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Environmental Assessment

Eradication and Control of Invasive Plants

Eldorado National Forest (ENF)
Alpine, Amador, Eldorado, and Placer Counties, California

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On the cover – Eldorado NF fire staff hand pull and bag weeds between fire assignments

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INTRODUCTION

Document Structure

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

- *Introduction:* The section includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Comparison of Alternatives, including the Proposed Action:* This section provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes possible mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Environmental Consequences:* This section describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource area. Within each section, the affected environment is described first, followed by the effects of the No Action Alternative that provides a baseline for evaluation and comparison of the other alternatives that follow.
- *Agencies and Persons Consulted:* This section provides a list of preparers and agencies consulted during the development of the environmental assessment.
- *Appendices:* The appendices provide more detailed information to support the analyses presented in the environmental assessment.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the ENF Supervisors Office at 100 Forni Road, Placerville, CA 95667.

Background

Invasive plants are species that are non-native, whose introduction does or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112; http://ceq.hss.doe.gov/nepa/regs/eos/eo13112.html). In their native habitat, these species often have natural predators and competitors that control population size. When introduced into new areas and in the absence of their natural controls, invasive plants can quickly spread, often resulting in monocultures that alter vegetation recovery with changes to species diversity, soil processes and natural disturbance patterns such as frequency and intensity of wildfires. Within the State of California, displacement of native plant species by invasive plant species has impacted wildlife habitats, fire regimes, recreation opportunities, forage production, and scenic beauty.

Within California there are approximately 200 invasive plant species identified by the California Invasive Plant Council (Cal-IPC), about 127 of which Cal-IPC identifies as occurring in the Sierra Nevada region. Invasive plants are spreading at an alarming rate in California, and fast encroaching onto National Forest System (NFS) lands. Within the last 20 years in California, studies show that yellow starthistle alone has increased from 1 million acres to at least 12 million - about 12 percent of the state's land base (as reported by California Department of Food and Agriculture). Current inventories indicate that approximately 50 invasive plant species occur on the ENF and that many species are spreading at an increasing rate.

The ENF has prepared an Invasive Plant Management Strategy to address the problem of invasive plant spread (Appendix F, Forest Strategy, 2012). The Forest Strategy presents a comprehensive approach for all aspects of invasive plant management including prevention of invasive plant introductions, inventory and mapping, coordination and cooperation among agencies and ownerships, public education, and control and restoration. The Forest Strategy describes treatment goals (eradication, control, or no treatment) for the invasive plant species that occur on the Forest, and prioritizes the treatment of individual infestations based upon direction in the Sierra Nevada Forest Plan Amendment (USDA 2004). Environmental analysis under the National Environmental Policy Act (NEPA) is not required to implement the education, prevention, inventory, and monitoring aspects of the strategy, but is required to implement the control and restoration elements of the Forest Invasive Plant Management Strategy.

Thirty-two species of invasive plants have been identified in the Forest Strategy as a priority for eradication or control based upon 1) the California Department of Food and Agriculture (CDFA) Pest Rating; 2) the California Invasive Plant Council (Cal-IPC) Rating and Scores for Ecological Impact/Invasiveness in wildlands, (http://www.cal-ipc.org/ip/inventory/pdf/Criteria.pdf); and 3) Lists provided by El Dorado, Amador and Placer County Weed Management Areas (WMAs) (Appendix F). The mapped infestations of these priority species occupy 2,610 acres of NFS lands (Figure 1). Currently, most invasive plant species found on the Forest are in infestations totaling less than five acres in size, with individual infestations of less than an acre. Eradication of many of these infestations and species from ENF lands is therefore a reasonable goal.

Since 2002, the ENF treated approximately 250 acres infested with yellow starthistle annually using herbicide and handpiling methods. Over the last seven years, these treatments reduced or eradicated occurrences at 13 sites (representing approximately 160 gross acres). In addition, the ENF has collaborated with El Dorado County and Sierra Pacific Industries to eradicate spotted knapweed from the South Fork of Silver Creek since 2001. Initially spotted knapweed was established at 46 sites on private and NFS lands with up to 25,000 plants per site. Diligent and aggressive eradication efforts over eight years have reduced the occurrences to 28 sites with an average of less than 10 plants per site. In 2011 no knapweed plants were found on ENF lands. These efforts demonstrate both the opportunity for success and the need for consistent efforts in reducing the size and density of invasive plant infestations. They have also highlighted the importance of treating infestations before they become extensive.

Purpose and Need for Action

There is a need for elimination or control of known priority infestations, and for prevention of the establishment of new infestations of invasive plants. Inventories show that 2,610 acres of ENF land are occupied with invasive plants that are a priority for eradication or control (ENF 2012). Asher and Dewey (2005) document annual rates of spread varying from 10 to 24 percent for many invasive plant species in the western United States. Since non-native species have proliferate seeding rates that quickly colonize disturbed settings, potential influx along major travel routes poses risk for high rates of weed spread into areas where vegetation is being treated to reduce the risk of wildfire or to provide conditions supporting more natural fire regimes, Wildfire incidence, in particular, poses the highest risk for weed spread with bare ground, high nutrient availability and a lack of competing plants.

Although the ENF mapping of invasive plant species is extensive, the size and number of invasive plant infestations is continually changing. The risk of delaying treatment of these sites is that small infestations will spread from roadsides and developed sites into natural forest settings. Once in these natural setting, the costs and potential damages increase since these weeds affect the natural successional response to disturbance and create large infested areas too difficult to eradicate with existing control measures.

For this reason there is a need for treatments that eliminate or control known priority infestations, while allowing for the timely treatment of small, newly detected infestations. The National Invasive Species Management Plan refers to this approach as Early Detection and Rapid Response (EDRR). The approach allows for quick reaction to new disturbances that can lead to rapid weed spread and is an essential piece of an effective invasive species control program.

In meeting this need the following purposes should be achieved:

1. Increase treatment extent and effectiveness relative to past efforts through use of an Integrated Pest Management (IPM) approach for control of invasive plants using manual, mechanical, cultural and chemical control measures.
2. Reduce costs by eradicating new infestations early-on, before they have a chance to spread.
3. Reduce impacts to other resources caused by delays that result in needless invasive plant establishment and spread.

Management direction to prevent, control, and eliminate priority infestations of invasive species on NFS lands can be found in Executive Order 13112, Forest Service Manual 2900, National and Regional Strategy documents, and the Sierra Nevada Forest Plan Amendment of the ENF Land and Resource Management Plan (USDA Forest Service 2004, Record of Decision p. 36, 54-55)..

Proposed Action

The Proposed Action is to annually treat a portion of the invasive plant infestations on the ENF. The number of infestations and acreages treated each year will depend upon available funding; current and historic funding suggests that between 300 and 600 acres of treatments would be completed annually. The integrated pest management approach combines a mixture of preventative, control and restoration/reclamation measures. Control measures would involve integrated prescriptions that generally combine the use of herbicides with mechanical, manual, and cultural control methods over several years. Currently 2,610 acres are mapped as being infested by 32 invasive plant species identified as a priority for treatment.

Control measures could occur outside of the 2,610 acres of currently mapped infestations, but treatments in these areas would be subject to an Annual Implementation Process. Known infested areas and newly discovered areas could total up to 16,472 acres across the ENF using liberal estimates of potential invasive plant spread over ten years.

Decision Framework

Given the purpose and need, the deciding official reviews the proposed action and the other alternatives in order to make the following decisions:

- Whether to implement the project as proposed;
- To not implement the project;
- Or to modify the project

Public Involvement

The proposal was listed in the Schedule of Proposed Actions (SOPA) on October 1, 2008 and posted to the Eldorado National Forest public website. The proposal was provided to the public and other agencies for comment during scoping February 6-27, 2012. In addition, as part of the public involvement process, the agency outreached the project in several formats.

1. Meeting with UC Extension and El Dorado County Ag Dept. regarding the project on September 2, 2008
2. Presentation to the California Native Plant Society, El Dorado Chapter regarding the ENF intent to implement an Integrated Pest Management (IPM) approach to eradicate and control invasive plants, September 22, 2008
3. Open House, held on October 29, 2008 was advertised in the Mountain Democrat newspaper, and through notifications of interested Federal and state agencies, Weed Management Areas, County Agricultural Commissioners, environmental organizations, and Native American tribes. held on October 29, 2008 (Open House was advertised in the Mountain Democrat on Oct. 22, 27, & 29)e-mails and calls were made to agencies, weed management areas, County Ag Commissioners for Placer, El Dorado, Amador and Alpine counties, environmental groups, and

tribes regarding the Open House. Early input was received on the proposal, at Open House and a mailing list of interested individuals was created.

4. Open House was held on October 29, 2008 (Open House was advertised in the Mountain Democrat on Oct. 22, 27, & 29)e-mails and calls were made to agencies, weed management areas, County Ag Commissioners for Placer, El Dorado, Amador and Alpine counties, environmental groups, and tribes regarding the Open House. Early input was received at Open House and a mailing list of interested individuals was created.
5. Public scoping notice (mailed on February 6, 2012) requesting public participation in the form of written or verbal comments to the proposal was sent to interested individuals, non-profit groups, special-use and grazing permit holders, adjacent private landowners, recreation residence associations, government agencies, tribal governments and Native American organizations, that might be interested or who had requested notification on the project.
6 Letter inviting consultation with tribes on the proposal, sent on 2/6/12 to 24 tribal contacts (Federally recognized Tribes and non-recognized Tribes and Tribal Groups)

In response to the Scoping Notice comments were received from 19 individuals, organizations, or groups. Scoping input, and the Forest Service response to this input, are contained in the project record and summarized in Appendix G. Using the comments from the public and other agencies the interdisciplinary team developed a list of issues to address (see Issues section). An issue is defined as a point of disagreement, debate, or dispute with a Proposed Action based on some anticipated effect.

A collaborative meeting was held with Public Employees for Environmental Responsibility in May 2012 to discuss their concerns with the proposed activities. This resulted in refinement of the Proposed Action and design features. In addition, follow-up telephone and email discussions were held with the Pacific Crest Trail Association, and an interested member of the California Native Plant Association, leading to refinement of design features and improvements to the analysis of project effects.

The 30-day comment period (pursuant to 36 CFR 215) was initiated on February 22, 2013 with a legal notice published in the Mountain Democrat Newspaper. Additionally, notification of the availability of a preliminary EA was mailed to 26 individuals, organizations and government agencies including federally recognized tribal governments, tribal groups currently applying for federal recognition and Native American organizations/non-profit groups, that are interested in projects that are located on this portion of the Forest or who had requested notification on the project.

Comments were received from four individuals/organizations; timely comments were received from the California Invasive Plant Council, the Mariposa County Department of Agriculture, and the Pacific Crest Trail Association. In response to comment, the Proposed Action was revised to include a design feature excluding spot spraying within 100 feet of the Pacific Crest Trail. Two commenters included recommended changes to the treatment goals for particular invasive plant species, while expressing general support for the Proposed Action. A summary of Forest Service consideration of comments received is contained in Appendix G.

Issues

The Forest Service separated the issues into two groups: Important and unimportant issues. Important issues were defined as those directly or indirectly caused by implementing the proposed action. Unimportant issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations require this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" A list of issues and a summary of how these issues are addressed in this EA, may be found in Appendix G.

Issues directly or indirectly caused by implementing the proposed action concerned: 1) the potential for herbicide treatments to result in adverse impacts to sensitive resources including non-target vegetation, sensitive wildlife species, and water quality, and 2) the desire for additional specificity and/or changes to design features to avoid potential adverse effects from herbicide treatments. As described in Appendix G, modifications were made to the Proposed Action and a number of design features were added or modified to address specific issues raised in scoping. In addition, as requested in a number of scoping comments, information included in appendices provides greater specificity and transparency in implementing the treatments in the Proposed Action. Appendix B provides site specific management requirements for sensitive plant occurrences that are in proximity to invasive plant infestations, Appendix C provides a project monitoring plan, Appendix D describes the Annual Implementation Process, including forms to be completed for determining annual treatment methods for specific infestations, Appendix E provides a Restoration Plan, and Appendix F contains the Forest Invasive Plant Management Strategy which describes the integrated program including Education, Prevention, Inventory, and Control measures associated with managing the spread of invasive plants on the forest.

The Forest Service identified two topics raised during scoping as important issues requiring an alternative to the Proposed Action: 1) that invasive plants be treated without the use of herbicides, and 2) that design criteria and buffers limiting herbicide use not exceed the requirements specified on the herbicide manufacturer's label. Alternatives addressing these issues were considered by the interdisciplinary team, but were dismissed from detailed consideration as described in the alternatives section.

ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This chapter describes and compares the alternatives considered for the Eradication and Control of Invasive Plants project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative (i.e., treatment or non-treatment of weed infestations) and some of the information is based upon the environmental, social and economic effects of implementing each treatment method (i.e., hand treatment or herbicide use).

Alternatives Considered but Eliminated from Detailed Study

No Herbicide Use

Some scoping comments suggested that herbicide use should be eliminated. The No Action Alternative accomplishes this, as it would not allow any use of herbicide except where already approved. This alternative would not meet the purpose and need of the project for two reasons: 1) manual treatments cannot keep pace with the growth of the larger infested sites, and 2) certain invasive plant species or infestations cannot be effectively treated with methods other than herbicides.

In particular, non-chemical treatment methods have shown little success at treating tall whitetop (DiTomaso and Healy 2007), which is spreading along the highway 50 corridor, Weber Mill Road, Highway 88 and Iron Mountain Ski Resort. Canada thistle and tree of heaven, are additional species occurring on the Eldorado National Forest that cannot be effectively treated without herbicides. Infestations of yellow star thistle within the Star Fire, Cleveland Fire and Fred’s Fire areas are too extensive to reasonably hand pull, but can be effectively controlled with the use herbicides.

This alternative was eliminated from detailed study because it would not meet the project need of eliminating or controlling known priority infestations and it would not achieve the project’s stated purpose of:

1 Increasing treatment extent and effectiveness relative to past efforts through use of an Integrated Pest Management (IPM) approach

2 Reducing costs by eradicating new infestations early-on, before they have a chance to spread.

3 Reducing impacts to other resources caused by delays that result in needless invasive plant establishment and spread.

Follow Herbicide Label Directions – No Additional Design Criteria

Some comments expressed a concern that proposed project design criteria and herbicide buffers that exceed label directions are unnecessary and costly and it was recommended that only label directions be used. An alternative that only follows label directions may meet some, but will not meet all of the management direction contained in the ENF Land Management Plan. Action alternatives are intended to minimize and/or eliminate adverse effects on non-target organisms while meeting the purpose and need for the project. . This alternative was eliminated from detailed study because it would not meet existing Forest management direction.

Alternative 1

No Action

The No Action alternative is required by law and serves as a baseline for comparison of the effects of the action alternatives. Under this alternative there would be no change to the level and type of activities currently being implemented for the control or eradication of invasive plant infestations on the ENF. Invasive plant treatments allowed under existing NEPA decisions (Table 1) would continue to occur but new or additional efforts would not be implemented.

The Forest would implement the prevention measures described in the Forest Invasive Plant Management Strategy (Appendix F), but would not implement the control measures described in the Strategy as part of an integrated pest management plan. While prevention measures will help slow the spread of invasive plants, prevention alone is insufficient to address the spread of existing infestations.

Table 1. Invasive plant treatment projects on the forest.

Project or area	Treatment Acres on NFS lands	Treatment Method	Current-Ongoing or Reasonable Future Project
Yellow starthistle control project	250	chemical/manual	Ongoing since 2001
El Dorado Irrigation District invasive plant program	10	chemical/manual	Ongoing since 2009
PG&E Mokelumne Hydroelectric project invasive plant program	17	chemical/manual	Ongoing since 2008
Invasive plant treatments at Riverside Recreation project	1	chemical/manual	Ongoing since 2009

Invasive plant treatments at Bridal Veil falls	1	chemical/manual	Ongoing since 2009
Spotted knapweed control project	2	chemical/manual	Eradication accomplished –monitoring ongoing
Treatment of invasive plants at Forest Service office and work center sites.	5	chemical/manual	Ongoing
IFG invasive plant treatments	20	chemical/manual	Ongoing
Marshall Mine	10	manual	Ongoing since 2011
Polkadot Motorcycle Race Special Use Permit	1	manual	Ongoing since 2012
Misfire	5	manual	Ongoing since 2012
Rock Creek Recreation area invasive plant treatments along trails	25	manual	Ongoing since 2010
Fred's Fire Reforestation invasive plant treatments	75	Chemical/manual	Ongoing since 2010
Cement Hill	20	manual	Future
Iron trap	5	manual	Future
Big Grizzly Fuels Reduction Project	15	chemical/manual	Future
2 Chaix Fuels Reduction Project	12	chemical/manual	Future

Alternative 2

The Proposed Action

The Proposed Action is to annually treat a portion of the invasive plant infestations on the ENF. The number of infestations and acreages treated each year will depend upon available funding; current and historic funding suggests that between 300 and 600 acres of treatments would be completed annually. The integrated pest management approach combines a mixture of preventative, control and restoration/reclamation measures. Control measures would involve integrated prescriptions that generally combine the use of herbicides with mechanical, manual, and cultural control methods over several years. Restoration and reclamation lowers the potential re-invasion of noxious weeds. Currently 2,610 acres are mapped as being infested by 32 invasive plant species identified as a priority for treatment. The infested areas occur across the ENF and range in size from individual plants to the largest mapped infestation of 353 acres. The average (mean) size of infested areas is 3.5 acres, but more than 85 percent of known infested area patches are less than one acre in size.

Treatment of newly discovered (currently unmapped) infestations of invasive plants would occur as described in the Section on Early Detection Rapid Response. Treatments could occur outside of the 2,610 acres of currently mapped infestations, but treatments in these areas would be subject to the Annual Implementation Process described. Known infested areas and newly discovered areas could total up to 16,472 acres across the ENF using liberal estimates of potential invasive plant spread over ten years (See "Areas Proposed for Treatment" Section). The treatments applied would be modified by project Design Features (DFs), described in the Project Design Features section, which define the set of conditions or requirements that the proposed activities must meet to avoid or minimize potential effects on sensitive resources.

Implementing Treatment Strategies

For each known invasive plant infestation, and for future infestations that may be discovered, one of four treatment strategies is proposed:

1. Annually treat and monitor the infestation with the goal of eradication
2. Treat and monitor a portion of the identified occurrences each year, focusing on reducing the area coverage and amount over time
3. Treat only leading edge infestations or where concurrent with higher priority species
4. No treatments are proposed at this time

Treatment strategies have been developed to address the goals established in the ENF Invasive Plant Management Strategy. Criteria for prioritizing treatment sites, given limited funding, is described in the Forest Invasive Plant Management Strategy (Appendix F). The following prioritization is described:

1) Infestations with a high potential for future spread (prolific species found in high traffic areas such as administrative sites, trailheads, major access points for the forest, and systems vulnerable to invasion (recent fires)
2) High value areas (such as Wilderness) and surrounding points of access
3) Early invaders with small isolated infestations on the forest.
4) Leading edge and satellite occurrences of larger more established infestations
5) The perimeter of larger infestations

Species goals and responses will be reviewed, and if necessary updated, at least once every five years based on new information concerning 1) changes in the occurrence and abundance of invasive plants, and 2) the effectiveness of treatments (see monitoring plan section). The species that will be addressed by each of these treatment strategies are described in the following section.

Treatment Strategy 1: Annually Treat and Monitor with the Goal of Eradication

Infestations of the following 11 invasive plant species would be visited and treated each year until eradicated. These species are documented as highly invasive with severe or substantial ecological impacts in California (Cal-IPC 2006), and are currently limited in their distribution and abundance on the Forest making their eradication an achievable goal. Twenty-four known infestations (Table 2 and Figure 1), as well as newly discovered infestations of the species shown below would be treated and monitored annually to achieve the goal of eradication.

Scientific Name	Common Name
Acroptilon repens	Russian knapweed
Ailanthus altissima	Chinese tree of heaven
Acroptilon repens	Russian knapweed
Aegilops triuncialis	barbed goatgrass
Arundo donax	arundo/giant reed
Centaurea calcitrapa	purple starthistle
Centaurea diffusa	diffuse(white) knapweed
Centaurea stoebe	spotted knapweed
Cirsium arvense	Canada thistle
Euphorbia oblongata	oblong spurge
Lepidium latifolium	tall whitetop
Lythrum salicaria	purple loosestrife

Treatment Strategy 2: Annually treat and monitor a portion of known occurrences with the Goal of Control

A portion of the known occurrences of the following 14 invasive plant species would be annually treated, focusing first on eradicating or containing the most isolated, outlying occurrences and, over time, reducing the footprint of larger, less isolated occurrences. Treatments will also be designed to contain infestations along transit routes in order to prevent these invasive plants from moving into natural forest settings. Restoration and reclamation activities would be designed to lower spread potential. Eight of these species are currently mapped; infestations of Italian thistle, yellow sweetclover, white sweetclover, cheatgrass, Jerusalem oak goosefoot and fennel have not yet been mapped but are known to occur on ENF lands. Yellow star thistle and broom infestations (primarily Scotch broom, but including French and Spanish brooms), in particular, are larger and more widespread than infestations of other species. The goal for treatment of these infestations is to reduce the infestation over time using a strategy of containing the species first, then reducing its area coverage and amount. There are 62 leading edge infestations of yellow star thistle and 74 leading edge infestations of broom that would be the highest priority for treatment.

Depending upon annual funding and resources, the forest would treat and monitor a portion of the 387 known infestations of the following species, as well as newly discovered infestations (the current mapped infestations and acreage is shown in Table 2).

Scientific Name	Common Name
Bromus tectorum	cheat grass
Carduus pycnocephalus	Italian thistle
Centaurea melitensis	tocalote
Centaurea solstitialis	yellow starthistle
Chenopodium botrys	Jerusalem oak goosefoot
Chondrilla juncea	rush skeleton weed
Cytisus scoparius	Scotch broom
Elymus caput-medusae	medusahead
Foeniculum vulgare	fennel
Genista monspessulana	French broom
Melilotus alba	white sweet clover
Melilotus officinalis	yellow sweet clover
Salsola tragus	Russian thistle/tumbleweed
Spartium junceum	Spanish broom

Treatment Strategy 3: Treat isolated, leading edge occurrences or where concurrent with higher priority infestations, with the goal of Control

Targeted efforts to treat the following 10 species would be limited to isolated, leading edge occurrences or areas where these species occur with invasive plants that are a higher priority for treatment (strategies 1 and 2 species). Targeted efforts to control, contain or eradicate these species would be a lower priority for one or more of the following reasons: 1) the species is less invasive and unlikely to create large monocultures on NFS lands; 2) the species cannot be feasibly addressed with available treatments at the Forest-wide scale; or 3) the species is not causing significant ecological impacts. Future analyses may target specific infestations where ecological or resource damage is observed.

Scientific Name	Common Name
Brassica nigra	black mustard
Cirsium vulgare	bull thistle
Hedera helix	English Ivy
Hypericum perforatum	Klamath weed
Lathyrus latifolius	perennial sweet pea
Leucanthemum vulgare	oxeye daisy
Rubus armeniacus	Himalayan blackberry
Rubus lacineatus	cut leaf blackberry
Silybum marianum	milk thistle
Torilis arvensis	hedge parsley
Vinca major	periwinkle

Treatment Strategy 4: No Treatment is Proposed at this Time

An additional 18 invasive plant species have been mapped or are known to occur on the forest, but would not be targeted for eradication or control at this time due to widespread occurrence or limited ecological impact (Appendix F). Future analyses may target specific infestations where ecological or resource damage is observed.

Potential Invasives

The following species may occur on the ENF but have not yet been discovered or mapped. If found, infestations of these species will be targeted for treatment as shown in parentheses, using the methods shown in Table 4.

Scientific Name	Common Name
Aegilops cylindrica	jointed goatgrass (1)
Cardaria chalepensis	small whitetop (1)
Cardaria draba	hoarycress (1)
Cardaria pubescens	whitetop (1)
Carduus nutans	musk thistle (1)
Carthamus lanatus	woolly distaff thistle (1)
Centaurea pratensis	meadow knapweed (1)
Centaurea sulphurea	Sicilian starthistle (1)
Cortaderia selloana	Pampas grass (2)
Dittrichia graveolens	stinkwort (3)
Euphorbia esula	leafy spurge (1)
Isatis tinctoria	dyer's woad (1)
Linaria genistifolia ssp. dalmatica	Dalmatian toadflax (1)
Linaria vulgaris	yellow toadflax (1)
Nicotiana glauca	tree tobacco (2)
Onopordum acanthium	Scotch thistle (1)
Phragmites australis	common reed (1)
Polygonum cuspidatum	Japanese knotweed (2)
Polygonum sachalinens	Sakhalin knotweed (2)
Sesbania punicea	scarlet wisteria (1)
Tamarix chinensis	salt cedar/tamarisk (1)
Tanacetum vulgare	tansy (3)
Ulex europaeus	gorse (1)
Potentilla recta	sulfur cinquefoil (2)

Areas Proposed for Treatment

The area proposed for treatment is described in three separate categories: 1) currently mapped infestations, 2) potential growth of mapped infestations, and 3) infestations discovered subsequent to this analysis. The known or estimated acreage of each is shown in Table 1 and described below.

Mapped Infestations Approximately 2,610 acres with invasive plants are currently mapped and proposed for treatment as strategy 1, 2 or 3 sites; an additional 1,851 acres (an area double the size of each recorded infestation) will be analyzed for proposed treatments assuming population growth or increased extent of some currently mapped occurrences. When weed sites are mapped, a boundary is drawn around an area of infestation, usually in the field with a hand-held Global Positioning Unit. Some are patchy, some are dense, and some are single plants scattered widely in the site. Therefore, mapped weed sites incorporate more land than is actually infested, and only a portion of the mapped area will be treated for invasive species. Table 3 displays the proportion of known infestation proposed for treatment that occurs at administrative sites, on roadside, or within areas recently disturbed by wildfire.

An integrated approach will often involve a variety of treatment methods at a single site and effective eradication or control may require multiple treatments at the same site during a season and during the duration of this project. Treatments are proposed on as many infested acres as is feasible over time, but, in general, treatments have occurred on about 300 to 600 acres annually based upon recent funding levels (generally in sites less than 5 acres in size).

Growth of Mapped Infestations Where there are limited resources to accomplish treatments, infested areas will continue to increase in size. Potential growth depends on disturbance agents. Large fires are particularly hazardous for noxious weed control given the open site, high flux of nutrients and unoccupied habitat. The potential for spread is high along major roads due to grading and material imported for road reconstruction or repair, and high traffic; in order to reduce rates of spread, these and other vectors are a high priority for treatments as described in the ENF Weed Management Strategy (Appendix F). The literature documents rates of noxious weed spread varying from 10 to 24 percent for many of the species proposed for treatment (Asher and Dewey 2005). For analysis purposes, the following assumptions have been used to arrive at an estimate of the area that might become infested and treated over a 10-year timeframe: 1) the size of mapped infestations has been doubled to account for the potential growth of previously mapped infestations, 2) no growth of treatment strategy 1 infestations was assumed since these infestations would be treated annually with a goal of eradication 3) treatment strategy 2 and 3 infestations (other than scotch broom) were assumed to increase at a rate of 20 percent per year, (scotch broom infestations were assumed to be static in size, since large infestations have existed for many years and are unlikely to be expanding at rapid rates). Considering these liberal assumptions, infestations could occur over an area of 16,472 acres during a ten year timeframe. Resource limitations are likely to limit the area that would be treated during the ten-year time frame, however. Under the liberal scenario of 600 acres of new treatment each year, current funding levels suggest that a cumulative area of less than 6,000 acres would be likely to receive treatment within a 10 year timeframe. With this in mind, treatment prioritization, as described in the ENF Invasive Plant Management Strategy (Appendix F) will need to occur.

Infestations Discovered Subsequent to this Analysis The proposed action would also allow for treatment of newly discovered (currently unmapped) infestations of invasive plants as described under the Section on Early Detection Rapid Response (EDRR). Although sites are not identified, based on the rate of discovery of new infestations in 2008 and 2009 (about 25 acres per year), an additional (estimated) 250 acres of ground might be treated under the provisions of the EDRR program over a 10 year period.

Table 2. Projected treatment areas over life of project.

	Mapped acres at start of project	Potential infested area acres[1]	20% annual growth/year over 10 years	Maximum acres after 10 years
Known strategy 1 infestations	84	168	NA	0.00
Known strategy 2 infestations (excluding broom)	997	1,869	11,572	13,441
Known strategy 3 infestations	2	3	19	22
Known strategy 2 broom infestations	1,638	2,759	2,759	2,759
New Infestations treated under EDRR	N/A	25	NA	250
Total Area[2]	2,610[2]	4,461[2]	14,435	16,472

[1] Potential infested area was estimated to be double the size of current mapped sites. New infestations discovered and proposed for treatment under EDRR estimated at 25 acres per year.
[2]Total area is less than the sum of acres of strategy 1, 2, and 3 infestations because of overlapping infestations and non-NFS lands not included in doubled acres.

Table 3. Site Type Descriptions for Proposed Treatment Areas

Site Type Description	Infested Acres	% of Treatments
Rec. Site, Admin. Site, Recreation Residence Site	73	3
Roadside[1]	331	13
Wildfire Area[2]	620	24
Other	1,585	60
Total Proposed Treatment Areas	**2,610**	

[1]Within 15 feet of center of road prism
[2] Non-roadside wildfire area occurring in last 20 years

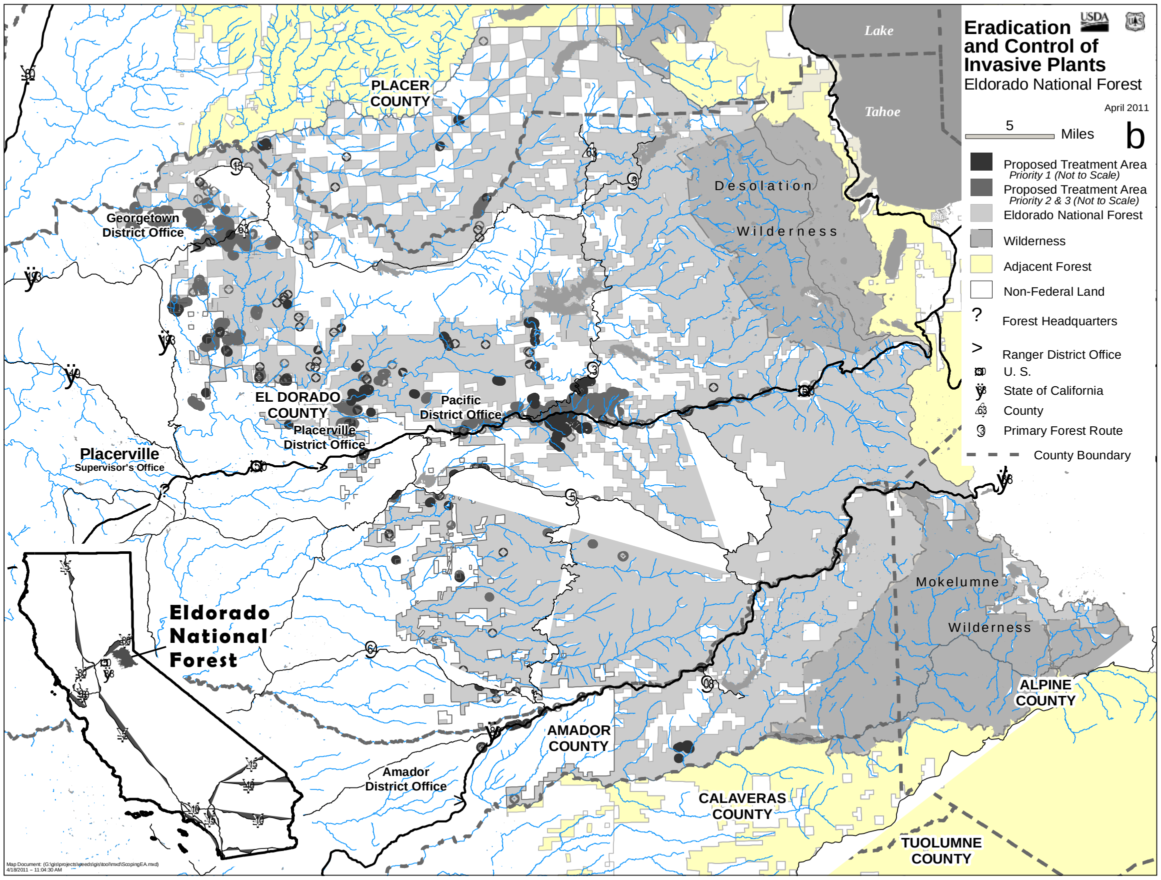

Figure 1. Map of Invasive Plant Infestations Proposed for Eradication or Control

Treatment Methods

An Integrated Pest Management (IPM) control approach employs a combination of treatment methods including manual, mechanical, and chemical (herbicide) methods. Successful treatments often require multiple years of treatments, and sometimes require multiple treatments per year, involving a combination of methods. The treatments are tailored depending on:

- Target invasive plant species and its biology (e.g. mode of reproduction)
- Population size and density
- Site type (e.g. disturbed roadside, riparian, upland)
- Prior treatments and their effectiveness

Table 4 displays the methods proposed as possible treatments for each invasive species. Treatments are usually a combination of methods; for example, an initial application of herbicide will often be followed with manual treatments after the density and extent of an infestation is reduced. The choice of methods in a particular year and for a particular infestation, would consider the effectiveness of all possible methods described in Table 4.

An Annual Implementation Process (see following section) would require a description of methods proposed for use that season; where herbicide treatments are proposed, a determination would need to be made that methods other than herbicides would not be effective or practical for the needed treatment or control. Assuming a treatment method meets design features and is effective, practical, and cost efficient, treatment methods described in the annual implementation plan would be applied in the following order of preference:

1. Manual and mechanical treatment methods, such as hand pulling and cutting.
2. Application of herbicide via targeted treatment methods such as cut stump, wiping, or directed foliar spray from backpack sprayers.
3. Application of herbicide via a targeted spot spray method using backpack sprayers. This treatment method targets a plant and the immediate area surrounding the plant in order to reduce seed germination. It would be limited to disturbed sites dominated by non-native species and would be followed by revegetation where needed to improve treatment effectiveness.

This treatment approach utilizes the principles described in "Ecologically-Based Invasive Plant Management" (www.EBIPM.org) by considering the biology of particular species and particular site conditions when designing the appropriate treatment. The order of preference for treatment methods addresses the fact that, despite their initial efficacy, herbicides can have some undesirable longer-term consequences by potentially making a site more susceptible to reinvasion, and potentially shifting species composition and reducing diversity of native plant communities as less herbicide-tolerant species are replaced by more herbicide-tolerant species (www.EBIPM.org). To minimize unintended consequences, only targeted chemical treatment methods are proposed. Secondary invasion from invasive plants is addressed using restoration and reclamation. The feedback from the monitoring during annual implementation provides information on treatment efficacy. By using this conservative IPM approach unintended consequences are avoided.

Proposed treatment methods are described more specifically in the following section.

Manual Methods

Hand Pulling Uprooting plants by hand or pulling, removing as much of the root as possible while minimizing soil disturbance. Control by hand pulling is effective for some annual and tap-rooted plants, such as scotch broom seedlings; it is not effective against many perennial plants with deep underground roots and/or plants with easily broken roots that are left behind to re-sprout. Hand pulling is the preferred method of treatment where it is effective and efficient. This applies to small, young infestations of many species, as well as follow-up treatments for many larger infestations initially treated with other methods.

Pulling Using Tools Most plant-pulling tools, such as the weed wrench, are designed to grip the plant stem and provide the leverage necessary to pull its roots out. Ground disturbance is localized but because of the larger stems and root systems that can be treated in this manner, use of pulling tools may result in greater ground disturbance than would occur through hand pulling. This approach has been successfully used for broom plants.

Clipping Clipping refers to cutting or removing seed heads and/or fruiting bodies to prevent germination. This method is labor-intensive but can be effective for small and spotty infestations or as follow-up treatments to treat target plants missed by initial herbicide use. This method may also be used in sensitive areas with resource concerns from other treatment methods. This approach does not involve ground disturbance or impacts; it is currently being used when small numbers of invasive plants are discovered with seed heads present. This method is appropriate for annual plants or for perennial plants that should not be pulled by hand.

Cutting Cutting of woody stems when plants are drought stressed has been shown to be effective at eliminating or reducing mature scotch broom plants. This approach is labor-intensive but can be effective for treating small or sensitive areas.

Mulching and Tarping Mulching involves covering plants with “weed free” and plastic free mulch as wood chips or rice straw to shade out weeds. Tarping places tarps to shade out weeds or to injure them through long exposure to heat from the sun. Tarping can be effective for controlling small infestations.

Mechanical Methods

Mowing or Cutting with a Hand-held String or Blade Trimmer Mowing or cutting with a gas powered string or blade trimmer can reduce seed production and restrict invasive plant growth, especially in annuals cut before they flower and set seed. The timing of treatment should be appropriate to the species. Some species re-sprout vigorously when cut, replacing one or a few stems with many that can quickly flower and set seed. Mowing and cutting may be used as a primary treatment or a follow-up treatment to another initial treatment method. Mowing or cutting can also be used to promote vigorous growth in order to increase herbicide effectiveness.

Chemical Methods

Six herbicides are proposed for use, using the methods and application rates shown in Table 4. The following is a description of the methods and chemical products listed in Table 5.

Cut stump Herbicide is applied to cut stem surfaces (primarily the cambium) to eliminate or greatly reduce resprout. A backpack sprayer with a regulated nozzle, spray bottle, wicking apparatus, or paintbrush can be used to apply a 50-100% solution of herbicides soon after the cut is made. This treatment is applied to individual target plants thereby reducing drift from falling onto non-target plants, soil or water.

Wiping onto foliage A sponge or wick is used to wipe a 25-50% solution of herbicide onto foliage and stems of target plants. Wicking apparatus vary in design, but generally consists of a reservoir attached to a sponge or wick. Ball valves would be installed on the reservoir to control the flow of herbicides from the reservoir to the wick to prevent drips. Wicking would be used in sensitive areas to avoid effects from drift.

Drizzle The drizzle application method employs a backpack sprayer and a spray gun fitted with an orifice disk (0.5 mm). With a head of 20 psi, the spray gun shoots a fine stream that breaks into large droplets when it contacts the plant. Invasive plants would be treated from about 6 feet away using a "W" shape spray pattern that disperses the herbicide solution over the shrub canopy in a "drizzle" or sprinkled fashion. The method uses a lower volume, but higher concentration of herbicide. A 10% solution of glyphosate would be used to treat areas with a dense cover of scotch broom.

Directed Foliar Spray A backpack sprayer or compressed air sprayer (holding 1-5 gallons) of dilute herbicide solution is used to apply herbicides to targeted plants. A backpack sprayer has a hand operated hydraulic pump that forces liquid herbicide through a spray wand with a regulated nozzle held near the application surface. Spray is typically controlled by using a wand to direct herbicides to target vegetation, regulating tank pressure, utilizing different nozzle types, and combining dyes with spray solution. Directed foliar spray concentrates spray upon the target plant with the intent of minimizing spray between target plants.

Spot Spray This method would be limited to areas heavily dominated (generally greater than 85% cover) by non- native species. In this analysis, "spot spray" refers to herbicide application that is targeted at an invasive plant and the area immediately surrounding the plant. Herbicide would be applied using a backpack sprayer with no boom. The spot spray method would be limited to aminopyralid and clopyralid, herbicides that can provide residual control in the soil for starthistles and knapweeds that germinate through the spring and early summer. The use of this method at disturbed sites reduces the need for re-treatment to capture target plants that germinate later in the season and would otherwise require re-treatment to implement effective control. Treated sites would be evaluated for the need for retreatment and the need for revegetation as described in Project Design Feature (DF) 29.

Proposed Herbicides

Six herbicides are proposed for use in this project, using the application methods and rates shown in Table 5: **aminopyralid, clopyralid, chlorsulfuron, glyphosate, imazapic,** and **triclopyr**. When appropriate, herbicides with different modes of action have been proposed for an invasive plant species. This can help reduce the risk of populations developing herbicide tolerance from repeated application with the same herbicide.

Herbicide treatments would include the use of a surfactant to enable herbicide penetration of the plant cuticle (a thick, waxy layer present on leaves and stems of most plants). Surfactants are materials that facilitate the activity of herbicides through emulsifying, wetting, spreading or otherwise modifying the properties of liquid chemicals. Treatments would also include use of a dye to assist the applicator in efficiently treating target plants and avoiding contact with plants that have already been treated. A methylated seed oil surfactant, such as Hasten or Competitor, would be used as a surfactant and a water soluble dye, such as Highlight Blue, would be used as a dye.

Herbicides would be applied in accordance with 1) product label directions; 2) California Department of Pesticide Regulation requirements; 3) Forest Service best management practices for water quality (USDA Forest Service 2011); and 4) Forest Service direction (FSM 2080, 2150 and 2200) and Handbook (FSH 2109.14). This project includes a Pesticide Use Spill Plan that is prepared and reviewed prior to herbicide use each year. In addition, prior to any herbicide use, a Pesticide Use Proposal (PUP) (FS-2100-2) and safety plan (FS-6700-7) would be completed by the project lead and approved by the Forest Supervisor.

Only the proposed herbicides that have been approved for use in the state of California and have a label certifying that the chemical has been approved for use by the Federal Environmental Protection Agency (EPA) and the California Department of Pesticide Regulation (DPR), would be used (imazapic does not currently have an approved label in the State of California and would not be used prior to this approval). The label contains information about the product, including its relative toxicity, potential hazard to humans and the environment, directions for use, storage and disposal, and first aid treatment in case of exposure. Label directions provide for public and worker safety by requiring posting of treated areas, pre-designation of mixing, storage and filling sites, and transportation and handling practices in accordance with toxicity of each formulation. Label directions, as well as all 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. A site-specific safety and spill plan would be developed prior to herbicide applications. Where herbicide treatments are proposed, the lowest effective label rates would be used.

The following is a short description of the proposed herbicides and their uses.

Glyphosate Glyphosate is a non-selective systemic herbicide that can control most annual and perennial plants. Glyphosate rapidly binds to soils, and is not readily absorbed by plants roots. Its non-selectiveness causes this herbicide to kill most plants where applied, including desirable native species. Plants can take several weeks to die and a repeat application in the same season is sometimes necessary to remove plants that were missed during the first application. Directed foliar spray, wiping, drizzle, and cut stump application methods would be used with this herbicide, at the rates shown in Table 5. Only formulations without a premixed surfactant are being proposed for use. A product example is **Accord; Rodeo** or **Aquamaster** are examples of available aquatically labeled formulations.

Aminopyralid Aminopyralid is a pre- and post-emergent herbicide that can control a number of key invasive broadleaf species, especially in the Asteraceae, Fabaceae, Apiaceae, Solanaceae, Polygonaceae, Violaceae plant families. Aminopyralid provides residual weed control activity, reducing the germination of target plants and the need for re-treatment. The herbicide has a lower effective application rate (compared to other registered herbicides) and a non-volatile formulation. Aminopyralid is labeled for use to water's edge in California. Aminopyralid is generally applied to young weeds that are actively growing during time of application. It is proposed for use primarily on starthistles, knapweeds, Canada thistle, and rush skeletonweed using directed foliar spray, spot spray or wicking. Spot spray would be limited to disturbed areas dominated by non-native species. A product example is **Milestone**.

Clopyralid Clopyralid is a pre- and post-emergent herbicide that can control a number of key invasive broadleaf species, especially in the Asteraceae, Fabaceae, Solanaceae, Polygonaceae, and Violaceae plant families. Clopyralid also provides residual weed control activity, reducing the germination of target plants and the need for re-treatment. An integrated approach that includes revegetation may be required. For best results Clopyralid is generally applied to young weeds that are actively growing during time of application. It is proposed for use primarily on starthistles and knapweeds, using directed foliar spray, spot spray or wicking. Spot spray would be limited to disturbed areas dominated by non-native species. A product example is **Transline**.

Chlorsulfuron Chlorsulfuron is a selective pre- and post-emergent herbicide used to control many broadleaf species. Chlorsulfuron would be used only as a post-emergent and only when other treatment methods are no better than marginally effective for treating a species. It is proposed for use on tall whitetop, (*Lepidium latifolium*), hoarycress (*Cardaria spp*.), dyer's woad (*Isatis tinctoria*), butter and eggs (*Linaria vulgaris*) and Dalmatian toadflax (*Linaria genistifolia ssp. dalmatica*) using directed foliar spray or wiping. A product example is **Telar**.

Triclopyr Triclopyr is a selective post-emergent herbicide used to control woody and broadleaf plants. There are two basic formulations of triclopyr- a triethylamine salt (TEA) and a butoxyethyl ester (BEE). Only the triethylamine salt formulation is proposed for use in this project. It is proposed for use primarily on woody species (e.g. brooms, Chinese tree of heaven); and purple loosestrife (*Lythrum salicaria*). Application for woody species would include cut stump, directed foliar spray or wiping. **Garlon 3A** is a product example.

Imazapic Imazapic is effective upon annual and perennial grasses and some broadleaf plants, and vines that would be used for post-emergent control. It is currently not labeled for use in California and would only be used if and when a product label becomes available. It is proposed primarily for control of annual grasses including medusahead (*Taeniatherum caput-medusae*), barbed goatgrass (*Aegilops triuncialis*), and cheatgrass (Bromus tectorum). Imazapic may also be used to control some broadleaf species such as dyer's woad (*Isatis tinctoria*), Dalmatian toadflax (*Linaria genistifolia ssp. dalmatica*), and tall whitetop (*Lepidium latifolium*) using directed foliar spray, or wiping.

Table 4. Mapped infestations, Treatment Strategy and Treatment Methods for Invasive Plant Species.

				HAND / MECHANICAL			CHEMICAL TREATMENTS								
							Spot Spray	Directed Foliar Spray, Drizzle or Wiping						Cut Stump	
Species	**Strategy**	**# of Sites**	**Mapped Acres**	Handpull or pull with tools	Cut plants/ Clip seedhead	Mulch or Tarp	Aminopyralid/Clopyralid	Aminopyralid	Glyphosate	Chlorsulfuron	Clopyralid	Triclopyr	Imazapic	Glyphosate	Triclopyr
Russian knapweed *(Acroptilon repens)*	1	1	<1	X[3]		X	X	X	X		X				

				HAND / MECHANICAL			CHEMICAL TREATMENTS								
							Spot Spray	Directed Foliar Spray, Drizzle or Wiping						Cut Stump	
Species	**Strategy**	**# of Sites**	**Mapped Acres**	Handpull or pull with tools	Cut plants/ Clip seedhead	Mulch or Tarp	Aminopyralid/Clopyralid	Aminopyralid	Glyphosate	Chlorsulfuron	Clopyralid	Triclopyr	Imazapic	Glyphosate	Triclopyr
Purple starthistle *(Centaurea calcitrapa)*	1	1	<1	X			X	X	X		X				
Diffuse knapweed *(Centaurea diffusa)*	1	3	1	X[3]			X	X	X		X				
Spotted knapweed *(Centaurea stoebe)*	1	4	6	X[3]			X	X	X		X				
Oblong spurge *(Euphorbia oblongata)*	1	1	1	X[3]		X			X				X		
Tall whitetop *(Lepidium latifolium)*	1	9	2		X[4]	X			X	X			X		
Purple loosestrife (*Lythrum salicaria)*	1	1	<1		X[4]	X			X						
Arundo (*Arundo donax)*	1	1	<1	X[3]					X					X	
Canada thistle (*Cirsium arvense*)	1	3	<1		X[4]	X		X	X		X				
Barbed goatgrass *(Aegilops triuncialis)*	1	18	2		X			X	X[2]				X		
Chinese tree of heaven *(Ailanthus altissima)*	1	3	<1	X[3]	X[4]									X	X
Scotch thistle (*Onopordum acanthium)*	1	--	--	X				X	X		X				
Musk thistle *(Carduus nutans)*	1	--	--	X				X	X		X				
Wooly distaff thistle (*Carthamus lanatus*)	1	--	--	X				X	X		X				
Meadow knapweed (*Centaurea debeauxii*)	1	--	--	X[3]	X[4]			X	X		X				
Hoarycress, Whitetop (*Cardaria draba)*	1	--	--		X[4]	X			X	X					
Leafy spurge (*Euphorbia esula*)	1	--	--	X[3]		X			X				X		

				HAND / MECHANICAL			CHEMICAL TREATMENTS								
							Spot Spray	Directed Foliar Spray, Drizzle or Wiping						Cut Stump	
Species	**Strategy**	**# of Sites**	**Mapped Acres**	Handpull or pull with tools	Cut plants/ Clip seedhead	Mulch or Tarp	Aminopyralid/Clopyralid	Aminopyralid	Glyphosate	Chlorsulfuron	Clopyralid	Triclopyr	Imazapic	Glyphosate	Triclopyr
Dalmatian toadflax *(Linaria genistifolia ssp. dalmatica)*	1	--	--		X[4]				X	X			X		
Yellow toadflax (*Linaria vulgaris*)	1	--	--		X[4]				X	X			X		
Dyer's woad *(Isatis tinctoria)*	1	--	--	X					X	X			X		
Salt cedar, tamarisk *(Tamarix chinensis)*	1	--	--	X											X
Common reed (Phragmites australis)	1	--	--		X				X						
Gorse *(Ulex europaeus)*	1	--	--	X	X[5]				X			X		X	X
Scarlet wisteria *(Sesbania punicea)*	1	--	--	X[3]	X[4]							X		X	X
Small whitetop (*Cardaria chalepensis)*	1	--	--		X[4]	X			X	X					
Whitetop *(Cardaria pubescens)*	1	--	--		X[4]	X			X	X					
Sicilian starthistle *(Centaurea sulphurea)*	1	--	--	X	X		X	X	X						
Broom species *(Cytisus, scoparius, etc)*	2	160	1,637	X	X[5]				X					X	X
Medusahead *(Taeniatherum caput-medusae)*	2	16	8		X			X	X[2]				X		
Yellow starthistle *(Centaurea solstitialis)*	2	116	600	X	X		X	X	X		X				
Tocalote *(Centaurea melitensis)*	2	2	4	X	X			X	X		X				
Rush skeletonweed *(Chondrilla juncea)*	2	72	108	X[1]				X	X		X				
Russian thistle *(Salsola tragus)*	2	5	<1	X					X						
Italian thistle *(Carduus pycnocephalus)*	2	P	P	X				X	X		X				

				HAND / MECHANICAL			CHEMICAL TREATMENTS								
							Spot Spray	Directed Foliar Spray, Drizzle or Wiping						Cut Stump	
Species	**Strategy**	**# of Sites**	**Mapped Acres**	Handpull or pull with tools	Cut plants/ Clip seedhead	Mulch or Tarp	Aminopyralid/Clopyralid	Aminopyralid	Glyphosate	Chlorsulfuron	Clopyralid	Triclopyr	Imazapic	Glyphosate	Triclopyr
Fennel *(Foeniculum vulgare)*	2	P	P	X[3]	X[4]				X					X	X
Yellow sweet clover *(Melilotus officinalis)*	2	P	P	X	X			X	X		X				
White sweet clover *(Melilotus alba)*	2	P	P	X	X				X		X				
Cheat grass *(Bromus tectorum)*	2	P	P		X			X					X		
Jerusalem oak goosefoot *(Chenopodium botrys)*	2	P	P	X					X						
Tree tobacco *(Nicotiana glauca)*	2	--	--	X					X			X		X	X
Japanese knotweed (Polygonum cuspidatum)	2	--	--	X[3]					X			X		X	X
Sakhalin knotweed (*Polygonum sachalinens*)	2	--	--	X[3]					X			X		X	X
Sulfur cinquefoil *(Potentilla recta)*	2	--	--	X				X	X		X				
Jointed goatgrass *(Aegilops cylindrical)*	2	--	--		X				X[2]				X		
Pampas Grass *(Cortaderia selloana)*	3	--	--	X	X				X						
Hedge parsley *Torilis arvensis*	3	P	P	X	X	X			X						
Himalayan blackberry *(Rubus armeniacus)*	3	P	P	X[3]	X	X			X			X			
Cut leaf blackberry *(Rubus lacineatus)*	3	P	P	X[3]	X	X			X			X			
English / Algerian Ivy *(Hedera helix)*	3	P	P	X[3]	X[4]	X			X			X		X	X
Bull thistle *(Cirsium vulgare)*	3	P	P	X	X			X	X		X				
Milk thistle *(Silybum*	3	P	P	X	X			X	X		X				

				HAND / MECHANICAL			**CHEMICAL TREATMENTS**								
							Spot Spray	Directed Foliar Spray, Drizzle or Wiping						Cut Stump	
Species	**Strategy**	**# of Sites**	**Mapped Acres**	Handpull or pull with tools	Cut plants/ Clip seedhead	Mulch or Tarp	Aminopyralid/Clopyralid	Aminopyralid	Glyphosate	Chlorsulfuron	Clopyralid	Triclopyr	Imazapic	Glyphosate	Triclopyr
marianum)															
Perennial sweet pea *(Lathyrus latifolius)*	3	P	P	X[3]		X			X			X			
Klamathweed *(Hypericum perforatum)*	3	P	P	X[3]	X				X						
Oxeye daisy *(Leucanthemum vulgare)*	3	P	P	X[3]				X	X		X				
Black mustard *(Brassica nigra)*	3	P	P	X	X				X						
Periwinkle *(Vinca major)*	3	P	P	X[3]		X			X						
Tansy *(Tanacetum vulgare)*	3	--	--	X	X[4]			X	X		X				
Stinkwort *(Dittrichia graveolens)*	3	--	--	X				X	X		X				

[1] First year plants only

[2] Limited to isolated infestations in degraded areas (roads, landings, helipads)

[3] Removal of root system is required to prevent resprouting

[4] Effective for preventing seed production, need to combine with other treatment methods where goal is eradication

[5] Cutting when drought stressed will limit resprouting.

P = Present but mostly unmapped

-- = not yet known to occur on the forest

Table 5. Herbicide Application Rates

Herbicide	**Application Methods**	**Expected lb acid equivalent per acre per year (one treatment)**	**Expected lb active ingredient or acid equivalent per acre per year (multiple treatments)**	**Maximum lb active ingredient or acid equivalent per acre per year (label max)**	**Expected application volume of diluents and chemical (gallons/acre)**	**Maximum # of treatments per year**
Aminopyralid	spot spray	0.047-0.11	NA	0.1116	25	1
	directed foliar spray	0.047-0.11			25	
	wiping (50% solution)	0.0235-0.055			0.0235-0.055	
	wiping (100% solution)[1]	0.047-0.11			0.0235-0.055	

<table>
<tr><th>Herbicide</th><th>Application Methods</th><th><u>Expected</u> lb acid equivalent per acre per year (one treatment)</th><th><u>Expected</u> lb active ingredient or acid equivalent per acre per year (multiple treatments)</th><th colspan="2"><u>Maximum</u> lb active ingredient or acid equivalent per acre per year (label max)</th><th><u>Expected</u> application volume of diluents and chemical (gallons/acre)</th><th>Maximum # of treatments per year</th></tr>
<tr><td rowspan="3">Clopyralid</td><td>spot spray</td><td>0.25</td><td rowspan="3">NA</td><td colspan="2" rowspan="3">0.25</td><td>25</td><td rowspan="3">1</td></tr>
<tr><td>directed foliar spray</td><td>0.25</td><td>25</td></tr>
<tr><td>wiping (100% solution)</td><td>wiping (100% solution)</td><td>0.083</td></tr>
<tr><td rowspan="2">Chlorsulfuron</td><td>directed foliar</td><td rowspan="2">0.046-0.12 (a.i)</td><td rowspan="2">NA</td><td rowspan="2">NA (non rangelands)</td><td rowspan="2">0.062 (rangelands)</td><td>25</td><td rowspan="2">1</td></tr>
<tr><td>wiping (100% solution)</td><td>0.0078-0.0234</td></tr>
<tr><td rowspan="4">Glyphosate</td><td>directed foliar</td><td>3</td><td>6</td><td colspan="2" rowspan="4">8</td><td>25</td><td>2</td></tr>
<tr><td>cut stump (50-100% solution)</td><td>1.5-3.0</td><td>NA</td><td>1.5</td><td>1</td></tr>
<tr><td>Drizzle (10% solution)</td><td>1.5</td><td>NA</td><td>3.75</td><td>1</td></tr>
<tr><td>wiping (33% solution)[1]</td><td>1.5</td><td>3</td><td>1.125</td><td>2</td></tr>
<tr><td>Imazapic</td><td>directed foliar</td><td>0.0625-0.1875</td><td>NA</td><td colspan="2">0.1875</td><td>25</td><td>1</td></tr>
<tr><td rowspan="3">Triclopyr (triethylamine salt formulation)</td><td>directed foliar</td><td>1.5</td><td rowspan="3">NA</td><td rowspan="3">6 (Forestry)</td><td rowspan="3">9 (nonforestry)</td><td>25</td><td rowspan="3">1</td></tr>
<tr><td>cut stump (50% solution)</td><td>1.5</td><td>2.3</td></tr>
<tr><td>wiping (25-50% solution)[1]</td><td>0.75-1.5</td><td>1.1- 2.3</td></tr>
</table>

1-Literature suggests that wiping uses 50% less herbicide (lbs active ingredient) than spraying.

Site Restoration/Revegetation

Guidelines for revegetation of invasive plant sites are described in Appendix E. Revegetation will involve site preparation, such as raking to prepare a seed bed to promote seed germination, planting of seeds and/or propagules (depending on the species, this is done either in early spring or late fall to take advantage of available moisture), vigilant treatment of invasive plants as they germinate from the existing seedbank, and monitoring the results. In some cases, a follow-up seeding/planting may need to be done.

Revegetation with carefully selected plant materials is a critical component of integrated weed management strategies. Commonly used control tactics, such as manual or chemical treatments, in effect create a disturbance on the current vegetation community. These control tactics may eliminate or suppress target invasive species in the short term, but the resulting gaps in vegetation and bare soil create open niches susceptible to secondary invasion by the same or other undesirable plant species. The spot method can leave sites open to secondary invasion since larger areas of vegetation are eliminated. Spot spray areas would be reviewed and determination made about the need for active restoration. Areas with bare soil created by the treatment of invasive plants would be evaluated for restoration needs by a botanist and soil scientist. Revegetation would occur where needed to meet resource goals, including desired conditions for ground cover and native plant composition.

Determining the need for active restoration/revegetation versus passive restoration (allowing plants on site to fill in a treated area) is the first step when addressing this need. Passive restoration depends on re-colonization from the existing seedbank and from plant propagules dispersed from surrounding sources, as well as native species from within the invasive plant site. Passive restoration may be appropriate where treated sites leave relatively little bare ground or along less-disturbed roadsides where adjacent native vegetation can provide adequate seed source to recolonize treated areas.

Active revegetation is a long-term commitment that would be focused on areas that are either ecologically unique, or where active revegetation is necessary to provide competition for highly aggressive invasive plant species. In some cases, active restoration is not the preferred choice due to the nature of the site. Examples include continually disturbed areas, such as road shoulders that are frequently maintained, active landings, and river banks that are prone to annual scouring. The need for revegetation would be evaluated during the annual implementation process as outlined in the following section and in Appendix D.

Old roadbeds, mining sites, are examples of sites that are unproductive but need stabilization. Revegetation may be difficult since these sites are not yet ready to support desired native vegetation. Applying groundcover with mulch stabilizes the site against erosion, while creating a weed barrier. For these extreme cases, the initial site stabilization methods are the first stage for future revegetation efforts.

Monitoring

Treatment effectiveness and the effectiveness of project design features would be monitored in accordance with the monitoring plans in Appendix C.

Treatment Effectiveness: Treatment effectiveness would be monitored each year using standard procedures described in the National Data Recording Protocols for Invasive Species Management. These protocols record data on the location of treatments, and the percentage of the targeted invasive species population (infestation) that was controlled by the treatment. The effectiveness of each treatment would be evaluated annually by reviewing the treatment efficacy ratings and adjusting methods (within the parameters of the Project Decision) to improve effectiveness. For example, annual monitoring may show a need to adjust treatment timing to increase efficacy or to revise use of a particular method. Treatment effectiveness will be formally reviewed and reported at least once every five years and, at a minimum, adjustments would be recommended where annual efficacy ratings are less than "Fair" over a period of five years. Monitoring would continue at treated sites for three years after a target species infestation has been determined eradicated on the site since seeds of many invasive plants will remain viable for several years, leaving sites vulnerable to reinfestation.

Non-targeted Impacts to Sensitive Plants and Native Vegetation: If invasive plant treatments occur within and around sensitive plant occurrences or other botanically unique areas (i.e. Special Interest plant communities; Botanical Special Interest Areas (SIA); and riparian plant communities), the forest will implement monitoring designed to detect non-targeted impacts to surrounding native vegetation. The risk to native vegetation from continued invasive treatment efforts will be weighed against the potential impacts of spreading invasive species, when developing and modifying invasive plant treatments.

Water Quality: Water quality monitoring would be implemented in compliance with the Regional Water Quality Management Handbook. BMP implementation checklists will document whether, and when, the site-specific BMPs specified in NEPA analyses were implemented. The checklist will be the primary systematic means for early detection of potential water-quality problems, and will be completed early enough to allow corrective actions to be taken, if needed, prior to any significant rainfall or snowmelt throughout the duration of the project.

In addition to BMP implementation monitoring, monitoring of spray drift and direct measurement of water for herbicides (BMP 5.9) would occur at a sample of sites with highest possibility of experiencing direct surface runoff. These sites are roads and roadside ditches with high connectivity to perennial and intermittent streams. The following monitoring would occur to confirm that project design features are preventing entry of herbicides into water: 1) Drift cards would be used at a sample of sites where spraying occurs within 25 feet of a roadside ditch that has connectivity to a perennial or intermittent stream. Sample sites would be road surfaces or roadside ditches within 100 feet of a stream, where vegetation does not buffer or filter the surface flow; 2) Water quality monitoring would occur annually in streams associated with these sites to detect whether surface runoff is resulting in any detectable herbicide entry into waterbodies. Samples would be taken after the beginning of the wet season (approximately November) when runoff observably has responded to increased soil moisture. Design features and/or stream/waterbody buffers would be revised if herbicides are detected in water. Following two years of negative results, the need for continued monitoring for a particular chemical would be evaluated. Specific monitoring locations, timing and methodologies would be specified during the Annual Implementation Process described below and in Appendix D

Annual Implementation Process

The Early Detection/Rapid Response (EDRR) approach is an essential component of the Invasive Plant Management Strategy and, coupled with prevention guidelines and an annually-updated inventory, will allow the ENF to maintain a greater portion of the forest in an invasive plant-free condition. Under the EDRR approach, new or previously undiscovered infestations would be treated using the range of methods described in this Proposed Action, and in accordance with the Project Design Features described. EDRR is a necessary component of the Forest's treatment program because, 1) the precise location of individual target plants, including those mapped in the current inventory, is subject to change; and 2) newly discovered infestations may grow substantially during the time it takes to prepare NEPA documentation.

The intent of the EDRR approach is to treat new infestations when they are small so that the likelihood of adverse effects from treatment are minimized, and the invasive plants will do less ecological damage. This approach assumes that new infestations will be similar to current infestations and will occur within the same variety of conditions. We also expect that the impacts of similar treatments would be predictable. The precise location or timing of the treatment may be unpredictable; however, project design features – intended to minimize or eliminate adverse effects that could occur – would keep effects within those disclosed for the current inventory.

The EDRR approach allows the Forest Service to analyze treatments of invasive plants based upon the current inventory and anticipated rates of spread, and assumptions about similar new infestations that may be detected in the future. The Annual Implementation Process detailed below would ensure that effects are within the scope of those disclosed in the project analysis; if new proposed treatment sites would result in effects or conditions not analyzed or addressed in the project environmental analysis, those treatments would be deferred to a future NEPA analysis.

The following steps were taken in developing the approach to EDRR:

1. The invasive plant inventory for the ENF was updated with inventory data through 2011.
2. The Interdisciplinary Team considered the site conditions within and surrounding mapped infestations and developed project Design Features (DFs) to minimize or eliminate the potential for adverse effects at these sites.
3. The Interdisciplinary Team considered the variety of conditions that may occur on NFS lands and identified DFs that would minimize or eliminate potential adverse effects across these conditions. The Annual Implementation Process was developed to ensure that project design features would be applied to situations and conditions similar to those analyzed in the environmental analysis.

Annual treatments, including EDRR, would be implemented using the annual Implementation Process displayed in Appendix D, Figure C-1. This process, led by the Forest Invasive Species Coordinator, would allow resource specialists to review maps of the specific areas proposed for treatment each year, including all newly identified infestations, and mapped expansions of existing infestations.

Guidelines for Annual Implementation, provided in Appendix D, include a review and documentation of treatment options, a checklist of project Design Features, and an Integrated Pest Management Treatment Card. A treatment card would be completed for each annual treatment site to ensure that the selected alternative is properly implemented. This process integrates the strategies outlined in this EA and also satisfies pesticide use planning requirements in the Forest Service Handbook (FSH 2109.14). Resource specialists would review maps showing the annual program of work, and any newly found infestations proposed for treatments would be highlighted. Resource specialists would specify applicable project Design Features and required notifications. An annual Pesticide Use Proposal would be approved by the Forest Supervisor. The following process would be followed:

1. Update Invasive Plant Database based upon annual inventories and map sites proposed for treatment. This step incorporates information from surveys and monitoring to update the invasive plant database by December 1 of each year.

2. Develop the annual treatment plan. Annual planned treatment areas and methods would be proposed by the Forest Invasive Species Coordinator using the Guidelines for Annual Implementation provided in Appendix D. This step would identify the preferred method of treatment and the Project Design Features applicable to each infestation proposed for treatment. Maps of annual planned treatment areas with newly discovered infestations highlighted, and descriptions of treatment methods would be developed by the Forest Invasive Species Coordinator.

3. Annual Treatment Plan Review. Prior to implementing treatments, reviews of the annual treatment plans would be completed by an Assessment Review Team consisting of resource specialists addressing heritage resources, hydrology, soils, botany, terrestrial wildlife, aquatic wildlife, recreation, and range resources. Reviews would confirm use of the DFs or would identify any changes needed to ensure that the effects of proposed treatments would be within the range of those analyzed in the selected alternative. The review process would be documented on invasive species treatment cards where DFs or limitations specific to the treatment area would be documented, and the cards would be used in the field during invasive species treatments.

4. Coordination and Notification. Notifications in the local newspapers, on the Forest website, individual notifications of adjacent landowners, and permit holders and concessionaires would occur to ensure that landowners, partners, the general public, regulatory agencies and Tribes are aware of proposed invasive plant treatments.

5. Treatment and Post-Treatment Monitoring and Adaptive Management. Effectiveness of treatment and effectiveness of project design features would be monitored as described in the Monitoring Plan.

PROJECT DESIGN FEATURES (DF)

DFs define a set of conditions or requirements that an activity must meet to avoid or minimize potential effects on sensitive resources and to ensure consistency with the Forest Land Management Plan. DFs involving herbicides are an added layer of caution to the already-regulated and approved use of these chemicals. DFs are not optional and application of these measures is the basis for the effects analysis for this project.

These project DFs are based on site-specific resource conditions within the project area, including (but not limited to) the current invasive plant inventory, the presence of sensitive species and their habitats, proximity to water and potential for herbicide delivery to water, and the social environment. For emphasis, some design features include herbicide label guidance and Forest Plan standards. The DFs listed are not an exhaustive list of all Forest Plan Standards and Guidelines or label guidance; however, all Forest Plan direction and herbicide label guidance would be followed in implementing this project. Best Management Practices (BMP), described in Appendix A, would be followed in addition to the following design features.

Standard Treatment Procedures

1. Herbicides will be used in accordance with label instructions, except where Project Design Features describe more restrictive measures. Herbicide applications will treat only the minimum area necessary to meet project objectives (BMP 5.8)

2. Prior to the start of application, all spray equipment would be calibrated to insure accuracy of delivered amounts of pesticide. Regularly inspect equipment used during pesticide application to insure it is in proper working order.

3. Herbicides will be applied by trained and/or certified applicators in accordance with label instructions and applicable federal and state pesticide laws. Label instructions include precautions on application under certain wind, temperature, precipitation and other weather conditions to reduce drift, volatilization, leaching, or runoff (BMP 5.8 and 5.13).

4. Herbicide spray applications will not occur when wind velocity is five miles per hour or greater. A weather kit will be carried by applicators and weather conditions (wind speed and direction, precipitation, precipitation probability, temperature, temperature inversions, atmospheric stability, and humidity) will be monitored periodically by trained personnel during herbicide applications to minimize drift, volatilization, and leaching or surface runoff of herbicides, based on label precautions. Prior to beginning work, applicators will be provided with information on local terrain and wind patterns and how they affect spray drift.

5. Herbicide applications will not be conducted during rain nor immediately following rain when soil is saturated or runoff or standing water is present. Application will occur only under favorable weather conditions, defined as:
    - 30% or less chance of precipitation on the day of application based upon NOAA weather forecasting, and
    - If rain, showers or light rains are predicted within 48 hours, the amount of rain predicted shall be no more than ¼ inch of rain, and
    - Rain does not appear likely at the time of application

6. Preparation of herbicides for application, including mixing, filling of wands and rinsing of spray equipment, will take place outside of Riparian Conservation Areas and other sensitive sites, and more than 300 feet from surface water. Herbicide preparation will occur only on level, disturbed sites such as the interior of landings. Water drafting from aquatic features will not utilize equipment that has been in contact with herbicides. A screen covered drafting box is required for water withdrawal from water holes, ponds, and streams.

7. A spill cleanup kit will be readily available whenever herbicides are transported or stored. A spill kit would be carried by the applicator at all times when using wicking application method.

8. Low nozzle pressure (<25 PSI), and a coarse spray (producing a median droplet diameter of >500 microns) will be used in order to minimize drift during herbicide applications.

9. When invasive plants are grubbed or manually removed, methods that prevent seed spread or resprouting will be used. If flowers or seeds are present, the weed will be pulled carefully to prevent seeds from falling and will be placed in an appropriate container for disposal. If flowers

and seedheads are not present or are removed and disposed of as described above, the invasive plant may be pulled and placed on the ground to dry out.

10. Equipment, vehicles, and personal involved in invasive plant treatments will be cleaned prior to moving from one plant infestation to another. All equipment will be cleaned to ensure it is free of soil, seeds, vegetative matter or other debris before entering new treatment areas.

11. Straw or mulch used for erosion control and revegetation will be native weed-free materials (pine needles), certified weed-free straw or, if certified straw is not available, rice straw will be used. A certificate from the county of origin stating the material was inspected is required. Any Mulch contaminated with aminopyralid or clopyralid will not be used.

12. Any seed used for restoration or erosion control will be from a locally collected source (ENF, Seed, Mulch and Fertilizer Prescription, 2000).

13. Manual removal of invasive plants will occur within designated or recommended wilderness areas wherever possible. If, under EDRR procedures, it is determined that manual treatments will not be effective, Regional Forester approval will be sought where herbicide use is proposed to control an invasive plant infestation in any Wilderness Area (FSM 2320, and Wilderness Management Plans) or Research Natural Area (Refer to FSM 4060).

To Address Recreation and Public Land Uses

14. The public will be notified about upcoming herbicide treatments via the Forest Service website, fliers, individual notification, or posting signs. Signs regarding herbicide use will be placed at treatment areas and access points to treatment areas prior to initiating treatment. Signs will list herbicides to be used, effective dates, and name and phone number of Forest contact.

15. Treatments at special use sites, developed recreation sites and areas of concentrated public use will avoid holidays and will be scheduled to avoid high use periods of the day. Permittees and District Resource or Recreation Managers will be notified prior to treatments so that treatments can be scheduled to minimize conflicts.

16. Special Use Permit holders with wells or domestic water sources within 500 feet of proposed treatment areas will be notified prior to annual treatements and diversion points will be marked on the ground prior to treatments.

17. The Forest Service will coordinate with the Pacific Crest Trail Association (PCTA) during the annual implementation process if new treatments are proposed under EDRR within the viewshed of the Pacific Crest Trail. Temporary interpretive signing would be used if the trail’s viewshed is altered by treatment activities. Herbicide spot applications will not occur within 100 feet of the Pacific Crest Trail.

18. Tribes will be notified of proposed treatments during the Annual Implementation Process to ensure that traditional plant gathering areas and other sensitive sites are protected. Areas identified as sensitive will either be avoided or appropriate treatment measures will be developed in consultation with tribes.

To Address Heritage Resources

19. The Forest Archeologist will be consulted during the Annual Implementation Process to confirm that all treatments conform to provisions within the Sierra Programmatic Agreement.

To Address Terrestrial and Aquatic Wildlife Resources

20. Use of mechanical equipment (e.g. weed whacker) will be prohibited within ¼ mile of bald eagle, California spotted owl, or northern goshawk nest sites during the following breeding season periods unless surveys confirm that birds are not nesting:
    spotted owl: March 1 - August 15
    northern goshawk: February 15 – September 15
    bald eagle: January 1 – August 15
    Use of mechanical equipment would be excluded from the LOP if it is within a 100-foot buffer of regularly used roads or facilities. Non-mechanical treatments during the breeding seasons would not occur within a 132- foot visual buffer of a nest tree for more than one hour (FWS 2006).

21. Herbicide applications below 3,000 feet in elevation will not occur within 100 feet of elderberry plants in order to avoid effects to habitat for the Federally threatened Valley elderberry longhorn beetle. Treatment areas below 3,000 feet in elevation will be visually surveyed for elderberry plants prior to herbicide application and sites will be flagged.

22. Herbicides will not be applied within 500 feet of water bodies occupied by California red-legged frogs and will not be applied within 500 feet of aquatic habitat in areas designated as California red-legged frog Critical Habitat. This currently applies to North Fork Weber Creek and its tributaries and all streams and ponds within Bear Creek HUC 7 watershed, and Little Silver Creek, Ralston pond, and Sopiago Creek impoundment (as shown on exclusion area maps in the project file). Herbicides will not be applied within 300 feet of suitable CRLF breeding habitat unless surveys have confirmed absence of CRLF. During the annual Implementation Process, treatments will be reviewed by an aquatic biologist to ensure this design feature is implemented based upon the most recent survey information.

23. Herbicides will not be applied within 50 feet of stream reaches occupied by the foothill yellow-legged frog, or within 100 feet of habitat occupied by Sierra Nevada yellow-legged frog or Yosemite Toad (as shown on exclusion area maps in the project file). During the Annual Implementation Process, an aquatic biologist will review new treatment sites identified under EDRR that are within 500 feet of Sierra Nevada yellow-legged frog or Yosemite toad occurrences or within their designated critical habitats. Consultation with the U.S. Fish and Wildlife Service will occur if treatments may affect these species or habitats.

To Address Sensitive Plants and Native Vegetation

24. The herbicide spray nozzle will be kept as close to target plants as possible (within 20 inches) while achieving uniform coverage in order to limit overspray and drift to non-target vegetation.

25. Where riparian vegetation or lavacap communities occur herbicide application will be limited to directed foliar spray or wiping methods and spray will be directed away from native vegetation. Post treatment monitoring of these sites will be implemented as described in Appendix C.

26. Protection measures for sensitive and select special interest plant occurrences within 500 feet of treatment sites will be implemented as described in Appendix B. During the Annual Implementation Process, a botanist will review new treatment sites identified under EDRR that are within 500 feet of sensitive and special interest plant occurrences. Herbicide protection buffers shown in Table 7 will be implemented unless a botanist identifies treatments that are consistent with management direction for the particular sensitive plant species. Where needed, sensitive plant buffers will be flagged prior to treatments.

27. Herbicide treatments will not occur within 500 feet of sensitive bryophyte occurrences unless a botanist has established treatment guidelines that are consistent with management direction for the species.

28. Invasive plant treatments on gabbro or serpentine soils under EDRR will not occur unless surveys for *Packera layneae* have been completed. Buffers shown in Table 7 will be applied to any occurrences located under EDRR to ensure no effects to this species.

29. Treatment areas with bare soil created by the treatment of invasive plants will be evaluated for restoration and revegetation by the area Botanist and Soil Scientist. Best Management Practices (BMPs), such as weed-free ground cover, will be implemented as needed.

30. Treatments within Botanical Special Interest Areas (SIA) will be implemented under the guidance of the area botanist to protect unique characteristics of the SIA. Direction for currently known infestations in Botanical SIA are described in Appendix B. Post treatment monitoring of Botanical SIA will be implemented as described in Appendix C.

31. Under the EDRR approach, herbicide application within wet meadows will be limited to treating invasive plant infestations that occupy less than 100 square feet. Herbicide applications will be limited to wiping techniques with aminopyralid, chlorsulfuron, and glyphosate and treatment of the following high priority species: Canada thistle (*Cirsium arvense*), purple loosestrife (*Lythrum salicaria*), Russian knapweed *(Acroptilon repens)* or tall whitetop (*Lepidium latifolium*) which are difficult to eradicate with non-chemical means. Meadows will be surveyed for sensitive plant species prior to any chemical treatments and will be monitored post-treatment to determine effects to non-targeted vegetation.

32. Where treatments occur within TES plant occurrences, the area botanist will instruct workers in the proper identification of plant species to be avoided and ensure that individual TES plants are protected.

To Address Soil and Water Resources

33. Herbicide application will not occur within the established buffers for aquatic features shown in Table 6 (BMP 5.12).

34. Maintain effective soil cover as follows: 70% or greater on slopes exceeding 35%, shallow soils or other soils with high runoff potential, soils within RCAs; effective soil cover of 50% or greater for all other areas. Apply weed free mulch where treatment causes effective soil cover to be deficient. It is not necessary to consider effective soil cover where soil cover is not normally expected such as road treads and quarries.

    (Effective soil cover shall be defined as …"living vegetation (grasses, forbs and prostrate shrubs), plant and tree litter (fine organic matter), surface rock fragments, and applied mulches (straw or chips)" (Region 5 Soil Quality Standards). Surface rock fragments do not include those fragments partially imbedded in the soil surface).

35. Spot spray application of Aminopyralid or Clopyralid, (including equipment rinsing), will not occur on soils with low permeability (defined as either fine-textured soils with permeability less than 2.0 inches per hour; or coarse textured soils with a restrictive layer 48 inches or less below the surface) based upon mapping provided by the Forest soil scientist and shown on exclusion area maps in the project file. During the Annual Implementation Process newly discovered infestations will be reviewed by a soil scientist to determine if they occur on soils with low permeability.

36. Application of Aminopyralid, Clopyralid, Chlorsulfuron, Imazapic, and Triclopyr (including equipment rinsing) will not occur on deep, coarse textured soils (those above 5,000 feet in elevation*)* prior to snowmelt and soils being drained. For elevations above 5,000 feet, the Forest

soil scientist will be consulted about the proper timing of herbicide application in the spring prior to treatments.

37. Mixing or application of herbicides will not occur within 100 feet of a well or spring used as a domestic water source. Certified applicators will be briefed about the locations of water sources prior to beginning work and buffers will be flagged on the ground.

38. Annual herbicide treatments within 150 feet from the water's edge will not exceed 10 acres of treatment along any 1.6 miles of stream. This design feature combined with buffers shown in Table 6, ensures that herbicide concentrations within the aquatic influence zone will be far less than those modeled in SERA risk assessment scenarios.

39. Herbicide application is limited to targeted treatments directed at the plant (spot treatments of the immediate area surrounding the plant are allowed with aminopyralid and clopyralid, only) using a backpack sprayer; broadcast spray methods will not be used.

40. Avoid application of Aminopyralid and Clopyralid sprayed mulch materials on revegetation sites.

41. Hand pulling or wrenching of invasive plants along streambanks or natural lake or pond shorelines will not exceed 20 percent of the stream reach or 20 percent of the shoreline.

42. Herbicide treatments will not be implemented under the Eradication and Control of Invasive Plant Species project in any year in locations where such treatments would spatially overlap herbicide treatments being implemented under a prior project decision (see prior project decisions in Appendix H).

To Address Livestock Grazing

43. The Forest rangeland specialist will be notified annually of the proposed treatment schedule. Grazing permittees will be provided with treatment information (schedule and labels) each grazing season as part of Annual Operating Instructions for Grazing Permits.

44. Any need to exclude livestock from treated or revegetated sites would not exceed ten acres within an allotment and would be met through temporary fencing constructed by the Forest Service.

Table 6. Minimum Buffers (ft) for Herbicide Application Near Aquatic Features

Herbicide	Application Method	Dry Aquatic Features[1]	Streams[1] or Ditches with water[2]	Special Aquatic Features (lake,springs, seeps, meadows)[3]
Aminopyralid	Spot & directed foliar spray	25	25	100
	wiping	15	15	15
Chlorsulfuron	directed foliar spray	25	100	100
	wiping	15	15	15
Glyphosate	directed foliar spray or drizzle	0	25	25
	cut stump or wiping	0	15	15
Imazapic	directed foliar spray	25	75	75
Triclopyr (TEA)	directed foliar	25	75	75
	wiping or cut stump	15	15	15
Clopyralid	Spot & directed foliar spray	25	50	50
	Wiping	15	15	15

[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.
[3]As measured from the edge of the wet area surrounding the special aquatic feature, or the meadow vegetation, whichever is greater. Limited conditions allowing for herbicide application within meadows are described in DF #31.

Table 7. Distances (ft) from sensitive plants within which herbicide application will not occur except as identified in site- specific protection measures, Appendix B.

Herbicide	Distance from sensitive plants for spot and directed foliar spray[1]	Wiping Distance from sensitive plants
Aminopyralid (0.11 lb/ac)	200	25
Chlorsulfuron (0.14 lb/ac)	500	
Glyphosate (3 lb/ac)	300	
Imazapic (0.1875 lb/ac)	50	
Triclopyr (TEA) (1.5 lb/ac)	200	
Clopyralid (0.25 lb/ac)	200	

[1] Distances may be reduced based upon the area botanist's determination that treatments are consistent with management direction for a given sensitive plant species.

ENVIRONMENTAL CONSEQUENCES

This section summarizes the physical, biological, social and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for comparison of alternatives.

Alternative 1

Vegetation and Botany

Botany

Most invasive plants of concern on the ENF are early successional species, meaning they colonize areas that have been recently disturbed. Since invasive plants have the ability to deplete available resources to lower levels than native vegetation can tolerate, they can quickly dominate disturbed sites, displacing native vegetation. When invasive plants dominate native plant communities, native plant species diversity is decreased. Invasive plants can out-compete native species because they produce abundant seed, have fast growth rates, are more effective at extracting available resources, and lack natural enemies. For example, yellow starthistle is able to compete effectively with desirable native species by producing abundant seeds and growing a deep taproot system that extracts more deep soil moisture during the dry season (DiTomaso, 2006). Some invasive plants also produce secondary compounds, which can be toxic to native plant species or animals. Results from experiments on spotted knapweed suggest that this invader produces chemicals that inhibit the growth and germination of native species (Perry et al, 2005). Invasive plants can also physically interfere with the germination of native vegetation. For example, dense thatch from medusa head infestations has been shown to inhibit the germination of desirable native vegetation (Young, 1992). Invasive plant infestation can therefore lead to a decrease in native plant species, potentially impacting a larger ecological process such as wildlife behavior (Trammell and Butler, 1995), fire ecology (Pellant, 1996), and hydrology (Renz et al, 2012).

Under Alternative 1, existing invasive species within and adjacent to unique and significant plant communities (Table 8) are expected to continue to threaten native vegetation. Plant communities associated with lava cap will continue to be impacted by invasive species, particularly barbed goatgrass (*Aegilops triuncialis*), medusahead (*Elymus caput-medusae*), and yellow starthistle (*Centaurea solstitialis*). Meadow and riparian areas would also continue to be impacted by known invasive species, except where existing decisions already allow for limited treatment of invasive species. Of particular concern under Alternative 1 is the continued spread of perennial pepperweed infestations into riparian communities already present near the South Fork American River and Whitehall Canyon. Existing infestations of yellow starthistle at Traverse Creek would be partially controlled under existing decisions under Alternative 1, primarily using hand pulling; however control of medusahead and barbed goatgrass would not occur, potentially impacting the unique botanical character of the Special Interest Area.

Table 8. Unique and significant plant communities likely impacted under Alternative 1

Plant community	Invasive species threatening native vegetation	Number of known sites
Lava cap	Barbed goatgrass, medusahead, yellow starthistle,	11
meadows	Yellow starthistle, scotch broom, skeletonweed, medusahead, barbed goatgrass	13
Riparian	Himalayan blackberry, perennial pepperweed, English ivy, vinca, purple loosestrife	unknown
Botanical special Interest Areas (Traverse Creek)	Medusa head, barbed goatgrass, yellow starthistle, Maltese starthistle, Scotch broom	1

The ENF first priority for managing invasive species is through education and prevention. While prevention will continue to serve as the first-line of defense for managing invasive species, these measures are not expected to completely eliminate the risk of future introductions. Under Alternative 1, the forest will continue to include feasible methods to limit the introduction and spread of invasive species. However, ongoing activities will still pose some risk of spreading and introducing invasive species even after all required prevention measures are implemented. Any new infestation found after recent project activity would not be treated under Alternative 1 unless analyzed under a future decision.

Invasive Plants

Under Alternative 1 the forest would continue with a limited invasive plant control and eradication program. Small infestations along existing trails and roadways would likely be controlled when feasible, primarily using pulling, mechanical removal, clipping, and weed eating when covered by existing decisions, or under future decisions for routine trail and road maintenance along existing travel routes on the forest. Current chemical treatments of yellow starthistle (2002 Yellow starthistle Control EA) would be reviewed and likely continue. Chemical control of invasive species would also continue at some administrative sites with known infestations. Within FERC boundaries approved integrated pest management would continue by various partner groups and other decisions including invasive plant management would continue.

While a number of infestations would be treated under Alternative 1, a fraction infestations will remain untreated, or will be treated with limited efficacy (i.e. reduce seed production but not eradicating the infestation). The lack of effective control measures for treating these priority infestations will likely result in the continued spread of invasive species across the forest. Perennial pepperweed infestations would continue to threaten uninfested areas as it would be difficult to seeds and root fragments from establishing new infestations along riparian corridors. Larger infestations of scotch broom on the Georgetown District and yellow starthistle in the Cleveland fire would likely go untreated and continue to act as seed source for invasion into uninfested areas. Many of these species are high priorities for treatment and eradication by various groups in California (Cal-IPC, local Weed Management Areas, and CDFA) and are expected to persist and likely spread onto adjacent uninfested lands. Not treating these priority infestations will inhibit the forests ability to prevent further spread, especially of small isolated leading edge infestations of yellow starthistle, scotch broom perennial pepperweed, and rush skeleton weed.

Table 9. Infestations of priority 1 and 2 species that will not be treated under Alternative 1.

Species	Number of infestations	Estimate gross Acres	Forest Priority for Treatment
Acroptilon repens Russian knapweed	1	<1	1
Aegilops triuncialis Barbed goatgrass	18	2	1
Ailanthus altissima Chinese tree of heaven	3	<1	1
Centaurea stoebe Spotted knapweed	2	<1	1
Lepidium latifolium Perennial pepperweed	9	2	1
Centaurea melitensis tocalote:	2	4	2
Centaurea solstitialis yellow starthistle	100	330	2
Chondrilla juncea rush skeleton weed	54	93	2
C*ytisus scoparius, Genista monspessulana, Spartium junceum* Brooms	143	775	2
Elymus caput-medusae medusahead grass	15	7	2

Federally Listed Species

There are two occurrences of Layne’s butterweed (*Packera layneae*) with infestations of invasive plants occurring adjacent to the known occurrences (within 500 feet). Alternative 1 will not result in direct effects to Layne’s butterweed. Indirect effects from not treating existing infestation could result from the spread of certain invasive plants such as yellow starthistle, barbed goatgrass, and medusahead into habitat for Layne’s butterweed.

Candidate species

Alternative 1 will not result in direct, indirect or cumulative effects to white bark pine (*Pinus albicaulis*). The higher elevation habitats occupied by white bark pine are not highly infested with invasive plants currently and are not expected to be appreciably impacted under Alternative 1.

R5 Sensitive Species

There are 53 occurrences of ENF sensitive plant species in the vicinity (500 feet) of known invasive plants. Of these 53 occurrences, 17 have invasive species already documented within sensitive plant habitat or in close proximity (Table 10). Alternative 1 would have no direct effect upon Sensitive plant species in the vicinity of known invasive plants. Indirect effects could result from the spread of certain invasive plants such as yellow starthistle, barbed goatgrass, and medusahead grass into sensitive plant habitat. Therefore Alternative 1, may affect individuals and habitat indirectly from continued spread of invasive species, but would not lead to trend toward Federal listing or loss of viability.

Table 10. Sensitive plant occurrences with invasive plant infestations.

Threatened and Sensitive species	Number of sensitive plant occurrences	Invasive species	Occurrences protected by existing decision allowing for invasive plant treatments
Pleasant Valley Mariposa lily	11	yellow starthistle, rush skeletonweed, barbed goat grass, scotch broom, medusahead	7 (only covers treatment of yellow starthistle)
Parry Horkelia	2	Scotch broom, medusahead, rush skeletonweed	0
Yellow bur Navarretia	3	Yellow starthistle, scotch broom, barbed goatgrass	0
Tripod buckwheat	1	Barbed goatgrass, medusa head, yellow starthistle.	1 (only covers treatment of yellow starthistle)

Special Interest Species

Currently 25 occurrences of Special Interest species are within close proximity to invasive plant infestations proposed for treatment under the Eradication and Control of Invasive Plants project. Under Alternative 1 the continued presence and expected spread of invasive species is likely result in indirect impacts to special interest species, especially occurrences of red hill soap root.

Range

At the projected rate of spread of 20% annual growth of known infestations and expectation that new infestations will be discovered, there would be a substantial increase in invasive plants within active grazing allotments over the next 10 years. The current level of activities being implemented for control or eradication would be insufficient and infestations would continue to expand and additional infestations would become established.

With an increase in the size and number of infestations, there would be an increased likelihood that livestock would move through or graze within infestations and act as vectors, contributing to the spread of some invasive species to other areas on NFS land and private property within grazing allotments. An increase in invasive plant species would lead to a reduction in palatable forage available for livestock. Invasive species would displace important streambank stabilizing species where infestations occur in riparian areas.

The No Action alternative would not adequately control or eradicate invasive plant infestations and would not protect rangeland health and forage production. The No Action alternative would result in an adverse effect to rangeland health.

Terrestrial Wildlife

The No Action Alternative does not result in direct effects to terrestrial wildlife or wildlife habitat. Indirect effects would result from the continued expansion of invasive plant infestations on the Forest. Although the No Action Alternative would allow for treatments on about 401 acres infested with invasive plants and addressed in prior project decisions, 2,249 acres of invasive plants identified for eradication or control would not be treated. Over time the projected growth of these infestations would result in increasing impacts to habitats and wildlife populations. Any species of wildlife that depends upon native understory vegetation for food, shelter, or breeding, is or can be adversely affected by invasive plants. Species restricted to very specific habitats, meadow associated species for example, are more susceptible to adverse effects of invasive plants.

The assortment of wildlife species supported by native habitats can be altered where non-native plants become established and displace native plants. Where non-native plants become abundant, they can result in highly detrimental effects on native wildlife species. These effects include alterations in vegetation type and structure, reductions in natural food and cover species, and changes in the natural fire regime. Invasive plants are known or suspected of causing the following impacts to animals and to wildlife populations:

- Direct injury to individuals from embedded seeds in animal body parts or scratches leading to infection.
- Alteration of habitat structure leading to habitat loss or increased chance of predation.
- Reduction in availability of native forage species, leading to lack of proper forage quantity or forage nutritional value at critical life periods.
- Poisoning due to direct or indirect ingestion of toxic compounds found on or in invasive plants.

Habitats that become dominated by invasive plants are often not used, or used much less, by native and rare wildlife species. Weeds, such as yellow starthistle and knapweed, can impact upland game bird habitat. Scotch broom has infested more acres of the ENF than any other invasive plant, in some locations dominating the plant community by forming a dense stand impenetrable by wildlife. In these locations scotch broom has impacted deer and other wildlife by affecting the availability and nutrition of forage since broom seeds are toxic to ungulates and mature shoots are unpalatable. Scotch broom grows more rapidly and can shade out tree seedlings of native species, affecting forest structure. It may also increase the fire threat because it burns easily and hotly and can quickly spread a fire from the understory into the canopy. Its seeds are adapted to frequent fire and rapidly capture sites which have recently burned.

In very rare situations, wildlife species may actually benefit from the presence of non-native species. For example, lesser and American goldfinches (*Carduelis psaltria* and *C. tristis*, respectively) may benefit from feeding on yellow star-thistle fruits. Black bears (*Ursus americanus*) feed heavily on Himalayan blackberries, which provide an unnatural food source. While some invasive plants may be beneficial to certain animals, the alteration of native plant communities, overall, has deleterious effects to wildlife populations and wildlife diversity. On the ENF habitat changes are most prevalent at lower and mid-elevations where the majority of invasive plant species are found. With only 401 acres of proposed treatment within 2,249 acres of mapped infestations, at projected rates of spread (10-15% annually on western federal lands, (Asher and Dewey 2005), this alternative could result in a substantial loss of habitat over time for several wildlife species.

The potential for cumulative impacts from ongoing activities is reduced through implementing the Forest's Invasive Plant Management Strategy (Appendix F) which includes weed prevention measures. In addition, the Forest Service Manual and Forest Land Management Plan require preparation of a Noxious Weed Risk Assessment for all ground disturbing activities which ensures that projects with high or moderate risk of spreading weeds are designed to mitigate this risk (USDA Forest Service 2004, FSM 2900). Nonetheless, on-going recreation activities (camping, hiking, cycling), road and trail use and maintenance, and livestock grazing all have potential to promote the spread of invasive plants. Past and future wildfires, through opening of the canopy and the ground disturbance that results from reforestation efforts, have and will continue to pose a major risk for the spread of invasive plants. These activities, combined with the indirect effects of the no action alternative, have the potential to result in substantial spread of invasive plants on the ENF and associated impact to wildlife habitats and populations.

Federally Listed Species

Valley Elderberry Longhorn Beetle

The No Action Alternative would have no direct effect upon the Valley elderberry longhorn beetle. Indirect effects could result from the spread of certain invasive plants such as scotch broom, blackberry, or English Ivy, if these invasive species were to spread into riparian habitat that supports elderberry; such areas are not currently known, however.

Region 5 Designated Sensitive Species

The No Action Alternative will not result in direct, indirect, or cumulative effects to Region 5 designated Sensitive Wildlife Species. Under the No Action Alternative, the continued spread of invasive plants into forested stands could have indirect effects upon sensitive species associated with forested habitats. In particular, where scotch broom has formed a dense understory in forested stands, it has altered the native understory vegetation which may, in turn, reduce or alter prey density or hunting success for spotted owls or goshawks. Scotch broom also increases the fire threat because it burns easily and hotly and can quickly spread a fire from the understory into the canopy.

The No Action Alternative will not result in direct, indirect or cumulative effects to willow flycatchers, great gray owls since mapped invasive plant infestations do not occur in the vicinity of any known occupied habitat. If invasive plants infest meadow habitats in the future, however, the No Action Alternative could allow habitat to decline if meadows becomes dryer or prey species are affected due to a dominance of invasive plants. Similarly, the No Action Alternative will not result in direct, indirect or cumulative effects to fisher, marten, Sierra Nevada red fox or wolverine. These forest carnivores have large home range areas and the small, scattered invasive plant infestations that occur in dense canopied forests (fisher) or the high elevation habitats occupied by marten, Sierra Nevada red fox and wolverine, are probably having little impact on these species. If invasive plants infest meadow habitats in the future, however, the No Action Alternative could allow the quality of this important habitat type to decline, with potential effects on foraging habitat for marten and Sierra Nevada red fox.

Terrestrial and Aquatic Management Indicator Species (MIS)

The no action alternative is not expected to have any direct effects to the MIS species habitat on the ENF including aquatic macroinvertebrates, fox sparrow, mule deer, yellow warbler Pacific tree frog, mountain quail, sooty grouse, California spotted owl, American marten, or northern flying squirrel. Indirect effects over the long term could result from the continued expansion of invasive plant infestations resulting in the reduction of natural biodiversity affecting the food web.

Migratory Landbird Conservation

The No Action Alternative does not result in direct effects to terrestrial wildlife or wildlife habitat. Indirect effects would result from the continued expansion of invasive plant infestations on the Forest (as described in the section on “All Species”. Invasive plants affect birds by replacing native vegetation needed for food, shelter and nesting. Invasive plants are typically of lower nutritive value to birds than native shrubs and species like yellow starthistle can dramatically affect the availability of food, nesting habitat and cover where it expands into large monocultures.

Aquatic Organisms

Direct effects to aquatic organisms would not result from the no action alternative, although indirect effects could occur over the long term. The no action alternative would allow invasive plants to continue growing within riparian areas, thus reducing the biodiversity and abundance of native plants growing there. Eventually, over many years, changes in vegetation composition could affect the natural food web in the Riparian Conservation Areas, and thereby indirectly impact aquatic species from changes in cover and food availability. Because these indirect effects would occur as relatively small, incremental changes over time, they are unlikely to result in substantial cumulative impacts when combined with any known direct and indirect effects of activities occurring on the Eldorado National Forest.

Soil and Water

Soil

There are no direct effects of choosing the no action alternative. Current use of herbicides and manual methods with the on-going efforts for spotted knapweed and yellow star thistle eradication on a total of 59 mapped sites would continue.

Alternative 1 would indirectly affect soils by not treating the areas mapped with invasive plants. The spread of invasive plants is largely controlled by disturbance of ground by management activity, usually in close proximity to already infested ground. Isolated occurrences of noxious weeds can quickly spread into adjoining forest lands if disturbed by wildfire. Seeds of invasive plants can be carried some distance by wind, animals, equipment, or even on clothing and shoes. In the absence of treatments, invasive weed occurrences would continue to grow along the main travel corridors leading to higher risk for spread onto ENF lands where adjacent disturbance occurred. By far, the dry droughty areas below 6000 feet elevation, and on warm aspects have the highest risk since native vegetation recovers slowly.

Invasive plants often maintain infested sites with a higher proportion of bare ground than native species, which increases risk of erosion. Disturbed areas that are slow to revegetate may be replaced with less diverse life forms if invasive forb species or annual grasses take over. An indirect result of the dominance of either single stemmed forb or annual grass is bare soil interspace that can erode via ravel or rainfall. These weeds typically invade open areas that lack a tree or shrub overstory that intercepts and disperses rainfall. Most natural forest or native rangeland resists erosion in this climate regime; whereas continued high levels of bare soil can perpetuate a disturbed state. In Montana, a simulated rainfall test found double the soil erosion in a spotted knapweed site compared to natural bunchgrass grassland (Lacey et al 1989).

The potential spread of weeds into meadows, natural forest and rangeland areas is heightened concern since California's valley and foothill grasslands is a case study for conversion from perennial to exotic annual grasses. The annual grasses create a self-perpetuating system that changes soil properties and nutrient cycling to its favor (D'Antonio and Vitousek 1992, Norton et al 2007). The incursion of the annual grasses leads to higher gross N turnover rates, with boom bust cycling which the grasses high uptake rates can quickly respond to compared to native perennial grasses, and shifts in the mycorrhizal networks of native plants (Hawkes et al 2005, Eviner and Firestone 2007). Given that soil communities can be tightly coupled to plants (Wardle et al 2004), the danger in dominance of any single plant or change from a diverse plant community assemblage to a single stemmed forb such as the spotted knapweed is an accompanied shift in soil properties whereby a return to the prior desired vegetation becomes difficult (Seastedt et al 2008).

No additional treatment of invasive plants would occur over that already approved under previous analysis. The number of acres of ground treated for invasive plants would not increase. Since 2001 the Forest has had a program to eradicate spotted knapweed, which has reduced the infested sites by 40 percent. And since 2002 the Forest has undertaken a program of herbicide and manual treatment for yellow star thistle that has reduced infested ground by 36 percent.

The number of acres of ground infested by invasive plants, aside from those targeted sites for star thistle and spotted knapweed, would increase along the roads and thus create risk for invasion into NFS lands if disturbed. The very high propagule pressure along travel ways and the open site characteristics with absence of competing vegetation create ideal circumstances for invasive weed growth. Once established, invasive weeds can complicate native vegetation recovery after disturbance. Homogenous stands of exotic forbs or annual grasses can leave bare ground susceptible to erosion. Soils dominated by invasive plant cover could also change nutrient dynamics to perpetuate invasive species and limit restoration of desired vegetation. Dry grasslands and forests have the highest potential for invasive species spread due to slow recovery after disturbance. Dry aspects and steep erosive cutslopes along roads are highly prone to invasive species.

Hydrology

There are no direct effects of choosing the no action alternative. Current use of herbicides and manual methods with the on-going efforts for spotted knapweed and yellow star thistle eradication on a total of 59 mapped sites would continue

The number of acres of ground infested by invasive plants, aside from those targeted sites for star thistle and spotted knapweed, would increase along the roads and thus create risk for invasion into NFS lands if disturbed. Dry aspects and steep erosive cut slopes along roads are highly prone to invasive species.

The spread of invasive plants is largely controlled by disturbance of ground by management activity, usually in close proximity to already infested ground. Isolated occurrences of noxious weeds can quickly spread into adjoining forest lands if disturbed by wildfire. Seeds of invasive plants can be carried some distance by wind, animals, equipment, or even on clothing and shoes. In the absence of treatments, invasive weed populations would continue to grow along the main travel corridors leading to higher risk for spread onto ENF lands where adjacent disturbance occurred.

No additional treatment of invasive plants would occur over that already approved. The number of acres of ground treated for invasive would not increase. Since 2003 the Forest and El Dorado County have cooperated in a program to eradicate spotted knapweed, which has reduced the infested sites along the SF Silver Creek by 40 percent and has eradicated the sites on NF land. And since 2001 the Forest has undertaken a program of herbicide and manual treatment for yellow star thistle that has reduced infestations within the project area by 36 percent. Alternative 1 would indirectly affect hydrology by not treating the 2,606 acres mapped with invasive plants.

Climate

In the Western United States, increased temperatures have led to more precipitation falling as rain rather than snow, earlier snowmelt and snowmelt-driven stream flow (Stewart and others 2005, Hamlet and others 2007), and reduced spring snowpack (Mote 2003, Mote and others 2005, Barnett and others 2008). For the mountainous regions of the Western United States, snowmelt provides approximately 70 percent of annual stream flow (Mote and others 2008). Both increased winter rain (as opposed to snow) and shifts to earlier spring snowmelt result in greater winter and spring stream flows leading to increased flood risk and reduced summer stream flows in snowmelt-dominated and transient (rain/snow) watersheds. This reduction in summer stream flow could have major implications for fisheries, wildlife, water supply, and agriculture. Climate controls ecosystem structure and processes such as species distribution and abundance, regeneration, vegetation productivity and growth, and disturbance, including insects, and fire. Increasing temperatures and changes in precipitation with climate change will impact both ecosystem structure and ecosystem processes. Viability of a species is dependent on the availability of suitable habitat. Animal species respond to climate variability in the short term through shifts in geographic range (migration) when suitable habitat is not available in the former range. Mortality and population extirpation in parts of a species' former range often occur. Over time, extirpation and colonization events cumulatively result in shifts of the species' distribution range (Davis and Shaw 2001, Delcourt and Delcourt 1991). Land-use changes, development, and introduction of invasive species often impede the ability of species to respond to climate change adaptively resulting in small population sizes and isolation of populations as a result impede gene flow (Joyce and others, in press). The no action alternative is not expected to interfere with the large-scale changes in temperature or precipitation, but could further impact available habitat and impede species' ability to adaptively respond to climate change.

Cultural Resources

There are no direct effects of choosing the no action alternative. Current use of herbicides and manual methods associated with the on-going efforts for invasive plant infestations would continue. The effects of these treatments were analyzed for the cultural resources in previous NEPA documents that previously complied with NHPA and Sierra PA.

Tribes

This alternative continues treatment approved under previous NEPA documentation. This alternative would have no new effects from treatment actions that have not already been approved, and therefore, would not contribute to cumulative effects. Invasive plants would likely continue to compete with traditional cultural plants, and continued spread of invasive plants could reduce the extent and abundance of traditional cultural plants.

Recreation, Public Uses, and Land Designations

Recreation

Under the No Action alternative invasive plant infestations would not be sufficiently controlled and would expand in areas of concentrated public use such as along roads, trails and in developed recreation areas where over 400 acres of infestations are already present. Invasive plant infestations in areas that the public uses for recreating would have an adverse effect to native vegetation and other resources that contribute to the natural character and visitor experience. In some instances, infestations may displace desired native plant species that are desired for collection or other purposes.

Special Areas

Under the No Action Alternative, activities for the control or eradication of invasive plant infestations would not be sufficient to protect Special Areas from expanding infestations. The unique values of Botanical SIAs and RNAs have a greater probability of special botanical resources being adversely affected by expanding invasive plant species competing with native species; however the unique values of all of these areas would be adversely affected by increased invasive plant infestations. Forest visitor use and enjoyment of all Special Areas would be negatively affected by the presence of invasive plant infestations.

Wilderness

There would be no direct effect to Wilderness areas at this time from the No Action Alternative because there are no known infestations in Desolation or Mokelumne Wilderness and therefore no treatments planned. However, with the No Action alternative, known invasive plants on other NFS land would not be substantially controlled and as infestations expand, there would be an increased likelihood they would spread into Wilderness areas. If invasive plant infestations are found in Wilderness in the future and are not sufficiently controlled or eradicated, there would be an adverse impact to Wilderness values in the Wilderness Act of 1964 and direction in the Mokelumne and Desolation Wilderness Plans to prevent, detect and eradicate invasive plant species would not be met. Infestations in Caples Creek recommended wilderness would not be sufficiently controlled or eradicated under the No Action alternative and potential infestations would reduce Wilderness valves that are to be protected for future designation under the Wilderness Act.

Wild and Scenic Rivers

Under the No Action Alternative invasive plant infestations would not be substantially controlled. Invasive plant infestations would continue to expand on the Forest, increasing the probability of infestations within areas managed as Wild and Scenic Rivers, and adversely affecting the outstandingly remarkable values identified including scenery and recreation. There would also be a risk of expanding infestations having an adverse effect on fisheries, historical and cultural values. The No Action alternative would not negatively affect the free flowing condition of these rivers.

Inventoried Roadless Areas

Under the No Action Alternative invasive plant infestations would not be substantially controlled within the IRAs and other areas of the Forest, so would continue to expand, increasing the probability of infestations within IRAs and Wilderness areas. With this alternative there would be an increased likelihood that multiple roadless characteristics, that the Forest Service is to maintain, would be compromised. In particular there would be a risk that the IRAs would not function as biological strongholds for populations of threatened and endangered species, would not provide large, relatively undisturbed landscapes that are important to biological diversity and the long-term survival of many at risk species. They would not serve as bulwarks against the spread on non-native invasive plant species and provide reference areas for study and research. There would likely be indirect adverse impacts to characteristics and purposes of IRAs.

Visual Resources

Under the No Action Alternative, activities for the control or eradication of invasive plant infestations would not be sufficient to reduce the existing occurrences, prevent the expansion of those occurrences or prevent new occurrences within sensitive viewsheds. The visual character in areas of existing invasive plant occurrences would remain degraded and in some areas would not meet desired objectives. There would not be the opportunity to rehabilitate and restore the visual character of these areas to meet VQOs. Infestations that are small and not currently impacting the visual quality would continue to expand and over time would become more pronounced on the landscape. Expanding and new occurrences of invasive plants would change the form, texture, line, color and overall characteristic landscape. The No Action Alternative would not meet the VQOs in the ENF LRMP and would likely contribute additional adverse impacts to visual resources.

Human Health

In the no action alternative, no new herbicide sources would occur. Past and ongoing use on the ENF (2006-2010) includes the use of glyphosate, hexazinone, triclopyr, chlorsulfuron, and clopyralid. There is the potential for exposure from projects on the ENF involving the herbicides in the proposed action. They include the Yellow Starthistle Control Project (clopyralid and glyphosate), Spotted Knapweed Control Project (glyphosate), PG and E/SMUD Transmission line (clopyralid), Big Grizzly Fuel Reduction Project (glyphosate and triclopyr), 2-Chaix Fuels Reduction and Forest Health Project (aminopyralid, clopyralid, glyphosate, and triclopyr), and Freds Fire Reforestation Project (glyphosate and triclopyr). Potential future use of herbicides may include glyphosate due to its possible use on the Power Fire and the Callecat Project areas. It is assumed that there would not be any extensive changes in these use patterns into the near future as those projects have been analyzed in other NEPA documents.

Alternative 2

Vegetation and Botany

On the ENF the primary vegetation type infested with invasive species consists of coniferous forest types including; Ponderosa pine alliances, Douglas-fir-pine alliance, and mixed conifer alliances. The largest number of invasive plant infestations is found in Douglas-fir pine alliance and Ponderosa pine alliances (79 percent of known infestations). These larger infestations are primarily the result of either recent wildfires or well-established occurrences of scotch broom on the Georgetown Ranger District. Remaining plant communities with known infestations tend to occur in shrub lands (120 acres), barren and herb dominated communities (50 acres), and low elevation hardwood communities (127 acres). Generally these infestations are all associated with some type of disturbance within the native plant communities (e.g. recent wildfires, roadways, landings, thinning projects) and are rarely found in intact native plant communities on the ENF.

There is always some risk of impacts to surrounding non-target vegetation whether using handpulling, mechanical, herbicides, or other proposed control efforts. Although these potential impacts are of concern, the continued spread of invasive also poses risks to the native plant communities, as well as sensitive and threatened plant occurrences; necessitating careful efforts to eliminate invasive plants while also preventing impacts to non-target vegetation. This project proposes to use a variety of control methods under an integrated pest management (IPM) program including 1) hand pulling 2) mechanical pulling 2) string trimmer/mowing 3) clipping and cutting 4) tarping/mulching and 5) herbicide application. Each method presents different hazards for non-target vegetation as described below:

Handpulling and mechanical: Handpulling and other mechanical methods for removing invasive species can be effective and highly selective but there is a slight risk for crews to inadvertently trample, uproot, or otherwise disturb non-target vegetation. It is also possible that invasive plant material could be left on-site impacting native vegetation. When using a string trimmer or mower there is some risk of impacting non-target vegetation intermixed with the target invasive species. Tarping and mulching invasive species may cause localized effects to surrounding non-target native vegetation. Handpulling and other mechanical treatments in close proximity of sensitive plants could result in adverse impacts if crews trample, uproot or disturb non-target vegetation. To avoid potential impacts, all invasive plant treatments within 500 feet of known occurrences will be designed and overseen by a Forest Service Botanist.

Herbicides: Potential effects to non-target vegetation from invasive plant treatment involving herbicide fall into four broad categories including 1) direct exposure (direct spraying or over spraying) 2) off-target drift 3) movement of chemicals on soil and 4) accidental spills. Each exposure scenario is described further below:

Direct exposure: Effects from direct exposure is dependent on a combination of factors including the non-target native plant species, the timing and method of application, and the herbicide being applied. The risk of direct exposure would also be dependent on the applicator's knowledge of non-target vegetation to be avoided (riparian vegetation, lava cap communities) and the selectivity of the application method. For all herbicide applications, potential for direct exposure will be limited to those plants in the immediate vicinity (within 5 feet) of targeted vegetation. Spot spray and directed foliar spray have the greatest risk for direct exposure to non-target vegetation from overspray. Drizzle methods could also have a high potential for affects to non-target vegetation if the herbicide stream in not fully intercepted by the targeted invasive species. Wicking and wiping are expected to have the least potential for direct exposure to non-target vegetation since herbicides are directly applied onto the target vegetation (no overspray).

While all herbicide applications have some risk of direct exposure to surrounding non-target vegetation, Alternative 2 has been designed to reduce effects to non-target vegetation by always favoring the most selective/targeted treatment available whenever effective and feasible. When spot applications are selected, surrounding vegetation must be dominated by non-native species. Selective herbicide applications, largely for small isolated, leading edge infestations, would be used so widespread effects to non-target vegetation from direct exposure (i.e. overspray) would not be expected under Alternative 2.

For Sensitive and Threatened species, the risk of direct exposure would be dependent on the applicator ability to identify sensitive plant species, the selectivity of the application method, and proper identification of avoidance areas (flag and avoidance). Spot spray and directed foliar spray have the greatest risk for direct exposure to non-target vegetation if used in the vicinity of threatened and sensitive plant species. To avoid affects from direct spraying, over spraying, or other exposure scenarios, sensitive plant protection zones have been established for Alternative 2. Within the sensitive plant protection zone, invasive plant treatment, including herbicide application, would not occur unless a botanist proposes the use of a specific invasive plant treatment to improve or maintain habitat quality for threatened and sensitive plant occurrences. Under EDRR the area botanist would work closely with applicators to design treatments to effectively remove invasive species without adversely impacting the sensitive plant occurrences and to also insure that sites are properly protected (i.e. flagged on the ground) when invasive plant treatments are conducted.

Off-target drift: When using targeted spray applications there is some potential for impacts from drift down-wind of application area. These impacts can range from reduced plant vigor, abnormal growth, or necrosis, to death depending on both the exposure (dose) and sensitivity of the affected plant. Herbicide drift is influenced by a number of factors including site topography and surrounding vegetation; spray droplet size; wind speed and direction; and height of spray nozzle. Project design features have been included for all herbicide spray applications to reduce the potential of off-target drift including, 1) use coarse droplet size thereby limiting the presence of driftable droplets, 2) restrictions on the maximum height of spray nozzle above the ground and 3) restriction on wind-speed and direction when applying herbicides. Additional design features excluding herbicide spray applications near streams and other special aquatic features

(DF 38) would further reduce the risk of off-target effects from herbicide drift to various non-target species and vegetation of concern.

Alternative 2 includes limitations on the use of herbicide spray application within a distance where adverse effects to threatened and sensitive species may occur (Table 7). These spray restriction zones are based on documented no observable effect concentrations (NOEC), no observable effect level (NOEL) or no observable adverse effect concentration (NOAEC) for the most sensitive vascular plant species known for a proposed herbicides from SERA risk assessments. For threatened and sensitive plant species, distances where spray herbicide applications would be restricted were set by identifying the modeled distance where the hazard quotient from drift for a proposed herbicides approached a value of one at the maximum proposed application rate. In other words, the distance for restricted herbicide spray application around threatened and sensitive plant species is the distance from a plant (downwind of application area) where the modeled concentration from drift would be similar to the lowest concentration of observable effect for the most sensitive plant species. The drift coefficients used for this analysis are based on a boom application using a fine-coarse droplet spray at 20 inches above the target vegetation. This coefficient is the same for the six herbicides proposed for use to control invasive plant species on the ENF. It is worth noting that the drift scenario used for this analysis exceeds a number of restrictions included in Alternative 2 to limit drift, so the actual drift expected from backpack applications are expected to be lower than the modeled hazards in the Herbicide Risk analysis (SERA 2009).

A majority of the proposed invasive plant treatments near existing threatened and sensitive plant occurrences (within 500 feet) do not include spray application of herbicide where the hazard quotient (HQ) from drift exceeds a threshold of concern; therefore, there is little risk of death or damage to threatened and sensitive plant species from spray drift. The two exceptions are the proposed use of chlorsulfuron within 900 feet of threatened and sensitive plants and use of glyphosate within 300 feet.

According to the SERA Risk assessment the hazard quotient for spray application of chlorsulfuron exists at the maximum modeled distance. While the SERA worksheets indicate that an extremely low amounts of herbicides may affect intolerant species at >900 feet, these HQ quantify the potential hazard from broadcast application (SERA 2004), which is not proposed under the Eradication and Control of Invasive Plant Project. Similarly, the recent risk assessment completed for glyphosate (SERA 2011) indicates that off-target effects from drift could occur up to 300 feet from application sites. According to the SERA risk assessment for chlorsulfuron and glyphosate, offsite drift from backpack applications should be reduced substantially compared to broadcast applications from a boom (scenario used in risk assessment), but the extent of this reduction cannot be quantified. However, based on the inclusion of a number of project design features that are proven (Marer 2000) to reduce the risk of offsite affects from drift (wind restrictions, course droplet size, low nozzle height), it is reasonable to conclude that adverse effects to susceptible species from drift are unlikely from this project when treating invasive species outside the buffer distances for sensitive plants (Table 7).

Under Early Detection Rapid Response (EDRR), future invasive plant treatments may occur near threatened and sensitive plant species if a botanist has determined that the treatment is consistent with management direction for a given species and other control methods are likely to be ineffective. In the event that future control efforts include herbicides near sensitive plants, the botanist would work closely with applicators to avoid affects from off-target (drift, runoff, leaching) and direct exposure. Possible methods to limit affects from drift could include the use of alternative application methods that do not produce driftable fines associated with spray application such as wicking, wiping, drizzle; timing selective application methods so threatened and sensitive plants are not likely to be affected by drift; using a spray cone; covering sensitive plants during herbicide applications; scheduling spray applications when prevailing winds (< 5 mile/hr) are blowing away from sensitive plant habitat; or flagging and avoiding occurrences. In addition, if herbicides are sprayed where the HQ would be greater than 1, or within 500 feet of sensitive lichens and bryophytes, post-treatment monitoring of the sensitive plant occurrence would be used to insure that the assumption that targeted herbicide application would not adversely affect sensitive plant occurrence are correct.

Other Off-target movement (wind erosion, runoff, leaching): Off-target affects from herbicides are primarily a concern for chemicals that remain active in the soil (i.e. herbicide with pre-emergent properties) such as aminopyralid, clopyralid, chlorsulfuron, and imazapic. Off-target affects could occur from wind erosion moving contaminated soil, water moving across a treated area into an untreated area, or herbicides moving in the soil. Potential for off-target movement is greatest for spot applications (allowed only with aminopyralid and clopyralid) where the herbicide is applied directly to the soil. Other targeted herbicide applications (directed foliar, wicking and wiping, and drizzle) proposed for Alternative 2 are expected to have limited risk of movement from runoff since herbicides are not applied directly to the soil.

Off-target movement from runoff is modeled in the SERA Herbicide Risk Assessment using the GLEAMS model, an edge of field model that considers annual precipitation and soil texture. Where potential hazards are identified (HQ>1) it is possible that some plant species in the vicinity of the herbicide application would be affected by off-site movement in runoff. The GLEAMS model predicts the functional off-site application rate assuming broadcast application in an adjacent field (agricultural setting). In wildland settings, local conditions such as slope, topography and drainage patterns will greatly influence the actual potential for adverse effects in the vicinity of herbicide applications.

Wind erosion leading to off-site contamination of pesticides is also likely to be highly site-specific. The amount of herbicide that might be transported by wind erosion depends on several factors, including the application method, the depth of incorporation into the soil, the persistence in the soil, the wind speed, and topographical and surface conditions. Wind erosion is calculated as the amount of herbicide that might be transported off-site is based on estimates of annual soil loss associated with wind erosion and the assumption that the herbicide is incorporated into the top 1 cm of soil in the National Pesticide Risk Assessments. Review of exposure scenarios and risk characterizations for Glyphosate, Aminopyralid, Clopyralid, Chlorsulfuron, and Imazapic, indicate that hazard quotients are below the threshold of concern for the majority of potential off-target exposure scenarios. The two exceptions are potential runoff from clay soils with aminopyralid and clopyralid, which would be addressed by project design features restricting spot applications from areas with soils prone to runoff.

Accidental spills: There is always a remote risk of accidental spills or other exposure scenarios other than those described above. To limit the potential for herbicide spills in sensitive plant occurrences and other sensitive plant communities, mixing and loading of herbicides would occur outside of the sensitive plant protection area, RCA and lavacap plant communities. Another possible exposure scenario for impacts to non-target vegetation is accidental equipment malfunction when treating invasive plant infestations. A design feature requiring regular inspection and tests of all equipment used for herbicide application would greatly reduce the risk of herbicides spills when working in sensitive plant populations. In addition, a small spill containment kit would be carried by herbicide applicators when wicking and wiping to further limit potential effects in the event of equipment failure.

Threatened and Sensitive species

Within the project area surveys for threatened and sensitive plant species have occurred since the early 1980s. Past sensitive plant and invasive plant surveys have been conducted across the ENF for various FS projects. These surveys have focused on different plant species depending on the USFWS list and Region 5 sensitive plant list used at the time of the survey.

There are 53 occurrences of sensitive occurrences with known invasive plants either within or in close proximity (500 feet) of the occurrence. Most infestation would be treated manually (handpulling, or mechanical removal) when working within threatened and sensitive plant occurrences. For some infestations string trimming would be used (primarily annual grasses, and starthistle), but only when working outside the sensitive plant occurrence (>25 feet). For all known threatened and sensitive plant occurrences direct and indirect effects from proposed treatments within or in close proximity are not expected. When working within or adjacent to threatened and sensitive plants the unit botanist would instruct workers on the proper identification of species to avoid and flag out occurrences prior to treatments when necessary. Additional site specific DF have also been developed to avoid impacts when removing invasive plants from sensitive plant occurrences.

Direct benefits to sensitive plant species from the proposed invasive plant control are expected at 17 occurrences currently invaded by invasive species. By carefully designing invasive plant treatments within these sensitive plant occurrences Alternative 2 would improve existing habitat quality and prevent further impacts to existing sensitive plants.

In addition to removing invasive plants from known occurrences, Alternative 2 would also limit the threat of future invasion into threatened and sensitive plant occurrences from adjacent infested areas. While it is expected that reducing invasive plants across the forest would benefit threatened and sensitive plants, it is difficult to quantify both the current threat to threatened and sensitive occurrences or to what degree treating invasive plants would reduce this threat since successful invasion involves a number of site specific conditions and variables (such as available vectors, presence of intact native vegetation, or soil disturbance).

Unknown- imperfect survey coverage Potential direct and indirect effects described for known threatened and sensitive plant occurrences also apply for any newly discovered occurrence on the ENF. Past plant surveys conducted do not provide 100% coverage for the entire forest and older surveys did not target all threatened and sensitive plant species currently on the ENF sensitive plant list. Even with full survey coverage there is always a remote possibility that threatened and sensitive plants were not seen or detected (surveys can only confirm presence not a species absence). If proposed or EDRR treatments occur within unidentified sensitive plant occurrences potential effects could range from none (occur when plants are dormant) to trampling, direct spraying, uprooting, or piling materials on plant. To limit affects to unknown threatened and sensitive plant occurrences the following precautions have been included in the project:

- Under EDRR implementation planning process future treatments would be reviewed by a FS botanist for potential affects to threatened and sensitive plant species.
- If new threatened and sensitive occurrences are found they would be protected.
- Accidental treatment in unknown sensitive plant occurrences would be avoided by providing annual training to invasive plant treatment crews on threatened and sensitive plant identification.

The annual implementation planning meeting would also insure that crews assigned to work near or within threatened and sensitive plant occurrences have sufficient training to avoid impacts when removing invasive plants within and adjacent to threatened and sensitive plants.

Bryophytes and Lichens Unfortunately risk assessments for the proposed herbicides included in Alternative 2 are for vascular plant species which may serve as a poor surrogate for nonvascular species. In general lichens and bryophytes are considered highly sensitive to various forms of pollution and environmental contaminants because of their inability to regulate uptake of material. In addition bryophytes utilize many of the same growth regulators as vascular plants and could be susceptible to herbicide exposure (Newmaster, 1999). Therefore, it is possible that FS Sensitive bryophytes and lichen species are more susceptible to low concentrations of herbicides than the most susceptible vascular plant used in the SERA risk assessments. In the absence of available information on bryophyte and lichen sensitivity herbicide application within 500 feet would not occur unless treatments are overseen by a Forest Service Botanist. Currently only one infestation of medusa head occurs in the vicinity of a known Sensitive lichen or bryophyte. The infestation of medusa head is approximately 400 feet from a veined aquatic lichen occurrence and would be treated using a string trimmer. Project Design Feature restricting herbicide spray application within 500 feet of sensitive lichen and bryophytes would limit potential impacts from any future treatments conducted under EDRR.

Federally Listed Species

There are two occurrences of Layne's butterweed (*Packera layneae*) with infestations of invasive plants occurring within or adjacent to the known occurrences. Direct and indirect impacts from Alternative 2 are not expected since proposed invasive plant treatments have been designed to avoid impacts to both occurrences of Layne's butterweed. In addition future invasive plant treatments that may occur under early detection rapid response (EDRR) would not occur on gabbro or serpentine soils if surveys for Layne's butterweed have not occurred. Therefore, it is determined that the proposed Eradication and Control of Invasive plant on the ENF Project would have no effect Layne's butterweed.

Candidate species

Alternative 2 would not result in direct, indirect or cumulative effects to white bark pine (*Pinus albicaulis*). The higher elevation habitats occupied by white bark pine are not highly infested with invasive plants currently and are not expected to be appreciably impacted under Alternative 2.

R5 Sensitive Species

There are 53 occurrences of ENF sensitive plant species in the vicinity (500 feet) of known infestations of invasive plants. Impacts from project activities are not expected since proposed invasive plant treatments have been designed to reduce potential impacts to sensitive plant occurrences. Therefore, the proposed Invasive Plant Eradication and Control Project, may affect individuals, but would not lead to trend toward Federal listing or loss of viability for *occurrences in the vicinity of proposed invasive plant treatments*.

The proposed project also allows for the treatment of new infestations when found on the forest. Direct and indirect effects to sensitive plants from future EDRR treatment are not expected since all treatments in the vicinity of threatened and sensitive plants will be developed by a Forest Service botanist. Therefore, it is concluded that the proposed action alternative, may affect individuals, but would not lead to trend toward Federal listing or loss of viability for: *Allium tribracteatum, Arctostaphylos nissenana, Balsamorhiza macrolepis var. macrolepis, Botrychium ascendens, Botrychium crenulatum, Botrychium lunaria, Botrychium minganense, Botrychium montanum, Botrychium paradoxum, Bruchia bolanderi, Calochortus clavatus var. avius, Cypripedium montanum, Draba asterophora var. asterophora, Draba asterophora var. macrocarpa, Eriogonum tripodum, Epilobium howellii, Helodium blandowii, Horkelia parryi, Lewisia kelloggii ssp. hutchisonii, Lewisia kelloggii ssp. kelloggii, Lewisia longipetala, Lewisia serrata, Meesia triquetra, Meesia uliginosa, Navarretia prolifera ssp. lutea, Pinus albicaulis, Peltigera hydrothyria*, or *Phacelia stebbinsii.*

Special interest species

Currently 25 occurrences of Special Interest species in close proximity to invasive plant infestations proposed for treatment under the Eradication and Control of Invasive Plants project. Potential impacts of invasive plant management near Special Interest species may include trampling, uprooting, herbicide application, or otherwise altering habitat quality. Over half of the Special Interest occurrences within 500 feet of proposed invasive plant treatments are greater than 150 feet from proposed invasive plant work and are unlikely to be affected by Alternative 2. However, the remaining occurrences currently overlap with proposed invasive plant infestations. Red hill's soap root is most frequently infested with invasive plants, but there is one occurrence of Pacific yew and Sanborn's onion in close proximity to known infestations. Treatments in Special Interest occurrences would be designed to limit impacts to Special Interest species while effectively removing invasive plants from the occurrence. In addition, future treatments conducted under EDRR would also consider the Special Interest species when developing treatment strategies for removing invasive species. It is expected that the proposed invasive plant treatments would benefit Special Interest species on the ENF by removing invasive species from known occurrences.

Botanical Special Interest Area (SIA) There are four Botanical Special interest areas on the ENF. Traverse Creek Botanical SIA is the only Botanical SIA with known invasive plant populations. The SIA is home to Layne's butterweed (*Packera layneae*) and tripod buckwheat (*Eriogonum tripodum*) and Sanborn's onion (*Allium sanbornii* var. *sanbornii*). The SIA also includes a diverse and unique plant community with a number of serpentine endemic species. Unfortunately the SIA is also infested with yellow starthistle (*Centaurea solstitialis*) maltese starthistle (*Centaurea melitensis*), medusa head (*Elymus caput-medusa*), and scotch broom (*Cytisus scoparius*). In order to maintain and improve the unique botanical resources at the SIA the forest would make every effort to control known infestations within the sensitive area. To limit impacts to the Botanical SPI, all invasive plant treatments would be conducted under the direction of a Forest Service botanist.

Riparian Vegetation Typical, invaders for riparian communities on the Eldorado include blackberry (*Rubus armeniacus* and *R.lacineatus*), vinca (*Vinca major*), English ivy (*Hedera helix*), perennial pepperweed (*Lepidium latifolium*), and purple loosestrife (*Lythrum salicaria*). Of the common riparian invaders Himalayan blackberry is generally the most prevalent species on the forest. To a lesser extent invasive species associated with upland habitat will occur in riparian areas and include scotch broom (*Cytisus scoparius*), yellow starthistle (*Centaurea solstitialis*), spotted knapweed (*Centaurea stoebe*), and oblong spurge (*Euphorbia oblongata*). Currently 791 acres of invasive species are mapped within Riparian Conservation Areas for perennial stream and ephemeral streams (generally were riparian vegetation occurs).

The proposed project includes the limited use of herbicides to treat invasive species within and adjacent to aquatic features which may include riparian vegetation. These proposed invasive plant treatments would be buffered from aquatic features limiting the potential effects to non-target riparian vegetation. In general non-spray applications of herbicides (wicking and wiping) would be used to treat invasive species within and adjacent to riparian vegetation. Wicking and wiping is extremely selective so it is unlikely that non-target riparian vegetation will be impacted.

Spray application of herbicides would occur between 25 and 100 feet from perennial streams and other special aquatic features depending on the proposed herbicide method (Table 11). Hazard quotients for potential off-target effects to riparian vegetation associated with these aquatic features range from 2- 38 (Table 11). As these values are all above 1, it is possible that spray applications of herbicides occurring near aquatic features may effect some riparian vegetation. Potential effects could range from abnormal growth, reduced vigor, seedling emergence, or possible death depending on the effected non-target vegetation and applied herbicides. However, in a study of non-target effects from herbicide drift (Marrs et al 1989), recovery from off-target effects, when it occurred, was observed by the end of the growing season. While the SERA risk assessment indicates that off-target effects to riparian vegetation are possible, a number of project Design Features to reduce the potential for off-target effects have been included. The inclusion of these project DFs, and the avoidance of spot application where riparian vegetation is dominant, would greatly limit the potential for adversely impact riparian vegetation from invasive plant treatments. Furthermore, Alternative 2 would monitor native vegetation in sensitive areas and implementing revegetation when necessary. This would insure that any riparian or other non-target vegetation effected by invasive plant treatments would be restored.

Table 11. Hazard quotients from drift for riparian vegetation near streams and special aquatic features

Herbicide	Application Method	Perennial or Intermittent Streams /Ditches with water		Special Aquatic Features (springs, seeps, meadows)	
		Distance from feature (ft)	associated HQ from drift	Distance from feature (ft)	associated HQ from drift
Aminopyralid	Spot & directed foliar spray	25	5	100	1.3
Chlorsulfuron	directed foliar spray	100	38	100	38
Glyphosate	directed foliar spray or drizzle	25	19	25	19
Imazapic	directed foliar spray	75	0.5-0.8	75	0.5-0.8
Triclopyr (TEA)	directed foliar	75	1.3-2	75	1.3-2
Clopyralid	Spot & directed foliar spray	50	2	50	2

Meadows and fens Meadows represent unique hotspots for plant diversity in the Sierra Nevada. In a landscape dominated by conifers and forested communities, Sierran meadows offer unique and valuable habitat for wildlife, habitat for rare and unique plants, and serve valuable ecosystem services. Sierran meadows can vary from peatlands (fens) seasonal depressions (vernal pools), to dry meadows. There are 13 meadows with invasive species adjacent to, or within the mapped meadow.

Fens There are 44 fens known from the ENF. None of the known fens have invasive plant infestations within the peat body or associated meadow complex. One fen (near Granite Springs) on the Placerville Ranger District is in the vicinity (< 500 feet) of existing yellow starthistle infestations within the Fred’s fire perimeter

Treating invasive plants in meadow communities could result in a number of short and potentially long-term impacts on meadow ecology. Hazard include direct and indirect effects to non-target vegetation from herbicide application, trampling or uprooting native vegetation, and tarping native vegetation. Most effects from proposed invasive plant treatments are expected to be localized and short-lived within meadow communities on the ENF. Even if tarping, trampling, or off-target effects from limited herbicide application occurs it is expected that surrounding intact vegetation would readily recolonize disturbed areas.

Currently there are 13 meadows with invasive species adjacent to, or within the mapped meadow. A majority of known meadows with invasive plant infestations are largely intact meadow communities with small isolated infestations that can effectively be controlled with handpulling when treating near wet meadow vegetation. Proposed treatments within and adjacent to these meadows are not expected to result in appreciable impacts to surrounding vegetation. Effects from future invasive plant treatments conducted as part of the projects Early Detection Rapid Response Strategy (EDRR) are not likely because of DF restricting herbicide application within and surrounding special aquatic features. In addition Alternative 2 would limit the use of herbicide to treat small infestations (<100 sq feet) of high priority infestations that cannot be effectively controlled using other treatment methods.

Lavacap plat communities Lava caps are volcanic tabular ridges formed from andesitic lahars or mudflows of the Mehrten Formation occurring from 2,000 to 3,000 feet. The forest has an incomplete mapping of lava cap plant communities. For this analysis of invasive plant infestation on or adjacent to lava caps, the forest soil layer was queried for Ledmount-Rock outcrop association and McCarthy-Ledmount Associations. This data was supplemented with local knowledge of lava caps on the forest that are not mapped on the forest soil GIS data. There are approximately 14 lava caps with mapped invasive species immediately adjacent or within the lava cap plant community.

These plant communities are generally dominated by high diversity of herbs and shrubs adapted to growing on rocky and volcanic soils eroded from Mehrten formation mudflow. Early each spring, these rocky areas give rise to a rich and varied ephemeral plant community. The rest of the year lava cap communities often have a sparse barren appearance. This community type is recognized by CNPS as a sensitive plant community type. Threats to these unique plant communities include OHV activity, fuels reduction activities, landing construction and invasive plant introduction. Because of the lava cap physical situation, on fairly level ridgetops, much of this habitat has been impacted by the construction of roads, trails, and landings. The ENF generally avoids ground disturbance including landings, and equipment staging on pristine lava cap communities.

Lava cap plant communities are vulnerable to invasive plant invasion. These plant communities are generally dominated by high diversity of herbs and shrubs adapted to growing on rocky and volcanic soils eroded from Mehrten formation mudflow. The limited canopy closure in many lava cap communities increases the vulnerability of these unique plant assemblages to invasion by non-native invasive plant species adapted to growing in dry upland conditions such as yellow starthistle (*Centaurea solstitialis*), barbed goatgrass (*Aegilops triuncialis*), and medusahead (*Elymus caput-medusae*). Unfortunately, non-native annual grasses have already become established as a minor component of many lava cap plant communities on the forest. There are 11 lavacap sites that are believed to be infested with invasive plant species. Non-native annual grasses are also prevalent in many lavacaps across the forest but current information is unavailable to quantify the number of sites occupied by non-native grasses.

Invasive plant treatments in and around lava cap communities could impact the unique vegetation by off-target herbicide application, trampling slow growing perennial species, uprooting or disturbing native vegetation when removing invasive species, piling invasive plant materials in the lavacap, and string trimming native annual species prior to seed production. During the annual implementation planning processes the presence of lava cap plant communities would be considered when developing management strategies for targeted invasive plant infestations. Treatments would take into consideration the unique flora and avoid activities that may cause long-term impacts to the diversity and cover of native species. In addition spot application would not occur when treating invasive species in intact lava cap communities. With the above project design features it is expected that any impacts to lava cap plant communities, if they do occur, would be limited and localized to portions of lava caps already compromised by the invasive species targeted for treatments.

Special forest products On the ENF some of the more commonly collected forest products include wild berries, ferns, medicinal plants, and mushrooms. In addition there are a number of culturally significant native species for local tribes including elderberry, dogwoods, choke cherry, alder, and willow.

A majority of potential special forest products are not considered invasive and would not be directly targeted for removal by Alternative 2. However, non-native berries, Klamath weed, and fennel would be targeted for control. While localized removal of these species may occur within the analysis area, it is unlikely that these widespread species be completely removed from the forest. Other than species targeted for direct control there is some potential to effects culturally significant plant species and other species targeted for plant collection during invasive plant treatments (see section on effects to non-target vegetation). These effects are expected to be limited across the analysis area and would generally be restricted to the immediately vicinity surrounding invasive plant treatments when they occur.

Repeated invasive plant treatment Under Alternative 2 some infestations would require repeated treatments to achieve management objectives. When repeated treatments are required, especially when using spot herbicide applications, there is some risk for impacts to surrounding non-target vegetation. Some studies have documented clear shifts in native vegetation diversity from repeated treatment of invasive plant infestations using intensive herbicide applications to control yellow starthistle (Ditomaso et al 2006). Ideally invasive plant treatments would allow for the successful removal of the undesirable invasive species while also preserving all existing native vegetation within treated areas. This idealized scenario is not always achievable, but alternative 2 has been developed so invasive plant treatments would be implemented using the most targeted method available to minimize potential effects to non-target vegetation. This would be accomplished by prioritizing manual and targeted herbicide applications whenever feasible and effective before selecting treatment methods that may affect non-targeted vegetation.

Benefits to Native Vegetation The continued spread and establishment of invasive species can reduce native plant diversity by changing ecological processes, and outcompeting native vegetation for limited resources (space, water, light, and nutrients).

By controlling and eradicating invasive plants this project would reduce the potential impacts to native vegetation from existing and new invasive species on the forest. In addition, alternative 2 also includes the use of restoration as a component of integrated pest management. This will improve native vegetation cover in areas currently occupied by invasive species. To the degree that proposed treatments are effective, benefits to native plant communities are expected within Botanical Special Interest areas (Traverse Creek), unique plant communities (lava cap), riparian vegetation, and general forest communities. In addition, direct benefits to Sensitive plant species from invasive plant control is expected at seventeen occurrences currently invaded by invasive species. By carefully designing invasive plant treatments within these sensitive plant occurrences (Appendix E) Alternative 2 would improve existing habitat quality and prevent further impacts to existing sensitive plants. In addition to removing invasive plants from known occurrences, Alternative 2 should limit the threat of future invasion to Threatened and Sensitive plant occurrences by reducing sources of invasive plants which could move into threatened and sensitive plant habitat in the future.

Invasive Plants

Across the ENF both the majority of large infestations and total infested acres occur below 5,000 feet in elevation on the Forest. The Georgetown District has the highest number of total infested followed by the Placerville, Pacific, and Amador Ranger District. The most prevalent invasive plant species on the Forest is Scotch broom (*Cytisus scoparius*) with infestations totaling more than 1,600 acres primarily on the Georgetown Ranger District. Yellow starthistle (*Centaurea solstitialis*) is the next most prevalent invasive plant species with large infestations documented within the Cleveland and Fred's wildfire areas. Rush skeletonweed (*Chondrilla juncea*) has become established across much of the Forest. Annual grasses, such as cheatgrass (*Bromus tectorum)*, ripgut brome (*Bromus diandrus*) and red brome (*Bromus madritensis var. rubens*) are also prevalent across the Forest. Other species of high concern for the ENF are perennial pepperweed (*Lepidium latifolium*), spotted knapweed (*Centaurea stoebe*), oblong spurge (*Euphorbia oblongata*), purple loosestrife (*Lythrum salicaria*), and diffuse knapweed (*Centaurea diffusa*). The majority of these species consist of scattered isolated infestations less than 5 gross acres. Table 12 below list the known acres by species on each ranger district and a summary of the species.

Table 12. Known acres of invasive species by district for the ENF.

Species	Amador	Georgetown	Pacific	Placerville	Total
barbed goatgrass	0.62	0.79	9.85	34.99	46.24
Perennial pepperweed	0.50	0.02	0.01	1.77	2.30
bull thistle	0.02	0.54			0.56
Canada thistle	3.32	0.05		0.24	3.61
cheatgrass	1.27			5.94	7.21
Klamathweed	0.37			0.07	0.45
diffuse knapweed	1.91			1.37	3.27
oblong spurge	0.50			0.93	1.43
French broom	0.98				0.98

Russian knapweed	0.25			8.83	9.08
Himalayan blackberry	0.06	0.62		0.04	0.72
Italian thistle		5.05			5.05
Maltese star-thistle		10.42		3.58	14.00
medusahead	2.30	3.27	0.02	3.99	9.57
prickly Russian thistle	0.50			0.54	1.04
purple loosestrife				0.29	0.29
purple star-thistle				0.03	0.03
rush skeletonweed	0.51	127.09	10.51	17.80	155.90
Scotch broom	0.52	1,392.02	83.44	161.64	1,637.62
Spanish broom				0.25	0.25
spotted knapweed	1.00	0.25	13.09	0.88	15.22
sweet fennel		0.00	0.00		0.01
tree of heaven	0.00	2.43		0.29	2.72
yellow star-thistle	29.66	31.52	297.41	445.22	803.82
Grand Total[1]	**44.27**	**1,574.07**	**414.34**	**688.68**	**2,721.37**

Under the proposed Action, about 2,610 acres of existing invasive plant infestations could be treated using integrated pest management. The proposed action would also allow for eradication or control of new infestations when found over the life of the project (10 years). The amount of new infestations that may be treated under the proposed action is difficult to quantify, as invasive species spread and introduction is often stochastic in nature and dependent on a number of variables (vectors, suitable habitat, etc). However, based on rates of discovery in 2008 and 2009 approximately 25 acres of new infestations are expected to be discovered annually on the forest. It is expected that 600 acres would be treated annually following the treatment priorities outlined in the Eldorado's invasive plant management strategy. Strategy 1 and 2 infestations, including small isolated infestations of perennial pepperweed (*Lepidium latifolium*), tree of heaven (*Ailanthus altissima*), Canada thistle (*Cirsium arvense*), and skeletonweed (*Chondrilla juncea*), are expected to be quickly eradicated under the proposed action. Other invasive species including, spotted knapweed (*Centaurea stoebe*), isolated broom infestations (primarily *Cytisus scoparius*) purple starthistle (*Centaurea calcitrapa*), and yellow starthistle (*Centaurea solstitialis*) have seed banks which would necessitate additional retreatments to effectively eradicate targeted infestations. With consistent funding, it is expected that a majority of these infestations can be eradicate over the life of Alternative 2, providing the opportunity to restore native plant communities. Larger infestations of yellow starthistle (*Centaurea solstitialis*), barbed goatgrass (*Aegilops triuncialis*), and scotch broom (*Cytisus scoparius*) would be challenging to manage given the size of some infestations on the forest. Annual treatments would focus on treating leading edge infestations while controlling the perimeter of larger infestations. Over the life of the project it is expected that these efforts would reduce current infested areas and also limit further spread of these species on the forest.

One potential effect of repeated invasive plant treatment is the development of herbicide resistant biotypes from repeated use of similar herbicides (DiTomaso, 2006). While a concern, the proposed action is based on the principles of integrated pest management (IPM) and includes a variety of available methods to control and eradicate invasive species on the Forest. According to DiTomaso and Orlaff (1996) IPM is one of the most effective methods to minimize the development of herbicide resistant biotypes. In addition, multiple herbicides have been included as potential tools to control most of the invasive species considered for treatment on the ENF. This would allow the forest to vary chemical treatments whenever repeated treatments are required for a targeted infestation. Additionally, the first priority under the proposed action is to implement manual treatments whenever effective and practical. During the annual implementation process the forest would revisit prescriptions for all infestations that require additional treatments. This process would allow for the Eldorado's Invasive Plant program to practice adaptive management, shifting ongoing treatments towards non-chemical IPM methods whenever a given infestation has reached a stage where other methods become effective and feasible.

While Alternative 2 is designed to control invasive species on the ENF, there is a slight risk that project activities could spread existing invasive plant since crews would be working in areas already infested with high priority species. In addition the project would generally occur in areas of the forest vulnerable to invasive species invasion and would also create localized area of open canopy and bare soil where new invasive species could become established. Project Design feature limiting herbicide application, and requiring the inclusion of active restoration when appropriate would reduce the risk of project activities spreading invasive species. In addition, recommended DF for using weed-free materials and cleaning equipment when moving between invasive plant infestations further limit the potential for the spread of invasive species from project activities.

Range

The ENF administers nine active livestock grazing allotments totaling 192,366 acres of NFS lands. An additional 86,232 acres of privately owned land located within these active allotment boundaries is grazed in conjunction with the NFS. There are 15 vacant allotments on the Forest containing 202,480 acres NFS and 57,315 acres privately owned. These vacant allotments were grazed in the past, however grazing is not currently occurring or planned in the foreseeable future.

Invasive species are present on the NFS portion of eight of the nine active allotments. The total potential infested area within the active allotments in 300 acres. The potential infested area is based on the size of mapped infestations doubled in size to account for potential growth. The following (Table 13) displays the potential infested area by allotment and treatment strategies in the proposed action. One active allotment has no known infestations of invasive plants and four allotments have less than two acres within the NFS. Data is not available for invasive infestations on privately owned land within the active grazing allotments, however it is assumed conditions and level of occurrences is similar to that on NFS.

Table 13. Projected treatment areas based on potential infested area within active grazing allotments.

	Total potential infested area acres[1]	Strategy 1 potential infested area acres	Strategy 2 (excluding broom) potential infested area acres	Strategy 2 (broom only) potential infested area acres	Strategy 3 potential infested area acres
Corral Flat	-	-	-	-	-
Cody Meadow	0.08	0.03	0.05	-	-
Pardoe	0.50	-	0.50	-	-
Sopiago	0.61	0.03	-	0.53	0.04
Sherman	1.86	1.86	-	-	-
Bear	38.05	1.16	34.93	1.97	-
Chipmunk	53.73	0.10	53.14	0.50	-
Neilsen	67.87	3.70	63.63	0.54	-
Old Pino	138.08	1.05	44.95	90.91	1.17

[1] Potential infested area was estimated to be double the size of current mapped sites.

Measures to prevent the spread and introduction of invasive species are incorporated into current grazing allotment permit administration. Invasive plant prevention actions are discussed at annual meetings and included as a requirement in Annual Operating Instructions. Permittees are restricted to the use of weed free feed for horses or livestock. Permittees are required to clean vehicles prior to entry on NFS land if they are moving from an area that has invasive species.

Many invasive plant species are not palatable as livestock grazing forage and often replace native forage. Native vegetation in healthy riparian areas includes species with root systems that anchor and stabilize streambanks. Many invasive species do not have these same soil stabilizing properties so if they replace native vegetation within riparian areas of grazing allotments, stream bank stability can be weakened and more susceptible to impacts from livestock grazing.

A reduction in the current level of invasive species infestations through prevention, control and eradication treatments and restoration activities would maintain or improve the availability of palatable native forage for livestock grazing and protect rangeland health. Maintaining native species in riparian areas and preventing replacement with invasive species would help to maintain streambank stability and reduce streambank susceptibility to impacts from grazing. Control of invasive species would reduce or eliminate the risk of livestock, horses and equipment used in livestock management activities from acting as vectors to their spread on NFS land and adjoining private land within grazing allotments.

The proposed action could result in the need for short term restrictions on livestock access to treatment areas needing restoration activities. If any restrictions are necessary, they would be applied to very small areas in relation to the size of allotments and represent a negligible amount of forage lost during restoration. There would be improved forage quality and quantity after invasive treatments and restoration activities.

Some grazing permittees could potentially need to adjust their end of season practices in accordance with herbicide label restrictions if grazing on allotments treated with triclopyr. Cattle must be withdrawn from grazing treated grass at least 3 days before slaughter. In accordance with Design Feature 33, permittees would be notified annually of planned treatments, to implement any needed adjustments to livestock management.

Implementation of the Proposed Action alternative would protect rangeland health from degradation by invasive plant infestations and protect the availability of native forage, while causing negligible impacts to range permittee grazing operations. There would be no direct or indirect adverse impact to rangeland resources. Past, present and reasonably foreseeable future projects to control invasive plants or manage vegetation for reforestation were considered in combination with the proposed action and determined there would be no cumulative adverse impacts.

Terrestrial Wildlife

The Proposed Action has the potential to affect terrestrial wildlife through:

1. Disturbance of individuals from noise or visual disturbance associated with treatments;
2. Secondary effects upon habitat
3. Toxicity from acute or chronic exposure to herbicides

Disturbance or Displacement

All treatment methods can result in disturbance from human presence and noise. Because manual and mechanical techniques are slower than herbicide methods, the duration of disturbance, caused by the presence of people, may be longer in the treatment area. None of the treatments methods are likely to exceed a few days within a given area, however, and the use of a string trimmer is the only method that will generate any substantial noise. The use of a string trimmer may generate noise sufficient to flush birds from a nest or interfere with feeding of nestlings if conducted in proximity to nests.

Habitat Alteration

Invasive plant treatment methods described in the Proposed Action (manual, mechanical, and chemical), can result in secondary effects upon habitat. Where invasive plants occur in large, dense patches, treatments can temporarily create bare ground by reducing plant cover. The removal of invasive plants can, in the short-term, decrease in the amount of vegetative cover available to wildlife. Due to the small and patchy nature of most of invasive plant infestations on the ENF, the amount of cover lost would be insubstantial. For the most part, invasive plant treatments restore, rather than reduce, habitat available to wildlife and the successful control of invasive plant infestations provides long-term benefits by restoring and preventing further loss of native habitat. Removal of invasive plants generally increases the diversity of native herbaceous and shrub species within treated areas. Large infestations and monocultures of invasive plants (such as some areas on the ENF infested with scotch broom or with yellow star thistle) do not support healthy wildlife populations and the benefits associated with restoring native plant communities far outweigh the impacts of removing non-native vegetation cover. Invasive plants can actually act as a population sink by attracting a species and then exposing them to increased mortality or failed reproduction (Chew 1981).

There are no invasive plants on the ENF that are known to provide essential habitat for wildlife. Despite the rare situations where certain species may benefit from the presence of a non-native invasive plant (animals may consume blackberry fruits for example), removal of invasive plants is unlikely to reduce food availability or habitat quality for any native wildlife species to a meaningful degree. Reducing the presence of invasive plants will benefit habitat for the vast majority of species which are adapted to and depend upon healthy native plant communities.

Herbicide Toxicity

Methodology and Assumptions Used for Herbicide Risk Assessments. Analysis of effects to wildlife from herbicides and the associated surfactants or dyes proposed for use in this project, utilizes risk assessments prepared for the Eradication and Control of Invasive Plants project, unless stated otherwise (risk assessment worksheets are available in the project record). The risk assessments are based upon Human Health and Ecological Risk Assessment reports prepared by Syracuse Environmental Research Associates (SERA 2011a, 2011b, 2007, 2004a, 2004b, 2004c) which utilize the best available science to describe the level of herbicide expected to be introduced, persist, and transport within the forest environment, and to evaluate the likelihood of adverse ecological effects. FS/SERA risk assessments use peer-reviewed articles from the open scientific literature and current EPA documents. The likelihood that an animal will experience adverse effects from an herbicide depends on: (1) toxicity of the chemical, (2) the amount of chemical to which an animal is exposed, (3) the amount of chemical actually received by the animal (dose), and (4) the inherent sensitivity of the animal to the chemical, all of which are evaluated in FS/SERA risk assessments. There is insufficient data on species-specific responses to herbicides for free-ranging wildlife, so wildlife species were placed into groups based on taxa type (e.g. bird, mammal), with similar body size and diet.

When enough data was available for a particular type of animal, an exposure scenario was developed, and a quantitative estimate of dose received by the animal type in the scenario was calculated as described in the SERA risk assessments. The quantitative estimates of dose were compared to available toxicity data to determine potential adverse impacts. Because of the uncertainty with regard to how accurately a surrogate species may represent other wildlife, the FS/SERA risk assessments use the most sensitive endpoint from the most sensitive species tested as the toxicity index for all wildlife. The estimated dose (from the scenarios) is divided by the "toxicity index" and the result is known as the Hazard Quotient. When the Hazard Quotient is less than 1.0, the dose is less than the toxicity index. Potential effects from doses calculated to be below the toxicity indices are discountable. When a calculated dose was greater than the toxicity index, there is a potential for adverse effects. This very protective approach constitutes a "worst-case" analysis for potential effects of herbicides.

For all herbicides included in the proposed action, sufficient data were available to determine the dose that resulted in no observable adverse effects (NOAEL) and the NOAEL was used as the toxicity index. The following definitions apply to this analysis.

Exposure Scenario The mechanism by which an organism (person, animal, fish) may be exposed to herbicides active ingredients or additives. The application rate and method influences the amount of herbicide to which an organism may be exposed.

Threshold of Concern A level of exposure below which there is a low potential for adverse effects to an organism. Effects on wildlife and other organisms are considered insignificant and discountable when herbicide exposure is below the threshold of concern.

Hazard Quotient (HQ) A "toxicity threshold" was established for each herbicide to indicate the point below which adverse effects would not be expected for a variety of organisms (e.g. people, wildlife, fish). The predicted level of exposure from herbicide use is compared to the toxicity threshold and expressed in terms of a "hazard quotient (HQ)." The Hazard Quotient is the amount of herbicide or additives to which an organism may be exposed over a specified period, divided by that estimated daily exposure level at which no adverse health effects are likely to occur. An HQ less than or equal to one indicates an extremely low level of risk. Toxicity thresholds are based on extrapolated laboratory results and accepted scientific protocols. The probability of harmful effects increases with HQ.

Terrestrial animals might be exposed to any applied herbicide from direct spray, the ingestion of contaminated media (vegetation, prey species, or water), grooming activities, or indirect contact with contaminated vegetation, and these sources of exposure were considered in the risk assessments used for this analysis. As discussed above, the threshold of concern is the no observable adverse effect level (NOAEL), where research has shown no statistically significant effect when compared to animals not exposed to the chemical. Thus hazard quotients (HQ) of less than 1.0 indicate that the exposure poses little reason for concern. Hazard quotients greater than 1.0 pose concern for effects to wildlife. Toxicity data and hazard quotients for herbicides, surfactants and dyes for the application rates described in the ENF Eradication and Control of Invasive Plants project, have been evaluated in project risk assessment worksheets.

Risk assessments show that the highest exposures for terrestrial vertebrates would occur after the consumption of contaminated vegetation or contaminated prey. Other routes of exposure, including direct spray, dermal contact with contaminated vegetation, ingestion of contaminated water, or the consumption of contaminated fish, lead to levels of exposure considerably below the level of concern for all species groups and all herbicides being considered in this project. Thus, the following discussion focuses on acute and chronic herbicide exposures resulting from ingestion or exposure to contaminated vegetation or prey, for the herbicides included in the Proposed Action.

Mammals Review of exposure scenarios and risk characterizations for Glyphosate, Aminopyralid, Clopyralid, Chlorsulfuron, and Imazapic, indicate that for both acute and chronic exposures, hazard quotients are below the threshold of concern, 1.0, in all exposure scenarios. The assessments included consideration of accidental acute exposure (from direct spray, or contamination following a spill), non-accidental acute exposures (from contaminated vegetation, water, or consumption of contaminated insects or small mammals), and from chronic/longer term exposures associated with consumption of contaminated vegetation, water, or fish). The weight of evidence from available studies suggests that no adverse effects to mammals are plausible using typical or worst-case exposure assumptions at application rates proposed in this project. Hazard quotients for all exposure scenarios, at both the central and upper range, are well below one (the level where potential effects from doses are considered discountable). This indicates there is a low level of concern that application of these herbicides in the Eradication and Control of Invasive Plants project would adversely affect mammals.

Review of the risk characterization for triclopyr, however, indicates that HQs exceed the level of concern (HQ > 1) for exposures to mammals involving the consumption of contaminated vegetation. The HQs for mammals increase as body weight increases. While small mammals may consume more than larger animals, the higher sensitivity of larger mammals to triclopyr suggest they are at greater risk. The high hazard quotients particularly for large mammals under chronic exposure to contaminated vegetation, suggest the potential for adverse effects. The "worst case" exposure scenarios do not, however, account for factors such as timing and method of application, animal behavior and feeding strategies and/or implementation of project design criteria. When these factors are considered, it is evident that risk is overestimated for both the acute and chronic exposure scenarios relative to the Proposed Action.

Under the acute exposure scenario, the environmental risk model assumes that 100 percent of the animal's diet is made up of contaminated vegetation within a 24-hour period. This is an unlikely scenario for herbivorous mammals under the Proposed Action, since Design Feature 39 of the Proposed Action does not allow for broadcast application of triclopyr. Triclopyr is proposed for use in a targeted manner on a very limited number of invasive plant species. These species occur as scattered, isolated populations for which treatments expected to be limited and lower priority (strategy 3) and are not known to occur across large acreages on the ENF (English ivy, blackberry, perennial sweatpea), or are species which are not yet known to be present on the Forest (e.g. gorse, scarlet wisteria, knotweeds). Under the chronic exposure scenario, it is assumed that 30 percent of an animal's diet will come from treated vegetation over a 90-day period. Since treated plants will rapidly brown and die, they will not remain palatable or available as forage for more than about five to ten days following treatments, making the chronic scenario implausible. For these reasons, the magnitude of risk for mammals consuming vegetation treated with triclopyr under the Proposed Action is considerably less than the risk characterization provided in the SERA risk assessments.

In addition, the quantitative risk characterization must be tempered by information from field applications of triclopyr. None of the available field studies of wildlife report adverse effects which might be attributed to the toxicity of triclopyr. This may be because the upper bound HQs represent multiple worst case exposure assumptions that may not occur frequently in the field. Another likelihood is that many mammals, such as deer, are likely to avoid treated areas. If larger mammals avoid treated areas, the proportion of the contaminated diet could be much less than 100 percent and as the proportion of the diet that is contaminated decreases, the HQs will also decrease. It should also be noted, however, that there is a lack of detailed field studies involving longer-term observations in populations of large mammals following applications of triclopyr.

Birds Review of herbicide worksheets, exposure scenarios and risk characterizations for Glyphosate, Aminopyralid, Clopyralid, Chlorsulfuron, and Imazapic, indicate that there are no toxicity effects anticipated in birds. This was true for scenarios involving direct spray, consumption of contaminated vegetation, contaminated insects, or contaminated prey.

For triclopyr, scenarios involving consumption of contaminated vegetation or contaminated insects by a small bird (10 g) resulted in HQs that exceeded one for both acute and chronic exposures at the central and upper bounds. This indicates there is a risk that birds could be affected by the application of triclopyr in the Eradication and Control of Invasive Plants project. As described for mammals, however, the limited use of triclopyr in this project minimizes the exposure of birds to vegetation or insects treated with triclopyr over any length of time. Birds are very unlikely to consume 100 percent of their diet in contaminated vegetation or insects over a 24 hour period, and the chronic exposure scenarios (30 percent of the diet over a 90- day period) would be even less plausible, since treated vegetation will brown and die. All exposure scenarios for a large bird, such as an eagle, are below the threshold of concern.

Invertebrates Review of exposure scenarios and risk characterizations for Aminopyralid, Clopyralid, Chlorsulfuron, and Imazapic, indicate that adverse effects in invertebrates due to herbicide toxicity are unlikely. Based on available information there is no indication that adverse effects on terrestrial invertebrates would occur. As with mammals and birds, the risk characterization for terrestrial invertebrates is based on data covering very few species relative to the large number of terrestrial invertebrates that might be exposed to these chemicals.

The upper bound HQs for glyphosate reach or slightly exceed one (HQ=1.8) for terrestrial invertebrates consuming small insects or vegetation. This raises concerns that moderate to high application rates of glyphosate could have an adverse impact on some terrestrial invertebrates. (It should be noted that these risk quotients were based on the more toxic formulation of glyphosate that includes a surfactant; HQs were not calculated for the less toxic formulation of glyphosate being used in this project). The available field studies on terrestrial invertebrates do not, for the most part, reinforce a concern. Most field studies suggest that effects on terrestrial invertebrates will be minimal and secondary to changes in vegetation.

Similar to glyphosate, the upper bound HQs for triclopyr slightly exceed one (HQ=1.3) for terrestrial invertebrates consuming vegetation. For triclopyr, there is a reasonably extensive group of field studies indicating that effects on terrestrial invertebrates are most likely to be associated with changes in habitat and food availability rather than herbicide toxicity. The risk characterization for insects is therefore based primarily on the field studies rather than the HQs and does not indicate that adverse effects are likely. Similar to the risk characterization for mammals, only the dietary HQs approach a level of concern for terrestrial invertebrates.

Surfactants The Proposed Action describes use of methylated seed oil, such as Hasten or Competitor, as a surfactant that may be used with any of the herbicides. Its primary ingredient is ethylated canola oil, which is considered food grade. Polyoxyethylene dialkylester and Sorbitan alkylethoxylate ester are other active ingredients (Bakke 2007). Two carcinogenic impurities are known to be in the surfactant: ethylene oxide and 1,4 dioxane. Manufacture labels recommend using 0.25-1% surfactant mixed with the herbicide. Other than ethylated canola oil, the chemicals in the surfactant have received very little study and scrutiny to determine what affect the chemicals may have. Overall the hasten/competitor surfactant appears to have a lower level of toxicity than the herbicides and is used in small quantity compared to the herbicide, and thus appears to have little concern for wildlife, except for the uncertainty concerning some of the chemicals and carcinogen effects of the impurities in hasten/competitor.

Adjuvants Highlight blue is the only adjuvant proposed for use. It is a colorant that makes the herbicide more visible during application. Actual ingredients are unknown but are identified as minimal risk inert ingredients or as inerts of unknown toxicity by the EPA (Bakke, 2007). Highlight blue is considered virtually non-toxic to humans, and there is no evidence indicating toxicity to wildlife.

Federally Listed species

Valley elderberry longhorn beetle

The Valley elderberry beetle is listed as Threatened under the Federal Endangered Species Act. The range of the valley elderberry longhorn beetle occurs below 3,000 feet in elevation, where potential habitat is provided by elderberry plants with stems larger than one inch diameter. Below 3,000 feet in elevation, elderberry plants occur most commonly within broad riparian zones along the major rivers. Extensive loss of riparian forest in California's Central Valley is identified as a primary factor is this species decline.

On the ENF, potential habitat for elderberry was mapped as all areas below 3,000 feet in elevation with less than 20 percent canopy cover in trees. The ENF provides very limited potential habitat for the elderberry beetle, since areas with broad riparian forest are limited, and little elderberry has been found below 3,000 feet in elevation. The ENF has mapped approximately 5,000 acres of potential habitat, all along the west administrative boundary but field surveys of this habitat have not located suitable elderberry plants to date. The closest location suspected of supporting Valley elderberry longhorn beetle, occurs several miles to the west of the Forest boundary, and outside the project area, at the Forest Service Institute of Forest Genetics in Camino, CA.

Habitat Alteration Because the Valley elderberry longhorn beetle is not known to occur within the project area, effects to this species are unlikely. Elderberry plants would not be the target of, and would not be affected by manual or mechanical treatments described in the Proposed Action. Removal of invasive plant species by hand pulling or cutting with a string trimmer would not directly affect this species or its elderberry habitat. Indirect benefits could result if elderberry and other native vegetation is promoted through the removal of invasive plants within low elevation riparian zones.

Herbicide Toxicity Review of SERA risk assessments and project worksheets indicates that HQs for clopyralid, aminopyralid, and chlorsulfuron are below the level of concern for terrestrial invertebrates under all scenarios. For these herbicides there are no acute or chronic exposure scenarios at application rates described in the Proposed Action that will result in a Hazard Quotient (HQ) above one for terrestrial invertebrate species. HQs for triclopyr and for glyphosate are just slightly above one at the upper bound, indicating a slight risk that high application rates of glyphosate or triclopyr could have an adverse impact on a terrestrial invertebrate. However, since the Proposed Action utilizes only targeted treatment methods (spot spray or directed foliar spray) as an application method, the likelihood of direct exposure of elderberry plants or the beetle to chemical treatments is minimized. A further level of caution is provided by Design Feature (DF) 21 which states that herbicide application will not occur within 100 feet of elderberry plants where such plants occur within the elevation range of the beetle (below 3,000 feet in elevation).

This Design Features ensures that there will be No Affect to the Valley elderberry longhorn beetle from activities included in the project Proposed Action. Indirect benefits could result where elderberry and other native vegetation is promoted through the removal of invasive plants within low elevation riparian zones.

Region 5 Designated Sensitive Species

Bald Eagle

The bald eagle was removed from the federal list of Threatened and Endangered Species on June 28, 2007. Since 1978 populations have increased nationwide as well as in the Sierra Nevada and on the ENF. Management direction for the bald eagle is now provided by the Bald and Golden Eagle Protection Act of 1940 and the Migratory Bird Treaty Act of 1972. Under these acts, disturbance that is likely to cause injury, substantial interference with normal breeding, feeding or sheltering behavior, or nest abandonment is prohibited (USDI Fish and Wildlife Service, 2007).

Bald eagles use habitat in proximity to major lakes and reservoirs on the ENF, both in summer and winter. Bald eagle nests are usually located in uneven-aged (multi-storied) stands with old growth components (Anthony and Isaacs 1989). Most nests in California are located in predominantly coniferous stands. Nest sites typically occur within a mile of open water, and trees selected for nesting are characteristically one of the largest in the stand or at least co-dominant with the overstory.

On the ENF, both wintering and summer nesting surveys have occurred annually since the early 1980s. The number of nesting bald eagles has increased on the ENF over the past couple of decades from a single nesting pair in the mid-1980s to three nesting pairs documented on NFS lands, and two additional pairs on private land within the ENF boundary. Nine reservoirs on the ENF provide potential nesting habitat for bald eagles, and five of these reservoirs have recently supported a nesting pair of bald eagles.

Disturbance or Displacement Potential effects of invasive plant treatment methods on bald eagles are associated with disturbance that may occur during the nesting season. The direct effects from invasive plant treatment could include disturbance caused by noise, people and vehicles. Human and vehicle presence can disturb bald eagles during the breeding season, causing the birds to leave nests, or stay away from the nest long enough to have detrimental effects to eggs or young (USDI Fish and Wildlife Service, 1986). Effects would be more likely to result from mechanical methods (e.g. string trimmers) which could cause disturbance at greater distances from the treatment site, because machinery creates louder noise. Bald eagles are sensitive to human disturbance during the period of time between January 1 and August 15, particularly within sight distance of nest sites.

Invasive plant treatment areas do not occur within 0.25 mile of known bald eagle nest sites; noise or visual disturbance would not result from treatments of mapped infestations, however future invasive plant infestations could be found in proximity to bald eagle nest sites. Project Design Feature 20 ensures that a Limited Operating Period will be applied to eliminate sources of disturbance in proximity to known nest sites. This DF minimizes the likelihood that disturbance of bald eagles will result from treatment of future infestations under EDRR.

Habitat Alteration Invasive plant treatments will not result in the removal of bald eagle nest or roost trees, or the alteration of bald eagle habitat, because invasive plants do not provide elements of bald eagle habitat.

Herbicide Toxicity SERA risk assessments and project worksheets have been reviewed. There are no acute or chronic exposure scenarios at application rates described in the Proposed Action that will result in a Hazard Quotient (HQ) above one for a large fish-eating bird such as the bald eagle. Herbicides and surfactants applied as described in the Proposed Action pose no risk to bald eagles.

In summary, there will be No Effect to the bald eagle from activities in the Proposed Action.

Peregrine Falcon

The peregrine falcon was listed as a federally endangered species from 1970 through 1999. The final rule to de-list the Peregrine falcon was published in the Federal Register on August 25, 1999, at which time the species was added to the Regional Foresters list of sensitive species in Region 5. The most commonly occupied habitats contain cliffs, for nesting, with open gulfs of air (rather than in confined areas) and generally open landscapes for foraging. Peregrine falcons forage upon many species of birds and sometimes mammals in a variety of open habitats; meadows, riparian areas or lakes may provide preferred foraging areas but are not essential (CWHR 2005).

Peregrines have relatively strict nesting requirements: Vertical cliff habitat with large potholes or ledges that are inaccessible to land predators and are preferentially located near habitat that has a high avian prey population (Monk and Walton 1988). Habitat mapping and surveys conducted in 1980 mapped 77 potential cliff nesting sites on the ENF; 47 of these sites were rated as having high or moderate potential (Boyce and White 1980).

Surveys of suitable cliff nesting habitats occurred in 1980 and 1993-1994. Peregrine falcons were absent from the ENF for two decades prior to 2004, when a pair established an eyrie and successfully fledged young. This site at Lover’s Leap is the only active peregrine eyrie known on the Forest at this time. Young have been fledged from this site during the past several breeding seasons, reflecting an increasing population trend on the ENF, as is occurring within other parts of the State. Another eyrie, on the Stanislaus NF but adjacent to the ENF, was last used in 1994.

Disturbance or Displacement Noise and human activity associated with invasive plant treatments would be unlikely to disturb nesting peregrine falcons. The U.S. Fish and

Wildlife Service reports that if cliffs are high and nesting ledges are inaccessible, "the proximity to roads, buildings, recreational sites, and other human disturbances does not prevent peregrines from successfully breeding (USDI 1982)." The peregrine cliff-nesting location on the ENF is high and inaccessible and therefore unlikely to be disturbed by invasive plant treatments. Use of a string trimmer, which generates greater noise than other treatment methods, would be unlikely to impact nesting since any activity near the site would be of short duration.

Habitat Alteration Invasive plant treatments will not result in alteration of habitat that would affect the peregrine falcon or its prey.

Herbicide Toxicity SERA risk assessments and project worksheets have been reviewed. There are no acute or chronic exposure scenarios at application rates described in the Proposed Action that will result in a Hazard Quotient (HQ) above one for a carnivorous bird, such as the peregrine falcon. Herbicides and surfactants applied as described in the Proposed Action pose no risk to peregrine falcons.

There will be No Effect to the peregrine falcon from activities in the Proposed Action.

California Spotted Owl and Northern Goshawk

The California spotted owl and northern goshawk are Forest Service designated sensitive species; the spotted owl is also a management indicator species (MIS) for late seral closed canopy coniferous forest. Both species utilize dense, multi-layered mature forested stands for nesting and roosting. Foraging may occur in forested stands with moderate to dense canopy cover and for goshawks, often includes areas with small openings and meadows. Spotted owls and goshawks prey upon a variety of small mammals and birds. On the ENF, spotted owls are known to occur between 2,000 ft. and 7,200 ft. in elevation, with most of the nesting pairs found in the Sierran mixed conifer habitat type. For mapping and analysis purposes, spotted owl and goshawk habitat has been represented by CWHR 4M, 4D, 5M, and 5D size and density classes in most coniferous forest types as displayed in the California Wildlife Habitat Relationships modeling of spotted owl habitat and goshawk habitat (CWHR 2005).

The ENF has conducted surveys for spotted owl presence and reproductive status on the Forest since the late 1980s. Although not comprehensive, these surveys, combined with incidental sighting data, have covered a large proportion of the Forest. The best available habitat is maintained as 300-acre Protected Activity Centers (PACs) for spotted owls and in 200-acre PACs for northern goshawks. Desired conditions are specified in the LRMP for these land allocations.

The ENF has conducted surveys for goshawk presence and reproductive status within project areas since 1987. The spatial scale used has varied by project. Surveys conducted after 2000 used the current Goshawk survey protocol, but observations on the Forest have been recorded since the late 1980s. Although not comprehensive, these surveys, combined with incidental sightings, have occurred over much of the Forest. Two hundred acres of nesting habitat is currently maintained for each of these sites in goshawk Protected Activity Centers (PACs).

Disturbance or Displacement Invasive plant treatments have the potential to disturb spotted owls or goshawks during the nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people, vehicles and equipment. Noise or visual stimuli may interrupt or preclude essential nesting and feeding behaviors, cause flushing from the nest or missed feedings of young. Equipment used to treat invasive plants (a string trimmer) could create noise above ambient levels causing disturbance to birds nesting within a quarter mile of activities, where this work is occurring along roadsides with elevated ambient noise levels, the likelihood of effects is fairly low. Spraying or handpulling activities occurring within a visual distance from a spotted owl or goshawk nest, could also cause nest site disturbance. Seventy-seven spotted owl or goshawk nest sites occur within a quarter mile of proposed treatment areas; 23 occur within a visual disturbance distance of 132 meters--a distance within which northern spotted owls considered to be potentially affected by activities that were within sight distance from the nest stand (USDI Fish and Wildlife Service, 2006). By applying a Limited Operating Period (LOP) within 132 meters of a spotted owl or goshawk nest location (or within a quarter mile where use of a string trimmer occurs), Project DF 20 minimizes potential for project activities to disturb nesting spotted owls or goshawks.

Habitat Alteration Invasive plant treatments will not result in alteration of habitat or habitat components that would directly affect spotted owls or goshawks. Where scotch broom infestations are prevalent and dense, primarily on the Georgetown Ranger District, the Proposed Action may indirectly benefit spotted owls and goshawks as treatments, overtime, reduce further expansion and density of scotch broom infestations. This may become increasingly important as fuels treatments, both mechanical and prescribed fire use, result in increased opportunity for the spread of scotch broom.

Herbicide Toxicity SERA risk assessments and project worksheets have been reviewed. At proposed application rates, the estimated doses from the exposure scenarios are all less than the reported NOAEL (no-observable adverse effect level) for all herbicides. There are no acute or chronic exposure scenarios at application rates described in the Proposed Action that will result in a Hazard Quotient (HQ) above one for carnivorous birds, such as the spotted owl or goshawk. Herbicides and surfactants applied as described in the Proposed Action pose no risk to these species. Chronic exposures are also unlikely because spotted owl and goshawk prey are not known to prefer foraging on invasive plant species. This reduces the likelihood of chronic exposure since treatments are focused on the invasive plants and prey species are unlikely to consume these plants.

In summary, there will be no direct effects to California spotted owls or northern goshawks from activities in the Proposed Action. If a nest occurs in proximity to a future EDRR treatment area, a Limited Operating Period will be applied in accordance with DF #20. Beneficial effects could occur indirectly from EDRR treatments that may reduce the spread of scotch broom infestations into forested habitats. The Proposed Action does not result in adverse cumulative effects upon spotted owls or goshawks.

Great Gray Owl

The Sierra Nevada represents the southern range of the great gray owl in the western United States. Historic sightings are recorded for all counties in the Cascade range in California and the Sierra Nevada as far south as Tulare County. In the Sierra Nevada, great gray owls are found in mixed coniferous forest from 2,400 to 9,000 feet elevation where such forests occur in combination with meadows or other openings with herbaceous vegetation. Meadows or grassy openings appear to be the most important hunting habitat for great gray owls. For analysis purposes, great gray owl habitat on the ENF has been mapped as occurring within and surrounding meadows. Nesting usually occurs within 600 feet of the forest edge and adjacent open foraging habitat.

Nesting great gray owls have been detected at one mid-elevation meadow site on the ENF. In addition, several great gray owl nest sites have been located on private timberland within or adjacent to the western edge of the forest boundary, in mixed conifer/montane hardwood stands surrounding grassy openings.

Disturbance or Displacement Invasive plant treatments have potential to affect great gray owls from disturbance that may occur during the nesting season. Human and vehicle presence can disturb birds enough to leave nests, or stay away from the nest long enough to have detrimental effects to eggs or young. Effects would be more likely to result from mechanical methods (e.g. string trimmers) which could cause disturbance at greater distances from the treatment site, because machinery creates louder noise. Other treatment methods could cause disturbance within site distance of the nest.

Since invasive plant treatment areas do not occur within 0.25 mile of nesting great gray owls, treatment of mapped infestations would not result in nest site disturbance. It is possible that future invasive plant infestations may be found in proximity to a great gray owl nest site, however, and those treatments would be planned under EDRR. If this were to occur, the Annual Implementation Process provides the mechanism for identifying and implementing a Limited Operating Period where needed to eliminate sources of disturbance in proximity to known nest sites. This minimizes the likelihood that disturbance of great gray owls will result from treatment of future infestations under EDRR.

Habitat Alteration Invasive plant treatments will not alter habitat components directly utilized by the great gray owl. Reduction of plant cover within meadows could affect habitat for prey species, particularly if vegetation is removed or altered across a large portion of the meadow. Project design feature #30 limits herbicide application in meadows to wiping techniques, and to an area less than 100 square feet. This DF prevents herbicide treatments from altering or reduced meadow vegetation at a scale that would affect prey density or availability. Treatments under EDRR would benefit great gray owls by reducing the likelihood of meadow habitat becoming dominated by invasive plants. Maintaining the native plant community in meadows would benefit great gray owls by maintaining meadow vegetation known to support healthy prey populations.

Herbicide Toxicity SERA risk assessments and project worksheets have been reviewed. At proposed application rates, the estimated doses from the exposure scenarios are all less than the reported NOAEL (no-observable adverse effect level) for all herbicides. There are no acute or chronic exposure scenarios at application rates described in the Proposed Action that will result in a HQ>1 for a carnivorous bird such as the great gray owl. Herbicides and surfactants applied as described in the Proposed Action pose no risk to this species.

In summary, there will be no direct effects to the great gray owl from activities in the Proposed Action. If a great gray owl nest occurs in proximity to a future treatment area under EDRR, an appropriate Limited Operating Period surrounding the site would be identified during the annual implementation process, avoiding the potential for activity related disturbance. Beneficial effects could occur indirectly from EDRR treatments that may reduce the spread of new invasive plant infestations in meadow habitats. The Proposed Action does not result in adverse cumulative effects upon great gray owls or great gray owl habitat.

Willow Flycatcher

Historically, willow flycatchers nested throughout California wherever thickets of riparian deciduous shrubs, primarily willow, occurred (USDA Forest Service 2001). In the last four decades, however, willow flycatcher breeding populations have been extirpated from most lower elevation riparian areas in California and it appears that the species may no longer breed at elevations below 3,000 feet in the Sierra Nevada, in the Central Valley, and in the valleys of the central coast. Historic records combined with recent survey efforts indicate a long-term decline of willow flycatchers at elevations above 3,000 feet in the Sierra Nevada as well. Breeding populations occur on Forests surrounding the ENF (the Tahoe, Lake Tahoe Basin, and Humboldt-Toiyabe NFs).

In the Sierra Nevada, willow flycatchers breed in shrubby vegetation in meadow and riparian communities. Preferred habitat generally occurs in meadows larger than 10 acres in size, and willow flycatchers are consistently associated with meadows where high water tables result in standing water and riparian shrubs (specifically willow) abundance. For analysis purposes, preferred willow flycatcher habitat on the ENF has been mapped as occurring within meadows larger than 10 acres in size, containing a willow shrub component.

Surveys in 1992, 1997, and 1998 have occurred at historic breeding locations, and in emphasis habitat (suitable meadows greater than 10 acres in size), with negative results. Willow flycatchers were detected in Indian Valley in 2003 and 2004. These are the only detections on the ENF in recent years, though willow flycatchers are known to occur adjacent to the ENF on the Lake Tahoe Basin Management Unit and at Red Lake. One hundred sixteen meadows have been mapped as providing preferred habitat for this species.

Disturbance or Displacement Invasive plant treatments, other than use of a string trimmer, are unlikely to disturb nesting willow flycatchers or other passerine birds. Use of a string trimmer could disturb birds enough to leave nests, or stay away from the nest long enough to have detrimental effects to eggs or young. Since invasive plants are not present in Indian Valley or in other potential habitats, treatment of mapped infestations would not result in nest site disturbance. It is possible that future invasive plant treatments under EDRR could be proposed in occupied willow flycatcher habitat. If this were to occur, the Annual Implementation Process provides the mechanism for identifying and implementing a Limited Operating Period where needed to eliminate sources of disturbance in proximity to known nest sites. Given this species very limited distribution, it is highly unlikely that treatment of future infestations under EDRR will disturb willow flycatcher nesting.

Habitat Alteration Invasive plant treatments will not alter habitat components directly utilized by the willow flycatcher for nesting or foraging. Reduction of plant cover within meadows could reduce insect density, if vegetation is removed or altered across a large portion of the meadow. Project design feature #30 limits herbicide application in meadows to wiping techniques, and to an area less than 100 square feet. This DF prevents herbicide treatments from altering or reducing meadow vegetation at a scale that would affect the willow flycatcher. As described for the great gray owl, treatments under EDRR would benefit the willow flycatcher by reducing the likelihood of meadow habitat becoming dominated by invasive plants, potentially reducing meadow wetness and habitat quality for willow flycatchers.

Herbicide Toxicity SERA risk assessments and project worksheets have been reviewed. At proposed application rates, the estimated doses from the exposure scenarios are less than the reported NOAEL (no-observable adverse effect level) for proposed herbicides other than triclopyr. The acute exposure scenario at triclopyr application rates described in the Proposed Action will result in a HQ slightly above one for a small bird such, as the willow flycatcher, eating contaminated insects. Therefore, willow flycatchers consuming insect prey exposed to triclopyr could be at slight risk for adverse effects. Willow flycatcher exposure to triclopyr or insect prey contaminated with triclopyr, would be implausible under the proposed action since Design Feature #30 does not allow the use of triclopyr in meadows and meadows provide the only habitat with potential to support willow flycatchers on the ENF. Given this, the use of herbicides to treat known infestations or new occurrences under EDRR, as described in the Proposed Action, poses no risk to this species.

In summary, there will be no direct effects to the willow flycatcher from activities described in the Proposed Action. If a willow flycatcher nest site occurs in proximity to an area proposed for treatment under EDRR, an appropriate Limited Operating Period surrounding the site would be identified during the annual implementation process, avoiding the potential for activity related disturbance. Beneficial effects could occur indirectly from EDRR treatments that may reduce the spread of new invasive plant infestations in meadow habitats. The Proposed Action does not result in adverse cumulative effects upon willow flycatchers or meadow habitat.

Fisher, Sierra Nevada Red Fox, Wolverine

Fisher are thought to be absent from the ENF; wolverine and Sierra Nevada red fox, if present, occur in very low numbers and in habitats with few invasive plant infestations. It is highly unlikely that proposed treatments would occur in the vicinity of individual fishers, wolverine, or Sierra Nevada red fox, causing impacts or disturbance. If treatments were to occur in an area utilized by one of these species, the likelihood of acute or chronic exposure to contaminated prey is remote, given the small acreages treated and the large areas in which these carnivores forage. Furthermore, HQs for a canid consuming small mammals contaminated by direct spray, is below one for all herbicides in the Proposed Action. The Proposed Action will not result in direct, indirect or cumulative effects to fisher, wolverine or Sierra Nevada red fox.

American marten

The American marten is found on all Sierra Nevada NFs but, range-wide, the current distribution of marten is a small portion of their historic range (Zielinski et al. 1995). Habitat modification and fragmentation along with trapping and fire are major factors contributing to this contraction of historic range. Large home range sizes combined with low reproductive potential result in limited ability for populations to recover from natural or human caused disturbances. On the ENF, marten have not been detected below 5,000 feet in elevation and predominantly occur above 6,000 feet in elevation. Preferred forest types include mature mesic forests of red fir, red fir/white fir mix, lodgepole pine, and Sierran mixed conifer. Preferred habitat is characterized by dense (60 to 100 percent canopy), multi storied, late seral coniferous forests with a high number of large snags and downed logs.

Systematic surveys designed to detect the presence of fisher and marten have occurred in the Sierra Nevada, including on the ENF, between 1996 and 2002 (Zielinski et al. 2000). From both incidental observations and surveys, marten are known to occur most frequently above 6,000 feet in elevation on the ENF, and to be fairly well distributed in the red fir and lodgepole pine elevation zone.

Disturbance or Displacement Invasive plant treatments are unlikely to cause more than very limited and short-term alteration of movement patterns for American marten. Very few acres of invasive plant treatment are planned at the higher elevations occupied by American marten and treated areas are small and localized in relation to the home ranges occupied by this species.

Habitat Alteration As described for other wildlife, invasive plant treatments do not reduce habitat available to marten or their prey, and the successful control of invasive plants may provide long-term benefits by restoring and preventing loss of native habitat.

Herbicide Toxicity Under the proposed application rates, for all herbicides the estimated doses from the exposure scenarios are all less than the reported no-observable adverse effect level (NOAEL) for a large mammal eating contaminated prey. The use of herbicides described in the Proposed Action results in HQs below one, and poses no risk to marten.

In summary, the Proposed Action will not result in direct, indirect or cumulative effects to the American marten.

Townsend's Big-Eared Bat, Pallid Bat, Western Red Bat

The Townsend's big-eared bat is both a Forest Service sensitive species and a State Species of Special Concern. In California, the species is found in a variety of habitats including mid-elevation mixed conifer, mixed hardwood-conifer forests, and riparian habitats. Distribution of this species is strongly correlated with the availability of caves and cave-like roosting habitat. The species is highly sensitive to roost disturbance (Zeiner et al. 1990). Populations have incurred serious declines over the past 40 years in parts of California Maternal colonies form between March and June (may vary by local climate conditions), with a single pup born between May and July (Zeiner et al. 1990). Individuals are very loyal to their natal sites and usually do not move more than 10 kilometers from a roost site (Fellers and Pierson 2002).

The pallid bat is both a Forest Service sensitive species and a State of California Species of Special Concern. The species uses a variety of habitats, including grasslands, shrublands, woodlands, and coniferous forests. Pallid bats are most common in open, dry habitats that contain rocky areas for roosting. The species tends to be a roosting habitat generalist, using many different natural and man-made structures (USDA Forest Service

2001). Tree roosting has been documented in large conifer snags and bole cavities in oaks (Orr 1954). It is a yearlong resident in most of its range and hibernates in winter near its summer roost (Zeiner et al. 1990). Pallid bats are a gregarious species, often roosting in colonies of 20 to several hundred individuals.

The Western red bat is both a Forest Service sensitive species and a State Species of Special Concern. Western red bats occur from Shasta County to the Mexican border, west of the Sierra Nevada crest and deserts (Zeiner et al. 1990). Populations are scattered and considered rare throughout the state. The species is found primarily in riparian and wooded habitats from lower elevations up through the mixed conifer forest (Zeiner et al. 1990). Red bats are typically solitary and these bats roost singly within tree foliage or shrubs, and often along edge habitat adjacent to streams or open fields.

In 2002 a multi-species monitoring program inventoried bats at several sites on the ENF, and bat inventories have occurred at several abandoned mines and tunnel structures on the Forest. Townsend's big-eared bats and pallid bats have been detected but maternal roost structures on the forest remain unknown. Western red bats have not been detected; the species is thought to be strongly associated with riparian habitats, particularly mature stands of cottonwood found in the Central Valley, and riparian and hardwood forests in the Sierra Nevada foothills probably provides potential habitat.

Disturbance or Displacement Invasive plant treatments are unlikely to cause more than very limited and short-term alteration of movement patterns for American marten. Very few acres of invasive plant treatment are planned at the higher elevations occupied by American marten and treated areas are small and localized in relation to the home ranges occupied by this species.

Habitat Alteration Invasive plant treatments do not reduce habitat available to bats or their insect prey, and the successful control of invasive plants may provide long-term benefits by restoring and preventing loss of native habitat.

Herbicide Toxicity SERA risk assessments and project worksheets have been reviewed. At proposed application rates, the estimated doses from the exposure scenarios are all less than the reported NOAEL (no-observable adverse effect level) for all herbicides. There are no acute exposure scenarios at application rates described in the Proposed Action that will result in a HQ >1 for a small mammal consuming contaminated insects. The likelihood of a chronic exposure to contaminated insects is remote, given the small acreages treated and the relatively large areas in which bats forage. The bats are not likely to forage exclusively within treated areas over a 90- day period (the chronic exposure) so there does not appear to be a plausible risk from chronic exposure. Herbicides and surfactants applied as described in the Proposed Action pose no risk to these species.

In summary, the Proposed Action will not result in direct, indirect or cumulative effects to the Townsend's big-eared bat, the pallid bat, or the western red bat.

Terrestrial Management Indicator Species (MIS)

The ENF LRMP as amended by the 2007 SNF MIS Amendment ROD directs that the effects of projects on the habitat of MIS be analyzed by discussing how direct, indirect, and cumulative effects will change MIS habitat in the analysis area. The following terrestrial MIS species and habitats were identified as potentially affected by the project: aquatic macroinvertebrates, fox sparrow, mule deer, yellow warbler, Pacific tree frog, mountain quail, sooty grouse, California spotted owl, American marten, and northern flying squirrel.

Aquatic macroinvertebrates There should be no measurable change in flow, sedimentation, and shade with the Eradication and Control of Invasive Plants Project that would alter the existing trend in the habitat or aquatic macroinvertebrates across the Sierra Nevada bioregion.

Fox sparrow The project does not result in changes to native shrubland habitat, though it will provide long-term benefits to the health of shrublands through removal of non-native invasive plants. It will not alter the existing trend in the habitat, nor will it lead to a change in the distribution of fox sparrows across the Sierra Nevada bioregion.

Mule deer The Eradication and Control of Invasive Plants Project will not alter the existing trend in the habitat, nor will it lead to a change in the distribution of mule deer across the Sierra Nevada bioregion.

Yellow warbler The Eradication and Control of Invasive Plants Project will not alter the existing trend in the habitat, nor will it lead to a change in the distribution of yellow warblers across the Sierra Nevada bioregion.

Pacific tree frog The 2.62 acres of wet meadow habitat within 200 feet of analyzed treatment areas in the Eradication and Control of Invasive Plants, and any future areas analyzed in 3,103.99 acres of wet meadow habitat within the ENF, will not alter the existing trend in the habitat, nor will they lead to a change in the distribution of Pacific tree frogs across the Sierra Nevada bioregion.

Mountain quail The Eradication and Control of Invasive Plants Project will not alter the existing trend in early and mid seral habitat, nor will it lead to a change in the distribution of mountain quail across the Sierra Nevada bioregion.

Sooty grouse The Eradication and Control of Invasive Plants Project will not alter the existing trend in the late seral open canopy habitat, nor will it lead to a change in the distribution of sooty grouse across the Sierra Nevada bioregion.

California spotted owl, American marten, and northern flying squirrel The Eradication and Control of Invasive Plants Project will not alter the existing trend in the habitat, nor will it lead to a change in the distribution of California spotted owl, American marten, or northern flying squirrel across the Sierra Nevada bioregion.

Migratory Landbird Conservation

The project will not adversely impact migratory landbird species or their associated habitats. The project is designed to improve habitat conditions through maintaining the composition of native plant communities and habitats (see Effects to MIS habitats). Impacts to non-target vegetation from herbicides has been minimized through limiting treatments to targeted methods rather than broadcast spray (Project Design Feature 39). Project Design Feature 25, which includes monitoring of treatments near riparian vegetation, further reduces risk of herbicides affecting riparian vegetation (which is important to many migratory bird species).

The effects of herbicide toxicity on migratory birds is discussed under the section for "all species – birds." Triclopyr is the only herbicide with a hazard quotient above one, and with any potential to have toxicity effects upon birds (small birds eating contaminated vegetation). For several reasons, the magnitude of risk for birds consuming vegetation treated with triclopyr under the Proposed Action is considerably less than the risk characterization provided in the SERA risk assessments and is unlikely to probably insubstantial.

Aquatic Organisms

Within the administrative boundary of the ENF, aquatic features include 903 miles of perennial streams, 740 miles of intermittent streams, 3,640 miles of seasonal streams, and 1,108 lakes ranging in size from less than 1 ac to over 2,740 ac in size (Table 14). There are approximately 1,857 meadows totaling 10,416 acres on the ENF. They range in size from <1 ac to a maximum size of 274 acres; the average meadow size on the forest is approximately 5.6 ac.

Aquatic systems of special note are the Jones Fork of Silver Fork (above Union Valley Reservoir), North Fork American River, North Fork Mokelumne River, Rock Creek, and the Rubicon River. These drainages have been identified by the Sierra Nevada Ecosystem Project as potential Aquatic Diversity Management Areas (Moyle 1996). The management goal of these aquatic ecosystems is the protection of aquatic biodiversity.

With this invasive plant treatment project, there are a total number of 52 treatment sites that lie within 200 feet of a rainbow trout stream and 7.28 miles of streams known to have rainbow trout that lie within 200 feet of mapped invasive plant treatment sites. In the future there are expected to be additional sites where new invasive plants infestations are discovered and need to be eradicated or controlled.

Table 14. Total miles of streams on the ENF, and total occurrences or miles of stream with TES species habitat that have invasive plant treatments within 200 feet.

Miles of streams on NF land of the ENF	
Perennial	*903*
Intermittent	*740*
Seasonal	*3640*
Total	5,282
Total occurrences or miles of species habitat within 200 feet of mapped treatment areas	
rainbow trout	7.28 miles known and suspected with 52 occurrences
hardhead	2 occurrences
foothill yellow-legged frog	9 occurrences
Sierra Nevada yellow-legged frog	0 occurrences
western pond turtle nesting	884.98 acres
Yosemite toad	0 occurrences

Mechanical treatments and the application of herbicides require a careful assessment of risk to aquatic wildlife. A full discussion of risk from herbicides to aquatic species are presented in the Invasive Plant Aquatic Biological Assessment and Biological Evaluation for this project (Williams, 2012)

SERA risk assessments have been reviewed to evaluate potential herbicide toxicity to aquatic organisms using spray methods and concentrations described in the Proposed Action. In the SERA Risk Assessments, risk is expressed as hazard quotients (HQ), which is the ratio of the anticipated level of the exposure to EPA reference doses for acceptable exposure. Hazard quotients less than 1.0, indicate that the exposure poses little reason for concern. Hazard quotients nearing 1.0 pose a greater reason for concern. The Biological Evaluation for aquatic species lists the results of the SERA risk assessments based on the herbicides proposed and application rate for the Eldorado National Forest Eradication and Control of Invasive Plants project area. Hazard quotients are developed for scenarios involving an accidental spill, peak Estimated Environmental Concentration (EEC), and longer-term EEC (which gives chronic effects from herbicide exposure).

A review of risk assessments for aquatic species shows that most of the concern for aquatic species is associated with exposures scenarios for an accidental spill. These scenarios were above a threshold of concern for hazards to aquatic plants and algae. Glyphosate was the only herbicide where an accidental spill scenario exceeded a threshold of concern for fish, amphibian, or invertebrate species. While the risk of accidental spill cannot be completely eliminated, Project design features (DF) preventing herbicide mixing and loading within 300 feet of water have been included in the Proposed Action, and will limit the potential for a spill to enter water and impact aquatic plants or algae. Additional DFs requiring a project spill plan and the use of spill kits further limit potential impacts to aquatic resources if a spill were to occur. Finally, it should be noted that SERA risk assessments are likely to overestimate hazards from a spill relative to activities in the Proposed Action, since the risk assessments model for a 20-200 gallon spill whereas the Proposed Action would be using five gallon backpack sprayers and require preparation of substantially less herbicide.

Hazard quotients for triclopyr glyphosate, and chlorsulfuron were also above a threshold of concern for either chronic or acute exposure scenarios relative to effects to algae or aquatic plants (Williams 2012). Reduction of algae or aquatic plants can indirectly impact food and cover resources for aquatic wildlife. For these herbicides aquatic buffers that exceed label requirements were established to avoid herbicide entry into aquatic habitats.. These aquatic buffers, as well as design features preventing herbicide treatments during wet weather conditions and design features avoiding herbicide preparation within RCAs, are expected to prevent movement of herbicides into aquatic habitat through surface runoff (see soil and water section of the EA for further details). Additional layers of precaution have been applied where there are known occurrences of Endangered, Threatened or Sensitive aquatic species, as described in the following section.

Federally Listed species

California Red-Legged Frog

The detailed species and habitat account for the California red-legged frog (CRLF) can be obtained at the ENF Supervisors Office. Critical habitat lies in the North Fork Weber Creek watershed. Recovery core areas (USDI 2002) for the CRLF within the ENF are Traverse Creek and Cosumnes River watersheds.

California red-legged frog detections have occurred at Ralston Ridge, Little Silver Creek, Sopiago Creek (as reported in CNDDB 2012), Bear Creek and a tributary to Bear Creek. Half of the CRLF detections on or adjacent to the ENF were along North Fork Weber Creek where 35 individuals in various life stages have been observed since 1975. Other detections of California red-legged frogs have occurred along the South Fork Weber Creek and Traverse Creek, none of which were on NFS lands.

Hand treatments such as use of a string trimmer, hand pulling, cutting, clipping, mulching, and tarping are not expected to cause effects to CRLF since these activities would typically occur in small, localized areas and would not involve ground disturbing mechanized equipment. In addition, any new treatment locations would be reviewed annually through annual Implementation Procedures described in Appendix D.

Actions proposed by this alternative that could be a concern for CRLF are direct or indirect effects as a result of herbicide application. Herbicides will not be applied within 500 feet of water bodies occupied by California red-legged frogs and within California red-legged frog Critical Habitat. In addition, suitable reproductive habitat, mapped as low gradient streams below 4,000 feet in elevation with slow moving water during the reproductive period, shall have 300 foot buffers from herbicide treatments unless surveys have confirmed the absence of CRLF. This is the foraging distance of CRLF from aquatic habitats during the summer months and reproductive periods (USDI 2001).

Project design features, particularly the extremely protective buffers excluding herbicide applications within 500 feet of ponds and streams occupied by CRLF, are likely to avoid the potential for effects from herbicide exposure. In addition, a 300 foot buffers along unsurveyed suitable breeding habitat will insure that impacts to any un-discovered populations are avoided. CRLFs are extremely unlikely to occur within, or travel through, areas treated with herbicides because herbicide treatments will not occur within 500 feet of CRLF occurrences. Critical habitat for CRLF (North Fork Weber Creek watershed) shall not have herbicide treatments. There is therefore an extremely low probability that there would be any adverse effects on CRLF.

Herbicide Toxicity

Best Management Practices (BMP) (USDA Forest Service 2011) employed during herbicide treatments will protect water quality and riparian vegetation. These BMPs are specifically designed to prevent degradation of downstream water quality. The BMPs pertinent to the use of pesticides and the proposed actions are Forest Service Pacific Southwest Region BMP's 5-7, 5-8, 5-9, 5-10, 5-11, 5-12, and 5-13.

An accidental spill could expose an aquatic organism to a possibly harmful dose of herbicides. Best Management Practices 5.7-5.13 would be implemented to prevent occurrences of spills or contamination to the streams (USDA Forest Service 2011). In addition, project Design Features that prevent herbicide preparation within 300 feet of water minimize the potential for impacts to aquatic habitats from an accidental spill.

With the large buffers applied within California red-legged frog habitats, implementation of herbicide application and other treatment methods in this alternative would have no effect on the California red-legged frog or its habitat. Implementation of this alternative would have no effect on California red-legged frog designated critical habitat.

Region 5 Designated Sensitive Species

Foothill Yellow-legged Frog

Between 1992 and 2009 in and adjacent to the ENF, there have been 220 detections of foothill yellow-legged frogs. A total of 2,680 individuals in various life stages have been observed. There are nine sites to be treated with invasive plants within 200 feet of where foothill yellow-legged frogs have been observed in the past. These known sites occurred along Silver Creek, Otter Creek, Camp Creek, and South Fork American River.

Most creeks below 6,000 feet elevation have the potential to have foothill yellow-legged frogs, as this species was historically common in the Sierra Nevada mountains. However, this species has apparently disappeared from 66 percent of its historic range (Jennings 1996). The reduction in the range of the foothill yellow-legged frog is generally attributed to aquatic and riparian habitat alterations and changes in stream hydrology. Foothill yellow-legged frogs are found primarily in sunny areas along streams and rivers with a rocky substrate. The timing and breeding of foothill-yellow legged frogs varies across its range. However, breeding occurs almost exclusively in streams and rivers with cobble and pebble being the preferred sites for egg laying (Ashton and others 1997).

On the ENF, potential habitat for foothill yellow-legged frogs is considered to be all perennial streams and intermittent streams with persistent pools below 6,000 ft in elevation. This includes approximately 1844 miles of perennial stream on the ENF.

Actions proposed by this alternative that may be a concern for foothill yellow-legged frogs are the direct or indirect effects as a result of pesticide application. Manual treatments by hand are not expected to crush foothill yellow-legged frogs or result in sedimentation into downstream aquatic habitat.

Herbicide Toxicity

The Proposed Action includes stream buffers that were developed based on areas of concern in the SERA risk assessment worksheets. Where hazard quotients in the SERA worksheets are over 1 for exposure types, the stream buffer was increased to be protective of aquatic habitats. In a meta-analysis of buffer studies, Zhang et al. (2010) reported that buffers of 65 feet had a 92% efficacy at herbicide removal. There are nine sites to be treated with invasive plants within 200 feet of where foothill yellow-legged frogs have been observed in the past. These known sites occurred along Silver Creek, Otter Creek, Camp Creek, and South Fork American River. SERA risk assessments indicate that there is a potential for foothill yellow-legged frogs to be affected through accidental spill or indirectly through the effects of herbicides on algae. The tadpole stage is especially sensitive to herbicides that reduce algae, which is their food. In *"A Review* *and Assessment of the Results of Water Monitoring for Herbicide Residues For the Years 1991 to 1999"*, USFS Region 5, written by David Bakke, Regional Pesticide-Use Specialist, compiles and summarizes the results from fifteen separate water monitoring reports in USFS Region 5. These reports documented results from over 800 surface and ground water samples, as a result of reforestation and noxious weed eradication projects utilizing two herbicides (glyphosate and triclopyr). Glyphosate and triclopyr were rarely detected, except in the cases where no stream buffers were used.

The Sierra Nevada Framework (USDA 2004b) states, "Within 500 feet of known occupied sites of California red-legged frogs, Sierra-Nevada yellow-legged frogs, foothill yellow-legged frogs, and Yosemite toads, design pesticide applications to avoid adverse effects to individuals and their habitats." On streams where foothill yellow-legged frogs are known to reside or have been detected in the past, there will be a 50 foot buffer or more from herbicide application. This design feature was established as an added layer of precaution at locations with foothill yellow legged frogs, and minimizes the chance of affecting algae within the stream and indirectly affecting foothill yellow-legged frog tadpoles. The application buffer distance is great enough that the chance of herbicide entering the stream is unlikely. If an unforeseen accidental contamination or spill occurred, this could expose foothill yellow-legged frogs to a possibly harmful dose of pesticides, but label requirements and standard treatment procedures described in the Proposed Action (such as the requirement that herbicide preparation occur on level sites more than 300 feet from surface water and the requirement to carry a spill kit), minimizes the risk or potential that herbicide would reach surface water in the unlikely event of an accidental spill.

Cumulative Effects

On a worldwide basis, acid precipitation, ultraviolet radiation, viruses, pesticides, habitat destruction, and global climate change have all been suggested as causes for the decline of amphibians (Carey 1993). Increased isolation of threatened frog populations may also have significantly reduced the probability of recolonization of a site where extinction occurred (Wilcox 1980, Hanski and Gilpin 1991). This effect 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).

Hydropower developments have significantly altered stream flows in the larger rivers on the ENF; dams are barriers to foothill yellow-legged frog migration, and water temperatures and flows have been inhospitable for recruitment in many rivers.

The implementation of this alternative is not expected to cause an increase in any of these present effects. In conclusion, the cumulative effects, which probably have significantly affected habitat suitability for foothill yellow-legged frogs, are not expected to be added to by the implementation of the proposed action.

Implementation of this alternative 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.

Hardhead

Hardhead is known to occur in Middle Fork American River, in the lower Rubicon River, in the lower North Fork Mokelumne River, and in the South Fork American River below Silver Creek to Slab Creek Reservoir and below the Mosquito Bridge to Chili Bar Reservoir. Past hydropower projects have surveyed and found hardhead (North State Resources 2010, PCWA 2010, Ecorps 2011, Stillwater Sciences 2008). There are two sites to be treated with invasive plants within 200 feet of where hardhead have been observed in the past. These known sites occurred along Slab Creek Reservoir and South Fork American River.

A combination of manual and chemical treatments is proposed to be used to control invasive plants, depending on conditions. Actions proposed by this alternative that may be a concern for hardhead are the direct or indirect effects as a result of pesticide application. Effects to hardhead from the project activities pertain primarily to downstream effects entering rivers inhabited by hardhead. These effects would be from pesticides flowing into rivers and downstream in concentrations that could affect hardhead fish.

There are two sites to be treated with invasive plants within 200 feet of where hardhead have been observed in the past. These known sites occurred along Slab Creek Reservoir and South Fork American River.

Stream buffers were developed for the protection of aquatic species in the stream. The buffers were developed based on areas of concern in the SERA worksheets. Where hazard quotients in the SERA worksheets are over 1 for exposure types, the stream buffer has been increased to ensure protection of aquatic species, including hardhead.

Herbicide Toxicity

It is not likely that hardhead would be adversely affected from pesticide spraying. Even if the herbicides did reach the river, the continual flushing of stream flows, and the large volume of water in the large rivers where hardhead reside, would quickly dilute any chemical and be less and less concentrated as it flows downstream. Following the recommended buffers and timing and using Best Management Practices (USDA Forest Service 2011) for this application, and applying the design features specified in this alternative, it is not expected that there would be any effects to hardhead.

Accidental contamination of the stream is always a possibility, by leaking backpack sprayers crossing stream channels, or from chemicals on the boots of sprayers walking in water. This risk would be minimized by implementation of BMP 5.11 (USDA Forest Service 2011), and design feature #6, which limits transportation of pesticides to designated routes, limits batching and mixing locations to more than 300 feet from water, and requires the maintenance of a spill kit on site. Educating sprayers of possible water contamination methods would be important.

Overland flow occurs infrequently on most forest lands because the infiltration capacity of the forest floor and the soil is usually far greater than rates of precipitation (Rothacher and Lopushinsky 1974), therefore, it is not expected to be an issue with the buffers that are applied in the Prosed Action. Leaching of chemicals through the soil profile is a process of major public concern, but it is the least likely to occur in forest environments

(Norris et al. 1983) and has little potential to result in impacts associated with the Proposed Action (see Soil and Water sections of the EA).

Combining all the cumulative effects from other activities in the watersheds of the project area over time has contributed to the present status of the species. The implementation of the Proposed Action is not expected to contribute to cumulative effects and should not allow pesticides to enter the rivers in concentrations that could affect hardhead, even in the smallest chronic effects concentrations. If herbicides unexpectedly reached the rivers, the large volume of water would further dilute any herbicide.

Cumulative Effects

Hardhead were once abundant enough in reservoirs to be regarded as a problem species, under the assumption they competed for food with game fishes such as trout (Moyle 2002). Most populations likely resulted from colonization by juveniles before introduced predators became abundant and largely extirpated hardhead from reservoirs. Currently, they are largely absent from reservoirs that undergo strong annual variations in water level, although they can survive in reservoirs where large predatory fishes are uncommon (Moyle 2002).

The ongoing declines of hardhead populations result from the interactions of from habitat loss, decline in water quality, and invasions of alien species (Moyle 2002, May and Brown 2002). The principle causes of decline can be broken down into the effects of (1) dams and diversions, (2) agriculture, (3) urbanization, (4) in-stream mining, (5) stream modification for transportation, (6) fisheries management (‘harvest’), and (7) alien species.

The proposed action is not expected to contribute to cumulative impacts that have resulted in declines to hardhead populations.

Implementation of this alternative may impact individuals, but is not likely to cause a trend toward Federal listing or a loss of viability for hardhead.

<u>Sierra Nevada Yellow-legged Frog</u>

Approximately 616.96 mi of perennial streams are located in on the ENF above 5,000 ft in elevation and approximately 939 waterbodies <50 acres in size are located on NFS lands above this elevation. All of these aquatic features are considered potential habitat for the purposes of this discussion.

Between 1989 and 2012 in and adjacent to the ENF, there have been approx. 500 detections of Sierra Nevada yellow-legged frogs. Approx. 28,200 individuals in various life stages have been observed; 24,600 of these individuals were observed since 2000. Approximately 295 of these detections were made in wilderness areas. The herpetofauna layer in GIS shows the existing known locations. There are no sites to be treated with invasive plants within 500 feet of where Sierra Nevada yellow-legged frogs have been observed in the past.

A combination of manual and chemical treatments is proposed to control invasive plants, depending on conditions. Actions proposed by this alternative that may be a concern for Sierra Nevada yellow-legged frogs (SNYLF) are the direct or indirect effects as a result of pesticide application. Manual treatments by hand are not expected to crush Sierra Nevada yellow-legged frogs or result in sedimentation into downstream aquatic habitat.

Effects to Sierra Nevada yellow-legged frogs from implementing the project activities pertain to herbicide entry into streams or ponded water in concentrations that could affect Sierra Nevada yellow-legged frogs living there.

Herbicide Toxicity

Stream buffers were developed to be protective of any aquatic species in the stream based on areas of concern in the SERA risk assessment worksheets. Where hazard quotients in the SERA worksheets are over 1 for exposure types, the stream buffer was increased to ensure a very low probability of herbicide entry into aquatic habitat (see Soil and Water section of this EA). There are no proposed treatment sites within 500 feet of Sierra Nevada yellow-legged frog occupied habitats. If new invasive plant infestations are detected within 500 feet of Sierra Nevada yellow-legged frog occurrences and are proposed for herbicide treatments under EDRR procedures, the aquatic biologist will review these sites and confer or consult with the U.S. Fish and Wildlife Service prior to implementing treatments that may affect the species or its critical habitat (Project design feature #23). Under design features described in the proposed action, a minimum aquatic habitat buffer of 100 feet would be applied where Sierra Nevada yellow-legged frogs are known to reside. This is expected to prevent any harmful effects to frogs occurring alongside streams, lakes, and ponds. The tadpole stage is especially sensitive to herbicides that reduce algae, which is their food. Although some pesticides and surfactants are moderately toxic to amphibians, these more toxic herbicides would be applied with wider stream buffers (as described above for the foothill yellow-legged frog). Surrounding known occurrences, the application buffer distance is great enough that the chance of herbicide entering the stream is unlikely. There is a potential for SNYLF to be affected through accidental spill of herbicide, but the lack of treatments in proximity to Sierra Nevada yellow-legged frog occurrences, and design features, including the requirement that herbicide preparation take place more than 300 feet from surface water, minimizes the likelihood of accidental spills that could affect the species. Given these design features there are anticipated to be no effects to Sierra Nevada yellow-legged frogs.

Cumulative Effects

Several factors believed to be responsible for the decline of SNYLF include acid precipitation, pesticide residue, ultraviolet exposure and disease outbreak (Martin 2008). To date there has not been a cause-and-effect relationship established between any of these indirect factors and the original decline in SNYLF populations, largely because contemporaneous studies are lacking (Martin 2008).

Despite the long history of fish stocking in the Sierra, a sudden decline in SNYLF populations in Sequoia National Park was not observed until after the harsh winters of 1977-1978 and 1978-1979 (Bradford and Gordon 1992); so fish, which had been present for over 100 years at that time, were not considered to be a major component of the decline by some (Drost & Fellers 1996). However, research into the impact that introduced fish stocking has had on this species has established a direct link between fish stocking and the continuing decline and isolation of local SNYLF populations (Martin 2008). Chytridiomycosis is an emerging infectious disease brought about by an endemic pathogen that has become more virulent due to changing environmental conditions rather than a novel pathogen that has been widely dispersed over a short period of time (Martin 2008).

Implementation of the proposed action is not expected to have direct or indirect effects or contribute to cumulative effects upon the Sierra Nevada yellow-legged frog.

Western Pond Turtle

A GIS analysis based on south and southwest facing slopes with a slope angle of 15 degrees or less and adjacent to perennial stream courses, indicates that approximately 26,227 acres of nesting habitat for western pond turtles exists in and immediately adjacent to the ENF.

Sixty-five observations of western pond turtles in various life stages have been made in or adjacent to ENF lands between 1990 to present, of these observations, 36 were adults.

Individuals may be subject to disturbance by activities when western pond turtles travel overland between May to July to lay their eggs. Threats to nests and hatchlings would occur from May through March since the incubation period for western pond turtles is approximately eight months and may remain in the nest for a week or more.

The majority of western pond turtle nest sites have been found on dry, well-drained soils with significant clay/silt content and low (<15 degree) slopes. Most have been in open areas dominated by grasses or herbaceous annuals, with few shrubs or trees in the immediate vicinity. There are 884.98 acres of western pond turtle nesting habitat within 200 feet of areas to be treated with invasive plants. Streams known to have or most likely to have western pond turtles where invasive plnats will be sprayed within 200 feet include: Otter Creek, Camp Creek, Bear Creek, South Fork Silver Creek, Rock Creek, Traverse Creek, and South Fork American River.

There are 884.98 acres of western pond turtle nesting habitat within 200 feet of areas to be treated with invasive plants. Streams known to have or most likely to have western pond turtles where invasive plants will be sprayed within 200 feet include: Otter Creek, Camp Creek, Bear Creek, South Fork Silver Creek, Rock Creek, Traverse Creek, and South Fork American River.

Herbicide Toxicity

Studies on herbicides are usually tested on fish or frogs, and not aquatic reptiles, therefore the test results for fish and frogs are displayed. Western pond turtles would be primarily susceptible to herbicide exposure during the non-nesting and non-migrating times of the year when they live a more aquatic life, or when traveling through a sprayed area. Their thick skin would make them less susceptible than frogs would be with semi-permeable membranes.

Overland flow of herbicides occurs infrequently on most forest lands because the infiltration capacity of the forest floor and the soil is usually far greater than rates of precipitation (Rothacher and Lopushinsky 1974). Leaching of chemicals through the soil profile is a process of major public concern, but it is the least likely to occur in forested environments (Norris et al. 1983).

As far as affecting viability of a population of western pond turtles, only a major spill could affect the future reproductive ability of western pond turtles in a stream. The continual flushing of stream flows would quickly dilute any chemical spill and be less and less concentrated as it flows downstream, and since turtles appear to prefer deeper water situations, or bask on rocks or logs in the sun, they are not likely to spend much time in slow, stagnant water situations. Having stream buffers and using Best Management Practices for herbicide application helps to ensure that herbicides would not enter streams. Western pond turtles could move through an area recently sprayed, and potentially eat the vegetation that was recently sprayed. The thicker skin of western pond turtles is expected to provide more of a barrier from herbicide contamination, as compared with amphibians or fish. The invasive plant treated sites are very dispersed and narrowly focused, such that it is unlikely that western pond turtles would consume or come into contact with a recently sprayed herbicide location.

Cumulative Effects

The hydropower developments downstream significantly altered stream flows in the larger rivers and dams are considered barriers to migration by western pond turtles.

Cumulative effects, which probably have significantly affected habitat suitability for western pond turtles, are not going to be added to by the implementation of this alternative.

Implementation of this alternative may impact individuals, but is not likely to result in a trend toward Federal listing or a loss of viability for the western pond turtle.

Yosemite Toad

There have been 59 detections of Yosemite toads and/or Yosemite toad/western toad hybrids in or immediately adjacent to the ENF since 1992. All of these detections have been south of Highway 88. This area is the northern extent of the range of the Yosemite toad.

In 2002 and 2003, the California Department of Fish and Game undertook an intensive effort to survey ponds in and near the Mokelumne Wilderness. In 2002, a USDA Forest Service fisheries crew surveyed 54 sites, all ponds, and wet meadows in the range of the Yosemite toad within the Pardoe Grazing Allotment. In 2003, more USDA Forest Service surveys took place in areas with past toad sightings outside of the allotment in order to collect genetics samples for a study by Molly Stephens of UC Davis, and for Region-wide amphibian survey monitoring.

At Upper Blue Lake, toad adults and eggs have been observed annually; these are suspected to be western toad/Yosemite toad hybrids/intercrosses, as they call like Yosemite toads but are not as sexually dimorphic in color as Yosemite toads. Toads suspected to be intercrosses have been observed in the following locations: Upper Blue Lake, Twin Lakes, Clover Valley, Indian Valley, Summit City Creek, and Snow Canyon.

Actions proposed by this alternative that may be a concern for Yosemite toad are the direct or indirect effects as a result of pesticide application. There are no treatment sites proposed that are within 500 feet of known Yosemite toads (hybrids), although future herbicide treatments could if invasive plants are detected and proposed for treatments under EDRR.

Effects to Yosemite toads from implementing the project activities pertain primarily to downstream effects entering reservoirs, lakes, or creeks inhabited by them. It is not likely that Yosemite toads would be adversely affected from pesticide application described in the proposed action as a 100 foot buffer would be applied to Yosemite toad occupied habitats. Following the buffers and using Best Management Practices (USDA 2011), and applying the project design features, it is not expected that there would be any effects to Yosemite toads or their habitats. Herbicide application in meadows is limited to direct application (wiping) of targeted invasive plants within an area less than 100 square feet. This very localized and limited application of herbicides would not alter meadow habitat to any meaningful degree.

A site buffer of 100 feet would prevent any harmful effects to streams, meadows, and ponds where Yosemite toad hybrids are known to reside. It is expected that any invasive plants at the high elevations of the Yosemite toad range would be very few and focused in location. If new invasive plant infestations are detected within 500 feet of habitat occupied by Yosemite toads and these sites are proposed for herbicide treatments under EDRR procedures, the aquatic biologist will review the sites and confer or consult with the U.S. Fish and Wildlife Service prior to any treatments that may affect Yosemite toads or their critical habitat (Project Design Feature #23). Therefore, there is not expected to be any effects from this alternative on the Yosemite toad.

Herbicide Toxicity

Minimum buffers of at least 100 feet or more will be used where past sightings of Yosemite toads have been detected in the past, as well as the other Forest Service sensitive amphibians. The buffers were developed based on areas of concern in the SERA worksheets. Where hazard quotients in the SERA worksheets are over 1 for exposure types, the stream buffer was increased to avoid effects to Yosemite toads.

Cumulative Effects

The Proposed Action would not result in direct or indirect effects upon the Yosemite toad and would therefore not have cumulative effects upon this species. Implementation of this alternative would have no effect on the Yosemite toad.

Soil and Water

A long growing season coupled with moderate rainfall support strong forest growth. Precipitation on the plateau is from 40 to 60 inches (Daley et al 2002). The orographic effects of the Sierra crest and storm tracks increase precipitation towards the northeast.

Temperatures along the plateau average in the 50s annually with warm dry summers and occasional thunderstorms.

Oxic conditions are common for soils along the plateau with reddish hues (SCS 1974). Though deep accumulations of organic matter can occur, the low base cations content of less than 35% can lead to lower calcium and potassium availability for plants. Humid climates typically lead to low base conditions and these deficiencies in the ENF soils indicate past climate influence. Organic matter serves as a larger proportion of the nutrient base in these soils.

Despite the high annual rainfall, seasonal drought is common. Plant available water can be limiting on warm aspects or shallow soils. High late spring and summer temperatures create an evapotranspiration gradient which leaves droughty conditions. The deep soil mantles on the plateau are large reservoirs for trees and shrubs that can access the moisture. However, surface grasses and forbs depend more on surface soil moisture and thus subject to daily warming and droughty periods. The lower foothills experience "first" and "second" springs as the moisture tails off during spring and returns in the fall.

Soil

There are six herbicides proposed for use on infested ground: Aminopyralid, Clopyralid, Chlorsulfuron, Glyphosate, Imazapic, and Triclopyr. The toxicity, persistence and mobility in the soil environment of the various herbicides approved for use are the primary factors affecting the potential effects of herbicide application in this analysis. Table 15 gives measured properties of adsorption on soil, solubility in water, degradation rates, toxicity to microbes and activation mechanisms of the herbicides. Information was obtained from the Syracuse Environmental Risk Assessment publications (2003a, b; 2004a-c, and 2007), contracted specifically for the USDA Forest Service. Application rates are taken from the proposed action, found in Chapter 2 of the Environmental Assessment. Additional information was gathered from the Forest Service Region 6 Herbicide Information Summary and Project Design Criteria Crosswalk by Shauna Bautista and Stephen Bulkin, the California Department of Pesticide Regulation, the Environmental Protection Agency's Fact Sheets on Herbicides, the herbicide labels and peer reviewed literature.

Table 15. Herbicide properties for mobility in soil and water transport.

Herbicide	Toxicity to Soil Microbes	Adsorption	Water Solubility (mg/l)	Degradation Half-Life (days)		
				Soil Microbes	Water and Sunlight	Ground-water
Aminopyralid	low	low	205,000 pH 7	14-343	0.6	127-447
Clopyralid	low	low	1,000	12-70	8-40	261
Chlorsulfuron	low	low	27,900 pH 7	120-180	?	37-168
Glyphosate	low	strong	12,000	3-130	4-11	50-70

Herbicide	Toxicity to Soil Microbes	Adsorption	Water Solubility (mg/l)	Degradation Half-Life (days)		
				Soil Microbes	Water and Sunlight	Ground-water
Imazapic	No info	moderate	>2670 mg/l	25-142	1-2	30
Triclopyr (salt)	Inhibits fungal and bacterial growth	low	8,100 mg/l	14-46	2-6 **hours**	6 **hours**

The proposed use of herbicides is to spray or wick foliage of target plants. Herbicide residue that falls on the soil surface may work its way through the soil solution into plant roots. The proposed herbicides are weak acids that dissociate into the parent acid which is the active ingredient to penetrate plant tissue. After application, herbicides are decomposed in the soil along with treated plant materials. The main degradation pathways for herbicides are by soil microbial decomposition, light (photolysis) and water (hydrolysis). Offsite transport of herbicides can occur through rainfall generated runoff, wind erosion, and percolation into groundwater or lateral movement through permeable soils. These fates are a function of the herbicide specific properties, but also by soil physical and biological function.

The primary degradation pathway for most herbicides is biological decomposition by soil microbes (Bollag and Liu 1990, Radcliff et al 2006, Gish et al 2007). In a review paper on Glyphosate persistence in soils, Glyphosate degradation is ascribed to soil microbes with evidence of almost no degradation in sterilized soil (Borggaard and Gimsing 2008). Findings outlined in water contamination studies in Forest Service Region 5 monitoring report summary (Bakke 2000), including three on the ENF suggest that much of the herbicides do not penetrate the lower soil depths with very little of Glyphosate and Triclopyr leaching. In the case of Clopyralid, a highly soluble herbicide with very low adsorption, an eight year study in Montana found very little of the herbicide detectable below 25 cm (Rice et al 1997). The SERA report on Clopyralid (2004a) speculated that the lack of leaching was from the relative ease of decomposition, exemplified by the short half-life.

Herbicide half-life ranges in Table 15 reflect the high variability of decomposition due to environmental factors: presence of soil microbes, exposure to sunlight, temperature and soil moisture content. A half-life is the time it takes for 50 percent of the chemical to degrade into harmless or essentially inert compounds. Soils with high organic matter content, and thereby high CEC, can increase decomposition rates by binding herbicide molecules while providing usable carbon that facilitates microbial processing (Bolag and Liu 1990).

Persistence of chemicals in soil depends on levels of soil biological activity; long growing seasons with ample moisture have high decomposition rates. The climate of the ENF, with 40 to 60 inches annually and moderate temperatures in fall, is favorable for high rates of decomposition. Less favorable conditions exist on dry rocky slopes, canyon rims, sunny aspects, as well as sites with soils that have inherently rapid drainage, such as the granitics with less available water for decomposition. Microbial activity ramps up at the start of the growing season, when mean soil temperatures rise over 44 degrees (Davidson et al. 1998). Water limits microbial activity during the dry hot summer when soil moistures drops below 10%-.

Similarly, disturbed soils that have less water availability and scarce soil microbes have less potential for metabolizing herbicides. Soils along roadsides and old compacted surfaces from equipment use and excavation may have less water holding capacity and organic matter to support decomposition.

Beyond the biological potential, herbicide half-life is correlated to properties of soil adsorption and water solubility using laboratory studies. There is an inverse relationship between adsorption rate and half-life. Glyphosate has strong adsorption rates and the lowest half-life of the proposed herbicides. Soil properties influence adsorption rates depending on soil texture and level of organic matter. Fine textured soils and/or soils with high organic matter have more electrically positive charged sites for adsorption. Imazapic has a moderate adsorption rates if organic matter content is high, but has low adsorption rates when soil organic matter content is low.

Assays of herbicide decay do not always find results that correlate directly with soil texture, pH, CEC and percent organic matter (Wauchope et al. 2002). Clay and hydrated metal oxides, derivatives more closely associated with the soil parent rock material, are thought to have strong influence on herbicide degradation in the soil solution (Fast et al. 2010).

The high solubility of the proposed herbicides creates a plausible risk for off-site runoff and leaching if sufficient rainfall. Using a Forest Service Region 6 classification, the proposed herbicides rank as high to very highly soluble; three hundred to three thousand mg per liter (mg/l) have high solubility and three thousand to one million (mg/l) have very high solubility. Substantial rainfall within one to two days after application is the highest risk for runoff. Site conditions that have bare soils on steep or compacted ground, poorly drained soils, shallow soils with bedrock close to the surface, and low permeability soils would be prone to runoff.

Most ENF forest soils have very low runoff potential if relatively undisturbed and having vegetation cover over 50%. All the forest soils found associated with weed sites had well drained to somewhat excessively well drained conditions, which reduces the chance for surface runoff. Rainfall intensity only rarely exceeds infiltration capacity of intact soils with cover.

On the surface and in the unsaturated soil column degradation of herbicides proceeds rapidly in presence of sunlight, or by soil microbes with ample moisture. Outside these environments such as deeper into the soil mantle the half-life is measured in months. All the herbicides are highly soluble and therefore have potential for at least some downward movement into the soil column with percolating water from precipitation.

Groundwater flow (rate and consistency) depends on soil properties, on slope gradient, and also precipitation pattern. Herbicide transport follows the wetting front as moisture moves down from the surface into the soil, the vadose zone and then possibly into the water table. Wetting front follow substantial moisture from snowmelt and successive rainfall. Water moves downward when soil pore water content is high and there is sufficient depth for hydraulic head to overcome properties of adsorption. Little to no downward movement occurs (and possibility of herbicide movement) during the droughty summer season when water content is at or below field capacity.

Direct effects

Active control measures would benefit plant and soil communities to limit the spread of invasive plants onto natural vegetation communities. Spread of noxious weeds adversely affects these systems as described in Alternative 1. The highest risk for spread is within the dry grasslands, meadows, and dry forests proximate to roads using logic from the Center for Invasive Plant Management (Prather 2009). Wildfire poses a very high risk since this leaves open space in addition to high nutrient resources for invasive weeds to occupy.

The direct effect of herbicides on fungal and bacterial soil microorganisms vary with the herbicide used, and even then depend on the residue reaching the soil and the degradation rate, or half-life of the chemical. The effect to micro-organisms is usually not gauged by direct measurements, but inferred by changes in productivity factors such as respiration (CO2 production) of which microbial activity is one cause (SERA, 2003a). However the measurement of toxicity of herbicides to soil micro-organisms may be relevant only in the soil medium itself. Busse et al (2001) showed that Glyphosate, which can be toxic to microbes grown directly on the herbicide in the laboratory, had an un-measurable effect on microbes when applied directly to soil in the laboratory or in the field. In a later study on Glyphosate effects to soil microbial community structure, Ratcliff et al (2006) showed a sizable increase in the bacteria to fungal ratio for the spill scenario (100% solution) and not for the diluted field rate. The increase may be only temporary as bacteria metabolize the herbicide, a labile carbon source, with an anticipated return to normal composition as the active carbon supply returns to natural levels.

Based on the current SERA risk assessments, and the intended use rates, the herbicides would have a low risk for adversely impacting the soil biota. Triclopyr has reportedly affected fungal and bacterial strains in soil, but at use rates above ten times the intended rate (SERA 2003b). The limited use on cut stumps and foliage would limit the dose.

The re-establishment of desired vegetation life forms - trees, shrubs, forbs and grasses would depend on the site potential. In general, shading from shrubs and forest structure would have the most benefit in deterring the most common noxious weeds on the ENF, these are predominantly dryland species. Treatment areas with bare soil created by the treatment of invasive plants will be evaluated for restoration and revegetation by the area Botanist and Soil Scientist. Best Management Practices (BMPs), such as weed-free ground cover, will be implemented as needed (DF 29). Feedback in the Annual Implementation Process would be used to tailor restoration treatments according to desired vegetation and site potential.

The planting of vegetation and site stabilization would be positive for the desired plant and soil productivity. Site restoration after immediate control measures lowers the recolonization potential of noxious weeds by addressing ecological factors of site availability including light, nutrients, and lack of competing plants for noxious weed colonization (James et al 2010). This approach addresses the root cause of invasive species colonization rather than just immediate control. Longer term control of noxious weed presence would avoid potential hazards of soil degradation and plant community shifts from noxious weed advance as outlined in the no action alternative.

Mechanical Treatments

Manual methods are hand-pulling or using hand tools. Ground disturbance would occur from drawing up a plant by its roots, or digging sufficient to leverage the roots out. Other treatments, cutting, clipping, mowing and mulching do not incur any disturbance of the ground. Disturbance from manual and mechanical treatments would be short term and not lead to chronic erosion from the relatively small disturbance footprint and retained groundcover. There is a short term risk of erosion from disturbed ground if a highly infested area has contiguous bare ground sufficient to initiate surface erosion, or is on a feature such as a roadside slope that is in the influence of surface runoff. The risk is largely due to slope of the ground and erosiveness of the slope whether it is a natural surface or not. Any disturbance within 100 feet of a water body, sufficient in size to cause surface erosion could potentially deliver sediment to the water body.

Indirect Effects

Potential offsite transport of the proposed herbicides could adversely affect non-target vegetation and soil communities, in addition to contaminate water. From the proposed action, by far the most common herbicides for treatment are Aminopyralid, Clopyralid and Glyphosate. All six proposed herbicides are highly soluble in water with solubility greater than 300 mg/l (Bautista and Bulkin 2008, Forest Service Unpublished Internal Report) and label restrictions concerning runoff and leaching. For the ENF, the main risk is a chance of an intense summer rainstorm that could produce runoff. The risk for runoff is within the first 24 hour period, and on steep areas where erosive overland flows could generate. Leaching was not found a concern since most of the herbicide is applied to foliage, application is during the dry season which lacks a wetting front to percolate the herbicides downward during the initial half-life, and application is mainly away from bottomland areas that could support groundwater. Output from GLEAMS Modeling in the SERA assessments were in agreement with ENF monitoring and worst case modeled scenarios for this project whereby herbicides mostly stayed in the upper 12 inches of soil,

Runoff Herbicide movement off site that could damage non-target vegetation could leave a larger open site for recolonization by weeds. Modeled herbicide runoff for the most soluble herbicide, Aminopyralid, is predicted as 1 to 5% for this climate regime (SERA 2007). However, runoff primarily depends on a substantial rainfall event that could generate sheet wash. Applied herbicides quickly bind to vegetation and runoff, at least in solution, diminishing rapidly within 24 hours of application (SERA 2007, Gish et al 2011). Runoff is avoided by monitoring the climate, suspending application if the forecast exceeds a 30% percent chance for rain (DF 5, see Table 6). Potential runoff is less since the late spring through summer is when most of the spraying would occur, outside of the rainy season. ENF monitoring showed that past intensive broadcast spraying did not increase erosion since the dead plant material supplemented ground cover enough to protect against soil erosion.

Disturbed sites have the highest potential offsite transport of herbicide laden runoff either in solution or adsorbed on eroded sediments. Slope steepness, lack of cover and amount of potential rainfall are key determinants of sheet or rill erosion (Grismer 2012). Sheet flow and subsequent erosion occurs where rainfall exceeds the ability of soil to infiltrate. Infiltration capacity is inherently low on fine textured soils or disturbed soils. Soil moisture content also affects infiltration capacity, outside of inherent soil properties. Very dry soils typically have low infiltration rates because hydraulic head of water percolating downward must overcome the resisting pressure of air-filled pores. Similarly, saturated soils, with pores filled or nearly filled with water resist further input. During the dry months, disturbed bare soils may form a surface crust that resists infiltration. Thus, even granitic soils which have high infiltration capacity because of coarse texture can produce runoff if soils are dry.

Since groundcover is the most effective erosion control, runoff risk is mitigated by stabilizing treatment sites with either mulch or vegetation. Sites within the ENF productive landbase, not roads or quarries, can limit runoff by maximizing groundcover that holds herbicides and limits sediment transport (DF 29).

Using the current weed locations, the most erosive sites are along road side cutbanks. In nearby studies at Lake Tahoe, Grismer and Hogan (2005) showed runoff from bare road cutslopes has 10 to 50 times the runoff of similar intact native soils. Runoff rate was highest for the finer texture volcanic soils than granitic soils (2005). We expect similar results on the ENF for the lahar and metasedimentary soils versus the granitic soils. However, surface runoff on granitic soils can vary considerably due to the influence of bedrock near the surface (Burcar et al 1994). Exposed bedrock has substantial risk for runoff with no infiltration. Thus, road cutslopes on steep granitic terrain would be expected to have high runoff due to bedrock close to the surface.

For the Annual Implementation Process, volume of road cutbank runoff can be calculated using the Road Cut and Fill Slope Sediment Loading Assessment Tool developed in the Lake Tahoe basin (Drake et al 2010). Emphasis would be where road drainage connects through surface erosion channels or engineered drainage to natural water bodies. Many of the warm aspect, steep custlopes within the deeply incised, granitic canyons have the highest erosion potential but are not directly connected hydrologically to natural water bodies. Roads in valley bottoms and canyon footslopes with steep cutslopes have the highest risk for offsite transport (see Hydrology analysis).

Currently, 760 miles of roads are adjacent to mapped infestations. Of these roads, 585 miles occur along moderate and steep slopes. Road segments that have high risk for hydrologic connection to perennial streams and percolation comprise 26 miles across the forest. These segments occur with 100 feet of stream drainages, account for culvert diversion to drainages, and exclude the riparian buffers.

Of the herbicides proposed for use, Chlorsulfuron has the highest risk of movement by surface erosion if applied to soils with high clay content or that are shallow and unproductive. Chlorsulfuron degrades mostly by water, but persists in soil (Table 15). Runoff risk increases within the presence of clays; higher solubility results from the strong negative ion of the herbicide's acid dissociation that repels against the slightly negative soil matrix with clays. Of the clay influenced soils, most occur in the northwest corner within the old metasediments. The risk for increased runoff in the presence of these clays is tempered since the dominant kaolinitic clays have less negative charge and thus present less of a factor to Chlorsulfuron solubility. However, the proposed project excluded Chlorsulfuron from spot spray application as an extra layer of caution. Maintained cover over 50% limit potential soil erosion that could translocate Chlorsulfuron (DF 29).

Aminopyralid and Clopyralid have potential runoff risk from very high water solubility. Spot application of Aminopyralid and Clopyralid, including equipment rinsing, will not occur on soils with low infiltration rates (fine textured soils with percolation less than 2.0 inches/hr) and shallow soils with an impermeable bedrock layer less than 48 inches deep in well drained, sandy soils (DF 30). Near surface bedrock limits drainage and thus soils can saturate after snowmelt and after successive rainfall. Annual precipitation on the ENF creates potential saturated conditions from late fall through early spring within swales and drainages.

Runoff risk is particularly high for saturated soils during snowmelt because of low infiltration capacity. Herbicide application of Aminopyralid, Clopyralid, chlorsulfuron, Imazapic, and Triclopyr is avoided on deep coarse textured soils in elevations above 5000 feet prior and during snowmelt when soils are saturated. Herbicide application at these sites will coordinate with the Forest Soil Scientist to ensure adequate soil conditions (DF 31).

Dust Wind-blown dust is most severe along native surface roads with fine textured soils. Deep, more highly developed soils on the mid elevation plateaus may have dusty conditions during the dry summer. This hazard is particularly high for the Aiken and Jocal soil series which have fine soil textures and low rock content.

Aminopyralid, Clopyralid, and Chlorsulfuron are potent enough to affect the growth of nontarget plants if transported by wind borne sediment. These herbicides readily decay and risk is largely mitigated by not using aerial and boom broadcast spray. Furthermore an HQ less than one for these herbicides indicates an extremely low level of risk. Chlorsulfuron has a higher risk due to consistently longer residence time (Table 15). This herbicide is limited to direct foliar applications to avoid treatment onto bare soil (DF 39). Aminopyralid and Clopyralid are also potent but decay quickly in favorable soil biological conditions. The decay rate on bare soils that can erode is controlled by the organic matter and soil moisture available for soil biologic processes. Adding soil cover onto disturbed sites lowers the risk for wind transport by stabilizing the soil (DF 31) and increasing the biologic capacity to breakdown the herbicides. Offsite drift and application onto bare soils is limited by applying these potent herbicides in stable atmospheric conditions with less than 5 m.p.h. winds (DF 3).

Leaching Risk for leaching is highest where water concentrates on permeable soils, soils are unproductive with sparse microbial populations, and the water table resides close to the surface. Sites that have the highest potential for leaching are along the valley bottoms, described as undifferentiated stream channel systems in the ENF geomorphology mapping. Valley bottoms concentrate groundwater, and have high permeability from accumulated gravels and cobble material. Thirty eight of the 821 recorded sites occur within these bottomlands using geomorphic mapping, although only a few of these are within sediments with a proximate water table.

Roads that intersect slopewash with inboard ditches can hold water for infiltration in permeable valley fills. The analysis for runoff identified potential road segments that could divert runoff to waterways. Within these road sections, areas were identified on the lower hillslope where concave drainages could concentrate hillslope drainage and percolate herbicides further downslope into shallow or throughflow pathways. Twenty-six miles of road segments within 100 feet of drainage road crossings in valley bottoms or otherwise intercepting riparian corridors have high potential for routing runoff onto permeable fills that could leach.

Though evidence for percolation of herbicides into groundwater and surface water over thresholds of concern was not found, potential leaching of the most common herbicides are discussed. Aminopyralid has the highest risk for leaching from very high solubility. Once in water out of sunlight, this herbicide degrades slowly. Aminopyralid degrades readily in soil (ave 30 day half-life), but has a very slow breakdown if in groundwater (129-447 days).

Clopyralid also has high solubility coupled with low adsorption potential, although field test cases find very little penetrates below 10 inches (SERA 2004b). The lack of deep percolation by Clopyralid is attributed to rapid decomposition by soil microbes. Reported average half-life from research ranges from 10 to 25 days (2004b). Despite the high solubility and low adsorption, field studies have not found Clopyralid below the 10 inch soil depth.

The Triclopyr salt formulation (Garlon 3A) has low leaching potential despite the high solubility. Soil adsorption increases with time. The herbicide solubility also changes with the organic matter content. From a research review, Ganapathy (1997) reported almost no lateral or vertical movement in soil; most was held by the forest litter at the surface.

Currently, shallow soil sites that have aminopyralid and Clopyralid specified for spot spraying make up 41 of the treatment sites. Five of these occur within valley bottom areas that could connect to stream areas or shallow groundwater. Site specific determinations during the implementation and from the Annual Implementation Process would refine soil hazard risks from throughflow transfer to groundwater or surface water for these identified sites and conditions (DF 30 and 31). Avoidance during spring snowmelt would substantially reduce the risk (DF 30 and 31). Potential accumulated herbicide residue in soil available for yearly spring leaching is unlikely since over half of the herbicide residue reduces within with the first half life, typically 20 to 30 days.

Treatment areas with bare soil created by the treatment of invasive plants will be evaluated for restoration and revegetation by the area Botanist and Soil Scientist. Best Management Practices (BMPs), such as weed-free ground cover, will be implemented as needed (DF 29) and can further limit risk. The potential for leaching is minimized where optimal biological conditions can degrade herbicide laden foliage and sprayed soil. Biologic activity increases with moisture and temperature. Disturbed sites that are prone to weeds typically lack organic matter. Increasing groundcover stabilizes soils while also providing organic matter from mulch or vegetation. Groundcover from plants and mulch is key on warm aspects where moisture is limiting and drainage is rapid. Despite the high mobility of Triclopyr in soil, a study found that triclopyr was held in the forest floor and found no vertical and very little lateral movement in soil (Ganapathy 1997).

Though these sites could route herbicide residue, the GLEAMS modeling did not support this conclusion. As noted earlier the downward percolation of the herbicides, given the foliar application and rainfall for the area did not translocate the herbicides to depth. The herbicides stayed in the upper 12 inches where active decay occurs from photolysis on the surface soil or microbial decomposition within the soil. The buffers attached to stream features within the slope depressions add another layer of protection; in an internal forest service review, Neil Berg with the Pacific Southwest Research Station found buffers worked effectively to prevent herbicides contaminating drinking water or affecting sensitive species over thresholds of concern. The finding of herbicides concentrating in the topsoil is due to the chosen herbicides having rapid degradation, the reduced amount sprayed and the avoidance of spraying during the wet season.

Cumulative Effects

Active control measures would benefit plant and soil communities to limit the spread of noxious weeds onto natural vegetation communities. Spread of noxious weeds adversely affects these systems as described in Alternative 1. The highest risk for spread is within the dry grasslands, meadows, and dry forests adjacent to roads. The planting of vegetation and site stabilization would be positive for the desired plant and soil productivity. Site restoration after immediate control measures lowers the recolonization potential of noxious weeds by addressing ecological factors of site availability including light, nutrients, and lack of competing plants for noxious weed colonization. Disturbance from manual and mechanical treatments would be short term and not lead to chronic erosion from the relatively small disturbance footprint and retained groundcover.

Unintended consequences from offsite herbicide transport and treatment on non-target vegetation would be minimized by directly applying herbicide to foliage rather than broadcast spraying and using herbicides effective at lower dosage. There is a possibility of transport of residue herbicide in certain circumstances of soil drainage and erosiveness. The main process for herbicide decomposition would be microbial decomposition with very little percolating below the soil profile. Herbicides are degraded primarily by the soil microbes and thus persistence will be longest on poor productivity sites where soil microbes are sparse and moisture is lacking. Given application rates proposed for treatment, concentration of herbicides at levels toxic to soil micro-organisms is unlikely. Herbicide half-life period largely precludes cumulative effects from multiple treatments at a single site and concentrations of the herbicides are likely to be very much below toxic level for any organism.

There is the possibility of multiple applications of herbicides over a period of up to ten years on an individual site. The effect of a given herbicide could be compounded if excess residues are produced and the degradation of the herbicide does not occur at expected rates before the next round of herbicide was applied. Although the application of herbicide is likely in successive years on most sites, the time between applications and the half-life of the various herbicides will minimize residue accumulations. Applying herbicides at the typical, and not maximum recommended rates will limit the amount of excess residue present on site each year, while the presence of soil microbes and soil temperatures conducive to degrading the herbicides will allow this to occur at rates cited by research. As a result, the extent of residues remaining in the soil when subsequent applications occur should be minimal.

Hydrology

Direct effects

Manual methods are hand-pulling or using hand tools. Ground disturbance would occur from drawing up a plant by its roots, or digging sufficiently to leverage roots out. Other treatments, cutting, clipping, mowing and mulching do not incur any disturbance of the ground. There is a short term risk of erosion from disturbed ground, particularly if in a high infested area a contiguous patch of ground is disturbed sufficient to initiate surface erosion, a road cut bank or fill slope.

Indirect Effects

Runoff Bare soil is susceptible to erosion and overland flow by effects of rainfall. Raindrop impact can be great enough to break down soil aggregates, reducing through physical disintegration surface pore space area and thereby the soil's infiltration capacity (Moore and Singer, 1989; Cattle et al, 2004). With sufficient wetting of the soil surface dispersion of fine grains will cause a crust to form, a fine grain coating with low permeability. Overland flow is often associated with creation of soil crusts (Esteves et al, 2000; Cedan et al, 2001). Surface sheet flow can carry fine grain soil particles of the order of silts and clays (<0.0625 mm in diameter). Despite high solubility in water of the herbicides, the chemical's very large mass and some attraction to negatively charge soil particles means that transport in water is only likely to occur when attached to soil particles that may be moved by shallow sheet flow.

Resistance to surface flow on most natural surfaces is amply provided by vegetation and litter cover. Winnowing of sediment laden sheet flow can be as much as 90% effective by vegetative buffer of 30 meters in width, even on steep slopes (Castelle et al. 1994, Castelle and Johnson 2000, Fishcher and Fischinich 2004). It is unlikely that whole surfaces of treated areas would be made barren by herbicide treatment, if for no other reason that poisoned weeds would provide a dead organic cover on the soil. Furthermore Design Feature 34 ensures effective soil cover as follows: 70% or greater on slopes exceeding 35%, shallow soils or other soils with high runoff potential, soils within RCAs; effective soil cover of 50% or greater for all other areas. Apply weed free mulch where treatment causes effective soil cover to be deficient. It is not necessary to consider effective soil cover where soil cover is not normally expected such as road treads and quarries.

Treatment on roads does pose a greater risk to eventual surface water contamination because surface runoff from bare and or compacted surfaces within the road prism shed precipitation water more readily and frequently than natural slopes. In a study at Lake Tahoe, Grismer and Hogan (2005) showed runoff from bare road cut slopes have 10 to 50 times the runoff of similar intact native soils. Further and possibly more significant, road prism runoff from running surfaces and cut banks is often facilitated with engineered ditches and relief pipes. To the extent that drainage may lead onto natural slopes, road surface runoff may be buffered. However, road segments that cross streams or penetrate into stream buffers provide routes for contaminants to reach streams, whether from rutted running surface, roadside ditches or runoff projected onto natural slopes an inadequate distance from the channel for proper buffering.

There are 760 miles of roads running through or adjacent mapped infestations areas, 3.6 miles of which are within 30 meters of perennial or intermittent streams. These buffer zone miles are in 76 segments ranging from a few feet up to one half mile in length, and include 40 crossings of channels. Those segments that cross channels, insofar as the running surface may drain directly into the channel or floodplain are the highest risk areas for contamination of natural water. Results from modeling include a road site that crosses a small channel. No buffer is assumed for this site. Contaminate values are 2 orders of magnitude above those of buffered treatment sites. These results agree well with monitoring results from applications on roads in Oregon’s Willamette Valley by the Oregon Department of Transportation (Berg, 2004). Project design features reduce risk by limiting application of all herbicides to wind conditions less than 5 mph, thereby lowering application to erodible sediment (DF 4). To avoid transport from rain, treatment is delayed if a chance of rain is forecast (DF 5). Herbicides are most mobile during the initial 24 hour period after treatment.

Groundwater It has already been discussed that the herbicides proposed have high solubility, but also large molecule mass and varying affinity to adhere (adsorb) onto soil and organic particles. Herbicides that are highly water soluble or strongly adsorbed to soil particles have the potential to move off site following application, during the half-life period. Five of the six proposed herbicides are highly soluble in water with solubility greater than 300 mg/l (Bautista and Bulkin 2008, Forest Service Unpublished Internal Report). Once into solution herbicides may transport through the soil as groundwater flow, potentially reaching natural surface water bodies. However, as groundwater is dispersed through a soil there is also increasing chance that chemicals will adsorb to the soil. The depth of a wetting front for precipitation events following herbicide application marks the probable depth of penetration of chemicals and an accumulation zone from additional applications of herbicides.

Direct foliar application lowers offsite effects for leaching. If rainfall were to occur during application or within the first day after, the risk for leaching exists for all the herbicides. Project design feature 4 lowers leaching risk by avoiding treatment within 24 hours of forecasted rainfall.

Runoff risk is particularly high for saturated soils during snowmelt, because of low infiltration capacity. Herbicide application of aminopyralid, clopyralid, chlorsulfuron, imazapic, and triclopyr is avoided on deep coarse textured soils in elevations above 5000 feet prior and during snowmelt when soils are likely to be saturated. Herbicide application at these sites will coordinate with the Forest Soil Scientist to ensure adequate soil conditions (DF 35).

Spraying in spring when soil moisture is high and groundwater flow active may pose greater risk to transport of chemicals than in early fall when soil moisture content is very low, even under the same conditions of precipitation. Chemicals move into the soil with infiltrating precipitation, but depth of initial movement is important. A contaminated wetting front that stops in the top few inches of the soil, in the zone of microbial activity, would degrade faster. Herbicides infiltrating into soil with high water content and active gravity flow may quickly percolate beyond the range of most soil biota that would reduce the chemical. Herbicide half-life (the time it takes half the chemical to degrade), increases sharply when in groundwater. Project design feature 5 safeguards against spraying under conditions of active infiltration or obvious saturated conditions, when herbicides most easily are transported deep into the soil column.

Since groundcover is the most effective erosion control, runoff risk is mitigated by stabilizing treatment sites with either mulch or vegetation. Sites on the ENF productive land, not roads or quarries, can limit runoff by maximizing groundcover that holds herbicides and limits sediment transport (DF 34).

The Groundwater Loading Effect of Agricultural Management Systems (GLEAMS) model (Website: http://www.tifton.uga.edu/sewrl/Gleams/gleams_y2k_update.htm), is used to examine the fate of herbicides in the rooting zone of the soil. It may be modified for site specific parameters of climate, soils, topography, vegetation cover and size and flow rate of natural water bodies and application rate of herbicides. The application rates used were on the high end of the range of expected as stated in the proposed action. The start date of the model runs was September 15 of any given year. Applications are once a year on that date. While most spraying may occur earlier in the summer a September date is shortly before the rainy season typically begins, and chances that chemical drifting onto the soil will either be washed away on the surface or carried into the soil with infiltrating precipitation is higher than at the beginning of the summer.

Results of GLEAMS runs are on selected sites on the ENF. These sites were all adjacent to streams with flow rates varying by orders of magnitude. A 30 meter buffer was assumed with one exception which was that of a forest road crossing. The road sloped down towards a crossing of a small perennial stream. The treated road was assumed to provide a direct hydrologic conduit to the channel. The herbicide suite of Aminopyralid, Clopyralid and Glyphosate are the most commonly used, and besides a limited site use of Triclopyr are the only used in extensive area spraying. Chlorsulfuron and Imazapic have more specialized use and would not be used except as directed foliar treatment. Site #781 had a mapped treatment area of 57 acres, however 10 acres is the maximum area adjacent to a stream buffer that can be treated at one time (DF 38). The model run assumed a 10 acre treatment. The GLEAMS model incorporates climate data from local stations, in this case the station at Tiger powerhouse was chosen as central to many of the infested sites. The Cligen program developed by the National Soil Erosion Research Lab, and uses real weather data to generate simulated yearly data (Website: http://www.ars.usda.gov/Research/docs.htm?docid=18094). Cligen data are uploaded by the GLEAMS program.

In all cases soil concentration were 1 to 2 orders of magnitude greater than water concentration. The greatest water concentrations were for the road site #654. Beneficial uses of the major streams draining the forest include municipal and domestic use, irrigation, livestock and aquatic habitat (State of California, 1998). Of all the uses municipal and domestic use would have the lowest concentration levels for a threshold of concern. However, not many chemical herbicides have had standards developed for concentration in water. The California Code of Regulation (Title 22, Division 4, and Chapter 15) only lists Glyphosate of all the herbicides proposed for use in this project. Risk assessment worksheets produced by SERA and based on the comprehensive reports (SERA 2003a-b, 2004a-c, and 2007) have listed concentration levels deemed at acute or chronic toxicity for humans and various organisms potentially at risk from water contamination. It can be seen with comparisons of concentrations from the model runs are 2 to 4 or more orders of magnitude less than thresholds of concern for human use and well below those for fish and aquatic invertebrates.

Bakke (2001) in a review of monitoring results after herbicide spraying on Eldorado and Stanislaus NFs found that buffers of greater than 20 feet were completely effective in eliminating Glyphosate and Triclopyr in detectable levels (about 0.5 parts per billion) in adjacent streams. Slight but detectable levels (0.5-2.4) were found when buffer widths were 10-15 feet for Glyphosate on the Stanislaus NF.

Berg (2004) in a comprehensive review of Best Management Practices associated with herbicide spraying in region 5 and elsewhere in the United States found similar results. Detectable levels of herbicides such as Glyphosate, Triclopyr and Clopyralid were found in various locations (Washington, Oregon, New York and Florida) mainly as a result of drift from boom broadcast spray or aerial application. An Oregon Department of Transportation study sampled runoff from road shoulders after treatment of Glyphosate, with no buffers on a stream. Under simulated rainfall of high intensity they found 100's of ppb could be transported off site. In a similar test, under natural rainfall 0.1-1 ppb was detected leaving the road prism. The results of these studies show that the GLEAMS results for this project are reasonable, and that the greatest risk is from roads with direct hydrologic connection to stream channels.

Cumulative Effects There is the possibility of multiple applications of herbicides over a period of up to ten years on an individual site. The effect of a given herbicide is compounded in the soil as excess residues from each year concentrate at the average depth of penetration of infiltrating precipitation water for a given soil type and climate. Depths of maximum concentration presented in GLEAMS results are between 8 and 12 inches. The GLEAMS model does show gradual rates of increase for at least the three years of simulation, but weather record sets for longer simulations were not available. This residue buildup in the soil does not affect water concentrations however, as the chemicals are strongly attracted to soil particles and not readily transported by water. Although the application of herbicide is likely in successive years on most sites, the time between applications and the half-life of the various herbicides will minimize residue accumulations. Applying herbicides at the typical and not maximum recommended rates will limit the amount of excess residue present on site each year, while the presence of soil microbes and soil temperatures conducive to degrading the herbicides will limit the amount of accumulation.

The ERODA model was used to assess the effect of manual treatment of weeds. The model equates ground disturbance to a forest road with native surface, which is considered to be largely impervious. Implicitly the model assesses runoff response to management action, but there is no provision for process or spatial array of treated ground. In other words the model simply indexes amount of treated ground without consideration of where in the watershed treatments will occur and connectedness to natural drainages. The effects are considered to be transitory and hand grubbing within the model has a 3 year recovery period. There are 89 7th field HUC watersheds that have mapped infestations proposed for treatment. Five of these were chosen for the assessment. These watersheds were adjacent to one another, contained some of the largest mapped infestation units, other projects were planned within them—mostly private timber sales—and at least one, Bear Creek, was close to the Threshold of Concern

(TOC). The TOC is a level of disturbance that observable and significant effects to water quality might occur. It is not meant as a definitive limit, but to serve as a cautionary level that warrants further investigation, particularly for large projects. The TOC is calculated as a percent ERA. The manual grubbing was assessed by assigning a coefficient of 0.05 to total treated acres. In other words, for every acre treated by grubbing the hydrologic function would be equivalent to 0.05 acre of hard compact forest road. The results show that the percent ERA change due to the weeds project is very slight, much less than 1 percent. These results include watersheds with some of the largest areas of invasive plants to be treated and therefore represent some of the largest impacts that can be expected from the proposed action. In none of the 89 watersheds does the weeds project impact push ERA percent to the level of, or over TOC, or could even add more than small fractions of 1 % ERA , given the input coefficients. Ascribing significance to a change of 0.20% ERA, in the context of a TOC of 10%, suggest a very high confidence that such change is observable or measureable, a level of precision unwarranted by the construction and function of the model. It is unlikely that large patches of weeds would be in fact entirely treated by manual methods, but probably mostly by spraying which involves no ground disturbance. Of the 89 watersheds, 4 are currently over TOC. Overall it was judged that further modeling in the remaining watersheds was unnecessary because the results of the proposed action—change in %ERA—would certainly be less than those already calculated, and not significant in terms of runoff. Given the low contribution of the project to the percent ERA, it was determined by the Forest that treatment of weeds was warranted even if watersheds were currently over TOC. Under the proposed action, the treatment of invasive plants on all sites would have cumulative effects within acceptable levels for maintaining water quality. The cumulative effects of the proposed action would be small in comparison to the potential effects of untreated invasive plants described under the No Action Alternative.

Compliance Design features for ground cover meet or exceed LRMP standards (IV-97 for soil cover). All land management activities on USFS lands are to be conducted in accordance with Forest Plan standards and guidelines and BMPs. Land Management Plans are developed by the USFS for each NF, following public review and comment. Use of water quality and other resource protection BMPs in NFs is required by the NFMA and prescribed in the Forest Plans. Consequently, all land management activities, must be implemented using BMPs for control of non-point source water pollution (USDA 2011).

State of California Water Resources Control Board Resolution #68-16 (State of California, 1968) directs that high quality water or water of higher quality than required by regulation be maintained at that higher quality. Similarly anti-degradation EPA policy 40 C.F. R. Section 131.12 states that existing water quality, even when it exceeds required levels for stated beneficial uses will be maintained. Potential effects of the proposed action, either through surface runoff of sediment and chemicals or chemicals entering water bodies through groundwater sources do not constitute a significant degradation of quality or impair existing beneficial uses.

Riparian Conservation Objectives (RCO) is an adopted management strategy stated within the Sierra Nevada Forest Plan Amendment (Website: http://www.fs.usda.gov/detail/r5/landmanagement/planning/?cid=STELPRDB5349922).

The RCOs are to guide management activities toward achieving desired future conditions.

Summary Given application rates proposed for treatment, concentration of herbicides approaching levels of concern for health hazards is unlikely. Half-life period, solubility or adsorption of each herbicide determines how readily each will transport off site. The greatest risk to water contamination is the possibility of transport of residue herbicide on roads that have direct connection to a stream channel. In these circumstances engineered drainage features may effectively circumvent buffers. However, the concentrations of the herbicides are likely to be very much below toxic level for any organism for which research tests are available. Herbicide half-life period largely precludes cumulative effects from multiple treatments at a single site.

The result of the GLEAMS model runs on various scenarios of real sites agrees well with results of several monitoring studies reviewed by Bakke (2001) and Berg (2004). Amounts of herbicides in natural streams were below levels of concern for human or aquatic health, and mostly the result of drift from broadcast or aerial application, neither of which method would be employed by the action proposal.

The effect of manual treatment of weedy plots is slight, even if all mapped acreage were treated by grubbing of weeds which is very unlikely. The ERA model runs on watersheds with large acreage of weeds show effects of change much less than 5 percent of current condition. In the 89 watersheds (7th level HUC) affected by the proposed action none would be push to or over Thresholds of Concern (TOC) by the proposed action. Five watersheds are currently over the TOC. Given the minimal contribution of this project to ERA, it was determined that control of weeds warrants action in these watersheds despite being over threshold.

Climate

The current condition of vegetation and sensitive plant species on the ENF reflects the effects of past and present management activities. Presently there is not enough evidence to suggest whether native plant populations and/or ranges are increasing, decreasing, or stable. Monitoring of sensitive plant occurrences which detects decreases or increases from year to year, may merely reflect normal variation in individual numbers as a response to annual climatic changes. There is also considerable uncertainty regarding future changes in local climatic patterns. Given the lack of data needed to take a proactive management approach to sensitive plant species, the best available interim management approach is to minimize impacts to known occurrences of sensitive plant species while allowing expansion into suitable unoccupied habitat. This strategy would also maximize the diversity of habitat and microsite conditions (slope, aspect, elevation, etc.) for sensitive plants on the ENF which may be important in face of future climate change. Much is unknown about the potential long-term effects of a warming and/or drying climate on native vegetation and sensitive plant species. In the near term, maintaining habitat diversity across the species range may be the best means to manage for plant and animal species which could require unique microsites to persist under future climatic conditions.

Research has indicated that non-native species such as cheatgrass and Scotch broom can alter and increase fire behavior and frequency. More frequent wildfires, higher intensity fires, and timing of fires may contribute to effects from climate change. The effect of changed fire patterns on the climate is not well understood. Particulate matter volatized from fires is well understood to have negative health effects, and may contribute to broader atmospheric pollutants. Control of weeds that increase fire effects may have a positive indirect effect on the atmosphere.

Cultural Resources

Activities associated with both alternatives will comply with the National Historic Preservation Act (NHPA) of 1966, as amended, and it's implementing regulations 36 CFR 800 and Forest Service Manual 2360.

In addition, this project complies with the provisions set forth within the "Programmatic Agreement among the USDA. Forest Service, Pacific Southwest Region, California State Historic Preservation Officer, and Advisory Council on Historic Preservation Regarding the Identification, Evaluation, and Treatment of Historic Properties Managed by the National Forests of the Sierra Nevada, California." (Sierra PA) of 1996.

The procedures and stipulations within the Sierra PA include the identification and treatment of at-risk historic properties. An at-risk historic property is a property that has been identified as susceptible to being adversely affected as a result of activities associated with this project. A property is identified as "at risk" based on that property's characteristics that may be affected by specific actions. Therefore, there may be a lower number of at-risk historic properties than the number of known cultural resource sites located within the project's area of potential effects (APE).

The Sierra PA also includes certain classes of project activities that have no or negligible potential to adversely affect cultural resources; such as non-ground disturbing vegetation treatments, herbicide application, activities confined within previously disturbed areas such as quarries and road prisms), and activities that entail no more than one cubic meter (cumulative) of soil disturbance.

Direct, Indirect & Cumulative Effects

This alternative will have no direct or indirect effect on cultural resources as the treatment methods are either; non-ground disturbing, entail minimal disturbance, or located in areas within previous disturbance (such as road corridors).

With the potential exception of treatment methods for certain locations of scotch broom, the treatment methods will have little or no potential to adversely affect cultural resources.

In areas of established Scotch Broom populations that call for ground disturbing activities greater than one cubic meters; potential at-risk cultural resources, all share common characteristics. These sites are prehistoric or historic archaeological sites of varying complexities and include buried deposits including lithic scatters and, or midden and that are located within or immediately adjacent to these locations. Values associated with buried deposits can cause these sites to be susceptible to ground disturbance such as erosion, rutting and down cutting of the soil on these routes. In addition, site boundaries of these sites are ill defined as they have been based solely on surface observations, sub-surface testing of these sites will only assure the true extent of these sites.

These treatment areas will be assessed during the Annual Implement Process and the Forest Archaeologist will to review project locations to determine if any cultural resources could be affected and. If a treatment area is determined to have a potential effect, alternative treatment methods will be selected.

With the Project Design Features, no direct or indirect adverse effects to cultural resources are predicted, and no contribution to cumulative adverse effects would occur.

Tribes

The mechanical and manual treatment methods are not likely to affect traditional cultural plants. Manual methods such as weed pulling allow a great deal of plant specificity and reduce the likelihood to impact non-target plants.

Proposed herbicides have the potential to effect broadleaf varieties and grasses, including cultural plants. Project design features require annual consultation with American Indian tribes as treatments are scheduled so that tribal members may provide input and/or be notified prior to gathering cultural plants. Any areas identified for avoidance will be buffered similar to the design criteria for Sensitive Plants or an alternative, non-herbicide method for treatment will be utilized.

By following the project design features, no direct or indirect adverse effects are predicted, and no contribution to cumulative adverse effects would occur.

Recreation, Public Uses, and Land Designations

Recreation

Some treatments under the proposed action would have a short term (one season or less) effect on visitor use, primarily in developed sites and concentrated visitor use areas. Visitors might avoid areas when workers are present and where chemical treatments have been implemented during the posted effective time, or the entire growing season if dead vegetation is obvious. Any impacts would be minor inconveniences that would be for a limited time period and a small portion of any recreation use area. Design Features 14-16 would reduce impacts to Forest visitors by providing public information prior to and at the time of treatments, to assist visitors in avoiding treatment areas, and by scheduling treatments to avoid high visitor use periods. Treatment of invasive species will promote maintaining native vegetation and the natural character of the landscape, which is a key component of why recreationists visit the Eldorado National Forest.

The Human Health and Risk Assessment addresses potential for chemical exposure by Forest visitors engaged in recreation and other user activities.

Special Areas

The Annual Implementation Process, including Design Features 13, 17 and 30 specific to Botanical SIAs, RNAs, Pacific Crest National Scenic Trail and Wilderness areas, would ensure invasive plant treatments are implemented in a manner that would not negatively impact the unique features for which these areas were designated. Control or eradication of invasive plant species would have a beneficial effect by protecting special botanical, recreation and scientific resources for research and public enjoyment in all designated Special Areas. There would be minor short term impacts from treatments, but there would not be any substantial direct or indirect effects to the recreation or scientific values in the Special Areas. There are no known past, present or reasonably foreseeable future projects within these areas that when considered with the proposed action would contribute to cumulative adverse impacts.

Wilderness

The ENF and project area contains portions of two congressionally designated wilderness areas; Desolation Wilderness and Mokelumne Wilderness. These areas are managed to maintain and protect wilderness values in accordance with the Wilderness Act of 1964.

Any future infestations in the Mokelumne or Desolation Wilderness would be treated with non-chemical methods unless additional analysis is conducted for Regional Forester approval of herbicide use. It is likely that newly discovered infestations in these designated or recommended wilderness areas and the associated treatments would be small scale. Anticipated impacts from manual treatments in Wilderness would be minor, short term and of minimal consequence. Visitors might notice signs of activity such as pulled weeds left to dry or small areas of bare ground. The Proposed Action alternative would have a beneficial effect on designated and recommended Wilderness by providing effective control of any future infestations of invasive plants and protecting Wilderness values. Control or eradication of invasive plant infestations on other areas of NFS land would reduce the likelihood of spread to Wilderness and proposed wilderness areas. There are no known past, present or reasonably foreseeable future projects within these areas that when considered with the proposed action would contribute to

Wild and Scenic Rivers

The project area contains rivers that are identified in the LRMP for management as Wild and Scenic Rivers to protect and enhance the values that caused them to be included in the system (PL 90-542, as amended), without limiting other uses that do not substantially interfere with public use and enjoyment of these values. These areas are managed to preserve their free flowing condition and protect their outstandingly remarkable values, identified to determine eligibility for eventual inclusion in the National Wild and Scenic River System. Identified river segments have been classified as wild, scenic or recreation based on outstandingly remarkable values which include scenery, recreation, geology, fisheries, historical and cultural. One river segment that has been determined to be suitable, Middle Fork American River below Rubicon River, contains 66 potential infested acres. The potential infested area is based on the size of mapped infestations doubled in size to account for potential growth. There are 251 potential infested acres within eligible segments including Bear River, Beaver Creek, Cole Creek, Middle and North Forks Consumnes River, Silver and South Forks American River. There are 124 acres potential infested acres within the recommended Lower and Upper Rubicon River segments.

The Proposed Action alternative would not have an adverse effect on the outstandingly remarkable values or the free flowing condition of areas managed as Wild and Scenic Rivers. Controlling invasive plant infestations would have a beneficial effect by protecting and preserving the outstandingly remarkable values of these rivers and providing for ongoing public use and enjoyment. There would be no adverse direct or indirect effects from the Proposed Action alternative. There are no known past, present or reasonably foreseeable future projects within these areas that when considered with the proposed action would contribute to cumulative adverse impacts.

Inventoried Roadless Areas

Forest Service direction for management of Inventoried Roadless Areas (IRA) is to provide lasting protection for IRAs and to maintain the roadless characteristics which consist of 1) high quality or undisturbed soil, water, and air; 2) sources of public drinking water; 3) diversity of plant and animal communities; 4) habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land; 5) primitive, semi-primitive non-motorized and semi-primitive motorized classes of dispersed recreation; 6) reference landscapes; 7) natural appearing landscapes with high scenic quality; 8) traditional cultural properties and sacred sites; and 9) other locally identified unique characteristics.

The proposed project area contains 101,152 acres of IRA, of which 18,571 acres is designated Wilderness area. There are two infestations totaling 34 acres of potential infested area within the Rubicon IRA. The potential infested area is based on the size of mapped infestations doubled in size to account for potential growth.

The Proposed Action alternative would have a beneficial effect on IRAs by providing effective control of the two existing infestations and control or eradication of any future infestations to protect roadless characteristics and protect wilderness valves for potential future designation under the Wilderness Act. Control or eradication of invasive plant infestations on other areas of NFS land would reduce the likelihood of expansion into IRAs which would further increase the likelihood of protection against expansion into Wilderness areas. There would be no direct or indirect adverse effects from the proposed action. There are no known past, present or reasonably foreseeable future projects within these areas that when considered with treatment of the 34 acres potential infested area and projected new infestations as described in the proposed action would contribute to cumulative adverse impacts.

Visual Resources

The ENF LRMP states that the forest uses the visual management system to deal with its visual resources. Forest landscapes are mapped by measurable standards for visual resource management known as Visual Quality Objectives (VQO). VQOs include five levels of objectives (Preservation, Retention, Partial Retention, Modification, Maximum Modification). The ENF LRMP also allows for use of the Visual Resource Improvement Practice in the visual management system known as Rehabilitation (reh) and Enhancement (e). Desired VQOs are identified for each Management Area. Where an area does not currently meet the desired VQO, lands are to be restored to the desired VQO under the Visual Resource Improvement Practice. A VQO of Rehabilitation and or Enhancement is an acceptable short term management alternative used to restore landscapes containing undesirable visual elements, to desired visual quality. The natural appearance and diversity of the landscape is altered when invasive plant infestations replace native vegetation. Invasive species out-compete native vegetation and create large monoculture areas that contrast with the diversity that makes up the characteristic landscape. Invasive plant infestations, as well as proposed treatments to control infestations, have the potential to affect VQOs. Invasive plant occurrences are concentrated along roads, trails and in areas of concentrated public use. These areas may overlap with areas of VQOs of Preservation, Retention, Partial Retention and viewsheds that receive high public use and importance to visitor visual quality experience.

The proposed action alternative would have an overall beneficial effect on visual resources by reducing or eliminating existing invasive species infestations and restoring areas currently degraded and not meeting VQOs to the appropriate desired conditions identified in the LRMP.

There could be short term adverse effects to visual quality in treatment areas. However, implementation of the proposed action would comply with the Visual Resource Improvement Practice. Treatment areas would meet the existing VQOs after a Visual Resource Improvement of Rehabilitation (reh) and Enhancement (e) for the extent of any short term impacts, maintaining compliance with the ENF LRMP. Short term impacts from chemical treatments could include indictor dye, potentially visible for approximately one week, and browning vegetation that could be visible for the season. Most species are low profile herbaceous plants that would have little contrast or noticeable change in color or form; however, brooms are shrubs up to 7’ tall with a light green color and have taken over areas in the forest floor. Brooms repetition creates a solid form of color and fine texture making the change noticeable. The short term change in color and form from treatment would be replaced by the long term beneficial effect of enhancing and restoring the diversity of texture and color in the characteristic landscape in areas occupied by broom. Control of existing infestations and control of new infestations under EDRR would reduce the likelihood that infestations would increase in size or number and adversely affect visual resource in areas that currently meet the VQOs. The proposed action alternative would meet the VQOs in the ENF LRMP.

Human Health

The analysis of the potential human health effects associated with the use of chemical herbicides uses the methodology of risk assessments generally accepted by the scientific community (National Research Council, 1983; EPA 1986). In essence, this herbicide risk assessment compares possible herbicide doses for various exposure scenarios experienced by workers and the public with EPA’s established reference doses (RfDs). RfDs are based upon doses shown to cause no observed ill effects in test animals in either short-term (acute) or long-term (sub-chronic or chronic) studies. Much of the information used in the risk assessment completed for this project (available in the project record) was gathered from herbicide-specific risk assessments completed by Syracuse Environmental

Research Associates, Inc. (SERA), under contract to the Forest Service. 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. 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.

The Human Health Risk Assessment completed for this project was conducted to analyze the potential for adverse health effects in workers and members of the public from the use of the proposed herbicides. Workers include applicators, supervisors, and other personnel directly involved in the application of the herbicides. The public includes forest workers who are not directly involved in the herbicide application, and forest visitors who could be exposed through the drift of herbicide spray droplets, through contact with 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 residues. The risk assessment examines the potential health effects on all groups of people who might be exposed to any of the herbicides proposed for use. Effects to workers and forest users from proposed herbicides are summarized from Carroll (2012).

Herbicides

For aminopyralid and imazapic the hazard quotients for all exposure scenarios for workers and the general public are below a threshold of concern. These results imply that long-term employment applying aminopyralid and imazapic can be accomplished without toxic effects to workers. For the general public acute/accidental scenarios and the long-term/chronic exposures, hazard quotients were also all below a level of concern for the above herbicides indicating little hazard to the general public from application of these pesticides. Of the remaining herbicides proposed for use in Alternative 2, potential effects to human health were identified (Carroll 2012) and are discussed below:

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. However, chlorsulfuron is a mild irritation to the skin and eyes at relatively high levels - 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 by workers. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of the compound.

General Public –The longer-term consumption of contaminated vegetation after application of the highest dose yields a hazard quotient that is greater than unity (HQ = 3). At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. This is a common pattern with herbicides or any pesticide applied directly to plants. The scenario for the longer-term consumption of contaminated vegetation is also an extremely conservative assumption in that most plants treated with a herbicide at the highest application rate would show some signs of damage and humans would not be likely to consume the plant over a prolonged period of time. All other potential exposure scenarios for general public do not approach a level of concern.

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 approach a level 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 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. The consumption of contaminated vegetation 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. All other potential exposure scenarios for general public do not approach a level of concern.

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.

However, 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. As discussed in SERA 2003a, glyphosate with the POEA surfactant, is about as irritating as standard dishwashing detergents, all-purpose cleaners, and baby shampoos.

General Public For the acute scenarios, the consumption of contaminated vegetation after application of the highest dose yields a hazard quotient that is greater than unity (HQ= 2). 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. In addition, 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. All other potential exposure scenarios for general public do not approach a level of concern.

Triclopyr

Workers –None of the general occupational exposure scenarios, acute or chronic, exceed the RfD at the upper bound of the estimated dose associated with the highest application rate. 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 triclopyr TEA that are regarded as unacceptable. Under typical application conditions, levels of exposure will be well below levels of concern.
None of the accidental scenarios for workers, involving triclopyr TEA exceed a level of concern based on the acute RfD of 1 mg/kg/day. However, this acute RfD is not applied to women of childbearing age and the chronic RfD of 0.05 mg/kg/day is used. Thus, for female workers, the level of concern would be 0.05 rather than unity. Even with this more conservative criterion, none of the hazard quotients for accidental scenarios for triclopyr TEA formulations exceed a level of concern. However, ocular exposure to the triclopyr TEA formulations is characterized in MSDS' variously as *Irreversible, Corrosive/Irreversible, or simply Corrosive.* The Garlon 3A label carries a Danger signal word for eye effects, among other effects. The potential for eye irritation associated with handling triclopyr TEA formulations is clear. While eye irritation is not treated quantitatively in the current risk assessment, eye irritation is a clear concern for occupational exposures.

General Public – Several acute/accidental scenarios lead to hazard quotients that are above the level of concern. The consumption of contaminated fruit exceeds the level of concern at the upper level of exposure (HQ = 6), while the consumption of contaminated vegetation exceeds the level of concern at the central (HQ = 5) and upper estimate of exposure (HQ = 41). None of the other acute/accidental scenarios considered in the Project Risk Assessment lead to hazard quotients that are above the level of concern. These findings suggest that in the event that someone consumed broadleaf vegetation sprayed with triclopyr from the Forest, or from a vegetable garden that had been sprayed with triclopyr, adult females who consume the vegetation 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 2.0 mg/kg which could result in overt signs or symptoms of toxicity after acute exposures. The plausibility of this scenario is limited by several important factors. First, most areas proposed for treatment with triclopyr are well removed 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.

Similarly, adult females who consume contaminated fruit could be exposed triclopyr residues. At the upper level of exposure, the consumption of contaminated fruit could lead to acute exposures where the nature and severity of effects are uncertain (a one-time dose of 0.28 mg/kg). At the typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. This scenario is conservative in that it does not consider the effects of washing contaminated fruit in reducing doses and 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. In addition, 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.

The same longer-term exposure scenarios (consumption of contaminated fruit and vegetation) exceed a level of concern (HQ of 4 and 10, respectively) at the upper levels of exposure. 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. None of the other longer-term scenarios lead to hazard quotients that are above the level of concern.

TCP- TCP (3,5,6-trichloro-2-pyridinol) is of concern for 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. Because of the toxicity of TCP, it was considered separately in this risk assessment. Similar to triclopyr TEA, scenarios of concern involving exposures to 3,5,6-trichloro-2-pyridinol (TCP) are also limited to the consumption of contaminated vegetation. The upper bound of the acute exposure scenario for the consumption of contaminated vegetation by a young woman is 15, lower than corresponding upper bounds for general exposures in workers applying triclopyr TEA, based on chronic RfD.

Potential exposures to TCP also exceed the level of concern at the upper bound of the HQs for both the acute and longer-term consumption of contaminated vegetation and fruit. For TCP, the upper bound of HQs for acute exposures is less than the upper bound of the HQs for longer-term exposures. For the central estimates and the lower bounds, the opposite pattern is apparent. While this may seem incongruous, the calculations are correct and reflect the interplay of the lower chronic RfD and the different half-lives used to estimate the longer-term time-weighted average doses. As indicated in the worksheets, the 90-day time-weighted average doses for TCP are below the estimated acute doses of TCP.

The qualitative interpretation of the HQs for TCP is similar to that of the HQs for triclopyr. In the event members of the general public consume contaminated fruit or vegetation, these people could be at risk.

The plausibility of the acute scenario is limited by several important factors. First, most areas proposed for treatment with triclopyr are well removed 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.

For the longer term scenario, 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 or fruit 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.

Impurities and metabolites

Virtually no chemical synthesis yields a totally pure product. Technical grade herbicides, as with other technical grade products, contain some impurities. To some extent, concern for impurities in technical grade herbicides is reduced by the fact that existing toxicity studies of these herbicides were conducted using technical grade products. Thus, if toxic impurities are present in a technical grade product, their effects are reflected in the toxicity measurements. An exception to this general rule involves carcinogens, most of which are presumed to pose risks in any concentrations. In the case of the herbicides under consideration, known carcinogen impurities include:

- hexachlorobenzene in clopyralid
- Ethylene oxide potentially in surfactant
- 1,4 dioxane potentially in surfactant

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 the project Human Health risk assessment (Carroll 2012), the amount of hexachlorobenzene in technical grade clopyralid is not toxicologically significant for workers. Similarly, hazard quotients for the general public from all modeled exposure scenarios result in hazard quotients that are below one. The simple verbal interpretation of this risk characterization is that, in general, the contamination of clopyralid with hexachlorobenzene does not appear to pose a risk to the general public. This is consistent with the conclusions reached by the U.S. EPA.

Risk of cancer from exposure to ethylene oxide is considered negligible for occupationally exposed individuals, based on a standard of acceptable risk of 1 in 1 million. Risks from exposure to ethylene oxide are considered acceptable, given the conservative assumptions about exposure. Risks of cancer from the exposure to 1,4-dioxane are considered negligible for occupationally exposed individuals, based on a standard of acceptable risk of 1 in 1 million. Accordingly, risks from 1,4-dioxane exposure are considered acceptable. As with impurities, the potential effects of metabolites is encompassed by the available in vivo toxicity studies, under the assumption that toxicological consequences of metabolism in the species tested would be similar to those of humans. Uncertainties in this assumption are countered by using an uncertainty factor in deriving the RfD and relying upon conservative studies in determining the appropriate RfD.

Adjuvants

Hi-Light™ Blue colorant would be mixed with herbicides to assist with applications and alert workers and public of recently treated areas. 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. It is considered to be virtually non-toxic to humans. The use of these colorants in the formulations would result in almost no increase in risk to the health and safety of the workers or public, and in fact the use of a dye can reduce exposures and hence the risks since treated vegetation can be avoided.

The only surfactant proposed for use under Alternative 2 is methylated seed oil. Methylated seed oils are formed from common seed oils, such as canola, soybean, or cotton. They act to increase penetration of the herbicide. 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

Synergism has rarely been observed in toxicological tests involving combinations of herbicides with other commercial pesticides. The six herbicides and various adjuvants proposed for this project have not shown synergistic effects in humans who have used them 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.

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. However, an uncertainty factor of 10 for sensitive subgroups may not cover all 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. When available specific information regarding potential effects for sensitive subgroups from the six proposed herbicides are provided below. Further information concerning risks to sensitive individuals can be found in USDA (1989, pages 4-114 through 4-116).

Aminopyralid There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of aminopyralid. Due to the lack of data in humans, the critical effect of aminopyralid, if any, cannot be identified. It is not clear that aminopyralid has any remarkable systemic toxic effects. The most common effects in experimental mammals involve effects on the gastrointestinal tract which may be viewed as portal of entry effects. These effects are variable among different species of mammals and appear to be associated with levels of exposure that are substantially higher than any likely human exposures. Thus, it would seem highly speculative to suggest that individuals with gastrointestinal diseases might be more susceptible than other individuals to aminopyralid.

Chlorsulfuron-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.

Clopyralid-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).

Imazapic-The likely critical effect of imazapic in humans cannot be identified clearly. Imazapic exposures have been associated with changes in blood, bone marrow, muscle, and possibly the liver. However, it is unclear if individuals with pre-existing diseases of the hematological system, muscle, or liver would be particularly sensitive to imazapic exposure. Individuals with any severe disease condition could be considered more sensitive to many toxic agents. Nonetheless, given the very low hazard quotients for imazapic, there is no basis for asserting that adverse effects in a specific subgroup are plausible.

Glyphosate-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 2011a).

Triclopyr -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 2011c). This group is given explicit consideration and is central to the risk characterization.

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 via various routes of exposure resulting from the management scenarios presented in Alternative 2 and (2) additive doses if an individual is exposed to other herbicide treatments.

Additional sources of exposure include: use of herbicides on adjacent private timberlands or home use by a worker or member of the general public. Using Forest Service and State of California pesticide-use records, Table 16 displays the use of herbicides by total use and Forestland use within the four-counties that make up the ENF area (Alpine, Amador, El Dorado, and Placer Counties).

Table 16 Reported Herbicide Use (lbs active ingredient) within ENF Counties (2006-2010)

	Forestry, Rangeland, and Right-of-Ways					
Chemical	2006	2007	2008	2009	2010	Total
Aminopyralid	0	62	277	414	201	956
Chlorsulfuron	66	66	67	30	57	285
Clopyralid	324	151	83	70	78	706
Glyphosate	27,706	30,479	24,122	26,936	35,219	144,462
Triclopyr TEA	164	566	508	352	526	2,114
	All Reported Uses					
Chemical	2006	2007	2008	2009	2010	Total
Aminopyralid	15	200	426	499	350	1,491
Chlorsulfuron	73	79	79	36	81	348
Clopyralid	701	258	186	168	241	1,555
Glyphosate	44,003	45,448	37,020	42,673	65,186	234,340
Triclopyr TEA	1,004	1,609	2,241	2,338	2,698	9,891

Source - California Department of Pesticide Regulation, Annual (2006-2010) Pesticide Use Reports for Alpine, Amador, El Dorado and Placer Counties, accessed on line at http://www.cdpr.ca.gov/docs/pur/purmain.htm on July 30, 2012.

Glyphosate is primarily used in forestland, other crops, right-of-way, and landscape maintenance. Clopyralid is primarily used for rangeland, landscape maintenance, and right-of-way. Chlorsulfuron and aminopyralid are primarily used in right-of-way and landscape maintenance. Triclopyr TEA is primarily used in rice, right-of-way, and landscape maintenance

Under Alternative 2, it is estimated that from 300 to 600 acres would be treated annually. Based on the pesticide use from 2006-2010 displayed in Table 16, Alternative 2 would result in at most a 6% increase in herbicide use for forest and rangeland treated within the counties the ENF is located. [Average annual use (lbs) from Table 16 = 148,523/5 = 29,705. (600 acres in Alternative 2 at 3 lbs/acre = 1,800 lbs. 1,800/29,705 = 0.061 or approximately 6%.] This is an overestimation, as the rates for most of the herbicides proposed for use are less than 3 lbs/ acre.

It is conceivable that workers or members of the public could be exposed to herbicides as a result of treatments on surrounding public or private forestlands or from fire restoration efforts on Forest Service lands. Where individuals could be exposed by more than one route, the risk of such cases can be quantitatively characterized by simply 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 0.02. 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 triclopyr residues up to 1.5 years after treatment (glyphosate, up to 66 weeks), however, these levels were less than 1 part per million (Segawa et al. 2001). Based on the re-treatment schedule in the proposed action, 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 so would likely be undesirable for collection.

Table 16 indicates that several of these herbicides are used primarily outside of forestlands in the four-county area. 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 (Human Health Risk Assessment). Adding the TMRC to this project's chronic dose estimates 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 does not change the risk conclusions based on the project-related HQ values.

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.

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. 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 2011c) along with triclopyr.

Notwithstanding the above assessment in U.S. EPA (1998, 2002a), this risk assessment does specifically include a consideration of exposures to TCP that may result from activities in the use of triclopyr. Thus, oral exposures to TCP which may result from the use of triclopyr are addressed in in this risk assessment, and the risks that might be associated with these exposures are discussed in the risk characterization for triclopyr, above.

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 the four-county ENF area, chlorpyrifos use in 2010 totaled 1,965 pounds, primarily used in walnut orchards. 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 100 times higher in 2010 then the four ENF counties combined. 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.

CONSULTATION AND COORDINATION

The Forest Service consulted the following individuals, Federal, State, and local agencies, tribes and non-Forest Service persons during the development of this environmental assessment:

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Federal, State, and Local Agencies:

Federal Agencies/Organizations (UC Coop. Extension, U.S. Fish and Wildlife Service Sacramento Field Office, BLM, neighboring NFs)

Scoping Letter including an initial project proposal was sent to the Sacramento Field Office, Endangered Species Branch, of the USFWS on 2/6/2012.

State Agencies (CDFG, State Water Board, Cal Trans)

Meeting with UC Extension and El Dorado County Ag Dept. regarding the project on September 2, 2008

County Agencies/Organizations (RCDs, Board of Supervisors, Agricultural Commissioners, Dept. of Transportation, County WMAs)

Water Agencies and Utilities (EID, PCWA, GPUD, PG&E, SMUD)

Tribes:

Letter inviting consultation with tribes on the proposal, sent on 2/6/12 to 24 tribal contacts (Federally recognized Tribes and non-recognized Tribes and Tribal Groups)

Others:

Presentation to CNPS, El Dorado Chapter regarding the ENF intent to implement an IPM approach to eradicate and control invasive plants, September 22, 2008

Owners of commercial timberlands within the NF boundary (SPI, Bruce-Girard-Mason, Lonestar, Fruitgrowers)

Ski Areas (Kirkwood Meadows, Sierra at Tahoe)

Special Use Permittees (Summer Home Owners Associations, Organization Camps, Resorts, Water pipelines/storage or wells, apiary permits, Outfitters)

Range Allotment Permitees

Private landowners (all private landowners with property within 500 feet of treatment areas)

Conservation and Environmental Organizations (Audubon, Sierra Club, Sierra Forest Legacy, CATS)

Additional Individuals that requested to be on the ENF scoping mailing list

LITERATURE CITED

Asher, J., and S. Dewey. 2005. Estimated Annual Rates of Weed Spread on Western Federal Wildlands. Draft white paper. December 2005. Federal Interagency Committee for Management of Noxious and Exotic Weeds. Available at http://www.blm.gov/weeds/BOISUMMI.WPD.html.

Anthony, R.G.; and Isaacs, F.B. 1989. Characteristics of bald eagle nest sites in Oregon. Journal of Wildlife Management 53(1): 148-159.

Ashton, D.T., Lind, A.J., and Schlick, K.E. 1997. Foothill Yellow-legged Frog (*Rana boylii*); Natural History. Unpublished. USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory. Arcata, California.

Bakke, D. 2000. A Review and Assessment of the Results of Water Monitoring for Herbicide Residues For the Years 1991 to 1999. Unpublished Internal Forest Service Report. Region 5, Vallejo, CA. 38p.

Bakke, D. 2001. Unpublished. A Review and Assessment of the Results of Water Monitoring for Herbicide Residues for the Years 1991 to 1999, USFS Region Five.

Bakke, D. 2007. Analysis of Issues Surrounding the Use of Spray Adjuvants With Herbicides. Unpublished report, US Forest Service.

Bautista, S.L., and S.P. Bulkin. 2008. Herbicide Information Summary and Project Design Criteria Crosswalk. Forest Service Unpublished Internal Report. USDA Forest Service, Region 6. Portland, OR. 36p.

Berg (2004)– Assessment of Herbicide Best Management Practices: Status of Our Knowledge of BMP Effectiveness. Pacific Southwest Research Station, USDA Forest Service, ,Albany, CA.

Bollag, J.M., S.Y. Liu. 1990. Biological Transformation processes of Pesticides. In Pesticides in the Soil Environment. H.H. Cheng. (ed.) Soil Science Society of America book series, no. 2. Madison, Wis., USA: Soil Science Society of America. p. 169-211

Borggaard, O.K., A.L. Gimsing. 2008. Fate of Glyphosate in sioil and the possibility of leaching to ground and surface waters: a review. Pest Management Science. 64: 441-456

Boyce, D.A., and C.M. White. 1980. Peregrine falcon nesting habitat survey on U.S. Forest Service lands along the west slope of the Sierra Nevada Mountains. Submitted to the U.S. Forest Service, Eldorado National Forest, by the Wilderness Research Institute. Sebastopol, CA. USDI Fish and Wildlife Service. 1982. Pacific Coast American peregrine falcon recovery plan. U. S. Fish and Wildlife Service and the Pacific Coast American Peregrine Falcon Recovery Team.

Bradford, D. F., and M. S. Gordon. 1992. Aquatic Amphibians in the Sierra Nevada: Current Status and Potential Effects of Acidic Deposition on Populations. California Air Resources Board, Contract No. A932-139., Sacramento, CA.

Burcar, S., W.W. Miller, S.W. Tyler, and D.W. Johnson. 1994. Seasonal preferential flow in two Sierra Nevada soils under forested and meadow cover. Soil Science Society of America Journal. 58: 1555-1561

Busse, M.D., A.W. Ratcliff, C.J. Shestak, and R.F. Powers. 2001. Glyphosate toxicity and the effects of long-term vegetation control on soil microbial communities. Soil Biology & Biochemistry (33) 1777-1789.

Cal-IPC. 2006. California Invasive Plant Council. California Invasive Plant Inventory Database. Cal-IPC Publication 2006-02. California Invasive Plant Council: Berkeley, CA. http://www.cal-ipc.org/ip/inventory/weedlist.php

Carlson, J. and H. Fiore. 1993. Water monitoring report, 1991 herbicide application projects, Eldorado National Forest. Found in Supervisors Office files, Placerville, CA.

Carey, C. 1993. "Hypothesis concerning the causes of the disappearance of boreal toads from the mountains of Colorado." Conservation Biology 7(2): 355-362.

Castelle, A.J., A.W. Johnson, and C. Conolly. 1994. Wetland and Stream Buffer Size Requirements—A Review. Journal of Environmental Quality 23:878-882

Castelle, A.J., And A.W. Johnson. 2000. Riparian Vegetation Effectiveness. National Council for Air and Stream Improvement. Technical Bulletin 799.

Cattle, S. I. Cousin, F. Darboux and Y. Le Bissonnais. The Effect of Soil Crust ageing, Through Wetting and Drying, on Some Surface Structural Properties.SuperSoil 2004: 3rd Australian New Zealand Soils Conference, 5-9 December 2004, University of Sydney Australia. www.regional .org.au/au/asssi/

Cerdan, O., V. Souchere, V. Lecomte, A. Couturier, and Y. Le Bissonnais. 2001. Incorporating Soil Surface Crusting Process in an Expert-Based Runoff Model: Sealing and Transfer by Runoff and Erosion Related to Agricultural Management. Catena 46 189-205.

Chew, F.S. 1981. Coexistence and local extinction in two Pieris butterflies. American Naturalist118: p.655-72.

CWHR 2005. California Department of Fish and Game. California Interagency Wildlife Task Group. 2005. California Wildlife Habitat Relationships version 8.1 personal computer program. Sacramento, California

CNDDB 2012. California Natural Diversity Database. http://www.dfg.ca.gov/biogeodata/cnddb/mapsanddata.asp

D'Antonio, C.A. and P.M. Vitousek. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. Annu. Rev. Ecol. Syst. 23: 63-87

Daly, C. 2002. Climate division normals derived from topographically-sensitive climate grids. In: Proc., 13th AMS Conf. on Applied Climatology, Amer. Meteorological Soc., Portland, OR, May 13-16, 177-180.

Davidson, E.A., E. Belk, and R.D. Boone. 1998. Soil water content and temperature as independent or confounded factors controlling soil repiration in a temperate mixed hardwood forest. Global Change Biology. 4: 217-227.

DiTomaso 2006a Yellow starthistle management Guide

DiTomaso, Joseph M., Guy B. Kyser, Jessica R. Miller, Sergio Garcia, Richard F. Smith, Glenn Nader, J. Michael Connor, and Steve B. Orloff, 2006. Integrating prescribed burning and clopyralid for the management of yellow starthistle (*Centaurea solstitialis*). Weed Science 54: 757-767.DiTomaso Joseph and Evelyn Healy. 2007. Weeds of California and Other Western States Vol. 1 Aizoaceae-Fabaceae. pg 514

DiTomaso and Healy 2007, Weeds of California and Other Western States Vol.1 and Vol. 2. University of California Agriculture and Natural Resources Publication.

Drake, K., R. Arst McCullough, and M. Grismer. 2010. Road Cut and Fill Slope Sediment Loading Assessment Tool: Project Report. Prep. for USDA Forest Service, Pacific Southwest Research Station. Integrated Environmental Restoration Services. South Lake Tahoe. Available [ONLINE] @ http://www.fs.fed.us/psw/partnerships/tahoescience/documents/final_rpts/P039RCATFinalProjectReport.pdf [May 2012]

Drost, C. A., and G. M. Fellers. 1996. Collapse of a regional frog fauna in the Yosemite area of the California Sierra Nevada, USA. Conservation Biology 10:414-425.

Ecorp Consulting, Inc. 2011. 2011 Hardhead (*Mylopharodon conocephalus*) Surveys in the South Fork American River, El Dorado Hydroelectric Project, FERC No. 184.

Eldorado National Forest. 2012. Noxious Weed, Sensitive Plant, and Special Interest plants GIS database and occurrence records. Placerville, CA

Esteves, M. X. Faucher, S. Galle, and M. Vauclin. 2000. Overland Flow and Infiltration Modeling for Small Plots During Unsteady Rain: Numerical Results Versus Observed Values. Journal of Hydrology 228 265-282.

Eviner, VT, MK Firestone. 2007. Mechanisms determining patterns of nutrient dynamics. in M. stromberg, J. Corbin, and C D'Antonio (eds) Ecology and management of California grasslands. pp. 94-106

Fast, B.J., J.A. Ferrell, G.E. MacDonald, L.J. Krutz, and W.N. Kline. 2010. Picloram and Aminopyralid sorption to soil and clay minerals. Weed Science. 58: 484-489

Fellers, G. and Pierson, E.D. 2002. Habitat Use and Foraging Behavior of Townsend's Big-Eared Bat (*Corynorhinus townsendii*) in Coastal California. J. of Mammalogy 83(1): 167-177.

Fischer, R.A., and J.C. Fischenich, 2000. Design recommendations for riparian corridors and vegetated buffer strips. U.S. Army Engineer Research and Design Center. ERDC-TN-EMRRP-SR-24.

Ganapathy, C. 1997. Environmental fate of Triclopyr. California Department of Pesticide Regulation, Environmental Monitoring & Pest management Branch, Sacramento, CA. Available [ONLINE] @ http://www.cdpr.ca.gov/docs/emon/pubs/fatememo/Triclopyr.pdf [May 2012]

Gish, T.J., J.H. Pruieger, W.P. Kustas, J.L. Hatfield, L.G. McKee, and A. Russ. 2011. Herbicide Off-Site Fate. *In* Soil Health and Land Use Management. Hernandez-Soriano (ed). Intech. Croatia. pp. 231-252

Grismer, M.E., and M.P. Hogan. 2005. Simulated rainfall evaluation of revegetation /mulch erosion control in the Lake Tahoe basin: 2. Bare soil assessment. Land Degradation & Development. 16: 397-404

Grismer, M.E. 2012. Erosion Modeling for Land Management in the Tahoe Basin – Scaling from plots to small forest catchments. Hydrological Sciences J. 24p.

Hanski, I. 1989. Metapopulation dynamics: Does it help to have more of the same? Trends in Ecology and Evolution 4:113-115.

Hanski, I., and M. Gilpin. 1991. Metapopulation dynamics: Brief history and conceptual domain. Biological Journal for the Linnean Society 42:3-16.

Hawkes, C.V., I.F. Wren, D.J. Herman, and M.K. Firestone. 2005. Plant invasion alters nitrogen cycling by modifying the soil nitrifying community. Ecology Letters. 8: 976-985

James, J.J., B.S. Smith. E.A. Vasquez, and R.L. Sheley. 2010. Principles for ecologically based invasive plant management. Invasive Plant Science and Management. 3: 229-239

Jennings, M.R. 1996. Status of Amphibians. Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options. Centers for Water and Wildland Resources Report No. 37: 921-944. University of California. Davis. Davis, California.

Kreutzweiser, D.P., Holmes. S.B., and Eichenberg, D.C. 1994. Influence of exposure duration on the toxicity of triclopyr ester to fish and aquatic insects. Arch. Environ. Contam. Toxicol. 26:124-129.

Lacey, R.C., C.B. Marlow and J.R. Lane. 1989. Influence of spotted knapweed (*Centaurea maculosa*) on surface runoff and sediment yield. Weed Technology (3) 627-631.

Martin, D. L. 2008. Decline, Movement and Habitat Utilization of the Yosemite Toad (*Bufo canorus*): An Endangered Anuran Endemic to the Sierra Nevada of California. Doctoral dissertation, UC Santa Barbara.

Monk, J., B.J. Walton, R. Olendorff and D. Carrier. 1988. California peregrine falcon implementation plan. Santa Cruz Predatory Bird Research Group. 44 pp.

Moore, D.C. and M.J. Singer. 1990. Crust Formation on Soil Erosion Processes. Soil Sci. Soc. AM J., 54:1117-1123.

Moyle, P.B. 2002. Inland fishes of California. Regents of the University of California, Berkeley and Los Angeles, CA.

Norris, L.A., H.W. Lorz, and S.V. Gregory. 1983. Forest chemicals. Gen. Tech. Report PNW-149, February. USDA Forest Service, PNW Forest and Range Exp. Stn.

North State Resources, Inc. 2010. Mokelumne River Project (FERC Project No. 137), 2009 Fish population monitoring report. Prepared for PG&E, San Ramon, CA. January.

Norton. J.B., T.A. Monaco, and U. Norton. 2007. Mediterranean annual grasses in western North America: kids in a candy store. Plant Soil. 298: 1-5

Olson, B.E. 1999. Impacts of noxious weeds on ecologic and economic systems. in: Sheley, R.L., Petroff, J.K. editors. Biology and management of noxious rangeland weeds. Corvallis, Oregon: OSU Press. p 4-18.

Orr, R.T. 1954. Natural History of the Pallid Bat, *Antrozous pallidus*. Proceedings of the California Academy of Sciences, Vol. XXVIII, No. 4, pp. 165-246.

PCWA. 2010. Final AQ2 – Fish population technical study report 2007-2009. Placer County Water Agency-Middle Fork Project, Auburn, CA.

Pellant, M. 1996. Cheatgrass: The invader that won the west. ed. I. C. B. E. M. Project.

Perry, L. G., C. Johnson, É. R. Alford, J. M. Vivanco & M. W. Paschke (2005) Screening of Grassland Plants for Restoration after Spotted Knapweed Invasion. *Restoration Ecology*, 13**,** 725-735.

Prather, T. 2009. Chapter 6. Risk Assessment and Decision Making for Invasive Plant Management Planning. Center for Invasive Plant Management, Online Invasive Plant Management Textbook. Available [ONLINE] @ http://www.weedcenter.org/textbook/pdf_files/chapter6.pdf [May 2012]

Ratcliff, A.W., M.D. Busse, and C.J. Shestak. 2006. Changes in microbial community structure following herbicide (Glyphosate) additions to forest soils. Applied Soil Ecology. 34: 114-124

Renz, M. J., S. J. Steinmaus, D. S. Gilmer & J. M. DiTomaso (2012) Spread Dynamics of Perennial Pepperweed (*Lepidium latifolium*) in Two Seasonal Wetland Areas. *Invasive Plant Science and Management*, 5**,** 57-68.

Rothacher, J., and W. Lopushinsky. 1974. Soil stability and water yield and quality. In environmental effects of forest residues management in the Pacific Northwest: a state-of-knowledge compendium. USDA For. Serv. Gen. Tech. Rep. PNW-24, p. D-1 to D-19. Pac. Northwest For. and Range Exp. Stn., Portland, OR.

Seastedt, T.R., R.J. Hobbs, and K.N. Suding. 2008. Management of novel ecosystems: are novel approaches required? Front. Ecol. Environ. 6(10): 547-553

SERA. Mar. 1, 2003a. Glyphosate—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc. Fayetteville, New York 13066-0950.

SERA. Mar. 15, 2003b. Triclopyr—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc., 5100 Highbridge Street, Fayetteville, New York 13066-0950.

SERA. Nov. 21, 2004a. Chlorsulfron—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc., 5100 Highbridge Street, Fayetteville, New York 13066-0950.

SERA. Dec. 5, 2004b. Clopyralid—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc., 5100 Highbridge Street, Fayetteville, New York 13066-0950.

SERA. Dec. 23, 2004c. Imazapic—Human health and ecological risk assessment—final report. Syracuse Environmental Research Associates, Inc. Fayetteville, New York 13066-0950.

SERA (Syracuse Environmental Research Associates, Inc.) 2007a. Preparation of Environmental Documentation and Risk Assessments for the USDA/Forest Service. January 21, 2007. SERA MD 2007-01a. 147 pages.

SERA (Syracuse Environmental Research Associates, Inc.) 2007b. Amniopyralid - Human Health and Ecological Risk Assessment – Final Report. June 28, 2007. SERA TR 052-04-04a. Fayetteville, New York. 231 pages.

SERA (Syracuse Environmental Research Associates, Inc.) 2011a. Glyphosate – Human Health and Ecological Risk Assessment – Final Report. March 25, 2011. SERA TR 052-22-03b. Fayetteville, New York. 313 pages.

SERA (Syracuse Environmental Research Associates, Inc.) 2011b. Triclopyr – Human Health and Ecological Risk Assessment – Final Report. May 24, 2011. SERA TR 052-25-03a. Fayetteville, New York. 251 pages.

Sjogren, P. 1991. Extinction and isolation gradients in metapopulations: The case of the pool frog (*Rana lessonae*). Biological Journal of the Linnaean Society 42: 135-147.

Soil Conservation Service. 1974. Soil Survey of El Dorado Area, California. USDA Soil Conservation Service and Forest Service In Cooperation with University of California Agricultural Experiment Station. 95p.

Stillwater Sciences. 2008. Technical Report on the 2007 Slab Creek Dam Reach Fish Distribution Study. Created for Sacramento Municipal Utility District by Stillwater Environmental Sciences, Davis, CA. Dec. 29.

Thompson, D.G. Kreutzweiser, D.P., Capell, S.S., Thomas, D.R., Staznik, B., and Viinikka, T. 1995. Fate and effects of triclopyr ester in a first-order forest stream. Environ. Toxicol. Chem. 14:1307-1317.

Trammell, M.A., and Butler, J.L. 1995. Effects of exotic plants on native ungulate use of habitat. Journal of Wildlife Management 59(4):808-16.

USDA 1996 *"Programmatic Agreement among the USDA. Forest Service, Pacific Southwest Region, California State Historic Preservation Officer, and Advisory Council on Historic Preservation Regarding the Identification, Evaluation, and Treatment of Historic Properties Managed by the National Forests of the Sierra Nevada, California."*.

USDA Forest Service. 1988. Eldorado National Forest Land and Resources Management Plan. USDA Forest Service, Region 5, Eldorado NF. Placerville, CA. USDA Forest Service. 2011. Forest Service Handbook - Pacific Southwest Region

USDA Forest Service 2001. Final Environmental Impact Statement for the Sierra Nevada Forest Plan Amendment, vol. 3, chapter 3, part 4. USDA Forest Service, Pacific Southwest Region.

USDA Forest Service. 2004. Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement. USDA Forest Service, Pacific Southwest Region. Vallejo, California.

USDA Forest Service. 2004b. Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement, Record of Decision. USDA Forest Service, Pacific Southwest Region. Vallejo, California. USDA Forest Service. 2011. R5 Forest Service Handbook—2509.22. Soil and Water Conservation, Chapter 10, Water Quality Management Handbook.

USDA Forest Service 2011. Best Management Practices, Chapter 10-Water Quality Management Handbook, R5 -2509.22 Soil and Water Conservation Handbook, Pacific Southwest Region, USDA Forest Service.

USDI Fish and Wildlife Service. 1986. Recovery Plan for the Pacific Bald Eagle U.S. Fish and Wildlife Service, Portland, Oregon.

USDI Fish and Wildlife Service. 1982. Pacific Coast American peregrine falcon recovery plan. U. S. Fish and Wildlife Service and the Pacific Coast American Peregrine Falcon Recovery Team.

USDI Fish and Wildlife Service. 2001. Federal Register – Final determinations of critical habitat for the California red-legged frog; final Rule. March 13.

USDI Fish and Wildlife Service. 2002. Recovery plan for the California red-legged frog (*Rana aurora draytonii*), Portland, Oregon.

USDI Fish and Wildlife Service, 2002. Federal Register/Vol. 67, No. 237. December 10. Proposed Rules. 50 CFR Part 17. Endangered and Threatened Wildlife and Plants: 12-month finding for a petition to list the Yosemite toad.

USDI Fish and Wildlife Service. 2006. Estimating the Effects of Auditory and Visual Disturbance to Northern spotted Owls and Marbled Murrelets in Northwestern California. Guidance provided by the Arcata Fish and Wildlife Office, July 31, 2006.

USDI Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. May 2007. 23 pp.

United States Environmental Protection Agency. 1998. Reregistration Eligibility Decision (RED) – Triclopyr. U.S. EPA 738-R-98-011. October 1998. 285 pages

United States Environmental Protection Agency. 2002a. Triclopyr; Pesticide Tolerance. September 18, 2002. Federal Register. 67(181):58712-58725.

Young, J. A. 1992. Ecology and management of medusahead (*Taeniatherum caput-medusae* ssp. *asperum* [Simk.] Melderis). *Great Basin Nat* 52:245–252.

Wardle, D. A., Bardgett, R. D., Klironomos, J. N., Setälä, H., Van der Putten, W. H. and Wall, D. H. 2004. Ecological linkages between aboveground and belowground biota. Science 304: 1629-1633

Wauchope, R.D., S. Yeh, J.BHJ Linders, R. Kloskowski, K. Tanaka, B. Rubin, A. Katayama, W. Kordel, Z. Gerstl, M. Lane, and J.B. Unsworth. 2002. Petsicide soil sportion parameters: theory, measurement, uses, limitations and reliability. 2002. Pesticide Management Science. 58: 419-445

Wilcox, B.A. 1980. Insular ecology and conservation. Pages 97-117 in M.E. Soule and B.A. Wilcox. Conservation biology. Sinauer Associates, Sunderland, Massachusetts.

Williams, J. 2012. Aquatic Species Biological Assessment and Evaluation of the Eradication and Control of Invasive Plants

Zhang, X; Xingmei, L; Zhang, M; Dahlgren, RA; Eitzel, M. 2010. A Review of Vegetated Buffers and a Meta-Analysis of their Mitigation Efficacy in Reducing Non-Point Source Pollution. J. Environ. Qual. 39:76–84.

Zielinski, W.J., Truex, R.L., Campbell, L.A., Carroll, C.R., Schlexer, F.V. 2000. Systematic surveys as a basis for the conservation of carnivores in California forests—Progress Report II. 1996-1999. USDA Forest Service, Pacific Southwest Region.

Zeiner, D.C., W. Laudenslayer, Jr., K. Mayer, and M. White (eds.). 1990. California's wildlife, Vol. 3, Mammals. California Department of Fish and Game, Sacramento, CA. 732 pp.

Zielinski, W.J., Kucera, T.E., Barrett, R.H. 1995. Current distribution of the fisher, Martes pennanti, in California. California Fish and Game 81(3): 104-112.

APPENDIX A - BEST MANAGEMENT PRACTICES

APPENDIX B- SITE SPECIFIC SENSITIVE PLANT PROTECTION MEASURES

APPENDIX C - MONITORING PLAN

APPENDIX D – ANNUAL IMPLEMENTATION PROCESS

APPENDIX E - GUIDELINES FOR REVEGETATION

APPENDIX F – ELDORADO NATIONAL FOREST INVASIVE PLANT MANAGEMENT STRATEGY

APPENDIX G – RESPONSE TO COMMENT AND INPUT RECEIVED FROM PUBLIC SCOPING

APPENDIX H – PRIOR PROJECT DECISIONS WITH INVASIVE PLANT TREATMENTS

APPENDIX I – MAPS