* or *in vitro* studies. Glyphosate has been specifically tested for neurotoxicity in rats after both acute and chronic exposures and in hens. In all three assays, glyphosate was negative for signs of neurotoxicity. U.S. EPA has determined that there is no evidence of neurotoxicity in any of the exposure studies conducted (U.S. EPA, 2000b). Large-scale controlled epidemiological studies of glyphosate exposure and neurological outcomes have not been reported. A small clinical investigation found no evidence for neurological effects among forest workers who mixed and sprayed Roundup during a workweek. The clinical case literature of acute glyphosate intoxication is reasonably extensive and does not provide evidence for glyphosate being an acute neurotoxicant in humans. Several long-term experimental studies examined various endpoints of neurotoxicity (brain morphology) in dogs, mice, or rats and did not find evidence of neurotoxicity. An acute study found no effect of glyphosate exposure on nervous system reflexes in dogs. Studies conducted in various bird species did not find evidence for neurological effects. One study reported a case of Parkinsonism in an adult male who was exposed to glyphosate (Barbosa et al 2001 as referenced in SERA 2003a). This study stands in contrast to the abundant case literature that suggests glyphosate is not a neurotoxicant in humans. Any direct connection between glyphosate exposure and onset of Parkinsonism from this one study cannot be established, as the effects could be coincidental. There appears to be no evidence for glyphosate being a neurotoxicant in humans or other species.

Schiffman et al. (1995, as referenced in SERA 2003a) conducted a study of the effects of glyphosate on taste response in gerbils. This study appears to be the only reported investigation of the effects of glyphosate on sensory mechanisms. Glyphosate (1 or 10 micromolar concentration (mM)) applied to the tongue of anesthetized gerbils decreased taste receptor response to table salt, sugars, and acids. These tests on glyphosate involved exposure periods of one minute and were conducted along with tests on ten other pesticides, with one-minute rinses between each agent. The mechanism of this effect on the taste response has not been investigated and the implications in terms of dietary preferences in the field cannot be assessed. The effect could have been produced by a general biochemical alteration in the epithelial cells of the tongue, including the specialized cells that detect taste (glyphosate has been shown to produce injury to the oral cavity), by chemical injury to the tongue, or by a direct neurotoxic effect on the sensory nerve endings. Thus, effects reported in Schiffman et al. (1995) cannot be classified clearly as a glyphosate-induced neurologic effect.

Based on results from the available studies in humans and experimental studies in rodents, glyphosate does not appear to be an immunotoxicant in humans or other animals. This conclusion is supported not only by an extensive set of standard mammalian bioassays on toxicity but also by an *in vivo* assay specifically designed to detected humoral immune response and an *in vitro* assay specifically designed to detect cell-mediated immune response.

Epidemiological studies and clinical cases have not found evidence for allergic reactions or sensitization to dermal exposures to glyphosate formulations. Two human experimental studies provide evidence that Roundup® is not a dermal allergen or sensitizing agent. Tests conducted in guinea pigs provide further support for glyphosate not being a dermal sensitizing agent. Several long-term experimental studies have examined the effects of exposure to glyphosate on lymphoid tissue morphology and blood leukocyte counts; treatment-related effects were not observed.

Three specific tests on the potential effects of glyphosate on the endocrine system have been conducted and all of these tests reported no effects. That glyphosate is not an endocrine disruptor is reinforced by epidemiological studies that have examined relationships between occupational farm exposures to glyphosate formulations and risk of spontaneous miscarriage, fecundity, sperm quality, and serum reproductive hormone concentrations. The studies have not found positive associations between exposure to glyphosate formulations and any reproductive or endocrine outcomes. The clinical case literature does not provide evidence for glyphosate being an endocrine active agent. Several long-term experimental studies have examined the effects of exposure to glyphosate on endocrine organ morphology, reproductive organ morphology, and reproductive function; treatment-related effects were not observed.

Notwithstanding the negative results on endocrine function, the current RfD for glyphosate is based on reproductive effects. In addition, glyphosate has not undergone an extensive evaluation for its potential to interact or interfere with the estrogen, androgen, or thyroid hormone systems (i.e., assessments on hormone availability, hormone receptor binding or post-receptor processing (EDSTAC 1998, as referenced in SERA 2003a)). Thus, the assessment of the potential endocrine effects of glyphosate cannot be overly interpreted.

Inhalation Exposures – Because of the low volatility rate for glyphosate and the available inhalation toxicity studies on a number of glyphosate formulations, the U.S. EPA waived the requirement of an acute inhalation study for technical grade glyphosate in the re-registration of glyphosate. The acute inhalation LC_{50} value of the isopropylamine salt of glyphosate is >6.37 mg/L – i.e., no mortality in any of five rats of each sex exposed to this concentration for four hours (Mcguirk 1999a, as referenced in SERA 2003a). The short-term (typically 4 hours) inhalation LC_{50} values for various glyphosate formulations range from >1.3 mg/L to >7.3 mg/L. The lowest LC_{50} value that is not designated with a greater than (>) symbol is 2.6 mg/L, the reported LC_{50} value for several glyphosate formulations (refer to SERA 2003a).

Impurities - Glyphosate contains small amounts of a nitrosamine, N-nitrosoglyphosate (NNG). Certain groups of nitrosoamines have served as model compounds in some of the classical studies on chemical carcinogenicity. While there is a general concern for the carcinogenic potential of nitroso compounds, the contribution of specific nitroso compounds to carcinogenic risk is difficult to quantify. Monsanto has conducted an apparently extensive series of tests on NNG. A summary of the studies stated that NNG is relatively non-toxic, is rapidly excreted without undergoing any chemical change, does not bioaccumulate, is not mutagenic, and does not cause birth defects or cancer in laboratory test species.

Metabolites – Glyphosate is metabolized to a minor extent in animals, to aminomethylphosphonate (AMPA). In mammals, only very small amounts of AMPA, less than 1% of the absorbed dose, are formed. In addition, AMPA is formed in environmental media such as water and soil as a breakdown product of glyphosate. The approach of examining the potential importance of the metabolism of a chemical agent by a mammal is common in the risk assessment of xenobiotics, which generally involve the formation of one or more mammalian metabolites, some of which may be more toxic than the parent compound. Usually, the parent compound is selected as the agent of concern because the toxicology studies and monitoring studies provide information about the agent. Thus, the dose measure for the risk assessment is most clearly expressed in terms of the parent compound. In cases where a toxic metabolite is known to be handled differently by humans, this simple approach may be modified. There is no indication that such a modification is necessary for glyphosate. Thus, in terms of assessing direct exposures to technical grade glyphosate, the inherent exposures to AMPA as a metabolite are encompassed by the existing toxicity data on glyphosate.

This approach does not, however, encompass concern for exposures to AMPA as an environmental metabolite. The U.S. EPA has assessed the potential consequences of exposures to AMPA as an environmental metabolite. Based on this review, the U.S. EPA concluded that only the glyphosate parent is to be regulated and that AMPA is not of toxicological concern regardless of its levels in food. The position taken by the U.S. EPA is supported by more extensive reviews. The position taken by U.S. EPA appears to be reasonable and is well supported. Consequently, in this risk assessment, AMPA is not quantitatively considered in the dose-response and exposure assessments.

Inerts – The only listed inert ingredient in Rodeo® and Accord® is water (46% to 58%), although it is likely that small amounts of isopropylamine and related organic acids of glyphosate also are present.

Hexazinone (USDA 1984, USDA 1989, SERA 2002, SERA 2005)

Acute and Chronic Exposures - The toxicity of hexazinone has been relatively well-characterized in a number of standard bioassays that are required by U.S. EPA for the registration on pesticides. Acute oral toxicity studies indicate the oral LD_{50} for hexazinone in mammals is in the range of 1000 mg/kg. The reported acute oral LD_{50} values range from 860 mg/kg (guinea pig) to 1200 mg/kg (rat). Generally, the signs of toxicity in various mammalian species are similar, including tearing, salivation, vomiting, tremors/ataxia/weakness, diarrhea, and increased rates of respiration and/or labored breathing.

Several standard subchronic and chronic bioassays were conducted on hexazinone and none of the studies suggest a specific mode of toxic action. Most of the reported effects from longer-term exposures are limited to decreases in body weight, increases in liver weight, and changes in blood enzyme levels associated with liver toxicity. Body weight decreases are typically slight and appear to be related primarily with decreases in food consumption rather than changes in food conversion efficiency. Although decreases in body weight appear to be non-specific rather than secondary to an identifiable mode of toxic action, this endpoint is used by the U.S. EPA as the critical effect for hexazinone (i.e., the toxic effect that occurs at the lowest dose level). The study selected by the U.S. EPA for the chronic RfD is the 1-year feeding study in dogs, which involved feeding male and female beagles diets with concentrations of hexazinone of 0, 200, 1500, and 6000 ppm. Decreases in body weight were noted in the mid- and high-dose groups.

Effects on the Skin and Eyes - Hexazinone is a severe irritant to the eyes but has a much lesser effect on the skin. Both powdered and liquid formulations of hexazinone as well as technical grade hexazinone are shown to be moderate to severe eye irritants. U.S. EPA classifies hexazinone as a severe eye irritant, and this classification is amply supported by the available data.

Eye damage may include corneal injury with opacity as well as conjunctivitis. In one study, corneal damage in rabbits persisted up to 28 days after exposure, at which time the study was terminated. The corneal damage, however, seems to be restricted to unwashed eyes. Most of the studies indicate that longer-term and potentially irreversible ocular effects are observed only in unwashed eyes after the instillation of hexazinone. Granular formulations, however, appear to be less irritating than hexazinone or the other hexazinone formulations, causing no or transient irritation, with complete recovery by the seventh day.

Based on human experience, in a California study (Spencer, as referenced in SERA 2005), workers applying Pronone 10G using a belly grinder exhibited eye irritation and upper respiratory tract irritation (reported burning sensations in mouth, nose and throat, coughing, spitting) at the highest operational levels of exposure. No attempt was made to determine if the potential effects were attributable to hexazinone or the clay matrix used in Pronone formulation. These effects were transient and did not persist after exposure was terminated. It is important to recognize that the product applied in this study was recognized as defective, with excessive dustiness. As a result of this study, the USFS, Region 5 established additional requirements for protective equipment when applying granular hexazinone formulations via belly grinder. In addition, this direction instructs applicators not to continue applications if excessive dustiness is seen.

Technical hexazinone is classified as a mild skin irritant. Some formulations of hexazinone, including granular formulations, appear to cause little if any irritant effects. are much less irritating to the skin. The threshold for systemic toxicity after dermal exposure seems to be comparable to the threshold for skin irritation. In other words, levels of hexazinone that are sufficient to cause systemic toxic effects are associated with only mild reddening of the skin. Furthermore, skin sensitization studies on hexazinone are negative.

Based on a comparison of acute oral and dermal LD_{50} values, it appears that the dermal absorption rate is much less than the rate of absorption after oral exposure. Oral LD_{50} values for hexazinone generally range from about 500 to 3500 mg/kg. Conversely, dermal exposure to as much as 7,500 mg/kg is not associated with mortality. Based on a comparison of the acute oral and dermal toxicity of hexazinone, the U.S. EPA waived the registration requirement for a dermal penetration study for this compound

Carcinogenicity and Mutagenicity - U.S. EPA conducted a review of two unpublished studies on the potential carcinogenicity of hexazinone. In a study using rats, no statistically significant increases in tumor incidences were observed except for a dose-related trend in C-cell thyroid tumors. Interpretation of the study by the U.S. EPA is as follows: *Under the conditions of this study, carcinogenic potential of hexazinone is considered negative.* Similar results were noted in the study using mice. Although no statistically significant increase in the incidence of malignant tumors was observed in terms of pair-wise comparisons, a number of liver endpoints did evidence a statistically significant dose-response relationship. This study was classified by the U.S. EPA as follows: *evidence of carcinogenic potential was equivocal: a positive trend test for neoplasia was observed in female mice, but no significant difference was determined by pair-wise comparison.* Based on the weight of evidence, the U.S. EPA concluded that hexazinone should be classified Class D, not classifiable as to human carcinogenicity. Consequently, the U.S. EPA did not conduct a quantitative risk assessment for carcinogenicity associated with exposures to hexazinone. The World Health Organization has not evaluated the carcinogenicity of hexazinone.

The decision of U.S. EPA to decline to conduct a quantitative risk assessment for the carcinogenicity of hexazinone is supported by the lack of mutagenic activity of hexazinone in several *in vivo* and *in vitro* bioassays, although one bioassay for chromosomal damage was positive. Hexazinone yielded negative results in the Ames assay, the Chinese hamster ovary cell HGPRT assay, a chromosome aberration assay using bone marrow cells from rats, and an assay for unscheduled DNA synthesis in rat hepatocytes. In a chromosome aberration assay using Chinese hamster ovary cells, however, there was a significant increase in the number of structural chromosomal aberrations.

This risk assessment will defer to the position taken by the U.S. EPA and no quantitative risk assessment for carcinogenicity will be proposed.

Reproductive and Teratogenic Effects - U.S. EPA classifies 400 mg/kg/day as the lowest observed adverse effect level (LOAEL) for rats based on an increase in fetuses with kidney abnormalities and/or delayed ossification. No such effects were seen at 100 mg/kg/day, the dose classified as a NOAEL. Similarly, in rabbits, increased resorptions were noted at 125 mg/kg/day but not at lower doses (20 or 50 mg/kg/day). In multi-generation feeding studies at dietary levels up to 5000 ppm, no effects were noted on reproductive capacity. However, in a more recent multi-generation feeding study in rats, decreased pup survival was noted at 250 mg/kg/day but not at 10 mg/kg/day or 100 mg/kg/day. At 100 mg/kg/day, however, decreases in pup weight as well as maternal body weight were observed. This no effect level for decreased pup weight (at a dose of 10 mg/kg) is only a factor of two greater than the no effect level for changes in adult body weight in the study on which the RfD is based. The NOEL of 5 mg/kg/day on which the RfD is based is, nonetheless, below any of the effect levels for reproductive toxicity or teratogenic effects.

as changes in differential blood cell counts. No such effects are reported in the hexazinone RED. The only changes in blood noted in any of the toxicity studies involve blood enzymes that are indicative of damage to liver cells.

The U.S. EPA RfD for hexazinone (0.05 mg/kg/day) is based on a NOAEL of 5 mg/kg/day. This NOAEL is based on the most sensitive effect – histological evidence and biochemical indicators of liver damage. While this study and other chronic studies on hexazinone cannot rule out the possibility of immunologic effects, they provide no evidence that such effects occurred. If such immunologic effects had occurred, changes in differential blood cell counts and/or pathological changes in lymphoid tissues would be expected along with some indication of increased susceptibility to infection. No such effects have been noted. Thus, there is no plausible basis for asserting that the current RfD established by U.S. EPA should be revised to accommodate concern for potential effects on the immune system.

Hexazinone has not undergone evaluation for its potential to interact or interfere with the estrogen, androgen, or thyroid hormone systems (i.e., assessments on hormone availability, hormone receptor binding or post-receptor processing). The U.S. EPA has not yet adopted standardized screen tests for endocrine disruptors.

Hexazinone as well as a number of other herbicides were found to influence the activity of estrogen in the E-SCREEN assay. This test system uses a human breast cell line and measures estrogen-induced proliferation in the number of these cells and the inhibition or enhancement of this proliferation by the test agent. Additional inferences concerning the potential effect of hexazinone on endocrine function must be based on results from standard toxicity studies. The U.S. EPA has concluded that: In the available toxicity studies on hexazinone, there was no evidence of endocrine disruptor effects. While this statement is substantially correct, some studies have suggested that hexazinone exposures may be associated with reductions in food conversion efficiency – i.e., reduced body weights that cannot be directly attributed to decreases in food consumption. This effect has been demonstrated clearly in female rats in three studies and in male rats in one study. The decrease in food conversion efficiency in male rats was not dose-related – i.e., it was noted in the 1000 ppm exposure group but not the 2500 ppm exposure group.

In addition, Kaplan et al. (1987, as referenced in SERA 2005) reported a statistically significant dose-related increase in thyroid C-cell adenomas in male rats. The differences were not statistically significant, however, based on comparisons of incidence of these adenomas in any exposed group relative to the incidence in the matched control group. The occurrence of thyroid tumors is noteworthy because thyroid adenomas can secrete thyroxine (also known as thyroid hormone or T), which causes weight loss through an increase of the basal metabolic rate, thereby leading to a hyperthyroid state (Hansen 1998 as referenced in SERA 2005). While hexazinone may not directly disrupt the endocrine system, thyroid adenomas may secondarily cause of weight loss through alteration of thyroid function. The development of adenomas seen in this study, however, cannot be clearly related to the more commonly seen decrease in food conversion efficiency noted in other studies.

As noted by U.S. EPA/OPP (2002, as referenced in SERA 2005), the EPA may elect to have hexazinone screened for effects on endocrine function once standardized screening assays have been developed. Such tests would help to clarify any possible endocrine involvement associated with exposure to hexazinone.

Inhalation Exposures - Inhalation of hexazinone is not a typical route of exposure. The lowest reported inhalation LC_{50} for hexazinone is about 4 mg/L or 4 g/m^3 and no adverse effects were observed after repeated exposure to 2 mg/L. These air concentrations are far below any plausible exposure during brown-and-burn operations. Nonetheless, no information is available regarding the combustion products of hexazinone. Given the implausibility of significant residues of hexazinone on treated vegetation, this adds relatively little to uncertainties associated with this risk assessment. On the other hand, hexazinone is a respiratory irritant. As documented in the study by Spencer et al. (1996) workers applying a granular formulation of hexazinone have exhibited upper respiratory tract irritation (reported burning sensations in mouth, nose and throat, coughing, spitting) at the highest operational levels of exposure.

Impurities - There is no information available in the open literature on the identity or toxicity of any impurities in hexazinone. The U.S. EPA, however, has reviewed the information on the impurities and determined that there are no reported impurities of toxicological concern in hexazinone.

Metabolites - Hexazinone is virtually completely metabolized in mammals, with little parent product recovered in tissue. The primary metabolic pathway in rats and humans appears to be hydroxylation, (adding a hydroxyl group (OH), resulting in oxidation), with lesser amounts of hexazinone undergoing deamination (the loss of an amine group) and demethylation (the loss of a methyl group (CH_3)). There is relatively little information available regarding the toxicity of the metabolites. One study reports that the approximate lethal dose for the metabolites is about 5000 mg/kg, which is substantially greater than the LD_{50} for hexazinone in rats. Any uncertainty with the estimates of the toxicity of the metabolites of hexazinone does not have a significant impact on this risk assessment. The toxicity studies on which the hazard identification and subsequent dose-response assessment are based involve *in vivo* exposure to hexazinone and the subsequent formation of hexazinone metabolites. Therefore, the toxicological effects, if any, of the metabolites are likely to be captured by animal toxicology studies involving exposure to hexazinone.

Inerts - The major component of granular formulations of hexazinone appears to be montmorillonite clay (U.S. EPA inert list 4A). The other inert ingredients are listed in the Hexazinone Herbicide Information Profile (USDA 1992). Based on the acute toxicity of these formulations relative to technical grade hexazinone, there is no indication that the carriers contribute to the toxicity of the granular formulations of hexazinone. The granular formulations of hexazinone appear to be less toxic than hexazinone itself. U.S. EPA considers none of the other inert ingredients hazardous (on inert lists 1 or 2).

Triclopyr

(References: USDA, 1984; USDA, 1989; U.S. EPA, 1998; SERA 2002, 2003b)

Acute and Chronic Exposures - Triclopyr has a low order of acute lethal potency. Oral LD_{50} values range from 600 to 1,000 mg/kg. The signs and symptoms of acute oral intoxication generally include lethargy, impaired coordination, weakness, labored respiration, and tremors. Anorexia and diarrhea have also been observed in rodents and domestic animals. Similar signs and symptoms are associated with triclopyr acid, triclopyr butoxyethylester (BEE), and triclopyr triethylamine salt (TEA). The few available studies regarding histopathology and clinical chemistry data on triclopyr suggest that the liver and kidney are the primary target organs in acute intoxication.

The kidney appears to be the most sensitive target organ for triclopyr, and the dog was initially thought to be the most sensitive species. The lowest effect level for triclopyr is 2.5 mg/kg/day in the dog. In this study, this dose was associated with decreased urinary excretion, determined by means of a phenolsulfonphthalein (PSP) dye excretion test, as well as reduced absolute and relative kidney weights. The inhibition of PSP excretion in the dog could be attributed to competition between triclopyr and PSP for elimination via anion transport. U.S. EPA does not consider PSP excretion appropriate for establishing a NOEL. In the absence of other toxic effects, the 2.5 mg/kg/day dose in the dog study was classified as a NOEL by U.S. EPA. This determination formed the basis of U.S. EPA's provisional acceptable daily intake of 0.025 mg/kg/day. In a follow-up study, the dose of 2.5 mg/kg/day was associated with a statistically significant increase in serum urea nitrogen and creatinine in male dogs. These effects were also evident but more pronounced at 5 mg/kg/day. The NOEL for this effect was 0.5 mg/kg/day. This resulted in the lowering of the provisional U.S. EPA/OPP RfD to 0.005 mg/kg/day using the 0.5 mg/kg/day dose group as the NOEL for effects on kidney function. However, in the 1998 triclopyr RED (U.S. EPA, 1998), U.S. EPA determined that these two studies, while showing statistically significant results, did not represent a toxic response to triclopyr, but rather a physiologic response of the dog, based on the dog's limited ability to excrete organic acids at higher plasma concentrations. They used the lack of histopathological changes in the kidneys as support for this decision.

In rodents, kidney effects - hematological and histopathological changes and increased kidney weight - have been observed after subchronic exposure to triclopyr doses as low as 7 mg/kg/day for 90 days. The highest NOEL below the 7 mg/kg/day AEL for kidney effects in rodents is 5 mg/kg/day for 90 days. This result is supported by additional NOAELs of 5 mg/kg/day for exposure periods ranging from 90 days to 2 years. All of these NOAELs are based on the lack of tissue pathology in the kidney rather than tests of kidney function. In 1998, U.S. EPA determined that the RfD would be based upon the NOEL of 5 mg/kg/day, from a two-generation reproduction study (U.S. EPA, 1998).

The other general systemic toxic effects of triclopyr are un-remarkable. At high doses, signs of liver damage may be apparent as well as decreases in food consumption, growth rate, and gross body weight.

Effects on the Skin and Eyes - Exposure to triclopyr formulations may cause irritation to the skin and eyes. Technical grade triclopyr is classified as only slightly irritating (Category IV). Triclopyr TEA is not a primary skin irritant but has been shown to cause delayed contact sensitization in some studies. Triclopyr BEE has also been shown to cause delayed contact hypersensitivity. Triclopyr BEE causes more severe skin irritation than triclopyr acid or TEA. This may be due to the more rapid absorption of triclopyr BEE.

Ocular exposure appears to follow a different pattern with triclopyr TEA being much more irritating than triclopyr acid or triclopyr BEE.

Triclopyr is poorly absorbed by the skin, and very high doses (>2,000 mg/kg) applied to the skin have not caused death or other signs of toxicity, except weight loss. This result suggests that triclopyr, like many herbicides, is less readily absorbed after dermal exposure than after oral exposure.

There have been repeated dosing studies on triclopyr. Three of these studies involve applications of Garlon® 4 – i.e., triclopyr BEE. The only study reporting systemic toxic effects involved rats that received dermal doses of 24, 240, and 480 mg a.i./kg/day, 5 days per week for 3 weeks. A significant decrease in food intake and growth was observed in males at all dose levels and a significant decrease in food efficiency was observed in males at all dose levels and in females at the highest dose. Based on a review of these and other studies, the U.S. EPA/OPP classified the dermal NOAEL for multiple exposures to triclopyr as greater than 1,000 mg/kg.

Reproductive and Teratogenic Effects - Triclopyr has been subject to several teratogenicity studies, and two multi-generation reproduction studies. At sufficiently high doses, triclopyr can cause adverse reproductive effects as well as birth defects. A consistent pattern with triclopyr, however, is that adverse reproductive effects as well as teratogenic effects occur only at doses that are maternally toxic. At doses that do not cause maternal toxicity, there is no apparent concern for either reproductive or teratogenic effects.

The most significant study is the two-generation reproduction study by Vedula et al. (1995 as referenced in SERA 2003b). This study is the basis of the current RfD on triclopyr. In this study, male and female rats were exposed to triclopyr in the diet at concentrations resulting in doses of 0, 5, 25, or 250 mg/kg/day, except that the first generation males in the high dose group were exposed only to concentrations resulting in a daily dose of 100 mg/kg/day. The 5 mg/kg/day dose groups evidenced no adverse effects in parents or offspring. At 25 mg/kg/day, kidney effects were noted only in adult animals. At 250 mg/kg/day, parental effects included decreased food consumption and body weights as well as histopathologic changes in the liver and kidney. Fetotoxic effects – decreased pup survival and litter sizes – were noted only at 250 mg/kg/day. This dose also resulted in decrease parental fertility. Because no effects were observed at this dose on spermatogenesis or the testes, the decreased fertility was attributed to effects on the female rats.

At substantially higher doses – i.e., greater than or equal to 100 mg/kg/day, triclopyr has been shown to result in birth defects. Most of the abnormalities have been indicative of delayed growth and have been associated with maternal toxicity. Based on several studies with triclopyr BEE and triclopyr TEA, these two forms of triclopyr appear to be equally toxic, consistent with the basic position adopted by U.S. EPA.

Carcinogenicity and Mutagenicity - In 1995, U.S. EPA's Carcinogenicity Peer Review Committee (CPRC) classified triclopyr as a Group D chemical (not classifiable as to human carcinogenicity). This decision was based on increases in mammary tumors in female mice and rats and adrenal tumors in male rats. The CPRC felt that the evidence was marginal (not entirely negative, but yet not convincing), and when combined with lack of genotoxicty and mutagenicity and lack of carcinogenicity of structural analogs, supported the Group D classification. The decision by U.S. EPA to classify triclopyr as Group D is accompanied automatically by a decision not to derive a cancer potency factor for triclopyr and hence, in terms of a risk assessment, the potential carcinogenicity of triclopyr is not considered quantitatively.

There is concern however, since triclopyr has been shown to cause the same type of tumors in two species. In addition, while all cancers are a public health concern, the particular tumor type noted in rats and mice (breast cancer) is a common and important form of cancer in humans. Nonetheless, it is worth noting that none of the dose groups in either rats or mice evidenced a statistically significant pair-wise increase in breast tumors. In other words, the magnitude of the response was not substantial. The other important factor considered by U.S. EPA is the apparent lack of mutagenic activity of triclopyr. Only one study indicated any form of mutagenic activity and the other standard assays for genotoxicity were negative. This is an important point because even if the U.S. EPA had decided to classify triclopyr as a carcinogen, it is plausible that a threshold dose-response assessment would be conducted. In the current risk assessment, a threshold-based approach is used for standard toxicity and this approach is based on the most sensitive endpoint – effects on the kidney.

Other Toxic Endpoints - There is no evidence for triclopyr being a direct neurotoxicant in humans or other species. Studies designed specifically to detect impairments in motor, sensory, or cognitive functions in mammals or other species exposed sub-chronically or chronically to triclopyr have not been reported. This is not surprising, since the undertaking of such studies on a substance for which the clinical and experimental toxicology experience provide no reason to suspect a neurotoxicity potential, would be highly unusual. Experiments conducted in fish suggest possible effects of triclopyr on behavior when exposures are at or near lethal levels. As is the case with mammals, these studies provide no evidence that triclopyr is a direct neurotoxicant.

Acute toxicity studies conducted in various mammalian species have observed lethargy, impaired coordination, weakness, labored respiration, and tremors in animals exposed to lethal or near-lethal dose levels of triclopyr. Direct neurotoxic activity is expected in longer-term experimental studies in which exposures were well below lethal levels. However, studies conducted in rodents, dogs, monkeys, birds, and amphibians have not provided evidence of direct neurotoxicity, even at the maximum tolerated dose. Neurological endpoints evaluated in these studies may have been limited to brain morphology and observation of the animals for gross abnormalities in movement or balance. Nevertheless, these studies suggest that the acute neurological effects of triclopyr observed at near lethal doses may indeed be secondary to cardiovascular trauma from treatment-induced injuries to other organs, possibly kidney and liver. Studies designed specifically to detect impairments in motor, sensory, or cognitive functions in mammals exposed sub-chronically or chronically to triclopyr have not been reported. Two studies found evidence for possible neurological effects of triclopyr in fish. The effects observed included lethargy, hypersensitivity to light stimuli, and avoidance behavior but were only observed at lethal or near-lethal exposure levels. In the absence of any signs of direct neurotoxicity in other species, these observations are consistent with indirect neurological effects secondary to general poisoning.

There is very little direct information on which to assess the immunotoxic potential of triclopyr. The only studies specifically related to the immune effects of triclopyr are skin sensitization studies conducted on triclopyr BEE and the triclopyr TEA salt. For both of these forms of triclopyr, skin sensitization was observed following standard protocols accepted by the U.S. EPA (1998, as referenced in SERA, 2003b). While these studies provide support for asserting that triclopyr may cause skin sensitization, they provide no information useful for directly assessing immune suppressive potential of triclopyr. The toxicology of triclopyr has been examined in subchronic, chronic, and multi-generation studies in rodents and in subchronic studies in dogs. In these reviews of the toxicity of triclopyr, morphologic abnormalities in lymphoid tissues have not been reported.

Triclopyr has not undergone evaluation for its potential to interact or interfere with the estrogen, androgen, or thyroid hormone systems (i.e., assessments on hormone availability, hormone receptor binding, or post-receptor processing). However, extensive testing in experimental animals provides reasonably strong evidence that triclopyr is not an endocrine disruptor. No epidemiological studies of health outcomes of triclopyr have been reported, and there is no clinical case literature on human triclopyr intoxication. Several long-term experimental studies in dogs, rats, and mice have examined the effects of exposure to triclopyr on endocrine organ morphology, reproductive organ morphology, and reproductive function; treatment-related effects on these endpoints were not observed.

Inhalation Exposures – There is very little information regarding the inhalation toxicity of triclopyr. Three studies on the inhalation toxicity of triclopyr have been reviewed involving technical grade triclopyr as well as triclopyr BEE and triclopyr TEA. No mortality was observed in any animals. The only study not summarized in U.S. EPA (1998) is the recent report by Carter (2000, as referenced in SERA 2003b) on technical grade triclopyr. The results of this study – i.e., an LC_{50} of greater than 2.56 mg/L – is essentially equivalent to the reported LD_{50} value of 2.6 mg/L for triclopyr TEA. Based on these results, the U.S. EPA classified inhalation exposures to not be of toxicological concern.

Metabolites - Triclopyr is not extensively metabolized in humans or experimental mammals. In a study involving rats, >90% of the administered dose of triclopyr acid was recovered in the urine as un-metabolized triclopyr. The remainder was identified as the metabolite 3,5,6-trichloro-2-pyridinol (TCP) and possible conjugates. TCP acute and chronic toxicity is similar to triclopyr. TCP has an acute NOEL of 25 mg/kg/day (compared to 30 mg/kg/day for triclopyr) and a chronic NOEL of 3 mg/kg/day, from a 1-year dog study (compared to a NOEL of 5 mg/kg/day for triclopyr). TCP is also the major metabolite of the insecticide chlorpyrifos. Because of the toxicity of TCP, it will be considered in this risk assessment, specifically in Section 5 (Cumulative Effects).

Inerts –Garlon® 4 contains the butoxyethyl ester (BEE) of triclopyr (61.6%) as well as inerts (38.4%) that include deodorized kerosene.

As reviewed by U.S. EPA, triclopyr BEE hydrolyzes to triclopyr acid and 2-butoxyethanol. There is an extensive database on the toxicity of 2-butoxyethanol. The acute oral maximum residue level (MRL) for 2-butoxyethanol is 0.4 mg/kg/day and the intermediate MRL for 2-butoxyethanol is 0.07 mg/kg/day. The acute MRL for 2-butoxyethanol is on the same order as the acute RfD for triclopyr (1 mg/kg/day) and the intermediate MRL for 2-butoxyethanol is similar to the intermediate and chronic RfD for triclopyr (0.05 mg/kg/day). In terms of a practical impact on the risk assessment, the most relevant factor is that 2-butoxyethanol will mineralize very rapidly in the environment – i.e., be completely degraded to CO_2. This is not the case for triclopyr or TCP, a metabolite of triclopyr. Thus, the comparable toxicity of 2-butoxyethanol to triclopyr has relatively little impact on this risk assessment. Because triclopyr and the TCP metabolite of triclopyr persist in the environment much longer than 2-butoxyethanol, it is triclopyr and the TCP metabolite that are the major quantitative focus of the risk assessment. This approach is identical to the position taken by U.S. EPA.

Garlon® 4 causes substantially less acute toxicity in mammals than does triclopyr (oral LD_{50} values in rats = 2,140-2,460 mg/kg (1,540-1,770 mg a.e./kg)). U.S. EPA classifies deodorized kerosene as a List 3 Inert. The toxicity of kerosene was reviewed recently by the Agency for Toxic Substances and Disease Registry (ATSDR). At sufficiently high doses, kerosene can cause many gastrointestinal, central nervous system (CNS), and renal effects. The acute lethal dose of kerosene for humans ranges from approximately 2,000 to 12,000 mg/kg; the acute oral LD_{50} values in experimental mammals range from approximately 16,000 to 23,000 mg/kg. In experimental mammals, acute oral LD_{50} values for triclopyr range from approximately 600 to 1,000 mg/kg. Thus, the acute lethal potency of kerosene is approximately 16 times less than the acute lethal potency of triclopyr. Given the relative potency of kerosene, the acute effects associated with exposure to Garlon® 4 are probably attributable to triclopyr and not to kerosene.

In contrast, the material safety data sheet for Garlon® 4 specifies that inhalation exposure to its vapors may cause central nervous system (CNS) depression attributable to kerosene. CNS depression is consistent with inhalation exposure to kerosene. No monitoring data are available regarding kerosene levels during the application of Garlon® 4. One study monitored triclopyr in air at levels ranging from approximately 5 to 15 $\mu g/m^3$, based on the personal breathing zone air of workers involved in backpack sprays. If kerosene in Garlon® 4 is present at a concentration of ≤20%, the corresponding concentration of kerosene in the air would range from approximately 1 to 3 $\mu g/m^3$. The NOAEL for neurological effects in experimental mammals after exposure to kerosene, which ranged from 14 days to 1 year, is approximately 100 mg/m^3; the NIOSH TLV for petroleum distillates is 350 mg/m^3. Thus, plausible levels of exposure to kerosene during applications of Garlon® 4 are approximately 30,000-100,000 below the NOEL for kerosene in experimental mammals and a factor of 120,000-350,000 below the TLV for petroleum distillates. Although some components of kerosene are known to be carcinogenic to humans (e.g., benzene) kerosene is not classified as a carcinogen, and quantitative risk assessments have not been conducted on kerosene. Exposure to Garlon® 4 may present a hazard, based on the toxicity of triclopyr. Relative to those concerns, the presence of kerosene in Garlon® 4 is not toxicologically significant.

Nonylphenol Polyethoxylate

(References: USDA, 2003a)

Introduction: The primary active ingredient in many of the non-ionic surfactants used by the Forest Service is a component known as nonylphenol polyethoxylate (NPE). NPE is found in these commercial surfactants at rates varying from 20 to 80%. NPE is formed through the combination of ethylene oxide with nonylphenol, and may contain small amounts of un-reacted nonylphenol. Nonylphenol (NP) is a material recognized as hazardous by the U.S. EPA (currently on U.S. EPA's inerts list 2). Both NP and NPE exhibit estrogen-like properties, although they are much weaker than the natural estrogen estradiol. Because of the potential for exposure to nonylphenol, as well as the demonstrated estrogenicity of these compounds, a comprehensive consideration of NPE is warranted.

In the production of NPE, various numbers of ethoxylate groups are attached to a nonylphenol (NP) molecule, through a reaction of NP with ethylene oxide. The properties of the particular NPE depend upon the number of ethoxylate groups that are attached, and this number can vary from just a few, up to about a hundred. The most common NPE used in surfactants for pesticide is a mixture that has, as a majority, 8-10 ethoxylate groups attached.[1] But it is important to understand that there is a bell-shaped distribution curve around 9 ethoxylate groups in such a mixture, and that other longer and shorter-chain NPEs also exist in the mixture. An average of 8-10 ethoxylate groups makes these surfactants highly water-soluble.

Acute and Chronic Exposures: - Various NPEs have been acutely tested in rats, rabbits, mice, and guinea pigs. NP4E, NP5E, NP6E and NP9E are classified as slightly toxic to practically non-toxic to

[1] In this risk assessment, the average number of ethoxylate groups and the NPE will be combined into a standard shorthand. For example NP9E will represent a nonylphenol polyethoxylate with an average of 9 ethoxylate groups. Unless otherwise stated, NP9E will represent the average surfactant ingredient, even though these surfactants may contain an average of 8 to 10 ethoxylate groups.

mammals and are placed in EPA toxicity category III or IV (tested LD_{50} values ranging from 620 to 7,400 mg/kg). In comparison with these NPEs, the acute toxicity of NP is somewhat higher (tested LD_{50} values in rats ranging from 580 to 1,620 mg/kg).

Based on subchronic and chronic testing, it appears that the liver and kidney are the organs most likely to be affected by exposures to NPE and NP. In 90-day subchronic studies in rats and dogs, exposure to NP9E resulted in slight reductions of polysaccharide in the liver, increased relative liver, kidney, or spleen weight, and decreased weight gain; in rats the NOELs range from about 10-20 mg/kg/day. In 90-day subchronic studies in rats, the oral toxicity of NP6E resulted in a male rat NOEL of 40 mg/kg/day based on increased liver to body weight ratios at 200 mg/kg/day; in females this effect was noted at 1,000 mg/kg/day. In a 90-day subchronic test with beagles, the NOEL for NP4E and NP6E was 40 mg/kg/day; emesis was evident at 200 mg/kg/day, with relative liver weight being affected at highest dose (1,000 mg/kg/day). In a 2-year chronic exposure test of NP9E in dogs, there was an increase in relative liver weight at a dose of 88 mg/kg/day, with a NOEL of 28 mg/kg/day.

In a 90-day subchronic study, rats exposed to NP in feed had a NOAEL of 650 ppm (50 mg/kg/day) based on small decreases in body weight and food consumption.

NP and NPE have been determined to be weakly estrogenic in both *in vitro* and *in vivo* tests involving aquatic and terrestrial organisms. Non-reproductive effects appear to be the more sensitive endpoint. The NOAEL for chronic effects is assumed to be 10 mg/kg/day based on kidney effects in rats.

Effects on the Skin and Eyes -. NP9E is considered minimally to severely irritating to rabbit skin; acute dermal LD_{50} of 2,830 mg/kg. Acute dermal LD_{50} of NP5E in rabbits is greater than 2,000 mg/kg; with NP6E in rabbits, the acute dermal LD_{50} exceeds 3,000 mg/kg. Both NP5E and NP6E are considered at most, slightly toxic to rabbits via dermal exposure. NP5E and NP6E are skin irritants in rabbits; NP6E is not a skin sensitizer in guinea pigs. Dermal acute toxicity assessment of NP in rabbits gives LD_{50} values > 2,000 mg/kg. NP is considered moderately to severely irritating to rabbit skin.

NP9E is considered moderately to severely irritating to rabbit eyes. The ocular irritation potential of NP6E was evaluated in a Draize test using rabbits; the eyes were not rinsed. NP5E and NP6E are considered severe ocular irritants. NP is considered moderately to severely irritating to rabbit eyes.

Exposure data for NP9E in humans is limited to its use as a component of spermicides and in cosmetics and cleaning products. Incidents of vaginal irritation, irritation of the urinary tract, and allergic contact dermatitis have been reported. Contact dermatitis and contact photosensitivity has been reported in humans following exposure to NP6E, NP10E, and NP12E in consumer products NP2E and NP4E were evaluated as a skin sensitizer on humans; there was no sensitization with a 5% solution of NP2E, but sensitization was seen with NP2E at 10% dilution and NP4E at 10% dilution.

In one study on rats, NP9E was administered dermally to females during gestational days 6-15 at doses of 0, 50, or 500 mg/kg/day. There were no dose-related reproductive or teratogenic effects following this dermal exposure, although there was a decrease in feeding in dams exposed to the highest dose.

Reproductive and Teratogenic Effects - NP and NPE have been determined to be weakly estrogenic in both *in vitro* and *in vivo* tests involving aquatic and terrestrial organisms. In comparison to the natural estrogen 17-beta-estradiol, NP is approximately 1,000 - 100,000 times weaker in eliciting estrogenic responses. NP9E is less potent than NP, by 1 to 3 orders of magnitude. In general, estrogenic effects appear to decrease with increasing ethoxylate number.

NP increased uterine weight in immature or ovariectomized rats (the ovaries are removed) and in mice following oral administration of 75 mg/kg/day and above and following subcutaneous and intraperitoneal administration, with a NOAEL of 37.5 mg/kg/day. With NP4E and NP9E, no evidence of estrogenic activity was observed in rats *in vivo* as evidenced by a lack of the stimulation of uterine growth following oral exposure of ovariectomized females at doses up to 1000 mg/kg/day for 3 or 4 days. *In vivo* tests in mammals have shown that high chronic dietary levels of NPE need to be administered to show any estrogenic effects (on the order of hundreds or thousands of ppm).

Because of the demonstrated estrogenicity of NP, there have been many studies completed concerning potential reproductive effects of exposure. There are relatively few reproductive tests completed concerning NP9E or other NPEs.

In a multi-generation reproduction study in rats, a 200-ppm daily dose of NP (the lowest dose tested) in the diet (12-18 mg/kg/day in males; 16-21 mg/kg/day in non-lactating females, 27-30 mg/kg/day in lactating females) was the LOEL based on kidney effects (Chapin et al 1999, as referenced in USDA 2003a). No developmental effects were seen at any exposure level, however a range of effects on endocrine-regulated endpoints were observed at 650 and 2,000 ppm in females (increased estrous cycle length, accelerated vaginal opening, increase in relative weights of uterus and vagina). There were no consistent detectable effects on male reproductive parameters (*ibid*). A reproductive NOEL of 200 ppm (~12-40 mg/kg/day) was determined. The authors conclude that NP at low doses would appear to pose a greater hazard to the kidneys than to the reproductive system of male or female rats (*ibid*).

In a multi-generation study in rats where they were continuously exposed to NP via oral gavage at doses of 0, 2, 10, and 50 mg/kg/day, the authors concluded that the reproductive NOAEL for all three generations would be 10 mg/kg/day (Nagao et al, 2001, as referenced in USDA 2003a). In this study, the F0 generation (6 week-old males and 13 week old females at the beginning of the test) showed no dose-related reproductive effects after exposure to NP at any dose. However effects were seen at the 50 mg/kg/day dose in the F1 generation. Although there were no treatment related effects on mating ability or fertility, there were effects to hormone levels in the F1 males and females at the highest dose, although the authors caution against assuming this is treatment related due to inconsistent changes in various related hormones and an absence of effect to the thyroid. There was also a significant decrease in both absolute and relative ovary weight and an acceleration of vaginal opening. There was a significant decrease in the number of implants and live pups born to F1 females in the highest dose group. Histopathologic examination found no treatment related effects to the testes, and spermatogenesis was normal; there was no effect on male fertility in any generation at any dose, which agrees with the findings in Chapin et al 1999.

De Jager et al 1999 (as referenced in USDA 2003a) provided oral doses of NP to female rats during gestation through weaning and to the male offspring from point of weaning through mating to determine both maternal effects and effects to male reproduction. There were no offspring born to the highest dose group (400 mg/kg/day). There were adverse effects to body and testicular mass and decreased seminiferous tubule diameter at 100 and 250 mg/kg/day dose levels (NOEL < 100 mg/kg/day). There were no significant effects to sperm count, or testis/body weight ratio at 100 mg/kg/day. In Nagao et al 2000 (as referenced in USDA 2003a), after subcutaneous injection of 500 mg/kg/day on post-natal days 1-5, rats were evaluated for reproductive function after puberty. There were effects to reproductive function in females, assumed to be the result of effects to the estrous cycle and histopathological alterations to the ovaries and uterus. In males, there was a decrease in germ cells in the seminiferous tubules, and an increase in degenerated germ cells was noted in the epididymides (*ibid*). There were no effects to sperm motility or plasma testosterone (*ibid*).

NP9E was injected (intraperitoneal) into 9-10 week old male mice at doses of 20, 40, 50, 60 mg/kg/day for 5 days along with a positive and negative control to study the effects on sperm (Johnson 1999, as referenced in USDA 2003a). Evaluations were completed 35 days after injections were completed. The authors concluded that NP9E did not increase the frequency of morphologically abnormal sperm (NOEL > 60 mg/kg/day). No reproductive or developmental effects were observed following oral exposure during gestation to 600 mg/kg/day NP10E in mice. In another study, NP10E was administered subcutaneously to 7-week old female rats at dose levels of 2 and 20 mg/kg/day for 15 weeks (Aso et al 1999a, as referenced in USDA 2003a). There were no effects to reproductive ability and no effects to fetuses (external, skeletal or visceral effects). The same authors conducted another study in which NP10E was administered subcutaneously to female rats at dose levels of 5, 20, and 80 mg/kg/day from date of offspring birth through day 21 after birth to explore the effects on offspring from lactation exposure. There were no effects to physical development or reproductive ability, however there were growth effects at the highest dose. The authors consider 20 mg/kg/day to be the NOEL, based on growth effects to both the dams and offspring.

Oral exposure in rats to NP9E on gestation days 6-15 indicated teratogenic NOEL at 50 mg/kg/day based on litter size decrease, pre-implantation loss, and skeletal anomalies seen in fetuses after maternal exposures to 250 and 500 mg/kg/day. These doses of 250 and 500 mg/kg/day were also maternally toxic, based on decreases in maternal weight gain.

The relationship between birth defects and use of NP9E as a spermicide was examined in an epidemiological study involving 462 women (426 of whom had used spermicides containing NP9E or OP9E in the first four months of pregnancy). Limb reduction deformities, neoplasms, Down’s syndrome, and hypospadias (birth defect of the penis) did not occur in excess in children whose mothers were exposed to spermicides (Shapiro et al 1982, as referenced in USDA 2003a). Although this provides no quantitative information, it is useful in that it is a study involving human health.

Carcinogenicity and Mutagenicity - NP9E was not mutagenic in the Ames test (either with or without metabolic activation) or on the unscheduled DNA synthesis assay (adult rat liver cells). NP9E did not induce malignant transformations (*in vitro*) in rat liver cells. In one study NP9E did induce malignant transformations in BALB/3T3 cells, but this was not duplicated in another study. NP10E was not mutagenic in the Ames test (either with or without activation). NP4E showed no evidence of genotoxicity in tests of reverse mutation in bacteria or in unscheduled DNA repair studies in rat primary liver cells. NP4E did not induce micronuclei in the bone marrow cells of mice following intraperitoneal injection. NP did not show any initiating activity for BALB/3T3 cell transformation, implying that NP did not cause any genetic alteration that was inherited by daughter cells. In another study, NP did cause transformation of pre-treated BALB/3T3 cells in the promotion phase, but not in the initiation phase, indicating that NP may cause the enhancement of carcinogenesis *in vivo* (Sakai 2001, as referenced in USDA 2003a). NP was consistently negative in bacterial tests of mutagenicity, although it induced DNA damage in human sperm, lymphocytes, and MCF-7 breast cancer cells exposed *in vitro*.

No evidence of carcinogenicity was reported in 2-year chronic oral toxicity studies of NP9E with rats and dogs. Intravaginal dosages of NP9E in rats, up to 20 times the rates recommended for use in humans as a spermicide, for 2 years, indicated no carcinogenicity.

No chronic toxicity studies with NP were found with the exception of the two multi-generation studies discussed above (Chapin et al 1999; Nagao et al 2001). There was no indication of carcinogenesis in either of these two studies. As paraphrased from European Union 2002 (as referenced in USDA, 2003a), carcinogenicity of NP has not been directly studied, however, some information on the carcinogenic potential can be derived from other data. On the basis of information currently available it is unlikely that NP is mutagenic, so concerns for cancer caused by a genotoxic mechanism are low. Considering the potential for carcinogenicity by a non-genotoxic mechanism, no evidence of sustained cell proliferation or hyperplasia was seen in the standard repeated exposure toxicity studies. Overall, there are low concerns for carcinogenicity by a non-genotoxic mechanism.

Other Toxic Endpoints - Some xenoestrogenic chemicals may also have an effect on the immune system; estradiol and diethylstilbestrol have shown both types of effects. In one study using female mice, the mice were injected with 0.2 ml of 0.2% NP9E daily (approximately 130 mg/kg/day) for 24 days followed by a challenge with sheep red blood cells. There were no effects to white blood cell counts, primary and secondary anti-SRBC titers, and serum immunoglobulin M (IgM) and serum immunoglobulin G (IgG) concentrations.

Indirect observations of potential immunotoxicity can be developed from *in vivo* studies that conduct histopathological examinations of body tissues that are part of the immune system such as the lymphoid tissues (lymphocytes), thymus, spleen, bone marrow, and lymph nodes (SERA 2002). In Nagao et al, 2001, after continuous exposure to NP (oral gavage) at 50 mg/kg/day in rats, there was a decrease in both relative and absolute thymus weight, but no histopathologic alterations observed in this organ; these effects were not seen at the next lower dose of 10 mg/kg. In the same study, after exposure of males to 250 mg/kg/day over several months, reduced thymus was observed in most of the males, and upon histopathologic examination, there was atrophy with pyknosis (reduction in the nucleus) and a reduction in lymphocyte number. Based on this observation, it was felt that the reduced thymus weights seen at 50 mg/kg were likely related to the exposure to NP (*ibid*).

In a subchronic study in rats exposed to NP, there was no effect to spleen weight, and histopathological examinations of sternum bone marrow, the spleen, mandibular and mesenteric lymph nodes, and the thymus reveled no treatment related changes after a 90-day exposure to NP in male and female rats up to 129 (males) and 149 mg/kg/day (females) (Cunny et al 1997, as referenced in USDA 2003a). In the multigeneration study by Chapin et al 1999, there were no effects to the spleen, in terms of relative weight, in any generation at any NP dose tested (up to 2,000 ppm).

There are few studies that look at neurological effects of exposure to NP9E or the other NPEs. After subcutaneous injection of NP10E in the female rats at 2 and 20 mg/kg/day for 15 weeks, effects to offspring that were conceived and delivered during the maternal exposure period showed no effects in several behavior tests (open field test, water maze test), nor showed any effects in several reflex response assessments (righting on surface, negative geotaxis, corneal or pinna reflex).

There are several *in vivo* studies that look at the neurological effects of exposure to NP. In a recent multigenerational study by Flynn et al. (2002 as referenced in USDA 2003a), rats were exposed to NP in the diet at rates of 0, 25, 200, 750 ppm (equivalent to 0, 2, 16, 60 mg/kg/day) over two generations (F_0, F_1). Females in each of three generations (F_0, F_1, F_2) were tested at several points during their lives using a water maze test. The study showed that two generations of dietary exposure to NP did not significantly alter the water maze performance in young adult or middle-aged female rats. This suggests that chronic dietary exposure to NP does not cause gross alterations in spatial learning and memory in female rats.

In Nagao et al 2001, performance in behavioral tests (open field activity, water maze, and running wheel activity) was assessed, as was the development of neural reflexes (righting response, cliff-drop aversion response, negative geotaxis) in developing pups. There were no significant effects seen in any of these parameters in the F_1 or F_2 generations after lifetime exposures to up to 50 mg/kg/day NP via oral gavage. There was an increase in salivation in F_0 males at 50 mg/kg.

Pregnant rats were exposed to NP in the diet at 0, 25, 500, and 2,000 ppm and after weaning, their offspring were exposed to the same diet until postnatal day 77. At several points during the growth of the offspring, behavioral tests were conducted to assess effects of NP exposure. There were no consistent NP-related effects in open-field activity, running wheel activity, play behavior, or intake of a saccharin-flavored solution. Intake of a sodium-flavored solution as well as water intake was increased at the 2,000 ppm level in offspring. The authors note that increased sodium solution intake has been seen in experiments after developmental exposure to other estrogenic compounds (such as genistein and estradiol), indicating that this may be an estrogenic response. Male rats exposed to NP during development and weaning (through maternal dosing), and after weaning (oral gavage) showed no signs of behavioral abnormalities when exposed to NP up to 250 mg/kg/day through post natal day 70.

Indirect observations of potential neurotoxicity can be developed from *in vivo* studies that conduct histopathological examinations of body tissues that are part of the nervous system such as the spinal cord, the brain, peripheral nerves (such as the sciatic nerve) (SERA 2002). In the study by Cunny et al, 1997, there were no effects seen to the brain or brainstem in terms of absolute weight or based upon microscopic examination of the tissues after subchronic 90-day exposures to NP up to 149 mg/kg/day in male or female rats.

Impurities – To some extent, concern for impurities in technical grade NPE is reduced by the fact that the existing toxicity studies on NPE were conducted with the technical grade product. Thus, if toxic impurities are present in the technical grade product, they are likely to be encompassed by the available toxicity studies on the technical grade product. An exception to this general rule involves carcinogens, most of which are presumed to act by non-threshold mechanisms. Because of the non-threshold assumption, any amount of a potential carcinogen in an otherwise non-carcinogenic mixture may represent a carcinogenic risk. This is the situation with NPE. NPE may contain ethylene oxide and 1,4-dioxane as impurities. U.S. EPA considers ethylene oxide to be a probable human carcinogen for which the data are adequate to consider risk quantitatively.

Ethylene oxide has been found in NP9E at low levels, <3.6 to 12.2 mg/L (ppm), in the unreacted form as a residual from the manufacturing process. Depending upon processing methods, this can be reduced essentially to zero. Ethylene oxide is used in the production of many chemicals, including ethoxylates, and used as a hospital sterilant, but most use is for the production of ethylene glycol. Ethylene oxide is likely present in many products that contain ethoxylates, such as surfactants containing linear alcohol ethoxylates. Unreacted levels of ethylene oxide in these products should reduce with time due to reaction, storage, further pumping, and other processing.

Ethylene oxide has been described as a probable human carcinogen with sufficient evidence in experimental animals to support a finding as a carcinogen; it is also a mutagen (refer to USDA, 2003a, Appendix 2). Ethylene oxide has a high vapor pressure and high water solubility, and at normal room temperature and pressure is a gas. Because of its high vapor pressure and high water solubility it is not expected to bio-accumulate or accumulate in soil or sediment. Metabolism of ethylene oxide in larger mammals is primarily through hydrolysis to ethylene glycol, which in turn is converted to oxalic acid, formic acid, and CO_2. While a detailed review of ethylene oxide is beyond the scope of this risk assessment, adequate information is available on ethylene oxide to quantify the carcinogenic risk associated with the use of NP9E. This discussion of risk is contained in USDA (2003a, Appendix 2). Based on conservative assumptions concerning exposure, the carcinogenic risks to workers from ethylene oxide are at acceptable levels. Ethylene oxide will not be discussed further in this risk assessment.

1,4-dioxane has also been found as an impurity in NP9E at low levels (<4.5 to 5.9 ppm). 1,4-dioxane has also been classified as a carcinogen. Borrecco and Neisess (1991) conducted a risk assessment of the impurity 1,4-dioxane in the surfactant in Roundup® formulations of glyphosate. In that risk assessment, they assumed a concentration of 1,4-dioxane at 0.03% in the Roundup® formulation, which is about two orders of magnitude greater concentration than found in NP9E. Borrecco and Neisess used a systemic NOEL of 9.6 mg/kg/day and a cancer potency value of 0.0076 mg/kg/day. With the higher percentage of 1,4-dioxane assumed in Roundup®, they concluded that the risk of acute, chronic, or reproductive effects would be acceptably low, even at maximum labeled rates for Roundup®. They included a cancer risk assessment written by Heydens 1989, which looked at the increased risk of cancer caused by the use of surfactants that contained 1,4-dioxane as a contaminant. Heydens, using a cancer potency value of 0.0076 mg/kg/day, and a 300 ppm contamination rate, determined that the risk of cancer from 1,4-dioxane was well below the 1 in 1 million threshold considered acceptable. Heydens concluded that the carcinogenic risk from exposure to 1,4-dioxane is negligible for occupationally exposed individuals. As these two documents have adequately considered the risk of 1,4-dioxane, this impurity will not be considered further in this risk assessment.

It is important to note that chronic studies involving NP9E have not determined cancer to be an endpoint in mammals.

Metabolites – Based on one study of NP9E, it appears to be rapidly metabolized and excreted (Walter et al 1988, as referenced in USDA 2003a). After injection of NP9E into female rats, bile and urine were monitored for metabolites. The NP9E was completely metabolized by the rats and these metabolites were primarily excreted in feces and secondarily in urine (all radioactivity being excreted within 48 hours after injection). Analysis of urinary metabolites 24 hours after an intravenous dose indicated the presence of highly polar neutral and acidic species.

Doerge et al 2002 (as referenced in USDA 2003a) analyzed for NP metabolites in rats after feeding over 2 generations at levels of 1.5, 12, and 45 mg/kg/day. Glucuronides were identified as the primary metabolite, with lesser amounts of NP-aglycone and NP-catechol. Glucuronides are not active as an estrogen receptor (nor as anti-estrogens, androgens, or anti-androgens) while the NP-aglycone and NP-catechol are expected to continue to act as estrogen mimics. After a 50 mg/kg oral dose, there was rapid absorption and elimination of NP in both males and females (elimination halftimes of 3.1 to 4.0 hours). In a human exposure experiment to NP, radio-labeled NP was injected intravenously (14 µg/kg) or given orally (66 µg/kg) to two human volunteers to study metabolism and excretion. Elimination from the blood was rapid, with no detectable residue after 10 hours through either method of exposure. Only a relatively small percentage of NP or glucuronide or sulphate conjugates were detectable in the urine or feces (approximately 10% of the dose), suggesting further metabolism to compounds unidentified in this study or storage in tissues, likely lipids.

Inerts – NP9E-based surfactants also commonly include an alcohol (such as butyl or isopropyl alcohol), making up about 10% of the mixture; a silicone defoamer (about 1% of the mixture); and water. The NP9E makes up the majority of the formulation, often around 80% of the formulation. Most of these inert ingredients are on U.S. EPA list 4B (considered safe in pesticide formulations).

Section 3 – Exposure Assessment

Workers

Pesticide applicators are the individuals most likely to be exposed to a pesticide during application. Two types of worker exposure assessments are considered: general and accidental/incidental. The term general exposure assessment is used to designate those exposures that involve estimates of absorbed dose based on the handling of a specified amount of a chemical during specific types of applications. The accidental/incidental exposure scenarios involve specific types of events that could occur during any type of application.

The USDA Forest Service has generally used an absorption-based model for worker exposure modeling, in which the amount of chemical absorbed is estimated from the amount of chemical handled. Absorption based models have been used by the USDA Forest Service because of two common observations from field studies. First, most studies that attempt to differentiate occupational exposure by route of exposure indicate that dermal exposure is the dominant route of exposure for pesticide workers. Second, most studies of pesticide exposure that monitored both dermal deposition and chemical absorption or some other method of bio-monitoring noted a very poor correlation between the two values (e.g., Cowell et al. 1991, Franklin et al. 1981, Lavy et al. 1982, all as referenced in SERA 2007). In this exposure assessment for workers, the primary goal is to estimate absorbed dose so that the absorbed dose estimate can be compared with available information on the dose-response relationships for the chemical of concern.

In past risk assessments for the USDA Forest Service, exposure rates were by the estimated dermal absorption rate, typically using 2,4-D as a surrogate chemical when compound-specific data were not available (USDA 1989). In 1998, SERA conducted a detailed review and re-evaluation of the available worker exposure studies that can be used to relate absorbed dose to the amount of chemical handled per day (SERA 1998). This review noted that there was no empirical support for a dermal absorption rate correction. Two factors appear to be involved in this unexpected lack of association: 1) algorithms for estimating dermal absorption rates have large margins of error; and, 2) actual levels of worker exposure are likely to be far more dependent on individual work practices or other unidentified factors than on differences in dermal absorption rates.

Thus, in the absence of data to suggest an alternative approach, no corrections for differences in dermal absorption rate coefficients or other indices of dermal absorption seem to be appropriate for adjusting occupational exposure rates. Although pesticide application involves many different job activities, exposure rates can be defined for three categories: directed foliar applications (including cut surface, streamline, and direct sprays) involving the use of backpacks or similar devices, broadcast hydraulic spray applications, and broadcast aerial applications. While these may be viewed as crude groupings, the variability in the available data does not seem to justify further segmenting the job classifications - e.g., hack-and-squirt, injection bar.

General Exposures - As described in SERA (2007), worker exposure rates are expressed in units of milligrams (mg) of absorbed dose per kilogram (kg) of body weight per pound of chemical handled (mg/kg/lb applied). The exposure rates used in this risk assessment are based on worker exposure studies on nine different pesticides with molecular weights ranging from 169 to 416 and the base-10 log of the octanol water coefficient (log K_{ow}) values at pH 7 ranging from –2.90 to 6.50 (SERA 1998, Table 1). The estimated exposure rates (Table D-2) are based on estimated absorbed doses in workers as well as the amounts of the chemical handled by the workers (SERA 1998, Table 5). Exposure rates are shown as milligrams of chemical per kilogram of body weight per pound of active ingredient (ai) applied. The molecular weight and log K_{ow} of the five herbicides considered in this risk assessment are within the range of pesticides studied in SERA (1998). Although the molecular weight of NP9E is outside this range, the values derived in SERA (1998b), should be conservative for this use, because larger molecules would tend to be absorbed at lower rates. As described in SERA (2007), the ranges of estimated occupational exposure rates vary substantially among individuals and groups, (i.e., by a factor of 50 for backpack applicators). It seems that much of the variability can be attributed to the hygienic measures taken by individual workers (i.e., how careful the workers are to avoid unnecessary exposures).

Table D-2: Estimated Exposure Rates from Herbicides used on the Freds Fire

Job Category	Typical (mg/kg/lb ai)	Lower (mg/kg/lb ai)	Upper (mg/kg/lb ai)
Ground Application	0.003	0.0003	0.01

Source: SERA, 1998, Table 5.

The estimated number of acres treated per hour is taken from recent experiences (1991-2004) on the Eldorado National Forest. Experience on the Eldorado National Forest for work similar to what is proposed indicates typical production rates of 2.0 acres per day per worker for backpack application. Crew sizes are expected to range from 8 to 12 workers when applying these herbicides. The number of hours worked per day is expressed as a range, 6-8 hours per day in activities that actually involve herbicide exposure.

The range of acres treated per hour and hours worked per day is used to calculate a range for the number of acres treated per day. For this calculation as well as others in this section involving the multiplication of ranges, the lower end of the resulting range is the product of the lower end of one range and the lower end of the other range. Similarly, the upper end of the resulting range is the product of the upper end of one range and the upper end of the other range. This approach is taken to encompass as broadly as possible the range of potential exposures. The central estimate of the acres treated per day is taken as the arithmetic average of the range. Because of the relatively narrow limits of the ranges for backpack spray workers, the use of the arithmetic mean rather than some other measure of central tendency, like the geometric mean, has no marked effect on the risk assessment.

The application rates are based on the planned application rates for each of these herbicides under the proposed action (Alternative 1) and are based on previous experience using these herbicides on the Eldorado National Forest (refer to Table D-3). Rates are expressed as either acid equivalents (ae) or active ingredient (ai). Similarly, the application rates are based on Eldorado National Forest experience. The typical application rate is 20-25 gallons per acre of herbicide mixture applied, with the lowest dilution being 10 gallons per acre, and the highest being 30 gallons per acre. For hexachlorobenzene, the application rate is based on the application rate for clopyralid and the percentage of hexachlorobenzene in clopyralid.

Table D-3: Herbicide and Nonylphenol Polyethoxylate Application Rates to be used on the Freds Fire (Including the Incidental Rate of Application of the Impurity Hexachlorobenzene)

Herbicide	Application Rate Typical (lb/ac)	Application Rate Lowest (lb/ac)	Application Rate Highest (lb/ac)
Chlorsulfuron	0.062 ai	0.047 ai	0.062 ai
Clopyralid	0.25 ae	0.10 ae	0.25 ae
Glyphosate	3.2 ae	2.7 ae	4.8 ae
Hexazinone	3.0 ae	2.0 ae	3.0 ae
Triclopyr (BEE)	2.0 ae	1.6 ae	2.4 ae
Nonylphenol polyethoxylate	1.3 ai	1.1 ai	2.0 ai
Hexachlorobenzene	0.000000625 ai	0.00000025 ai	0.000000625 ai

The central estimate of the amount handled per day is calculated as the product of the central estimates of the acres treated per day and the application rate. The ranges for the amounts handled per day are calculated as the product of the range of acres treated per day and the range of application rates. Similarly, the central estimate of the daily-absorbed dose is calculated as the product of the central estimate of the exposure rate and the central estimate of the amount handled per day. The ranges of the daily-absorbed dose are calculated as the range of exposure rates and the ranges for the amounts handled per day. The lower and upper limits are similarly calculated using the lower and upper ranges of the amount handled, acres treated per day, and worker exposure rate.

Accidental Exposures - Typical occupational exposures may involve multiple routes of exposure (i.e., oral, dermal, and inhalation); nonetheless, dermal exposure is generally the predominant route for herbicide applicators. Typical multi-route exposures are encompassed by the methods used on general exposures. Accidental exposures, on the other hand, are most likely to involve splashing a solution of herbicides into the eyes or to involve various dermal exposure scenarios.

The available literature does not include quantitative methods for characterizing exposure or responses associated with splashing a solution of a chemical into the eyes; furthermore, there appear to be no reasonable approaches to modeling this type of exposure scenario quantitatively. Consequently, accidental exposure scenarios of this type are considered qualitatively in the risk characterization.

There are various methods for estimating absorbed doses associated with accidental dermal exposure. Two general types of exposure are modeled: those involving direct contact with a solution of the herbicide and those associated with accidental spills of the herbicide onto the surface of the skin. Any number of specific exposure scenarios could be developed for direct contact or accidental spills by varying the amount or concentration of the chemical on or in contact with the surface of the skin and by varying the surface area of the skin that is contaminated.

For this risk assessment, two exposure scenarios are developed for each of the two types of dermal exposure, and the estimated absorbed dose for each scenario is expressed in units of mg chemical/kg body weight.

Exposure scenarios involving direct contact with solutions of the chemical are characterized by immersion of the hands for 1 minute or wearing contaminated gloves for 1 hour. Generally, it is not reasonable to assume or postulate that the hands or any other part of a worker will be immersed in a solution of an herbicide for any period of time. On the other hand, contamination of gloves or other clothing is quite plausible. For these exposure scenarios, the key element is the assumption that wearing gloves grossly contaminated with a chemical solution is equivalent to immersing the hands in a solution. In either case, the concentration of the chemical in solution that is in contact with the surface of the skin and the resulting dermal absorption rate are essentially constant.

For both scenarios (the hand immersion and the contaminated glove), the assumption of zero-order absorption kinetics is appropriate. Following the general recommendations of U.S. EPA (1992, as referenced in SERA 2007), Fick's first law is used to estimate dermal exposure.

Exposure scenarios involving chemical spills on to the skin are characterized by a spill on to the lower legs as well as a spill on to the hands. In these scenarios, it is assumed that a solution of the chemical is spilled on to a given surface area of skin and that a certain amount of the chemical adheres to the skin. The absorbed dose is then calculated as the product of the amount of the chemical on the surface of the skin (i.e., the amount of liquid per unit surface area multiplied by the surface area of the skin over which the spill occurs and the concentration of the chemical in the liquid) the first-order absorption rate, and the duration of exposure. For both scenarios, it is assumed that the contaminated skin is effectively cleaned after 1 hour. As with the exposure assessments based on Fick's first law, this product (mg of absorbed dose) is divided by bodyweight (kg) to yield an estimated dose in units of mg chemical/kg body weight. The specific equation used in these exposure assessments is taken from SERA (2007).

See Tables F-4a to F-4g for the results of worker exposure calculations. (Actual calculations are displayed on worksheets contained in the project file and are based on the referenced SERA risk assessments and USDA (2003a).

Table D-4a. Summary of Worker Exposure Scenarios – Chlorsulfuron

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack Application	8.45E-04	1.69E-05	4.2E-03
Accidental/Incidental Exposures (dose in mg/kg/event)			
Immersion of Hands - 1 Minute	2.58E-07	4.42E-08	7.73E-07
Contaminated Gloves - 1 Hour	1.55E-05	2.65E-06	4.64E-05
Spill on Hands - 1 Hour	9.68E-06	9.41E-07	4.84E-05
Spill on Lower Legs - 1 Hour	2.38E-03	2.32E-06	1.19E-04

Table D-4b. Summary of Worker Exposure Scenarios – Clopyralid

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack Application	1.51E-03	3.60E-05	7.50E-03
Accidental/Incidental Exposures (dose in mg/kg/event)			

Immersion of Hands - 1 Minute	4.08E-07	1.06E-07	1.56E-06
Contaminated Gloves - 1 Hour	2.45E-05	6.34E-06	9.36E-05
Spill on Hands - 1 Hour	7.26E-05	1.50E-05	3.57E-04
Spill on Lower Legs - 1 Hour	1.79E-04	3.69E-05	8.79E-04

Table D-4c. Summary of Worker Exposure Scenarios – Glyphosate

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack Application	2.90E-02	9.72E-04	1.44E-01
Accidental/Incidental Exposures (dose in mg/kg/event)			
Immersion of Hands - 1 Minute	5.70E-06	1.18E-06	2.39E-05
Contaminated Gloves - 1 Hour	3.42E-04	7.10E-05	1.44E-03
Spill on Hands - 1 Hour	7.48E-04	2.00E-04	1.82E-03
Spill on Lower Legs - 1 Hour	1.84E-03	4.92E-04	4.49E-03

Table D-4d. Summary of Worker Exposure Scenarios – Hexazinone

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack Application	1.81E-02	7.20E-04	9.00E-02
Accidental/Incidental Exposures (dose in mg/kg/event)			
Immersion of Hands - 1 Minute	2.44E-03	1.58E-03	3.83E-03
Contaminated Gloves - 1 Hour	1.47E-01	9.50E-02	2.30E-01
Spill on Hands - 1 Hour	NA	NA	NA
Spill on Lower Legs - 1 Hour	NA	NA	NA

Table D-4e. Summary of Worker Exposure Scenarios – Triclopyr BEE

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack Application	1.45E-02	5.76E-04	7.20E-02
Accidental/Incidental Exposures (dose in mg/kg/event)			
Immersion of Hands - 1 Minute	1.57E-02	8.45E-03	2.88E-02
Contaminated Gloves - 1 Hour	9.45E-01	5.07E-01	1.73E+00
Spill on Hands - 1 Hour	3.70E-02	2.49E-04	6.06E-02
Spill on Lower Legs - 1 Hour	9.12E-02	6.13E-04	1.49E-01

Table D-4f. Summary of Worker Exposure Scenarios – NPE

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack Application	0.012	0.0004824	0.06
Accidental/Incidental Exposures (dose in mg/kg/event)			
Immersion of Hands - 1 Minute	0.00017	0.0000624	.00044
Contaminated Gloves - 1 Hour	0.010	0.0037440	0.026
Spill on Hands - 1 Hour	5.4 E-5	0.0000077	0.00069
Spill on Lower Legs - 1 Hour	0.00013	0.0000189	0.0017

Table D-4g. Summary of Worker Exposure Scenarios – Hexachlorobenzene

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack Application	3.8E-09	9 E-11	1.9 E-08
Accidental/Incidental Exposures (dose in mg/kg/event)			
Immersion of Hands - 1 Minute	4.68E-07	1.44E-07	1.50E-06
Contaminated Gloves - 1 Hour	2.81E-05	8.64E-06	9.00E-05
Spill on Hands - 1 Hour	6.27E-09	1.35E-09	2.74E-08
Spill on Lower Legs - 1 Hour	1.54E-08	3.33E-09	6.75E-08

General Public

Under normal conditions, members of the general public should not be exposed to substantial levels of any of these herbicides. Nonetheless, any number of exposure scenarios can be constructed for the general public, depending on various assumptions regarding application rates, dispersion, canopy interception, and human activity. Several highly conservative scenarios are developed for this risk assessment.

There are permanent residences or second homes within a ¼ mile of some of the proposed treatment areas, containing an estimated 250 residents. These residences are located along the South Fork of the American River. All other treatment areas are greater than ¼ mile from permanent human habitation. Any exposure from an herbicide spray project, due to drift, to residents living beyond ¼ mile from treatment sites would be negligible (USDA 1989, pages F-79 to F-81). According to recent work completed by the Department of Pesticide Regulation (DPR), exposure to native plant material collectors can be essentially eliminated if they remain at least 100 feet from the treated areas (Goh, K., as referenced in Bakke, 2000). In DPR's study (Segawa et al, 2001), herbicides were detected in 19 of 227 (8%) samples taken outside both aerial and ground-based herbicide application units, the majority of these positive samples (90%) were within 70 feet of the sampled unit edge, and all positive samples had concentrations of herbicides less than or equal to 2.68 parts per million. This study did not determine whether these detected amounts were due to drift or errors in application. This would indicate that with ground-based applications, negligible amounts of off-site movement due to drift would be expected beyond 75 to 100 feet from the unit edge.

The proposed units are near or within parts of the Eldorado National Forest used for dispersed recreation, which might include activities such as hiking, hunting, fishing, woodcutting, berry-picking, or collection of plant materials for basket weaving. The public generally will pass through or near these units while participating in these activities. This dispersed use is estimated to be around 10-30 people per year on any given unit. Assuming each of the units could have people in them at the same time would represent 400 to 1200 people per year.

The two types of exposure scenarios developed for the general public includes acute exposure and longer-term or chronic exposure. All of the acute exposure scenarios are primarily accidental. They assume that an individual is exposed to the compound either during or shortly after its application. Specific scenarios are developed for direct spray, dermal contact with contaminated vegetation, as well as the consumption of contaminated fruit, vegetation, water, and fish. Most of these scenarios should be regarded as extreme, some to the point of limited plausibility. The longer-term or chronic exposure scenarios parallel the acute exposure scenarios for the consumption of contaminated fruit, vegetation, water, and fish but are based on estimated levels of exposure for longer periods after application.

Direct Spray -- Direct sprays involving ground applications are modeled in a manner similar to accidental spills for workers. In other words, it is assumed that the individual is sprayed with a solution containing the compound and that an amount of the compound remains on the skin and is absorbed by first-order kinetics. As with the similar worker exposure scenarios, the first-order absorption kinetics are estimated from the empirical relationship of first-order absorption rate coefficients to molecular weight and octanol-water partition coefficients (SERA 2007).

For direct spray scenarios, it is assumed that during a ground application, a naked child is sprayed directly with the herbicide. The scenario also assumes that the child is completely covered (that is, 100% of the surface area of the body is exposed), which makes this an extremely conservative exposure scenario that is likely to represent the upper limits of plausible exposure. An additional set of scenarios are included involving a young woman who is accidentally sprayed over the feet and legs. For each of these scenarios, some standard assumptions are made regarding the surface area of the skin and body weight.

Dermal Exposure from Contaminated Vegetation -- In this exposure scenario, it is assumed that the herbicide is sprayed at a given application rate and that an individual comes in contact with sprayed vegetation or other contaminated surfaces at some period after the spray operation. For these exposure scenarios, some estimates of dislodgeable residue and the rate of transfer from the contaminated vegetation to the surface of the skin must be available. No such data are directly available for these herbicides, and the estimation methods of Durkin et al. (1995, as referenced in SERA 2007) are used. Other estimates used in this exposure scenario involve estimates of body weight, skin surface area, and first-order dermal absorption rates.

Contaminated Water - Water can be contaminated from runoff, as a result of leaching from contaminated soil, from a direct spill, or from unintentional contamination from applications. For this risk assessment, the two types of estimates made for the concentration of these herbicides in ambient water are acute/accidental exposure from an accidental spill and longer-term exposure to the herbicides in ambient water that could be associated with the typical application of this compound to a 100-acre treatment area.

The acute exposure scenario assumes that a young child (2- to 3-years old) consumes 1 L of contaminated water (a range of 0.6 to 1.5L) shortly after an accidental spill of 200 gallons of a field solution into a pond that has an average depth of 1 m and a surface area of 1000 m^2 or about one-quarter acre. Because this scenario is based on the assumption that exposure occurs shortly after the spill, no dissipation or degradation of the herbicide is considered. This is an extremely conservative scenario dominated by arbitrary variability. The actual concentrations in the water would depend heavily on the amount of compound spilled, the size of the water body into which it is spilled, the time at which water consumption occurs relative to the time of the spill, and the amount of contaminated water that is consumed. It is also unlikely that ponds would be the waterbody receiving any herbicides in this project. Flowing streams are the more likely recipients, so dilution would occur. For these reasons, a second scenario is developed in which a stream is contaminated through drift, runoff, or percolation and a child consumes water from that stream. For the level of herbicide in this stream, an assumption of the short-term water contamination rate is developed (Table D-5a).

Water monitoring results following herbicide applications in Region 5 (USDA, 2001) were used to estimate concentrations of glyphosate, hexazinone, and triclopyr in water. For hexazinone, the lower, central, and upper estimates are based on the 50th, 90th, and 99th percentile results from Region 5 monitoring. For triclopyr the lower estimate is taken as zero (no detect) and the central estimate is taken as 3 ppb, which is rounded up from the highest detection in non-accidental or erroneous applications. For glyphosate the lower estimate is taken as zero. The SERA estimate was used for the upper estimate of triclopyr, and the central and upper estimate for glyphosate. For the other chemicals concentrations of these herbicides in water used levels derived from the SERA Risk Assessments.

The scenario for chronic exposure to these herbicides from contaminated water assumes that an adult (70 kg male) consumes contaminated ambient water for a lifetime. There are some monitoring studies available on many of these herbicides that allow for an estimation of expected concentrations in ambient water associated with ground applications of the compound over a wide area (glyphosate, hexazinone, and triclopyr). For the others, such monitoring data does not exist. For those herbicides without monitoring data, for this component of the exposure assessment, estimates of levels in ambient water were made based on the GLEAMS (Groundwater Loading Effects of Agricultural Management Systems) model.

GLEAMS is a root zone model that can be used to examine the fate of chemicals in various types of soils under different meteorological and hydro-geological conditions (Knisel et al. 1992, as referenced in SERA 2001). SERA (2001) illustrated the general application of the GLEAMS model to estimating concentrations in ambient water. The results of the GLEAMS modeling runs are displayed in the respective SERA risk assessments.

The specific estimates of longer-term concentrations of these herbicides in water that are used in this risk assessment are summarized in Table D-5b. These estimates are expressed as the water contamination rates (WCR) in mg/L (ppm) per pound of active ingredient or acid equivalent applied. The values in Tables F5a and F5b must be multiplied by the rates of application in Table D-3 (with the exception of NPE, which already encompasses a range of application rates). It is important to note that water monitoring conducted in the Pacific Southwest Region since 1991, involving glyphosate, triclopyr, and hexazinone has not shown levels of water contamination as high as these for normal (i.e., not accidental) applications (USDA 2001). This indicates that, at least for these herbicides, the assumptions in this risk assessment provide for a conservative (i.e. protective) assessment of risk. In addition, water monitoring involving clopyralid and hexachlorobenzene conducted on the Eldorado National Forest between 2002 and 2006 have not shown levels of water contamination as high as these for normal (i.e., not accidental) applications (USDA 2003c, 2006). Based on these samples, the assumptions in this risk assessment provide for a conservative (i.e. protective) assessment of risk for these two chemicals.

Table D-5a: Short-Term Water Contamination Rates (WCR) of Herbicides, Nonylphenol Polyethoxylate, and the Hexachlorobenzene Impurity (in mg/L per lb applied)

Herbicide	Typical WCR	Low WCR	High WCR

Chlorsulfuron	0.1	0.01	0.2
Clopyralid	0.02	0.005	0.07
Glyphosate	0.02	0.0	0.4
Hexazinone	0.005	0.003	0.1
Triclopyr	0.003	0.0	0.4
Nonylphenol Polyethoxylate	0.012	0.0031	0.031
Hexachlorobenzene	0.09	0.001	0.3

Table D-5b: Longer-Term Water Contamination Rates (WCR) of Herbicides, Nonylphenol Polyethoxylate, and the Hexachlorobenzene Impurity (in mg/L per lb applied)

Herbicide	Typical WCR	Low WCR	High WCR
Chlorsulfuron	0.0006	0.0001	0.0009
Clopyralid	0.007	0.001	0.013
Glyphosate	0.001	0.0001	0.008
Hexazinone	0.02	0.00001	0.07
Triclopyr	0.03	0.008	0.05
Nonylphenol Polyethoxylate	0.007	0.0	0.014
Hexachlorobenzene	0.0005	0.00003	0.001

Oral Exposure from Contaminated Fish - Many chemicals may be concentrated or partitioned from water into the tissues of animals or plants in the water. This process is referred to as bio-concentration. Generally, bio-concentration is measured as the ratio of the concentration in the organism to the concentration in the water. For example, if the concentration in the organism is 5 mg/kg and the concentration in the water is 1 mg/L, the bio-concentration factor (BCF) is 5 L/kg. As with most absorption processes, bio-concentration depends initially on the duration of exposure but eventually reaches steady state. Details regarding the relationship of bio-concentration factor to standard pharmacokinetic principles are provided in Calabrese and Baldwin (1993, as referenced in SERA 2007).

Most of the herbicides in this risk assessment have BCF values for fish of 1 or less. There are three with BCF values greater than 1: hexazinone (1-2), chlorsulfuron (1-12), and hexachlorobenzene (10,000). These values are generally determined from a standardized test that is required as part of the registration process.

For both the acute and longer-term exposure scenarios involving the consumption of contaminated fish, the water concentrations of the herbicides used are identical to the concentrations used in the contaminated water scenarios. The acute exposure scenario is based on the assumption that an adult angler consumes fish taken from contaminated water shortly after an accidental spill of 200 gallons of a field solution into a pond that has an average depth of 1 meter and a surface area of 1000 m^2 or about one-quarter acre. No dissipation or degradation is considered. Because of the available and well-documented information and substantial differences in the amount of caught fish consumed by the general public and native American subsistence populations (U.S. EPA 1996, as referenced in SERA 2007), separate exposure estimates are made for these two groups. The chronic exposure scenario is constructed in a similar way.

Oral Exposure from Contaminated Vegetation - Under normal circumstances and in most types of applications, it is extremely unlikely that humans will consume, or otherwise place in their mouths, vegetation contaminated with these herbicides. Nonetheless, any number of scenarios could be developed involving either accidental spraying of crops, the spraying of edible wild vegetation, like berries, or the spraying of plants collected by Native Americans for basketweaving or medicinal use. These scenarios assume that vegetation is directly sprayed and that no washing of vegetation occurs. Again, in most instances and particularly for longer-term scenarios, treated vegetation would probably show signs of damage from herbicide exposure, thereby reducing the likelihood of consumption that would lead to significant levels of human exposure. Notwithstanding that assertion, it is conceivable that individuals could consume contaminated vegetation.

Two sets of exposure scenarios are provided: one for the consumption of contaminated fruit and the other for the consumption of contaminated vegetation. One of the more plausible scenarios involves the consumption of contaminated berries after treatment along a road or some other area in which wild berries grow. A second scenario is the consumption of contaminated vegetation after treatment. The two accidental exposure scenarios developed for each exposure assessment include one scenario for acute exposure and one scenario for longer-term exposure. In both scenarios, the concentration of herbicide on contaminated vegetation is estimated using the empirical relationships between application rate and concentration on vegetation developed by Hoerger and Kenaga (1972, as referenced in SERA 2007) as modified by Fletcher et al (1994, as referenced in SERA 2007). For the acute exposure scenario, the estimated residue level is taken as the product of the application rate and the residue rate. This approach, however, is not applicable to granular formulations of hexazinone, where the formulation will not tend to adhere to the surface of vegetation. For granular formulations, the residue rates from Fletcher et al. (1994) are divided by a factor of 25 based difference in residues on vegetation between granular and liquid formulations (Michael, 1992, as referenced in SERA, 2005). For the longer-term exposure scenario, a duration of 90 days is used and the dissipation on the vegetation is estimated based on the estimated or established foliar halftimes.

For hexachlorobenzene, the estimated residue level is taken as the product of the bioconcentration factor in vegetation and the long-term concentration in soil. The bioconcentration factor in vegetation is established as 19 (ATSDR 1998, as referenced in SERA 2004). GLEAMS is used to estimate concentrations in soil.

See Tables F-6a to F-6g for the results of public exposure calculations. (Actual calculations are displayed on worksheets contained in the project file and are based on the referenced SERA risk assessments and USDA (2003a).

Table D-6a. Summary of Public Exposure Scenarios – Chlorsulfuron

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
Acute/Accidental Exposures (dose in mg/kg/day)			
Direct Spray, Entire Body, Child	3.66E-04	3.55E-05	1.83E-03
Direct Spray, Lower Legs, Woman	3.67E-05	3.57E-06	1.84E-04
Dermal Exposure, Contaminated Vegetation	5.32E-05	3.15E-06	2.64E-04
Contaminated Fruit	1.65E-03	5.52E-04	2.61E-02
Contaminated Vegetation	2.27E-02	1.58E-03	1.89E-01
Contaminated Water, Spill	3.19E-02	9.72E-03	4.78E-02
Contaminated Water, Stream	1.05E-03	2.15E-05	3.16E-03
Consumption of Fish, General Public	9.57E-04	4.78E-04	9.57E-04
Consumption of Fish, Subsistence Populations	4.66E-03	2.33E-03	4.66E-03
Chronic/Longer Term Exposures (dose in mg/kg/day)			

Contaminated Fruit	6.93E-04	2.32E-04	1.10E-02
Contaminated Vegetation	9.54E-03	6.66E-04	7.95E-02
Consumption of Water	2.40E-06	9.38E-08	4.32E-06
Consumption of Fish, General Public	1.80E-08	1.01E-09	2.70E-08
Consumption of Fish, Subsistence Population	1.46E-07	8.14E-09	2.19E-07

Table D-6b. Summary of Public Exposure Scenarios – Clopyralid

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
Acute/Accidental Exposures (dose in mg/kg/day)			
Direct Spray, Entire Body, Child	2.74E-03	5.66E-04	1.35E-02
Direct Spray, Lower Legs, Woman	2.75E-04	5.68E-05	1.35E-03
Dermal Exposure, Contaminated Vegetation	3.48E-04	2.66E-05	1.67E-03
Contaminated Fruit	2.94E-03	1.18E-03	4.67E-02
Contaminated Vegetation	4.05E-02	3.38E-03	3.38E-01
Contaminated Water, Spill	6.83E-02	4.17E-02	1.02E-01
Contaminated Water, Stream	3.76E-04	2.29E-05	1.97E-03
Consumption of Fish, General Public	2.05E-03	2.05E-03	2.05E-03
Consumption of Fish, Subsistence Populations	9.99E-03	9.99E-03	9.99E-03
Chronic/Longer Term Exposures (dose in mg/kg/day)			
Contaminated Fruit	1.19E-03	3.79E-04	2.46E-02
Contaminated Vegetation	1.63E-02	1.09E-03	1.78E-01
Consumption of Water	5.00E-05	2.00E-06	1.11E-04
Consumption of Fish, General Public	2.50E-07	1.43E-08	4.64E-07
Consumption of Fish, Subsistence Population	2.03E-06	1.16E-07	3.76E-06

Table D-6c. Summary of Public Exposure Scenarios – Glyphosate

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
Acute/Accidental Exposures (dose in mg/kg/day)			
Direct Spray, Entire Body, Child	2.82E-02	7.54E-03	6.89E-02
Direct Spray, Lower Legs, Woman	2.84E-03	7.58E-04	6.92E-03
Dermal Exposure, Contaminated Vegetation	5.70E-03	9.68E-04	1.38E-02
Contaminated Fruit	5.64E-02	3.18E-02	8.96E-01
Contaminated Vegetation	7.78E-01	9.11E-02	6.48E+00
Contaminated Water, Spill	1.08E+00	5.56E-01	1.62E+00
Contaminated Water, Stream	7.22E-03	0.00E+00	2.17E-01

Consumption of Fish, General Public	1.23E-02	1.04E-02	1.23E-02
Consumption of Fish, Subsistence Populations	6.01E-02	5.06E-02	6.01E-02
Chronic/Longer Term Exposures (dose in mg/kg/day)			
Contaminated Fruit	3.09E-02	1.74E-02	4.90E-01
Contaminated Vegetation	4.26E-01	4.99E-02	3.55E+00
Consumption of Water	1.37E-04	5.40E-06	1.32E-03
Consumption of Fish, General Public	2.61E-07	1.47E-08	2.08E-06
Consumption of Fish, Subsistence Population	2.11E-06	1.19E-07	1.69E-05

Table D-6d. Summary of Public Exposure Scenarios – Hexazinone

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
Acute/Accidental Exposures (dose in mg/kg/day)			
Direct Spray, Entire Body, Child			
Direct Spray, Lower Legs, Woman			
Dermal Exposure, Contaminated Vegetation	5.60E-04	1.75E-04	1.14E-03
Contaminated Fruit	1.41E-03	9.41E-04	2.24E-02
Contaminated Vegetation	1.94E-02	8.10E-03	1.62E-01
Contaminated Water, Spill	1.36E+00	3.33E-01	4.09E+00
Contaminated Water, Stream	1.13E-03	2.75E-04	3.38E-02
Consumption of Fish, General Public	4.10E-02	1.64E-02	8.19E-02

Contaminated Vegetation	3.89E-01	5.40E-02	3.24E+00
Contaminated Water, Spill	5.46E-01	3.33E-01	8.20E-01
Contaminated Water, Stream	5.41E-04	0.00E+00	1.08E-01
Consumption of Fish, General Public	9.84E-04	9.84E-04	9.84E-04
Consumption of Fish, Subsistence Populations	4.80E-03	4.80E-03	4.80E-03
Chronic/Longer Term Exposures (dose in mg/kg/day)			
Contaminated Fruit	3.65E-03	1.87E-03	5.45E-02
Contaminated Vegetation	1.90E-01	2.03E-02	2.14E+00
Consumption of Water	2.06E-03	2.56E-04	4.11E-03
Consumption of Fish, General Public	6.17E-07	1.10E-07	1.03E-06
Consumption of Fish, Subsistence Population	5.00E-06	8.89E-07	8.33E-06

Table D-6f. Summary of Public Exposure Scenarios – Nonylphenol Polyethoxylate

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
Acute/Accidental Exposures (dose in mg/kg/day)			
Direct Spray, Entire Body, Child	0.0020	0.00029	0.026
Direct Spray, Lower Legs, Woman	0.00020	2.9 E-5	0.0026
Dermal Exposure, Contaminated Vegetation	0.00038	3.5 E-5	0.0048
Contaminated Fruit	0.024	0.016	0.37
Contaminated Water, Spill	0.46	0.28	0.68
Contaminated Water, Stream	0.00094	0.00014	.0035
Consumption of Fish, General Public	0.014	0.014	0.014
Consumption of Fish, Subsistence Populations	0.067	0.067	0.067
Chronic/Longer Term Exposures (dose in mg/kg/day)			
Contaminated Fruit	0.00037	2.5 E-4	0.006
Consumption of Water	0.00020	0	0.00048
Consumption of Fish, General Public	1.0 E-6	0	2.0 E-6
Consumption of Fish, Subsistence Population	8.1 E-6	0	1.6 E-5

Table D-6g. Summary of Public Exposure Scenarios – Hexachlorobenzene

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
Acute/Accidental Exposures (dose in mg/kg/day)			
Direct Spray, Entire Body, Child	2.37E-07	5.10E-08	1.04E-06
Direct Spray, Lower Legs, Woman	2.38E-08	5.13E-09	1.04E-07
Dermal Exposure, Contaminated Vegetation	7.46E-09	7.14E-10	1.65E-08

Contaminated Fruit	1.34E-08	5.35E-09	9.90E-08
Contaminated Water, Spill	1.71E-07	1.04E-07	2.56E-07
Contaminated Water, Stream	4.23E-09	1.15E-11	2.11E-08
Consumption of Fish, General Public	1.03E-05	1.03E-05	1.03E-05
Consumption of Fish, Subsistence Populations	5.00E-05	5.00E-05	5.00E-05
Chronic/Longer Term Exposures (dose in mg/kg/day)			
Contaminated Fruit	5.19E-10	4.79E-11	4.58E-09
Consumption of Water	8.93E-12	1.50E-13	2.14E-11
Consumption of Fish, General Public	8.93E-10	2.14E-11	1.79E-09
Consumption of Fish, Subsistence Population	7.23E-09	1.74E-10	1.45E-08

Section 4 – Dose Response Assessment

Chlorsulfuron

The U.S. EPA derived a chronic RfD for chlorsulfuron of 0.05 mg/kg/day. This RfD is currently listed on the U.S. EPA IRIS web site. This RfD is based on a two-year rat feeding study. The rats were given chlorsulfuron in the diet at concentrations of 100, 500 and 2,500 ppm for two years. Treatment related adverse effects of decreases in mean body weights and weight in male rats occurred at the 500 ppm and 2,500 ppm dose level. No frank signs of toxicity were seen at the 100 ppm or higher dose levels. Dose related effects on various hematological parameters were observed in males; however, these effects were observed during the first year. The investigators indicated that although the findings suggest the presence of reticulocytosis, reticulocyte counts were not measured. Consequently, the investigators concluded that in the absence of clarifying data, the biological significance of these hematological effects is unclear. No other behavioral, nutritional, clinical, hematological, gross, or histopathological abnormalities were observed. In deriving the RfD, the U.S EPA accepted the 100 ppm dose as a NOAEL and estimated the daily intake as 5 mg/kg/day and used an uncertainty factor of 100.

The U.S. EPA Office of Pesticide Programs has recently proposed a lower chronic RfD of 0.02 mg/kg/day, which appears to be based on the identical study used by U.S. EPA in deriving the RfD of 0.05 mg/kg/day. The difference in the two RfDs is accounted for by an additional uncertainty factor required under the FQPA. Citing a three-generation reproduction study in which effects "...considered of questionable toxicological significance..." were noted at 125 mg/kg/day, the U.S. EPA selected an FQPA uncertainty factor of 3. Thus, the chronic NOAEL of 5 mg/kg/day was divided by 300 – factors of 10 for extrapolating from animals to humans, 10 for extrapolating to sensitive individuals within the human population, and 3 for accounting for differences in children as required by FQPA. This value was rounded to one significant decimal to yield the RfD of 0.02 mg/kg/day. For this risk assessment, the lower and more recent RfD of 0.02 mg/kg/day will be used to characterize all risks involving chronic or longer-term exposures.

The NOAEL of 5 mg/kg/day for chronic toxic effects is below the NOAEL of 25 mg/kg/day for reproductive effects. Thus, doses at or below the RfD will be below the level of concern for reproductive effects.

The U.S. EPA did not explicitly derive an acute/single dose RfD for chlorsulfuron. Nonetheless, for several short-term exposure scenarios the U.S. EPA recommends that an acute RfD be 0.25 mg/kg/day. This acute RfD appears to be based on a developmental study in rabbits with decreased body weight gains at 200 mg/kg/day. As with the chronic RfD, the NOAEL of 75 mg/kg/day was divided by an uncertainty factor of 300. Consistent with U.S. EPA, this risk assessment will use the short term RfD of 0.25 mg/kg/day to characterize all risks acute or short-term exposures.

Chlorsulfuron is listed by the state of California on its Groundwater Protection List and is a reproductive toxicant under Proposition 65 (the Safe Drinking Water and Toxic Enforcement Act of 1986).

Clopyralid

Up until 2001, U.S. EPA had established a provisional RfD of 0.5 mg/kg/day. This RfD was based on a two-year rat feeding study in which groups of male and female rats were administered clopyralid in the diet for 2 years at concentrations that resulted in daily doses of 0 (control), 5, 15, 50 or 150 mg/kg/day. No gross signs of toxicity, changes in organ or body weight, or histopathologic effects attributable to treatment were seen at doses of 50 mg/kg/day or lower. At 150 mg/kg/day, the only effect noted was a decrease in the body weight of the female rats. Thus, the U.S. EPA designated the dose of 50 mg/kg/day as a NOAEL and used an uncertainty factor of 100 (10 for species-to-species extrapolation and 10 for sensitive subgroups in the human population) to derive the RfD of 0.5 mg/kg/day. In 2001, U.S EPA changed the chronic NOAEL to 15 mg/kg/day, based on a study in rats showing effects at 150 mg/kg/day. This change is currently under discussion between the clopyralid registrant and the U.S. EPA, however, for this risk assessment, the value of 15 mg/kg/day will be used as the chronic NOAEL, resulting in a chronic RfD of 0.15 mg/kg/day.

Based on these data, the critical effect - i.e., the adverse effect that will occur at the lowest dose level - is somewhat ambiguous. At a factor of 3 to 10 above the chronic NOAEL, effects have been reported on body weight, liver weight, and the gastric epithelium. Decreases in body weight and changes in organ weight are commonly observed in chronic toxicity studies and can indicate either an adaptive or toxic response. Changes in epithelial tissue are less commonly observed and the toxicological significance of this effect is unclear.

U.S. EPA has established an acute oral RfD of 0.75 mg/kg, based on a maternal NOEL of 75 mg/kg/day in rats in a developmental toxicity test (U.S. EPA, 2001). This value can be used as an indicator of short-term risk.

There are no drinking water standards established for clopyralid, either by U.S. EPA or CalEPA.

Although the two chlorinated benzenes should be regarded as much more potent toxicologically than clopyralid, the chlorinated benzenes do not appear to be present in a significant quantity with respect to systemic toxicity. In addition, all of the toxicity studies on clopyralid used the technical grade clopyralid and thus encompass the likely toxic contribution of the chlorinated benzene contaminants.

Glyphosate

The U.S. EPA Office of Pesticide Programs has established a provisional RfD of 2 mg/kg/day for glyphosate (U.S. EPA, 2000b). This is based on the maternal NOAEL of 175 mg/kg/day from a rabbit developmental study and an uncertainty factor of 100 (10 for sensitive individuals and 10 for species to species extrapolation). The RfD of 2 mg/kg/day is a rounding of the 1.75 mg/kg/day value to one significant digit.

The U.S. EPA has also derived an RfD for glyphosate of 0.1 mg/kg/day (U.S. EPA/IRIS 1990, as referenced in SERA 2003a). This RfD was originally derived in 1990 by the U.S. EPA Integrated Risk Information System (IRIS) workgroup and is the current RfD posted on IRIS. This RfD is based on a dietary 3-generation reproduction study. In this study, rats were exposed to glyphosate in the diet with resulting dose rates of 0, 3, 10 and 30 mg/kg/day. No signs of maternal toxicity were observed. The only effect in offspring was an increase in the incidence of unilateral renal tubular dilation in male pups from the F3b mating. Thus, the NOAEL was identified as 10 mg/kg/day and an uncertainty factor of 100 was applied to derive an RfD of 0.1 mg/kg/day.

Unlike the two RfD values proposed by the U.S. EPA, the ADI proposed by WHO (1994, as referenced in SERA 2003a) is not based on a reproductive toxicity study. Instead, WHO (1994) selected a life-time feeding study in rats. This study involved dietary concentrations of 0, 30, 100, or 300 ppm for 26 months which corresponded to approximate daily doses of 0, 3.1, 10.3, or 31.5 mg/kg/day for males and 0, 3.4, 11.3, or 34.0 mg/kg/day for females. No effects were seen at any dose levels and thus WHO (1994) used a NOAEL of 31.5 mg/kg/day and uncertainty factor of 100. Rounding to one significant digit, the recommended ADI was set at 0.3 mg/kg/day.

The U.S. EPA/OPP will sometimes derive acute RfD values that can be used to assess risks associated with very short-term exposures – i.e., accidental spills. No acute RfD has been proposed, however, for glyphosate.

For the current risk assessment, the RfD of 2 mg/kg/day derived by U.S. EPA/OPP (1993) will be used as the basis for characterizing risk from longer term exposures in this risk assessment. For short-term exposures, the value of 2 mg/kg/day recommended by U.S. EPA/ODW (1992, as referenced in SERA 2003a) will be used. Since this is identical to the chronic RfD, this approach is equivalent to applying the same RfD to be short-term and long-term exposures. Given the lack of a significant dose-duration relationship for glyphosate, this approach seems appropriate.

The U.S. EPA Office of Water has established a lifetime health advisory level (HA) of 0.7 mg/L (700 ppb) and a 10-day HA of 20 mg/L (20 ppm) for glyphosate in drinking water (U.S. EPA, 2006). The lifetime HA is an estimate of acceptable drinking water levels for a contaminant at which adverse health effects would not be expected to occur, even over a lifetime of exposure. The 10-day HA is designed to be protective of a child consuming 1 liter of water a day. These are not legally enforceable Federal standards, but serve as technical guidance to assist others. In addition, U.S. EPA has set a Maximum Contaminant Level (MCL) of 0.7 mg/L. This is an enforceable standard for drinking water quality. The state of California has also established a Public Health Goal (PHG) of 1 mg/L (1 ppm), based on a similar analysis as U.S. EPA (CalEPA, 1997). The PHG describes a level of contamination at which adverse health effects would not be expected to occur, even over a lifetime of exposure

Hexazinone

In the process of reregistration, a 2-year feeding study in dogs was submitted to the U.S. EPA. In this study, doses of 41 and 38 mg/kg/day in males and females, respectively, were associated with changes in clinical chemistry and histopathology. The NOEL for these effects was 5 mg/kg/day. Based on this NOEL and using an uncertainty factor of 100 for species-to-species extrapolation (10) and sensitive subgroups (10), the Office of Pesticides derived an RfD of 0.05 mg/kg/day. The U.S. EPA determined that an additional uncertainty factor for the protection of infants and children is not required because of the information indicating that hexazinone does not have developmental or reproductive effects at doses below those associated with the same effect in dams. Hence, the RfD should protect against effects in both dams and offspring.

Based on developmental studies in rats and rabbits, the U.S. EPA identified acute dietary exposures to women of child bearing age as a potential concern and derived an acute RfD of 4 mg/kg. For the general population, no acute RfD was proposed because ... no appropriate endpoint attributable to a single-dose [was] identified in the database (U.S. EPA, as referenced in SERA, 2005). The RfD of 4 mg/kg is based on the developmental NOAEL of 400 mg/kg/day with an uncertainty factor of 100.

The U.S. EPA Office of Water has established a lifetime health advisory level (HA) of 0.4 mg/L (400 ppb) and a 10-day HA of 2 mg/L for hexazinone in drinking water (U.S. EPA 2006).

Triclopyr

The U.S. EPA has established a chronic RfD for triclopyr at 0.05 mg/kg/day (U.S. EPA 1998). The U.S. EPA has concluded that the triethylamine acid (TEA) and butoxyethyl ester (BEE) of triclopyr are toxicologically equivalent; thus, this RfD is applicable to both forms of triclopyr. The RfD is based on a two-generation reproduction study in rats, with a NOEL of 5.0 mg/kg/day, the lowest dose tested. At the next dose level (25 mg/kg/day), an increased incidence of proximal tubular degeneration of the kidneys was observed in parental rats. An uncertainty factor of 100 was applied to this NOEL.

Under the Food Quality Protection Act (FQPA), the U.S. EPA is required to evaluate whether or not an additional uncertainty factor is required for the protection of children. The parental NOAEL of 5 mg/kg/day is below any adverse reproductive effects. Consequently, the U.S. EPA (1998) has determined that no additional FQPA uncertainty factor is required.

In the most recent pesticide tolerance for triclopyr, the U.S. EPA has recommended an acute RfD of 1 mg/kg/day for the general population (U.S. EPA 2002a). This appears to be based on the NOAEL of 100 mg/kg/day from a study in which rats were administered gavage doses of triclopyr BEE on days 6 through 15 of gestation. At 300 mg/kg/day, toxic responses included signs of marked maternal toxicity, overt clinical signs in a few dams, mean body weight loss and decreased mean body weight gain, decreased mean feed consumption, increased mean water consumption, and increased mean liver and kidney weights. In addition, fetal effects included both skeletal and soft-tissue malformations. This acute RfD is not applicable to females between the ages of 13-50 years – i.e., of childbearing age. For these individuals, the U.S. EPA recommends an acute RfD of 0.05 mg/kg/day, equivalent to the chronic RfD. This is based on a chronic 2-generation reproduction study with a NOAEL of 5 mg/kg/day and an increased incidence of defects in offspring at the next dose level of 25 mg/kg/day. In the triclopyr RED (U.S. EPA 1998), U.S. EPA considers a value of 30 mg/kg/day as a measure of acute dietary risk, based on a developmental toxicity study in rabbits administered triclopyr BEE . At the next highest dose (100 mg/kg/day), effects included parental mortality as well as decreased number of live fetuses, increased number of fetal deaths, and increased number of fetal and/or litter incidence of skeletal anomalies and variants. The 30 mg/kg/day NOEL is supported by a number of other teratogenicity studies as well as a multi-generation reproduction study.

For risk characterization, this risk assessment will adopt the most recent RfD values recommended by U.S. EPA – i.e., 1 mg/kg for acute exposures in the general population and 0.05 mg/kg/day for exposure scenarios of one month to a lifetime. Also consistent with the approach taken by U.S. EPA, the acute RfD of 1 mg/kg/day will be applied to the general population, but not to women of child-bearing age.

Some exposure scenarios for the general public and workers yield estimates that are above the current chronic (and adult female acute) RfD of 0.05 mg/kg/day or above the acute RfD of 1.0 mg/kg/day for the general population. Consequently, some attempt must be made to characterize the consequences of exposures above the RfD. The RfD is intended to be a conservative estimate and does not explicitly incorporate information on dose-duration or dose-severity relationships. In other words, doses below the RfD, regardless of the duration of exposure, are of no substantial concern as long as the RfD is based on a sound set of data. The assumption that exposures above the RfD will result in adverse human health effects is not necessarily correct, particularly when the duration of exposure is substantially less than a lifetime. All exposure scenarios considered in this risk assessment are less than lifetime. Triclopyr rapidly dissipates or degrades, and high levels of exposure generally occur only over short periods. Workers may be exposed repeatedly during an application program in a particular season and may use triclopyr formulations over the course of a career but exposures at occupational levels will be intermittent and less than lifetime.

The most sensitive effect, and the effect on which the chronic RfD is based, involve kidney toxicity. All of the kidney effects noted in rats are based on histopathological changes or increased kidney weight. The effect and no effect levels based on changes in kidney weight in rats after chronic exposure are very similar to those for subchronic exposures.

The issue of species sensitivity is important in assessing the use of a 10-fold factor for species-to-species extrapolation, as used in the RfD for triclopyr. For many chemicals, differences in species sensitivity are apparent and generally indicate that small animals are less sensitive than large animals. Triclopyr does not follow this pattern: there is no apparent relationship between body weight and toxicity measured as acute oral LD_{50} values. The lack of consistent species differences in sensitivity suggests that U.S. EPA's use of an uncertainty factor of 10 for species-to-species extrapolation may be conservative. For assessing effects of exposures, an uncertainty factor of three will also be used as a range-bounding value.

Using data from acute studies on various species, including cattle and ponies, SERA (1996b) concluded that taking an approach analogous to that for the RfD, 60 mg/kg might be taken as a conservative 1-day NOAEL. Dividing by 100, as is done with the RfD, yields the adjusted value of 0.6 mg/kg for a reference 1-day exposure that should not be associated with adverse effects. As with the RfD, a 3-fold higher value, 1.8 mg/kg, could be proposed based on a less conservative but still protective species extrapolation.

From SERA (1996b), the AEL of 75 mg/kg, based on the data in cattle, yields a corresponding AEL range for humans of 0.75-2.25 mg/kg. This range of doses would not be associated with acute signs of toxicity but would be regarded as undesirable because adverse effects on the kidney might occur. The minimum dose associated with mortality in experimental mammals is 252 mg/kg in rabbits. After applying an uncertainty factor of 100, the estimated dose associated with concern for acute lethal effects in humans is 2.5 mg/kg, with an upper range of 7.5 mg/kg.

Dose-severity relationships used for triclopyr risk characterization.

Dose (mg/kg/day)	Plausible Effect
2.5 – 7.5	potentially lethal doses, especially at upper end of range, overt signs or symptoms of toxicity after acute exposures
0.75 to 2.25	with longer term exposure, probable effects on kidneys, offspring; acute exposures at upper end may also result in kidney effects, other clinical effects
0.05 to 0.75	nature and severity of toxic effects for chronic exposures are uncertain in general population; potential developmental effects in offspring of women
≤1.8	no effects anticipated with one-time exposures
≤0.05	no effects anticipated with chronic exposures.

Nonylphenol Polyethoxylate

At present there are no existing State or Federal human exposure guidelines for NP9E or NP. U.S. EPA has not established an RfD. Since it appears that NP could be a component of the NP9E mixture, NP could be a metabolite of NPE, and that NP appears to be more toxic in mammalian systems, one method of establishing a human threshold value would be to utilize NP toxicity studies to establish a benchmark level for use in assessing risks of exposure.

The use of the LOEL value of 12 mg/kg/day for NP from the study by Chapin et al. (1999, as referenced in USDA 2003) as a functional NOAEL value is the approach utilized by the Canadian government. However, the more recent multi-generation study by Nagao et al. (2001, as referenced in USDA 2003) provides a NOEL value of 10 mg/kg/day for NP.

Utilizing a 10X safety factor for interspecies differences and a 10X safety factor for intraspecies differences provides a value of 0.10 mg/kg/day which should be protective of human health from chronic exposures to NP and NPEs. Since the toxicity of NPEs decreases with increasing numbers of ethoxylate groups, and that the general population is exposed to mixtures that include NPEs of longer chain lengths, this protective value, based on NP, should be considered conservative.

Another method would be to utilize the experimental values for NP9E, with the assumption that any testing involving the NP9E mixture would include minor amounts of NP and the short-chain NPEs. However there is a lack of chronic test results involving NP9E, and the sub-chronic test results are not much different than the corresponding values for NP. Hence the derived value of 0.10 mg/kg/day for NP will be used to assess risks of chronic human exposure.

For shorter-term exposures, 90-day sub-chronic tests involving NP9E in rats and beagles resulted in NOELs ranging from 10 to approximately 30 mg/kg/day. LOAELs from these same studies ranged upwards from 50 mg/kg/day. Slightly higher NOELs of 40 mg/kg/day were seen in 90-day sub-chronic studies with NP4E and NP6E. The use of the lowest sub-chronic NOEL of 10 mg/kg/day will be another conservative measure, considering that in these studies there is a considerable gap in dosing intervals between the NOEL and LOAEL levels determined in these studies. Again, using the same two safety factors as above, the human acute NOEL that will be used is 0.10 mg/kg/day. Based on the sub-chronic studies, however, short-term, or acute exposures to humans in the range of 0.1 to 0.4 mg/kg/day should not be associated with adverse health effects.

As regards the estrogenicity of NP and NPEs, it appears that most estrogenic effects are seen at relatively high exposure rates in mammals. The assessment level of 0.10 mg/kg/day should be protective of any estrogenic or reproductive effects that NP and NPE exposure may represent in mammalian systems.

Hexachlorobenzene

The U.S. EPA chronic RfD for hexachlorobenzene is 0.0008 mg/kg/day. This RfD is based on a 130-week feeding study in male and female rats that also included a 90-day exposure to offspring. The U.S. EPA judged the NOAEL for liver effects at a dose of 0.08 mg/kg/day with a LOAEL at 0.29 mg/kg/day. The U.S. EPA used an uncertainty factor of 100 to derive the RfD of 0.0008 mg/kg/day.

The U.S. EPA RfD for pentachlorobenzene is also 0.0008 mg/kg/day (U.S. EPA 1988a, as referenced in SERA 2004b). This RfD is based on a subchronic feeding study in male and female rats in which hyaline droplets were seen in proximal kidney tubules at 8.3 mg/kg/day, the lowest dose tested. Thus, this study did not identify a NOAEL. The RfD is based on the LOAEL of 8.3 mg/kg/day divided by an uncertainty factor of 10,000. The uncertainty factor of 10,000 is based on four factors of 10 for interspecies variability, variability in the human population, the use of a subchronic rather than chronic study, and the use of a LOAEL rather than a NOAEL.

ATSDR has derived an acute Minimal Risk Level (MRL) for hexachlorobenzene of 0.008 mg/kg/day, a factor of 10 above the chronic RfD derived by U.S. EPA. The U.S. EPA Office of Drinking Water has derived a maximum contaminant level of 0.001 mg/L of drinking water and a maximum short-term health advisory of 0.05 mg/L of drinking water.

In addition to systemic toxicity, hexachlorobenzene has been shown to cause tumors of the liver, thyroid and kidney in three species of rodents - mice, rats, and hamsters. Based on a two-year feeding study in rats, the U.S. EPA derived a cancer slope factor for lifetime exposures of 1.6 $(mg/kg/day)^{-1}$. In other words, cancer risk over a lifetime (P) is calculated as the product of the daily dose (d) over a lifetime and the potency parameter (â) (P = d x â). The lifetime daily dose associated with a given risk level is therefore: d = P÷â. Thus, the lifetime daily dose of hexachlorobenzene associated with a risk of one in one million is 0.000000625 mg/kg/day (6.25 E-7).

As noted previously, clopyralid is not classified as a carcinogen. While it can be argued that the technical grade clopyralid used in the standard bioassays encompasses any toxicologic effects that could be caused by hexachlorobenzene, this argument is less compelling for carcinogenic effects because, for most cancer causing agents, the cancer risk is conservatively viewed as a non-threshold phenomenon - i.e., zero risk is achieved only at zero dose.

The potency factor of 1.6 $(mg/kg/day)^{-1}$ is intended for application to lifetime daily doses. Many of the exposure assessments used in this risk assessment involve much shorter periods of time. Following the approach recommended by U.S. EPA this risk assessment assumes that the average daily dose over a lifetime is the appropriate measure for the estimation of cancer risk. Thus, the lifetime potency of 1.6 $(mg/kg/day)^{-1}$ is scaled linearly when applied to shorter periods of exposure. As calculated in SERA (2004b), the potency parameter for a one-day exposure is 0.000063 $(mg/kg/day)^{-1}$. Thus, the lifetime risk associated with a single dose of 0.001 mg/kg would be calculated as 6.3×10^{-8} or 6.3 in one hundred million. This method of estimating cancer risk from short-term exposures is used in the next section for hexachlorobenzene.

No explicit dose response estimate is made for the potential carcinogenic effects of pentachlorobenzene. This is consistent with the approach taken by the U.S. EPA (1988b, as referenced in SERA 2004b) and reflects the fact the available data on pentachlorobenzene are inadequate to classify this compound as a carcinogen or to estimate carcinogenic potency.

Section 5 - Risk Characterization

A quantitative summary of the risk characterization for workers associated with exposure to these herbicides is presented in Tables F-7a-1 to F-7g-1. The quantitative risk characterization is expressed as the hazard quotient, which is the ratio of the estimated exposure doses from Tables F-4a to F-4g to the RfD. The quantitative hazard characterization for the general public associated with exposure to these herbicides is summarized in Tables F-7a-2 to F-7g-2. Like the quantitative risk characterization for workers, the quantitative risk characterization for the general public is expressed as the hazard quotient, which again is the ratio of the estimated exposure doses from Tables F-6a to F-6g to the RfD.

As a standard for formatting, numbers greater than 1.0 are expressed in standard decimal notation and smaller numbers are expressed in scientific notations - e.g., 7 E-7 equivalent to 7×10^{-7} or 0.0000007.

The only reservation attached to this assessment is that associated with any risk assessment: Absolute safety cannot be proven and the absence of risk can never be demonstrated. No chemical has been studied for all possible effects and the use of data from laboratory animals to estimate hazard or the lack of hazard to humans is a process that contains uncertainty. Prudence dictates that normal and reasonable care should be taken in the handling of these herbicides.

Chlorsulfuron

Workers -The toxicity data on chlorsulfuron allows for separate dose-response assessments for acute and chronic exposures. For acute exposures, the hazard quotients are based on U.S. EPA's recommended acute RfD of 0.25 mg/kg/day. For chronic exposures, the hazard quotients are based on the proposed chronic RfD from U.S. EPA of 0.02 mg/kg/day.

Given the very low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios approach a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 5,000 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects.

The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limit of the hazard quotients (HQ=0.2) is below the level of concern - i..e., a hazard quotient of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of chlorsulfuron that are regarded as unacceptable. Under typical application conditions, levels of exposure will be far below levels of concern.

Mild irritation to the skin and eyes can result from exposure to relatively high levels of chlorsulfuron- i.e., placement of chlorsulfuron directly onto the eye or skin. From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling chlorsulfuron. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of the compound.

General Public – As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on an acute oral RfD of 0.25 mg/kg/day and the hazard quotients for chronic exposures are based on a proposed chronic RfD of 0.02 mg/kg/day.

None of the acute scenarios exceed a level of concern. The consumption of contaminated vegetation has a hazard quotient of 0.8, at the upper level. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially.

The longer-term consumption of contaminated vegetation after application of the highest dose yields a hazard quotient that is greater than unity (HQ= 4) at the highest dose. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. This scenario may be extremely conservative in that it does not consider the limited projected use of this herbicide on this project or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Table D-7a-1. Summary of Risk Characterization for Workers – Chlorsulfuron

Chronic RfD = 0.02 mg/kg/day Acute RfD = 0.25 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.04	.0008	0.2
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	1E-06	2E-07	3E-06
Contaminated Gloves - 1 Hour	6E-05	1E-05	2E-04
Spill on Hands - 1 Hour	4E-05	4E-06	2E-04
Spill on Lower Legs - 1 Hour	1E-04	9E-06	5E-04

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Table D-7a-2. Summary of Risk Characterization for the Public – Chlorsulfuron

Chronic RfD = 0.02 mg/kg/day Acute RfD = 0.25 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	1E-03	1E-04	7E-03
Direct Spray, Lower Legs, Woman	1E-04	1E-05	7E-04
Dermal Exposure, Contaminated Vegetation	2E-04	1E-05	1E-03
Contaminated Fruit	7E-03	2E-03	0.1
Contaminated Vegetation	9E-02	6E-03	0.8
Contaminated Water, Spill	0.1	4E-02	0.2
Contaminated Water, Stream	4E-03	9E-05	1E-02
Consumption of Fish, General Public	4E-03	2E-03	4E-03
Consumption of Fish, Subsistence Populations	2E-02	9E-03	2E-02
Chronic/Longer Term Exposures			
Contaminated Fruit	3E-02	1E-02	0.5
Contaminated Vegetation	0.5	3E-02	**4**
Consumption of Water	1E-04	5E-06	2E-04
Consumption of Fish, General Public	9E-07	5E-08	1E-06
Consumption of Fish, Subsistence Population	7E-06	4E-07	1E-05

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Clopyralid

Workers -The toxicity data on clopyralid allows for separate dose-response assessments for acute and chronic exposures. For acute exposures, the hazard quotients are based on U.S. EPA's acute oral RfD of 0.75 mg/kg/day (U.S. EPA 2001). For chronic exposures, the hazard quotients are based on the provisional chronic RfD from U.S. EPA of 0.15 mg/kg/day. Given the very low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous; none of the exposure scenarios approaches a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 1,000 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects. The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limit of the hazard quotients for backpack application is below the level of concern - i.e., a hazard index of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of clopyralid that are regarded as unacceptable. Under typical application conditions, levels of exposure will be far below levels of concern.

Irritation and damage to the skin and eyes can result from exposure to relatively high levels of clopyralid - i.e., placement of clopyralid directly onto the eye or skin. From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling clopyralid. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of clopyralid.

General Public – As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on an acute oral RfD of 0.75 mg/kg/day and the hazard quotients for chronic exposures are based on a provisional chronic RfD of 0.15 mg/kg/day.

For the acute/accidental scenarios, the exposure resulting from the consumption of contaminated vegetation is the scenario with the highest hazard quotient (HQ = 0.5) at the upper level. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially.

For the other acute/accidental scenarios, the exposure resulting from the consumption of contaminated water by a child is the scenario with the highest hazard quotient (HQ = 0.1), a factor of 10 below a level of concern. It must be noted that the exposure scenario for the consumption of contaminated water is an arbitrary scenario: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of clopyralid, all of the hazard quotients would be a factor of 10 less. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For clopyralid, such scenarios involve oral (contaminated water) rather than dermal (spills or accidental spray) exposure.

For chronic scenarios, the consumption of contaminated vegetation has a hazard quotient slightly above unity (HQ = 1.2). At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously described, this scenario may be extremely conservative in that it does not consider the limited projected use of this herbicide on this project or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term. However, this scenario points out the importance of directing the herbicide onto the targeted vegetation and avoiding non-target deposition through overspray.

Table D-7b-1. Summary of Risk Characterization for Workers – Clopyralid

Chronic RfD = 0.15 mg/kg/day Acute RfD = 0.75 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.01	2E-04	0.05
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	5E-07	1E-07	2E-06
Contaminated Gloves - 1 Hour	3E-05	8E-06	1E-04
Spill on Hands - 1 Hour	1E-04	2E-05	5E-04
Spill on Lower Legs - 1 Hour	2E-04	5E-05	1E-03

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Table D-7b-2. Summary of Risk Characterization for the Public – Clopyralid

Chronic RfD = 0.15 mg/kg/day Acute RfD = 0.75 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	4E-03	8E-04	2E-02
Direct Spray, Lower Legs, Woman	4E-04	8E-05	2E-03
Dermal Exposure, Contaminated Vegetation	5E-04	4E-05	2E-03
Contaminated Fruit	4E-03	2E-03	6E-02
Contaminated Vegetation	5E-02	5E-03	0.5
Contaminated Water, Spill	9E-02	6E-02	0.1
Contaminated Water, Stream	5E-04	3E-05	3E-03
Consumption of Fish, General Public	3E-03	3E-03	3E-03
Consumption of Fish, Subsistence Populations	1E-02	1E-02	1E-02
Chronic/Longer Term Exposures			
Contaminated Fruit	8E-03	3E-03	0.2
Contaminated Vegetation	0.1	7E-03	**1.2**
Consumption of Water	3E-04	1E-05	7E-04
Consumption of Fish, General Public	2E-06	1E-07	3E-06
Consumption of Fish, Subsistence Population	1E-05	8E-07	3E-05

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Glyphosate

Workers - Given the low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios exceed a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 500 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects. The hazard quotients for these acute occupational exposures are based on a chronic RfD. This adds an additional level of conservatism and, given the very low hazard quotients for these scenarios, reinforces the conclusion that there is no basis for asserting that systemic toxic effects are plausible.

The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limits of the hazard quotients are below the level of concern - i.e., a hazard index of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of glyphosate that are regarded as unacceptable. Under typical backpack application conditions, levels of exposure will be at least 100 times below the level of concern.

Glyphosate and glyphosate formulations are skin and eye irritants. Quantitative risk assessments for irritation are not normally derived, and, for glyphosate specifically, there is no indication that such a derivation is warranted.

General Public - For chronic scenarios, the consumption of contaminated vegetation has a hazard quotient above unity (HQ = 1.8) at the upper level. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously described, this scenario may be extremely conservative in that it does not consider the limited projected use of this herbicide on this project or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term. However, this scenario points out the importance of directing the herbicide onto the targeted vegetation and avoiding non-target deposition through overspray. As detailed in Table D-6c, the upper range of exposure scenario involves a dose of 3.55 mg/kg bw. While this is an unacceptable level of exposure, it is far below doses that would likely result in overt signs of toxicity. As detailed in SERA (2003a), a dose of 184 mg/kg as Roundup – i.e., glyphosate plus surfactant – was not associated with any overt signs of toxicity in humans – and mild signs of toxicity were apparent at doses of 427 mg/kg, over 100 times higher than the upper range of 3.55 mg/kg in the consumption of contaminated vegetation scenario.

None of the other longer-term exposure scenarios approach a level of concern. Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard quotients are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to glyphosate.

For the acute/accidental scenarios, the exposure resulting from the consumption of contaminated vegetation is the scenario with the highest hazard quotient (HQ = 3) at the upper level. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. As detailed in Table D-6c, the upper range of exposure scenario involves a dose of 6.48 mg/kg bw. As described above, while this is an unacceptable level of exposure, it is far below doses that would likely result in overt signs of toxicity, and is over 50 times lower than doses where mild signs of toxicity were apparent (427 mg/kg).

For the other acute/accidental scenarios, the exposure resulting from the consumption of contaminated water by a child, at the highest application rates, approaches the level of concern. At the exposure level for a child drinking water, as per the discussion in Section 4, no effects would be anticipated for doses up to 20 mg/kg/day. It is important to realize that the exposure scenarios involving contaminated water are arbitrary scenarios: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of glyphosate, all of the hazard quotients would be a factor of 10 less. A further conservative aspect to the water contamination scenario is that it represents standing water, with no dilution or decomposition of the herbicide. This is unlikely in a forested situation where flowing streams are more likely to be contaminated in a spill, rather than a standing pond of water. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are substantially below 1. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For glyphosate, such scenarios involve oral (contaminated water) rather than dermal (spills or accidental spray) exposure.

Table D-7c-1. Summary of Risk Characterization for Workers – Glyphosate

RfD = 2.0 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
General Exposures			
Backpack Application	1E-02	5E-04	7E-02
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	3E-06	6E-07	1E-05
Contaminated Gloves - 1 Hour	2E-04	4E-05	7E-04
Spill on Hands - 1 Hour	4E-04	1E-04	9E-04
Spill on Lower Legs - 1 Hour	9E-04	2E-04	2E-03

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Table D-7c-2. Summary of Risk Characterization for the Public – Glyphosate

RfD = 2.0 mg/kg/day	
Scenario	Hazard Quotient[1]

worker exposures to hexazinone are likely to exceed exposures that would generally be regarded as acceptable if workers do not follow prudent handling practices that will minimize exposure.

For accidental scenarios, no scenarios result in HQ values exceeding 1. While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. The highest hazard quotient for any of the accidental exposures is a factor of about 10 below the level of concern. The hazard quotients for these acute occupational exposures are based on a chronic RfD. This adds an additional level of conservatism to the risk assessment.

As stated, hexazinone is a severe eye irritant. Quantitative risk assessments for irritation are not usually derived, and, for hexazinone specifically, the available data do not support any reasonable quantitative dose-response modeling. Nonetheless, human experience with this compound (Spencer et al. 1996) indicates that such effects are clearly plausible for granular formulations. As described in Section 2, workers applying Pronone 10G [on the Eldorado National Forest] using a belly grinder exhibited transient eye irritation and upper respiratory tract irritation (reported burning sensations in mouth, nose and throat, coughing, spitting) at the highest operational levels of exposure. These effects did not persist after exposure was terminated. It is important to recognize that the product applied in this study was recognized as defective, with excessive dustiness. As a result of this study, the USFS, Region 5 established additional requirements for protective equipment when applying granular hexazinone formulations via belly grinder. In addition, this direction instructs applicators not to continue applications if excessive dustiness is seen.

While skin irritation could also occur, it would probably be less severe than effects on the eyes.

General Public - For the acute/accidental scenarios, none exceed a level of concern. The consumption of contaminated water after a spill by a child or by consuming fish found in such contaminated waters, at the upper dose estimates equals the level of concern (HQ=1). The exposure scenarios involving contaminated water are arbitrary scenarios: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of hexazinone, all of the hazard quotients would be a factor of 10 less. A further conservative aspect to the water contamination scenario is that it represents standing water, with no dilution or decomposition of the herbicide. This is unlikely in a forested situation where flowing streams are more likely to be contaminated in a spill, rather than a standing pond of water. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are well below 1 (HQ = 0.008). The greatest practical consequence of a direct spray probably would be eye irritation, which could be severe

Of the longer-term scenarios, the consumption of unwashed vegetation after application of the highest dose yields a hazard quotient of 1.4. This scenario may be extremely conservative in that it does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Table D-7d-1. Summary of Risk Characterization for Workers – Hexazinone

Chronic RfD = 0.05 mg/kg/day Acute RfD = 4.0 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.4	1E-02	1.8

Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	6E-04	4E-04	1E-03
Contaminated Gloves - 1 Hour	4E-02	2E-02	6E-02

The accidental exposure scenario of wearing gloves contaminated with triclopyr for 1 hour exceeds the RfD for upper exposure levels (HQ = 1.7). Although it is unlikely that a one-time exposure to triclopyr at this level would result in toxic effects, this scenario indicates that adequate worker hygiene practices are important. As stated above, workers applying triclopyr only occasionally would be at much lower risk of such an accident. If a worker applies triclopyr often, and is sloppy with industrial hygiene, some effects to the kidney are plausible. The simple verbal interpretation of this quantitative characterization of risk is that under the most conservative set of accidental exposure assumptions, workers could be exposed to levels of triclopyr that are regarded as unacceptable. If triclopyr is not applied at the highest application and concentration rate or if appropriate steps are taken to ensure that workers are not exposed to the maximum plausible rates (i.e., worker hygiene practices) the risk to workers would be substantially reduced.

General Public – As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on acute RfD of 1.0 mg/kg/day and the hazard quotients for chronic exposures are based on the chronic RfD from U.S. EPA of 0.05 mg/kg/day. For women of childbearing age, the acute RfD is 0.05 mg/kg/day.

One acute/accidental scenario (the consumption of contaminated vegetation) exceeds a level of concern at all levels of exposure (HQ = 1 to 65). These findings suggest that in the unlikely event that someone had a vegetable garden growing in proximity to a treatment area that triclopyr was applied, especially at the typical or maximum application rates, adult females who consume the vegetables from such gardens could be at risk. At the typical level of exposure, the consumption of contaminated vegetation could lead to acute exposures where the nature and severity of effects are uncertain. At the upper level of exposure, the consumption of contaminated vegetation could lead to a one-time dose of 3.2 mg/kg which could result in overt signs or symptoms of toxicity after acute exposures. The plausibility of the existence of this scenario is limited by several important factors. First, the areas proposed for treatment with triclopyr are well removed (> 1 mile) from private residences, and hence, vegetable gardens. Secondly, unless the triclopyr contamination were to occur immediately before picking, it is plausible that the accidental contamination would kill the plants or diminish their capacity to yield consumable vegetation. Thirdly, this scenario is extremely conservative in that it does not consider the effects of washing contaminated vegetation in reducing doses. Finally, signs at likely access points informing the public that an area has been sprayed and the presence of dye on vegetation would reduce the potential that freshly sprayed material would be consumed.

In the other acute/accidental scenarios involving triclopyr, based on the high exposure assumptions, four of the acute/accidental scenarios reach or slightly exceed a level of concern (i.e., child sprayed, woman sprayed on lower legs, exposure to sprayed vegetation, and consumption of contaminated fruit). Based on the dose-severity relationship for triclopyr, at these levels of acute exposure (≤1.8 mg/kg), it is unlikely that there would be any adverse health effects associated with a one-time exposure.

Two longer term scenarios exceed a level of concern - the consumption of unwashed fruit and the consumption of unwashed vegetation. While the consumption of fruit slightly exceeds a hazard quotient of 1 at only the upper level of exposure, the consumption of vegetation exceeds a level of concern at both the typical and upper exposure level. At the highest application rate, the estimated dose at the upper level of exposure could be about 2.1 mg/kg/day. This value is in the range that, with longer term exposure, could result in effects on kidneys or offspring. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. This is a standard scenario used in all Forest Service risk assessments and is extremely conservative – i.e., it assumes that vegetation that has been directly sprayed is harvested and consumed for a prolonged period of time. In addition, this scenario does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

TCP is of concern to the human health risk assessment both because it is a metabolite of triclopyr and because the aggregate risks of exposure to TCP from the breakdown of both triclopyr and chlorpyrifos must be considered. While the U.S. EPA has not derived a formal RfD for TCP, the RED on triclopyr (U.S. EPA 1998, p. 31) as well as the RED on chlorpyrifos (U.S. EPA 2001b, as referenced in SERA 2003b) use a chronic value of 0.03 mg/kg/day for the risk characterization for TCP. In the more recent pesticide tolerances for triclopyr (U.S. EPA 2002a), a somewhat lower value is used for the risk characterization of TCP: a dose of 0.012 mg TCP/kg/day derived using an uncertainty factor of 1000 and data from a chronic study in dogs in which changes in clinical chemistry at a dose of 48 mg/kg/day (LOAEL) but no effects at 12 mg/kg/day (NOAEL). For acute effects, the pesticide tolerances for triclopyr (U.S. EPA 2002a) use an acute value of 0.025 mg/kg/day based on a developmental toxicity study in rabbits with NOAEL of 25 mg/kg/day and a corresponding LOAEL of 100 mg/kg/day in which an increased incidence of hydrocephaly and dilated ventricles were noted in rabbits.

For both acute and chronic exposures the uncertainty factor for TCP is set at 1,000. This value is comprised of the factors of 10 to account for uncertainties in species-to-species extrapolation and another factor of 10 to encompass sensitive individuals in the population as well as an additional factor of 10 for the potentially higher sensitivity of children – i.e., the FQPA uncertainty factor. For the current risk assessment, the values used for risk characterization are identical to the most recent and conservative values proposed by U.S. EPA: 0.025 mg/kg/day for acute exposures and 0.012 mg/kg/day for chronic exposures.

Table D-7e-1. Summary of Risk Characterization for Workers – Triclopyr

Chronic RfD = 0.05 mg/kg/day

Contaminated Fruit	0.1	1E-01	**1.7**
Contaminated Vegetation	**8**	**1.1**	**65**
Contaminated Water, Spill	0.5	0.3	0.8
Contaminated Water, Stream	5E-04	0E00	0.1
Consumption of Fish, General Public	1E-03	1E-03	1E-03
Consumption of Fish, Subsistence Populations	5E-03	5E-03	5E-03
Chronic/Longer Term Exposures			
Contaminated Fruit	7E-02	4E-02	**1.1**
Contaminated Vegetation	**4**	0.4	**43**
Consumption of Water	4E-02	5E-03	8E-02
Consumption of Fish, General Public	1E-05	2E-06	2E-05
Consumption of Fish, Subsistence Population	1E-04	2E-05	2E-04

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Nonylphenol Polyethoxylate

Workers - Given the low hazard quotients for accidental exposure, the risk characterization is reasonably unambiguous. None of the accidental exposure scenarios exceed a level of concern. While the accidental exposure scenarios are not the most severe one might imagine (e.g., complete immersion of the worker or contamination of the entire body surface for a prolonged period of time) they are representative of reasonable accidental exposures. Confidence in this assessment is diminished by the lack of information regarding the dermal absorption kinetics of NP9E in humans. Nonetheless, the statistical uncertainties in the estimated dermal absorption rates, both zero-order and first-order, are incorporated into the exposure assessment and risk characterization.

The upper limit of general worker exposure scenarios approach, but don't exceed, a level of concern (HQ = 0.7). The simple verbal interpretation of this quantitative characterization of risk is that under the most conservative set of exposure assumptions, workers should not be exposed to levels of NP9E that are regarded as unacceptable.

NP9E can cause irritation and damage to the skin and eyes. Quantitative risk assessments for irritation are not derived; however, from a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling NP9E. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of NP9E.

General Public –Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard indices are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to NP9E.

For the acute/accidental scenarios, exposure resulting from the consumption of contaminated water from a spill is of greatest concern. Exposure resulting from the consumption of contaminated vegetation is of somewhat less concern. None of the other acute exposure scenarios represent a risk of effects to the public from NP9E exposure.

Acute or accidental exposure scenarios involving consumption of contaminated water or consumption of contaminated vegetation represent some risk of effects. None of the other acute exposure scenarios represent a risk of effects to the public from NP9E exposure. At typical rates of application, the drinking of contaminated water after a spill (HQ = 4.6) approaches the level that could present a risk of subclinical effects to the liver and kidney (HQ values between 5 and 10). The upper HQ of 6.8 represents an increasing risk of clinical effects to the kidney, liver, and other organ systems. The exposure scenario for the consumption of contaminated water is an arbitrary scenario: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of NP9E, all of the hazard quotients would be a factor of 10 less. This scenario involving water contamination assumes that a small pond is affected, rather than a creek or river as would be more likely in this forested setting. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are substantially below one

At high application rates only (HQ = 3.7) the short-term consumption of fruit also approaches the level that could present a risk of subclinical effects to the liver and kidney (HQ values between 5 and 10). At the typical rate of application, the HQ is less than one. Signing and the presence of dye on vegetation would reduce the potential of freshly sprayed material to be consumed.

The public exposure scenario involving the consumption of fruit, both short-term (above) and long-term, most closely proxies the use of native material by basketweavers. The highest estimated HQ value for the long-term exposure scenario is 0.7. Plant materials in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable and very unlikely to be selected for basketweaving, medicine or food (Segawa, R., et al, 2001), reducing the likelihood of additive doses.

Table D-7f-1. Summary of Risk Characterization for Workers – Nonylphenol Polyethoxylate

RfD = 0.10 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.12	0.0048	0.7
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	0.0017	0.0006240	0.0044
Contaminated Gloves - 1 Hour	0.1	0.0374400	0.26
Spill on Hands - 1 Hour	0.0005	0.0000768	0.0069
Spill on Lower Legs - 1 Hour	0.0013	0.0001893	0.017

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Table D-7f-2. Summary of Risk Characterization for the Public – Nonylphenol Polyethoxylate

RfD = 0.10 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	0.02	0.0029	0.26
Direct Spray, Lower Legs, Woman	0.002	0.00029	0.026
Dermal Exposure, Contaminated Vegetation	0.004	0.00035	0.048

Contaminated Fruit	0.24	0.16	3.7
Contaminated Water, Spill	4.6	2.8	6.8
Contaminated Water, Stream	0.009	0.001	0.035
Consumption of Fish, General Public	0.14	0.14	0.14
Consumption of Fish, Subsistence Populations	0.67	0.67	0.67
Chronic/Longer Term Exposures			
Contaminated Fruit	0.004	0.0025	0.06
Consumption of Water	0.002	0	0.005
Consumption of Fish, General Public	1 E-5	0	2 E-5
Consumption of Fish, Subsistence Population	8 E-5	0	0.00016

As indicated in Section 2, all of these risk characterizations are based on the typical or average 2.5 ppm concentration of hexachlorobenzene in technical grade clopyralid. This is the upper range of hexachlorobenzene that may be expected in technical grade clopyralid and thus the actual risks are probably much lower than those given in these tables.

While there are substantial uncertainties involved in any cancer risk assessment, the verbal interpretation of the numeric risk characterization derived in this risk assessment is relatively simple. Using the assumptions and methods typically applied in Forest Service risk assessments, there is no plausible basis for asserting that the contamination of clopyralid with pentachlorobenzene or hexachlorobenzene will result in any substantial risk of cancer in workers applying clopyralid under normal circumstances.

The above discussion is not to suggest that general exposures to hexachlorobenzene – i.e., those associated with normal background exposures that are not related to Forest Service applications of clopyralid – are acceptable. At background exposure levels of about 1×10^{-6} mg/kg/day, the background risk associated with exposure to hexachlorobenzene would be 0.0000016 or about 1 in 625,000.

General Public –As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on the short-term MRL of 0.008 mg/kg/day and the hazard quotients for chronic exposures are based on the U.S. EPA RfD of 0.0008 mg/kg/day.

All exposure scenarios result in hazard quotients that are below unity **-** i.e., the level of exposure is below the RfD for chronic exposures and below the MRL for acute exposures. In addition, all of the acute exposure scenarios result in hazard quotients that are substantially below the corresponding hazard quotient for clopyralid. The highest acute hazard quotient for hexachlorobenzene is about 0.006, the upper range of the hazard quotient associated with the consumption of contaminated fish by subsistence populations. The consumption of fish contaminated with hexachlorobenzene is a primary exposure scenario of concern because of the tendency of hexachlorobenzene to bio-concentrate from water into fish. For chronic exposures, the highest chronic HQ is about 0.00002, the upper range of the hazard quotient associated with the consumption of fish by subsistence populations. This is also consistent with the general observation that exposure to hexachlorobenzene occurs primarily through the consumption of contaminated food.

As with worker exposures, none of the hazard quotients for cancer risk levels of 1 in 1-million exceed unity. As indicated in Table D-6g, the highest longer-term exposure rate associated with Forest Service programs is 1.45×10^{-8} mg/kg/day – i.e., the upper range of exposure for the consumption of contaminated fish by subsistence populations. This is below the typical background exposure by a factor of about 70.

No explicit dose response assessment is made for the potential carcinogenic effects of pentachlorobenzene, another impurity in clopyralid. Based on the comparison of apparent toxic potencies and the relative amounts of both hexachlorobenzene and pentachlorobenzene in clopyralid, a case could be made for suggesting that pentachlorobenzene may double the cancer risk over that associated with hexachlorobenzene. Given the extremely low levels of estimated cancer risk, this has essentially no impact on the risk characterization.

The simple verbal interpretation of this risk characterization is that, in general, the contamination of clopyralid with hexachlorobenzene and pentachlorobenzene does not appear to pose a risk to the general public. This is consistent with the conclusions reached by the U.S. EPA (1995a, as referenced in SERA, 1999).

As indicated in Section 2, all of these risk characterizations are based on the typical or average 2.5 ppm concentration of hexachlorobenzene in technical grade clopyralid. This is the upper range of hexachlorobenzene that may be expected in technical grade clopyralid and thus the actual risks are probably much lower than those given in these tables

Table D-7g-1. Summary of Risk Characterization for Workers – Hexachlorobenzene

Chronic RfD = 0.0008 mg/kg/day Acute MRL = 0.008 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
General Exposures			
Backpack Application	5 E-6	1 E-7	2 E-5
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	6E-05	2 E-5	2E-04
Contaminated Gloves - 1 Hour	4E-03	1E-03	1E-02
Spill on Hands - 1 Hour	8E-07	2 E-7	3E-06
Spill on Lower Legs - 1 Hour	2E-06	4 E-7	8E-06

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Table D-7g-2. Summary of Risk Characterization for the Public – Hexachlorobenzene

Chronic RfD = 0.0008 mg/kg/day Acute MRL = 0.008 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	3E-05	6E-06	1E-04
Direct Spray, Lower Legs, Woman	3E-06	6E-07	1E-05
Dermal Exposure, Contaminated Vegetation	9E-07	9E-08	2E-06
Contaminated Fruit	2E-06	7E-07	1E-05
Contaminated Water, Spill	2E-05	1E-05	3E-05
Contaminated Water, Stream	5E-07	1E-09	3E-06
Consumption of Fish, General Public	1E-03	1E-03	1E-03
Consumption of Fish, Subsistence Populations	6E-03	6E-03	6E-03
Chronic/Longer Term Exposures			
Contaminated Fruit	6E-07	6E-08	6E-06
Consumption of Water	1E-08	2E-10	3E-08
Consumption of Fish, General Public	1E-06	3E-08	2E-06
Consumption of Fish, Subsistence Population	9E-06	2E-07	2E-05

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Table D-7g-3. Summary of Cancer Risk Assessment for Workers – Hexachlorobenzene – Relative to Risk Level of 1 in 1 Million

Adjusted Cancer Potency Parameter = 6.26 E-5 $(mg/kg/day)^{-1}$			
Scenario	Cancer Risk Divided by 1 in 1 Million		
	Typical	Lower	Upper

General Exposures			
Backpack Application	6E-03	1E-04	3E-02

Table D-7g-4. Summary of Cancer Risk Assessment for Public – Hexachlorobenzene Relative to Risk Level of 1 in 1 Million

Adjusted Cancer Potency Parameter = 6.25 E-7 $(mg/kg/day)^{-1}$			
Scenario	Cancer Risk Divided by 1 in 1 million		
	Typical	Lower	Upper
Chronic/Longer Term Exposures			
Contaminated Fruit	8E-04	8E-05	7E-03
Consumption of Water	1E-05	2E-07	3E-05
Consumption of Fish, General Public	1E-03	3E-05	3E-03
Consumption of Fish, Subsistence Population	1E-02	3E-04	2E-02

Cumulative Effects

The proposed use of herbicides could result in cumulative doses of herbicides to workers or the general public. Cumulative doses to the same herbicide result from (1) additive doses resulting from various routes of exposure from this project and (2) additive doses if an individual is exposed to other herbicide treatments.

Additional sources of exposure include: use of herbicides on adjacent private lands, use of herbicides on adjacent National Forest System lands, or home use by a worker or member of the general public. Reported past use of glyphosate, hexazinone, chlorsulfuron, triclopyr, and clopyralid (1999-2006) in El Dorado County is displayed in Table D-8, below, by total use and Forestland use. Hexazinone is used primarily for forestland. Glyphosate is primarily used in forestland (41%), other crops, right-of-way, and landscape maintenance. Chlorsulfuron is primarily used in right-of-way and landscape maintenance. Triclopyr is primarily used in forestland (28%), right-of-way, and landscape maintenance. Clopyralid is primarily used for forestland (14%), rangeland, landscape maintenance, and right-of-way. We assume that there would not be any extensive changes in these use patterns into the near future.

Table D-8 Reported Herbicide Use (lbs active ingredient) in El Dorado County (1999-2006)

	Forestland Total								
Chemical	1999	2000	2001	2002	2003	2004	2005	2006	Total
Chlorsulfuron	0	0	0	0	0	0	0	0	0
Glyphosate	7,881	5,324	7,231	3,709	3,183	2,561	6,471	6,271	42,631
Clopyralid	51	0	89	88	14	51	24	18	335
Hexazinone	3,081	2,569	3,778	3,554	1,772	5,549	1,474	4,895	26,672
Triclopyr	541	770	633	978	69	67	532	50	3,640
	All Reported Uses								
Chemical	1999	2000	2001	2002	2003	2004	2005	2006	Total
Chlorsulfuron	3	3	4	7	3	8	23	46	97
Glyphosate	13,054	9,482	11,113	9,596	10,640	14,927	15,508	19,921	104,241
Clopyralid	178	103	376	400	468	222	224	372	2,343
Hexazinone	3,154	2,695	3,826	3,559	1,559	5,673	1,523	4,935	26,924
Triclopyr	1,336	1,504	1,521	1,904	2,101	1,076	1,900	1,438	12,780

Source - California Department of Pesticide Regulation, Annual (1999-2004) Pesticide Use Reports for El Dorado County, accessed on line at http://www.cdpr.ca.gov/docs/pur/purmain.htm on August 30, 2006(updated7/31/2008).

Additional sources of exposure on National Forest Lands – Past use on the Eldorado National Forest (1999-2005) of glyphosate, hexazinone, triclopyr, and clopyralid are displayed in Table D-9, below. Chlorsulfuron hasn't been used on the Eldorado National Forest. R-11 surfactant is assumed to have been used in all glyphosate and clopyralid applications. There is the potential for exposure from projects on the Eldorado National Forest involving the herbicides proposed for use on this project. They include the Yellow Starthistle Control Project (clopyralid and glyphosate), Spotted Knapweed Control Project (glyphosate), PG and E/SMUD Transmission line (clopyralid), Star Fire Reforestation Project (glyphosate), 2004 Vegetation Management in Conifer Plantations (glyphosate, clopyralid, and hexazinone) and Bosworth Forest Health project (glyphosate and triclopyr). This project would add an estimated maximum of 33,000 lbs (AI) of glyphosate, 280 lbs (AI) of hexazinone and 25 lbs (AI) of clopyralid, 240 lbs (AI) triclopyr, and < 1 lb. of chlorsulfuron over the life of the project. We assume that there would not be any extensive changes in these use patterns into the near future, with the following exception. Use of glyphosate and triclopyr on NFS land may increase over 1999-2005 levels for due to its possible use for reforestation on the Power Fire and the Big Grizzly Fuel Reduction Project.

Table D-9 – Herbicide Use (lbs active ingredient) Eldorado National Forest (1999-2005)

Year	Clopyralid	Glyphosate	Triclopyr	Hexazinone
1999	0	8,017	0	122
2000	0	3,315	395	180
2001	1	2,979	0	0
2002	46	940	612	0
2003	11	770	31	0
2004	27	4,978	0	0
2005	13	2,370	27	0

Eldorado National Forest includes portions of Alpine, Amador, El Dorado, and Placer Counties.

It is conceivable that workers or members of the public could be exposed to herbicides as a result of treatments on surrounding private forestlands or treatments on National Forest System Lands. Glyphosate and hexazinone have been used on Sierra Pacific Industries land (Barr, 2009). Where individuals could be exposed by more than one route, the risk of such cases can be quantitatively characterized by adding the hazard quotients for each exposure scenario. For example, using glyphosate as an example, the typical levels of exposure for a woman being directly sprayed on the lower legs, staying in contact with contaminated vegetation, eating contaminated fruit, and consuming contaminated fish leads to a combined hazard quotient of 0.04. Similarly, for all of the chronic glyphosate exposure scenarios, the addition of all possible pathways lead to hazard quotients that are substantially less than one. Similar scenarios can be developed with the other herbicides. This risk assessment specifically considers the effect of repeated exposure in that the chronic RfD is used as an index of acceptable exposure. Consequently, repeated exposure to levels below the toxic threshold should not be associated with cumulative toxic effects.

Since these herbicides persist in the environment for a relatively short time (generally less than 1 year), do not bio-accumulate, and are rapidly eliminated from the body, additive doses from re-treatments in subsequent years are not anticipated. According to recent work completed by the California Department of Pesticide Regulation, some plant material contained hexazinone residues for up to 2.5 years after treatment, triclopyr residues up to 1.5 years after treatment, and glyphosate up to 66 weeks after treatment; however, these levels were less than 1 part per million (Segawa et al. 2001). Since repeat treatments in this project are at one or more years into the future, it is likely that any residue from an application would be substantially degraded between applications. It is possible that residues from the initial herbicide application could still be detectable during subsequent re-treatments, but these plants would represent a low risk to humans as they would show obvious signs of herbicide effects as so would be undesirable for collection.

The information in Table D-8 indicates that these herbicides are also used outside of forestlands in El Dorado County. In order to consider the cumulative effects of these other uses, U.S. EPA has developed the theoretical maximum residue contribution (TMRC). The TMRC is an estimate of maximum daily exposure to chemical residues that a member of the general public could be exposed to from all published and pending uses of a pesticide on a food crop. Adding the TMRC to this project's dose estimate can be used as an estimate of the cumulative effects of this project with theoretical background exposure levels of these herbicides. The result of doing this doesn't increase the HQ values appreciably.

Herbicide	TMRC (mg/kg/day)	% of RfD	Data Source
Chlorsulfuron	0.00386	19.3	US EPA 2002f
Clopyralid	0.00903	6.0	US EPA 1999
Glyphosate	0.02996	1.5	US EPA 2000a
Hexazinone	0.0035	7.0	US EPA 1994
Triclopyr	0.00105	2.1	US EPA 2002a

Cumulative effects can be caused by the interaction of different chemicals with a common metabolite or a common toxic action. With the exception of triclopyr and chlorpyrifos discussed below, none of the other herbicides have been demonstrated to share a common metabolite with other pesticides. Although concern has been expressed about a possible link between the toxic effects of other triazine herbicides, such as atrazine, and the herbicide hexazinone, no studies on hexazinone have supported such a link. These two herbicides, while having some commonality in chemical structure, are dissimilar enough chemically that common toxic action is not expected.

As previously stated, the primary metabolite of triclopyr is TCP. TCP is also the primary metabolite of an insecticide called chlorpyrifos. U.S. EPA (1998, 2002a) considered exposures to TCP from both triclopyr and chlorpyrifos in their general dietary and drinking water exposure assessments. In the RED on triclopyr (U.S. EPA 1998) the provisional chronic RfD for TCP is 0.03 mg/kg/day, about the same as the 0.05 mg/kg/day for triclopyr. For acute exposures in this risk assessment, the corresponding values are 1 mg/kg/day for triclopyr and 0.25 mg/kg/day for TCP. The U.S. EPA estimated dietary exposures at the upper 99.5% level for a young woman – i.e., the most sensitive population in terms of potential reproductive effects, the endpoint of greatest concern for triclopyr. The upper range of acute exposure to triclopyr was estimated at 0.012 mg/kg/day and the upper range of exposure to chlorpyrifos was estimated at 0.016 mg/kg/day. Thus, making the assumption that both triclopyr and chlorpyrifos are totally converted to TCP, the total exposure is about 0.028 mg/kg/day, a factor of 8.9 below the level of concern. For chronic exposures, the U.S. EPA based the risk assessment on infants – i.e., individuals at the start of a lifetime exposure. The dietary analysis indicated that the total exposure expressed as a fraction of the RfD was 0.044 for TCP from triclopyr and 0.091 for TCP from chlorpyrifos for a total of 0.135 or a factor of about 7.4 below the level of concern [1÷0.135 = 7.4]. Based on this assessment, the U.S. EPA (1998) concluded that:

> *...the existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic dietary risks from TCP. Based on limited available data and modeling estimates, with less certainty, the Agency concludes that existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic drinking water risks from TCP. Acute and chronic aggregate risks of concern are also unlikely to result from existing uses of triclopyr and chlorpyrifos.* – U.S. EPA (1998, p. 34).

This conclusion, however, is based primarily on the agricultural uses of triclopyr – i.e., estimated dietary residues – and does not specifically address potential exposures from forestry applications. In forestry applications, the primary concern would be the formation of TCP as a soil metabolite. TCP is more persistent than triclopyr in soil and TCP is relatively mobile in soil (U.S. EPA 1998) and could contaminate bodies of water near the site of application. In order to assess the potential risks of TCP formed from the use of triclopyr, the TCP metabolite was modeled in the SERA risk assessment (SERA 2003b) along with triclopyr. The results for TCP are summarized in SERA (2003b) Table 3-10 for a small stream and Table 3-11 for a small pond.

There is very little monitoring data with which to assess the plausibility of the modeling for TCP. As discussed by U.S. EPA (1998, p. 65), TCP is seldom detected in surface water after applications of triclopyr that result in triclopyr concentrations of up to about 25µg/L, with a limit of detection (LOD) for TCP of 10 µg/L. Thompson et al. (1991, as referenced in SERA 2003b) examined the formation of TCP from triclopyr in a forest stream. Consistent with the results reported by U.S. EPA, these investigators failed to detect TCP (LOD=50 µg/L) in stream water with concentrations of triclopyr up to 140 µg/L. This is at least consistent with the GLEAMS modeling of both triclopyr and TCP. As indicated in SERA (2003b), the maximum modeled concentrations of triclopyr in stream water range from about 161 to 428 µg/L (for sandy and clay soils respectively) and the corresponding maximum modeled concentration of TCP in stream water range from about 5 to 11 µg/L. Thus, given the LOD of 50 µg/L in the study by Thompson et al. (1991, as referenced in SERA 2003b), the failure to find TCP in stream water is consistent with the GLEAMS modeling.

While triclopyr and chlorpyrifos would not be commonly applied together in forestry applications, at least one formulation of chlorpyrifos, Nufos 4E, is labeled for forestry applications and may be applied at a rate of 1 lb/acre for the control of insect pests in tree nurseries and plantations. In order to assess potential exposures to TCP from the application of both triclopyr and chlorpyrifos at the same site, GLEAMS was used to model the application of chlorpyrifos at 1 lb per acre under the same conditions used for triclopyr (SERA 2003b). It should be noted that the maximum concentrations for TCP in water do not necessarily reflect simultaneous application of triclopyr and chlorpyrifos. Because triclopyr and chlorpyrifos degrade at different rates, maximum concentration in soil, and hence maximum runoff to water, will occur at different times. Thus, in order to provide the most conservative estimate of exposure to TCP, the maximum concentrations reflect applications of triclopyr and chlorpyrifos spaced in such a way as to result in the maximum possible concentrations of TCP in water. As modeled, concentrations of TCP in a small stream could reach up to 11 ppb from the use of triclopyr at a rate of 1 lb/acre and up to 68 ppb in a small stream from the use of triclopyr at a rate of 1 lb/acre and chlorpyrifos at a rate of 1 lb/acre.

The current RfD for TCP used by U.S. EPA (2002a) is 0.012 mg/kg/day for chronic exposure and 0.025 mg/kg/day for acute exposure. The child is the most exposed individual, consuming 1L of water per day at a body weight of 10 kg. Thus, based on the chronic RfD of 0.012 mg/kg/day, the associated concentration in water would be 0.12 mg/L or ppm [0.012 mg/kg/day × 10 kg/1 L/day] which is in turn equivalent to 120 ppb. Since the peak exposure to TCP in water is below the concentration associated with the chronic RfD, there is no basis for asserting that the use of triclopyr with or without the use of chlorpyrifos will result in hazardous exposures of humans to TCP.

Recent studies have shown drift of chlorpyrifos, and other insecticides, from agricultural lands in the Sacramento/San Joaquin Valley to the Sierra Nevada range (McConnell et al. 1998). In El Dorado County, chlorpyrifos use in 2004 totaled 181 pounds, primarily used in wine grapes, landscape maintenance, and structural pest control. Levels of chlorpyrifos have been measured in watercourses in the Sierra Nevada as high as 13 ng/L (0.013 µg/L or ppb). These upper levels have been measured in the southern Sierra. As a comparison, the use of chlorpyrifos in Fresno County was over 291,000 pounds, 1,600 times higher in 2004 than El Dorado County. This would indicate that it is unlikely that such high aquatic levels of chlorpyrifos would be found in the Eldorado National Forest area as a result of atmospheric movement. Assuming that 100% of measured chlorpyrifos would degrade to TCP (an over-exaggeration of the rate of degradation), this would add 0.013 ppb of TCP. If this amount is added to the modeled peak exposure of 68 ppb, it would not result in any appreciable increase in risk

Estrogenic effects (a common toxic action) can be caused by additive amounts of NP, NPE, and their breakdown products. In other words, an effect could arise from the additive dose of a number of different xenoestrogens, none of which individually have high enough concentrations to cause effects (USDA 2003a). This can also extend out to other xenoestrogens that biologically react the same. Additive effects, rather than synergistic effects, are expected from combinations of these various estrogenic substances.

Other sources of exposure to NP and NPEs include personal care products (skin moisturizers, makeup, deodorants, perfumes, spermicides), detergents and soaps, foods, and from the environment away from the forest herbicide application site. In Environment Canada 2001 (as referenced in USDA, 2003a), the authors made estimates of these background exposures assuming a 100 percent dermal absorption rat of NP and NPs. This assumption was based on the inadequacy of the one *in vitro* study of absorption in human skin that showed absorption rates below 1%. Based on a review of the literature on surfactants and absorption (USDA, 2002) it would appear that a 100% figure is extremely conservative. The use of a 1% absorption rate would appear to be a realistic figure; the 100% figure should be considered a worst-case figure.

Contributions from the air, water, soil, and food of NP and NPEs in adult Canadians was estimated at 0.034 mg/kg/day (Environment Canada 2001, as referenced in USDA, 2003a). The contribution of NP and NPEs from the exposure to skin moisturizers, makeup, deodorant, fragrances, detergents, cleaners, paints, and spermicides are also estimated in Environment Canada (2001, as referenced in USDA, 2003a).). Both of these exposure sources are based on very small sample sizes and should be considered worst-case. Using the skin absorption figure of 100%, and the highest concentration estimates, these products contribute up to 27.0 mg/kg/day, assuming each is used every day. If a 1% dermal absorption figure is used, this total would be 0.27 mg/kg/day. In another study from Europe, the daily human exposure to NP is estimated at 0.002 mg/kg/day (2 μg/kg/day) as a worst-case assumption (note that this estimate does not include the ethoxylates) (Bolt 2001, as referenced in USDA, 2003b).

In addition to xenoestrogens, humans are exposed to various phytoestrogens, which are hormone-mimicking substances naturally present in plants. In all, more than 300 species of plants in more than 16 families are known to contain estrogenic substances, including beets, soybeans, rye grass, wheat, alfalfa, clover, apples, and cherries. Background exposures of Europeans to natural phytoestrogens (isoflavones (daidzein, genistein) and lignans), mainly from soybeans and flaxseed, is estimated at 4.5-8 mg/kg body weight for infants on soy-based formulae, and up to 1 mg/kg body weight for adults (USDA, 2003a). In East Asian populations where soy-based foods are more commonly consumed, estimates of intake of phytoestrogens are in the range of 50-100 mg/kg/day (*ibid*). Some might consider that the contribution from these natural phytoestrogens should be disregarded, as the human species has adapted over time to daily exposures to such compounds. However, at a biochemical level, these phytoestrogens can react similarly to the estrogenic xenoestrogens, such as NP.

From Section 2, based on the studies by Chapin et al. and Nagao et al., the lowest reproductive NOAEL for NP is 10 mg/kg/day from these studies in rats. Assuming a 100X safety factor to convert to a human reproductive NOAEL would result in a value of 0.10 mg/kg/day. Adding together the contributions from the worst-case background environment and consumer products, as described in Environment Canada 2001, there would be a background dose to a female worker of 27.034 mg/kg/day (assuming 100% dermal absorption) or 0.304 mg/kg/day (assuming 1% dermal absorption). Using a derived NP human NOEL of 0.10 mg/kg/day (as described in USDA, 2003b) these exposure estimates result in hazard quotients of 270 to 3. In terms of this risk assessment, the non-acute contribution of NP9E (backpack workers exposure ranged from 0.01 to 0.07 mg/kg/day) would contribute up to 0.7 to any hazard quotient. At typical application rates, the worker exposure would add 0.1 to the HQ. For the public chronic exposures at the upper range of application, the doses of NP9E would add 0.00002 to 0.06 to any HQ. These may be negligible depending upon the background exposures, lifestyles, absorption rates, and other potential chemical exposures that are used to determine overall risk to environmental xenoestrogens.

Inert Ingredients, Additives, Synergistic Effects, and Sensitive Individuals

Inert Ingredients

The issue concerning inert ingredients, additives, and the toxicity of formulations is discussed in USDA 1989 (pages 4-116 to 4-119). The approach used in USDA, 1989, the SERA Risk Assessments, and this site-specific analysis to assess the human health effects of inert ingredients and full formulations has been to: (1) compare acute toxicity data between the formulated products (including inert ingredients) and their active ingredients alone; (2) disclose whether or not the formulated products have undergone chronic toxicity testing; and (3) identify, with the help of EPA and the chemical companies, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients.

Researchers have studied the relationships between acute and chronic toxicity and while the biological end-points are different, relationships do exist and acute toxicity data can be used to give an indication of overall toxicity (Zeise, et al., 1984). The court in NCAP v. Lyng, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decisionmaker to make a reasoned decision. In SRCC v. Robertson, Civ.No. S-91-217 (E.D. Cal., June 12, 1992), and again in CATS v. Dombeck, Civ. S-00-2016 (E.D. Cal., Aug 31, 2001), the district court upheld the adequacy of the methodology used in USDA 1989 for disclosure of inert ingredients and additives.

The EPA has categorized approximately 1200 inert ingredients into four lists. Lists 1 and 2 contain inert ingredients of toxicological concern (USDA 1989, 4-116). List 3 includes substances for which EPA has insufficient information to classify as either hazardous (List 1 and 2) or non-toxic (List 4). List 4 contains non-toxic substances such as corn oil, honey and water. Use of formulations containing inert ingredients on List 3 and 4 is preferred on vegetation management projects under current Forest Service policy.

Since most information about inert ingredients is classified as "Confidential Business Information" the Forest Service asked EPA to review thirteen herbicides for the preparation of USDA, 1989 (includes glyphosate, triclopyr, and hexazinone) and the commercial formulations and advise if they contain inert ingredients of toxicological concern (Inerts List 1 or 2)(USDA, 1989, Appendix F, Attachment B). The U.S. EPA determined that there were no inerts on List 1 or 2, with the exception of kerosene in certain formulations triclopyr. Kerosene has since been moved to List 3. In addition, the CBI files were reviewed in the development of most of the SERA risk assessments. Information has also been received from the companies who produce the herbicides and spray additives.

Butoxyethanol (or EGBE) has been assessed for human health risk as an impurity in the Garlon 4 formulation of triclopyr (Borrecco and Neisess, 1991). In that risk assessment, the addition of butoxyethanol did not substantially increase the risk to human health over the risk of using the active ingredient of triclopyr. The amount of butoxyethanol in Garlon 4 is listed as 0.3% in that assessment.

Comparison of acute toxicity (LD_{50} values) data between the formulated products (including inert ingredients) and their active ingredients alone shows that the formulated products are generally less toxic than their active ingredients (USDA 1989, USDA, 1984, SERA risk assessments).

While these formulated products have not undergone chronic toxicity testing like their active ingredients, the acute toxicity comparisons, the EPA review, and our examination of toxicity information on the inert ingredients in each product leads us to conclude that the inert ingredients in these formulations do not significantly increase the risk to human health and safety over the risks identified for the active ingredients.

Adjuvants

The use of the NPE-based surfactants (such as R-11) is analyzed in this risk assessment, and its use under typical conditions should result in acceptable levels of risk to workers and the public. As with the herbicides, eye and skin irritation may be the only manifestations of exposure seen in the absence of spills and accidents. The exposure to ethylene oxide as a contaminant of NPE-based surfactants should also be at acceptable levels of risk.

Colorfast® Purple Colorant (SERA, 1997b)

The active ingredients in Colorfast Purple are acetic acid, dipropylene glycol, and Basic Violet 3. The exact amounts of the ingredients in this product are considered proprietary. Acetic acid, a major component of vinegar, is on the EPA's list 4A of inerts. Dipropylene glycol is on EPA's list 3 of inerts. None of the ingredients in this product are known to be on EPA List 1 or 2. Basic Violet 3 dye is the colorant in Colorfast Purple. Most of the information about its toxicological effects are attributed to the chloride salt, commonly referred to as Gentian Violet. Gentian Violet is used as an antifungal agent, a treatment for oral infections, and as laboratory reagent and stain (SERA, 1997b). Based on the MSDS no toxic chemicals are present that are subject to the reporting requirement of the Emergency Planning and Community Right-to-Know Act (EPCRA, also referred to as SARA Title III) and 40 CFR 372 (Toxic Chemical Release Reporting: Community Right-to-Know). In a Study by Littlefield et al (in SERA, 1997b) marked carcinogenic activity was observed in mice, and is the basis for a qualitative cancer risk assessment in SERA (1997b). Based on SERA, 1997b, risk characterization leads to typical cancer risks for workers of 4.7×10^{-7} or 1 in 2.1 million. For the public, the consumption of sprayed berries yielded an estimated single exposure risk of 1 in 37 million to 1 in 294 million. For public exposures, it is expected that the dye would reduce exposures both to itself and to the other chemicals it might be mixed with (herbicide and other adjuvants) as the public would be alerted to the presence of treated vegetation.

Hi-Light® Blue (USDA, 2007)

Hi-Light® Blue dye is not required to be registered as a pesticide; therefore it has no signal word associated with it. It is mildly irritating to the skin and eyes. It would likely be considered a Category III or IV material and have a Caution signal word if it carried one.

Hi-Light® Blue is a water-soluble dye that contains no listed hazardous substances. It is considered to be virtually non-toxic to humans. The dye used in Hi-Light® Blue is commonly used in toilet bowl cleaners and as a colorant for lakes and ponds (SERA 1997b).

MSO and Silicone/MSO blend surfactant (USDA, 2007)

Surfactants consisting of vegetable oil and a blend of silicone-based surfactant and vegetable oil are proposed for use A brief discussion of silicone-based and oil-based surfactants is below. An analysis of the ingredients in these adjuvants did not identify any of specific toxic concern with the exception of the ingredients discussed in this risk assessment (ibid). None were on U.S. EPA Inerts Lists 1 or 2.

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

Silicone-Based Surfactants

Also known as organosilicones, these are increasing in popularity because of their superior spreading ability. This class contains a polysiloxane chain. Some of these are a blend of non-ionic surfactants (NIS) and silicone while others are entirely silicone. The combination of NIS and a silicone surfactant can increase absorption into a plant so that the time between application and rainfall can be shortened. This is known as rainfastness. The surfactants extreme spreading ability may lead to droplet coalescence and subsequent runoff if applied at inappropriately high rates.

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

Vegetable Oils

The methylated seed oils are formed from common seed oils, such as canola, soybean, or cotton. They act to increase penetration of the herbicide. These are comparable in performance to crop oil concentrates. In addition, silicone-seed oil blends are also available that take advantage of the spreading ability of the silicones and the penetrating characteristics of the seed oils.

The U.S. Food and Drug Administration (FDA) considers methyl and ethyl esters of fatty acids produced from edible fats and oils to be food grade additives (CFR 172.225). Because of the lack of exact ingredient statements on these surfactants, it is not always clear whether the oils that are used in them meet the U.S. FDA standard.

Synergistic Effects

Synergistic effects (multiplicative) are those effects resulting from exposure to a combination of two or more chemicals that are greater than the sum of the effects of each chemical alone (additive). See pages 4-111 through 4-114 in USDA 1989, for a detailed discussion on synergistic effects.

Instances of chemical combinations that cause synergistic effects are relatively rare at environmental exposure levels. Reviews of the scientific literature on toxicological effects and toxicological interactions of agricultural chemicals indicate that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects (US EPA 2000c; ATSDR 2004; Kociba and Mullison 1985). The literature review by ATSDR (2004) cited several studies that found no synergistic effects for mixtures of four, eight, and nine chemicals at low (sub-toxic) doses. In assessing health risk associated with drinking water, Crouch et al. (1983) reach a similar conclusion when they stated:

> "...in most cases we are concerned with small doses of one pollutant added to a sea of many pollutants. For those small doses a multiplicative effect is not expected."

EPA (1986) concludes:

> "There seems to be a consensus that for public health concerns regarding causative (toxic) agents, the additive model is more appropriate than any multiplicative model."

Synergism generally has not been observed in toxicological tests involving combinations of commercial pesticides. The herbicide and additives proposed for this project have not shown synergistic effects in humans who have used them extensively in forestry and other agricultural applications. However, synergistic toxic effects of herbicide combinations, combinations of the herbicides with other pesticides such as insecticides or fertilizers, or combinations with naturally occurring chemicals in the environment are not normally studied. Based on the limited data available on pesticide combinations involving these herbicides, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis.

It is not anticipated that synergistic effects would be seen with the herbicides and the adjuvants that might be added to them. Based on a review of several recent studies, there is no demonstrated synergistic relationship between herbicides and surfactants (Abdelghani et al 1997; Henry et al 1994; Lewis 1992; Oakes and Pollak 1999, 2000 as referenced in USDA 2002). Synergistic effects are not expected from multiple exposures to NP, NPEs, and their breakdown products (Payne et al 2000, Environment Canada 2001, as referenced in USDA 2003b).

However, even if synergistic or additive effects were to occur as a result of the proposed treatment, these effects are dose responsive (Dost 1991). This means that exposures to the herbicide plus any other chemical must be significant for these types of effects to be of a biological consequence. As Dost explains:

> "While there is little specific published study of forestry herbicides in this particular regard, there is a large body of research on medical drugs, from which principles arise that govern such interactions. Amplifications of effect are not massive; one chemical cannot change the impact of another by hundreds or thousands of times. Rarely will such change be more than a few fold. This difference can be dangerous when dealing with drugs that are already at levels intended to significantly alter bodily functions, but is insignificant when both compounds are at the very low levels of exposure to be found associated with an herbicide treatment."

Based on the very low exposure rates estimated for this alternative, synergistic or additive effects, if any, are expected to be insignificant.

Although the combination of surfactant and herbicide might indicate an increased rate of absorption through the skin, a review of recent studies indicates this is not often true (Ashton et al 1986; Boman et al 1989; Chowan and Pritchard 1978; Dalvi and Zatz 1981; Eagle et al 1992; Sarpotdar and Zatz 1986; Walters et al 1993, 1998; Whitworth and Carter 1969 as referenced in USDA 2002). For a surfactant to increase the absorption of another compound, the surfactant must affect the upper layer of the skin. Without some physical effect to the skin, there will be no change in absorption as compared to the other compound alone. The studies indicate that in general non-ionic surfactants have less of an effect on the skin, and hence absorption, then anionic or cationic surfactants. Compound specific studies indicate that the alkylphenol ethoxylates generally have little or no effect on absorption of other compounds. In several studies, the addition of a surfactant actually decreased the absorption through the skin. It would appear that there is little support for the contention that the addition of surfactants to herbicide mixtures would increase the absorption through the skin.

<u>Herbicide-Specific Interaction Data</u>

The manufacturers recommend that chlorsulfuron formulations be mixed with a non-ionic surfactant. There is no published literature or information in the US EPA files that would permit an assessment of toxicological effects or risk assessment of chlorsulfuron mixed with a surfactant (SERA, 2004a).

Clopyralid may be applied in combination with other herbicides, particularly in combination with picloram. There are no data in the literature suggesting that clopyralid will interact, either synergistically or antagonistically with this or other compounds (SERA, 1999).

There is very little information available on the interaction of glyphosate with other compounds. The available data do not suggest a synergistic interaction between glyphosate and the POEA surfactant found in some formulations (e.g., Roundup) from plausible routes of exposure (SERA 1996a).

There is very little information available on the interaction of triclopyr with other compounds. The available data do not suggest a synergistic interaction between the triclopyr active ingredient and the other components in the commercial triclopyr formulations of Garlon 4 (SERA 1996b).

There is very little information available on the interaction of hexazinone with other compounds. The available data suggest that hexazinone may be metabolized by and may induce cytochrome P-450 (SERA 1997a). This is a very important enzyme in the metabolism of many endogenous as well as xenobiotic compounds. Thus, it is plausible that the toxicity of hexazinone may be affected by and could affect the toxicity of many other agents. The nature of the potential effect (i.e., synergistic or antagonistic) would depend on the specific compound and perhaps the sequence of exposure.

Sensitive Individuals

The uncertainty factors used in the development of the RfD takes into account much of the variation in human response. The uncertainty factor of 10 for sensitive subgroups is sufficient to ensure that most people will experience no toxic effects. "Sensitive" individuals are those that might respond to a lower dose than average, which includes women and children. The National Academy of Sciences report entitled Pesticides in the Diets of Infants and Children (NAS 1993) found that quantitative differences in toxicity between children and adults are usually less than a factor of approximately 10-fold. An uncertainty factor of 10 may not cover individuals that may be sensitive to herbicides because human susceptibility to toxic substances can vary by two to three orders of magnitude. Factors affecting individual susceptibility include diet, age, heredity, preexisting diseases, and life style. Individual susceptibility to the herbicides proposed in this project cannot be specifically predicted. Unusually sensitive individuals may experience effects even when the HQ is equal or less than 1. Further information concerning risks to sensitive individuals can be found on pages 4-114 through 4-116 in USDA, 1989.

There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of chlorsulfuron. Due to the lack of data in humans, the likely critical effect of chlorsulfuron in humans cannot be identified clearly. In animals the most sensitive effect of chlorsulfuron appears to be weight loss. There is also some evidence that chlorsulfuron may produce alterations in hematological parameters. However, it is unclear if individuals with pre-existing diseases of the hematological system or metabolic disorders would be particularly sensitive to chlorsulfuron exposure. Individuals with any severe disease condition could be considered more sensitive to many toxic agents.

The 1996 Food Quality Protection Act requires that U.S. EPA evaluate an additional 10X safety factor, based on data uncertainty or risks to certain age/sex groupings. U.S. EPA has evaluated chlorsulfuron against this standard and has recommended a 3X additional safety factor be used for the protection of infants and children. This additional 3X safety factor is factored into the acute and chronic RfD's of this risk assessment as it applies to chlorsulfuron.

The likely critical effect of clopyralid in humans cannot be identified clearly (SERA 2004b). Clopyralid can cause decreased body weight, increases in kidney and liver weight, deceased red blood cell counts, as well as hyperplasia in gastric epithelial tissue (*ibid*). These effects, however, are not consistent among species or even between different studies in the same species (*ibid*). Thus, it is unclear if individuals with pre-existing diseases of the kidney, liver, or blood would be particularly sensitive to clopyralid exposures, although individuals with any severe disease condition could be considered more sensitive to many toxic agents. There are no data or case reports on idiosyncratic responses to clopyralid (*ibid*).

No reports were encountered in the glyphosate literature leading to the identification of sensitive subgroups. There is no indication that glyphosate causes sensitization or allergic responses, which does not eliminate the possibility that some individuals might be sensitive to glyphosate as well as many other chemicals (SERA 2003a).

Because triclopyr may impair glomerular filtration, individuals with pre-existing kidney diseases are likely to be at increased risk (SERA 1996b). Because the chronic RfD for triclopyr is based on reproductive effects, women of child-bearing age are an obvious group at increased risk (SERA 2003b). This group is given explicit consideration and is central to the risk characterization.

Because hexazinone was demonstrated to induce fetal resorptions, pregnant women are an obvious group at increased risk (SERA 2005). This group is given explicit consideration and is central to the risk characterization. There are no other reports in the literature suggesting subgroups that may be sensitive to hexazinone exposure. There is no indication that hexazinone causes sensitization or allergic responses (*ibid*).

NP9E can cause increases in kidney and liver weight, and effects to kidney function and structure. Thus, individuals with pre-existing conditions that involve impairments of the kidney or liver may be more sensitive to this compound. There is some indication that sensitive individuals may develop contact allergies. People with a history of skin allergic reactions to soaps and detergents may be especially sensitive to dermal exposures of NP9E-based surfactants.

The potential of NP9E to induce reproductive effects described in section 2 should be considered low. Based on the available dose/duration/severity data, it appears that exposure levels below those associated with the most sensitive effect (i.e., kidney effects) are not likely to be associated with reproductive toxicity. However, as shown in the exposure scenarios, there is the potential for acute exposures to be in the range (considering a 100X safety factor) where effects to the developing fetus may occur, therefore women of child-bearing age could be considered a sensitive population.

Worksheets

All worksheets related to the information noted in this document can be found in the Project Record and are hereby incorporated by reference.

Glossary

Absorption -- The process by which the agent is able to pass through the body membranes and enter the bloodstream. The main routes by which toxic agents are absorbed are the gastrointestinal tract, lungs, and skin.

Acute exposure -- A single exposure or multiple exposures occurring within a short time (24 hours or less).

Additive effect -- A situation in which the combined effects of two chemicals is equal to the sum of the effect of each chemical given alone. The effect most commonly observed when two chemicals are given together is an additive effect.

Adjuvant(s) -- Formulation factors used to enhance the pharmacological or toxic agent effect of the active ingredient.

Adverse-effect level (AEL) -- Signs of toxicity that must be detected by invasive methods, external monitoring devices, or prolonged systematic observations. Symptoms that are not accompanied by grossly observable signs of toxicity. In contrast to Frank-effect level.

Assay -- A kind of test (noun); to test (verb).

Ataxia –inability to coordinate muscle activity; loss of balance

Bioconcentration factor (BCF) -- The concentration of a compound in an aquatic organism divided by the concentration in the ambient water of the organism.

Cancer potency parameter -- A model-dependent measure of cancer potency $(mg/kg/day)^{-1}$ over lifetime exposure. [Often expressed as $a_{q1}{}^{*}$ which is the upper 95% confidence limit of the first dose coefficient (q_1) from the multistage model.]

Carcinogen -- A chemical capable of inducing cancer.

Carrier -- In commercial formulations of insecticides or control agents, a substance added to the formulation to make it easier to handle or apply.

Chronic exposure -- Long-term exposure studies often used to determine the carcinogenic potential of chemicals. These studies are usually performed in rats, mice, or dogs and extend over the average lifetime of the species (for a rat, exposure is 2 years).

Contaminants -- For chemicals, impurities present in a commercial grade chemical. For biological agents, other agents that may be present in a commercial product.

Creatine – An organic acid composed of nitrogen. It supplies the energy required for muscle contraction.

Creatinine – The end product of the metabolism of creatine. It is found in muscle and blood and is excreted in the urine.

Dams – A term used to designate females of some species such as rats.

Degraded -- Broken down or destroyed.

Dermal -- Pertaining to the skin.

Dislodgeable residues – The residue of a chemical or biological agent on foliage as a result of aerial or ground spray applications, which can be removed readily from the foliage by washing, rubbing or having some other form of direct contact with the treated vegetation.

Dose-response assessment -- A description of the relationship between the dose of a chemical and the incidence of occurrence or intensity of an effect. In general, this relationship is plotted by statistical methods. Separate plots are made for experimental data obtained on different species or strains within a species.

Drift -- That portion of a sprayed chemical that is moved by wind off a target site.

Empirical -- Refers to an observed, but not necessarily fully understood, relationship in contrast to a hypothesized or theoretical relationship.

Endogenous – Growing or developing from or on the inside.

Enzymes -- A biological catalyst; a protein, produced by an organism itself, that enables the splitting (as in digestion) or fusion of other chemicals.

Epidemiology study -- A study of a human population or human populations. In toxicology, a study which examines the relationship of exposures to one or more potentially toxic agent to adverse health effects in human populations.

Estrogenic – a substance that induces female hormonal activity.

Exposure assessment -- The process of estimating the extent to which a population will come into contact with a chemical or biological agent.

Extrapolation -- The use of a model to make estimates outside of the observable range.

Formulation -- A commercial preparation of a chemical including any inerts or contaminants.

Frank-effect level (FEL) -- The dose or concentration of a chemical or biological agent that causes gross and immediately observable signs of toxicity.

Gavage -- The placement of a toxic agent directly into the stomach of an animal, using a gastric tube.

Genotoxic -- Causing direct damage to genetic material. Associated with carcinogenicity.

Geometric mean -- The measure of an average value often applied to numbers for which a log normal distribution is assumed.

Gestation -- The period between conception and birth; in humans, the period known as pregnancy.

Half-time or half-life -- For compounds that are eliminated by first-order kinetics, the time required for the concentration of the chemical to decrease by one-half.

Hazard quotient (HQ) -- The ratio of the estimated level of exposure to the RfD or some other index of acceptable exposure.

Hazard identification -- The process of identifying the array of potential effects that an agent may induce in an exposed human population.

Hematological -- Pertaining to the blood.

Hematology -- One or more measurements regarding the state or quality of the blood.

Herbicide -- A chemical used to control, suppress, or kill plants, or to severely interrupt their normal growth processes.

Histopathology -- Signs of tissue damage that can be observed only by microscopic examination.

Humoral – of, or related to, elements in the blood.

Hydrolysis -- Decomposition or alteration of a chemical substance by water.

Hydroxylation -- The addition of a hydrogen-oxygen or hydroxy (-OH) group to one of the rings. Hydroxylation increases the water solubility of aromatic compounds. Particularly when followed by conjugation with other water-soluble compounds in the body, such as sugars or amino acids, hydroxylation greatly facilitates the elimination of the compound in the urine or bile.

Hyperplasia – An abnormal increase in the number of cells composing a tissue or organ.

Immunotoxic – damaging to the immune system.

***In vivo* --** Occurring in the living organism.

***In vitro* --** Isolated from the living organism and artificially maintained, as in a test tube.

Inerts -- Adjuvants or additives in commercial formulations of pesticides that are not readily active with the other components of the mixture.

Intraperitoneal -- Injection into the abdominal cavity.

Invertebrate -- An animal that does not have a spine (backbone).

Irritant effect -- A reversible effect, compared with a corrosive effect.

LC_{50} (lethal concentration$_{50}$) -- A calculated concentration of a chemical in air or water to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

LD_{50} (lethal dose$_{50}$) -- The dose of a chemical calculated to cause death in 50% of a defined experimental animal population over a specified observation period. The observation period is typically 14 days.

Lowest-observed-adverse-effect level (LOAEL) -- The lowest dose of a chemical in a study, or group of studies, that produces statistically or biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control.

Lymphatic – Pertaining to lymph, a lymph vessel, or a lymph node.

Lymph – A clear water fluid containing white blood cells. Lymph circulates throughout the lymphatic system, removing bacteria and certain proteins from body tissue. It also is responsible for transporting fat from the small intestine and supplying mature lymphocytes to the blood.

Lymphocyte – white blood cell involved in immune system.

Malignant -- Cancerous.

Metabolite -- A compound formed as a result of the metabolism or biochemical change of another compound.

Minimal risk level (MRL) -- A route-specific (oral or inhalation) and duration- specific estimate of an exposure level that is not likely to be associated with adverse effects in the general population, including sensitive subgroups.

Mitochondria -- Subcellular organelles involved in the conversion of food to stored chemical energy.

Most sensitive effect -- The adverse effect observed at the lowest dose level, given the available data. This is an important concept in risk assessment because, by definition, if the most sensitive effect is prevented, no other effects will develop. Thus, RfDs and other similar values are normally based on doses at which the most sensitive effect is not likely to develop.

Mutagenicity -- The ability to cause genetic damage (that is damage to DNA or RNA). A mutagen is substance that causes mutations. A mutation is change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

Non-target -- Any plant or animal that a treatment inadvertently or unavoidably harms.

No-observed-adverse-effect level (NOAEL) -- The dose of a chemical at which no statistically or biologically significant increases in frequency or severity of adverse effects were observed between the exposed population and its appropriate control. Effects may be produced at this dose, but they are not considered to be adverse.

No-observed-effect level (NOEL) -- The dose of a chemical at which no treatment-related effects were observed.

Normal distribution -- One of several standard patterns used in statistics to describe the way in which variability occurs in populations.

Octanol-water partition coefficient (K_{ow}) -- The equilibrium ratio of the concentrations of a chemical in n-octanol and water, in dilute solution.

Ocular -- Pertaining to the eye.

Oxidative phosphorylation -- A metabolic process in which the metabolism of molecules in or derived from nutrients is linked to the conversion (phosphorylation) of ADP to ATP, a major molecule for storing energy in all living things.

Partition -- In chemistry, the process by which a compound or mixture moves between two or more media.

Pathway -- In metabolism, a sequence of metabolic reactions.

pH -- The negative log of the hydrogen ion concentration. A high pH (>7) is alkaline or basic and a low pH (<7) is acidic.

Pharmacokinetics -- The quantitative study of metabolism (i.e., the processes of absorption, distribution, biotransformation, elimination).

Prospective -- looking ahead. In epidemiology, referring to a study in which the populations for study are identified prior to exposure to a presumptive toxic agent, in contrast to a retrospective study.

Pup – The offspring or young of various animal species.

Reference dose (RfD) -- Oral dose (mg/kg/day) not likely to be associated with adverse effects over a lifetime exposure, in the general population, including sensitive subgroups.

Reproductive effects -- Adverse effects on the reproductive system that may result from exposure to a chemical or biological agent. The toxicity of the agents may be directed to the reproductive organs or the related endocrine system. The manifestations of these effects may be noted as alterations in sexual behavior, fertility, pregnancy outcomes, or modifications in other functions dependent on the integrity of this system.

Resorption -- Removal by absorption. Often used in describing the unsuccessful development and subsequent removal of post-implantation embryos.

Retrospective -- looking behind. In epidemiology, referring to a study in which the populations for study are identified after exposure to a presumptive toxic agent, in contrast to a prospective study.

RfD -- A daily dose which is not anticipated to cause any adverse effects in a human population over a lifetime of exposure. These values are derived by the U.S. EPA.

Route of exposure -- The way in which a chemical or biological agent enters the body. Most typical routes include oral (eating or drinking), dermal (contact of the agent with the skin), and inhalation.

Scientific notation -- The method of expressing quantities as the product of number between 1 and 10 multiplied by 10 raised to some power. For example, in scientific notation, 1 kg = 1,000 g would be expressed as 1 kg = 1 x 10^{3} g and 1 mg = 0.001 would be expressed as 1 mg = 1 x 10^{-3} .

Sensitive subgroup -- Subpopulations that are much more sensitive than the general public to certain agents in the environment.

Sensitization – A condition in which one is or becomes hypersensitive or reactive to an agent through repeated exposure.

Species-to-species extrapolation -- A method involving the use of exposure data on one species (usually an experimental mammal) to estimate the effects of exposure in another species (usually humans).

Subchronic exposure -- An exposure duration that can last for different periods of time, but 90 days is the most common test duration. The subchronic study is usually performed in two species (rat and dog) by the route of intended use or exposure.

Synergistic effect -- A situation is which the combined effects of two chemicals is much greater than the sum of the effect of each agent given alone.

Systemic toxicity -- Effects that require absorption and distribution of a toxic agent to a site distant from its entry point at which point effects are produced. Systemic effects are the obverse of local effects.

Teratogenic -- Causing structural defects that affect the development of an organism; causing birth defects.

Teratology -- The study of malformations induced during development from conception to birth.

Terrestrial – Anything that lives on land as opposed to living in an aquatic environment.

Threshold -- The maximum dose or concentration level of a chemical or biological agent that will not cause an effect in the organism.

Thymus – A small gland that is the site of T-cell production. The gland is composed largely of lymphatic tissue and is situated behind the breastbone. The gland plays an important role in the human immune system.

Toxicity -- The inherent ability of an agent to affect living organisms adversely.

Uncertainty factor (UF) -- A factor used in operationally deriving the RfD and similar values from experimental data. UFs are intended to account or (1) the variation in sensitivity among members of the human population; (2) the uncertainty in extrapolating animal data to the case of humans; (3) the uncertainty in extrapolating from data obtained in a study that is less than lifetime exposure; and (4) the uncertainty in using LOAEL data rather than NOAEL data. Usually each of these factors is set equal to 10.

Vertebrate -- An animal that has a spinal column (backbone).

Volatile -- Referring to compounds or substances that have a tendency to vaporize. A material that will evaporate quickly.

Xenobiotic – A substance not naturally produced within an organism; substances foreign to an organism.

Xenoestrogen – An estrogen not naturally produced within an organism.

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Appendix E
Freds Fire Reforestation Project

Economic Analysis

COST AND REVENUE PROJECTIONS BY ALTERNATIVE

Environmental data collection, analysis, and document writing costs have not been included in the economic analysis as these costs would be the same for each alternative and would not assist in the differentiation of alternatives. These costs usually range from $40.00 to $100.00 per acre analyzed depending upon the complexity of the analysis. In addition, appeals and litigation costs also have not been included. It is very difficult to predict which projects would get appealed and litigated. For instance, the Plantation Protection Project and the 2004 Vegetation management in Conifer Plantations Environmental Assessments were appealed. However, all the other projects on the Eldorado National Forest since 1991 involving herbicides, both plantation establishment and release projects, and noxious weed projects, have not been appealed or litigated.

Only future costs and benefits are analyzed. Costs already incurred are considered “sunk costs”, and are not used. These sunk costs are associated with past planting or radial grubbing to remove competing vegetation on approximately 1,870 acres. On going procedures such as fire protection or speculative actions such as future timber sale planning and administration, future road construction and logging costs are not included in the analysis.

All treatments would begin in base year 1, and end about year 6, except for invasive plant treatments. For this analysis, available funding to carry out all needed treatments is assumed, as is accomplishment of these treatments.

The estimates for implementation costs for each alternative are detailed in the following tables. All costs are discounted at 4 percent per year to reflect the time value of money. If we choose to invest $100 in reforestation, we lose the use of that money for a certain period of time. At a 4 percent discount rate, the annual cost to society of a $100 investment is $4. This is equivalent to the "real" rate of interest or the interest rate after subtracting the effects of inflation. By discounting all future costs and revenues at 4 percent, they can be compared on an equivalent value basis, what those dollars would be worth in terms of today’s dollars (present value).

Calculations:

All benefits and costs are discounted to 2009 dollars. The net present value is the present value of future cash flows is calculated using the standard formula:

$$\text{Present Value} = \text{Future Value} / (1.0 + i)^n$$

where the Discount Rate is: $(1.0 + i)^n$

and i = interest rate, and n = time in years

All future costs in this analysis are based on current values. Although these values are expected to change in the future, no attempt is made to predict these changes. However, when discounted to the present, these values provide a simple means to assess the relative economic value of one alternative against another.

Table E-1 displays the treatment cost, discounted cost per acre by year, and net present value for Alternatives 1 and 3. Table E-2 displays the number of person days and person years that would be employed for the Alternatives 1 and 3. There would be no monetary cost or employment associated with the no action alternative (Alternative 2).

DEFINITIONS

Direct Economic Impact: Effects caused directly by primary industry or contractors consuming goods and services at secondary or supporting industries such as hotels, restaurants, parts and equipment, supply, and retail stores and paying wages to its employees.

Indirect Economic Impact: Effects that occur when secondary or supporting industries consume goods and services at other secondary or supporting industries and paying wages to its employees.

Induced Economic Impact: Effects that occur when wages paid to employees (direct and indirect) consume goods and services.

Present Net Value: The present value of future cash flows, which includes only the benefits and costs of producing primary outputs, excluding secondary benefits.

Real Discount Rate: A discount rate adjusted to exclude the effects of inflation. The Forest Service basic discount rate used to evaluate long-term investments and operations in land and resource management is a real rate of 4 percent that does not include an inflation factor.

ALTERNATIVE 1				YEAR 1			YEAR 2			YEAR 3			YEAR 4			YEAR 5			YEAR 6		
ACTIVITY	METHOD	COST per ACRE	ACRES	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost
Plant	Hand	$275	1322							949	$260,975	$232,006	373	$102,575	$87,682						
Replant/interplant	Hand	$180	665	148	$26,640	$25,615				515	$92,700	$82,410									
Site Prep	Herbicide	$280	1322				949	$265,720	$287,403	373	$104,440	$92,847									
	Hand Cut	$500	300	300	$150,000	$144,231															
Initial Release	Herbicide	$280	1868	878	$245,840	$236,385	990	$277,200	$299,820												
	Hand	$450	35	35	$15,750	$15,144															
Follow-up Release	Herbicide	$280	3190				98	$27,440	$29,679	780	$218,400	$194,157	1939	$542,920	$464,090	373	$104,440	$85,842			
	Hand	$450	35							35	$15,750	$14,002				35	$15,750	$12,945	35	$15,750	$11,969
Mastication	Mechanical	$500	338													338	$169,000	$138,906			
																		$0			
Invasive Plants	Herbicide	$275	72	72	$19,800	$19,038	35	$9,625	$10,410	35	$9,625	$8,557	25	$6,875	$5,877	25	$6,875	$5,651	25	$6,875	$5,224
Subtotal						**$440,413**			**$627,312**			**$623,978**			**$557,649**			**$243,344**			**$17,193**
TOTAL COST																					

ALTERNATIVE 1				YEAR 7			YEAR 8			YEAR 9			YEAR 10		
ACTIVITY	METHOD	COST per ACRE	ACRES	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost
Plant	Hand	$275	1322												
Replant/interplant	Hand	$180	665												
Site Prep	Herbicide	$280	1322												
	Hand Cut	$500	300												
Initial Release	Herbicide	$280	1868												
	Hand	$450	35												
Follow-up Release	Herbicide	$280	3190												
	Hand	$450	35												
Mastication	Mechanical	$500	338												
Invasive Plants	Herbicide	$275	72	25	$6,875	$6,611	25	$6,875	$7,436	25	$6,875	$6,112	25	$6,875	$5,877
Subtotal						**$6,611**			**$7,436**			**$6,112**			**$5,877**
TOTAL COST															**$2,530,047**
										Cost per Acre		**$2,530,047 /3,319 acres =**			**$762**

ALTERNATIVE 3				YEAR 1			YEAR 2			YEAR 3			YEAR 4			YEAR 5		
ACTIVITY	METHOD	COST per ACRE	ACRES	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost
Plant	Hand	$275	592							592	$162,800	$144,729						
Replant/interplant	Hand	$180	665	148	$26,640	$25,615				515	$92,700	$82,410						
Release	Hand	$450	2460	900	$405,000	$389,423	1891	$850,950	$920,388	2588	$1,164,600	$1,035,325	2588	$1,164,600	$995,505	1653	$743,850	$611,390
Mastication	Mechanical	$500	338													338	$169,000	$138,906
Invasive Plants	Hand	$500	72	72	$36,000	$34,615	72	$36,000	$38,938	72	$36,000	$32,004	36	$18,000	$15,386	36	$18,000	$14,795
Subtotal						**$449,654**			**$959,325**			**$1,294,468**			**$1,010,891**			**$765,091**

ALTERNATIVE 3 -Continued				YEAR 6			YEAR 7			YEAR 8			YEAR 9			Year 10		
ACTIVITY	METHOD	COST per ACRE	ACRES	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost	Acres	Cost	Discounted Cost
Plant	Hand	$275	592															
Replant/interplant	Hand	$180	665															
Release	Hand	$450	2460	402	$180,900	$142,968												
Mastication	Mechanical	$500	338															
Invasive Plants	Hand	$500	72	36	$18,000	$14,226	36	$18,000	$13,679	36	$18,000	$13,152	36	$18,000	$12,647	36	$18,000	$12,160
Subtotal						**$157,194**			**$13,679**			**$13,152**			**$12,647**			**$12,160**
TOTAL COST																		**$4,688,260**
													Cost per Acre		**$4,688,260 /2,519 acres =**			**$1,906**

Alternative 1		Acres	Treament Acres by Year Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	SUM (Acres)	Crew size	Production (Acres/day)	Total Days	Crew Person Days	Contract Admin Crew Size	Admin Person Days
Plant	Hand	1322			949	373							**1322**	10	25	53	**529**	3	**159**
Replant/interplant	Hand	1000	148		515								**663**	10	25	27	**265**	3	**80**
Site Prep	Herbicide	1322			373								**373**	15	30	12	**187**	4	**50**
	Hand	559	300																
Initial Release																			
	Herbicide	1868	878	990									**1868**	15	25	75	**1121**	4	**299**
	Hand	35	35										**35**	15	15	2	**35**	1	**2**
Follow-up Release																			
	Herbicide	3190		98	780	1939	373						**3190**	15	35	91	**1367**	4	**365**
	Hand	35			35		35	35					**105**	15	15	7	**105**	1	**7**
Mastication																			
	Mechanical	338					338						**338**	1	3	113	**113**	1	**113**
Invasive Plants																			
	Herbicide	72	72	35	35	25	25	25					**217**	2	4	54	**109**		**0**
TOTAL			**1433**	**1,123**	**2,687**	**2,337**	**771**	**60**									**3830**		**1073**
																	Total Person Days		**4903**

Alternative 3		Acres	Treament Acres by Year Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	SUM (Acres)	Crew size	Production (Acres/day)	Total Days	Crew Person Days	Contract Admin Crew Size	Admin Person Days
Plant	Hand	592			592								**592**	10	25	24	**237**	3	**71**
Replant/interplant	Hand	1000	148		515								**663**	10	25	27	**265**	3	**80**
Release	Hand	2460	900	1891	2588	2588	1653	402					**10022**	15	15	668	**10022**	1	**668**
Mastication																			
	Mechanical	338					338						**338**	1	3	113	**113**	1	**113**
Invasive Plants																			
	Hand	72	72	72	72	72	36	36	36	36	36	36	**504**	2	0.25	2016	**4032**		**0**
TOTAL			**1120**	**1963**	**3767**	**2660**	**2027**	**438**	**36**	**36**	**36**	**36**					**14669**		**931**
																	Total Person Days		**15600**

Example - Plant 1322 acres/ 25 acres per day = 53 total days. 53 days x 10 person crew = 529 crew person days. 53 total days X Contract Admin Crew of 3 = 159 Admin Crew Person Days

Appendix F

Freds Fire Reforestation Project

Public Comments

The Notice of Availability of the Draft Environmental Impact Statement (DEIS) was published in the Federal Register September 11, 2009 (Vol. 74, No. 175) and copies of the DEIS/project summary mailed to 43 individuals, organizations, tribes, and government agencies. The comment period ended on October 26, 2009. 19 individuals responded during the comment period and are listed below. Two comments were received from federal, State, and local agencies, and elected officials and are listed below.

Commenters

1. Patricia Sanderson Port, Regional Environmental Officer	United States Department of the Interior
2. Kathleen M. Goforth, Manager, Environmental Review Office	United States Environmental Protection Agency
3. Steve Brink	California Forestry Association
4. Foresthill High School	California Forestry Challenge
5. Napa New Tech High School	California Forestry Challenge
6. Napa New Tech High School	California Forestry Challenge
7. Franklin High School	California Forestry Challenge
8. Sacramento New Tech High School	California Forestry Challenge
9. Sacramento New Tech High School	California Forestry Challenge
10. Livermore High School	California Forestry Challenge
11. Rio Linda High School	California Forestry Challenge
12. Grant High School	California Forestry Challenge
13. Grant High School	California Forestry Challenge
14. Upper Lake High School	California Forestry Challenge
15. Lincoln High School	California Forestry Challenge
16. Delta High School	California Forestry Challenge
17. Shenandoah High School	California Forestry Challenge
18. Elk Grove High School	California Forestry Challenge
19. Argonaut High School	California Forestry Challenge

20. Mike Vedder	California Forestry Challenge
21. Tessa Levine	California Forestry Challenge

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Pacific Southwest Region
1111 Jackson Street, Suite 520
Oakland, California 94607

IN REPLY REFER TO:
ER09/970

Electronically Filed

23 October 2009

Robert Carroll
4260 Eight Mile Road
Camino, CA 95709

Subject: Review of the Draft Environmental Impact Statement (EIS) for the Freds Fire Restoration, Eldorado National Forest, Placerville Ranger District, El Dorado County, California

Dear Mr. Carroll:

The Department of the Interior has received and reviewed the subject document and has no comments to offer.

Thank you for the opportunity to review this project.

Sincerely,

Patricia Sanderson Port

Patricia Sanderson Port
Regional Environmental Officer

cc:
Director, OEPC
FWS, Region VIII

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

SUMMARY OF EPA RATING DEFINITIONS*

This rating system was developed as a means to summarize the U.S. Environmental Protection Agency's (EPA) level of concern with a proposed action. The ratings are a combination of alphabetical categories for evaluation of the environmental impacts of the proposal and numerical categories for evaluation of the adequacy of the Environmental Impact Statement (EIS).

ENVIRONMENTAL IMPACT OF THE ACTION

"LO" (Lack of Objections)

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

"EC" (Environmental Concerns)

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

"EO" (Environmental Objections)

The EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

"EU" (Environmentally Unsatisfactory)

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potentially unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

ADEQUACY OF THE IMPACT STATEMENT

"Category 1" (Adequate)

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

"Category 2" (Insufficient Information)

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available

EPA DETAILED COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) FOR FREDS FIRE REFORESTATION, EL DORADO COUNTY, CA, OCTOBER 26, 2009

Additional Aquatic Toxicity Data and Analysis

Improve Aquatic Toxicity Data. The 50% lethal concentration (LC50) levels in Table 3-30 and 3-31 do not appear comprehensive. The Forest Service should review EPA's ECOTOX database (http://cfpub.epa.gov/ecotox/) for aquatic toxicity values. For example, ECOTOX contains over 1300 acute and chronic toxicity values for nonylphenol for a wide range of plant, vertebrate and invertebrate species. The Forest Service should evaluate the most appropriate values for comparison to the expected concentrations based on Water Contamination Rates shown in Tables 3-17a and 3-17b.

> ***Recommendation:***
> The FEIS should review the ECOTOX database for additional toxicity data for herbicides, surfactants and additives, and compare appropriate toxicity data with water contamination rates.

Future Herbicide Limitations

Review potential future herbicide use limitations posted by EPA. Although the project concludes that no federally threatened, endangered or proposed species or their habitat

State the EPA Registration Number of any products anticipated to be used for the project. Forest Service proposes to apply several types of herbicide, which include glyphosate, triclopyr, hexazinone, clopyralid and chlorosulfuron, to competing vegetation on approximately 3,200 acres within the Freds Fire area to hasten the development of a structurally diverse conifer forest.

Recommendation:
The FEIS should state the EPA Registration Number of any products anticipated to be used for the project. The pesticides used must be registered with EPA and the California Department of Pesticide Regulation and used according to the label directions and Federal and State pesticide laws (Executive Order 12088). Since the regulatory status of chemicals can change, a review of the current status of all herbicides

Appendix G

Freds Fire Reforestation Project

Response to Comments

Commentor: Kathleen M. Goforth, Manager, Environmental Review Office, United States Environmental Protection Agency

Additional Aquatic Toxicity Data and Analysis

Improve Aquatic Toxicity Data. The 50% lethal concentration (LC50) levels in Table 3-30 and 3-31 do not appear comprehensive. The Forest Service should review EPA's ECOTOX database (http://cfpub.epa.gov/ecotax) for aquatic toxicity values. For example, ECOTOX contains over 1300 acute and chronic toxicity values for nonylphenol for a wide range of plant, vertebrate and invertebrate species. The Forest Service should evaluate the most appropriate values for comparison to the expected concentrations based on Water Contamination Rates shown in Tables 3-17a and 3-17b.

Recommendation: The FEIS should review the ECOTOX database for additional toxicity data for herbicides, surfactants, and additives, and compare appropriate toxicity data with water contamination rates.

Response:

Tables 3-30 and 31 in the DEIS are a summary of the general chemical characteristics of the herbicides and additives proposed for use and include summaries of some of the relevant studies in the open literature and in the National and Regional risk assessments. In many cases the toxicity values presented in Table 3-30 and 31 are not the toxicity values used to characterize risk to aquatic species. The toxicity values used to characterize risk to aquatic species are displayed in Tables 3-32 to 3-36 of the DEIS. In order to clarify the toxicity values used to characterize risk, we have removed Tables 3-30 and 3-31 from the FEIS.

The toxicity values used to characterize risk to aquatic species are based on the analysis contained in peer-reviewed National (SERA 2003a, 2003b, 2004a, 2004b, 2005) and Regional (USDA 2003a) risk assessments referenced in this FEIS. These toxicity values from the National and Regional risk assessments are determined following a thorough review and analysis of available toxicological studies to determine the potential effects of the herbicides and additives and are the basis for analysis of risk to human health, and terrestrial and aquatic species potentially affected by the project. The information in these risk assessments is, in some cases, supplemented with additional studies (Trumbo, 2005, Mann and Bidwell, 2000) or information (Regional water monitoring data).

We have not found any published information, nor has the EPA indicated any published information, that would lead us to believe that the toxicity values used to assess the risk to aquatic species in this FEIS would need to be changed. Our risk assessments are not intended to be encyclopedic in nature, as it is recognized that there are many studies available for review. However, our risk assessments do cover the breadth of available data such that it is not necessary to include all available studies. In this case, EPA has not provided us with information on what specific toxicity information appears to be incorrect.

For clarification (FEIS, page 180) there is sufficient information in the literature to make the assumption that in a forested environment, contamination of surface water is more likely to involve nonylphenol polyethoxylate in the short-term and short-chain carboxylates (NP1EC, NP2EC) in the longer-term. As such, indicators of risk (Tables 3-20f-1, 3-20f-2, 3-35, and 3-47) are based upon these two compounds, not nonylphenol.

Using the Best Management Practices prescribed for this project we expect the water contamination rates to be lower than the short and long term water contamination rates shown in Tables 3-18a and 3-18b. This is based on water monitoring conducted in the Pacific Southwest Region since 1991, involving glyphosate, triclopyr, and hexazinone, which has not shown levels of water contamination as high as[the estimated water contamination rates in Tables 3-18a and 3-18b for normal (i.e., not accidental) applications.

Future Herbicide Limitations

Review potential future herbicide use limitations posted by EPA. Recommendation: The Forest Service should review EPA's website (http://www.epa.gov/oppfead1/endanger/litstatus/effects/) to ensure additional limitations have not been placed on pesticides planned for use.

Response:

The Aquatic Species Biological Assessment/Evaluation for the Freds Fire Reforestation Project determined that the herbicides proposed for use in Alternative 1 would have no effect on any of the threatened, endangered, proposed, and candidate species that may be present on the Eldorado National Forest.

As stated in the Aquatic Species Biological Evaluation/Assessment) there is no suitable habitat in the project area for the California red-legged frog (CRLF) or salmonid species. These are the species groups that EPA has entered into consultation with the Fish and Wildlife Service and the National Marine Fisheries Service on the effects of glyphosate (CRLF), hexazinone (CRLF), and triclopyr BEE (CRLF and salmonids). Therefore any potential future use limitations based on EPA's ongoing consultation efforts will not affect this project.

We have reviewed this website for additional limitations on the pesticides planned for use. Status changes for any of the herbicides planned for use would be analyzed in accordance with Forest Service Handbook 1909.15, Section 18 [Correction, Supplementation, or Revision of Environmental Documents and Reconsideration of Decisions to take Action].

Clarification of Herbicide Use

Clarify Comparison of Alternatives Table. Recommendation: We recommend the Comparison of Alternatives Table more accurately reflect the discussion of the DEIS.

Response: This table has been revised as per EPA's comments.

State the EPA Registration Number of any products anticipated to be used for the project. Recommendation: The FEIS should state the EPA Registration Number of any products anticipated to be used for the project.

Response:

The FEIS does not state EPA registration numbers for the chemicals proposed for use. As described in Table 2-3 of the FEIS, herbicide formulations, and not trade names, are proposed for use. Different herbicide formulations have different EPA Registration Numbers. The FEIS contains product labels that are examples of one or more formulation that will be used in the Freds Fire Reforestation Project area under Alternative 1.

Recommendation: The pesticides used must be registered with EPA and the California Department of Pesticide Regulation and used according to the label directions and Federal and State pesticide laws (Executive Order 12088).

Recommendation: Since the regulatory status of chemicals can change, a review of the current status of all herbicides considered for use should be conducted prior to each application season.

Response:
It is Forest Service Policy to use only those pesticide products registered by the U.S. Environmental Protection Agency and appropriate State agencies and to use them according to all label directions (Forest Service Handbook 2109.14, Chapter 15.1).

As described under Best Management Practice 5-8 (FEIS, page 29), "Label directions will be followed on all pesticides, dyes, and adjuvants. All pesticide applications will adhere to all appropriate laws and regulations governing the use of pesticides, as required by the U.S. Environmental Protection Agency, the California Department of Pesticide Regulation, CalEPA regulations and safety regulations, and Forest Service policy pertaining to pesticide-use.

Climate Change

Describe climate change and its effects on forest management practices, habitat, and biodiversity. Recommendation: We recommend the FEIS include a detailed description of climate change and its implications for effective management of forest resources and the ability to meet the requirement of the Forest Land and Resources Management Plan. For example, describe and evaluate projected climate change consequences, such as frequency of high intensity storms, amplified rain events, and the severity and frequency of insect outbreaks, droughts, and fire seasons, and their effects on the success of reforestation efforts and adaptive forest management.

Response: The Forest reviewed the following climate change documents:

- "State of Knowledge." Environmental Protection Agency (2007)

- Climate Change; Health and Environmental Effects: Forests. Environmental Protection Agency http://epa.gov/climatechange/effects/forests.html#ref

- Climate Change Considerations in Project Level NEPA Analysis. U.S. Forest Service (2009)

- Draft 2009 Climate Action Team Biennial Report to the Governor and Legislature (March 2009)

- Silviculture and Forest Management under a Rapidly Changing Climate (USFS GTR-203, 2007)

According to EPA (2007), some elements of climate change are known with near certainty:

- Human activities are changing the composition of Earth's atmosphere
- Atmospheric buildup of CO2 and other greenhouse gases is largely the result of human activities,
- An "unequivocal" warming trend of about 1.0 to 1.7 F occurred from 1906-2005.
- Major greenhouse gases emitted by human activities remain in the atmosphere for periods ranging from decades to centuries. It is therefore virtually certain that atmospheric concentrations of greenhouse gases will continue to rise over the next few decades.
- Increasing greenhouse gas concentrations tend to warm the planet.

However, it is uncertain how much warming will occur, how fast that warming will occur, and how the warming will affect the rest of the climate system including precipitation patterns (EPA (2007). The intensity and severity of these effects of these are expected to vary regionally and even locally, making any discussion of potential site-specific effects of global climate change on forest resources speculative.

The activities proposed under this project are short-term and are projected to be completed within ten years. For many resources the projected effects of the alternatives are short-term. Many highly conservative scenarios were used to frame the extent of potential environmental conditions in the project area. For example, a worst-case thunderstorm scenario for hydrologic effects, upper estimates of herbicide rates, exposure, and water contamination rates to analyze effects to human, aquatic, and terrestrial species, and extreme fire risk and very high fire hazard for fire effects. Use of these methods would likely encompass the range of environmental conditions, including effects of climate change, in the short-term.

Short-term relationship of soil and water resources to potential frequency of high intensity storms, and amplified rain events:

Soil Quality -The effects of the project on soils were evaluated in terms of the Soil Quality Standards of Forest Service Region 5 (FSH R5 Supplement No. 2509.18-95-1). Based on the current cover and growth projections, soil cover should be sufficient to meet soil quality standards and protect against soil loss under all Alternatives. Monitoring efforts have shown that soil cover is maintained at adequate levels after herbicide treatments to prevent accelerated erosion (FEIS page 130-132).

Water Quality- The effects of the project on Hydrology and Water Resources were evaluated, including a worst-case scenario or a large thunderstorm that quickly erodes sediment containing herbicides directly into a stream or water body (FEIS page 148).

> **Water Contamination- Domestic use** – Modeling results using the SERA risk assessments - even assuming worse-case conditions - show that the concentration of glyphosate of East and West Kyburz Creeks, as well as all perennial streams in the project area), is less than the MCL of 700 ppb. There is additional evidence (Wood 2001) that indicates that even the “worse-case” thunderstorm scenario still poses a low risk to water quality (FEIS page 147).
>
> **Water Contamination-Aquatic Species** - There is low overall risk (Hazard Quotient <1) to aquatic species from normal operations using project design features. Where Peak Estimated Environmental Concentrations result in a Hazard Quotient greater than one (several scenarios for hexazinone and triclopyr) stream buffers were included in the project design to reduce the risk that these chemicals would result in effects to aquatic species.

Sedimentation - In the short-term (less than 10 years), there may be a negligible or slight increase in the amount of sediment delivered to streams during and immediately after storm events. The current amount of sediment delivered to streams during large storm events - which is currently high - would likely overshadow any slight increase in sediment delivery to streams that would result from all alternatives. All State standards for suspended sediment and turbidity (Appendix C) will be met because of the small total amount of ground disturbance and high ground cover near streams under all the alternatives (FEIS, page 152-153) In the long-term, the difference between all the alternatives is negligible. Once the project is completed, the amount of vegetation in disturbed areas will increase - this will minimize erosion and sediment delivery to streams.

Best Management Practices and Soil Quality Standards used of this project, and by the Forest Service in Region 5, are designed to protect resources in the long-term.

Short-term relationship of fire and fuels to potential for increased length and severity of fire seasons:

Fire seasons - The project area is currently in an area predominantly classified as extreme fire risk and very high fire hazard (FEIS page 45). Thus, the fire effects were analyzed under conditions of extreme fire risk and very high fire hazard.

Under extreme fire risk and very high fire hazard conditions Alternative 1 would create fuel profiles in the project area into the future that would result in relatively easy control of any fires throughout the majority of the year. The increased ability of fire suppression provides the greatest probability of seedling survival. While any small conifer within a likely fire will probably not survive, the ability to contain fires at a smaller size increases the probability of seedling survival across the landscape.

Alternative 2 would develop a fuel complex in the longer term with rapid rates of spread and a higher resistance to control across the landscape. This fuel complex would make the deployment of suppression resources on ridgetops dangerous and ineffective. It would also decrease the effectiveness of suppression resources behind the town of Kyburz, putting this community at risk.

Alternative 3 would have the same effects as Alternative 2 because treatments would be discontinuous and would have little, if any, effect on the fuels and their development over time.

Fire history shows that the area would likely experience a disturbance in the form of a large fire within the next 25 years. Given the fuel conditions the effects of this fire in Alternatives 2 and 3 would be stand replacing. These circumstances could allow shrub stages to persist indefinitely

Future climate change scenarios of increased length and severity of fire seasons may result in a need for additional fuels treatments in the project area, beyond the timeline and scope of this FEIS.

Vegetation Management – We have added a Climate Change section to the FEIS (Chapter 3) addressing reforestation, insect and diseases, and precipitation based on information in the reviewed papers.

Commentor: Steve Brink, California Forestry Association

CFA supports the proposed action of this project.

Response: Thank you for your support.

It would be helpful if there was a table with some text describing:

1) How much of the 7,560 acres is productive forest land.
2) How much you intend to reforest into conifer and how much into oak.
3) Any acres that you are not going to reforest and why.

Response: Based on the Eldorado National Forest GIS Existing Vegetation Layer, about 7,325 acres are classified as productive forest site. The remaining acres are classified as non-forest type (such as transportation, barren, or urban) or non-productive forest site. These areas are often small inclusions within a larger area of productive forest site. Information describing proposed reforestation activities on federal lands has been added to the FEIS (Appendix B, Table B-3).

Commentor: California Forestry Challenge (18 teams)

Responses to a problem set from 18 teams from the California Forestry Challenge. The problem set contained three alternatives to analyze. These alternatives generally correspond with the three alternatives in the Freds Fire Reforestation Draft EIS. Their comments are summarized below.

Sixteen teams supported herbicide treatments as in Alternative One, the proposed action, although several suggested modifications related to planting acres, planting stock, and timing.

> "Our first suggestion would be to use the Alternative 1 suggestion."

> "We support Alternative 1 for the Freds Fire restoration because the results seem effective. We analyzed the Cleveland fire plots and how the land and trees progress through the years."
>
> "After reviewing all the sites. We have seen what the effects of using separate methods of reforestation have done and what the long term effects are. Now seeing this has made us believe the best action to take would be alternative One…"
>
> "We want to do ground application of the herbicides because of more accurate application."
>
> "We also propose that you use herbicides when planting the trees…"

Response: Thank you for your support.

Several teams (5) suggested using aerial application of herbicides.

> "The first herbicide treatment would be done 75% aerially…still protect the environment and is more cost effective"
>
> "Our budget will include aerial application of herbicides prior to replanting…."
>
> "It involves the use of aerial herbicides to control noxious weeds…"
>
> "In all other areas [outside of riparian buffer zones] we will aerially spray herbicides to ensure the most cost effective methods."
>
> 3,285 acres will have a herbicide treatment by aerial application."

Response: Aerial application of herbicides was not part of the proposed action. Aerial application can cost less, and reduce worker exposure to herbicides as compared to ground-based (backpack spray) applications. Aerial application can reduce risk to the public and to forest workers from the stand point of potential adverse effects to human health and safety if chemicals were to be utilized (USDA, 1989b). However, aerial applications could not be implemented using the project design features to utilize radial treatments in some areas. Extensive untreated buffer strips would be needed to protect water quality and other non-spray areas. We have added an aerial application alternative to the discussion on page 36 of the FEIS, Alternatives Considered But Eliminated from Detailed Study.

Two teams supported the use of non-chemical methods.

"…chemical removal can be harmful to water systems."

"Our proposal [non chemical treatment] is environmentally sound with a minimal degree of disruption to the ecosystem."

Response: A non chemical alternative (Alternative 3) was analyzed in detail. The effects of chemical treatments on water systems and the ecosystem were analyzed under Alternative 1.

One team suggested using controlled fire in thirty years to control fuels.

Response: Treatments commencing in thirty years are beyond the scope of this EIS. Future treatments would be analyzed under NEPA, based on conditions at that time.

Several teams suggested planting differing amounts of acres, ranging from 2,700 acres to 3,475 acres.

"No reforestation along Highway 50."

"You should plant only on 2,700 acres to save money on trees and put toward herbicide treatments."

"We believe replanting 3,000 of the 3,800 acres, and leaving 800 to naturally regrow and be used as snag retention areas."

Response: Alternative one would reforest about 3,320 acres in the burn area. Reductions from this acreage would not meet the purpose and need to reestablish a forested landscape.

Several teams suggested using precommercial thinning in the future.

Response: Masticating excess trees, in conjunction with fuel treatments, was dropped from the action alternatives between scoping and the Draft EIS because conditions into the future are speculative. A statement has been added to Chapter 2 of the FEIS (Alternatives Considered) to reflect this minor change. Future treatments, such as precommercial thinning, would be analyzed under a NEPA analysis based on conditions at that time.

Several teams suggested using volunteer labor to complete some of the treatments or using an "adopt a tree" type program to offset treatment costs.

Response: Individuals can volunteer on the Eldorado National Forest as we have an active volunteer program working on various projects on the Forest. While this can reduce costs, it does not affect the effects analysis for most resources. The Forest Service accepts donations for tree planting through the Penny Pines program. Additionally, grants for reforestation from organizations are also used to offset reforestation costs.