CHAPTER 3
Affected Environment and Environmental Consequences

CHAPTER 3: Affected Environment and Environmental Consequences

Chapter 3 of this EIS summarizes the physical, biological, social, and economic environments of the affected project area (existing conditions) and the potential changes to those environments due to implementation of the alternatives discussed in Chapter 2 (alternatives). It also presents the scientific and analytical basis for the comparison of alternatives presented. For ease in presentation and comparison, discussions are separated into individual resource areas, including human health and safety, botany, economic efficiency, soil productivity, water quality, aquatic organisms and habitat, wildlife, congressionally designated areas, and heritage resources.

The focus of the analysis disclosed in each section is on the effects of the No Action and action alternatives on the issues described in Section 1.8. Effects are defined as:

- **Effects:** Adverse and/or beneficial direct effects occur at the same time and in the same general location as the activity causing the effects. Adverse and beneficial indirect effects are those that occur at a different time or location from the activity causing the effects. Both types of effects are described in terms of magnitude, intensity, duration, and timing.

- **Cumulative Effects:** These result from the incremental impacts of the proposed actions/alternatives when added to other past, present, and reasonably foreseeable actions, both on the Forest and Scenic Area as well as other adjacent federal, state, or private lands.

Effects include ecological (i.e., the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative (40 CFR 1508.7 and 1508.8).

3.1. Life of the Project

This project would be implemented over five to 15 years as funding allows. Site-specific conditions are expected to change within this timeframe: treated infestations would be reduced in size, untreated infestations are likely to spread, specific non-target plant or animal species of local interest may change, and/or new invasive plants may become established within the project area. The effects analysis considers a range of possible treatments at each treatment site based on the invasive plant species present as well as a range of site conditions in order to accommodate the uncertainty associated with the project implementation scheduled, including the Early Detection/Rapid Response strategy (EDRR).

Three variables would contribute to the effectiveness of the invasive plant treatments and reductions in infested acres: treatment prescriptions and strategies; the effectiveness of invasive plant management on neighboring lands; and available funding. The treatment prescriptions at each site are not intended to be binding, but treatments would be selected from the range analyzed in order to most effectively treat the invasive plants based on the variables influencing the effectiveness. Annual treatment prescriptions would be based on information gathered through inventory and monitoring. The highest priority areas would be treated first, and newly discovered infestations may be prioritized over existing sites. Treatment methods would be chosen using the process described in Figure 1-4.

3.2. General Existing Conditions

The project area encompasses 1.1 million acres of the Mt. Hood National Forest (Forest) and 292,500 acres of the Columbia River Gorge National Scenic Area (Scenic Area). The treatment sites represent one percent of the total acreage on the Forest and Scenic Area. Seven sites (1,787 acres) are located on the Scenic Area and the remaining sites are located on the Forest. Sixty-two percent of these sites are located on the eastside of the Forest on the Barlow (2,444 acres) and Hood River (5,596 acres) ranger districts, and twenty-four percent of the sites are on the westside on the Clackamas River (1,270 acres) and Zigzag (1,868 acres) ranger districts. These sites are located in Hood River, Clackamas, Multnomah, and Wasco counties.

3.2.1. Treatment Area Site Descriptions

The treatment sites are located in a variety of land allocations and land types. Some infestations are located in congressionally designated areas, including the Mt. Hood Wilderness Area (three sites) and all Wild and Scenic River Corridors. The Scenic Area contains some sites that were previously cultivated for agriculture which are being restored. Approximately 122 acres in seven treatment areas are located within inventoried roadless areas. This includes 33 acres in Big Bend Lake, 77 acres in Mt. Hood Additions, and 12 acres in Wind Creek. The invasive plant treatments do not propose changing any road conditions within the project area.

The majority of treatment sites are located along roads and adjacent to disturbed areas (50 percent). Other dominant treatment sites are located at or along restoration sites (13 percent), recreation residences (nine percent), utility corridors (seven percent) and quarries (five percent) (Table 3-1). The remaining treatment sites include administrative sites, campgrounds, clearings, corrals, hiking trails, harvest units, lakes, landings, ski areas, meadows, and stream-sides. The restoration sites are all located on the Scenic Area. As these site descriptions indicate, the human contributions to invasive plant infestations can be significant. In addition, many of these treatment areas are located within the aquatic influence zone or riparian reserves (see Sections 3.9 and 3.10). The aquatic influence zone is land adjacent to perennial and intermittent streams, rivers, ponds, lakes, springs, and wetlands that has a direct or potentially direct influence on the water body and its function where herbicides may enter surface waters. Riparian reserves are areas along live and intermittent streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Also, special forest products and culturally significant plants could potentially be harvested and collected at these sites as well.

Table 3–1: Acres by Site Description. Approximately 62% of the sites are disturbed areas (roads, quarries, utility corridors), 20% are recreational sites (developed campgrounds, permit areas, recreational residences), 17% are natural/forested areas (clearing, flood plains, meadows, forested sites, plantations), and <1% are administrative sites.

Site Description	Acres	Percent
Developed Campground	168.8	1%
Major Resort/Permit Site	363.3	3%
Quarry	624.7	5%
Utility Corridors	863.2	7%
Recreational trails	963.1	7%
Recreational Residence & Adjacent Areas, including Roads	1,163.6	9%
Scenic Area Restoration Sites	1,640.0	13%
Road and Adjacent Disturbed Area	6,526.8	50%
Total	**12,313.5**	**95%**

Since treatment sites are located across the Forest as well as the Scenic Area, site conditions vary greatly. Annual precipitation varies from 10 to 120 inches per year across at the treatment sites, primarily in the winter months. The minimum distance to water ranges from zero to over 2,000 feet, with the majority of sites ranging from zero to 100 feet (66 percent). The categories of water located within 100 feet of these sites include streams, ponds, wetlands, ditches, springs, and rivers. The average percent slope ranges from zero to 62 percent. The average elevation ranges from 25 to 5,400 feet. The general vegetation type, flora, and fauna present at the treatment sites vary across the sites. More information about the existing conditions at each site can be found in Appendix O.

3.2.2. Invasive Plant Species and Infestations

Each of the treatment sites has invasive plants present that threaten healthy, native communities and function. At least 19 species have been inventoried by USDA Forest Service botanist and noxious weed specialists on the Forest and Scenic Area using inventory and mapping protocols established by the USDA Forest Service under the NRIS Terra Invasive Plant database (USDA Forest Service, 2002). It is likely additional species are present on the Forest and Scenic Area, but have not yet been discovered.

The invasive plants found most frequently in the treatment sites are: diffuse knapweed (33 percent), orange hawkweed (15 percent), spotted knapweed (14 percent), tansy ragwort (13 percent), Himalayan blackberry (12 percent), houndstongue (seven percent), and butter and eggs (two percent).

The most common invasive plants are not necessarily the species of most concern, which have significant ecological consequences and often are difficult to eradicate or control (see Section 3.6 for more details). The species of most concern are: butter and eggs, knotweed species, common hawkweed, meadow hawkweed, orange hawkweed, and yellow star thistle. These species are starting to spread within the Forest and Scenic Area; however, these species are present only in small infestations at the present so they can be treated and eradicated from the Forest and Scenic Area if prompt action is taken. Description of species of most concern follows.

- **Butter and eggs (*Linaria vulgaris*)**: This perennial species, also commonly known as yellow toadflax, typically becomes established in disturbed areas, such as along roads, in quarries, in floodplains, and in overgrazed rangelands. This species is a native of Eurasia and was introduced as an ornamental. Its bright yellow flowers with orange throat and spur is attractive. With its extensive root system, this plant could become very aggressive displacing native plants and could be difficult to control.

  This invasive plant is spread along road-sides, presumably by seed mixed with gravel. The predominant method of dispersal is by wind; the seeds are adapted for wind dispersal with papery circular wings. The other important dispersal mechanism is through underground rhizomes which leads to large, dense populations which tend to take over a site. Typically, one finds a single plant initially, followed by an increasing number of plants nearby rapidly forming a dense population. As the seed heads increase, new outlying populations begin to appear down-wind. A mature plant could produce over half million seeds.

  A similar species, Dalmatian toadflax (*Linaria dalmatica*), is similar and equally problematic.

- **Knotweed species**: Japanese knotweed (*Polygonum cuspidatum*) is currently reported on only five National Forests in the Pacific Northwest Region. The difficulty of control and the high potential for spread is of concern. Similar species of concern that have the potential to invade the Forest and Scenic Area include giant knotweed (*Polygonum sachalinense*) and Himalayan knotweed (*Polygonum polystachyum*).

  Japanese knotweed is native to eastern Asia and was introduced from Japan as an ornamental garden plant in the late 1800s. It is now widely distributed in much of the eastern United States, and occurs in coastal areas of Oregon and Washington. Japanese knotweed is a riparian species that spreads quickly to form dense tall thickets that shade out other species and prevent regeneration of native plants. It reduces species diversity and damages wildlife habitat (Seiger, 1991). Japanese knotweed poses a significant threat to riparian areas where it could survive severe floods and is able to rapidly colonize scoured shores and islands (Alien Plant Working Group, 2004). Once established, populations are extremely persistent.

Rhizomes could regenerate from small fragments. Dispersal could occur naturally when rhizome fragments are washed downstream and deposited on banks, or more commonly, when humans transport soil as fill dirt. Monitoring for the introduction of Japanese knotweed and manually removing the entire plant could prevent establishment. Repeated cutting may control a few individual plants, but the only known method to control larger stands is with repeated application of herbicides (Seiger, 1991). Innovative herbicide applications such as stem injection are being used with success and could mitigate effects to non-target species (Soll, 2004; USDA Forest Service, 2005a).

- **Common hawkweed (*Hieracium vulgatum*), Meadow hawkweed (*Hieracium pratense*) and Orange hawkweed (*Hieracium aurantiacum*)**: The hawkweeds resemble some of our native species, but they come from Eurasia. These invasive species are found along road-sides, trails, meadows, and other disturbed sites. The hawkweeds are perennial with a fibrous root system, milky juice, and the leaves are largely basal. The flowers are variously colored in yellow and red-orange on stems about 12 inches tall. They tend to colonize moist meadow sites or are found in areas with higher rainfall.

  While these species had been rather local in distribution, they have expanded their range dramatically in recent years, infesting some sensitive habitats. One population is known in the Mt. Hood Wilderness Area where it has begun to displace native grasses. Early detection and control of new infestations is important in keeping these species from infesting additional sensitive habitats. At lower elevations, these species have become increasingly widespread along highways and other roads where control is becoming more difficult.

  The hawkweeds reproduce by seeds, stolons, and rhizomes. Extensive stolons create dense mats of hawkweed plants that could eliminate other native flora. It is this tendency that makes this plant very difficult to control and of great concern.

- **Yellow starthistle (*Centaurea solstitialis*)**: Occurrence of yellow starthistle is reported on eight forests in the region, and is rapidly expanding in eastern Oregon. Yellow starthistle is a winter annual that could form dense impenetrable stands that displace desirable vegetation. This species was introduced into North America as a seed contaminant in Chilean-grown alfalfa seed sometime after 1849 (DiTomaso, 2001). In the past 40 years it has spread exponentially throughout the west.

  Yellow starthistle is best adapted to open grasslands with deep well-drained soils and annual precipitation between 10 and 60 inches, but competes successfully in a wide range of habitats (DiTomaso, 2001). It favors sites originally dominated by perennial grasses, primarily bluebunch wheatgrass (*Psuedoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), and Sandberg bluegrass (*Poa secunda*) (Sheley and Petroff, 1999).

  Yellow starthistle displaces native plant communities and reduces plant diversity. It forms solid stands that dramatically reduce forage production for livestock and wildlife. This species causes a fatal neurological disorder when ingested by horses called “chewing disease” (Sheley and Petroff, 1999; USDA Forest Service, 2005a).

3.2.3. Rate of Spread and Mechanism of Invasion

Invasive plant populations increase in acreage at an estimated rate of eight to 12 percent per year on National Forest System lands in the United States (USDA Forest Service, 1999b), which means the invasive plant infestations could continue to spread on the Forest and Scenic Area and on adjacent federal, tribal, county, and state lands. Most of the invasive plant infestations (94 percent of inventoried acreage) are in disturbed areas. The presence of invasive plants is not a new phenomenon. The geographic scope, frequency, and the number of species involved, however, have grown enormously as a direct consequence of expanding transport and commerce, especially in the past 200 years. Invasion occurs when invasive plant species are transported to new, often distant places where they proliferate, spread, and persist. For example, some invasive plants have been accidentally introduced to this country as contaminants among crop seed, ballast in cargo ships, or on other vessels (Mack et al., 2000). The rapid rate of human expansion accounts for a majority of the long-distance dispersal of newly invading species (Grime, 2001; USDA Forest Service, 2005a).

Purposeful and accidental introductions have occurred for centuries, but major introductions have occurred most rapidly over the past century. Introductions of invasive plants for forage (i.e., contaminated livestock feed), ornamental landscaping, road and dune stabilization, and erosion control have occurred throughout National Forest System lands and adjacent lands in Oregon and Washington. Most invasive plants have been introduced for horticultural use by nurseries, botanical gardens, and individuals (Reichard and White, 2001). Commercial landscape nurseries in Oregon and Washington sell, or once sold, exotic species for domestic landscaping that later were found to be invasive (e.g., English ivy, butterfly bush, pampas grass, purple loosestrife). These have spread to federal lands (Whitson, 2001). Invasive plant species have been used in seed mixes on National Forest System lands for erosion control, bank stabilization, and burned area rehabilitation (USDA Forest Service, 2005a).

The mechanisms of spread for invasive plants include natural vectors such as birds, insects, or wildlife, and natural forces, such as water and wind. Wind and water in particular, are major natural dispersal agents. Disturbance-based vectors are also mechanisms of spread for invasive plants. Invasion and dominance by invasive plants is highly correlated with soil disturbance, but are not limited to disturbed areas (Cox, 1999). Invasive plants readily invade, occupy and dominate conifer plantations, road prisms, trails and trailheads, mined sites, gravel pits, river corridors, wildlife wallows and bedding areas, and rangelands. Many invasive species could also establish in naturally occurring small openings. Natural and human induced small-scale and large-scale disturbance create safe sites for invasive plant establishment, and in areas where desirable species are not available to occupy these sites, invasive species could dominate (USDA Forest Service, 2005a).

Ground-disturbing activities on the Forest and Scenic Area include timber harvesting, recreational uses, road building and maintenance, fire suppression activities, grazing, and mining. All of these management activities can alter native plant communities and function, and provide the opportunity for invasive plants to become established and spread, as described in Section 3.1 of the Invasive Plant FEIS (2005a). Many of these activities have contributed to the current invasive plant infestations present on the Forest and Scenic Area, and would continue to contribute to the spread of invasive plants. Prevention standards, specifically the Invasive Plant ROD (2005b) standards (Appendix A) and local prevention standards (Appendix D) are an integral component to reduce the spread and establishment of invasive plant species.

In order to acknowledge the role of management activities, rate of spread was incorporated into the treatment areas (see Table 1-1) as well as in the treatment caps (see Section 1.3 – Proposed Action).The overall treatment cap is 30,000 acres. This includes the known infested treatment areas (13,000 acres), newly inventoried suspected infested areas (13,000 acres), and a one percent rate of unexpected infestations per year for the life of the project, which includes spreading invasive plants through management activities (4,000 acres). For more details, see Section 2.1.3, Subsection Early Detection/Rapid Response strategy.

3.2.4. Ownership Patterns and Herbicide Use on Other Lands

Ownership patterns within the boundaries of the Forest and Scenic Area are predominately National Forest System lands (90 percent). All fifth-field watersheds containing treatment areas have mixed ownership patterns (Appendix P). The Beaver Creek, Lower Clackamas River, Middle Deschutes River, Lower Hood River, and Lower Sandy River watersheds have the highest percentage of other ownerships within watersheds on the Forest and Scenic Area (See Figure 3-1 Map of Ownership Patterns). Two of these watersheds are located on both the Forest and Scenic Area – Lower Hood River and Lower Sandy.

Limited information on invasive plant treatments and herbicide use are known on the other ownership lands in all watersheds. As the mixed ownership indicates, invasive plants could spread from the Forest and Scenic Area to other ownerships and vice versa very easily, which would continue to contribute to the problem of invasive plants. This is the predominant concern in the watersheds located on the Scenic Area, where the ownership is the most mixed: these include the Lower Sandy River, Columbia River Gorge Tributaries, Middle Columbia/Eagle Creek, Middle Columbia/Grays Creek, and Middle Columbia/Mill Creek watersheds.

Five fifth-field watersheds (Upper Clackamas River, Oak Grove Fork Clackamas River, White River, Beaver Creek, and Middle Deschutes River watersheds) contain tribal lands on the Warm Springs Reservation. The Confederated Tribes of Warm Springs and Bureau of Indian Affairs released a Vegetation Management Noxious Weed Control Plan and Assessment (2005) that proposes manual, mechanical, biological, prescribed burning, and herbicide treatments. The plan is designed to treat and control invasive plants on the reservation over the next five years. Estimated amount of herbicide use and acres of invasive plant treatments on the tribal lands are not available.

Figure 3-1. Ownership Patterns in Vicinity of Mt. Hood National Forest and Columbia River Gorge National Scenic Area.

In addition to the tribal lands, the Oregon Department of Agriculture (ODA) and counties have active invasive plant programs. In 2005, ODA applied 15 gallons and 49 pounds of active ingredient of herbicides proposed for use in Multnomah and Clackamas counties; Multnomah County applied 439 gallons; Clackamas County applied 1,010 gallons and 119 pounds of active ingredients; and Hood River County applied 182 gallons. In addition to herbicide treatments, ODA and the counties use approximately one pint of surfactant per gallon of concentrate herbicide (Forney, 2006). Finally, ODA and the counties apply manual, mechanical and cultural treatments on their lands. Also, an orchardist estimated the herbicide use in Hood River County on private orchards to be 3,000 gallons per year. The estimate is based on the assumption that there are two applications of herbicide on orchards per year and that 1 to 1.5 gallons of herbicide are applied per acre over 15,000 acres.

3.3. Herbicides, Adjuvants, Surfactants and Inert Ingredients

The effects from the use of any herbicide or additive depends on the toxic properties (hazards) of that chemical, the level of exposure to that chemical at any given time, and the duration of that exposure. The Invasive Plant FEIS (2005a) used the herbicide risk assessments displayed in Table 3-2 to evaluate the potential for harm to non-target plants, wildlife, human health, soils and aquatic organisms from the herbicides considered for use in this EIS. This section summarizes the known information about herbicides and additives; discusses the risk reduction approach incorporated in the action alternatives and applied in the analysis of environmental impacts; and discloses the uncertainties associated with herbicides and additives. Appendix Q – Herbicide Information Summary and PDC Crosswalk summarizes herbicide characteristics, basic hazard identification, risk characterization, label restrictions and information, and PDC.

3.3.1. Herbicide Risk Assessments

Risk assessments were completed by Syracuse Environmental Research Associates, Inc (SERA) using peer-reviewed articles from the open scientific literature and current U.S. Environmental Protection Agency (EPA) documents, including Confidential Business Information. Information from laboratory and field studies of herbicide toxicity, exposure, and environmental fate was used to estimate the risk of adverse effects to non-target organisms.

The risk assessments considered worst-case scenarios including accidental exposures and application at maximum label rates. The risk assessments represent the best science available. The Invasive Plant FEIS (2005a) added a margin of safety to the SERA Risk Assessments (2001b, 2003a, 2003b, 2003c, 2004a, 2004b, 2004c, 2004d, 2004e, 2004f) by making the thresholds of concern substantially smaller to account for increased caution to federally listed wildlife and fish species. The adjustments varied based on the herbicide and species being analyzed. These adjustments followed the Environmental Protection Agency protocol (EPA, 2004) described in the Invasive Plant FEIS (2005a).

Table 3-2: Risk Assessments for Herbicides Considered in this EIS, including formulations and manufacturers. These risk assessments are available at: http://www.fs.fed.us/r6/invasiveplant-eis/Risk-Assessments/Herbicides-Analyzed-InvPlant-EIS.htm.

Herbicide Name	Formulations	Manufacturer	Date Final	Risk Assessment ID
Chlorsulfuron	Telar® DF	Dupont	November 21, 2004	SERA TR 04-43-18-01c
	Glean	Dupont		
	Corsair ™	Riverdale		
Clopyralid	Transline	Dow AgroSciences	December 5, 2004	SERA TR 04 43-17-03c
Glyphosate	Accord SP	Dow AgroSciences	March 1, 2003	SERA TR 02-43-09-04a
	Aqua Neat	Riverdale		
	Aquamaster	Monsanto		
	Cornerstone Labeled for aquatic use	Agrilliance		
	Credit	Nufarm		
	Credit Systemic	Nufarm		
	Debit TMF	Nufarm		
	Eagre *Aquatic herbicide*	Griffin		
	Foresters *Non-Selective Herbicide* *Labeled for aquatic use*	Riverdale		
	Glyfos	Cheminova		
	Glyfos *Aquatic herbicide*	Cheminova		
	Glyfos Pro *No Surfactant Needed* *Labeled for aquatic use*	Cheminova		
	Glyfos X-TRA	Cheminova		
	Glyphomax	Dow AgroSciences		
	Glyphomax Plus	Dow AgroSciences		
	Glyphosate	DuPont		
	Glyphosate Original	Griffin		
	Glyphosate VMF	DuPont		
	Glypro	Dow AgroSciences		
	Glypro Plus	Dow AgroSciences		
	Honcho	Monsanto		

Herbicide Name	Formulations	Manufacturer	Date Final	Risk Assessment ID
	Mirage	UAP		
	Prosecutor	Lesco		
	Prosecutor Plus Tracker	Lesco		
	Rattler	Helena Chemical Co.		
	Razor	Riverdale		
	Razor SPI	Riverdale		
	Rodeo	Dow AgroSciences		
	Roundup CUSTOM *Labeled for aquatic use*	Monsanto		
	Roundup ORIGINAL	Monsanto		
	Roundup PRO	Monsanto		
	Roundup PRO *Concentrate*	Monsanto		
	Roundup ProDry	Monsanto		
	Roundup UltraDry	Monsanto		
	Roundup ULTRA MAX	Monsanto		
Imazapic	Plateau	Registration transferred to: BASF (C&P Press 2003; BASF 2000, 2001) (Developed by: American Cyanamid (1998c, 2000))	December 23, 2004	SERA TR 04-43-17-04b
	Plateau DG.	Registration transferred to: BASF (C&P Press 2003; BASF 2000, 2001) (Developed by: American Cyanamid (1998c, 2000))		
Imazapyr	Arsenal	Supplied by: BASF (Produced by: American Cyanamid)	December 18, 2004	*SERA TR 04-43-17-05b*
	Arsenal AC	Supplied by: BASF (Produced by: American Cyanamid)		

Herbicide Name	Formulations	Manufacturer	Date Final	Risk Assessment ID
	Chopper	Supplied by: BASF (Produced by: American Cyanamid)		
	Stalker	Supplied by: BASF (Produced by: American Cyanamid)		
	Habitat	BASF		
Metsulfuron methyl	Escort XP	DuPont	December 9, 2004	SERA TR 03-43-17-01b
Picloram	Tordon K	Dow AgroSciences	June 30, 2003	SERA TR 03-43-16-01b
	Tordon 22K	Dow AgroSciences		
Sethoxydim	Poast	BASF	October 31, 2001	SERA TR 01-43-01-01c
Sulfometuron methyl	Oust	DuPont	December 14, 2004	SERA TR 03-43-17-02c
	Oust XP ®	DuPont		
Triclopyr	Forestry Garlon 4 *Specialty Herbicide*	Dow AgroSciences	March 15, 2003	SERA TR 02-43-13-03b
	Garlon 4 *Specialty Herbicide*	Dow AgroSciences		
	Garlon 3A	Dow AgroSciences		
	Pathfinder II *Specialty Herbicide* *Labeled for aquatic use*	Dow AgroSciences		
	Remedy RTU.	Dow AgroSciences		
	Renovate 3 (a.k.a. Triclopyr TEA)	*SePRO Corporation* (Appears to be identical to Garlon 3A)		
NPE (nonylphenol polyethoxylate)	*R-11®*	Wilbur-Ellis Company	May 2003 (October 2003)	USDA Forest Service, R-5

In addition to the analysis of potential hazards to human health from the active ingredients in herbicides, the SERA Risk Assessments (2001b, 2003a, 2003b, 2003c, 2004a, 2004b, 2004c, 2004d, 2004e, 2004f) evaluated available scientific studies of potential hazards of other substances associated with herbicide applications: impurities, metabolites, inert ingredients, and adjuvants. There is usually less toxicity data available for these substances (compared to the active ingredients) because they are not subject to the extensive testing that is required for the active ingredients under FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act).

3.3.2. Herbicide Toxicology Terminology

The following terminology is used throughout this chapter to describe relative toxicity of herbicides proposed for use in the alternatives.

- **Aquatic Label:** Some herbicides are labeled for direct application in water. While no direct application would occur in any alternative for this project, treatment of emergent invasives in standing water or dry stream beds may involve use of such formulations to meet label requirements. Aquatic labeled herbicides are not necessarily less hazardous to aquatic organisms than other herbicides, but have been more extensively tested. Aquatic labeled herbicides would not be favored over effective non-aquatic labeled herbicides that pose lower risk to aquatic organisms, assuming compliance with label advisories (see Section 3.10).

- **Bioaccumulation:** The increase in concentration of a substance in living organisms as they take in contaminated air, water, or food because the substance is very slowly metabolized or excreted (often concentrating in the body fat.)

- **Exposure Scenario:** The mechanism (e.g., dermal, ingestion) by which an organism (e.g., person, animal, fish) may be exposed to herbicides or additives. The application rate and method influences the amount of herbicide to which an organism may be exposed.

- **Hazard Quotient (HQ):** The HQ is the amount of herbicide or additives to which an organism may be exposed divided by the Threshold of Concern. An HQ less than or equal to 1 indicates an extremely low level of risk.

- **Lowest-Observed-Adverse-Effect Level (LOAEL):** The lowest dose of a chemical in a study, or group of studies, that produces statistically or biologically significant increases in frequency or severity of adverse effects between the exposed and control populations.

- **No Observable Adverse Effect Level (NOAEL):** Exposure level at which there are no statistically or biological significant differences in the frequency or severity of any adverse effect in the exposed or control populations.

- **No Observed Effect Concentration (NOEC):** Synonymous with NOEL.

- **No Observed Effect Level (NOEL):** Exposure level at which there are no statistically or biological significant differences in the frequency or severity of any effect in the exposed or control populations.

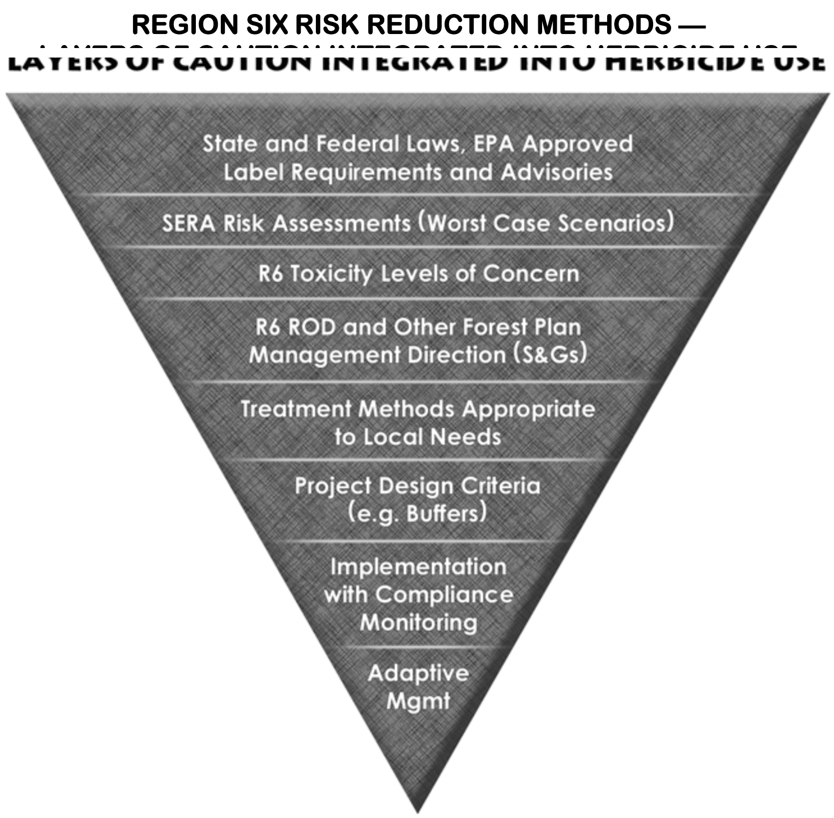
- **Reference Dose (RfD):** The RfD is a numerical estimate of a daily exposure to the human population, including sensitive subgroups such as children, that is not likely to cause harmful effects during a lifetime. RfDs are generally used for health effects that are thought to have a threshold or minimum dose for producing effects.

- **Threshold of Concern:** A level of exposure below which there is a low potential for adverse effects to an organism. This level was made more conservative in the Invasive Plant FEIS (2005a) to add a margin of safety to the risk assessment process.

3.3.3. Risk Reduction Framework

Figure 3-2 displays the layers of caution that are integrated into herbicide use in the USDA Forest Service, Pacific Northwest Region. First, label requirements, federal and state laws, and the EPA approval process provide an initial level of caution regarding herbicide use. Next, the SERA Risk Assessments (2001b, 2003a, 2003b, 2003c, 2004a, 2004b, 2004c, 2004d, 2004e, 2004f) disclosed hazards associated with worst-case herbicide conditions (maximum exposure allowed by the label). The Invasive Plant FEIS (2005a) included an additional margin of safety by reducing the level herbicide exposure considered to be of concern to fish and wildlife. These adjustments followed the Environmental Protection Agency protocol (EPA, 2004) described in the Invasive Plant FEIS (2005a). The Invasive Plant ROD (2005b) adopted standards to minimize or eliminate risks to people and the environment. This EIS is designed to comply with the Invasive Plant ROD standards (2005b). Finally, the PDC further reduce the risks associated with herbicide treatments by eliminating or minimizing as much as possible the impacts to the environment.

Figure 3-2: Layers of Caution Integrated into Herbicide Use
Figure 3-2: Risk Reduction Framework



Adjuvants, Surfactants and Inert Ingredients

Information on adjuvants and surfactants is taken from Analysis of Issues Surrounding the Use of Spray Adjuvants with Herbicides (Bakke, 2003a), Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications (Bakke, 2003b), and Invasive Plant FEIS (2005a). Refer to Appendix R for a list of adjuvants, and surfactants addressed by Bakke (2003a).

3.3.5. Definitions of Chemical Types

- **Adjuvants:** Adjuvants are spraying solution additives that are mixed with an herbicide solution to improve performance of the spray mixture. Adjuvants could either enhance activity of an herbicide's active ingredient (activator adjuvant) or offset any problems associated with spray application, such as adverse water quality or wind (special purpose or utility modifiers). Activator adjuvants include surfactants, wetting agents, sticker-spreaders, and penetrants (Bakke, 2003a).

  Adjuvants are not under the same registration guidelines as pesticides. The EPA does not register or approve the labeling of spray adjuvants. All adjuvants are generally field tested by the manufacturer with several different herbicides against many invasive plants and under different environments (Bakke, 2003a).

- **Surfactants:** Surfactants, or "surface-acting agents", are a broad category of chemicals that are added to herbicides in order to facilitate and enhance their absorbing, emulsifying, dispersing, spreading, sticking, wetting, or penetrating properties. Surfactants are most often used with herbicides to help it spread over and penetrate the waxy cuticle (outer layer) of a leaf or to penetrate through the small hairs present on the leaf surface.

  Most surfactants used with herbicides are "non-ionic", which means they have no electrical charge and are compatible with most pesticides. There are cationic (positive charge) and anionic (negative charge) surfactants, but they are not as commonly used, with the exception of the cationic surfactant in the Roundup formulation of glyphosate. Surfactants have the physical characteristics of both oil and water.

- **Inert Ingredients:** Identified inert ingredients found in herbicide formulations include some relatively innocuous substances, such as distilled water. Effects of inert ingredients are included in the risk assessment for specific herbicide formulations (Invasive Plant FEIS, 2005a).

3.3.6. Nonylphenol Polyethoxylate (NPE)

The primary ingredient in many of the non-ionic surfactants used by the USDA Forest Service when applying herbicides is a compound known as nonylphenol polyethoxylate (NPE). A separate risk assessment (Bakke, 2003b) for NPE surfactants was completed because concerns have been expressed about toxicity of the chemical components and breakdown products of NPE surfactants.

NPE surfactants are appropriate for some applications where the herbicide label requires the addition of a surfactant. NPE surfactants may also improve efficacy in other herbicide applications where addition of a surfactant is optional. In some, but not all of these situations, there are alternative surfactants that would be effective that do not contain NPE (Invasive Plant FEIS, 2005a).

The typical application rate of NPE for USDA Forest Service, Pacific Northwest Region is 1.67 pounds per acre (Invasive Plant FEIS, 2005a). It is estimated that Oregon Department of Agriculture as well as Multnomah, Clackamas, Hood River, and Wasco counties use approximately one pint of surfactant per gallon of concentrate herbicide (Forney, 2006).

3.3.7. Analysis of Adjuvants, Surfactants and Inert Ingredients

The EIS does not estimate the number of acres treated with surfactants, adjuvants or inert ingredients for each alternative because only limited information is available on these chemicals. Additionally, various herbicides potentially could be used at any treatment area, so the adjuvant, surfactants and inert ingredients used may vary. Each resource area evaluated the effects of these chemicals using the information available (see following sections).

Standard #18 from the Invasive Plant ROD (2005b) is designed to avoid, eliminate, or minimize potential effects from implementing herbicide-related treatments. Standard 18 states: "Use only adjuvants (e.g. surfactants, dyes) and inert ingredients reviewed in Forest Service hazard and risk assessment documents such as SERA, 1997a, 1997b; Bakke, 2003b." Also, PDC F.2. restricts the use of NPE near perennial streams, wetlands, lakes, ponds or in road ditches that are hydrologically connected to water bodies, and PDC A.9. limits broadcast spraying of NPE surfactant to less than 0.5 lb a.i./acre.

Surfactants that meet Standard 18 are addressed in various risk assessments by SERA and others (Bakke, 2003b; SERA 1997a, 1997b, 2003b, 2003d) and include NPE-based surfactants, POEA (polyethoxylated tallow amine), Agri-Dex, LI-700, R-11, Latron AG-98, AG surfactants in Glyphosate, and Polyglycol 26-2 in Picloram. Other adjuvants/surfactants addressed by Bakke (2003a) are listed in Appendix R.

3.3.8. Incomplete and Unavailable Information

Risk assessments have a high degree of uncertainty in interpretation and extrapolation of data. Uncertainty may result from a study design, questions asked (and questions avoided), data collection, data interpretation, and extreme variability associated with aggregate effects of natural and synthesized chemicals on organisms, including humans, and with ecological relationships. Due to data gaps, assessments rely heavily on extrapolation from laboratory animal tests (2005a). Regardless of disadvantages and limitations of ecological and human health risk assessments, risk assessments can determine (given a particular set of assumptions) whether there is a basis for asserting that a particular adverse effect is possible. The bottom line for all risk analyses is that absolute safety can never be proven and the absence of risk can never be guaranteed (SERA, 2001).

Further, a risk assessment has only been completed on one surfactant type (NPE) (Bakke, 2003b). Limited information on other surfactants, adjuvants, and inert ingredients is available in Bakke (2003a) and various risk assessments. Since risk assessments have not been completed for the surfactants, adjuvants and inert ingredients, information regarding the toxicity and effects of these chemicals is largely unavailable.

For risk assessments considering adjuvants, surfactants and inert ingredients in herbicide mixtures, the information within the risk assessment may not be complete. SERA (2001b) discusses how the risk assessments apply generally accepted scientific and regulatory methodologies to encompass these uncertainties in predictions of risk. SERA risk assessments identify and evaluate incomplete and unavailable information that is potentially relevant to human health and ecological risks. Each risk assessment identifies and evaluates missing information for that particular herbicide and its relevance to risk estimate. Such missing information may involve any of the three elements needed for risk assessments: hazard, exposure, or dose-response relationships. A peer-review panel of subject matter experts reviewed the assumptions, methodologies and analysis of significance of any such missing information. SERA addresses and incorporates the findings of this peer review in its final herbicide risk assessment.

3.4. Basis of Cumulative Effects Analysis

Cumulative effects result from the incremental impacts of any alternative when added to other past, present and reasonably foreseeable actions, both on the Forest and Scenic Area and other adjacent federal, state or private lands (40 CFR 1508.7). The cumulative effects considered in this EIS are related to the risks to the environment and human health associated with herbicides or other invasive plant treatments. Table 3-3 defines the baseline, spatial scale, temportal scale, applicable PDC, and desired condition that serve as the basis for cumulative effects analysis for each resource area.

Additionally, where appropriate, the potential for synergistic effects (where exposure to a combination of two or more chemicals could result in impacts that are greater than the sum of the effects of each chemical alone) were considered. Combinations of herbicides in low doses (less than one-tenth of the reference dose (RfD) have rarely demonstrated synergistic effects. Review of the scientific literature on toxicological effects and toxicological interactions of agricultural herbicides indicate that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects (ATSDR, 2004). Based on the limited data available on herbicide combinations involving the 10 herbicides considered in this EIS, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis. Synergistic or additive effects, if any, are expected to be insignificant. More information on this topic is included in Section 3.5 – Human Health and Safety.

Table 3-3: Cumulative Effects Information. Includes baseline conditions, spatial scale and temporal scale, for human health; botany and treatment effectiveness; economic efficiency; soil productivity; water quality; aquatic organisms and habitat; and wildlife resource areas.

Resource Area	Baseline (Existing Condition)	Spatial Scale	Temporal Scale	Applicable Project Design Criteria	Summary of Effects	Desired Condition
Human Health Section 3.5	No known threats to human health from current and past invasive plant treatments, including herbicide use.	Direct and indirect effects are limited to the immediate area (within 100-feet) from application site.	People may be exposed to herbicides in a chronic manner (e.g., applicators) or through multiple exposure mechanisms, such as breath, skin, and ingestion of contaminated meat, mushrooms or fruit.	D.1 – Personal Protective Equipment D.2 thru D.6 – Notification D.7 – Drinking water Intake	No acute or chronic exposures of concern. PDC increase the margin of safety to reduce potential exposures.	No increased risk to human health, as indicated by risk assessments.
Botany Section 3.6	No known threats from current or past invasive plant treatments, including herbicide use, to special status botanical species. Invasive plants threaten native plant communities and special status species.	Direct and indirect effects to native plant communities are analyzed at regional scale, which includes Oregon and Washington States. Direct and indirect effects to special status species are analyzed at the treatment area scale.	The life of the project is 5 to 15 years; the analysis assumes 15 years.	E.1 thru E.4 – Botanical Buffers E.5. – Preventing Reinfestation E.6. – Sample Sites	PDC, including the botanical buffers, reduce the risk to non-target vegetation. Buffers would be increase or other changes made if non-target effects are noted beyond the expected area.	No adverse effects from proposed treatments to special status species. No tend in plants towards becoming a special status species.

Resource Area	Baseline (Existing Condition)	Spatial Scale	Temporal Scale	Applicable Project Design Criteria	Summary of Effects	Desired Condition
Economic Efficiency Section 3.7	Some cost-effective treatment options (primarily herbicide treatments) are not available under the No Action Alternative. Invasive plants have an enormous economic impact on Oregon's economy and natural resources.	Direct and indirect effects are analyzed at regional scale, which includes Oregon and Washington States.	The life of the project is 5 to 15 years; the analysis assumes 15 years.	No specific PDC.	The treatment cost per acre varies from $194 for the No Action Alternative to $541 for the Restricted Herbicide Use Alternative. The Proposed Action would cost $324 per acre.	Implement economically efficient invasive plant treatments.
Soil Productivity Section 3.8	The soils in the proposed treatment areas are of relatively low fertility and once disturbed tend to be invaded by invasive plant species. No evidence that invasive plant treatments have resulted in loss of soil productivity. Invasive plant threaten to change soil characteristics over time, including erosion hazard and soil organisms.	Direct and indirect effects are analyzed at the treatment area scale within the Forest and Scenic Area.	The life of the project is 5 to 15 years; the analysis assumes 15 years.	G.1 thru G.4 – Herbicide Application G.5 – Equipment G.6 – Erosion Control Devices I.1 and I.2 – Site Restoration	PDC minimize or eliminate risk to soil productivity. The project would not contribute to significant cumulative effects at any scale.	No loss of soil productivity proposed invasive plant treatments.

Resource Area	Baseline (Existing Condition)	Spatial Scale	Temporal Scale	Applicable Project Design Criteria	Summary of Effects	Desired Condition
Water Quality Section 3.9	No evidence that pat or existing invasive plant treatment, including herbicide use, has resulted in a loss of water quality. Invasive plants may result in loss of functional riparian communities, loss of rooting strength and protection against erosion, decreasing slope stability and increasing sediment introduction into streams, and impacts on water quality.	Direct and indirect effects are analyzed at 5th field watershed scale. Additional considerations are discussed within the aquatic influence zone and riparian reserves. An aquatic influence zone is land adjacent to perennial and intermittent streams, rivers, ponds, lakes, springs, and wetlands that have a direct or potentially direct influence on the water body and its function where herbicides may enter surface waters; this zone has a default width of 100 feet.	The life of the project is 5 to 15 years; the analysis assumes 15 years.	B.6, B.7 and B.9 – Treatments near Water B.8 – Water Travel F.1 – Buffers F.2 – Surfactants F.3 – Wetlands F.4 – In-Water Guidelines	PDC, including aquatic buffers, minimize or eliminate risk to water quality, including drinking water and beneficial uses, at any scale.	No adverse effects from proposed invasive plant treatments on streams and water. No streams within analysis area becoming listed for chemical contamination under Section 303(d) of the Clean Water Act on the Department of Environmental Quality (DEQ) 2002 303(d) list.

Resource Area	Baseline (Existing Condition)	Spatial Scale	Temporal Scale	Applicable Project Design Criteria	Summary of Effects	Desired Condition
Aquatic Organisms and Habitat Section 3.10	There are over 1,600 miles of fish-bearing streams on the Forest, with approximately 300 miles supporting anadromous populations of salmon and steelhead. In the Scenic Area, there are 60 miles of fish bearing stream, with 17 miles supporting anadromous species. All these miles of streams have riparian habitat that might be impacted by invasive plants. No evidence that past invasive plant treatments, including herbicides, have harmed aquatic ecosystem.	Direct and indirect effects are analyzed at 5th field watershed scale. Additional considerations are discussed within the aquatic influence zone and riparian reserves. An aquatic influence zone is land adjacent to perennial and intermittent streams, rivers, ponds, lakes, springs, and wetlands that have a direct or potentially direct influence on the water body and its function where herbicides may enter surface waters; this zone has a default width of 100 feet.	The life of the project is 5 to 15 years; the analysis assumes 15 years.	F.1 – Buffers F.2 – Surfactants F.4 – In-Water Guidelines	Persistent herbicides posing risks to aquatic organisms would not be used in the aquatic influence zone. PDC, including the aquatic buffers, minimize or eliminate risk to aquatic organisms and habitat at any scale.	No adverse effects from proposed invasive plants treatments on aquatic organisms or habitats. No trend towards listing special status fish species.

Resource Area	Baseline (Existing Condition)	Spatial Scale	Temporal Scale	Applicable Project Design Criteria	Summary of Effects	Desired Condition
Wildlife Section 3.11	Wildlife specials status species, including Pacific Northwest Regional Forester's sensitive species, survey and manage species, Forest Plan management indicator species, and landbirds listed as Partners in Flight focal species, occur within or travel through the proposed treatment areas. Northern Spotted Owl and Northern Bald Eagle are threatened wildlife species. No evidence that past invasive plant treatments, including herbicides, have harmed wildlife species.	Direct and indirect effects are analyzed at the Forest and Scenic Area scale.	The life of the project is 5 to 15 years; the analysis assumes 15 years.	H.1 – Bald Eagle H.2 – Salamanders and mollusks H.3 – Larch Mountain Salamanders	PDC minimize or eliminate risk to wildlife species at all scales.	No adverse effects from proposed invasive plant treatments on individual animals or habitat. No trend towards listing of special status wildlife species.

The risk of adverse effects of invasive plant treatments in all action alternatives has been minimized or eliminated by the PDC described in Section 2.2. This limits, but does not exclude, the likelihood of cumulative adverse effects from treatment. The proposed use of herbicides on and off the Forest and Scenic Area could result in additive doses of herbicides to workers, the general public, non-target plant species, aquatic species, and/or wildlife species. For additive doses to occur, the two exposures would have to occur closely together in time, since the herbicides proposed for use are rapidly eliminated from humans and do not significantly bioaccumulate (Invasive Plant FEIS, 2005a). The application rates and extent considered in this EIS are unlikely to result in additive doses beyond those evaluated for chronic and acute exposures in the USDA Forest Service risk assessments, which formed the basis for the effects analysis in the Invasive Plant FEIS (2005a). The Invasive Plant FEIS (2005a), in return, served as the basis for the site-specific effects analysis discussed in this EIS.

Herbicides are commonly applied on lands other than the Forest and Scenic Area for a variety of agricultural, landscaping and invasive plant management purposes. Herbicide use occurs on tribal lands, state and county lands, private forestry lands, rangelands, utility corridors, road rights-of-way, and private property. No central source exists for compiling invasive plant management information off National Forests System lands within Oregon. There is no requirement for private or corporate land owners, or counties to report invasive plant treatment information, thus an accurate accounting of the total acreage of invasive plant treatment for all land ownerships is unavailable.

Only the land and roads within the National Forest System would be treated in the action alternatives. The Forest and especially Scenic Area, however, are intermingled with other federal, state, county, and private ownerships as discussed in Section 3.2.4 and Appendix M. Management activities and actions on neighboring lands may contribute to spread or containment of invasive plants on the Forest and Scenic Area and vice versa. The effectiveness of the proposed invasive plant treatments would be increased if adjacent landowners were also treating invasive plant infestations. Many adjacent land owners are taking action to decrease the spread of invasive plants (see Section 3.2.4 – Ownership Patterns and Herbicide Use on Other Lands). The cumulative effects analysis assumes that adjacent lands are effectively treated in cooperation with this project, which would decrease the spread of invasive plants on adjacent lands. In addition, the cumulative effects analysis assumes the release of biological control agents on the Forest and Scenic Area and adjacent lands by the Oregon Department of Agriculture, as analyzed by APHIS, would continue to reduce the invasive plant infestations in Oregon and decrease the spread of invasive plants.

Although it is difficult to estimate, the Invasive Plant FEIS (2005a) estimated that invasive plant control occurs on over 1.25 million acres in Oregon and Washington and greater than 90 percent of this control is through the use of herbicides. Even the highest use estimates of herbicide use on the National Forest System lands would amount to less than three percent of the estimated total acres treated with herbicides in Oregon and Washington (page 4-1, Invasive Plant FEIS, 2005a). Although limited information is available, complete information is not available to estimates for the area adjacent to the Forest and Scenic Area. This information is considered in the cumulative effects analysis for each resource area in conjunction with the herbicide use information presented in Section 3.2.4 – Ownership Patters and Herbicide Use on Other Lands.

Further, the cumulative effects analysis assumes that the Invasive Plant ROD (2005b) prevention standards (Appendix A) and the Forest and Scenic Area prevention standards (Appendix D) are properly implemented and effective. The prevention standards will be monitored as required by the Invasive Plant ROD (2005b). This analysis assumes that the monitoring would effectively identify where the prevention standards are not working, and the prevention standards would be adapted as needed.

Finally, the analysis assumes other planning projects, as required by Invasive Plant ROD (2005b) Standard 1, are considering the impacts on the establishment and spread of invasive plants. Specifically, Standard 1 requires all watershed analysis, roads analysis, fire and fuels management plans, Burned Area Emergency Recovery Plans, emergency wildland fire situation analysis, wildland fire implementation plans, grazing allotment management plans, recreation management plans, vegetation management plans, and other land management assessments to consider invasive plant prevention.

3.5. Human Health and Safety

3.5.1. Introduction

This section focuses on the health effects to workers and the public if herbicides are used as proposed in the alternatives. The Invasive Plant FEIS (2005a) and its Appendix Q: Human Health Risk Assessment detailed the potential for health effects from the use of the herbicides proposed for this project. Herbicide active ingredients, metabolites, inert ingredients, and adjuvants and people with particular herbicide sensitivity were addressed. The Invasive Plant ROD (2005b) adopted standards to minimize herbicide exposures of concern to workers and the public based on the human health risk assessments. Herbicides are an important component of the integrated weed management methods needed to meet the purpose and need for this project.

Site-specific PDC were developed to further minimize or eliminate exposures of concern to workers and the public plausible given the regional standards. The PDC ensure that herbicides and surfactants are used in rates low enough, or methods selective enough, to avoid exposures of concern.

The Invasive Plant FEIS (2005a) evaluated human health risks from herbicide and non-herbicide invasive plant treatment methods. Hazards normally encountered while working in the woods (strains, sprains, falls, etc) are possible during herbicide and non-herbicide invasive plant treatment operations. Such hazards are mitigated through worker compliance with occupational health and safety standards and, as such, are not analyzed again here.

Many people express concern about the effects of herbicides on human heath. Workers and the public may be exposed to herbicides used to treat invasive plants under all alternatives in this project; however, no exposures exceeding a threshold of concern are predicted. This conclusion is based on facts about chemistry of the herbicides considered for use and the mechanisms by which exposures of concern might occur. Scientific risk assessments do not indicate that any person would be adversely affected in any way by these herbicides used in the manner proposed for this project. This applies to all alternatives. More information on municipal watershed is available in Section 3.9 – Water Quality and more information on special forest products is available in Section 3.14 – Tribal Relations, Civil Rights and Environmental Justice.

3.5.2. Existing Conditions

Many people live near, spend time, work in, drink water from, or depend on forest products from the Forest and Scenic Area. Municipal watersheds, dispersed and developed recreation areas (trailheads, campgrounds, picnic areas, recreation sites, boat ramps, ski areas, work centers, etc) and special forest product collection areas currently occur in the vicinity of invasive plant sites.

3.5.3. Methodology

The following section tiers to the Invasive Plant FEIS (2005a), which relied on professional risk assessments completed by Syracuse Environmental Research Associates, Inc (SERA 2001b, 2003a, 2003b, 2003c, 2004a, 2004b, 2004c, 2004d, 2004e, 2004f). SERA based the assessments on peer-reviewed articles from the open scientific literature and current EPA documents, including Confidential Business Information. The risk assessments were done according to protocols that are accepted by the scientific community (NRC, 1983; EPA, 1987).

The basis for risk assessments consists of the following parts:

- **Hazard Characterization:** What are the dangers inherent with the chemical?
- **Exposure Assessment:** Who gets what and how much?
- **Dose Response Assessment:** How much is too much?
- **Risk Characterization:** Indicates whether or not there is a plausible basis for concern.

The integration of the exposure rate and dose response assessments characterize the risk for a particular herbicide. For example, the inherent hazard of the chemical (known to cause liver damage) may be discounted if the exposure and dose are below a no observable adverse effect level (NOAEL) and no liver damage results.

Herbicide formulations may contain additional compounds besides the herbicide active ingredient; these are termed impurities or inert ingredients. Other additives, called adjuvants and surfactants, may be mixed with the diluted formulation before spraying to either enhance the herbicide activity or to modify undesirable properties of the spray mixture. Additionally, when organisms in the environment internalize chemical herbicide formulation in their physiologic systems, they may transform them into other compounds called metabolites. Of these categories of substances, only the NPE group of surfactants has been tested and data produced that identify specific and quantifiable hazards to human health (Bakke, 2004). See Section 3.3 – Herbicides, Adjuvants, Surfactants and Inert Ingredients for more information on these chemicals.

The following terminology is used throughout this section and proceeding sections to describe relative toxicity of herbicides proposed for use in the alternatives.

- **Exposure Scenario:** The mechanism by which a person 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. This level was made more conservative in the Invasive Plant FEIS (2005a) to add a margin of safety to the risk assessment process.

- **Hazard Quotient (HQ):** The Hazard Quotient (HQ) is the amount of herbicide or additives to which an organism may be exposed divided by the exposure threshold of concern. An HQ less than or equal to 1 is indicates an extremely low level of risk. A HQ below 1 indicates a level below a threshold of concern. Invasive plant treatments pose potential risks to human health. This section focuses on plausible effects to people from herbicide exposure through direct contact, drinking contaminated water, and/or eating contaminated food (fish, berries, and mushrooms).

3.5.4. Direct and Indirect Effects

3.5.4.1. Worker Herbicide Exposure Analysis

Herbicide applicators are more likely than the general public to be exposed to herbicides. Worker exposure is influenced by the application rate selected for the herbicide; the number of hours worked per day; the acres treated per hour; and variability in human dermal absorption rates. Appendix Q: Human Health Risk Assessment in the Invasive Plant FEIS (2005a) displayed HQ values for typical and maximum label rates under a range of conditions. Four potential exposure levels were evaluated for workers, ranging from predicted average exposure (typical application rate-typical exposure variables) to a worst-case predicted exposure (maximum application rate-maximum exposure variables).

In routine broadcast and spot applications, workers may contact and internalize herbicides mainly through exposed skin, but also through the mouth, nose or lungs. Contact with herbicide formulations may irritate eyes or skin.

The ten herbicides proposed for use under Alternatives 2 and 3, used at rates and methods consistent with PDC, have little potential to harm a human being. Appendix Q of the Invasive Plant FEIS (2005a) lists the HQ values for all herbicides considered for this project. In most cases, even when maximum rates and exposures are considered, HQ values were below the threshold of concern (HQ values ranged from 0.01 to 1).

Risk assessments indicate concern for worker exposure to triclopyr, especially the Garlon 4 formulation. This is one reason why broadcast application of triclopyr is not allowed under Invasive Plant ROD (2005b) Standard 16. Despite this limitation, a potential worst-case scenario exists exceeding a level of concern for workers given a backpack (spot) application of the Garlon 4 formulation of triclopyr. PDC eliminate this scenario by favoring use of Garlon 3A, minimizing application rates of all triclopyr formulations, and following safe work practices and label advisories.

For all other herbicides and surfactants, the amount of plausible worker exposure is below levels of concern for all application methods, including broadcast. PDC for all action alternatives reduce both the application rate and the quantity of drift if triclopyr and/or NPE are used. Broadcast of triclopyr is not permitted in any situation (as per the Invasive Plant ROD (2006b), and non-NPE surfactants would always be favored where effective.

Chronic (daily over a period of time) worker exposure also was considered in SERA Risk Assessments (2001b, 2003a, 2003b, 2003c, 2004a, 2004b, 2004c, 2004d, 2004e, 2004f). Chronic exposures do not amount to levels of concern because the herbicide ingredients are water-soluble and are not retained in the body (they are rapidly eliminated).

3.5.4.2. Public Herbicide Exposure Analysis – Direct Contact, Special Forest Products, Drinking Water, and Endocrine Disruption

The general public would not be exposed to substantial levels of any herbicides used in the implementation of this project. Appendix Q of the Invasive Plant FEIS (2005a) considered plausible direct, acute and chronic exposures from herbicide ingredients. Few plausible scenarios exist that exceed even the most conservative threshold of concern for public health and safety. Appendix Q shows Risk Assessment results assuming a human being contacts sprayed vegetation or herbicide or consumes sprayed vegetation, contaminated water, and/or fish.

Direct Contact

There is virtually no chance of a person being directly sprayed given broadcast, spot and hand/select methods considered for this project. A person could brush up against sprayed vegetation soon after herbicide is applied. Such contact is unlikely because public exposure would be discouraged during and after herbicide application. For all herbicides, except triclopyr, even if a person were directly sprayed with herbicide applied at typical broadcast rates, chemical exposure would not exceed a level of concern.

Exposures exceeding a conservative level of concern could occur if a person accidentally contacts vegetation spot-sprayed with triclopyr (especially Garlon 4). Such contact, however, is implausible because no broadcast spraying with triclopyr would occur under any alternative, as per Standard 16 in the Invasive Plant ROD (2005b).

The use of Garlon 4 is further limited by the PDC (for instance, no use of Garlon 4 would be allowed within 150 feet of any water body or stream channel; Garlon 4 would be avoided in special forest product gathering areas, campgrounds, or administrative sites). Gathering areas, campgrounds and administrative sites may be closed immediately after triclopyr application to eliminate accidental exposures.

Eating Contaminated Special Forest Products

The public may be exposed to herbicide if they eat contaminated fish, berries or mushrooms, etc. Members of the public could eat invasive blackberries that have been sprayed; however, the target vegetation would quickly be browned and unappetizing. Non-target, native berries or mushrooms may be affected by drift or runoff. Several exposure scenarios for recreational and subsistence fish consumption were considered in the SERA Risk Assessments; none are near any herbicide exposure level of concern. Fish contamination is unlikely given the PDC that reduce potential herbicide delivery to water.

The Invasive Plant FEIS (2005a) considered exposure scenarios for both short term and chronic consumption of contaminated berries. The herbicide dose from eating a quantity of mushrooms would be greater than for the same quantity of berries (Durkin and Durkin, 2005). The dose, however, would be less than the dose from a dermal contact with sprayed vegetation scenario and thus, below the threshold of concern (HQ <1).

Appendix Q (USDA Forest Service, 2005a) displayed the exposure scenarios and HQ values associated with eating berries or other herbicide contact. Of the ten herbicides considered in this project, triclopyr remains the single herbicide with exposure scenarios exceeding a level of concern if berries or mushrooms containing herbicide residue are consumed. The PDC limit the application methods and rate of application for triclopyr, especially Garlon 4, addresses this concern. In addition, under worst-case scenarios and maximum label rates, exposure to NPE surfactant also may exceed a level of concern. Thus PDC limit the rate of NPE that may be applied. Special forest product gathering areas may be closed to public use immediately after triclopyr application to avoid inadvertent exposure.

People who both harvest and consume special forest products may be exposed both through handling contaminated plant material and chewing or eating it. Chewing and eating contaminated plant material cause different exposure and dose patterns. Such doses would be additive, but are unlikely to exceed a threshold of concern (see cumulative effects discussion below).

Drinking Contaminated Water

Acute exposures and longer-term or chronic exposures from direct contact or consumption of water, fruit or fish following herbicide application were evaluated in the Invasive Plant FEIS (2005a). Risks from two hypothetical drinking water sources were evaluated: 1) a stream, into which herbicide residues have contaminated by runoff or leaching from an adjacent herbicide application; and 2) a pond, into which the contents of a 200-gallon tanker truck that contains herbicide solution is spilled.

The only herbicide scenarios of concern would involve a person drinking from a pond contaminated by a spill of a large tank of herbicide solution. The risk of a major accidental spill is not linked in a cause-and-effect relationship to how much treatment of invasive plants is projected for a particular herbicide; a spill is a random event. A spill could happen whenever a tank truck involved in an herbicide operation passes a body of water. The potential risk of human health effects from large herbicide spills into drinking water are mitigated by PDC that require an Herbicide Transportation and Handling Plan be developed as part of all project safety planning, with detailed spill prevention and remediation measures to be adopted.

Endocrine Disruption

In 2007, the Environmental Protection Agency released a draft list of 73 pesticides, based on the high potential for human exposure that will be tested for potential to cause endocrine disruption. Glyphosate is the only herbicide considered for use on the Forest and Scenic Area that is included in the EPA testing. Endocrine disruption and glyphosate was studied by SERA in 2002 (SERA 2002), and considered in the Invasive Plant FEIS (2005a) and Appendix Q of that document.

SERA reported: "Three specific tests on the potential effects of glyphosate on the endocrine system have been conducted and all of these tests reported no effects. The conclusion that glyphosate is not an endocrine disruptor is reinforced by epidemiological studies that have examined relationships between occupational farm exposures to glyphosate formulations and risk of spontaneous miscarriage, fecundity, sperm quality, and serum reproductive hormone concentrations… the approach taken in the SERA risk assessment used by the Forest Service is highly conservative and no recent information has been encountered suggesting that this risk assessment is not adequately protective of any reproductive effects that might be associated with glyphosate exposure."

3.5.5. Comparison of Risks of Human Health Effects among Alternatives Considered In Detail

The expected array of potential treatment methods for every site is displayed in Appendices G – Site and Treatment Information and H – Proposed Herbicide Use at Sites in the Proposed Action.

Alternative 1 – No Action Alternative

The No Action Alternative (Alternative 1) continues current invasive plant management programs occurring under existing NEPA. The amount and proportion of invasive plant treatments by manual, mechanical, cultural, and herbicide treatment methods would remain approximately constant to recent historic practices. All herbicide applications for invasive plant treatments considered in No Action were previously analyzed and found to pose no significant potential risks to health for workers or the public as proposed, including relevant PDC identified in the associated Environmental Assessments and Environmental Impact Statement.

Alternative 2 – Proposed Action

No individual worker or public exposures of concern are predicted in Alternative 2. PDC, including limitations on herbicide use in Aquatic Influence Zones and limitations on application rate of some herbicide ingredients, eliminate plausible exposures of concern. No adverse effects to public drinking water supplies or health and safety are predicted. Table 3-4 below summarizes how PDC minimize exposures of concern.

Since the EDRR would apply PDC as appropriate, the effects would be similar to those discussed here for Alternative 2.

Alternative 3 – Restricted Herbicide Use

No individual worker or public exposures of concern are predicted in Alternative 3. As in Alternative 2, PDC eliminate any plausible herbicide exposures of concern. No adverse effects to public drinking water supplies or health and safety are predicted. Since the EDRR would apply PDC as appropriate, the effects would be similar to those discussed here for Alternative 3.

Table 3-4: Project Design Criteria to Minimize Exposures of Concern.

	Project Design Criteria to Minimize Exposures of Concern
Workers	Typical application rates of herbicides (PDC A.8. and A.9); limitations on broadcast of triclopyr as per Invasive Plant ROD Standard 16 (2005b). Wearing personal protective equipment (PDC D.1.).
Public	Typical application rates of herbicides (PDC A.8. and A.9); limitations on broadcast of triclopyr as per Invasive Plant ROD Standard 16 (2005b). These limitations reduce risks to the general public, even considering multiple exposures.
Special Forest Projects	Typical application rates of herbicides (PDC A.8. and A.9); posting areas (PDC D.2.), supplying information to public (PDC D.3.); Using flagging to mark treated areas (PDC D.6). Detectable impacts are implausible except in the event of an unpredictable exposure. Even multiple exposures (eating contaminated fish, drinking contaminated water, skin irritation) would not result in exposure levels of concern.
Drinking Water	Typical application rates of herbicides (PDC A.8. and A.9); Transportation and Handling Safety Plan and Spill Plan (PDC B.3.). Detectable impacts are implausible except in the event of a spill.

3.5.6. Cumulative Effects

While workers, and the public, may be exposed to herbicides within and outside the Forest and Scenic Area, multiple exposures do not necessarily equate to cumulative adverse effects. The herbicides proposed for use are water-soluble, are rapidly eliminated from humans and do not concentrate in fatty tissues and do not significantly bioaccumulate (2005a). Further, the PDC limit the mechanisms by which workers and the public may be exposed to herbicides. The PDC were developed considering the risks and properties of the herbicides proposed for use. The PDC ensure that chronic (long-term) and acute (short-term) herbicide exposures would not exceed thresholds of concern and sufficiently minimize risks to compensate for uncertainty about the impacts of herbicide use on neighboring lands.

Cumulative effects were analyzed in the Invasive Plant FEIS (2005a) and are briefly summarized below.

A person could be exposed to herbicide repeatedly over the course of their lifetime and exposure may occur any place that herbicides are used. Appendix Q (USDA Forest Service, 2005a) evaluated chronic exposure scenarios, including repeated drinking of contaminated water, repeated consumption of contaminated berries, and repeated consumption of contaminated fish over a 90 day period. The HQ values for chronic exposures of all herbicides considered for this project are below 1.

A person could be exposed to herbicides by more than one scenario, for instance, a person handling, and then consuming sprayed berries. The cumulative impact of such cases may be quantitatively characterized by adding the HQ values for each individual exposure scenario. An example of this scenario was considered for this cumulative effects analysis: the scenario assumes glyphosate contacts a person's bare skin (HQ for dermal exposure is less than 0.01)[1], and that person immediately eats contaminated berries and fish (HQ values for oral exposure are less than 0.01). Even if these three exposures occurred simultaneously, the combined HQ values are still far below a threshold of concern (HQ < 1).

Some of the herbicides considered for use in this project have HQ values greater than glyphosate; however, the combined HQ values for dermal and oral exposure are still likely to be very low. The body would metabolize some of the initial dose before receiving the second dose, thus reducing the cumulative dose. The risk of adverse effects to human health is low because the herbicides proposed for this project are water-soluble, are quickly eliminated from the body, and do not bioaccumulate. All alternatives comply with standards, policies and laws aimed at protecting worker safety and public health.

3.5.7. Management Standards and Guidelines

Relevant standards and guidelines contained in the Forest Plan and the Northwest Forest Plan are displayed in Appendix B of this document; relevant standards contained in the Scenic Area Management Plan are displayed in Appendix C. This analysis exhibits that the Proposed Action and Restricted Herbicide Use Alternatives are consistent with all relevant standards and guidelines, when the proposed amendments are incorporated. The Forest Plan amendments are discussed in Section 3.16.

---

[1] See Appendix Q of the Invasive Plant FEIS (2005a) for details about each scenario.

3.5.8. Incomplete or Unavailable Information

SERA Risk Assessments (2001b, 2003a, 2003b, 2003c, 2004a, 2004b, 2004c, 2004d, 2004e, 2004f) identify and evaluate incomplete and unavailable information that is potentially relevant to human health effects resulting from herbicide use in the alternatives. Information is necessarily incomplete on potential toxic doses of most herbicides in human, and on the variation in dose-response among individuals in the human population. *Preparation of Environmental Documentation of Risk Assessments* (SERA, 2001a) discusses the generally accepted scientific and regulatory methodologies to encompass these uncertainties in predictions of risk.

3.6. Botany and Treatment Effectiveness

3.6.1. Existing Conditions

An invasive plant can be defined as "a species that demonstrates rapid growth and spread, invades habitats, and displaces other species. Species that are prolific seed producers, have high seed germination rates, [are] easily propagated asexually by root or stem fragments, and/or rapidly mature predispose a plant to being an invasive…Alien species that are predisposed to invasiveness have the added advantage of being relatively free from predators (herbivores, parasites, and disease) and can, therefore, expend more energy for growth and reproduction" (NCRS, 1999). "Invasive weeds are plants that have been introduced into an environment outside of their native range. In their new environment, they have few or no natural enemies to limit their reproduction and spread (Anonymous, 2002). Invasive weeds affect us all—farmers, homeowners, taxpayers, consumers, and tourists" (OSU Extension Service, 2003). Usually, invasive plants are non-native (exotic) species although in some instances even native species may become invasive or expansive due to changes (e.g., fire suppression, nutrient enrichment/pollution) introduced in their environment. From a broad ecological standpoint, invasive plants alter native plant communities and ecosystems, cause a loss in biological diversity of plants and animals (loss of habitat and food), lead to ecosystem-level changes that affect soil and water, and at the landscape scale can even displace entire native communities with monocultures (e.g., yellow star thistle, gorse, cheatgrass, medusahead rye).

Invasive plants affect a variety of native plant communities that occur within the Forest and Scenic Area. Native plant communities on the west side of the crest of the Cascade Range, for the most part, consist of dense, moist forests of western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), Pacific silver fir (*Abies amabilis*), western red cedar (*Thuja plicata*), and mountain hemlock (*Tsuga mertensiana*). On a broad scale, the diversity of forested plant communities in the western and eastern Cascade Range can be grouped into a handful of major vegetation zones that are determined largely by environmental gradients in temperature and moisture (i.e., climate) resulting from elevation change and maritime influence. Each vegetation zone is named after the dominant reproducing tree species for that zone. On the westside, for example, the western hemlock zone dominates lower elevations--less than 2,000 to 3,000 feet.

Above roughly 3,000 to 4,500 feet in elevation, occupying a cooler and moister climate, lies the Pacific silver fir zone. Above this zone at still higher elevations, roughly 4,500 to 6,000 feet, lies the mountain hemlock zone. And above this zone lies the subalpine and alpine zones with subalpine fir (*Abies lasiocarpa*), whitebark pine (*Pinus albicaulis*), and treeless environments above timberline.

The same dominant vegetation zones occur as well on the east side of the crest of the Cascade Range within the Forest and Scenic Area, but because annual precipitation declines dramatically on the east side due to a strong rain-shadow effect, and temperature variation increases due to the greater influence of continental climatic patterns, a drier and cooler climate results in the replacement of Pacific silver fir with lodgepole pine (*Pinus contorta*), western larch (*Larix occidentalis*), and Engelmann spruce (*Picea engelmannii*) at higher elevations and vegetation zones at lower elevations being dominated by grand fir (*Abies grandis*) and ponderosa pine (*Pinus ponderosa*) instead of western hemlock (Halverson et al., 1986; Topik et al., 1988). Vegetation on the east side varies more than that on the west side ranging from dry, open ponderosa pine-Oregon white oak (*Quercus garryana*) savannahs to dense mixed stands of grand fir, Douglas-fir, Engelmann spruce, western larch, lodgepole pine, and other conifers.

Invasive plants tend to colonize disturbed ground, including roadsides, utility (powerline) corridors, quarries, landings, recreational residences, trails, and campgrounds where vegetation has been removed and growing space for plants adapted to disturbance has been created, but also can invade undisturbed habitats. Eastside forests are more susceptible to invasive plants. A major conclusion of the ICBEMP (Interior Columbia Basin Ecosystem Management Project) analysis (2000) was that, in general, grasslands, riparian areas, and relatively dry, open forests are more susceptible to invasion than dense moist forests and high montane areas since the former have frequent gaps in plant cover, which favor invasive plant establishment, whereas the latter have relatively closed plant cover or have extreme climate or soils, which are tolerated by fewer invasive plant species (USDA Forest Service, 2005a).

Invasive plants are present within the Forest and Scenic Area and pose a threat to native plant communities and rare plant species included on the Pacific Northwest Sensitive Species List (USDA Forest Service), Survey and Manage plant species (Northwest Forest Plan), federally listed plant species (U.S. Fish and Wildlife Service), local endemic plant species and species defined as sensitive by the Scenic Area Management Plan. In this document, all are referred to simply as special status plants. Roads are conduits for the spread of invasive plants, providing vectors for dispersal (e.g., seeds and vegetative reproductive parts of plants attached to vehicles) and disturbed ground for invasive plant colonization and establishment. Timber harvest, livestock grazing, road building, and other ground-disturbing management activities occurring on the Forest and Scenic Area all contribute to the establishment and spread of invasive plants.

3.6.2. Direct/Indirect Effects

The impacts of this project on special status plants and non-target plants are discussed below. Additional information is available in Botany Biological Evaluation and Specialist Report.

Alternative 1 – No Action Alternative

Under the No Action Alternative, the Forest treats 100 acres manually and 10 acres mechanically and the Scenic Area treats 25 acres manually and 500 acres mechanically on an annual basis. These 635 acres comprise only a fraction of the estimated number of acres of land containing invasive plants within the Forest and Scenic Area. Small infestations of some invasive plants could be treated effectively by manual or mechanical methods [See Mazzu (2005)]. Moderate to large infestations of invasive plants, however, are difficult to treat manually or mechanically because of treatments needing to be repeated over many years, the high likelihood of plants reproducing from vegetative parts (e.g., rhizomes, root fragments, stolons), and dormant seeds remaining viable in soils for many years (e.g., 75 to 80 years for Scotch broom). Also, treating moderate to large infestations requires labor-intensive efforts of large workforces.

Examples of small infestations that could be treated effectively by manual or mechanical methods include the following with important caveats:

- Canada thistle (perennial) can be killed by smothering plants with boards, sheet metal, tar paper, black plastic, or other means; however, the plant produces rhizomes (underground stems) that persist despite smothering or conscientious hand pulling, making even small populations (a few plants) of Canada thistle difficult to treat effectively except with herbicides.

- Small patches of yellow starthistle (annual) could be hand pulled, if all aboveground stem material and roots are removed. New plants can sprout, however, from seeds stored in the seedbank.

- As with yellow starthistle, small populations of spotted knapweed (biennial or short-lived perennial) can be removed by digging up plants, as long as the entire root crown is completely removed.

- Diffuse knapweed (biennial or short-lived perennial) can be hand pulled successfully if done before seed set, and if done several times in one year during its growing season treating the rosette, immature, and mature plant stages.

- Populations of houndstongue (biennial or short-lived perennial) can be reduced up to 85 percent with hand pulling, if roots are completely removed. Severing the root crown 1 to 2 inches below the soil surface and removing top growth could be effective with small populations when done before flowering. New plants can sprout, however, from seeds stored in the seedbank.

- Small infestations of invasive hawkweeds (fibrous-rooted perennial) can be effectively treated by digging out all of the rosette, rhizomes, and roots of the plant. Some authorities, however, consider manual treatment to be ineffective and do not recommend it because hawkweeds can reproduce from root or rhizome fragments.

- Small populations of St. Johnswort (taprooted perennial) may be treated effectively by hand pulling or digging of young plants, but repeated treatments are necessary because new plants can grow from the "runner" root system (lateral roots). Plants can also sprout from seed. Biocontrol agents (introduced beetles) may be the best way to treat St. Johnswort.

- Tansy ragwort (biennial or short-lived perennial) can be treated effectively by hand pulling or mowing small populations. The perennial form of this plant often has large woody rootstocks and more than one flowering stem, complicating removal. Seeds could also remain viable in the soil for many years.

Generally, species that are annuals or biennials can be effectively treated manually if the populations are small and/or if there are not too many populations. It is important to remove most of the root and not break off the plant at the soil surface since it can resprout and still flower later in the season (e.g., dandelions). Herbicide treatment is recommended for perennial species, especially those with rhizomes and/or creeping root systems like Canada thistle and leafy spurge. For many invasive plants, including those listed above, effective manual or mechanical treatment is difficult regardless of the size of the population. For example, manual treatment is not recommended for invasive knotweed species because digging out its rhizomes, in addition to being extremely labor-intensive, tends to spread rhizome fragments, which could produce new plants. Meadow knapweed is difficult to pull out because of its tough perennial root crown. Himalayan blackberry could be dug out but requires removal of the massive root crown and a large workforce to do it.

Treatment Effectiveness

Under the No Action Alternative, it is highly likely that the majority of invasive plant populations within the Forest and Scenic Area would continue to expand, spread, and become increasingly more difficult and costly to control in the future. As one example, highly invasive species such as Japanese, giant, and Himalayan knotweed threaten riparian areas within the Forest and Scenic Area. Knotweed species tend to grow in moist sites, such as stream sides, riverbanks, wetlands, river deltas, and ditches along roads. Species reproduce by extensive rhizomes, which could reach 50 to 65 feet in length, and disperse when rhizome fragments are washed downstream. Rhizomes could regenerate even if buried up to 3 feet deep and have been observed growing through two inches of asphalt (Mazzu, 2005). Knotweeds, if unchecked, could rapidly take over stream and river corridors, resulting in a loss of native riparian vegetation, such as willows (*Salix* spp.) and red alder (*Alnus rubra*), and biological diversity.

Dramatic takeovers of native plant communities along stream and river corridors by knotweed species have already occurred in northwestern Oregon (Soll, 2004b). Knotweed canes (woody stems) could be cut by hand (manually) or with a machine (mechanically) to set the plant back and curtail the spread of individuals and populations; however, these resilient plants grow back quickly after cutting (within weeks). To eliminate knotweed plants manually or mechanically, the entire plant must be carefully dug up and removed without leaving any rhizome fragments. Otherwise, the plant could survive, regenerate, and eventually reproduce. Large populations of knotweed species have invaded reaches along the Sandy River and its tributaries and are being treated by The Nature Conservancy outside the Forest and Scenic Area.

Manual or mechanical treatment of knotweeds, except perhaps for a few individual plants, is a losing proposition because of their ability to reproduce from root fragments left in the soil or washed downstream. Thus far, the most practical and effective way to treat knotweed species is with aquatic glyphosate, an herbicide designed for use in streamside and riverside habitats because it strongly adsorbs to soil particles and has a low potential of leaching into groundwater systems (USDA Forest Service, 2005a). The Nature Conservancy has been treating knotweeds with aquatic glyphosate, to which a small amount of triclopyr has been added, along river corridors in northwest Oregon with some proven success for several years now (Soll, 2004b). Some foliar spraying is done as follow-up treatment, but for the most part the herbicide is not sprayed on the plants but injected by hand with heavy-duty syringes into the plants' cane-like stems. Successive years of treatment are needed to kill the plants. Under the No Action Alternative, knotweed populations would continue to increase and become more difficult to treat.

Also, highly invasive are the non-native hawkweeds (orange, meadow or yellow, and common) in the genus *Hieracium*. They could rapidly colonize and spread across upland landscapes, especially disturbed areas. Hawkweeds are found in the BPA powerline transmission corridor along USDA Forest Service Road 18 and Lolo Pass on the Zigzag Ranger District, and they threaten to spread beyond the power corridor. Recently, scattered populations of orange hawkweed were found in a meadow complex along a trail in the Mt. Hood Wilderness Area. The population is about two acres in size. A field crew of three to five people worked for several days in the area this past summer (2005) digging out plants and removing them from the site. The consensus of the crew, after surveying the area that they had treated, was that they were only able to make small inroads on the population and that more time than they had available would be needed to manually control and contain the population. Since orange hawkweed can reproduce vegetatively by stolons and rhizomes as well as from seed, even a small piece of root or rhizome left in the soil after manual or mechanical treatment may develop into a new plant.

Some authorities do not recommend manual or mechanical treatment of hawkweeds because disturbance to the plant could stimulate the growth of new plants from fragmented roots, stolons, and rhizomes and redistribute the plants, increasing their rate of spread (Montana State University Extension Service, 2006). Herbicide application is currently the most effective way to treat orange hawkweed and other invasive non-native hawkweeds, control populations, and contain their spread. Under the No Action Alternative, hawkweeds would be difficult to control and contain without herbicides because of their ability to reproduce by seed or vegetatively (by rhizomes and stolons), effective manual treatment is difficult for moderate to large populations, and both manual and mechanical treatment may stimulate the growth of new plants from fragments of roots, stolons, and rhizomes.

Knapweeds are also highly invasive, but unlike knotweeds and hawkweeds reproduce entirely by seed. Knapweeds within the Forest and Scenic Area include spotted, diffuse, and meadow knapweed. They produce abundant seed that can remain viable for many years in the soil. Seeds can be dispersed up to three feet from plants and much farther when attached to vehicles and trains (Mazzu, 2005). Manual treatment (hand pulling) could be effective for small populations of spotted and diffuse knapweed, but manual treatment for meadow knapweed is difficult due to the species' tough perennial root crown. Repeated mechanical treatment (mowing) of spotted knapweed and meadow knapweed could be moderately effective, but mechanical treatment may actually increase populations of diffuse knapweed. Cultural treatments have been effective in controlling knapweeds: for example, grazing and plowing have proven to be effective in controlling spotted knapweed, but grazing is not an effective control method for diffuse knapweed because it is unpalatable and its spines could injure livestock.

Under the No Action Alternative, manual treatment may control small populations of spotted and diffuse knapweed, but mechanical treatment is not effective for diffuse knapweed and could have the unintended effect of spreading the plant. Herbicides are not permitted to be used on hawkweeds within the Forest or Scenic Area. Herbicides are being used to treat hawkweeds on private land adjacent to the Forest (Lolo Pass and nearby BPA power transmission corridor). The hawkweed populations on private land have spread from about one-quarter acre in size to about 1,000 acres that include national forest land in the last 10 to 15 years (Forney, 2006). Without the option of herbicides, moderate to large populations of hawkweeds, such as those at Lolo Pass, would be difficult to control and contain. As a result, the likelihood is high that populations of hawkweed would increase in number and size across the landscape over time under the No Action Alternative.

Butter and eggs, or yellow toad flax, tends to occur sporadically within the Forest and Scenic Area in disturbed habitat (e.g., roadsides) and drier habitats such as eastside forests and rangeland. Plants can produce a taproot as deep as three feet in the soil, and horizontal roots may grow to several feet long and develop adventitious buds that can form independent plants. Once established, the species can suppress other vegetation by intense competition for limited soil moisture. Seeds can remain dormant in the soil for up to ten years. According to some authorities, repeated manual treatments (hand pulling) could be effective and cutting the plant in the spring or early summer is proposed as an effective way to eliminate plant reproduction; however, others discourage manual treatment because of the ability of the plant to reproduce vegetatively and spread from rhizomes (Fissell, 2006). Mechanical treatment (mowing) could reduce plant populations but is only a temporary solution because it does not reduce rhizome growth (Mazzu, 2005). Herbicides are not permitted for the control and containment of butter and eggs under the No Action Alternative. Under the No Action Alternative, small populations of this plant (containing only a few individuals) may be possible to control or contain by manual or mechanical treatment; but moderate to large populations of butter and eggs would be difficult to control or contain without herbicide treatment and, therefore, could be expected to persist. Without effective treatment, populations of butter and eggs would likely increase in number and size across the landscape over time.

Infestations of yellow starthistle, another highly invasive plant species, are capable of producing 50 to 100 million seeds per acre. Manual removal is effective for small populations of yellow starthistle; however, plants could survive even if a fragment of stem less than 2 inches in length is left behind if leaves and buds are still attached at the base of the plant. Mechanical treatment (tillage or mowing) could control yellow starthistle but timing is important (Mazzu, 2005). Early summer tillage would control yellow starthistle provided that shoots are detached from the roots. Mowing, if done before viable seed production, could be effective, but mowing during the early growth stages of yellow starthistle could result in increased light penetration and rapid regrowth of the plant. Under the No Action Alternative, yellow starthistle may be controllable manually or mechanically at the present time because of the small number and size of known populations within the Forest and Scenic Area, and if new populations are detected and treated early.

Effects on Native Plant Communities

Invasive plant infestations could displace native plants, including special status plants (USDA Forest Service, Pacific Northwest Sensitive species; Survey and Manage species; federally listed or proposed endangered, threatened, and sensitive species; local endemic species; and plants listed as sensitive by the Scenic Area Management Plant) as well as alter or even displace native plant communities. Displacement of native plant communities by non-native plants results in alterations to the structure and function of ecosystems (MacDonald et al., 1991), and constitutes a principal mechanism for loss of native biological diversity at regional and global scales (Lacey and Olsen, 1991; Johnson et al., 1994; USDA Forest Service, 2005a). A healthy native plant community, which consists of a diverse assemblage of plant species that have evolved together in place over thousands of years (probably 4,000 to 5,000 years since the mid-Holocene), provides important ecosystem functions or services: for example, creation of habitats and microenvironments to which native plants, including special status plants, are adapted; creation and maintenance of important structural components in forests (e.g., downed wood, decaying logs, and snags); maintenance of critical soil flora and fauna for important belowground processes such as decomposition, nutrient cycling, and symbioses (e.g., mycorrhizal associations between the fine roots of trees and fungi); maintenance of hydrologic functions such as the interception of atmospheric moisture and its storage; and prevention of erosion through the stabilization of soils. For more information on mycorrhizal fungi, see page 3-30 in the Invasive Plant FEIS (2005a).

Invasive plant infestations upset ecosystem balances that have evolved over time in native plant communities and set in motion changes that compromise and degrade healthy native ecosystems. As stated in the Invasive Plant FEIS (2005a), “invasive plants have cascading effects on ecosystems and affect significant chemical, physical, and biological components and processes (e.g., nutrient cycling, erosion, species competition)” (page 3-27). Table 3-5 in Invasive Plant FEIS (2005a) provides a more substantial list of effects of invasive plants on ecosystems. A severe invasive plant infestation could displace an entire native plant community (e.g., a westside riparian plant community replaced by knotweed or an eastside sagebrush and bunchgrass community replaced by yellow starthistle) with dramatic negative repercussions for native plant and wildlife species that are dependent on the environment created by a community of native plants. A major conclusion of the ICBEMP analysis was that grasslands, riparian areas, and relatively dry, open forests are more susceptible to invasion than are dense moist forests and high montane areas since the former have frequent gaps in plant cover, which favor invasive plant establishment, whereas the latter have relatively closed plant cover or have extreme climate or soils, which are tolerated by fewer invasive plant species (USDA Forest Service, 2005a). Alterations of native plant communities in such environments by an invasive plant infestation could affect an ecosystem at all levels of organization, producing dramatic changes in vegetation across the landscape with repercussions for natural resource uses such as watershed management, timber harvest, livestock grazing, and recreation.

Although there is a need to treat invasive plants in order to maintain native plant communities, likewise the treatments have the potential to shift species composition and reduce diversity of native plant communities as less herbicide-tolerant species are replaced by more herbicide-tolerant species. For example, certain herbicides and the methods by which they are applied could also harm plant pollinators. If a reduction or shift in pollinator species occurs, changes to plant species composition or diversity could follow (USDA Forest Service, 2005a). There is also the risk, however minimized by PDC, that individuals within populations of special status plants may be harmed, weakened, or killed from herbicide application (e.g., from overspray, drift, surface runoff, root translocation, or applicator error). Manual or mechanical treatment likewise could result in changes in the composition, structure, and diversity of a plant community by creating available growing space or opportunities for those native plant species that are better adapted to exploit ground disturbance and could outcompete other native species.

Summary of Effects

Effects under the No Action Alternative can be summarized as follows:

- Manual and mechanical treatment of invasive plants is allowed and would continue within the Forest and Scenic Area. These treatment methods could be limited in their effectiveness as far as controlling or containing invasive plant populations, especially large populations and those species that could reproduce vegetatively from rhizomes, stolons, or root fragments (e.g., hawkweeds, knotweeds, butter and eggs). All invasive plant species are expected to expand and spread with the limited use of herbicides.

- Limited use of herbicides would continue within the Forest and Scenic Area, resulting in limited effectiveness in the treatment of existing and new invasive plant populations.

- With limited use of herbicides under the No Action Alternative, it could be expected that existing, especially difficult-to-control, invasive plant populations would continue to expand and spread.

- New sites of invasive plants are likely to expand unchecked, potentially threatening native plants and plant communities. The current limited treatment options of invasive plants within the Forest and Scenic Area would likely lead to biologically significant negative effects on native plants and plant communities.

- The No Action Alternative provides for ***no*** EDRR to treat newly inventoried infestations of invasive plants that were not identified or specified in existing NEPA documents (e.g., knotweed species, garlic mustard, policeman's helmet, herb Robert). At least 24 invasive plant species (Table 2-3) are suspected to have the potential to occur or spread within the Forest and Scenic Area, which could not be treated under this alternative. The absence of an EDRR mechanism in the No Action Alternative would greatly increase the potential for new invasive plant infestations to establish and spread, which in the case of highly invasive plant species (e.g., knotweeds, hawkweeds, garlic mustard) could be ecologically far-reaching because of their potential to radically alter native plant communities and ecosystem structure and functions (e.g., energy flow, distribution of biomass, plant-animal interactions, decomposition, nutrient cycling, mycorrhizal associations, hydrology, etc.).

Under the No Action Alternative, which precludes the option of expanding the current limited use of herbicides within the Forest and Scenic Area to treat invasive plants, existing populations of invasive species that are difficult to treat manually or mechanically would likely continue to persist, expand, and spread. Additionally, new populations would establish, expand, and spread. Infestations of invasive plants would continue to displace native plant species, including special status plants, and thereby lower native biological diversity; alter the composition and structure of native plant communities; reduce wildlife habitat, forage quality, substrates for nonvascular plants (bryophytes and lichens), and hosts for beneficial mycorrhizal fungi; and lead to increased soil erosion and changes in hydrology (water uptake, storage, and regulation). Invasive plants also alter natural fire regimes by effecting changes in the composition and structure of native plant communities, in many cases thereby increasing fire frequency and intensity in eastside forests and rangelands, resulting in a loss of recreational and economic opportunities as native vegetation is altered or lost.

Alternative 2 – The Proposed Action

The Proposed Action proposes to treat 208 areas (about 13,000 acres) containing invasive plants with a combination of manual, mechanical, cultural, and herbicide treatments. Table 3-5 lists the number of treatment areas for each invasive plant species analyzed in the EIS. Sites have been prioritized following Table 2-8. Priority 1 sites include: (1) sites currently occupied by knotweed species, hawkweed species, butter and eggs, and yellow starthistle; (2) new infestations of invasive plant species (e.g., new populations in areas not yet infested); and (3) active restoration sites where invasive plant control is essential. Within the Forest and Scenic Area, knotweed species are present in 15 of the proposed treatment areas; hawkweed species in 20 of the proposed treatment areas (12 orange hawkweed, five common hawkweed, and three meadow hawkweed); butter and eggs in nine of the proposed treatment areas; and yellow starthistle in one of the proposed treatment areas. Although knapweed sites are not considered a high priority for treatment under the Proposed Action (in earlier management plans they were considered a priority west of the Cascade Range), knapweeds are present in 156 of the proposed treatment areas within the Forest and Scenic Area (105 diffuse knapweed, 37 spotted knapweed, and 14 meadow knapweed).

Table 3-5: Number of Treatment Areas by Invasive Plant Species. Many treatment areas contain more than one invasive plant species, so the total number of sites adds up to more than 208 treatment areas.

Invasive Plant Species	Treatment Areas	Estimated Acres	High Priority Species/Site?
Butter and eggs (LIVU2)	9	232.5	Yes
Canada thistle (CIAR4)	5	5.4	
Common hawkweed (HIVU)	5	95.9	Yes
Common tansy (TAVU)	1	---	
Diffuse knapweed (CEDI3)	105	4,416	
English ivy (HEHE)	12	7.1	
Himalayan blackberry (RUDI2)	6	1,613	
Houndstongue (CYOF)	43	853.8	
Japanese knotweed (POCU6)	15	12	Yes
Orange hawkweed (HIAU)	12	1,709	Yes
Meadow hawkweed (HIPR)	3	61.6	Yes
Meadow knapweed (CEPR2)	14	79	
Reed canarygrass (PHAR3)	3	18.7	
Rush skeletonweed (CHJU)	1	---	
Scotch broom (CYSC4)	13	237.1	
Spotted knapweed (CEBI2)	37	1,918	
St. Johnswort (HYPE)	1	---	
Tansy ragwort (SEJA)	32	1,699	
Yellow starthistle (CESO3)	1	7.1	Yes

Note: Acreage estimates for common tansy, rush skeletonweed, and St. Johnswort are not available.

Under the Proposed Action, ten herbicides analyzed in the Invasive Plant FEIS (2005a) would be available to more effectively control invasive plant infestations, as discussed under treatment effectiveness for the No Action Alternative.

Treatment Effectiveness

As advanced through integrated weed management, a combination of invasive plant treatments, including herbicides, is considered more effective for moderate to large populations than using a single method. Repeated manual treatments may be effective for controlling and containing some invasive species, but for highly invasive species and for larger populations, herbicide treatment may be the most effective and practical means. Manual or mechanical treatments are ineffective and often highly difficult for moderate to large populations of invasive plants that could reproduce by seed or vegetatively by stolons (e.g., hawkweed species), rhizomes (e.g., hawkweed species), or root fragments (e.g., invasive knotweed species).

Anecdotal evidence and experience quickly demonstrates how challenging and time-consuming it could be to dig entire plants out of the ground without disturbing the plants in the process. Disturbing the plants or failing to remove the entire plant could leave stolons, rhizomes, or root fragments behind from which the plants could reproduce. These challenges increase when dealing with moderate to large populations.

Herbicides are often the only known effective way to control, contain, or eradicate invasive plant species that could reproduce from vegetative fragments. For example, herbicide treatment with aquatic glyphosate is the only effective way to treat all but small populations of knotweed species due to their ability to produce extensive rhizomes that could reach 50 to 65 feet in length and to reproduce from root fragments. Without the option to treat infestations of invasive plants with a combination of techniques that include herbicide treatment, existing populations of highly invasive plant species are difficult to treat manually, mechanically or culturally. As a result, infestations would continue to expand and new populations would become established across the landscape, reducing or displacing native vegetation, habitat for wildlife, and forage for native ungulates and grazing livestock.

Special Status Plants

Special status is an umbrella term referring to all plant species that have recognized legal or administrative status because of conservation concerns. They include plants on the Regional Forester's Sensitive Species List (USDA Forest Service Pacific Northwest, Region 6), Survey and Manage species (Northwest Forest Plan), federally listed and proposed species (U.S. Fish and Wildlife Service), local endemics (plants that occur only within the Forest or Scenic Area), and species defined as sensitive by the Scenic Area Management Plan. In 2004, 80 fungi, lichens, and bryophytes were added to the Regional Forester's Sensitive Species list. Seventy plant species on the Regional Forester's Sensitive Species list are documented or suspected to occur within the Forest and Scenic Area (32 vascular plants, 19 fungi, 15 lichens, and 4 bryophytes). Eight of those species have been identified in 13 of the 208 areas proposed for treatment in the Proposed Action (See Table 3-6). Six of the 13 areas are on the Clackamas River Ranger District containing 1 coldwater corydalis (*Corydalis aquae-gelidae*) site; 1 pale blue-eyed grass (*Sisyrinchium sarmentosum*) site; 2 adder's-tongue (*Ophioglossum pusillum*) sites; and 3 Methuselah's Beard (*Usnea longissima*) sites. Five of the 13 areas are on the Hood River Ranger District containing 4 elegant rockcress (*Arabis sparsiflora* var. *sparsiflor*a) sites and 2 Watson's desert-parsley (*Lomatium watsonii*) sites. And two of the 13 areas are in the Scenic Area containing 1 white fairypoppy (*Meconella oregana*) site and 1 Barrett's beardtongue (*Penstemon barrettiae*) site. Finally, one treatment area in the Scenic Area contains a local endemic plant species (i.e., known only to occur in the Scenic Area): Hood River milkvetch (*Astragagalus hoodinanus*). Coldwater corydalis and Methuselah's Beard are both USDA Forest Service, Pacific Northwest Sensitive species and Survey and Manage species. No federally listed plant species are in any of the treatment areas.

Table 3-6: Treatment Areas with Special Status Plants.

Treatment ID	Site Description	District	Acres	Special Status Plants Present	Invasive Plant Threats
66-074	Road	Hood River	109.0	Elegant rockcress (*Arabis sparsiflora* var. *sparsiflora*)	Knapweeds and tansy ragwort
66-042	Quarry	Hood River	2.8	Elegant rockcress (*Arabis sparsiflora* var. *sparsiflora*)	Knapweeds and tansy ragwort
65-038	Utility corridor	Hood River	262.0	Elegant rockcress (*Arabis sparsiflora* var. *sparsiflora*), Watson's desert-parsley (*Lomatium watsonii*)	Knapweeds and tansy ragwort
65-035	Utility corridor	Hood River	6.9	Watson's desert-parsley (*Lomatium watsonii*)	Knapweeds
65-033	Opening	Hood River	17.3	Elegant rockcress (*Arabis sparsiflora* var. *sparsiflora*)	Knapweeds and tansy ragwort
65-027	Small basin with seasonal pond along road	Clackamas River	0.7	Adder's tongue (*Ophioglossum pusillum*)	Canada thistle
69-027	Road	Clackamas River	31.5	Methuselah's Beard (*Usnea longissima*)	Scotch broom, blackberry, hawkweed, knapweed, and ivy
65-026	Meadow	Clackamas River	4.7	Pale blue-eyed grass (*Sisyrinchium sarmentosum*), Adder's tongue (*Ophioglossum pusillum*)	Canada thistle
65-023	Road	Clackamas River	416.0	Coldwater corydalis (*Corydalis aquae-gelidae*)	Knapweeds
65-020	Road	Clackamas River	69.2	Methuselah's Beard (*Usnea longissima*)	Scotch broom, blackberry, hawkweed, knapweed, and ivy
65-002	Road	Clackamas River	41.9	Methuselah's Beard (*Usnea longissima*)	Scotch broom, blackberry, hawkweed, knapweed, and ivy
22-11	Forested Site	Scenic Area	85.0	White fairypoppy (*Meconella oregana*), Hood River milkvetch (*Astragalus hoodianus*)	diffuse knapweed and houndstongue
22-08	Quarry	Scenic Area	24.0	Barrett's beardtongue (*Penstemon barrettiae*)	diffuse knapweed and Himalayan blackberry

The number of individuals for each of these plant species of concern in a treatment area varies from few (<20) to many (several hundred). Both diffuse and spotted knapweeds are proposed for treatment in the area containing coldwater corydalis. Canada thistle threatens the pale blue-eyed grass and adder's-tongue populations. Spotted, diffuse, and meadow knapweed and tansy ragwort threaten the elegant rockcress plants. Spotted and diffuse knapweeds threaten the Watson's desert-parsley plants. The treatment areas with Methuselah's Beard contain numerous invasive species: Scotch broom, Himalayan blackberry, orange hawkweed, meadow hawkweed, diffuse knapweed, spotted knapweed, and English ivy. Diffuse knapweed and houndstongue threaten the white fairypoppy and Hood River milkvetch populations. And diffuse knapweed and Himalayan blackberry threaten the Barrett's beardtongue-site. In many cases, invasive plant species are interspersed with the special status plants. For example, Canada thistle plants are scattered throughout the proposed treatment areas containing pale blue-eyed grass and adder's-tongue, encroaching on and threatening to displace each special status plant species. Because Canada thistle is rhizomatous, hand pulling it may harm pale blue-eyed grass and adder's-tongue. Additionally, hand pulling is usually ineffective when treating rhizomatous plants such as Canada thistle.

Repeated manual treatments may be effective for controlling or containing small populations of certain invasive plants in treatment areas and may pose less risk to special status plants compared to herbicide treatments. Associated labor, time, and cost may make manual treatments less practical and effective, especially when treating large infestations of invasive plants. Use of herbicides may occasionally harm, weaken, or kill individual special status plants in the short term, but it is expected that populations would not be jeopardized and would make a full recovery from inadvertent damage caused by herbicide use. Despite the risk of harming, weakening, or killing individual special status plants with herbicide treatments, "invasive plant treatments are more likely to benefit listed plant species" (USDA Forest Service, 2005a) than cause them harm in the long term because, without the availability of herbicides as a treatment option, invasive plants have the potential to overrun and displace special status plants.

Concerns have been raised about drift from triclopyr and glyphosate decreasing the sustainability, relative long-term abundance, and diversity of lichens and bryophytes (Newmaster et al., 1999; USDA Forest Service, 2005a). Lichens and bryophytes lack roots and instead obtain moisture and nutrients directly from the atmosphere; therefore, they are particularly sensitive and vulnerable to aerosols and contaminants in the atmosphere such as herbicide mist. The lichen, Methuselah's Beard (*Usnea longissima*), on both the USDA Forest Service, Pacific Northwest Region Sensitive Species and Survey & Manage lists, would be highly vulnerable to direct herbicide spray or to the fine mist drift from herbicides applied in its vicinity because of its large surface area. It is an extremely long pendant lichen (up to several feet in length) that hangs from tree branches reminiscent of tinsel on a Christmas tree. Epiphytes (plants that grow on other plants), such as Methuselah's Beard, would be especially vulnerable to direct application or drift from broadcast herbicide applications. Terrestrial (ground-dwelling) special status plants, on the other hand, would be protected through selective herbicide treatments and shielding. To prevent exposure of Methuselah's Beard to herbicide overspray and drift in identified treatment areas along Highway 224 near Lazy Bend Campground (Clackamas River Ranger District) and any future treated areas, invasive plants would be manually or mechanically treated first followed by manual application (hand wiping, painting, or wicking) of herbicides. Low-to-the-ground spot spraying of herbicides would be permitted if invasive plant populations are too large to treat effectively with hand application of herbicides.

Recommended treatments (manual, mechanical, or herbicide, or a combination thereof) have been made for all of the identified 208 treatment areas (See Appendices B and D). Herbicides could harm, weaken, or kill special status plants as well as invasive plants. A number of measures would be taken to protect special status plants in the 13 identified treatment areas; these are listed under the PDC in Section 2.1, Subsection E, Special Status Plants. Even with these PDC, there is some risk that special status plants may be harmed, weakened, or killed by herbicides (e.g., through root translocation or surface runoff); however, this risk can be minimized by following the precautionary methods described in the PDC.

Manual, mechanical, cultural, and herbicide treatments entail some risk to native plants and plant communities. Any species along roadsides or where activities occur that disturb native plant communities would be threatened by not only invasive plants, but by invasive plant treatments (USDA Forest Service, 2005a). Are populations of special status plants more at risk by treating or not treating invasive plants with herbicides? The risk of harming, weakening, or killing special status plants through the application of herbicides must be weighed against the risk of special status plants, native plants, and native plant communities being lost in areas because invasive plants have been left untreated or treated ineffectively. Not having the option of using herbicides to treat areas containing both invasive plants and special status plants would likely result in a reduction or loss of those special status plant populations as they are likely to eventually be overrun and displaced by invasive species. For example, treatments sites with pal blue-eyed grass and adder’s-tongue may be overrun by Canada thistle.

Effects on Native Plant Communities

Some of the herbicides proposed for treating invasive plants are selective for particular kinds of plants (e.g., dicots versus monocots). See Table 3-13, page 3-91 in the Invasive Plant FEIS (2005a) for more details. Dicots include broadleaved and woody plant species. Broadleaved refers to plants having broad leaves as opposed to those having needle-like or scale-like leaves (e.g., conifers). Monocots include grasses, sedges, rushes, lilies, irises, and orchids. The ability to damage or kill only certain plant species or families but not others makes an herbicide selective. Selective herbicides analyzed in the Invasive Plant FEIS (2005a) include chlorsulfuron, clopyralid, picloram, and sethoxydim (Table 3-7). The other six proposed herbicides analyzed in the Invasive Plant FEIS (2005a) are non-selective. The ability to damage a broad spectrum of plant species, families, or groups makes an herbicide non-selective (USDA Forest Service, 2005a). Since herbicides are designed to kill plants, native (non-target) plants and special status plants are vulnerable. Picloram, one of the more persistent herbicides, could move readily to non-target native plants through root translocation (movement of an herbicide from one plant to another across root surfaces) or surface runoff (Invasive Plant FEIS, 2005a). Due to its toxic persistence in soils and potential to spread to non-target plants, the potential impacts of picloram should be considered thoroughly before prescribing its application.

Table 3-7: Selective Herbicides Proposed for Treatment and Analyzed in EIS.

Selective Herbicides	Targeted Plant Groups/Families	Targeted Invasive Species
Chlorsulfuron	Broadleaved Plants	many species
Clopyralid	*Asteraceae*, *Fabaceae*, *Polygonaceae*	hawkweeds, knapweeds, knotweeds, tansy ragwort, yellow starthistle
Picloram	Broadleaved and Woody Plants	many species
Sethoxydim	Annual and Perennial Grasses	many species

NOTE: Information from *Pacific Northwest Weed Management Handbook* (William et al., 2004).

PDC included in the Proposed Action would reduce risks to special status plants (e.g., spot rather than broadcast spraying of invasive plant species, hand application of herbicides, shielding of special status plants with plastic or some other protective sheet). Many native plants in treatment areas, however, could be killed with the potential for short-term or even longer-term changes in the composition of native plant communities. It is expected, however, that native plants would return to occupy growing space released by killed plants. Active restoration in priority 1 (high priority) and priority 2 sites, such as seeding with native or non-native, non-invasive grass species or planting with native trees, shrubs, or herbs, would insure that the released growing space is occupied by native species and not allowed to be re-colonized by invasive plants. Active restoration for such sites is critical for success in managing and preventing invasive plant infestations; otherwise, released growing space following treatment is likely to be re-invaded by invasive plants.

Some species of fungi, lichens, and bryophytes and their communities could be negatively affected by at least two herbicides (triclopyr and glyphosate). Fungi could be negatively affected by herbicides known to affect soil mycorrhizae (sulfometuron methyl, picloram, glyphosate, triclopyr), but studies are laboratory-based and their results are difficult to extrapolate to field situations. Species of fungi associated with late-successional forest ecosystems are not highly susceptible to invasion and would not contain the vegetation communities most likely to be treated by broadcast application of herbicides (USDA Forest Service, 2005a). For a more detailed discussion, see Chapter 4.3 in the Invasive Plant FEIS (2005a) or Section 3.8 – Soil Productivity. Since fungi bioaccumulate heavy metals and other contaminants/toxins in the soil, the public, including mushroom gatherers, would be alerted before areas are treated through public notices (e.g., newspapers, posted signs). For a detailed discussion of effects of herbicide treatment on fungi and associated human health concerns, see 3.5 – Human Health and Safety.

Manual or mechanical treatment of invasive plant infestations could also negatively affect native plants and plant communities. Direct effects would be unintentional removal or trampling of flowers, fruits, or root systems of native plants (USDA Forest Service, 2005a). Other direct effects would be reduced plant vigor due to plants being damaged, reduced native seed production, soil disturbance, and canopy removal (understory, shrub layer, or overstory depending on the species). Indirect effects brought about by these direct effects could include microsite shifts such as reduction in productivity, reduction in soil moisture, disruption of mycorrhizal connections, and increase in soil temperature (USDA Forest Service, 2005a). These effects could produce a shift in species composition further away from a native community, and the removal of one invasive species could encourage another invasive species to take its place via windborne seeds or human transport (USDA Forest Service, 2005a). The best way to counter against such direct and indirect effects is active restoration. Passive restoration is a reasonable expectation for some sites, such as those with small populations of invasive plants in less disturbed habitat, such as moist, westside forests with largely intact native plant communities; however, active restoration provides the best means for preventing re-invasion (re-infestation) by an invasive plant. Active restoration is particularly effective at sites with large populations of invasive plants, highly disturbed ground, and drier eastside habitats where there is more rangeland, forests are more open, and more unoccupied growing space is available for plants to colonize.

Despite the potential for negative effects from manual or mechanical treatment described above, the consensus is that the effects of not treating invasive plants far outweigh the potential adverse effects of these treatments on native plants and plant communities. Without treatment, invasive plant infestations would increase and spread, displacing native plants and plant communities.

Early Detection/Rapid Response Strategy

The Proposed Action includes an EDRR (Section 2.1.3) for promptly treating newly inventoried infestations of invasive plant species. Candidate species that are currently known in the Portland area and may occur within the Forest and Scenic Area, now or in the future, would include such species as garlic mustard, false brome, shining geranium, herb Robert, and policeman's helmet. See Table 2-3 for a list of the 24 invasive plant species, including those above, that could be treated under the EDRR. The reproductive ecology and the effectiveness of treatment/management options, including recommended herbicides, for each of the 23 candidate species are summarized in Appendix G – Common Control Measures Summary.

The EDRR would allow effective treatment if nearby invasive plants infest the Forest or Scenic Area. As an example, policeman's helmet has been found growing along Bear Creek along Highway 26 near the Zigzag Ranger District office and in a stream/drainage channel at The Resort at The Mountain golf course in the nearby community of Welches. If these infestations spread to the Forest or Scenic Area, they could be treated promptly using this mechanism.

Under the Proposed Action, new infestations would be treated and, most likely, many with herbicides. The Proposed Action poses a greater risk of harming, weakening, or killing special status plants in the short term than does the No Action Alternative, which under current EA direction allows for the continuation of limited herbicide treatment; however, in the long term special status plants have a better chance of survival under the Proposed Action because without effective treatment, as under the No Action Alternative, special status plants in identified treatment as well as future EDRR areas are expected to be overrun and displaced by invasive plant species. The likelihood of harming, weakening, or killing special status plants, however, should be low to very low under the Proposed Action. The reasons are that (1) the majority of invasive plant populations are found where moderate to severe ground disturbance has occurred (e.g., road corridors, quarries, trails, clearcuts, human residences); (2) generally, special status plants are not found in areas where moderate to severe ground disturbance has occurred; and (3) the PDC designed for the Proposed Action (e.g., spot spraying, hand application of herbicides, shielding) would protect special status plants, if found in a treatment area. Translocation of herbicides (e.g., glyphosate, picloram) across root systems in the soil from target to non-target plants, including special status plants, and runoff from rain (e.g., a thunderstorm) carrying herbicide from target to non-target plants are risks associated with successive herbicide treatments over a five-year period, as proposed under the Proposed Action. Again, for reasons stated above, however, the risk of harming, weakening, or killing special status plants should be reasonably low.

Summary of Effects

Effects under Alternative 2 – The Proposed Action can be summarized as follows:

- A toolbox of ten herbicides, which have been analyzed in the Invasive Plant FEIS (2005a), would be available to more effectively control invasive plant infestations that potentially threaten native plants and plant communities, including special status plants.
- The ten herbicides analyzed for use have been determined to pose a low risk to all fauna and four of the herbicides are more selective as to which plants they target.
- The size and rate of spread of invasive plant populations on 13,000 acres within the Forest and Scenic Area in the 208 identified treatment areas would be controlled or contained with treatments rather than left ineffectively treated or to spread under the No Action Alternative.

- The expanded use of herbicides under the Proposed Action would increase the potential for negative effects on non-target plant species, including special status plants: there may be inadvertent harming, weakening, or killing of individual special status plants in the short term with herbicide treatment. In the long term, however, affected populations of special status plants would benefit from treatment in not being overrun or displaced by invasive plants. Without treatment, conversely, special status plants can be expected to be overrun and displaced by invasive plants over time. PDC would reduce the potential for short-term adverse effects on native plants and plant communities, including special status plants. For example, where an invasive plant species is to be treated within 5 feet of a special status plant, the invasive plant should be either manually treated or herbicide application would be applied by hand (e.g., wiping, wicking, painting, injection).

- Only 13 of the 208 areas identified for treatment contain special status plants.

- The inclusion of EDRR would provide for prompt treatment of new sites of invasive plant species not included in the current EIS (e.g., policeman's helmet, garlic mustard, herb Robert) and aid in eliminating populations before they become larger and more difficult to treat, requiring more extensive and costly control measures later.

Alternative 3 – Restricted Use Herbicide Alternative

Under Alternative 3, which restricts herbicide use and broadcast spraying, the spread of invasive plants would be checked through eradication, control, or containment more than under the No Action Alternative but less so than under Alternative 2 (The Proposed Action). Forty-three treatment areas totaling 4,047 acres would be treated with herbicides, roughly 31 percent of the 13,000 acres proposed under Alternative 2. Herbicides would only be permitted in high priority treatment areas.

In treatment areas where a combination of treatments, including herbicides, would be allowed, there is a greater likelihood that invasive plants could be treated effectively. Conversely, in treatment areas where herbicide treatment is prohibited and invasive plants, instead, would be treated manually, mechanically, or culturally, large populations of invasive plants and those species that are difficult to treat effectively without herbicides are expected to persist and increase over time. Special status plants, the pale blue-eyed grass and adder's-tongue sites (65-026 and 65-027), for example, are expected to be overrun and displaced by Canada thistle, which threatens both sites.

Summary

The Restricted Herbicide Use Alternative is similar to the Proposed Action except for the following:

- Some invasive plant infestations would be uncontrollable, resulting in adverse effects on native plants and plant communities, including special status plants.

- Forty-three treatment areas totaling 4,047 acres (roughly 31 percent) of the 13,000 acres proposed for herbicide treatment under the Proposed Action would be treated under the Restricted Use Alternative.

- Restricted herbicide use would reduce the potential of short-term negative effects from herbicide treatments, specifically broadcast herbicide applications, on non-target species.

3.6.3. Spread of Invasive Plants to Neighboring Ownerships

The Forest and Scenic Area are intermingled with other federal, state, county, and private ownerships. An issue was raised about the spread of invasive plants from the Forest and Scenic Area to adjacent ownerships.

Currently, under the No Action Alternative, about 1,235 acres of Forest and Scenic Area are being treated for invasive plants annually. This number of acres is less than 10 percent of the estimated 13,000 acres that are either occupied or immediately threatened by invasive species. Seeds from invasive plants in the Forest may end up on other ownerships. The opposite is also true: seeds from invasive plants on other ownerships end up in the Forest. The considerable number of untreated acres in the Forest does not imply that there is a net transport of invasive plant seeds from federal to non-federal lands. The activities, conditions, and vectors that determine spread are dynamic and variable. There is no quantitative measure of the net flow of plant materials across ownership boundaries.

The proliferation of invasive plants is caused by several factors. Robust seed production, seed dispersal mechanisms (light and feathery, sticky, or burr-like seeds), and the presence of conditions favorable to seed dispersal influence the spread of invasive plants. Natural vectors such as humans or animals, or natural forces, such as wind and water, spread invasive plant seeds. Increasing public mobility and access to remote areas of the landscape facilitate seed dispersal. Land management activities that scarify soil or accelerate erosion enhance the germination of invasive plants. These factors play out in difficult to quantify ways throughout the landscape without regard to land ownership. See Section 3.2.4 for more details.

Factors that reduce the spread of invasive plants include prevention and treatment actions, the number of acres treated, and the prioritization of treatment areas.

Due to the diversity of invasive plants affecting the Forest and Scenic Area, the effectiveness of each alternative is directly related to the variety of treatment tools. Given limited treatment budgets, deciding what and where treatments should occur first is a crucial step in the invasive plant management program. Without prioritization, funding may be spent on species or sites that pose lower threats. Adjacency to private or other public ownerships may be one criterion to set priorities for treatment. This criterion, however, should be considered in the context of all factors contributing to plant spread, the effects of different plant species in the landscape, and economic considerations.

Using the most viable treatment options available (combined with regional prevention standards) would most effectively reduce infestations and rates of spread. Some of the invasive plant species present in the Forest and Scenic Area are not controlled well by manual or mechanical treatments (see Section 3.5 – Botany and Treatment Effectiveness). Herbicide choice is the primary variable among the alternatives that would determine potential effectiveness. Because the Proposed Action prescribes broader use of herbicides that control the widest variety of species, it is probably the most effective in reducing the spread to adjacent ownerships. As invasive plant populations are reduced, there would be fewer seeds produced and the spread of invasive species would be diminished. Aggressive implementation and proper treatment area prioritization, however, are equally important in this regard. The No Action Alternative is the least comprehensive, least integrated approach to preventing spread to adjacent lands. The Restricted Herbicide Use Alternative, which relies more on manual and mechanical treatment methods, would produce better results than the No Action Alternative, but would not be as effective as the Proposed Action.

The EDRR treatment of newly discovered invasive plants is the most successful, cost effective, and least environmentally damaging control strategy (ODA, 2001). There is a short time period suitable for eradication and containment of new invasive plant populations. Unchecked, new populations become long-term management problems and sources of seed to spread off federal lands.

Both the Proposed Action and the Restricted Herbicide Use Alternative have an EDRR. The Proposed Action, however, would control some plant species more effectively, because of more permissive use of herbicides. The Restricted Herbicide Use Alternative would control new populations less effectively due to its heavier reliance on manual and mechanical treatment methods. Without an EDRR, the No Action Alternative would not treat newly detected populations.

3.6.4. Cumulative Effects

Common to all three alternatives is the cumulative effect of increased disturbance and recreation over time within the Forest and Scenic Area, driven by increasing human population growth and pressure. This translates into an expected increase in the spread of invasive plants over time, since the human and vehicular vectors would continue to increase.

Alternative 1 – No Action Alternative

Under the No Action Alternative, the likelihood is high, if not certain, that invasive plant infestations would persist, expand, and spread over time within the Forest and Scenic Area. New infestations could be expected to continue to occur over time. Other invasive plant species, not currently known to be within the Forest and Scenic Area, would become established. Native plants, including special status plants, may be lost as native plant communities are negatively altered or displaced. Ecosystem structure and functions, which include the many biogeochemical processes that maintain healthy and diverse forested and rangeland plant communities, would be negatively affected. High priority invasive plant sites would continue to increase in size over time.

Examples include the following:

- Increasingly more riparian corridors would come under threat of knotweed infestations since herbicide treatment with stem injected glyphosate is the only proven way to control this highly invasive knotweed species. Except perhaps in the case of very small populations (containing only a few individuals), manual treatment of knotweed species is ineffective. Manual treatment may actually be a drawback since it could facilitate the spread of knotweed species because of its ability to regenerate and reproduce from root fragments.

- Hawkweed infestations could be expected to spread. The three known orange hawkweed populations in the Mt. Hood Wilderness Area (totaling 15.3 acres in size) would be difficult to control and contain without the option of using herbicides since manual control (hand pulling) has proven to be difficult and of limited effectiveness. New infestations of orange hawkweed could be expected to spread to meadows and other wilderness areas.

Butter and eggs, yellow starthistle, knapweeds, and many other invasive plant species would continue to spread. Without an EDRR to respond to newly inventoried infestations of invasive plants (e.g., policeman's helmet, false brome, garlic mustard), there would be no way to act promptly in the future and eradicate these populations before they expand, spread, and become increasingly more difficult and costly to treat. Due to the limited use of herbicides currently being applied within the Forest and Scenic Area, there would be less potential risk for negative effects on fungi (including mycorrhizal fungi), lichens, and bryophytes.

Ground- and habitat-disturbing forest management activities, over time (10, 20, 30+ years hence), would continue to create opportunities for invasive plants to establish and spread. Management activities include timber harvest, increased visitor and recreational use, road building, road decommissioning, rock excavation at quarries, maintenance and improvement of existing facilities, and construction of new facilities. Demands on the Forest and Scenic Area are likely to continue to increase over the course of time as a result of steady human population growth in the Portland-Vancouver metropolitan area and surrounding areas. Spread of invasive plants from adjacent private lands onto the Forest and Scenic Area can be expected. Without effective treatment, invasive plant populations are highly likely to increase within the Forest and the Scenic Area over time, altering and degrading increasingly more native plant communities and thereby negatively affecting many ecosystem services and values, such as clean air and water, wildlife and plant diversity, forest and soil health, recreational opportunities, and scenic (viewshed) quality. All of these ecosystem services and values would become increasingly more valuable to society over time with the expansion of the greater Portland metropolitan area.

Alternative 2 – The Proposed Action

Under the Proposed Action, expanded use of herbicides to treat invasive plants may harm or kill non-target plants. Herbicide treatments have the potential to harm, weaken, or kill special status plants. For example, more persistent herbicides, such as picloram, could move readily to non-target plants through root translocation or runoff (USDA Forest Service, 2005). Special status plants, if exposed to herbicide applications, would be at greater risk of being harmed or killed. A treatment schedule for persistent infestations that may require herbicide application for three to five years would increase the potential for non-target plants being negatively affected (harmed, weakened, or killed) by herbicides. Many of the invasive plant populations in the 208 treatment areas could require successive years of herbicide application to be effectively treated depending on the extent and severity of the infestation and how invasive plant populations respond to a given treatment.

Non-target plants in the sunflower (*Asteraceae*), legume (*Fabaceae*), or mustard (*Brassicaceae*) families may be the most sensitive to herbicide treatment. Species in the lily family (*Liliaceae*) may be more sensitive to some of the sulfonylurea herbicides (USDA Forest Service, 2005). Potential adverse effects on mycorrhizal fungi, which are beneficial to Pacific Northwest conifers and other native plant species and increase the productivity of forest communities, could occur in treatment areas where herbicides are used. Bryophytes and lichens (e.g., Methuselah's Beard) in treatment areas or nearby could be negatively affected by direct exposure to herbicide spray or from drift because they lack roots and, instead, absorb water and nutrients directly from the atmosphere. PDC would require protection (hand application of herbicide(s), spot spraying, or physical shielding) of special status plants in the treatment areas where they occur with some exceptions. Only 13 of the 208 treatment areas identified and analyzed in the EIS contain special status plants; thus, adverse effects on special status plants would be low and PDC would reduce potential harmful effects.

Manual and mechanical treatments could also harm native plants as well as special status plants. PDC included in Alternatives 2 and 3 would reduce these risks and minimize harm. Manual and mechanical treatments could also alter the composition and structure of native plant communities, as released growing space previously occupied by invasive plants is made available. Certain native plants would be able to outcompete other native plants for this growing space. The growing space could also be re-invaded by invasive plant species. Active restoration for priority 1 (high priority) and priority 2 sites would help in preventing re-invasion (re-infestation) of invasive plants following treatment.

With the passing of time (3 to 10 years or longer), the cumulative effects of not treating invasive plants would be biologically significant and outweigh most concerns about effects on non-target plants and native plant communities, including special status plants. For example, knotweed species are an example of a highly invasive plant that is already present within the Forest and Scenic Area and spreading rapidly in riparian zones in stream and river corridors. Without additional treatment options (herbicide use), populations of invasive plants, including knotweed species, are expected to continue to expand in size, increase in number, and spread elsewhere, displacing native plants and plant communities, including special status plants and, in the process, degrading native ecosystems. By allowing the present situation of ineffective prevention and management of invasive plants within the Forest and Scenic Area to continue, any treatment efforts in the future would become increasingly more difficult and costly. Overall, manual, mechanical, cultural, and herbicide treatments would have an insignificant biological effect as far as harming native plants and plant communities as well as special status plants if the project is implemented with the appropriate PDC. Treatments could be expected to benefit native plants and plant communities and special status plants by restoring native habitats and plant communities.

As with the No Action Alternative, ground-disturbing management activities and use, over time (10, 20, 30+ years hence) would continue to create opportunities for invasive plants to establish and spread. Management activities include, but are not limited to, timber harvest, road traffic from visitor and recreational use, road building, road decommissioning, rock excavation at quarries, maintenance and improvement of existing facilities, and construction of new facilities. Demands on the Forest and Scenic Area are likely to continue to increase over the course of time as a result of steady human population growth in the Portland-Vancouver metropolitan area and surrounding areas. Under the Proposed Action, however, more effective treatment of invasive plants would begin with approximately 13,000 acres identified for treatment. The amount of treated acres and the addition of the EDRR for treating new invasive plant populations would contribute towards controlling and containing existing populations and checking the establishment of new invasive plant populations within the Forest and the Scenic Area. Expansion of herbicide treatment method(s) would protect native plant communities as well as ecosystem services and values from degradation resulting from invasive plant infestations.

Alternative 3 – Restricted Herbicide Use Alternative

Harming, weakening or killing of non-target plant species would be greatly reduced under this alternative since only 4,047 acres, compared to 13,000 acres under Alternative 2 (The Proposed Action), would be treated with herbicides, and broadcast spraying would only be allowed in three treatment areas (the Sandy River Delta, Lolo Pass utility road and corridor, and west side of the BPA power line corridor). Yet populations of invasive plants on the other 8,953 acres of the 13,000 inventoried acres, which contain invasive plants that would be treated only manually, mechanically, or culturally, can be expected to persist and expand over time. Non-herbicide treatments are effective against only small populations of certain invasive plant species.

Similar to the Proposed Action, the EDRR for treating new invasive plants and new infestations not inventoried in this EIS would greatly increase the ability to control and contain existing populations and to respond quickly to new infestations. Restricting broadcast spraying to three treatment areas would reduce effective treatment of existing and new invasive plant infestations compared to the Proposed Action. Invasive plant infestations would be more challenging (time-consuming and labor-intensive) to treat with spot (backpack) spraying and hand/selective application (hand wiping, wicking, painting, injection) of herbicides.

Similar trends in human population growth in the greater Portland metropolitan area with steadily increasing demands on the natural resources provided by the Forest and Scenic Area could be expected, as described under the No Action and Proposed Action Alternatives. The Restricted Herbicide Use Alternative would be expected to be more effective than the No Action Alternative, but less effective than the Proposed Action in treating invasive plants and maintaining native plant communities and the ecosystem services provided by healthy functioning forests and rangelands within the Forest and Scenic Area.

Spread of Invasive Plants to Neighboring Ownerships

The most effective means of combating invasive plants is a comprehensive landscape treatment strategy that integrates and coordinates the treatment actions of all affected and potentially affected land owners (GAO, 2005). Such a strategy, however, is beyond the scope of this project.

The USDA Forest Service estimates that invasive plant control occurs on over 1,250,000 acres in Oregon and Washington (Invasive Plant FEIS, 2005a). No central source exists for compiling invasive plant management information on lands intermingled with the Forest and Scenic Area. There is no requirement for private or corporate land owners to report invasive plant treatment information. Counties and the State of Oregon keep records of herbicide application. For example, records indicate that Clackamas County, Oregon, treated approximately 2,893 acres with five different herbicide formulations in 2004. There is, however, no comprehensive database for tracking herbicide treatment activity. Therefore, an accurate accounting of the total acreage of invasive plant treatment for all land ownerships is not available.

For all alternatives, present and reasonably foreseeable future actions would continue to cause ground disturbance on a landscape scale, resulting in the introduction and spread of invasive plants. Roads would continue to be a major conduit for invasive plants. National recreation studies as well as local trends indicate that recreation uses within the Forest and Scenic Area would continue to increase (Cordell, 1999). Other land management and use activities such as grazing, vegetation management, fuels management, and fire suppression would continue to cause ground disturbance and contribute to the introduction, spread, and establishment of invasive plants within the Forest and Scenic Area as well as on adjacent ownerships.

Some land uses and development on lands near the Forest and Scenic Area would likely continue to decrease effectiveness of USDA Forest Service, state, county, and private invasive plant management. For example, the use of invasive plants by landowners for landscaping, while small individually, can collectively result in significant impacts, especially along riparian corridors.

Positive cumulative effects could occur as the Forest efforts are combined with other Bureau of Land Management, State of Oregon, county, and private landowner efforts, reducing the rate of spread on a regional level. Oregon Department of Agriculture (ODA), for example, is a leader in early detection and rapid response, with up to 20 ongoing or proposed programs at a state or regional level. Also, the Invasive Plant ROD (2005b) contains seven standards to help prevent the spread of invasive plants.

As noted earlier in this document, ODA and Oregon Counties currently spend more than four million dollars annually to manage invasive plants. A January, 2001 report entitled *Oregon Noxious Weed Strategic Plan* recommends that this spending be increased by an additional 5.2 million dollars annually from state and local sources. The same report recommends that spending by all federal agencies in Oregon be increased by 7.2 million dollars per year to adequately implement invasive plant control programs on federal lands in Oregon (ODA, 2001).

3.6.5. Management Standards and Guidelines

Relevant standards and guidelines contained in the Forest Plan and the Northwest Forest Plan are displayed in Appendix B of this document; relevant standards contained in the Scenic Area Management Plan are displayed in Appendix C. This analysis exhibits that the Proposed Action and Restricted Herbicide Use Alternatives are consistent with all relevant standards and guidelines, when the proposed amendments are incorporated. The Forest Plan amendments are discussed in Section 3.16.

3.6.6. Incomplete and Unavailable Information

Studies are not available regarding the effects of herbicide on native non-target species. The EPA performs studies predominantly on crop species rater than native species. Bountin et al. (2004) concluded that it is likely that species tested were not representative of the habitats found adjacent to agricultural treatment areas; thus risk to native species may be underestimated.

Herbicide effects to native species can be extrapolated from the risk assessments or herbicide labels. This information would be used to comply with Invasive Plant ROD (2005b) standard 19, which directs that site-specific information, including potential effects of specific herbicides on non-target species, be considered when making a decision to use herbicides.